U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 80-18-691

LOOART PRESS INCORPORATED
COLORADO SPRINGS, COLORADO

MAY 1980

I. SUMMARY

During January, 1980, the National Institute for Occupational Safety and Health (NIOSH)* conducted an industrial hygiene survey at Looart Press Incorporated (SIC2770), Colorado Springs, Colorado. The main areas of concern were the platemaking and pressroom areas. No health problems were noted by either the company or individual pressroom employees. Time-weighted average (TWA) exposures were determined for 32 pressroom employees, one half sampled for isopropyl alcohol exposure and one half for a mixture of organic solvent vapors. Bulk samples of the three pressroom solvents indicated toluene, xylene, and ethylbenzene as constituents. Personal samples for the mixture of organic solvent vapors were subsequently analyzed for these compounds. Methylene chloride and tetrachloroethylene exposures of the two plateroom employees were below one tenth of the recommended NIOSH standards of 261 mg/M^3 and 339 mg/M^3, respectively. The average isopropyl alcohol exposure for pressroom employees over the two shifts was 396 mg/M^3 (range of values: 78-598 mg/M^3; OSHA standard: 980 mg/M^3). The average exposure level in the pressroom to the individual solvent vapor concentrations was well below applicable standards and exposure to the mixture of solvent vapors was 0.10 of a maximum permissible value for the mixture of 1.00 (range of values: 0.04-0.40). None of the exposures exceeded applicable evaluation criteria.

On the basis of the data obtained in this investigation, NIOSH determined that exposures of platemaking and pressroom employees at Looart Press Incorporated, are below applicable exposure criteria for isopropyl alcohol, toluene, xylene, ethylbenzene, methylene chloride and tetrachloroethylene. No hazard to health is believed to exist at this time based on the results of this investigation. Recommendations concerning employee education and improved work practices are presented on pages 6 and 7.

*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 an 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.

II. INTRODUCTION

On November 5, 1979, the Hazard Evaluations and Technical Assistance Branch of the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the Coordinator of Benefits, Safety, and Employee Communications at Looart Press Incorporated (SIC 2770), Colorado Springs, Colorado. The purpose of the study was to conduct a general evaluation of the chemical exposures in their plant. The focus of concern was the pressroom and platemaking areas where most of the chemicals in use were found. January 22-24, 1980 an industrial hygiene survey was conducted including a walk through survey and personal sampling of platemaking and pressroom employees.

III. BACKGROUND

Looart Press operates at two locations in Colorado Springs. The main or Stone location occupies 133,000 square feet and includes the 10,240 square foot pressroom which houses three 4-color and two 2-color offset presses. The Stone location has been occupied by Looart since 1967. All production occurs at this location. Looart Press prints, assembles, and sells directly by mail, a large variety of stationery products.

The pressroom and platemaking areas employ 44 and 4 hourly employees respectively. These areas operate on two shifts, the pressroom employees working on four separate 10-hour shift schedules, while platemaking employees work 8-hour shifts.

IV. Process Description and Raw Materials

Plateroom

Press plates are made from 41 inch by 50 1/2 inch anodized aluminum plates with one side having a photopolymer coating. The plate is exposed to a film negative by an ultraviolet light source on a step and repeat machine. The light source - film negative unit traverses the plate placing multiple images on the plate.

Exposed plates are taken to a working area which contains a downdraft table on which all washing and developing takes place. Developer is applied followed by plate finisher which neutralizes the developer and desensitizes the plate. Exposed areas of the plate (the hardened photopolymer coating remaining after development) will pick up the ink on the presses and transfer the image. Plates are moved to a bench where a thin coat of petro gum is applied with a sponge to prevent oxidation.

Potential chemical exposures in the platemaking area are from the developer, plate gum, and the solvents containing methylene chloride and perchloroethylene used to clean the step and repeat machine.

Pressroom

Finished plates are installed on the plate cylinder of the press. The petro gum is removed from the plate, and ink and fountain solution are applied to the plate via a series of rollers from their respective fountains. Ink is picked up by the hardened copolymer image area, and fountain solution by the diazo coating on the plate in the non-image areas.

