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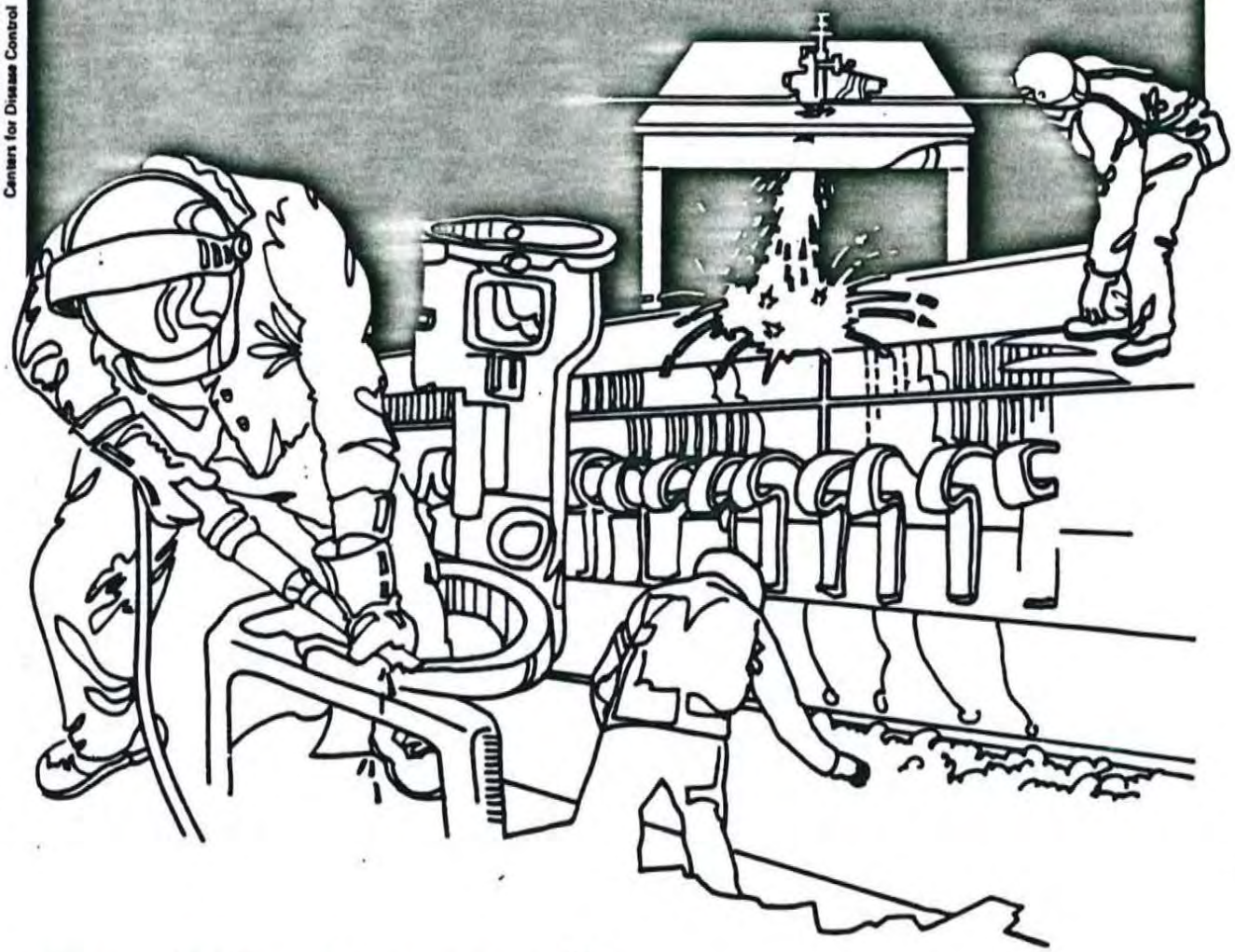

Health Hazard Evaluation Report

HETA 83-066-1531
GLOBE INDUSTRY
LOWELL, INDIANA

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 83-066-1531
NOVEMBER 1984
GLOBE INDUSTRY
LOWELL, INDIANA

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I. SUMMARY

On October 22, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Indiana State Division of Labor to investigate the possibility of an association between three cases of Hodgkins disease and employment at Globe Industries, Lowell, Indiana. Globe Industries manufactures asphalt siding for homes and automobile products. On February 10, 1983, NIOSH investigators conducted an initial walkthrough survey at Globe Industry. On June 29-30, 1983, a follow-up survey, which included environmental sampling, was conducted. Samples were collected for formaldehyde, phenol, hexamethylene tetramine, polynuclear aromatic compounds (PNAs), and nitrosamines.

