

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 78-100-590

J AND M PRINTING COMPANY
GWINNER, NORTH DAKOTA

MAY 1979

I. TOXICITY DETERMINATION

Based on environmental measurements and other information presented in this report, it is concluded that there was no toxic exposure to organic solvents on the days of this evaluation at J and M Printing Company. There are some substances and processes which cause occasional irritation.

The evaluation indicated concentrations of methylene chloride, isopropyl alcohol, methyl alcohol, ethyl alcohol, ethyl acetate, ethylene glycol monoethyl ether, and naptha below the recommended environmental criteria presented here on both time-weighted average and peak bases. There was no medical evidence that solvent exposure was the probable cause of the liver abnormalities exhibited by two J and M employees.

Recommendations are made in Section V of this report on possible methods to improve exhaust ventilation and decrease irritation from various processes in this plant.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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 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:

- a) J & M Printing Company
- b) U.S. Department of Labor, Region VIII
- c) NIOSH, Region VIII

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

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 the management of J & M Printing Company, Gwinner, North Dakota, to investigate potential health hazards associated with their printing operation. This request resulted from two employees being diagnosed by private physicians as having liver abnormalities.

During the conduct of this evaluation, there were several written and verbal communications with the parties involved. Following the September 19-21, 1978, on-site portion of the evaluation, a report was issued on September 28, 1978, summarizing the work that had been done. A more detailed report was issued on January 10, 1979, containing the results of environmental sampling and a discussion of their meaning.

IV. HEALTH HAZARD EVALUATION

A. Process Description

J & M is a commercial printing establishment which does most of its work on high speed rotary presses. The primary exposure to potentially toxic substances is not in the operation of these presses but rather in the cleanup process, since the only materials used during a run are the paper being printed and a small amount of ink.

At the end of a run, and also at the end of each work day, the presses are cleaned with solvents to remove the ink on the plates and other surfaces. This cleaning is done by hand, spraying solvent onto work surfaces from squeeze bottles and wiping with rags. The pressman, while he is cleaning his machine, is inhaling solvent vapors, and is also incurring skin exposure to the solvents. The cleaning process takes approximately fifteen minutes, and is normally done two to four times per day. Components of the cleaning solvents being used in this plant include methylene chloride, ethyl acetate, ethylene glycol monoethyl ether, naptha, and various alcohols. They are purchased under the trade names of Ronalane[®], Rogersol NY121[®], and Polychem 412[®].

Some work in this plant is produced on letter presses. These are cleaned with the solvents used on the rotary presses. Due, however, to the size and construction of the letter press, there is little likelihood of toxic exposure.

The developing of photographic film and subsequent developing or "burning" of photo-engraving plates appears to be a potentially hazardous operation. This judgement is based on the materials being used (acid and developing chemicals), as well as employee observations and ventilation measurements.

The only other area of the plant where a potential health hazard was observed was the plastic sealing operation. Sets of finished material are placed in plastic which is cut and sealed by a hot wire and sent through a heater which causes it to shrink tightly around the paper. This process, especially the hot wire cutting and sealing, potentially creates hydrochloric acid and other contaminants.

Other processes, such as cutting, collating, and binding, appear to have ample safety and health safeguards.

B. Evaluation Design

On September 19, 1978, a preliminary visit was made to the plant and a walk-through survey was conducted with the management representative who had requested the evaluation. On the following two days, personal and area environmental measurements were made to determine atmospheric concentrations of methylene chloride; methyl, ethyl and isopropyl alcohols; ethyl acetate; ethylene glycol monoethyl ether; and naptha. Detector tube measurements were made for methylene chloride and carbon monoxide. Employees were interviewed regarding job histories and medical problems. Ventilation measurements were made at existing exhaust points.

The concentrations of contaminants in employee's breathing zones were measured by using battery powered personal sampling pumps carried on the employees belt and connected by flexible tubing to charcoal or silica gel sorbent tube clipped on his collar. These samples were used to determine eight-hour time-weighted average exposures. Short-term exposures were measured with similar equipment during cleaning operations which were expected to be the times of highest exposure. To obtain the short-term samples, a NIOSH investigator held the sampler in the breathing zone of the employee during the operation of interest.