Runs on each press vary from 6000 to 200,000 sheets depending on the size of the job. During the survey the presses were printing about 25-30,000 sheets per press per shift.

Potential chemical exposures occurring in the press room are from the solvents used to clean the press rollers, cylinders, plates, and ink fountains; propyl and isopropyl alcohol used as components of the fountain solution; and the inks.

V. METHODS AND MATERIALS

All environmental sampling was done with personal sampling pumps, the collection media being mounted on the employee's collar to collect breathing zone samples. Bulk samples of the three solvents in use in the pressroom were taken to identify the most abundant solvent components. Three bulk samples of materials used on plates in the plateroom were taken to characterize their constituents.

Bulk Samples:

Bulk samples were submitted for qualitative analysis by gas chromatography/mass spectroscopy (GC/MS). Where possible the bulks were analyzed directly. Otherwise portions of the emulsion type bulks were put into carbon disulfide (CS_2) and the CS_2 extract was analyzed. The analyses were performed using SP1000 columns.

Methylene Chloride and Perchloroethylene:

Samples for both compounds were collected on standard charcoal tubes using low flow personal sampling pump calibrated at a flow rate of 50 cubic centimeters per minute (cc/min). Charcoal tubes were changed every two to three hours to prevent possible overloading and reduce migration of the material. Both sections of the tubes were analyzed by flame ionization detection gas chromatography following NIOSH Method P&CAM 127. The limit of detection was 0.01 mg per sample for both analytes.

Isopropyl and Propyl Alcohol:

Isopropyl and propyl alcohol were collected on standard charcoal tubes according to NIOSH Method S-65 with a flow rate of 50 cc/min. Tubes were changed every 2 1/2 - 3 1/2 hours over the 10-hour work shift. Both sections of the tubes were desorbed with CS_2 and analyzed by flame ionization gas chromatography. The limit of detection was 0.02 mg per sample for both analytes.

Toluene, Xylene, and Ethylbenzene:

Organic solvent vapors were collected on standard charcoal tubes using low flow personal sampling pumps calibrated at 50 cc/min. Tubes were changed every 2 1/2 - 3 1/2 hours over the 10-hour workshift. Both sections of the tubes were analyzed by gas chromatography according to NIOSH Method P&CAM 127. The limits of detection per sample were: 0.01 mg of toluene; 0.01 mg of xylene; and 0.01 mg of ethylbenzene.

Of the 17 pressroom employees during the second shift and 18 during the first shift, roughly half were sampled for solvent vapors, the other half for isopropyl alcohol. Each press had employees being sampled for one or the other compound. No formal interviews were conducted but discussions with employees during the shifts provided an opportunity to learn of employee health concerns.

VI. EVALUATION CRITERIA

The criteria used to evaluate the potential hazards associated with toxic substances found in the employee's work environment are obtained from two primary sources: (1) NIOSH Criteria Documents for Recommended Occupational Health Standards, and (2) Occupational Health Standards as promulgated by the U.S. Department of Labor. These exposure limits are derived from existing human and animal data and industrial experience.

The values for each contaminant are designed to permit an occupational exposure over an 8 to 10-hour workday, 40-hour work week throughout an individual's normal worklife without adverse effect. Because of wide variations in individual susceptibility a small percentage of workers may experience discomfort or adverse health effects from some substances at or below the applicable criteria. For some contaminants a Time Weighted Average (TWA) is inappropriate due to irritant or toxic properties of the material and consequently a ceiling value is applied which must not be exceeded even briefly. Contributions to the overall exposure by the cutaneous route are not included in the criteria, zero cutaneous absorption being assumed.

The occupational exposure criteria and health effects applicable to this investigation are presented in Table I.

VII. RESULTS

Bulk Samples: Six bulk samples were collected to characterize their composition. Three bulks were collected in the plateroom (plate cleaner, plate preserver, and litholene). Three bulks collected in the pressroom were: 2077 (a solvent used to clean presses); Roll-R-Wash #1 and Roll-R-Wash #2 - both used during press cleanup after completing a run. Most of the bulks contained petroleum distillates as the major components. The plate cleaner contained ethylene glycol monobutyl ether and ethylene glycol monobutyl ether acetate. Small amounts of solvent were found in the plate preserver, the bulk sample remaining for the most part insoluble in the organic solvent (CS_2). Bulk 2077, the general pressroom solvent, contained toluene, xylene, and alcohols. The Roll-R-Wash solvents contained ethyl benzene isomers. Table II lists the major identified constituents resulting from GC/MS analysis.

