

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 NO. 75-143-333

UNITOG COMPANY
WARRENSBURG, MISSOURI

SEPTEMBER 1976

I. TOXICITY DETERMINATION

It has been determined that employees in the pressing department, Unitog Company, Warrensburg, Missouri are not exposed to toxic concentrations of Aldehydes, Toluene, Methyl Ethyl Ketone (MEK), and Phenol in the workroom air. It was also determined that these same employees are exposed to particulate (lint fibers) which irritates their eyes, nose, and throat. These same employees handle uncured fabrics which were found to contain quantities of latent formaldehyde in excess of 1000 parts per million by weight, thus increasing the risk of contact dermatitis.

These determinations are based on an environmental evaluation conducted November 11-13, 1975 by Industrial Hygienists Dawn Gilles and Ray Rivera.

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. Copies have been sent to:

- a) Unitog Company in Warrensburg, Missouri
- b) Authorized representative of employees
- c) U.S. Department of Labor - Region VII
- d) NIOSH - Region VII

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

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorized 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.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding pressing department employees' exposure to substances described as "smoke" haze" and an offensive "odor" which allegedly burned employees' eyes and upper respiratory system.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The Unitog Company in Warrensburg, Missouri is engaged in the production of "business clothing"; most of which is of the permanent press type.

Permanent press clothing is cut and sewn in an adjacent department before it is sent to the pressing department. In the pressing department the final desired shape of the clothing items is achieved by first pressing it into the shape and then curing it in an oven which is also contained in the same room.

Items produced at the plant and pressed in the pressing department include shirts, pants, service suits, shopcoats, and jackets. These items were fabricated from a fabric that had been pretreated with a formaldehyde resin and purposely left partially uncured (incomplete cross linkage).

The pants, service suits, shopcoats, and some of the jackets are pressed by one of twelve operators; some jackets are cured only. The machines used by these operators are oriented in two rows and in such a manner that permits the operator to control two machines.

After these items have been pressed, one of two employees places them on hangers so that a third employee may place them on a conveyor (chain) which travels through the curing oven. One employee removes the items cured in the oven and folds and sizes the pants. Other items are sent to two other employees for folding and packaging.

Shirts are pressed on the opposite side of the room by utilizing a sleeve presser, a collar presser, and a body presser. Each of five "shirt pressers" operates two machines; a collar presser and a sleeve presser. The remaining three "shirt pressers" operate single machines which press the body of the shirts.

In addition to the employees mentioned above, there are two employees who fold shirts, one "bundle boy" who delivers bundles of clothes to be pressed to the operators, one utility person and one supervisor in this room.

Make-up air into this room (140' x 72') is provided by 1) forcing tempered air directly at the employee, 2) supplying general dilution air through two large fans located in one corner and 3) and through an open door way which leads to the next department. Air is removed from the room by 1) three mechanically powered roof fans, 2) three gravity type ventilators, located on the roof, 3) canopy hoods located above the shirt presses, and 4) the exhaust fans from the oven (provided to exhaust combustion gases).

B. Evaluation Methods

1. Environmental

The initial survey, conducted on November 11-13, 1975, included an introductory meeting with management representatives, conducting a walk-through survey of pressing department, collecting area and breathing zone samples for environmental air contaminants, evaluating the ventilation system, and administering confidential medical questionnaires to employees in the pressing department.

Contaminants sampled for included aldehydes, particulate, phenol, and "organics"

Pressing department employees exposure to aldehydes (Formaldehyde, Propionaldehyde, Isobutyraldehyde, Bulyraldehyde, and Acetaldehyde) was determined by collecting breathing zone samples. These samples were collected (at a rate of 1 liter per minute) in impingers using Sodium Bisulfite solution as the sampling media.

The formaldehyde concentration in the samples was determined colorimetrically using a spectrophotometer. Analysis for the other aldehydes mentioned was by gas chromatography.

Breathing zone samples collected for airborne particulate (mostly lint fibers) were collected at two liters per minute. Determination of airborne particulate was done simply by weighing the filter before and after collecting the sample.

Sampling for phenol was conducted by the method described for formaldehyde. Sodium Hydroxide was used for the sampling media.

In addition to sampling for the above mentioned air contaminants, twenty-nine breathing zone and area samples were collected on charcoal tubes in an attempt to determine if there were any other contaminants being liberated and to identify them. These samples were collected at approximately 50 cc per minute for approximately four hours.

Some of the samples were analyzed by Mass spectroscopy for qualitative determination. The remainder of these samples were analyzed by gas chromatography.

Four fabrics were also selected for the purpose of determining latent formaldehyde. After weighing the fabric and extracting the latent formaldehyde by generating steam, analysis of the condensed steam was by a colorimetric procedure utilizing a spectrophotometer.

