

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 75-81- 252

ARTEX MANUFACTURING COMPANY, INC.
OVERLAND PARK, KANSAS 66204

DECEMBER 1975

I. TOXICITY DETERMINATION

It has been determined that employees in the two main production areas were not exposed to toxic concentrations of vinyl chloride and organic solvents (e.g., 1,1,1-trichloroethane, toluene, xylene and petroleum naphtha). Environmental measurements show that vinyl chloride was not detectable, and the organic solvents were less than the American Conference of Governmental Industrial Hygienists (ACGIH) recommended Threshold Limit Value (TLV) for an eight-hour time-weighted average (TWA) for the combined effect of the organic solvents involved in this study. It has also been determined that the clean room operator was exposed to potentially toxic concentrations of organic solvents emanating from cleaning silk screens with an organic solvent containing primarily naphtha. Environmental measurements show that concentrations were approximately 1.9 times the ACGIH recommended TLV (eight-hour time-weighted average) for the combined effect of the solvents. The exposure of the clean room operator would vary throughout the week due to production operations.

The above determinations are based on results of environmental evaluations, data obtained from employee interviews, and the industrial hygienist's personal observations at the time of the evaluations conducted on May 20 and June 17, 1975. Detailed information concerning the results of these findings are contained in the body of the report. Recommendations are included in this determination which are designed to reduce employee exposure to these agents to a minimum.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH; U.S. Post Office Building, Room 508; Fifth and Main Streets; Cincinnati, Ohio 45202. Copies have been sent to:

- a. Artex Manufacturing Company, Inc.; Overland Park, Kansas
- b. Authorized Representative of Employees
- c. U.S. Department of Labor - Region VII
- d. NIOSH - Region VII

For the purpose of informing the approximately 35 "affected employees", the employer shall promptly "post" the Determination Report in a prominent place(s) near where exposed employees work for a period of 30 calendar days.

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 employer due to their concern over potential exposure of their employees to various organic substances, particularly vinyl chloride which is now suspected as being an etiological agent in the development of angiosarcoma (cancer of the liver).

IV. HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

The company receives various textile garments (e.g., sweat shirts, coats, etc.) from other companies and prints various decals such as numbers, pictures and advertisements on the garment for sale to retail or other stores. This is accomplished using a silk screen process with a water soluble dye (referred to as texdye) or a plastic type of dye (referred to as Plastisol). The garment, after application of the various colored texdyes or Plastisols on the garment, is placed on a conveyor belt which travels through an oven (travel time of around three minutes) heated to approximately 325°F for final curing of the dye on the garment. The finished product is then sorted and inspected prior to packaging for shipment. There is one line which is used for flocking operations where a colored flock is electrostatically added to the dye before drying operations. This line appears well ventilated after the initial silk screen printing operation. All ovens appear well ventilated assuring the flow of air is into the oven. Some of the garments do not pass the initial inspection due to dye smudge marks or excess flock. Garments not passing inspection are decontaminated in one of two hoods available for this purpose.

The production areas covered by this evaluation are confined to two main areas of approximately 80 feet by 80 feet each. The first area consist of two conveyor belts and one flock line, and the second area is comprised of three conveyor belts with several printing stations for each conveyor belt and one or two preliminary inspection stations at the end of the conveyor belt or flock line. A room (approximately 15 feet by 20 feet) adjoining the main production area is used for cleaning operations and contains a fairly large metal sink approximately 6 feet long, 2.5 feet wide and 3 feet deep. This is used for cleaning silk screens with an organic solvent solution. The sink also has a large overhead hood. The clean room operator can stand over the sink with most of his body between the sink and the overhead hood. After

this cleaning operation, the silk screens are cleaned with hot soapy water and rinsed with water.

B. Study Progress and Design

A summary of the procedures used to evaluate the areas of concern included on-site interviews with management and employees, a walk-through inspection of the workplace, contacting manufacturers of products used in the process to identify toxic substances, administering medical questionnaires to workers potentially exposed to plant contaminants, and extensive air sampling to detect potential exposure to airborne contaminants. Based on information obtained from contacts with management and suppliers of products used in the process, a walk-through inspection was conducted on May 19, 1975. The final study involved the evaluation of the employees' potential exposure to the following chemicals:

1. Vinyl chloride, and
2. Organic solvents which included 1,1,1-trichloroethane, toluene, xylene and petroleum naphtha.

The first environmental evaluation for the above substances was conducted on May 20, 1975. Due to analytical problems involving lengthy desorption time in the analysis of vinyl chloride, it was necessary to conduct a second environmental evaluation on June 17, 1975 concerning vinyl chloride only.