The concentration of phenol in five personal breathing-zone samples ranged from non-detectable to 6 mg/M^3 with a mean of 2 mg/M^3. The NIOSH recommended exposure limit for phenol is 20 mg/M^3. There were 11 workers exposed to formaldehyde at air levels ranging from 0.02 to 0.30 mg/M^3, with a mean of 0.15 mg/M^3. NIOSH recommends that formaldehyde exposures be kept as low as possible. Three personal breathing-zone samples were found to contain hexamethylene tetramine, which were not quantitated due to analytical problems. PNA's were not present in a sample of asphalt (detection limit of 21 ug/gm) used by Globe Industry during the NIOSH survey. No airborne nitrosamines were found near the rubber molding process (detection limit of 0.1 ug/M^3).

Review of the work and exposure histories of the three HD cases at Globe, showed that all were potentially exposed to phenol, formaldehyde and asphalt fumes while working at Globe, and that two cases were potentially exposed to chemicals on jobs prior to coming to work at Globe. A search of company personnel records and interviews of senior employees did not detect any additional HD cases among Globe employees.

Based on environmental sampling, chemical exposures did not pose a health hazard at Globe Industry at the time of the NIOSH survey. Based on existing information and information in this report, it is not possible to infer a causal association between the three HD cases and employment at Globe Industry.

KEYWORDS: SIC 3079 (Miscellaneous Plastics Products), Hodgkins disease, phenol, formaldehyde, hexamethylene tetramine.

II. INTRODUCTION

On October 22, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Indiana State Division of Labor to investigate the potential association between three cases of Hodgkins disease and employment at Globe Industry in Lowell, Indiana. On February 10, 1983, NIOSH conducted an initial walkthrough survey at Globe Industry. A letter dated March 10, 1983, summarizing the February 10 visit, was sent to Globe Industry. On June 29-30, 1983, a follow-up survey was conducted, which included environmental sampling. A letter dated July 21, 1983, summarizing the survey was sent to Globe Industry.

III. BACKGROUND

On December 28, 1981, the local newspaper official, in Hammond, contacted the Centers for Disease Control in Atlanta, Georgia, concerning a possible increase in cancer cases in Lake Dalecarlia, a small community near Hammond. The Center for Disease Control, Center for Environmental Health Division, cancer branch conducted a study of the residences comparing the community cancer rates to expected cancer rates. The study showed that all cancer types were within expected ranges except for Hodgkins's disease, which occurred significantly more often than was expected.(1) Five HD cases were identified by the study and three of those five had worked at Globe Industry, Lowell, Indiana. The Center for Environmental Health suggested that NIOSH be asked to investigate.

Globe Siding Products began operation in 1934, employing about 50 persons to manufacture asphalt siding for houses. In 1958, an automotive sound- deadening line was installed, and the company became Globe Industries, Inc., which currently employs about 180 people. Major operations for manufacturing automotive padding can be divided into three processes.

Padding Process

Textile scraps comprised of synthetic fibers and washed cotton are combined with a phenolic resin at 300°-500° F to form a green "phenolic pad" or combined with latex to form a gray "resinated pad". Phenolic pads are molded to fit the cars' shape in a hot press operationg at 300°-350° F.

Asphalt Process

A rolling machine forms a thin layer of petroleum asphalt which is then sandwiched between two sheets of polyethylene plastic.

Rubber Process

A sheet of rubber is combined with a phenolic pad and heated to 500°-550° F in a curing oven. The product is sprayed with cold water before being cold molded into its final shape.

IV. METHODS AND MATERIALS

A. Environmental

On June 29-30, 1983, NIOSH investigators collected air samples for formaldehyde, phenol, and other organic vapors associated with the padding process. A bulk sample was collected from the asphalt process for analysis of polynuclear aromatic compounds (PNAs). Nitrosamine air samples were collected from a rubber molding process.

Padding Process

Bulk air (about 200 liters) charcoal and silica gel tubes were collected for qualitative analysis of organic compounds by gas chromatography/mass spectrophotometry. Xylene, phenol and hexamethylene tetramine were the major contaminants that were identified. Thus, personal breathing-zone air samples for xylene were collected on charcoal tubes (NIOSH Method 127)[2], while air samples for phenol and hexamethylene tetramine were collected on silica gel tubes. These samples were drawn at a flow rate of 0.2 liters per minute for about seven hours. Analysis was by gas chromatography.