Ventilation measurements were made using an Alnor Velometer senior. Air flow measurements were made for the canopy hoods and the oven. No measurements of supplied air were made, but design figures were obtained.

C. Evaluation Criteria

1. Environmental Standards

The primary environmental evaluation criteria considered in this report are 1) American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLV's) and supporting documentation, 2) A technical report by Harvey D. Shipkovitz entitled "Formaldehyde Vapor Emissions in the permanent-press fabrics industry and 3) Federal Occupational Health Standards promulgated by the U.S. Department of Labor (29 CFR Part 1910.1000). Only the criteria used (TLV's) are listed below:

	8-hour time weighted average	
Formaldehyde	2 ppm*	3000 ug/m ³ **
Phenol	5 ppm	19 mg/m ³
Toluene	100 ppm	375 mg/m ³

At the present time there is both a federal standard and a TLV for nuisance particulate. However, these both imply that the particulate is physiologically inert; this is not the case with the airborne particulate (lint) in question. These fibers often contain latent formaldehyde, which make them considerably more irritating to the mucous membranes, than an inert particle. For this reason, a nuisance particulate standard or TLV is not considered applicable (by the Author).

An "informal" standard of 1000 parts per million latent formaldehyde in permanent finished fabrics was used as a guide line. This "informal" standard was established and is used by many of the large manufactures in the cotton garment industry for the purpose of accepting or rejecting fabrics from their supplies.

*Parts per million

**Micrograms per cubic meter; 1000 µg = 1 mg

2. Physiological Effects

Formaldehyde: Exposures to formaldehyde may produce irritation of the mucous membranes of the eyes, nose, throat, and respiratory tract. It's odor is detectable at 1 ppm and at 4-5 ppm, lachrymation and burning sensation of the and throat occurs. At concentrations greater than 10 ppm, difficulty in breathing, intolerable burning sensation of nose and throat as well as substernal discomfort may occur. These symptoms may persist for several hours after high exposures have ceased. Dermal sensitization to formaldehyde may occur to formaldehyde following repeated, direct contact with skin. Skin sensitization to formaldehyde vapor is rare.

Phenol: Due to a relatively low volatility, phenol does not frequently constitute a serious respiratory hazard in industry. Vomiting, dizziness, delirium, convulsions, collapse, loss of consciousness, and oliguria are common signs and symptoms in severe cases of poisoning, which usually occurs through ingestion. An early sign of mild poisoning is dark colored urine. Phenol is readily absorbed through the skin producing an initial numbness and blanching. Later the skin becomes reddened and necrotic.

Butyraldehyde: Physiological effects of butyraldehyde are similiar to those of formaldehyde. However, butyraldehyde, like other higher molecular weight aliphatic aldehydes is characterized generally by lower toxicity. Although relatively well tolerated by inhalation, local reaction on the skin and eyes may still be quite pronounced. Sensitization may also occur.

Toluene: Prolonged excessive exposure to this agent may acutely cause headache, weakness, fatigue, unconsciousness, loss of coordination, nausea, vomiting, anorexia, acute dermatitis and irritation of skin and mucous membranes.

D. Evaluation Results and Discussions

Breathing zone concentrations of Aldehydes were very low (See Table I). Only Formaldehyde and Butyraldehyde were detected in any of the samples.

Airborne particulate concentrations were quite low and less than 1 mg/m³ (See Table III). However, it should be pointed out that the particulate in question (mostly lint fiber) is quite irritating if it comes in contact with the mucous membranes; the reason for this is that many of these fibers contain formaldehyde or any of the other chemicals used in treating the fabric.

Phenol was not detected in any of the samples.

Methyl Ethyl Ketone (MEK), Isopropanol and Toluene were identified in the bulk air samples collected.

Because of mutual interferences, the detection limit for MEK and isopropanol was 0.03 mg per sample. Also, their respective concentrations was less than 0.03 mg in each sample. Toluene concentrations (all very low) are reported in Table II.

Concentrations of latent formaldehyde for the four selected fabrics are Presented in Table IV; two of the fabrics contained latent formaldehyde in excess of 1000 ppm.

Evaluation of ventilation the system was limited to measuring the capture velocity for the canopy hoods located above the shirt presses, measuring air velocity into the oven and obtaining design information for both incoming and exhausted air.

Air velocity flow rates at the face of these hoods was extremely low; ranging from 0 to 75 feet per minute and 150 feet per minute at the duct. The air movement through these hoods and subsequently through the ducts appeared to be due to thermal action instead of a fan.

While measuring the air flow for the curing oven it was determined that the air moved out of the oven and into the room for the top eighteen inches of the oven entrance. This air flow pattern was either due to thermal action or to a fan located just inside the oven entrance; this was in addition to the exhaust fan for combustion gases. This air flow, from the oven into the room, was very apparent when a particular fabric was cured during the lunch break; smoke was moving from the oven into the room.