Prior to the on-site environmental study, a NIOSH medical officer reviewed medical records of employees who had been diagnosed by their private physicians as having developed hepatic abnormalities.

C. Evaluation Criteria

Listed below are the maximum recommended workplace concentrations of the various substances evaluated in this study, along with the source of the recommendation as noted in Section VI of this report.

Substance	Recommended Maximum Concentration		Source
	Time-Weighted Average	Ceiling	
Methyl Alcohol	200 ppm	800 ppm	NIOSH(1)
Ethyl Alcohol	1000 ppm	-	ACGIH(2)
Isopropyl Alcohol	400 ppm	800 ppm	NIOSH(3)
Ethylene Glycol			
Monoethyl Ether	100 ppm	150 ppm	ACGIH(2)
Methylene Chloride	75 ppm	500 ppm	NIOSH(4) ACGIH(2)
Ethyl Acetate	400 ppm	-	ACGIH (2)
Naptha	350 mg/M ³	1800 mg/M ³	NIOSH (5)

The recommended maximum concentrations listed here are the same as the OSHA standards with the exception of ethylene glycol monoethyl ether which has an OSHA time-weighted average (TWA) standard of 200 ppm and methylene chloride which has an OSHA TWA of 500 ppm, a ceiling of 1000 ppm, and allowable excursion above the ceiling of 1000 ppm for five minutes in any two-hour period.

The criteria recommended for exposure to naptha is adopted from the NIOSH criteria document on refined petroleum solvents. While the naphas used in the cleaning solvents evaluated in this establishment are not specifically listed in this publication, they have similar boiling point ranges, specific gravities, aromatic/aliphatic ratios, appearance and other properties, and are therefore judged to have similar toxicity.

Symptoms attributed to inhalation exposure of high concentration of methyl alcohol include headaches, blurred vision, insomnia, conjunctivitis, and gastric disturbances. Most of the serious cases of methyl alcohol poisoning result from the ingestion of methyl alcohol in the belief that it is ethyl alcohol. Ethyl alcohol vapors can cause irritant effects on the eyes, headaches, sensation of heat, intraocular tension, stupor, fatigue, and a great need for sleep. Isopropyl alcohol also causes eye, nose, and throat irritation, although the most important toxic action is narcosis. The recommended maximum concentrations listed above for these three alcohols should be low enough to prevent all symptoms with the possible exception of slight irritation from isopropyl alcohol.

Exposure to ethylene glycol monoethyl ether and ethyl acetate at the recommended maximum concentrations might also result in mild irritation of eyes and nose. Animal studies have shown lung, kidney, liver and spleen damage at higher concentrations of the ether, and narcosis at higher concentrations of the acetate.

Narcosis is also the predominant effect of exposure to high concentrations of methylene chloride, along with dizziness, nausea, tingling or numbness of the extremities, a sense of heat, dullness and lethargy. Methylene chloride is slightly irritating to the eyes and skin. Methylene Chloride on absorption produces carboxyhemoglobin which decreases the oxygen carrying capacity of the blood which could be of significance in workers with heart or lung impairment.

From the similarities in the effects of these substances, it should be assumed that their effects, especially those of an irritant nature, could be adaptive and that consideration should be given to the combined effects of all substances in determining the potential for a health hazard.

D. Evaluation Results

The attached tables show the results of environmental samples collected during this evaluation. While there were a few samples which indicated concentrations greater than the maximum time-weighted average criteria, these were short duration samples. They were within the limits established as ceiling values, and therefore no toxic exposure is indicated. Analysis of bulk samples of the three cleaning solvents for benzene was done to eliminate the possibility of exposure to this compound. Therefore, environmental samples were not analyzed for benzene.

Detector tube measurements for methylene chloride indicated generally low concentrations except during cleaning operations when concentrations ranging up to approximately 300 ppm were found for short periods of time. Detector tube measurements for carbon monoxide indicated no measurable concentration of that compound (the limit of detection is approximately 2 ppm) and were taken as a precautionary measure due to the fact that CO is thought by some to effect on the toxicity of methylene chloride.

