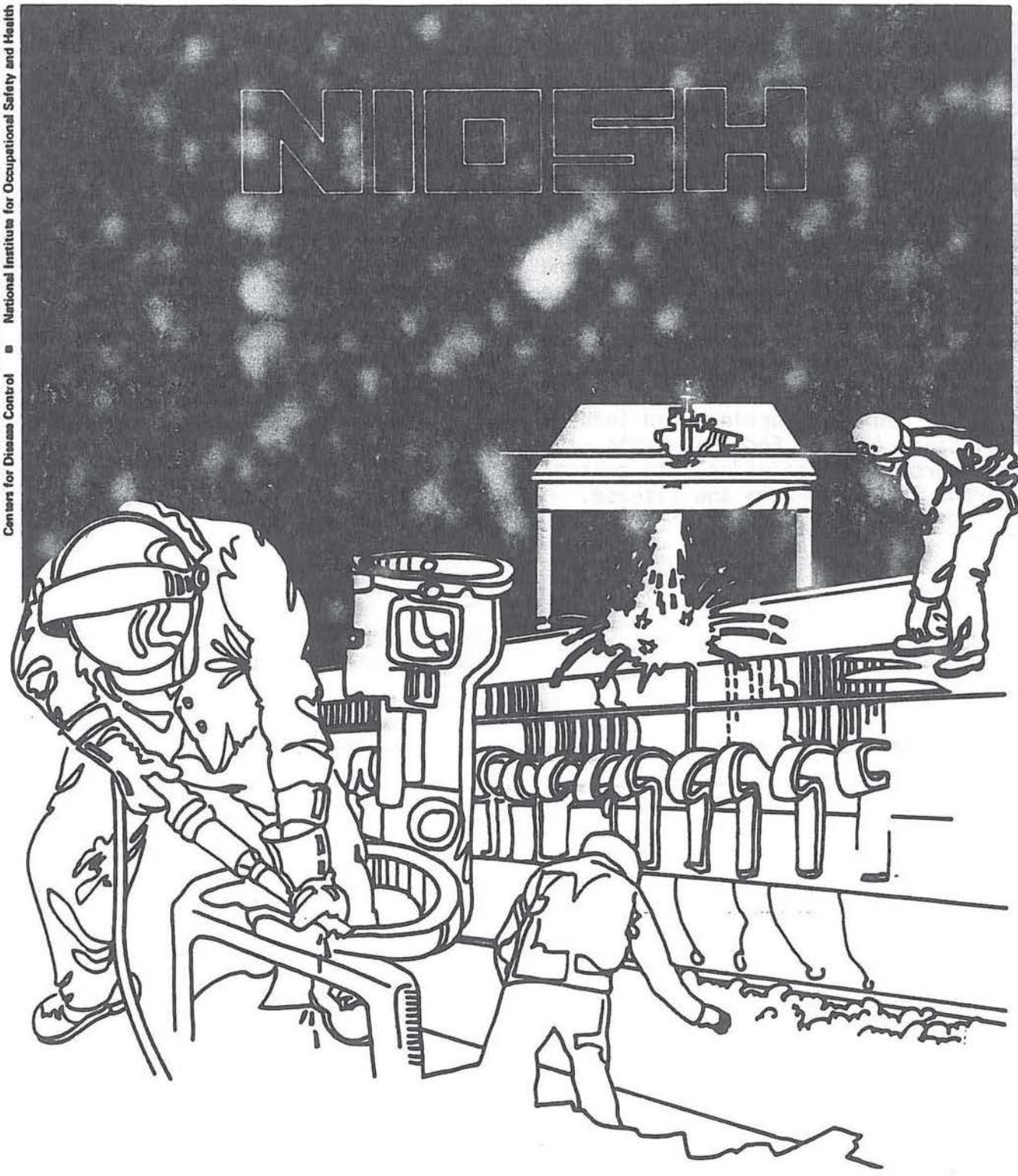
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-033-1208
PLACER COUNTY DISTRIBUTORS
TAHOE CITY, CALIFORNIA

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 81-033-1208
OCTOBER 1982
PLACER COUNTY DISTRIBUTORS
TAHOE CITY, CALIFORNIA

NIOSH INVESTIGATOR:
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I. SUMMARY

In October, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from Placer County Distributors, Tahoe City, California, formerly Pitkin County Distributors of Basalt, Colorado. The request asked that NIOSH evaluate the potential hazardous exposures to vinyl chloride, hydrogen chloride, formaldehyde, phthalates, benzene, hexane, styrene, lead, chromium (total), and other chemicals which may be generated where vinyl-type silk screened inks are used on garments. The operation is normally performed by two to three employees. Reported health complaints of workers included cough, chest tightness, sore throat, eye and nose irritation, and headaches.