Methylene Chloride and Perchloroethylene: Results of personal samples taken on the two emplyees working in the plateroom, one on each shift, were substantially below the applicable exposure criteria with some values below the limits of detection. No methylene chloride exposure was detected during the second shift, no perchloroethylene exposure during the first shift. See Table III.

Isopropyl and Propyl Alcohol: No propyl alcohol was detected in any of the samples taken on pressroom employees. Isopropyl alcohol exposures ranged from 78 mg/M^3 to 598 mg/M^3 with an average or mean exposure of 396 mg/M^3 (S.D. $\pm$ 160). One sample was deleted due to pump failure. Figure I and Table IV present the TWA exposures. None of the exposures exceeded applicable criteria, however, six exceed the action level of one half the applicable criteria. "Action level" means one half of the TWA for isopropyl alcohol.

Toluene, Xylene, and Ethylbenzene: The three components of solvents used in the pressroom were identified from the bulk samples. Solvent exposures of pressroom employees were determined for these compounds. All solvent exposures were well below the applicable exposure criteria in Table I. Toluene exposures ranged from 3.6 to 47 mg/M^3, mean value of 14 mg/M^3 (S.D. $\pm$ 12). Xylene exposures ranged from 10 to 110 mg/M^3, mean value of 22 mg/M^3 (S.D. $\pm$ 25). Ethylbenzene exposures ranged from 0.00 to 36 mg/M^3, mean value of 4.1 mg/M^3 (S.D. $\pm$ 8.9). The calculated exposure for the mixture of the three solvents ranged from 0.04 to 0.40 with a mean of 0.1 (S.D. $\pm$ .1). Figure II presents the exposure levels for the mixture. Table V presents exposure levels for each solvent and the solvent mixture.

VIII. DISCUSSION AND CONCLUSIONS

Plateroom

Plates are developed and washed on the downdraft table in the plateroom. Employees were observed wearing neoprene gloves during the entire washing and developing process (using plate cleaner and litholene). The fan on the downdraft table is turned on by the operator during the process. Plate preserver is applied on a side bench as a thin coating with a damp sponge.

Methylene chloride and perchloroethylene containing solvents were used on the step and repeat machine to clean and condition rubber seals. This process was reportedly done once a shift or as needed.

No health problems were reported by plateroom employees, and values obtained from personal sampling for methylene chloride and perchloroethylene do not indicate excessive exposure. Employees demonstrated good work practice and used the downdraft table and gloves when processing plates. Gloves weren't worn during the application of plate preserver but the bulk analysis indicates little problem with solvent exposure. The material is applied sparingly with a damp sponge on an intermittent basis.

Pressroom

Isopropyl and propyl alcohol sampling was conducted on pressroom employees, however, no propyl alcohol exposure was detected. The alcohol is used as a wetting agent in the isotroughs on the presses. The fountain solution used in the isotroughs consists mainly of alcohol and water (1 to 3 mix). The fountain solution is mixed up in large buckets and poured into the isotroughs.

It was during this filling process that spills occurred. Spills were mopped up promptly. Evaporation of the fountain solution on the press cylinders is considered the largest source of isopropyl alcohol vapors. The solution flows from troughs over rollers onto the cylinders providing extensive surface area and evaporation.

One press, Miehle #2-49,* 4-color, had four of the six exposures exceeding the action level and 2 other presses accounted for the remaining two. Exposures at or above the action level should be considered subject to the applicable monitoring, correction, and control activities specified by NIOSH in the isopropyl alcohol criteria document.

* Mention of company names or product does not constitute endorsement by NIOSH.

Solvent vapor exposures originated from the three solvents in use for press cleaning. The compounds to which exposures were evaluated were present and used as a mixture. Since toluene, xylene, and ethylebenzene have similar toxic effects, a mixture TWA was calculated for each worker sampled. The maximum value which would be permissible for the mixture is 1.0. The highest mixture TWA calculated was .4 and all but 2 of the 16 (88%) were at or below .1 of the mixture exposure value.