C. Evaluation Methods

Personal air samples were primarily used to evaluate the employees' exposure. The personal samplers were connected on or around the collar of the employees to collect a representative sample of air in the breathing zone of the workers. General area samples were collected in specific locations in the working environment. Charcoal tubes were used for collecting organic vapors and were analyzed by NIOSH Laboratories in Salt Lake City, Utah, by gas chromatographic methods.

Non-directed medical questionnaire forms were administered to approximately 30 employees by the industrial hygienist at the time of the survey on May 20, 1975. These interviews were to elicit complaints which employees believed might be related to work exposures.

D. Evaluation Criteria

1. Evaluation Standards or Criteria

The three primary sources of environmental evaluation criteria considered in this report are: (1) NIOSH Criteria Documents recommending occupational standards, (2) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's) with supporting documentation, and (3) Federal occupational health standards as promulgated by the U.S. Department of Labor.

Page 4--Health Hazard Evaluation Determination 75-81

For brevity, the recommended health guides of the ACGIH are used as reference points in the following presentation of evaluation criteria. Use of the two other sources of criteria would not change any conclusions contained in this report.

The occupational health guide promulgated by the ACGIH (1975) applicable to the principal individual substances of this evaluation are as follows:

<u>Substance</u>	<u>TLV 8-Hour Time-Weighted Average (TWA) Exposure Standard or Guide</u>	
	<u>ppm^a</u>	<u>mg/M³^b</u>
Vinyl Chloride	Pending ^c	Pending ^c
1,1,1-trichloroethane	350	1,900
Toluene - Skin	100	375
Xylene - Skin	100	435
Naphtha (petroleum)	100 ^d	400 ^d

a - Parts of vapor or gas per million parts of contaminated air by volume (ppm)

b - Approximate milligrams of substance per cubic meter of air (mg/M³)

c - The TLV for vinyl chloride is pending because of recently discovered carcinogenicity.

d - Assuming nothing more toxic than toluene and xylene are present.

An excursion factor for the above substances are as follows:

TLV = 0-1 ppm

TLV = 1-10 ppm

TLV = 10-100 ppm

TLV = 100-1000 ppm

Excursion Factor = 3

Excursion Factor = 2

Excursion Factor = 1.5

Excursion Factor = 1.25

The product of the TLV times the excursion factor represents a "ceiling value" which should not be exceeded (i.e., "ceiling value" = TLV x Excursion Factor). The number of times the excursion above the TLV is permitted is governed by conformity with the time-weighted average TLV.

The Federal Standard for vinyl chloride gas promulgated by the U.S. Department of Labor is 1 ppm or 3.85 mg/M³ based on an eight-hour time-weighted average. The standard also calls for specific steps by an employer when the eight-hour time-weighted average exceeds the "action level" of 0.5 ppm or 1.9 mg/M³. The NIOSH recommended standard for occupational exposure to vinyl chloride is the limit of detection for the sampling-analytical method¹ which is approximately 0.2 ppm.

2. Medical Standards or Criteria

The medical criteria used to determine a toxic response to the vapors under investigation consists of signs and symptoms which each substance contained in the formulation produces when toxic exposure occurs. A brief review of the substances of primary concern follows:

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.

Xylene: Excessive exposure to xylene may cause dermatitis, irritation of mucous membranes, nausea, vomiting, anorexia and heart burn. Dizziness, incoordination and a staggering gait may also occur.

Naphtha (Petroleum): Prolonged exposure to petroleum naphtha may produce dermatitis, photosensitivity, headache, nausea, lassitude, anorexia and extreme nervousness.

1,1,1-trichloroethane: Prolonged exposure to 1,1,1-trichloroethane at levels significantly in excess of the TLV (over four times) may result in a subjective response of a sleepy or dizzy feeling in exposed individuals. This compound is one of the least toxic of the common chlorinated hydrocarbon solvents. No injury to man following repeated exposures at concentrations of 500 ppm or 1,925 mg/M³ has been observed.

Vinyl Chloride: Prolonged exposure to vinyl chloride is now suspected as being an etiological agent in the development of angiosarcoma (cancer of the liver). Based on theoretical considerations as stated in NIOSH's Recommended Standard for Occupational Exposure to Vinyl Chloride there is probably no threshold for carcinogenesis although it is possible that with very low concentrations the latency period might be extended beyond the life expectancy. In view of these considerations and NIOSH's inability to describe a safe exposure level as required in Section 20(a)(3) of the Occupational Safety and Health Act the concept of a threshold limit for vinyl chloride gas in the atmosphere was rejected.