Ten personal and area air samples for phenol were also collected through midget bubblers containing 15 ml of 0.1 N sodium hydroxide. The samples were collected for seven hours at a flow rate of 1.0 liters per minute and analyzed by gas chromatography using NIOSH Method S-330[3].

Eleven personal breathing-zone air samples were collected for formaldehyde on "Supelco Orbo 22" sorbent tubes. The samples were drawn at a flow rate of 0.05 liters per minute for seven hours. Analysis was by gas chromatography using NIOSH Method 354[4].

Since no established method for analyzing hexamethylenetetramine on silica gel was known, spiked samples of hexamethylenetetramine were prepared on silica gel to be used for desorption efficiency testing with various solvents. Several spikes were desorbed for two hours in a sonic bath with 2 mL of each of the following solvents: 4:1 methanol-water, 4:1 methanol-water containing 1% HCl, 4:1 methanol-water containing 5% HCl, 1N H_2SO_4, deionized, distilled water, ethanol, and 4:1 tetrahydrofuran-water containing 1% HCl. Those samples desorbed with an acidic solvent were made basic with NaOH before analysis. All of the samples were analyzed by gas chromatography using a 30-meter DB-5 fused silica capillary column and a nitrogen-phosphorus detector. In all cases the desorption efficiency was less than 20%.

Because the usual desorbing solution for polyamine analysis is 4:1 methanol-water containing 1% HCl, this solvent was used for the samples. The samples were desorbed for two hours in a sonic bath with 2 mL of the above eluent. A 0.5 mL portion of each sample was made basic with the addition of 0.5 mL of 0.2N NaOH prepared in 4:1 methanol-water. The samples were then analyzed as above.

Asphalt Process

A bulk sample of asphalt was divided into three portions of approximately 300 mg each, and dissolved into 5 ml of acetonitrile, benzene, or cyclohexane. An aliquot of each sample solution was analyzed for PNAs by gas chromatography.

Rubber Process

Three area air samples were collected near the opening of the oven, and two personal breathing-zone air samples were collected from the press operator. The samples were collected on "Thermosorb/N" tubes, which were desorbed by backflushing the cartridges with a mixture of 25% methanol and 75% methylene chloride solution. The solutions were then analyzed by gas chromatography using a Thermal Energy Analyzer.

B. Medical

NIOSH medical investigators, reviewed the work histories of the HD cases at Globe Industry, reviewed company personnel records, and interviewed several senior Globe employees in search of additional HD cases.

V. EVALUATION CRITERIA

A. Environmental Criteria

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 primarily 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. Specific criteria for environmental contaminants evaluated in this report are listed in Table I.

VI. RESULTS

A. Environmental

Padding Process

Five personal breathing-zone samples for phenol ranged from non-detectable (< 0.1 mg/M^3) to 6 mg/M^3 with a mean of about 2 mg/M^3 (Table II). The highest phenol concentration found was 20 mg/M^3 from a process air sample taken directly inside the padding line. The NIOSH recommended exposure limit to phenol is 20 mg/M^3. The OSHA permissible exposure limit is 5 ppm (19 mg/M^3).

Workers were exposed to airborne formaldehyde concentrations ranging from 0.02 to 0.30 mg/M^3, with a mean of 0.15 mg/M^3 (Table III).

Xylene exposure was found to be negligible. A process air sample taken inside the padding line contained 0.3 mg/M^3. Five padding process workers were exposed to xylene at levels of 0.1 mg/M^3 or less. The NIOSH recommended exposure limit for xylene is 435 mg/M^3.

Since the desorption efficiency was so low, only qualitative results were reported for hexamethylenetetramine. All three personal breathing-zone samples from padding process workers contained hexamethylenetetramine.

Asphalt and Rubber Processes

None of the 17 normally analyzed PNA compounds were detected (< 21 ug/g) in any of the asphalt sample solutions. No nitrosamines were detected (< 0.1 ug/M^3) in any of the air samples taken in rubber molding areas.