Pressroom employees were conscientious about wearing gloves during press cleaning. However, it was noted that cleaning of loose parts, trays, and wiping up exterior press areas was done without gloves. Small open pans of solvent and tossing soiled, solvent saturated rags onto the floor adjacent to presses during cleaning contribute to any solvent vapor concentrations. It was noted by workers that application of the solvents to the hot cylinders and rollers during cleanup resulted in strong solvent odors. Personal samplers were worn during cleanup procedures and this activity was included in determining the TWA.

The pressroom did not have any exhaust system other than two ceiling fans. There were no windows. The pressroom was not heated other than by the heat generated by the presses, which was sufficient to produce temperatures in the 80's. Ventilation was limited to general dilution ventilation resulting from air influx from adjacent areas. Based on the results of this study, natural ventilation appears adequate.

Smoking and consumption of beverages was observed in the pressroom. No health problems were expressed by the employees, but a genuine interest in the potential health effects of the materials in use was shown. Due to the nature of the process, equipment, and product, housekeeping was very good.

IX. RECOMMENDATIONS

1. Education of pressroom employees concerning work practice with solvents is recommended. Employees demonstrated an interest in knowing about the health effects of the chemicals they work with and the necessary precautions.

2. Quantities of solvent standing open should be reduced, such as by providing covers for small containers used by employees.

3. An alternate method of collecting soiled solvent rags during press cleaning should be explored, such as using closed containers, to replace the present practice of pitching them into piles on the floor adjacent to the presses.

4. Smoking should be prohibited in the pressroom due to the large amount of solvent and alcohol used in the area. Consumption of food and beverages should also be discouraged in the pressroom.

5. Installation of an evaporative cooling system resulting in increased air exchange for the pressroom was stated to be in the planning stages. This system could reduce existing solvent and alcohol vapor levels.

6. Followup sampling of pressroom employees for isopropyl alcohol should be conducted to further define exposures exceeding the action level and to evaluate the effect of corrective actions.

7. The proposed employment of an occupational health nurse is encouraged and would be a valuable asset to the development of Looart Press's occupational health and safety program.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Steven H. Ahrenholz
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
Cincinnati, Ohio

Acknowledgements

Environmental Evaluation:

James Boiano
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and Technical Assistance Branch
Cincinnati, Ohio

Laboratory Analyses:

Ardith Grote
Chemist
Division of Physical Sciences and Engineering
Cincinnati, Ohio

Utah Biomedical Testing Laboratory
Salt Lake City, Utah

Report Typed By:

Jackie Woodruff
Clerk/Typist
Industrial Hygiene Section
Hazard Evaluations and Technical Assistance Branch
Cincinnati, Ohio

XI. REFERENCES

1. Method No. S-65. Isopropyl Alcohol. NIOSH Manual of Analytical Methods. Vol. 2. HEW Publication No. (NIOSH) 77-157-B. 1977.

2. NIOSH Criteria for a Recommended Standard . . . Occupational Exposure to Isopropyl Alcohol. HEW Publication No. (NIOSH) 76-142. 1976.

3. NIOSH Criteria for a Recommended Standard . . . Occupational Exposure to Methylene Chloride. HEW Publication No. (NIOSH) 76-138. 1976.

4. NIOSH Criteria for a Recommended Standard . . . Occupational Exposure to Tetrachloroethylene. HEW Publication No. (NIOSH) 76-185. 1976.

5. NIOSH Criteria for a Recommended Standard . . . Occupational Exposure to Toluene. HEW Publication No. (NIOSH) 73-11023. 1973.

6. NIOSH Criteria for a Recommended Standard . . . Occupational Exposure to Xylene. HEW Publication No. (NIOSH) 75-168. 1975.

7. NIOSH Current Intelligence Bulletin 20: Tetrachloroethylene. HEW Publication No. (NIOSH) 78-112. 1978.

8. OSHA Safety and Health Standards (29 CFR 1910) U.S. Department of Labor. OSHA 2206. Revised November 7, 1978.

9. P&CAM Method No. 127. Organic Solvents in Air. NIOSH Manual of Analytical Methods. Vol. 1. HEW Publication No. (NIOSH) 77-157-A. 1977.

