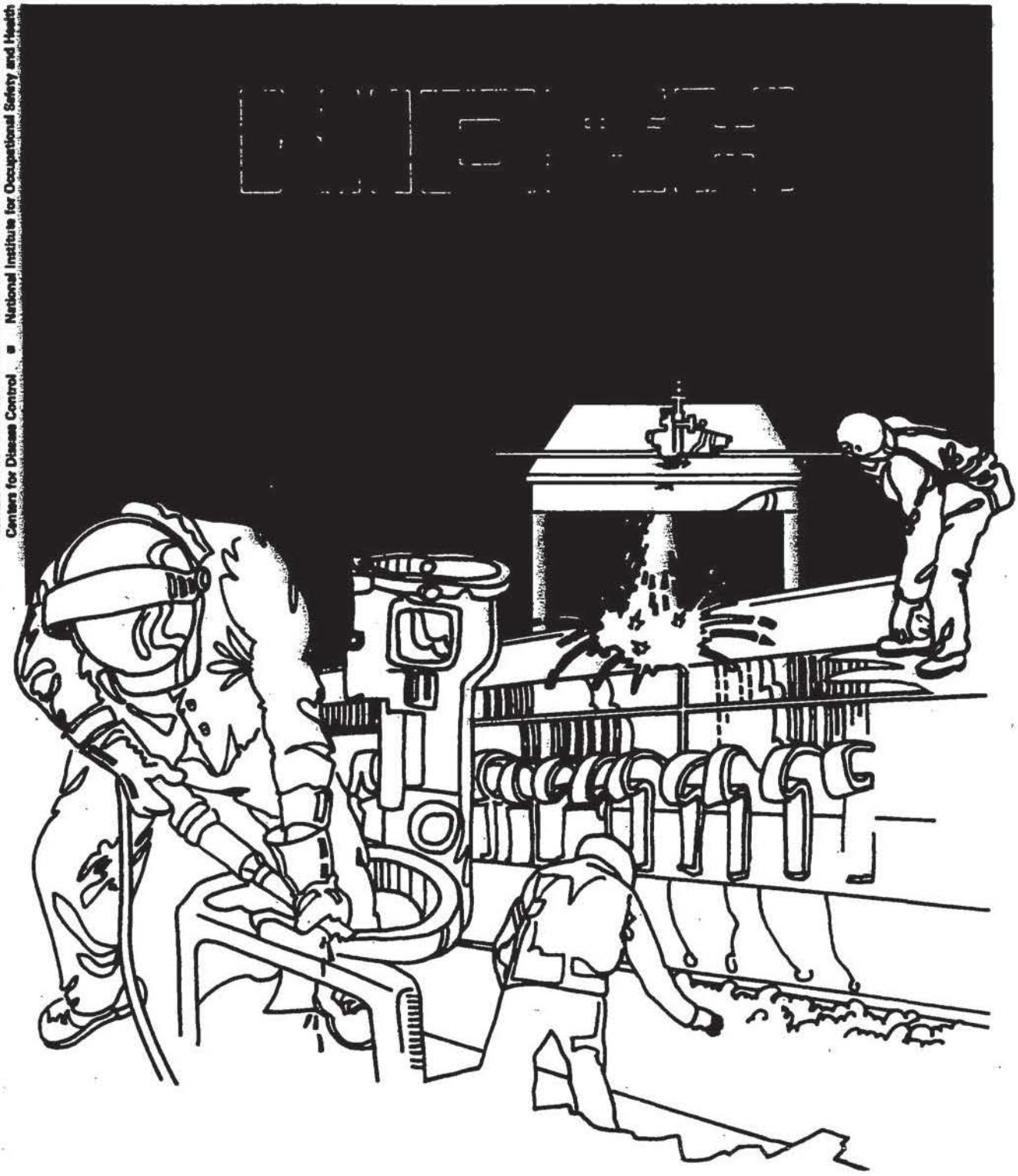
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