In April and June, 1981, personal time-weighted average (TWA) air samples, area air samples, and detector tube samples were obtained to evaluate exposures to these chemicals. Bulk samples were also obtained of the various raw materials used in order to determine their by-products when heated.

Personal and area air samples were below the criteria and/or standards used in this evaluation. The vinyl chloride, hydrogen chloride, phthalate, lead, styrene, and total chromium results were non-detectable. Hexane results (range ND to 0.4 mg/M^3) were also well below the criterion used in this survey.

Formaldehyde and benzene, also evaluated in this survey, are considered suspect carcinogens by NIOSH and no level of exposure is thought to be safe. During the survey period the formaldehyde results ranged from non-detectable to 0.02 mg/M^3. The benzene results ranged from 0.004 - 0.008 mg/M^3. Exposures should be reduced to the lowest feasible limit.

It was also determined that the existing ventilation systems are adequate for the operation performed in the new location.

The results of the medical questionnaire showed that all of the employees interviewed experienced some adverse health effects during busy periods in the old Basalt, Colorado, location, e.g. eye, nose, throat irritation, chest tightness, and headaches. However, the employees stated that in the new location these symptoms appear to have subsided.

On the basis of the data obtained in this evaluation, NIOSH determined that exposures to the employees at the new work location were below the applicable criteria for the chemicals evaluated. Recommendations are included in Section VIII of this report to reduce and/or eliminate problems which may occur if the rate of production at the present location should increase or problems similar to that which existed at the previous location should arise.

KEYWORDS: SIC 2751 (Commercial Printing, Letterpress, and Screen), silk screening, thermal degradation, printers, vinyl inks, vinyl chloride, hydrogen chloride, phthalates, benzene, hexane, styrene, formaldehyde, lead, and total chromium.

II. INTRODUCTION

In October 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from a representative of Placer County Distributors, Tahoe City, California, formerly Pitkin County Distributors of Basalt, Colorado. The request was to determine if there was a health hazard from exposures to vinyl chloride, hydrogen chloride, formaldehyde, phthalates, benzene, hexane, lead, and chromium inks which are used and/or by-products found in the process of silk screening garments. Prior to the NIOSH environmental surveys in April and June 1981, Pitkin County Distributors moved its Colorado location in January 1981 to Tahoe City, California, under the new name of Placer County Distributors. The results and recommendations presented in this report were given to the Company and employees when they became available. The April results and recommendations were given during the June follow-up survey and June's survey information was given in October 1981 by telephone.

III. BACKGROUND

Placer County Distributors is a manufacturing and retail silk screening outlet. One of the major features of this outlet is their ability to produce, by way of silk screening various designs, lettering, and numbering on garments. The shop produces, via the silk screening process, a large variety of designs, numbers, and lettering styles and these are available in single and multiple colors. The silk screening operation begins by applying single or multiple colored inks (either water soluble or non-water soluble) to the garment. If the garment requires only one color this in turn means only one screening application. Each additional color requires an additional screening per color. After the garment is screened it is then placed on a conveyor belt which slowly moves it into an ultraviolet heating chamber (temperature equals about 200 degrees Fahrenheit). The garment moves through the heating chamber allowing the inks to catalyze and the garment continues on the conveyor until it is received at the end. It is then placed on a table where the silk screen material completes its drying. This operation occurs daily, seven days a week, for 10-12 hours per day, and normally there are 2-3 employees in the shop during this period. The new shop has approximately the same area as the Colorado store and the silk screening operation is located in the back area of the shop.

The present shop has general room ventilation and local exhaust type ventilation which helps reduce and/or eliminate any buildup of gases or vapors generated by the heat drying operation. As described by the employees, the old shop had very little ventilation except for opening doors and windows during favorable weather. This became a major problem during the colder months and the employees described days of heavy smoke buildup. During these periods and even during times that were considered slow the employees would complain of eye and nose irritation. The employees also described days and weeks when they experienced coughing, chest tightness, and sore throats for extended periods. Since the operation has been in the new location, all the employees feel that the smoke and irritation has been reduced substantially.

The local exhaust hood located over the heater/dryer in the new location is 32 x 56 inches and is suspended approximately six inches off the conveyor or surface. The flow rates around the outer perimeter of the hood ranged from 20-40 feet per minute which is below the recommended flow rate.

