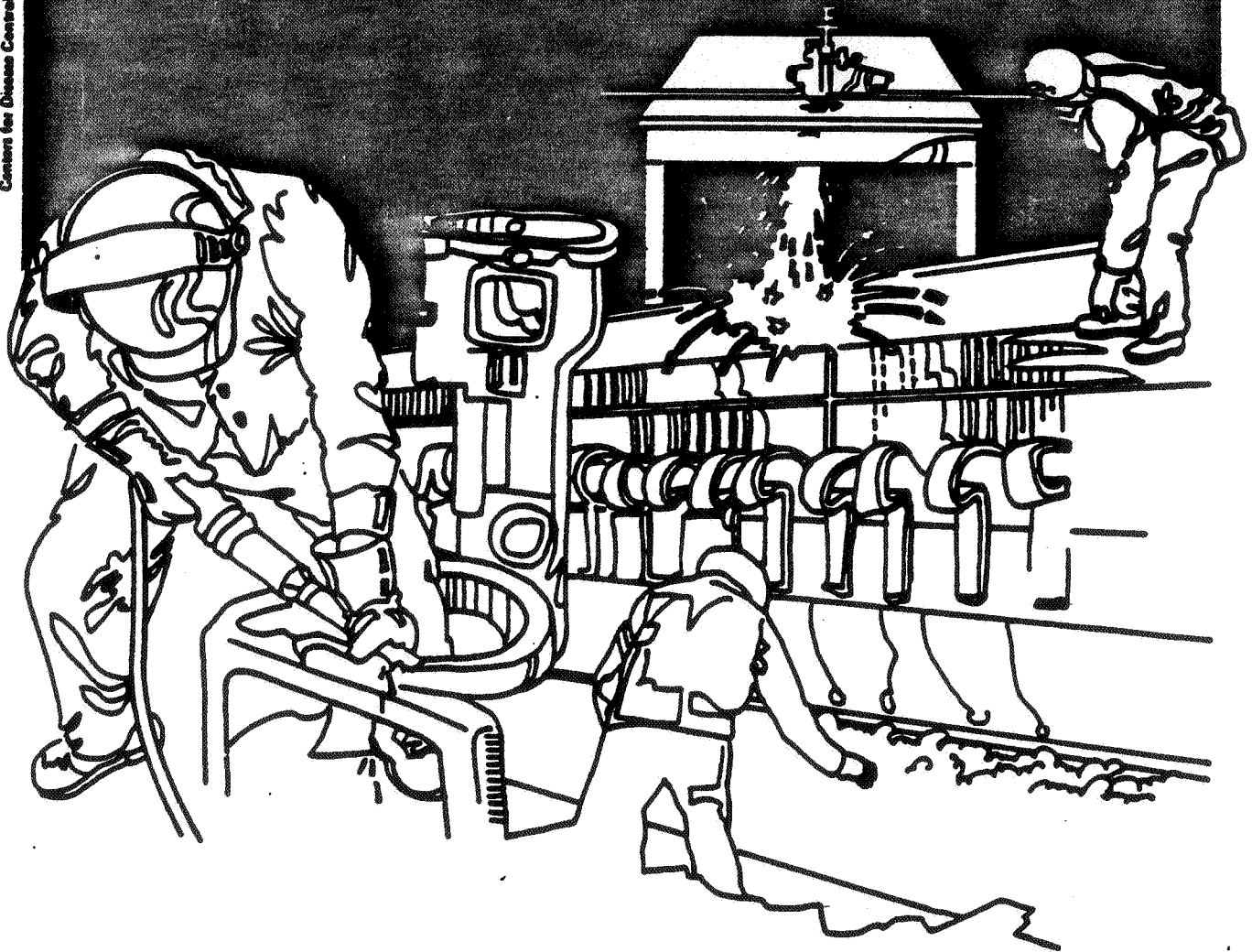


NIOSH



Health Hazard Evaluation Report

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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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

I. SUMMARY

In June, 1985 the National Institute for Occupational Safety and Health (NIOSH) received a request from the Tri-County District Health Department for technical assistance in evaluating solvent exposure in an office building. The offices where the complaints came from are located on the top floor of a two floor building. The bottom floor housed a printing company.