While no samples were taken in the photographic dark room and no overexposure was indicated in the burning room or plastic sealing operation, other observations and information suggest that additional ventilation should be considered in those areas. Ventilation measurements in the burning room and dark room showed minimal air movement. The air flow in the breathing zone of a person working under the exhaust hood in the burning room was approximately 50 feet per minute (fpm), which is considered almost negligible air flow.⁽⁶⁾ The four inch duct placed near table level had a face velocity greater than 800 fpm, but due to its design it is not operating as effectively as possible.

The exhaust system in the dark room moved approximately 150 cubic feet of air per minute. A calculation was made from the specific gravity, molecular weight, threshold limit value and quantity of developing compound (acetic acid) used per week to approximate the air flow necessary for a room the size of this dark room. The result of this calculation indicated that the air flow should be doubled. It is not necessary, however, to exhaust this air outside the building. The dilution achieved by venting the dark room exhaust into the main part of the plant is sufficient to prevent toxic exposures, thereby saving cost on installation and conditioning of make-up air.

Visible emissions were given off during the plastic sealing operation and the fan positioned to blow away these emissions was not effective. After approximately thirty minutes of operation, both the operator and a NIOSH investigator experienced nose and throat irritation.

No evidence was found to indicate that the hepatic abnormalities diagnosed in two employees were due to exposure to any substance present in the workplace. This opinion was formulated on the basis of the environmental data and the medical records of the employees.

Interviews with employees elicited some claims of skin dryness and transient irritation, but no new claims of major medical problems related to the work environment.

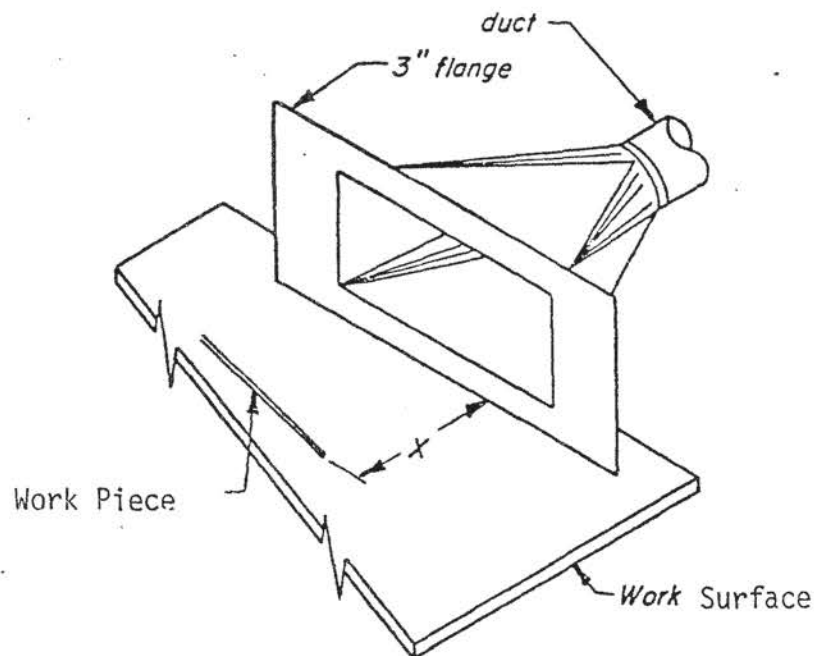
E. Summary and Conclusions

Based on environmental measurements and other information presented in this report, it is concluded that, while there are some substances and procedures which cause minor, occasional, transient irritation, there was no toxic exposure to any substance on the days of this evaluation. Environmental measurements indicate that atmospheric concentrations of all substances involved were below the appropriate criteria. Some instances of inadequate ventilation and resultant irritation were noted. Suggestions are made in Section V of this report on possible methods to reduce such irritation. No evidence was found to indicate that exposure to the solvents evaluated during this study was a probable cause of liver abnormalities exhibited by two J and M employees.