10. Proctor, N.H., J.P. Hughes. Chemical Hazards of the Workplace. J.B. Lippincott Company. Philadelphia. 1978.

11. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1979. American Conference of Governmental Industrial Hygienists. Cincinnati, Ohio. 1979.

XII. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, 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 Services, (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 the following:

a. Looart Press Incorporated, Colorado Springs, Colorado.
b. U.S. Department of Labor, Region VIII.
c. NIOSH, Region VIII.

For the purpose of informing the approximately 50 "affected employees" the employer shall promptly "post" for a period of 30 calender days, the Determination Report in a prominent place(s) near where the exposed employees work.

Figure I

Isopropyl Alcohol Concentrations in the Pressroom

Looart Press Inc.

January 23-24, 1980

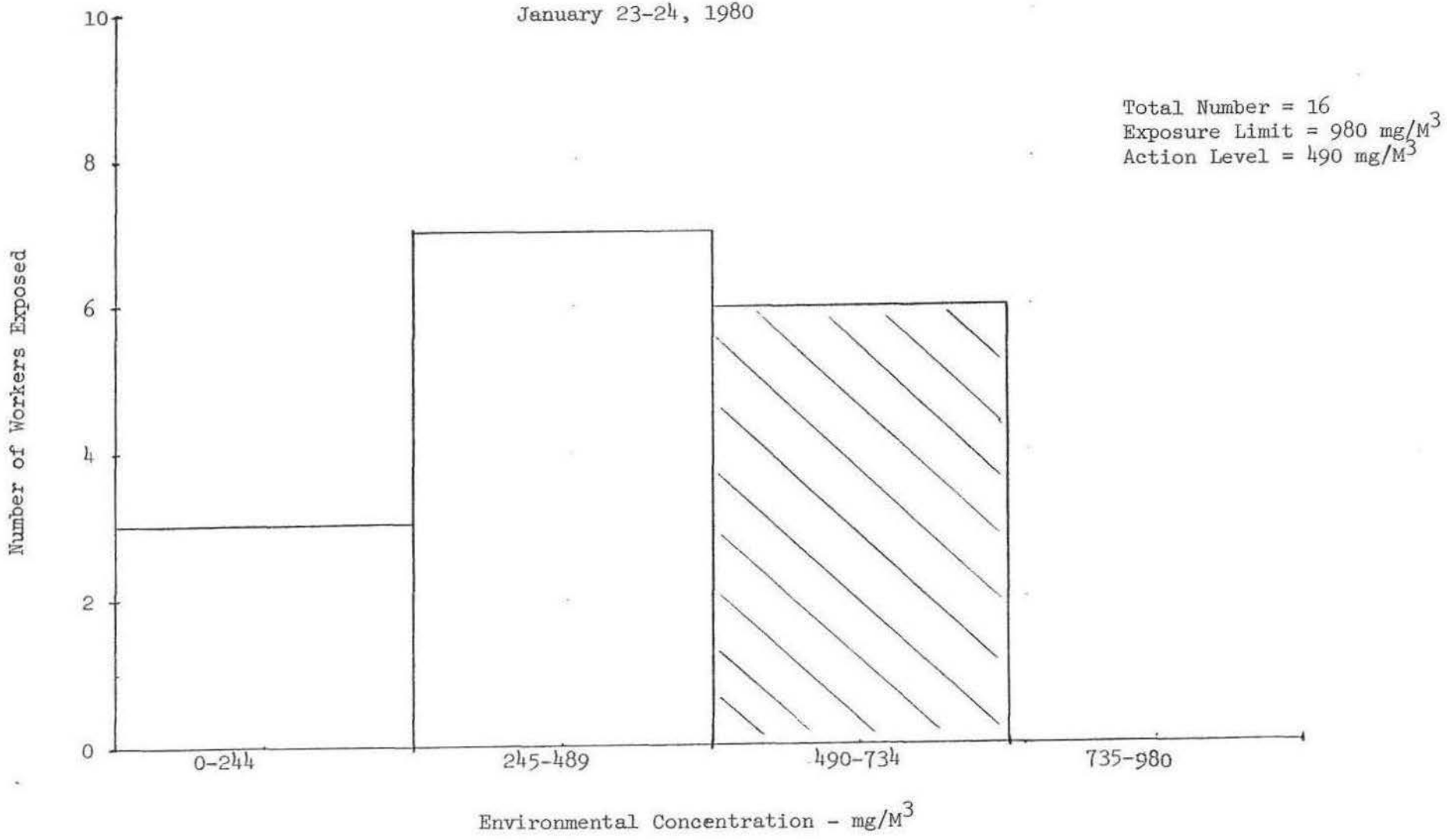

Figure II

Exposure of Pressroom Employees to a Mixture of Toluene, Xylene, and Ethylbenzene

Looart Press Inc.