An environmental and medical evaluation was performed on June 24, 1985. Breathing zone and general room air samples were taken on the second floor, in the office spaces, and throughout the printing press area. Samples were taken for toluene, perchloroethylene, chloroform, methylene chloride, and mineral spirits.

Exposure levels of toluene ranged from 0.6 to 34 mg/M³ with an average level of 6.6 mg/M³. Perchloroethylene levels ranged from less than 0.01 mg/sample to 3.5 mg/M³ with an average level of 0.9 mg/M³. Chloroform levels ranged from less than 0.02 mg/sample to 6.8 mg/M³ with an average level of 2.1 mg/M³. Methylene Chloride exposures ranged from less than 0.01 mg/M³ to 6.8 mg/M³ with an average concentration of 2.2 mg/M³. Mineral spirits levels ranged from 10 to 294 mg/M³ with an average concentration of 131 mg/M³. All individual contaminant concentrations were below the recommended evaluation criteria on the specific day of this evaluation. However, the ratio of concentration to TLV for the "mixed" exposure in the pressroom ranged from 0.22 to 1.03 with an average of 0.50. Thus, the highest exposure was at the evaluation criterion (1.0) for the mixture. Toluene and mineral spirits were found in both samples taken on the top floor in office spaces. Perchloroethylene and methylene chloride were also found in one of the top floor specimens.

Workers on both floors were interviewed by a NIOSH physician. Of the 12 office workers individually interviewed, 5 felt that exposures in the office were affecting their health, although all noticed the odors at least when first entering the building, and all but one had some symptoms. Symptoms of headache (58%) and fatigue, drowsiness, or "spaciness" (42%) tended to be worse as the week wore on. Other symptoms were: burning eyes (25%); sore or scratchy throat (25%); nausea or upset stomach (25%); stuffy nose or sinuses (17%). None of the four workers interviewed in the pressroom felt that their work exposures were affecting their health.

On the basis of environmental and medical data, NIOSH concluded that a potential health hazard did exist at the time of this evaluation. The hazard is the introduction of solvent vapors from the printing shop to the second floor executive office spaces. Recommendations for improving the situation are included in this report.

Keywords: SIC 2751 (Commercial printing), SIC 6162 (Mortgage Bankers and Loan Correspondents), SIC 8911 (Engineering, Architectural, and Surveying Services), mineral spirits, toluene, perchloroethylene, chloroform, methylene chloride, indoor air pollution.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in June 1985 from the Tri-County District Health Department to evaluate solvent exposures in an office building. This office building is located at 7950 S. Lincoln, Littleton, Colorado. Results of this evaluation were discussed with Tri-County Health Department officials upon receipt of laboratory analyses in July 1985.

III. BACKGROUND

The office facility which initiated this request is located on the top floor of a two floor building. The first floor houses a printing facility. Office personnel from the second floor complained to the Tri-County Health Department about solvent odors on their floor which they presumed were coming up from the first floor printing shop. After the NIOSH Project Officer talked with the owner of the print shop an environmental and medical evaluation of the print shop and the second floor office space was conducted.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Fourteen air samples were collected in the print shop and two in second floor office spaces, one each in the First Interstate Mortgage Company and in Lee Wan and Associates. All samples were collected on organic vapor charcoal sampling tubes using vacuum pumps operated at 50 cc/minute. NIOSH methods 1500, 1003, 1005 and P & CAM 127 were used to analyze the samples, for chloroform, methylene chloride, mineral spirits, perchloroethylene, and toluene. All available workers on both floors were interviewed.

B. Medical

Individual interviews were conducted with 5 workers in the First Interstate Mortgage Company (2nd floor, northwest); 7 workers in Lee Wan and Associates (2nd floor, northeast); and 4 workers in the first floor pressroom. In addition the office of Colorado Management and Associates (2nd floor, southeast) was visited.

VI. EVALUATION CRITERIA

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 solely 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 only 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.