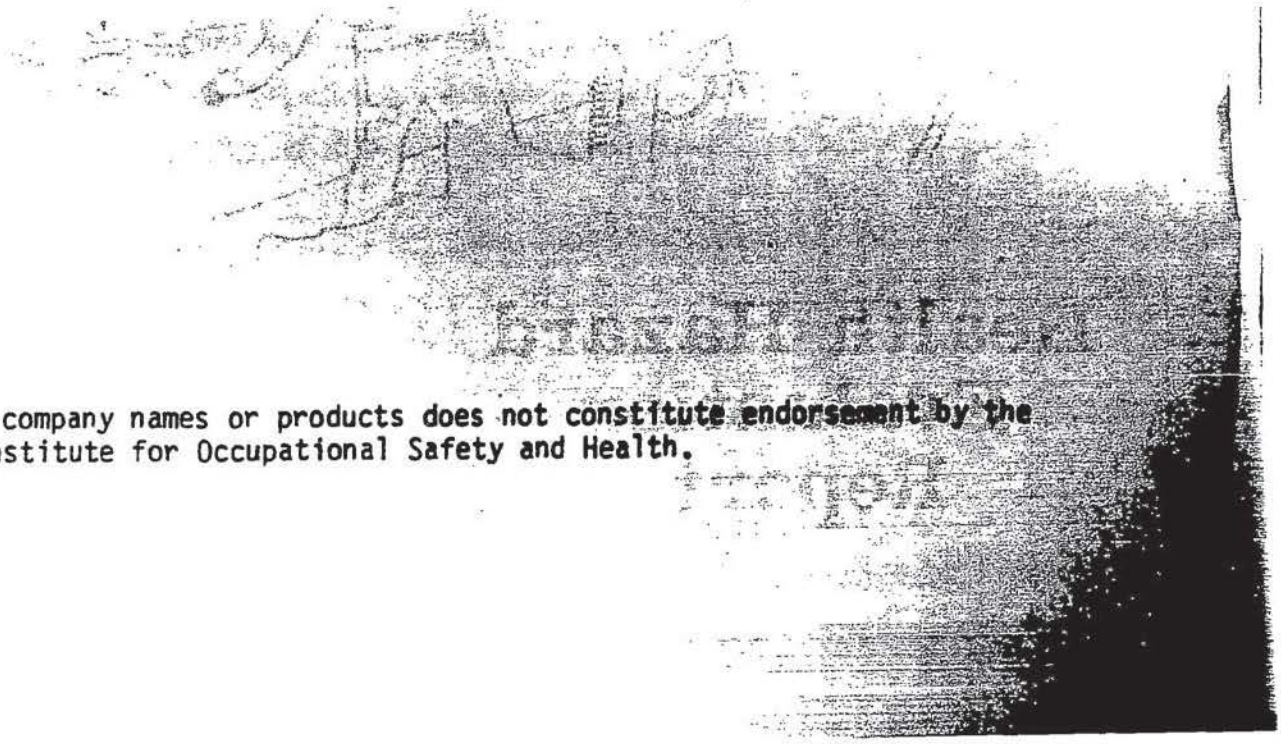
Health Hazard Evaluation Report

HETA 82-264-1232
/OLYMPIC MEDICAL LABORATORIES
BREMERTON, WASHINGTON

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 82-264-1232
November 1982
Olympic Medical Laboratories
Bremerton, Washington

NIOSH INVESTIGATORS:
Arvin G. Apol

I. SUMMARY

In July, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from Olympic Medical Laboratories to determine the employees' exposure to formaldehyde and xylene in the histology laboratory.

On July 13, and 21, 1982, NIOSH collected ten formaldehyde and seven xylene air samples to determine the workers' exposures to these substances. The employees were interviewed regarding current and past adverse health effects.

The three technicians' and pathologists' exposures to airborne vapors of xylene ranged from 3-14 ppm which are 14% or less of the criteria used. The formaldehyde concentrations ranged from 0.08 to 2.58 ppm. Two were above 1 ppm which was the 1976 NIOSH recommended 30 minute maximum exposure level. They were 1.26 and 2.58. The 1.26 ppm concentration was the pathologist's exposure while he was conducting gross tissue examination and the 2.58 concentration occurred when the technician was disposing of old specimens that were preserved in formaldehyde. The 2.58 ppm concentration exceeded the Washington State Standard Ceiling Value of 2 ppm. In 1981 NIOSH recommended that formaldehyde be considered a potential carcinogen and that all exposures be controlled to the lowest feasible limit.