E. Evaluation Results and Discussions

1. Environmental Results and Discussions

Organic Solvents - Table I of this report presents a summary of the analytical results of samples obtained during this survey. The major concern was the potential exposure of employees to petroleum naphtha. In this regard, there were 18 personal air samples and three general area samples obtained and analyzed for these compounds in the two main production areas. Of the 21 samples, none of the samples exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) recommended Threshold Limit Values (TLV) on an eight-hour time-weighted average (TWA) basis for the mixture of all organic

solvents. However, it should be noted that three of the air sample results did exceed the TLV for naphtha of 400 milligrams per cubic meter (mg/M^3) of air sampled, and the maximum concentration was 1670 mg/M^3 for naphtha. The maximum exposure was approximately 70 percent of the TLV on an eight-hour time-weighted average for the mixture of solvents for a texdye printer on Belt #4. It was noted during the survey on May 20, 1975, that smoke tube tests indicated that the oven on Belt #4 was the only oven which indicated an outflow or positive pressure of air as opposed to the other ovens. Also, during the survey it was noted that several gallon cans of various dyes were left open (no lid) throughout the two production areas. Although these concentrations may not be considered as toxic over extended periods of time, they are considered somewhat excessive in that they may produce some temporary symptomatology (e.g., light-headedness, dizzy, etc.) in some employees in these areas.

In addition to the production areas, operations in the clean room involving the cleaning of silk screens with a solvent containing primarily naphtha was evaluated on May 20, 1975. Two personal air samples were obtained from the operator, and both sample results (maximum of 910 mg/M^3) exceeded the TLV for naphtha of 400 mg/M^3 , and also the allowable excursion concentration of 600 mg/M^3 . The estimated exposure for the operator was approximately 1.9 times the TLV on an eight-hour time-weighted average for the mixture of solvents which would be considered as potentially toxic under the conditions noted during the evaluation. Also, smoke tube tests indicated that the current ventilation system did not control the fumes during the cleaning of the silk screens with the organic solvent. It is noted that the exposure of the clean room operator will vary from day to day. He was very busy with cleaning operations involving the organic solvent at the time of the survey.

Vinyl Chloride - There were 18 long term (over one hour) personal air samples and two long term general area samples obtained during the survey of June 17, 1975. Samples were obtained on those printers and inspectors working with the plastisol in both areas of production. The sample results were all less than the detectable level of 0.2 ppm for vinyl chloride. The air concentration levels were below the detectable limit for vinyl chloride and, therefore, are judged to be not toxic under the conditions noted during the evaluation.

2. Medical Results and Discussions

Interviews with employees identified only a few employees with occasional minor complaints of dizziness or light-headedness with, perhaps, the most consistent involving the cleaning operations. Such symptoms were temporary and not long lasting (over several hours). Ninety three percent of the employees had no complaints from a health standpoint which could be attributed to the work environment.

F. Conclusions and Recommendations

In view of the above environmental findings, the following recommendations are made to ameliorate existing or potential hazard(s), and to provide a better environment for employees covered by this evaluation:

1. Local or slot ventilation should be provided around the top back edge of the cleaning basin used for cleaning with organic solvents. The ventilation should have sufficient velocity to draw the organic fumes away from the breathing zone of the clean room operator. It is further suggested that the room be kept at a slight negative pressure from the production area to assure the flow of air is into the cleaning room and not from the cleaning room into the production area.
2. Evaluate and modify as appropriate the existing periodic testing and maintenance program on the ventilation systems servicing the ovens to assure the flow of air is into the ovens and not out of the ovens into the room, and if necessary, modify the ventilation system (e.g., oven on Belt #4) to assure the flow of air into the oven.
3. Provide tight tops for containers with dyes and/or solvents which are not in use in the production area.