	Environmental Exposure Limits 8-Hour Time-Weighted Average (TWA)		
	NIOSH mg/M ³	OSHA mg/M ³	ACGIH mg/M ³
Toluene	375	750	375
Perchloroethylene	*	670	335
Chloroform	10*	240	50
Methylene Chloride	260*	1700	350
Mineral Spirits	350	2000	350

* NIOSH considers these to be suspect carcinogens so exposures should be lowered to lowest possible level.

mg/M³ = milligrams of substance per cubic meter of air.

When considering a mixed exposure in which the individual substances have similar toxicologic effects, as in this case, ACGIH suggests that one add the concentrations of each substance divided by its TLV. If the sum is greater than unity (1) then the mixture as a whole exceeds the TLV for the mixture even though each of the components is below its individual TLV.

B. Toxicological

Toluene - Toluene can affect the body by all three routes of entry. Acute exposure may cause irritation to eyes, respiratory tract and skin. It may cause fatigue, weakness, confusion, headache, dizziness, and drowsiness. Chronic exposure may cause defatting dermatitis. Reversible liver and kidney damage can occur in overexposed workers. Hippuric Acid in urine is an index of worker exposure to toluene.¹

Perchloroethylene - Perchloroethylene is a widely used solvent with particular use as a dry cleaning agent, a degreaser, and a chemical fumigant. Repeated contact may cause a dry, scaly and fissured dermatitis. High exposures may produce eye and nose irritation. Acute exposures may cause CNS depression and liver damage. Overexposure may cause dizziness, headaches, increased perspiration, fatigue and slowing of mental ability. Because perchloroethylene is eliminated from the body more slowly than most solvents, there is a tendency for the body burden to gradually increase over the work week. Medical surveillance should include the skin with liver and kidney function.^{2, 3} The National Institute for Occupational Safety and Health (NIOSH). Current Intelligence Bulletin #20 states that perchloroethylene should be treated as a carcinogen due to its ability to cause cancer in experimental animals.⁴

Chloroform - The primary effect of Chloroform is Central Nervous System (CNS) depression with inebriation, anesthesia, and narcosis. Chloroform may be absorbed through the lung, gastrointestinal tract, and through the skin. Liver and kidney damage may occur with repeated overexposure, (5) because National Cancer Institute studies have shown chloroform to be carcinogenic in laboratory mice and rats, NIOSH considers it should be treated as a suspect carcinogen for humans. (6)

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. Maintaining exposures below 360 mg/M³ should eliminate metabolic injury.⁷ Recently the National Toxicology Program has reported that methylene chloride showed "clear evidence of carcinogenicity" in laboratory tests using mice. (8)

Mineral spirits - The petroleum distillate used in the printing industry and the one in use at this facility includes the distillate that distills between 95 degrees and 175 degrees Centigrade. These are chiefly aliphatic hydrocarbons chiefly of C₇ - C₁₀ series. The composition may vary widely since anyone of several fractions within this boiling range may be used.⁹

Depression of the central nervous system is one of the symptoms of exposure. Prolonged exposure causes irritation to mucous membranes, skin irritation, and defatting dermatitis. Liver and kidney damage can occur if excessive exposure is long term.

This product should be used under well ventilated conditions. If airborne concentrations are high (excess of 1000 mg/M³, the action level or one-half the TLV or OSHA standard), local exhaust ventilation should be used. For short exposure a respirator may be used.

V. RESULTS AND DISCUSSION

A. Environmental

On June 24, 1985, an environmental and medical evaluation was performed at the office building and printing press facility located at 7950 south Lincoln, Littleton, Colorado. All environmental samples were within the evaluation criteria. Trace quantities of mineral spirits, toluene, methylene chloride, and perchloroethylene were found in the office space on the second

floor. Since it is difficult to document exposures on a day to day basis one would assume that it would be possible for the office workers complaints to be based on the solvents arising from the printing press area on the first floor. All environmental data is presented in table 1. A summary of the environmental data is given below.