Two employees reported occasional eye and nose irritation at work. One technician experienced burning of his eyes and nose while he was disposing of the old specimens. Although the pathologist had no adverse health effects on the day of sampling he stated he experienced burning of the eyes and nose on days when the work load was greater.

On the basis of the data collected for this investigation, NIOSH determined that the three technicians and the three pathologists are exposed to formaldehyde vapor. Since NIOSH recommends that formaldehyde be considered a potential occupational carcinogen, as a prudent public health measure, engineering controls and stringent work practices should be employed to reduce occupational exposures to the lowest feasible limit. Recommendations involving exhaust ventilation and work practices have been included in the report.

KEYWORDS: SIC 8071 (Medical Laboratories) Formaldehyde, Xylene, Ventilation

II. INTRODUCTION

In July 1982 the the National Institute for Occupational Safety and Health (NIOSH) received a request from Olympic Medical Laboratories, Bremerton, Washington, to determine the employees' exposure to formaldehyde and xylene in the histology laboratory. The environmental survey was conducted on July 13, and 21, 1982. An interim report including the environmental results and recommendations was submitted to the requestor on August 25, 1982.

III. BACKGROUND

Olympic Medical Laboratories is a medical laboratory located in a hospital in Bremerton, Washington. This request involves only the histology lab. There are three technicians who work in the lab full-time and three pathologists who work in the lab for about one hour a day on a rotational basis. There are a number of chemicals used, however, formaldehyde and xylene comprise the bulk of the usage.

Biological specimens are sent from surgery to the histology lab and are preserved in formaldehyde solution. Once a day, for approximately one hour, the pathologist conducts a gross examination of the tissue. Portions of the tissue are removed for slide mounting. The specimens are placed back in formaldehyde for storage. The removed tissue is mounted in a paraffin block, sliced with a microtome and mounted on a slide. The mounted slide then goes through a series of solutions where the stains are applied and the slides fixed. The cover slips are applied and the slides are complete. About once a week the specimens that are no longer needed are disposed. The contents of the container (the specimen and formaldehyde solution) are put through a strainer and rinsed with water. The formaldehyde is washed down the sink and the specimen is placed in an uncovered container.

Two technicians conduct the slide preparation. The third one logs in the specimens, assists in gross tissue examination and disposes of the specimens. The pathologist conducts the gross tissue examination.

There is one local exhaust hood in the room. It is a canopy type hood over the counter next to one of the two sinks. It is not enclosed on the sides or front, is 21 inches above the counter top, has 10.5 square feet of open face area and exhausts approximately 250 cfm. Smoke tube tests show that it captures very little of the vapor emitted from the specimens during gross tissue examination or from the sink. There were also a number of open xylene containers in the room.

IV. EVALUATION DESIGN AND METHODS

The environmental survey consisted of measuring the employees' exposures to airborne vapors of formaldehyde and xylene in their breathing zone. Ten samples were collected for formaldehyde and seven samples for xylene. The employees were questioned regarding symptoms during the use of formaldehyde. Listed below are the sampling and analytical methods used in the evaluations.

Substance	Collection Method	Flow rate	NIOSH Analytical Method (1)
Formaldehyde	impinger 1% sodium Bisulfite	1.0 lpm	P&CAM 125
Xylene	Charcoal tubes	50 cc/min	P&CAM 127

V. EVALUATION CRITERIA

A. Environmental

The environmental criteria for exposure to toxic substances used in this evaluation are based on the NIOSH Criteria Documents, Recommended Standards for Occupational Exposure to Formaldehyde (2,3), to Xylene (4), and the Washington State Department of Labor and Industry General Occupational Health Standards (4). The Washington State Standard has a permissible 8 hour time weighted average formaldehyde exposure level of 2 ppm which is also a ceiling value not to be exceeded at any time. In 1976 NIOSH recommended a permissible formaldehyde exposure level of 1 ppm for any 30 minute period. However, in 1981, based on research that indicated formaldehyde is a potential occupational carcinogen, NIOSH recommended that formaldehyde exposure be reduced to the lowest feasible limit.