IV. ENVIRONMENTAL DESIGN AND METHODS

A variety of sampling techniques were used to evaluate the suspected contaminants in the shop. Personal and area samples were taken on each of the employees and at various locations around the heating/drying machine. Bulk samples of the various types and colors of inks were also submitted to the laboratory for analysis. The following is a description of the techniques used:

A. Vinyl Chloride

Six vinyl chloride air samples were collected on organic vapor charcoal tubes using vacuum pumps to draw the air through the tubes. The pumps operated at 200 centimeters (cc) per minute and the samples were analyzed by NIOSH Method No. P&CAM 178 (modified).

B. Hydrogen Chloride

Six hydrogen chloride air samples were collected on silica gel tubes using vacuum pumps. The pumps operated at 200 cc per minute and the samples were analyzed by NIOSH Method No. P&CAM 310.

C. Phthalates

Six dimethylphthalate and dioctylphthalate air samples were collected on glass fiber filters using vacuum pumps which operated at 1.5 liters per minute (lpm). The samples were analyzed by NIOSH Method No. S-40.

D. Solvents

A total of four benzene, styrene, and hexane air samples were collected on charcoal tubes using vacuum pumps which operated at 200 cc per minute. The samples were analyzed by NIOSH Method No. P&CAM 127 (modified).

E. Formaldehyde

Four formaldehyde air samples were collected using impingers which contained one percent sodium disulphite. The air was drawn through the solution with vacuum pumps which operated at one liter per minute (lpm) and these samples were analyzed by NIOSH Method No. P&CAM 127 (modified).

F. Lead

A total of seven lead air samples were collected on glass fiber filters and air drawn through the filter by vacuum pumps which operated at 1.5 liters per minute. The samples were analyzed by NIOSH Method No. P&CAM 173.

G. Chromium

A total of seven chromium air samples (three personal and four area) were collected on glass fiber filters and air drawn through the filter by vacuum pumps which operated at 1.5 liters per minute. The samples were analyzed by NIOSH Method No. P&CAM 173.

H. Medical Interviews

Each employee was administered a medical questionnare.

V. EVALUATION CRITERIA AND TOXICOLOGY

In this study numerous sources of environmental exposure criteria and existing research data were used to assess the worker's exposure to the suspected chemicals evaluated in the workplace at Placer County Distributors.

The exposure limits to toxic chemicals are derived from existing human and animal data, as well as industrial experience, to which it is believed that nearly all workers may be exposed for an 8-10 hour day, 40-hour work week, over a working lifetime with no adverse effects. However, due to variations in individual susceptibility, a small percentage of workers may experience effects at levels at or below the recommended exposure limit; a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by development of an occupational illness.

The environmental and medical (toxicological) evaluation criteria used for this investigation are presented in Table 1. Recommended environmental limits and/or general information concerning each substance are listed, i.e., the source of the recommended limits, the present OSHA standard, and a brief description of the primary health effects known to date.

VI. RESULTS AND DISCUSSION

A. Environmental

Employee exposures to suspected airborne concentrations of benzene, styrene, hexane, vinyl chloride, hydrogen chloride, phthalates, and formaldehyde were evaluated. The following are the results and conclusions of NIOSH's evaluation.

1. Benzene, Styrene, and Hexane

The results received for benzene, styrene, and hexane are presented in Table 2. These samples were collected for the silk screening operators and/or area samples adjacent to the heater/dryer machine. Benzene levels (0.04 to 0.08 mg/M^3) were well below the criterion of 3.0 mg/M^3 ceiling used in this survey. The styrene and hexane results were all non-detectable.

2. Vinyl Chloride, Phthalates, Hydrogen Chloride, and Formaldehyde

The results for vinyl chloride, three personal and three area type samples, were all non-detectable. This was also true for the phthalate samples taken. That is, six samples were collected for phthalate analysis, three on the operators and three area types, and each were below the analytical detection levels. This was also true for hydrogen chloride.

The results for the formaldehyde evaluation indicated levels of non-detectable to 0.02 mg/M^3 for those samples taken beside the heat/exhaust hood area. The personal sampling levels, however, were all non-detectable (refer to Table 3).

3. Ventilation

The ventilation system in this shop consists of a general room type system and a local exhaust system which is located on the heater/dryer unit. The local system was operating sufficiently, i.e., the owner of the building said that it is designed to provide ten air changes per hour.

The local exhaust system located on the heater/dryer unit, however, should be redesigned if it has not been to date. That is, the hood should be lowered as close to the conveyor as possible and an exhaust system designed to exhaust at a rate of 100 feet per minute at the surface of the conveyor or the opening of the hood. This flow rate would then provide sufficient exhaust flow for normal conditions, as well as during heavy production periods.