V. RECOMMENDATIONS

Exhaust ventilation should be increased in the dark room, the burning area, and the plastic sealing operation. As noted previously, general dark room exhaust should at least be doubled, but a more effective method of removing contaminant would be to put local exhaust ventilation near the developing chemicals. A small hood or other local exhaust system would also be the best method for controlling emissions from the plastic sealing operation. Care should be taken in the design and installation of all exhaust systems so that the exhaust is not drawing the contaminants through the breathing zone of the worker. This was a problem as the system was operating on the days of this evaluation. The fan at the plastic wrap operation, which was supposed to remove contaminant, was on occasion pushing that contaminant at the worker.

The exhaust hood in the burning area could be improved with minor modification. If the left and right sides were partially or completely enclosed, as the back is by the wall, the direction of air flow would be increased and the system would be more effective. The quantity of air passing close to the work table could be increased by lowering the hood or shortening the face opening from the top. All of the suggestions are designed to enclose the work piece as much as possible without interfering with production, and at the same time direct the air flow in the most advantageous manner. If it is found that the small auxiliary duct is still necessary after the process is enclosed as much as possible, it should be modified with a flange as shown in the figure below.



VI. REFERENCES

1. Criteria for a Recommended Standard. . .Occupational Exposure to Methyl Alcohol, HEW Publication No. (NIOSH) 76-148, Cincinnati, Ohio 1976.
2. American Conference of Governmental Industrial Hygienist, Documentation of the Threshold Limit Values for Substances in Workroom Air, 1977.
3. Criteria for a Recommended Standard. . .Occupational Exposure to Isopropyl Alcohol, HEW Publication No. (NIOSH) 76-142, Cincinnati, Ohio 1976.
4. Criteria for a Recommended Standard. . .Occupational Exposure to Methylene Chloride, HEW Publication No. (NIOSH) 76-138, Cincinnati, Ohio 1976.
5. Criteria for a Recommended Standard. . .Occupational Exposure to Methyl Alcohol, HEW Publication No. (NIOSH) 77-192, Cincinnati, Ohio 1977.
6. Industrial Ventilation, A Manual of Recommended Practice, 13th ed., 1974, American Conference of Governmental Industrial Hygienists.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

Evaluation Conducted By
and Report Prepared By:

G.E. Burroughs
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Medical Consultation:

Thomas Wilcox, M.D.
Medical Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Study Participant:

Kenneth D. Kreitel
Surveillance Branch
Cincinnati, Ohio

Report Typed By:

Linda Morris
Clerk-Typist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Table I

Alcohol Concentrations

J & M Printing
 Gwinner, North Dakota
 HE 78-100
 September 20 & 21, 1978

Description	Day	Time	Concentration		
			Methanol	Ethanol	Isopropanol
Breathing Zone of Pressman	9/20/78	7:25am-4:45pm	0.2 ppm	0.6 ppm	9.9 ppm
Breathing Zone of Pressman	9/20/78	7:25am-4:30pm	1.3 ppm	0.9 ppm	> 4.9 ppm*
Breathing Zone of Pressman	9/20/78	7:30am-4:30pm	1.3 ppm	0.2 ppm	≥ 9.9 ppm
Breathing Zone of Shrink- Wrap Operator	9/20/78	8:35am-4:30pm	0.3 ppm	0.4 ppm	≥ 7.0 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:30pm	≥ 2.6 ppm	≥ 2.1 ppm	≥ 3.1 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:00pm	1.3 ppm	1.5 ppm	≥ 4.4 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:30pm	≥ 0.2 ppm	≥ 0.5 ppm	≥ 3.1 ppm
Recommended 8-Hour Time Weighted Average Limit			200 ppm	1000 ppm	400 ppm

*In the analyses marked ">", a significant portion of contaminant was detected on the back-up section of the adsorption media. It should be assumed that the value is suspect and that the saturation limit of the silica gel may have been exceeded.