January 23-24, 1980

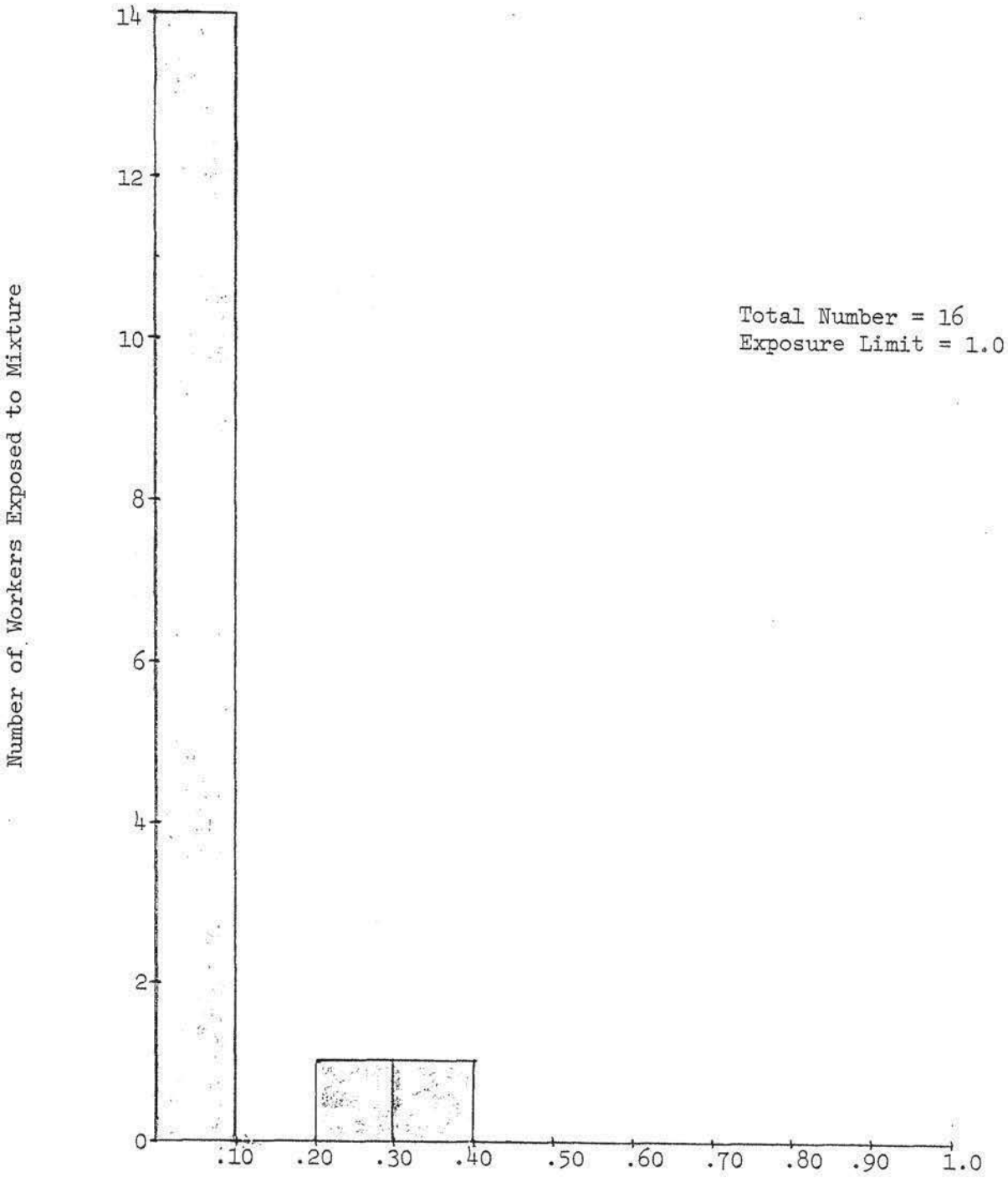

Table I

Occupational Exposure Criteria

Substance	Recommended Exposure Limit (mg/M^3)	Source[a]	OSHA[b] Standard (mg/M^3)	Primary Health Effects[c]	Comments
Ethylbenzene	435	OSHA	435	Skin, mucous membrane irritant; anesthetic effect at high concentrations	Skin absorption
Isopropyl alcohol	980	NIOSH	980	Mild eye and mucous membrane irritant; dermatitis	Odor threshold 98-490 mg/M^3
Methylene chloride	261	NIOSH	1735	Mild central nervous system depressant; eye, skin, respiratory irritant	Skin absorption
Tetrachloroethylene (Perchloroethylene)	339	NIOSH	678	Central nervous system depression; liver damage; chronic exposure causes peripheral neuropathy	Skin absorption Animal carcinogent. Potential cancer risk.[d]
Propyl alcohol	500	OSHA	500	Skin, mucous membrane, and eye irritant; narcosis from severe exposures	Skin absorption
Toluene	375	NIOSH	751	Central nervous system depression; dermatitis	Skin absorption
Xylene	433	NIOSH	435	Skin, mucous membrane, and eye irritant; narcosis at high concentrations	Skin absorption

a - American Conference of Governmental Industrial Hygienists: TLV's for Chemical Substances in Workroom Air 1979.
National Institute for Occupational Safety and Health: Criteria for a Recommended Standard . . . Occupational Exposure to _____.

b - OSHA Safety and Health Standards (29 CFR 1910), November 7, 1978. These standards are given for the purpose of comparison.

c - Chemical Hazards of the Workplace. N.H. Proctor, J.P. Hughes 1978.