The employees stated that both of the ventilation systems in the present shop seem to provide sufficient air circulation for personal comfort and that the air circulation in comparison to the previous location is far superior. They also stated that during heavy production periods smoke would occasionally appear around the face of the hood.

B. Medical

Each of the employees gave medical histories relating to adverse health symptoms, e.g., cough, chest tightness, sore throat, eye and nose irritation, and prolonged headaches. All of the employees felt that the symptoms occurred at the old location during heavy production periods and during winter months when windows and doors were kept closed. Each felt that even though they were in the new location for only a few months the symptoms had subsided.

The medical data elicited from the employees does indicate that they had symptoms suggestive of acute health effects from exposures to many of the substances found in this process, i.e., vinyl chloride, hydrogen chloride, solvents, etc.

VII. CONCLUSIONS

1. Air samples taken during the survey indicate that exposure levels to the materials used in the silk screening process and/or by-products produced from the heating process were below the recommended environmental criteria.

2. Due to the move from the Colorado location to the Tahoe City location that occurred prior to NIOSH's investigation, it was impossible to determine those exposure levels that existed in the past. However, the medical symptoms described by all the employees strongly suggest that a health hazard did exist at the Colorado shop.

3. If conditions at the new shop should develop that were similar to those at the previous store, e.g., buildup of smoke or health problems as described, steps should be taken to reduce and/or eliminate these problems.

   This would be especially necessary because of the health concerns regarding formaldehyde, hydrochloric acid, benzene, and the other solvents used in the process.

4. During the survey period it was told to the NIOSH project officer that this company was planning on adding heat transfer machines. When installing the exhaust ventilation system on these, reference should be given to HETA 81-032-1174 which describes various alternatives for proper exhaust systems for these heat transfer machines. This Company will be receiving a copy of HETA 81-032-1174.

VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental and medical study the following recommendations are made to provide a better work environment for the concerned employees:

1. If the situations should reoccur that contributed to the smoke buildup or irritations as described, the following evaluation should be made:

   a. Determine if the heating unit in the machine is working properly.

   b. Determine if the ventilation system is working adequately.

   c. Question if there has been a chemical composition change in the screening materials used.

   d. Is there additional equipment in the shop, e.g., heat transfer machines in the workplace, and/or a significant increase in production from the silk screen/heating machine?

   Each of these could significantly effect the breathing air in this environment.

2. If conditions in the future should exist which require a change in the ventilation system, that is, increased production or additional machines, the most cost efficient engineering system would be enclosure and/or local exhaust ventilation (refer to HETA 81-032-1174).

   Enclosure is basically confining as much of the operation/machine or machines as possible in order to contain the vapors and fumes in one location. Once confined local exhaust ventilation, i.e., an exhaust system which collects the smoke and exhausts as close to the point of generation should be installed.

3. It may be necessary, if large orders and/or during busy or heavy production periods, e.g., weekends, holidays, or summer vacations, that additional industrial type fans or air exhaust systems as described above be considered.

4. If large bulk orders are performed, these garments should be allowed to air either outside or under an exhaust system as described above in order to reduce and/or eliminate the off gassing from these large orders.

5. During the survey other concerns were noted in the shop which the company should attend to if they have not to date and these are:

   a. Fire extinguishers are essential where solvents are being used such as those used in this process; therefore, fire extinguishers should be available and maintained.

   b. Supplies of flammable and conbustible liquids must be stored in approved, fire resistant safety containers. Therefore, a fire protective cabinet should be purchased to store these chemicals.

   c. All flammable liquids must be kept in closed containers when not in use. Therefore, a safety can with a spring loaded top should be used for storing solvent soaked rags.

   d. Smoke detectors should also be installed in the shop.

IX. REFERENCES

1. Industrial Hygiene and Toxicology, second edition, Frank Patty (editor), Interscience Publishers, 1967, Vol. II.

2. Industrial Toxicology, third edition, Hamilton and Hardy, Publishing Service Group, Inc., 1974.

3. "Threshold Limit Values for Chemical Substances in Workroom Air", American Conference of Governmental Industrial Hygienists, 1981.

4. Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill Book Company, New York.

5. Occupational Diseases, A Guide to Their Recognition, U.S. Department of Health, Education, and Welfare, Public Health Service Publication (NIOSH) No. 77-181.

6. Current Intelligence Bulletin 34: Formaldehyde: Evidence of Carcinogencity. NIOSH Publication No. 81-111, April 15, 1981.