B. Medical

Case #1, diagnosed in 1979, was in a worker employed at Globe since 1974. During that eight year employment period, Case #1 worked as a coater operator, forklift operator, press operator, and utility relift person. These jobs gave Case #1 potential exposure to asphalt fumes,

phenol, formaldehyde, and smoke, in general, from the curing ovens. Case #2, diagnosed in 1970, was in a worker employed at Globe since 1967, as a forklift operator and a utility person. These jobs resulted in potential exposures to asphalt fumes, phenol, and formaldehyde. In addition, this individual was exposed to painting solvents on jobs prior to coming to work for Globe (1965-1967). Case #3, diagnosed in 1976, worked at Globe from 1966 to 1967 as a press helper and mixer. These jobs involved potential exposures to asphalt fumes, phenol, and formaldehyde. From 1967 to 1976 he worked at a saw mill, paper mill, and steel mill, giving potential for exposure to wood dust, formaldehyde, benzene, and coke oven emission.

Searching company personnel records and interviewing senior employees did not detect any additional HD cases among Globe employees.

VII. DISCUSSION/CONCLUSIONS/RECOMMENDATIONS

A. Environmental

Phenol and formaldehyde were the major airborne contaminants found at Globe Industries, but even these were present at concentrations well below any applicable environmental criteria. During the NIOSH survey, average phenol exposures were less than 2 mg/M^3. Over-exposure to phenol would not be expected even during adverse changes in environmental work conditions, since phenol concentrations directly in the process were only 20 mg/M^3. However, different resins with potentially differing free phenol contents have been used in the past. Thus, past exposures remain unknown.

Formaldehyde exposures were well below the 1976 NIOSH recommended exposure limit of 1.2 mg/M^3. Since that time, however, formaldehyde had been shown to cause a rare form of nasal cancer in laboratory rats and mice. Based on these findings, NIOSH currently recommends that formaldehyde be handled as a potential occupational carcinogen. Exposures should be reduced to the lowest feasible limit.[5]

Padding resins were also found to contain hexamethylenetetramine (HMTA) which was detected in workers's breathing-zone samples, but was not quantitated due to analytical problems. HMTA is a skin irritant and sensitizer. Solutions of HMTA release formaldehyde, so many of the toxic properties of HMTA might actually be due to formaldehyde[6].

The Padding Line process should be enclosed as much as possible to minimize worker exposure to padding resins, HMTA, and formaldehyde. Cleaning up settled dust that contains padding resins should be done by vacuum methods instead of dry sweeping.

There were no PNAs found in the asphalt used by Globe Industries during the NIOSH survey, nor were there any airborne nitrosamines associated with the rubber process.

B. Medical

One NIOSH epidemiologic study suggests an occupational association, between wood dust exposure and Hodgkins disease (HD) among wood workers in a variety of occupational settings.[7] Other studies have shown an excess of HD among workers in various occupations exposed to a variety of chemicals including polyethylene[8,9], phenoxy acids, chlorophenols, and organic solvents[10,11,12]. Measured exposure levels were not specified in these studies.

Risk factors for the three HD cases at Globe Industry, other than occupational exposure, are not addressed in this report. They were studied in a multi-cancer, case-controlled analysis of a local residential section in Lowell, Indiana, conducted by Centers for Disease Control (CDC), Atlanta, Georgia[1]. The CDC study found a statistically significant increase in HD, but it has limited statistical power because of the small number of HD cases.

All the HD cases had potential occupational exposure to asphalt fumes, phenol, and formaldehyde at Globe Industry. However, because of other potential risk factors such as diet, other environmental exposures, and genetic predispositions; and because of the small number of HD cases at Globe Industry, it is not possible to determine whether the cases represent a random cluster or are related to past occupational chemical exposures at Globe Industry.

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1. Globe Industries
2. Indiana State Division of Labor
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I
Evaluation Criteria
Globe Industry
Lowell, Indiana
HETA 83-066

Substance	Evaluation Criteria			Primary Health Effects
	NIOSH	OSHA	ACGIH	
Formaldehyde[13]	Lowest feasible limit	3 ppm TWA 5 ppm ceil 10 ppm peak	3.0 ppm ceiling	Formaldehyde is a suspected occupational carcinogen. Formaldehyde gas is an irritant to the eyes and respiratory tract; solutions cause both primary irritation and sensitization.
Phenol[14]	20 mg/m^3 60 TWA ceil	19 mg/m^3 TWA	-	Phenol is an irritatant of the eyes, nose and throat. Chronic poisoning is rare. The symptoms include nausea, vomiting difficulty swallowing, diarrhea, loss of appetite, headache, vertigo, and possibly skin eruption, with possible liver and kidney damage.
Asphalt fumes[15]	5 mg/M^3 (15-minute period)	-	-	Potent animal carcinogen. Suspected human carcinogen. Causes severe liver damage in humans, symptoms include nausea, jaundice, and other signs of liver injury.
Xylene[16]	100 ppm 10-hr. TWA 200 ppm 10-min. ceil	100 ppm TWA	100 ppm TWA	Xylene vapor is an irritant of the eyes, mucous membranes, and skin. At high concentrations it causes dizziness, excitement, drowsiness, incoordination, and staggering gait, eye damage, loss of appetite, nausea, vomiting, and abdominal pain.