d - NIOSH Current Intelligence Bulletin 20: Tetrachloroethylene. 1978.

Table II

COMPOUNDS IDENTIFIED[a] IN BULK SAMPLES TAKEN FROM THE PLATEROOM AND PRESSROOM

Kodak Polymatic Plate Cleaner

ethylene glycol monobutyl ether
butyrolactone
ethylene glycol monobutyl ether acetate
ethylene glycol

Kodak Polymatic Plate Preserver

xylene
alkanes (C_9 and up)
trimethyl/methyl ethyl benzene
napthalene
terpenes

Litholene

aliphatic hydrocarbons (C_{10}-C_{11}, saturated and unsaturated)
terpene
trimethyl and methyl ethyl benzene isomers

2077

xylene/ethyl benzene isomers
toluene
alkanes
acetone

Roll-R-Wash #1 and Roll-R-Wash #2[b]

n-propyl benzene
trimethyl and methyl ethyl benzene isomers
alkanes (C_{11}-C_{12}, cycloalkanes and defin)
xylene

a = Four to five most abundant compounds identified
b = These two compounds show similar composition according to the analytical method used.

Table III

Environmental Concentrations of Methylene Chloride and Perchloroethylene in the Breathing Zone of Platemaking Employees

Date/Shift	Sample Description: Location	Sample Number[b]	Total Duration (minutes)	Total Volume (liters)	Concentration (mg/M^3): Methylene Chloride	Concentration (mg/M^3): Perchloroethylene
1/23/80 2 nd	Plateroom	049-050	392	14.90	N.D.[a]	0.60
1/24/80 1 st	Plateroom	100-102	512	19.20	17	N.D.
Evaluation Criteria: (From Table I)					261	339

a = N.D. - None Detected.
b = Individual TWA values were calculated for the total sample period by combining all the samples taken for that individual during his shift.

