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 HE 78-107-563

SWINSTON COMPANY
PITTSBURGH, PENNSYLVANIA

February 1979

I. TOXICITY DETERMINATION

The silk screen printer is exposed to potentially toxic concentrations of isophorone. The workers' exposure while washing printing screens is characterized by symptoms of eye and nose irritation. An environmental sample collected on September 14, 1978 showed that the printers' breathing zone concentration of isophorone was 5 times the American Conference of Governmental Industrial Hygienists occupational health criteria of 5 ppm (ceiling). Environmental samples collected on September 13 and 14, 1978 showed that the printers' exposures to acetone, xylene and toluene were below the referenced occupational health criteria (based on 8-hr. time-weighted average exposure). However, the symptoms of nausea and headache reported to occasionally occur during screen printing and washing may be attributable to the additive toxicologic effects of these compounds.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are 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 Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies have been sent to:

a) Swinston Company, 100 Fifth Avenue, Pittsburgh, Pennsylvania 15222.
b) Authorized representative of the employees.
c) U.S. Department of Labor - OSHA - Region III.
d) Regional Program Consultant - NIOSH - Region III.

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.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of the employees of the Swinston Company concerning chemical exposures associated with a silk screen printing operation. The request alleged symptoms of nausea, dizziness, headache, sore throat, eye irritation, and burning sensation in the stomach.

IV. HEALTH HAZARD EVALUATION

A. Process Description and Associated Potential Health Hazards

The Swinston Company markets advertising and sales promotion specialties including ruler-thermometers, phone indexes, calendars, pens, notebooks and binders, and a multitude of other items. About 10 percent of the specialty items are silk screen printed by the Swinston Company and the remainder by the individual manufacturer. The health hazard evaluation was limited to the silk screen printing operation, which is handled entirely by one person.

The silk screen printing process is comparatively simple involving the direct reproduction of a stencil image by manually pressing ink by means of a rubber squeegee through a mesh screen directly onto the stock. The specialty items are printed with enamel, vinyl or lacquer based inks. The enamel and vinyl based inks make up approximately 90 percent of the inks used on a volume equivalent basis. The silk screen printer is exposed to multiple organic chemicals including acetone, xylene, toluene and isophorone.

The silk screen printing is conducted in a 700-square-foot room which is ventilated by a air conditioning unit and a 18-inch diameter wall fan. According to the silk screen printer the fan is seldom used because it stirs up dust and contaminates the printing surface.

B. EVALUATION DESIGN AND METHODS

The health hazard evaluation of the silk screen printing operation was conducted by a NIOSH industrial hygienist on September 12-14, 1978. The silk screen printers' exposure to the aforementioned organic vapors were evaluated on two consecutive days. Personal breathing zone air samples were collected on activated charcoal (sample 100 mg back-up 50 mg) contained in a glass sampling tube. The flow rates were either 200 or 1000 cc/min, depending on the nature and extent of exposure.

For example, the higher flow rate was used during washing of screens, where the exposure period was less than 10 minutes. The sample tubes were desorbed in carbon disulfide and analyzed with a gas chromatograph for the organic compound(s) of interest.[1]

A health questionnaire was completed on the silk screen printer.

C. Evaluation Criteria

The environmental criteria used to assess the workroom concentrations of the airborne contaminants evaluated are listed with the analytical results in Table 1. The criteria are based on the current state of the knowledge concerning the toxicity of the substances for an 8-hour workday, 40-hour workweek over a normal lifetime. The criteria are time-weighted averages (TWA) for an 8-hour exposure, except that for isophorone which is a ceiling concentration that should never be exceeded.

Exposure to the organic solvents evaluated can cause varying degrees of anesthesia, with minimal levels causing headaches, and greater exposure causing light-headedness, "drunkenness" and even unconsciousness. Additionally, they may have a somewhat disagreeable odor and be irritating to eyes, nose and throat. Skin contact with the solvents, particularly on a prolonged or repeated basis may remove the natural oil from the skin causing dryness and cracking.

V. RESULTS AND DISCUSSION

The personal breathing zone concentration of isophorone measured while the printer was washing screens on September 14 was 5 times the referenced occupational health criteria of 5 ppm expressed as a ceiling value (Table 1). The symptoms of eye and nose irritation reported by the printer are consistent with those known to occur with an exposure to 25 ppm isophorone.[3]

The airborne concentrations of acetone, xylene and toluene measured during screen printing and washing on September 13 and 14 were all less than the referenced occupational health criteria (Table 1). However, the symptoms of nausea and headache reported to occasionally occur during these working activities may be attributable to the combined effect of exposure to these organic chemicals which have simular toxicologic effects.