V. REFERENCES

1. NIOSH Manual of Analytical Methods. P & CAM #178, HEW Publication No. (NIOSH) 75-121.

VI. ACKNOWLEDGEMENTS AND AUTHORSHIP

Originating Office	: Jerome P. Flesch, Chief Hazard Evaluation Services Branch Cincinnati, Ohio
Report Prepared & Field Investigation By	: Raymond L. Herwin Regional Industrial Hygienist Kansas City, Missouri
Laboratory Analysis	: Richard Kupel, Chemist, DLCD Dr. Russell H. Hendricks, Ph.D., Chemist, DLCD

TABLE I

SUMMARY OF ENVIRONMENTAL RESULTS FOR ORGANIC SOLVENTS* FROM CHARCOAL TUBE SAMPLES OBTAINED DURING PRINTING, DRYING AND INSPECTION OPERATIONS AT ARTEX MANUFACTURING COMPANY, INC. (Note: Any sample number with the designation of "P" was a personal air sample obtained in the breathing zone of the operator; and any sample number with the designation of "GA" was a general area sample obtained in general location specified.) May 20, 1975

Sample Results Expressed as Milligrams of Compound Per Cubic Meter of Air Sampled - mg/M³ (ND - None Detected)

JOB - Description or location	SAMPLE NUMBER	TIME	AIR VOLUME LITERS	1, 1, 1- trichloroethane	toluene	xylene	naphtha	COMBINED EXPOSURE-WEIGHING BASED ON ONE SAMPLE (TMA)
Tunnel Flocker Plastisol Printer	P-13	6:40--9:46 AM	3.6	40	ND	6	ND	.01
" "	P-6	9:46-10:31 AM	1.1	70	ND	ND	1670	.40
" "	P-1	12:05--2:30 PM	9.5	ND	2	10	ND	.02
Belt #3 - Texdye Printer	P-3	12:02--2:30 PM	1.3	220	20	100	ND	.12
Belt #1 - Plastisol Inspector	P-22	6:51--8:20 AM	22	30	1	4	ND	.01
" "	P-4	9:27-10:32 AM	16	100	2	10	ND	.01
" "	P-11	12:08--1:18 PM	18	ND	3	20	650	.25
Belt #4 - Texdye Printer	P-16	7:03--8:26 AM	31	20	8	70	300	.16
" "	P-7	9:38-10:43 AM	24	70	9	70	470	.19
" "	P-10	10:44-12:37 PM	42	9	3	30	190	.13
" "	P-2	1:11--2:30 PM	30	70	10	110	390	.21
Belt #5 - Plastisol Inspector	P-14	7:08--9:50 AM	8.8	70	2	6	ND	.02
" "	P-9	9:50-11:30 AM	5.3	60	4	20	ND	.02
Belt #5 - Plastisol Printer	P-19	7:13--8:25 AM	27	30	2	20	ND	.01
" "	P-12	9:36-10:42 AM	25	50	4	30	340	.13

TABLE I - Continued

JOB - Description or location	SAMPLE NUMBER	TIME	AIR VOLUME LITERS	1, 1, 1- trichloroethane	toluene	xylene	naphtha	COMBINED EXPOSURE-WEIGHING BASED ON ONE SAMPLE (TMA)
Dry Flocker Plastisol Cleaner Inspector	P-24	7:18--8:45 AM	22	410	1	10	ND	.04
" "	P-5	9:33-10:36 AM	16	60	3	20	310	.11
Cleaning Booth Spot Remover Operator	P-8	10:50--2:30 PM	9.4	30	ND	ND	ND	.01
Clean Room Operator	P-26	7:25-10:15 AM	7.9	80	8	20	620	.59
" "	P-23	10:17--2:35 PM	12	60	10	20	910	1.28
Area - Clean Room Area	GA-17	7:40-11:30 AM	207	6	2	4	240	.30
Area - Belt #5 by oven entrance	GA-18	7:33-10:54 AM	221	10	1	10	70	.09
Area - Belt #3 by exit from oven	GA-20	7:39-10:55 AM	196	20	2	10	140	.16
Area - Belt #3 by entrance to oven	GA-21	11:00--1:30 PM	150	20	2	10	110	.10

*ACGIH Standards for 8 hour time weighted average (TLV) for Organic Solvents (ppm - parts of vapor or gas per million parts of contaminated air by volume; mg/M³ - See Below).

	ppm	mg/M ³		ppm	mg/M ³
1, 1, 1-trichloroethane	350	1,900	xylene, skin	100	435
toluene (toluol) skin	100	375	naphtha, coal tar	100	400

Combined Exposure Weighing - 1.0 or more

EXCURSION FACTORS: For all the above substances, the Excursion Factor is governed by the following Excursion Factors which are dependent upon conformity with the time weighted average TLV: the number of times the excursion above the TLV is permitted is governed by conformity with the time weighted average TLV.

TLV 10 ppm - 100 ppm - Excursion Factor of 1.5 x TLV
 TLV 100 ppm - 1000 ppm - Excursion Factor of 1.25 x TLV