Table IV

Environmental Concentrations of Isopropyl Alcohol in the Breathing Zone of Pressroom Employees

Date/Shift	Sample Description: Job Classification	Location Press[a]	Sample Numbers[b]	Total Duration (minutes)	Total Volume (liters)	TWA[c] (mg/M^3)
1/23/80 Second Shift	Pressman	800-4	001-003	615	29.13	466
	Press Helper	800-4	046-048	528	27.16	438
	Pressman	2-49-4	004-006	594	17.17	536
	Second Pressman	2-49-4	013-016	569	23.93	598
	Press Helper	1-49-4	037-039	569	25.52	246
	Press Helper	1-49-4	040-042	571	15.39	276
	Press Helper	38-2	025-027	572	23.76	353
	Pressman	800-2	016-018	576	26.62	128
	Press Helper	800-2	019-021	577	1.54[d]	-
1/24/80 First Shift	Press Helper	800-4	055-057	593	31.30	233
	Press Helper	2-49-4	088-090	559	23.61	534
	Pressman	2-49-4	091-093	618	20.41	571
	Second Pressman	1-49-4	079-081	588	29.07	517
	Second Pressman[e]	1-49-4	097-099	560	25.16	398
	Press Helper	38-2	070-072	582	25.08	504
	Press Helper	800-2	067-069	597	26.04	452
	Forklift Driver	Warehouse	103-104	334	15.47	78
	Evaluation Criteria: (From Table I)					980 mg/M^3

a = 800-4: Roland 800 4-color press
2-49-4: Miehle #2-49 4-color press
1-49-4: Miehle #1-49 4-color press
38-2: Miehle #38 2-color press
800-2: Roland 800 2-color press

b = Individual TWA values were calculated for the total sample period by combining all the samples taken for that individual during his shift.

c = Time Weighted Average over sample period.

d = Defective pump, no TWA calculated.

e = Employee worked in paper warehouse until 10 a.m.

Table V

Environmental Concentrations of Toluene, Xylene, and Ethylbenzene in the Breathing Zones of Pressroom Employees

Date/Shift	Sample Description: Job Classification	Location Press[a]	Sample Numbers[b]	Total Duration (minutes)	Total Volume (liters)	Environmental Concentration: TWA[c] (mg/M^3) Toluene	Xylene	Ethylbenzene	TLV of Mixture[d]
1/23/80 Second Shift	Press Helper	800-4	043-045	539	22.85	9.2	10	0.00	0.05
	Press Helper	2-49-4	007-009	589	25.82	13	14	1.5	0.07
	Press Helper	2-49-4	010-012	593	28.78	10	11	0.71	0.06
	Pressman	1-49-4	031-033	574	20.31	16	18	1.7	0.09
	Pressman	1-49-4	034-036	571	26.77	10	12	0.74	0.05
	Pressman	38-2	028-030	566	27.37	9.1	11	3.7	0.06
	Press Helper	800-2	022-024	568	23.93	44	45	36	0.30
1/24/80 First Shift	Press Helper	800-4	052-054	590	26.97	5.2	12	0.74	0.04
	Second Pressman	800-4	058-060	582	25.57	46	109	12	0.40
	Press Helper	2-49-4	085-087	542	24.84	9.6	19	1.2	0.07
	Second Pressman	2-49-4	094-096	553	25.51	12	24	2.8	0.09
	Pressman	1-49-4	076-078	584	26.48	9.0	13	1.2	0.06
	Press Helper	1-49-4	082-084	582	13.27	7.6	11	0.00	0.05
	Pressman	38-2	073-075	588	32.93	7.0	11	0.91	0.05
	Pressman	800-2	061-063	593	24.65	3.6	11	0.81	0.04
	Press Helper	800-2	064-066	595	24.38	7.4	22	2.1	0.08
Evaluation Criteria: (From Table I)						375	435	435	1.00

a = 800-4: Roland 800 4-color press
2-49-4: Miehle #2-49 4-color press
1-49-4: Miehle #1-49 4-color press
38-2: Miehle #38 2-color press
800-2: Roland 800 2-color press

b = Individual TWA values were calculated for the total sample period by combining all the samples taken for that individual during his shift.

c = Time Weighted Average over total sample period.

d = ACGIH TLV's (1979) Threshold Limit Values for Mixtures.