Exposure levels of toluene ranged from 0.6 to 34 mg/M³ with an average level of 6.6 mg/M³. Perchloroethylene levels ranged from less than 0.01 mg/sample to 3.5 mg/M³ with an average level of 0.9 mg/M³. Chloroform levels ranged from less than 0.02 mg/sample to 6.8 mg/M³ with an average level of 2.1 mg/M³. Methylene Chloride exposures ranged from less than 0.01 mg/M³ to 6.8 mg/M³ with an average concentration of 2.2 mg/M³. Mineral spirits levels ranged from 10 to 294 mg/M³ with an average concentration of 131 mg/M³. All these concentrations were below the evaluation criteria on the specific day of this evaluation. The ratio of concentration to TLV for the mixed exposure in the pressroom ranged from 0.22 to 1.03 with an average of 0.50. Thus the highest exposure was at the evaluation criterion for the mixture. Toluene and mineral spirits were found in both samples taken on the top floor in office spaces. Perchloroethylene and methylene chloride were also found in one of the top floor specimens.

A rough estimate of the amount of outside air introduced into the ventilating systems was obtained by comparing levels of carbon dioxide (CO₂) inside the building with levels outside the building in both the morning and again in the afternoon using low range detector tubes. As there was only a minimal rise in CO₂ levels, it was determined that insufficient outside air was not a major problem in this building.

B. Medical

The office workers identified the troublesome odors as that of fresh paint and/or as similar to odors in the print shop. It was worse during the winter, and had improved some with warm weather, particularly if 2nd floor outside doors were propped open at opposite ends of the building. Several identified odor levels as being somewhat dependent on the level of activity in the print shop.

Of the 12 office workers individually interviewed, 5 felt that exposures in the office were affecting their health, although all noticed the odors at least when first entering the building, and all but one had some symptoms. Symptoms of headache and fatigue, drowsiness, or "spaciness" tended to be worse as the week wore on. Symptoms were:

Headache	7 (58 %)
Fatigue, drowsiness, spaciness	5 (42)
Burning eyes	3 (25)
Sore or scratchy throat	3 (25)
Nausea or upset stomach	3 (25)
Stuffy nose or sinuses	2 (17)

These symptoms are consistent with solvent exposures.

None of the four workers interviewed in the pressroom felt that their work exposures were affecting their health although one had noticed that his cold this last winter lasted longer than in previous winters and another workers identified the shrink wrap machine as giving off irritating fumes. One of the others felt that this shop was better than others he had worked in.

VI. CONCLUSIONS

Through personal observations and personal medical interviews performed during this survey it was concluded that a potential health hazard does exist from solvent vapors on the top floor of this building.

VII. RECOMMENDATIONS

1. Better sealing of the ventilation duct that goes from the first floor through the second floor to the roof is recommended. This would prevent the leakage of solvent vapors into the office spaces on the second floor.
2. Installation of local exhaust ventilation in the vicinity of both presses on the first floor is recommended.
3. Print shop employees should be educated on correct handling of solvents.
4. Print shop workers should not wash their hands in the solvents they clean the presses with.

IX. REFERENCES

1. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards
Jan. 1981
2. Occupational Diseases: A Guide to Their Recognition, Department
of Health, Education and Welfare (NIOSH) Publication No. 77-181,
Revised Edition, June 1977.
3. NIOSH Criteria for a Recommended Standard: Occupational Exposure
to Tetrachloroethylene (Perchloroethylene). DHEW Publication No.
(NIOSH) 77-121, 1977.
4. NIOSH Current Intelligence Bulletin #20 -- Tetrachloroethylene
(Perchloroethylene). DHHS (NIOSH) Publication No. 78-112, 1978.
5. Toxicology "The Basic Science of Poisons" Casarett, Doull, 1975
page 504.
6. NIOSH Current Intelligence Bulletin Reprints -- Bulletins 1 thru
18. Current Intelligence Bulletin 9: Chloroform. March 15,
1976 DHEW (NIOSH) Publication No. 78-127, 1978.
7. Occupational Health Guidelines for Chemical Hazards, Department of
Health and Human Services Publication (NIOSH) No. 81-123, January
1981.
8. NTP Technical Report Series Report No. 306. NTP Report No.
85-024. HHS (NIH) Publication No. 85-1562m 1985.
9. NIOSH criteria for a Recommended Standard. Occupational Exposure
to Xylene. HEW Publication No. (NIOSH) 75-168, 1976.