In addition to the two exhaust systems already described, air was exhausted through the roof fans; no air velocity measurement were made for these fans.

No measurements of the supply air were made. Air forced at the press operators through the overhead branch ducts is tempered air. The air supply is in this manner because it serves as a make up air system and to cool the operator; large quantities of heat are generated by the presses.

During discussions with management it was learned that there is a trade off between the amount of air supplied and the temperature of the air supplied. In the past, management has sacrificed the amount of air for a lower temperature.

The general consensus among pressing department employees was that during warm weather there appeared to be no air movement. Employees also indicated that irritation of the eyes, nose, and throat was more pronounced during warm weather.

It was puported that 35,000 CFM of air was supplied to this room and 24,000 CFM was exhausted, thus resulting in positive pressure for this room. This information is not correct, because during the investigation air moved into this room through the door ways and not out of the room.

One case of dermatitis had been diagnosed, by a dermatologist. However, patch testing with the suspected materials resulted in a negative result. Four cases of what appeared to be contact dermatitis were observed by the industrial hygienists; the appearance of the contact dermatitis resembled heat rash with very minor blistering.

RECOMMENDATIONS

1. Increase the amount of air supplied through the spot cooling system: this would serve to provide an adequate supply of make-up air and to cool the "pressers".
2. Accurately determine the number of air changes per hour and increase the number of air changes if needed. Twelve to fifteen air changes per hour has proven satisfactory for low concentrations of irritant gases.
3. Provide appropriate protective clothing (e.g. long sleeve shirts) to prevent contact dermatitis.

BIBLIOGRAPHY

1. Harvey D. Shipkovitz; TR-52, Formaldehyde Vapor Emissions in the Permanent-press Fabric Industry, M.S. DHEW, PHS, Consumer Protection and Environmental Health Service, Environmental Control Administration September, 1968.
2. ACGIH; Threshold Limit Values for Chemical Substances in Workroom Air adapted by ACGIH for 1975 and Supporting Documentation. 1975
3. Federal Register, June 27, 1974, Vol. 39, No. 125, Title 29, Chapter XVIII, 1910, Sub part G.
4. Patty, F.; Industrial Hygiene and Toxicology, Vol. II, 1967.

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TABLE I

Aldehyde Concentration in Pressers' Breathing Zones

Unitog Company
Warrensburg, Missouri
November 12-13, 1975

Job Classification	Sample Number	Time	Concentration in ug/M ³		Comments
			Formaldehyde	Butyraldehyde	
Pants Presser (A)	F-3	0804-1200	53.4	N.D.*	Machines 604 & 605
	F-13	1300-1630	77.7	N.D.	Machines 604 & 605
Pants Presser (B)	F-1	0807-1200	54.9	N.D.	Machines 608 & 609
	F-11	1300-1600	133.9	N.D.	Machines 608 & 609
Pants Presser (C)	F-2	0808-1200	59.9	N.D.	Machines 600 & 601
	F-12	1300-1632	8.5	N.D.	Machines 600 & 601
Presser (D)	F-6	0813-1200	93.0	N.D.	Removing cured clothing from conveyor
	F-16	1300-1632	67.0	N.D.	Removing cured clothing from conveyor
Pants Presser (E)	F-4	0816-1200	72.8	N.D.	Machines 616 & 617
	F-14	1300-1635	16.7	N.D.	Machines 616 & 617
Pants Presser (F)	F-5	0821-1200	5.9	N.D.	Machines 622 & 623
	F-15	1300-1637	73.3	N.D.	Machines 622 & 623
Shirt Presser (G) (shirt body)	F-7	0829-1200	6.6	N.D.	Machine 629
	F-17	1300-1638	11.9	963	Machine 629
Shirt Presser (H) (shirt body)	F-8	0830-1200	112.4	N.D.	Machine 631
	F-18	1300-1639	9.1	N.D.	Machine 631
Shirt Presser (I) (collars & sleeves)	F-9	0833-1200	1188.4	N.D.	Machines 636 & 637
	F-19	1300-1640	73.2	N.D.	Machines 636 & 637
Presser (J)	F-10	0837-1200	36.0	N.D.	Placing clothes on conveyor
	F-20	1300-1640	74.1	409	Placing clothes on conveyor
Pants Presser (F)	F-21	1415-1447	81.3	N.D.	Machines 622 & 633
Pants Presser (K)	F-22	1414-1445	83.9	N.D.	Machines 606 & 607

*None detected; limit of detection is 0.01 mg/milliter of sampling solution

TABLE I (contd)

Aldehyde Concentration in Pressers' Breathing Zones
Unitog Company
Warrensburg, Missouri
November 13, 1975