Table I (continued)
Evaluation Criteria
Globe Industry
Lowell, Indiana
HETA 83-066

Substance	Evaluation Criteria (mg/m^3) NIOSH	OSHA	ACGIH	Primary Health Effects
Hexamethylene tetramine	-	-	-	Hexamethylenetetramine has caused dermatitis among rubber workers, but the lack of other reports of systemic intoxication suggest that it has relatively low toxicity and skin irritation potency.
Polynuclear aromatic Hydrocarbons (PNA's)[18]	0.2 mg/M^3 as benzene, or 0.1 mg/M^3 cyclo hexane extractable in the presence of specific PNA's* for 10-hour time weighted average.			Several PNA's are known to be carcinogenic while othe are considered potential carcinogens.
Nitrosamines[19]	none as low as feasible	-	-	Nitrosamines have been reguarded as one of the most potential animal carcinogens and are considered suspected human carcinogens.

* NIOSH has no specific criteria for each PNA. Thus, PNA's are evaluated as cyclohexane extracted substances in th presence of PNA's as a benzene soluble fraction (0.20 mg/M_3) for a specific substance, e.g. Coal tar pitch.

ppm - parts of contaminant per million parts of air sampled.
TWA - 8-hour time weighted average, unless otherwise specified.
Ceil- 15-minute ceiling limit, unless otherwise specified.
peak- peak concentration never to be exceeded.

TABLE II

Air Sampling Results for Phenol
Globe Industries, Inc.
Lowell, Indiana
HETA 83-66
June 29-30, 1983

Job/Location	Sample Time	Sample media	Concentration in milligrams/cubic meter
Hot Press Operator	7:30-11:30	silica gel	6
Utility Person	8:11-14:37	impinger	N.D.*
Utility Person	7:39-14:30	silica gel	1
Clean-up Person	8:00-14:30	impinger	1
Resin Operator	8:15-14:37	impinger	1
Hot Press Area Sample	7:30-14:30	silica gel	3
Hot Press Area Sample	11:45-14:48	impinger	1
Hot Press Area Sample	8:22-14:30	impinger	19
Hot Press Area Sample	8:23-14:30	impinger	3
Under Padding Line Hood Area Sample	11:15-14:37	impinger	20
Front Padding Line Area Sample	8:13-14:30	impinger	15
Rear Padding Line Area Sample	8:15-14:30	impinger	8
Padding Operator Desk Area Sample	8:11-14:30	impinger	6
Evaluation Criterion			20

*N.D. = none detected (< 0.1 mg/M^3)

TABLE III

Personal Breathing-zone Air Concentrations of Formaldehyde*
Globe Industries, Inc.
Lowell, Indiana
HETA 83-66
June 29-30, 1983

Job/Location	Sample Time	Concentration in milligrams/cubic meter
Press Operator	7:40-14:30 (6/29)	0.18
Press Operator	7:30-14:30 (6/30)	0.19
Utility Person	8:11-14:37 (6/29)	0.02
Utility Person	7:58-14:30 (6/30)	0.17
Picker Feeder	7:15-14:37 (6/29)	0.07
Picker Feeder	7:20-14:30 (6/30)	0.10
Resin Operator	7:50-14:40 (6/29)	0.16
Resin Operator	7:45-14:30 (6/30)	0.18
Clean-up Person	8:00-14:40 (6/29)	0.09
Clean-up Person	7:20-14:30 (6/30)	0.30
Hot Press Operator	7:55-14:30 (6/30)	0.14

*NIOSH recommends that formaldehyde be handled in the workplace as a potential carcinogen. The extent of the cancer risk to workers exposed to formaldehyde at or below the current OSHA 3.7 mg/M^3 permissible exposure limit has not yet been determined. In the interim, NIOSH recommends that engineering controls and stringent work practices be used to reduce exposure to the lowest possible level.

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