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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. Placer County Distributors.
2. U.S. Department of Labor/OSHA - Region IX.
3. NIOSH - Region IX.
4. California State 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

EVALUATION CRITERIA AND TOXICOLOGY

Placer County Distributors
Tahoe City, California

Substance	Recommended Environmental Limit[A]	Reference Source	Primary Health Effects	OSHA Standard
Vinyl Chloride	(C) 2.5 mg/M^3	NIOSH	Skin and eye irritation; central nervous system (CNS) depressant; lightheadedness; nausea, and hepatitis (liver) damage. Vinyl chloride is a human carcinogen.	2.5 mg/M^3
Hydrogen Chloride	(C) 7.0 mg/M^3	ACGIH[B]	Inflammation, ulceration of nose, throat irritation; cough and choking; eye and skin irritation, and dermatitis.	7.0 mg/M^3
Phthalates	5.0 mg/M^3	ACGIH	Irritation of nasal passages, upper respiratory; stomach irritation; potential sensitivity.	5.0 mg/M^3
Benzene	(C) 3.0 mg/M^3	NIOSH	Irritation to eyes, nose, respiratory system. giddy; headaches; nausea; blood changes, leukemia.	30.0 mg/M^3
Styrene	215 mg/M^3	ACGIH	Irritation of eyes and nose; drowsiness; weakness; unsteady gait; narcosis; dermatitis.	430 mg/M^3
Hexane	180 mg/M^3	ACGIH	Lightheadedness; narcosis, headaches; numbness; muscle weakness; irritation of eyes, nose; giddiness; dermatitis.	1800 mg/M^3
Lead	0.05 mg/M^3	ACGIH	Lassitude; insomnia; eye discolorations; anorexia; low weight; malnutrition; constipation; abdominal pain; colic; anemia; gingival lead line; tremors; paralysis wrist.	0.05 mg/M^3
Chromium	0.5 mg/M^3	ACGIH	Histologic fibrosis of the lungs.	0.5 mg/M^3
Formaldehyde	1.2 mg/M^3*	NIOSH	Irritation to eyes, nose, and throat; lacrimation; burning nose; cough; bronchial spasms; pulmonary irritation; dermal effects.	4.5 mg/M^3

[A] All air concentrations are expressed as time-weighted average (TWA) exposures for up to a 10 hour workday unless designated (C) for Ceiling which should not be exceeded.
[B] ACGIH = American Conference of Governmental Industrial Hygienists.
mg/M^3 = Approximate milligrams of substance per cubic meter of air.
(C) = Ceiling level which should not to be exceeded even instantaneously.
* = This level is based on formaldehyde's irritant effect (1976 NIOSH Criteria for Recommended Standard). Subsequently it has been shown to cause cancer in animals. Exposures should be controlled to the lowest feasible limits.

TABLE 2

SUMMARY OF PERSONAL AND AREA AIR SAMPLES FOR
BENZENE, STYRENE, AND HEXANE

Placer County Distributors
Tahoe City, California

June 1981

Job/Area Description	Sampling Time (minutes)	mg/M^3 Benzene	Styrene	Hexane
Silkscreen Operator	360	0.08	ND	0.4
Silkscreen Operator	360	0.08	ND	0.3
Left Side of Dryer	360	0.04	ND	0.1
Right Side of Dryer	360	0.04	ND	ND
EVALUATION CRITERIA		(NIOSH) 3.0 (OSHA) 30.0	(ACGIH) 215 (OSHA) 430	(ACGIH) 180 (OSHA) 1800
LABORATORY LIMIT OF DETECTION		0.001 mg	0.01 mg	0.01 mg

ND = non-detectable
mg = milligrams
mg/M^3 = milligrams of substance per cubic meter of air

TABLE 3

SUMMARY OF PERSONAL AND AREA AIR SAMPLES FOR FORMALDEHYDE

Placer County Distributors
Tahoe City, California

June 1981

Job/Area Description	Sampling Time (minutes)	mg/M^3 Formaldehyde
Silkscreen Operator	390	ND
Silkscreen Operator	390	ND
Dryer Exit	390	0.02
Above Dryer	390	0.02
Dryer Entrance	390	0.02
EVALUATION CRITERIA		1.2*
LABORATORY LIMIT OF DETECTION (mg/sample)		0.005

ND = non-detectable
mg = milligrams
mg/M^3 = milligrams of substance per cubic meter of air

* This level is based on formaldehyde's irritant effect (1976 NIOSH Criteria for Recommended Standard). Subsequently it has been shown to cause cancer in animals. Exposures should be controlled to the lowest feasible limit.