Job Classification	Sample Number	Time	Concentration in $\mu\text{g}/\text{M}^3$		Comments
			Formal- dehyde	Butyr- aldehyde	
Pants Presser (A)	F-29	0803-1145	50.9	1171	Machines 604 & 605
	F-30	1300-1640	70.1	N.D.	Machines 604 & 605
Pants Presser (C)	F-31	0800-1140	28.4	455	Machines 600 & 601
	F-32	1300-1640	137.3	N.D.	Machines 600 & 601
Pants Presser (L)	F-35	0809-1143	319.9	N.D.	Machines 614 & 615
	F-36	1300-1640	35.0	773	Machines 614 & 615
Pants Presser (M)	F-27	0804-1142	41.3	779	Machines 618 & 619
	F-28	1300-1640	76.8	1227	Machines 618 & 619
Pants Presser (N)	F-25	0805-1144	53.9	N.D.	Machines 610 & 611
	F-26	1300-1640	48.2	N.D.	Machines 610 & 611
Jacket Presser (O)	F-39	0807-1300	14.7	N.D.	
	F-40	1400-1632	118.4	N.D.	
Pants Presser (F)	F-33	0813-1140	67.2	N.D.	Machines 622 & 623
	F-34	1300-1640	72.7	N.D.	Machines 622 & 623
Shirt Presser (H)	F-37	0815-1140	88.8	N.D.	Machine 631
	F-38	1300-1640	121.8	N.D.	Machine 631
Folder & Boxer (P)	F-23	0817-1143	50.5	485	Folding & Boxing Coveralls
	F-24	1300-1620	63.2	485	Folding & Boxing Coveralls

Table II

Toluene Concentrations in Pressers' Breathing Zones

Unitog Company
Warrensburg, Missouri

November 12, 1975

<u>Job Classification</u>	<u>Sample Number</u>	<u>Time</u>	<u>Concentration of Toluene in ppm</u>	<u>Comments</u>
Area Sample	CT-1	0915-1207	0.3	Near oven
Area Sample	CT-2	1300-1630	0.2	Near oven
Pants Presser (B)	CT-3	0912-1155	N.D.	
	CT-4	1300-1630	0.9	
Pants Presser (M)	CT-5	0914-1200	0.7	
	CT-6	1300-1630	1.2	
Pants Presser (R)	CT-7	0919-1200	0.4	
	CT-8	1300-1630	0.4	
Pants Presser (G)	CT-9	0918-1200	0.3	
	CT-10	1300-1630	0.7	
Pants Presser (A)	CT-11	0913-1200	1.1	
	CT-12	1300-1630	1.7	
November 13, 1975				
Pants Presser (A)	CT-16	0848-1140	1.1	
	CT-17	1300-1640	0.6	
Jacket Presser (O)	CT-26	0846-1300	0.6	
	CT-27	1400-1640	0.7	
Presser (D)	CT-24	0849-1140	0.3	Removing clothers from conveyor
	CT-25	1300-1640	0.2	
Shirt Presser (H)	CT-20	0848-1140	0.3	
	CT-21	1300-1640	0.2	
Shirt Presser (T)	CT-22	0850-1140	0.3	Pressing collars and sleeves
	CT-23	1300-1640	0.2	
Pants Presser (E)	CT-18	0846-1140	0.4	
	CT-19	1300-1640	0.6	

Table III

Total Dust Concentration in Pressers' Breathing Zone

Unitog Company
Warrensburg, Missouri

November 13, 1975

<u>Job Classification</u>	<u>Sample Number</u>	<u>Time</u>	<u>Concentration mg/M³</u>	<u>Comments</u>
Pants Presser (B)	V1246	0820-1140 1300-1640	0.26	Machines 608 & 609
Presser (J)	V1216	0823-1140 1300-1640	0.20	Hanging pants on conveyer
Presser (D)	V1207	0826-1140 1300-1640	0.34	Removing Pants from conveyer
Shirt Presser (T)	V1215	0829-1140 1300-1640	0.67	Pressing collars and sleeves
Pants Presser (E)	V1210	0831-1140 1300-1640	0.09	Machines 616 & 617
Shirt Presser (G)	V1211	0834-1140 1300-1640	0.31	Pressing shirt bodies

TABLE IV

Latent Formaldehyde Concentrations in Selected Fabrics

Unitog, Co.
Warrensburg, Missouri

Fabric	Concentration in ppm
Gold English Popling Shirting 181-455 (Fabric code 314288596) cone mills	1,190
White/red stripe Shirting 5621 (fabric code 313288511) cone mills	1,699
Charcoal Gabardine Suiting 152-245 (fabric code 318367044) cone mills	339
Royal Blue ALT Century Twill Suiting 4398 (fabric code 317277041) Riegal	602