Table II

Concentrations of Naptha, Ethylene Glycol Monoethyl Ether, Methylene Chloride, and Ethyl Acetate

J & M Printing
Gwinner, North Dakota
HE 78-100
September 20 & 21, 1978

Description	Day	Time	Concentration			
			Naptha	Ethylene Glycol Monoethyl Ether	Methylene Chloride	Ethyl Acetate
Breathing Zone of Pressman	9/20/78	7:25am-4:45pm	66.0 mg/M ³	<2.4 ppm	> 4.1 ppm*	1.4 ppm
Breathing Zone of Pressman	9/20/78	7:25am-4:30pm	52.4 mg/M ³	<2.6 ppm	> 2.2 ppm	1.4 ppm
Breathing Zone of Pressman	9/20/78	7:30am-4:30pm	52.9 mg/M ³	<3.9 ppm	> 3.9 ppm	1.2 ppm
Breathing Zone of Letter Press Operator	9/20/78	7:40am-4:20pm	42.9 mg/M ³	<2.9 ppm	> 2.7 ppm	1.0 ppm
Breathing Zone of Shrink-Wrap Operator	9/20/78	8:35am-4:30pm	45.0 mg/M ³	<3.0 ppm	> 2.8 ppm	1.2 ppm
Breathing Zone of Plate Stripper	9/20/78	8:45am-10:00am	55.6 mg/M ³	<16.8 ppm	6.2 ppm	1.5 ppm
Area sample, on binder table	9/20/78	8:30am-4:25pm	48.4 mg/M ³	<3.1 ppm	> 2.9 ppm	1.2 ppm
Hand held in Breathing Zone of Pressman while cleaning press	9/20/78	2:48pm-2:53pm	316.7 mg/M ³	<45.4 ppm	>52.8 ppm	1.4 ppm
Hand held in Breathing Zone of Pressman while cleaning press	9/20/78	2:55pm-2:58pm	538.5 mg/M ³	<52.4 ppm	>160.7 ppm	2.7 ppm
Hand held in Breathing Zone of Pressman while cleaning press	9/20/78	4:16pm-4:27pm	548.6 mg/M ³	<18.9 ppm	> 64.1 ppm	38.7 ppm
Area sample in stripping area	9/21/78	8:45am-4:10pm	27.4 mg/M ³	<3.2 ppm	> 1.7 ppm	0.9 ppm
Area sample near hood in burning area	9/21/78	8:45am-4:10pm	27.4 mg/M ³	<3.0 ppm	> 1.9 ppm	1.0 ppm
Area sample on table in burning area	9/21/78	8:50am-3:50pm	21.1 mg/M ³	<3.0 ppm	> 1.6 ppm	0.7 ppm
Area sample on Letter Press	9/21/78	8:55am-3:50pm	19.6 mg/M ³	<3.3 ppm	> 1.6 ppm	0.7 ppm
Breathing Zone of Letter Press Operator	9/21/78	10:00am-4:20pm	22.2 mg/M ³	<6.0 ppm	> 1.9 ppm	0.5 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:30pm	56.3 mg/M ³	<4.3 ppm	> 6.3 ppm	2.3 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:00pm	34.1 mg/M ³	<6.6 ppm	> 2.9 ppm	0.8 ppm
Breathing Zone of Pressman	9/21/78	7:25am-4:30pm	34.3 mg/M ³	<2.6 ppm	> 2.0 ppm	1.0 ppm
Breathing Zone of Letter Press Operator	9/21/78	7:35am-10:00am	35.7 mg/M ³	<48.6 ppm	2.1 ppm	0.5 ppm
Breathing Zone of Shrink-Wrap Operator	9/21/78	8:15am-4:20pm	28.8 mg/M ³	<3.4 ppm	> 2.0 ppm	0.8 ppm
Hand held in Breathing Zone of pressman while cleaning press	9/21/78	1:06pm-1:12pm	1388.9 mg/M ³	<25.2 ppm	>266.9 ppm	54.1 ppm
Recommended 8-hour Time Weighted Average Limit			350 mg/M ³	100 ppm	75 ppm	400 ppm
Recommended Ceiling Limit			1800 mg/M ³	150 ppm	500 ppm	NA**

*In the analyses marked ">", a significant portion of contaminant was detected on the back-up section of the absorption media. It should be assumed that the value is suspect and that the saturation limit of the charcoal may have been exceeded.

**No recommended limit currently published.