VI. RECOMMENDATIONS

1. Until a local exhaust ventilation system is installed at the screen washing tank to reduce the air concentrations of isophorone below the prescribed health criteria, the company should immediately provide the printer with a respirator approved for organic vapors. The worker currently wears a half-fare face respirator while washing the screens; however, the filter cartridges are designed for dusts, fumes and mists, not organic vapors.

2. Establish a respiratory protection program in accordance with the minimal OSHA requirements as outlined in 29 CFR 1910.134. A NIOSH publication titled A Guide to Industrial Respiratory Protection[2], will serve as a reference source with information for establishing and maintaining a program that complies with 29 CFR 1910.134.

3. Isophorone is classified as a primary skin irritant - brief contact can cause inflammation. It is recommended that the worker wear gloves and other protective clothing (as necessary) to prevent skin contact.

4. In view of the fact that Class 1 flammable liquids are used and that the printing operation is located on the 4th floor of an apparently old building, the following (safety hazards) should be immediately corrected.

a. The portable fire extinguisher located in the east corner of the room was obstructed and obscured from view by shelving and boxes.

b. The fire extinguishers should be inspected monthly, or at more frequent intervals to insure they are in their designated places, to insure they have not been actuated or tampered with, and to detect any obvious physical damage, corrosion, or other impairments.

c. The fire extinguishers should be given maintenance service at lease once a year with a durable tag securely attached to show the maintenance or recharge date. Both of the extinguishers did not display any inspection tag.

d. Although no person was observed smoking in the printing room, "No Smoking" signs should be posted.

e. Care should be taken to insure that the flammable liquids are kept in covered containers when not actually in use. This also should extend to the solvent wash tank.

f. It is recommended that the Swinston Company determine that adequate general room ventilation exists. A rate of not less than 1 cubic-foot-per-minute per square foot of solid floor area should be considered minimum.

5. The floor fan used for drying freshly embossed screens has a guard with openings (at the widest point) of 5 1/4 inches. Such guards should have no openings larger than 1/2 inch in their least dimension. The use of fabric nets with 1/2 inch maximum openings to modify existing substance guards is acceptable.

VII. REFERENCES

1. Organic Solvents in Air. P&CA Method Number 127, NIOSH Manual of Analytical Methods. DHEW Publication No. (NIOSH) 75-127 (1974).

2. A Guide to Industrial Respiratory Protection. DHEW Publication No. (NIOSH) 76-189 (1976).

3. Silberman, L., H. F. Schulte and M. W. First. Further Studies on Sensory Response to Certain Industrial Solvent Vapors. J. Industrial Hygiene and Tox. Vol. 28:262 (1946).

VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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TABLE 1

Personal Breathing Zone Concentrations of Organic Vapors Measured at Screen Printing and Associated Operations

Swinston Company
Pittsburgh, Pennsylvania

NIOSH HHE Project 78-107

Date	Sample No.[1]	Sampling Period	Sample Volume (Liters)	Organic Vapor Concentration - ppm[2]				Comments
				Acetone	Xylene	Toluene	Isophorone	
9-13	K-01	0835-1520	76.0	22.3	19.3	LLD[3]	LLD	Sample obtained during all daily work activities.
9-13	K-02	0914-1144	33.0	24.3	10.1	LLD	LLD	Sample obtained only during actual screen printing.
9-13	K-03	0841-0846 1145-1148 1510-1523	11.0	344.3	137.1	LLD	LLD	Sample obtained while employee was washing screens at solvent tank.
9-13	K-04	1405-1515	11.8	366.6	LLD	LLD	LLD	Same as sample K-02.
9-14	K-05	0849-1154 1240-1430 1502-1550	41.8	4.6	2.8	LLD	LLD	Same as sample K-01.
9-14	K-06	0950-1033 1240-1430	23.6	8.6	LLD	0.23	0.30	Same as sample K-02 and K-04.
9-14	K-07	1450-1454	4.0	1532.3	67.5	LLD	25.7	Same as sample K-03.
Environmental Criteria:				1000[4]	100[4]	100[4]	5[4]	

1 All samples were obtained in the breathing zone of the same silk screen printing operator.

2 Denotes concentration of contaminant per million parts of contaminated air sampled by volune.

3 Denotes the lower limit of detection for the chemical analyzed. The LLD's for acetone, xylene, toluene and isophorone are: 0.10, 0.01, 0.02 and 0.03 mg per sample, respectively.

4 Denotes the American Conference of Governmental Industrial Hygienists Threshold Limit Values (1978). The values for acetone, xylene and toluene are 8-hour time-weighted averages (TWA). The value for isophorone is a ceiling concentration that should not be exceeded even instantaneously. The current (1976) 8-hour time-weighted average OSHA standards are: 1000 ppm acetone, 100 ppm xylene, 200 ppm toluene and 25 ppm isophorone.