Washington State standard for xylene is a time weighted average exposure of 100 ppm. In its criteria document for xylene, NIOSH also recommends a permissible time weighted average exposure of 100 ppm.

B. TOXICOLOGY

1. FORMALDEHYDE (3)

"Formaldehyde has induced a rare form of nasal cancer in both Fischer 344 rats and in B6C3F1 mice as reported in an ongoing study by the CIIT. In a second study by NYU, formaldehyde appears to have induced the same type of cancer in Sprague-Dawley rats. Although humans and animals may differ in their susceptibility to specific chemical compounds, any substance that produces cancer in experimental animals should be considered a cancer risk to humans. Formaldehyde has also demonstrated mutagenic activity in several test systems. Although a substance cannot as yet be designated a potential occupational carcinogen based solely on results of mutagenicity tests, positive results in mutagenicity tests should be used as supporting evidence for identifying a potential occupational carcinogen.

Based on these results, NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational

carcinogen. Safe levels of exposure to carcinogens have not been demonstrated, but the probability of developing cancer should be reduced by decreasing exposure. An estimate of the extent of the cancer risk to workers exposed to various levels of formaldehyde at or below the current 3 ppm (U.S. Department of Labor, OSHA Standard) standard has not yet been determined. In the interim, NIOSH recommends that, as a prudent public health measure, engineering controls and stringent work practices be employed to reduce occupational exposure to the lowest feasible limit."

Other Health Effects -"The first signs or symptoms noticed on exposure to formaldehyde at concentrations ranging from 0.1 to 5 ppm are burning of the eyes, tearing (lacrimation), and and general irritation to the upper respiratory passages. Higher exposures (10 to 20 ppm) may produce coughing, tightening in the chest, a sense of pressure in the head, and palpitation of the heart. Exposures at 50 - 100 ppm and above can cause serious injury such as collection of fluid in the lungs (pulmonary edema), inflamation of the lungs (pneumonitis), or death.

In one report, five nurses working near an artificial kidney (hemodialysis) machine developed wheezing and recurrent episodes of productive cough. The attacks generally occurred in winter and often followed colds. The formaldehyde used to sterilize the machine was found to have caused this respiratory distress.

Dermatitis due to formaldehyde solutions or formaldehyde-containing resins is a well-recognized problem. After a few days of exposure, a worker may develop a sudden inflammatory (eczematous) reaction of the skin of the eyelids, face, neck, scrotum, and flexor surfaces of the arms. An eczematous reaction may also appear on the fingers, back of the hands, wrists, forearms, and parts of the body that are exposed to the rubbing of clothing. This sometimes occurs after years of repeated exposure."

2. Xylene (6)

"Repeated prolonged exposure to vapor may produce conjunctivitis of the eys and dryness of the mouth throat and skin. Direct liquid contact may result in flaky or moderate dermititis. Inhaling of vapor may cause CNS excitation then depression, characterized by paresthesia, tremors, apprehension, impared memory, weakness, nervous initiation vertigo headache, anorexia and nausea.

VI. RESULTS AND DISCUSSION:

The results of the environmental samples are shown in Table 1. The workers' exposure to xylene ranged from 3 to 14 ppm. This is 14% or less than the criteria and is not considered a problem. The formaldehyde

concentrations ranged from 0.08 to 2.58 ppm. Two of the technicians' exposure ranged from 0.08 to 0.27 ppm. This is below the Washington State standard of 2 ppm and the 1976 NIOSH level of 1 ppm. However, it is not controlled to the lowest feasible level as recommended by NIOSH in 1981. Another technician had exposures of 0.43, 0.93 and 2.58 ppm. The 2.58 ppm sample occurred over a 30 minute period when he was disposing of old specimens. This exposure exceeded all the criteria used. The 0.93 ppm sample was collected when he was logging in specimens, doing miscellaneous work and when he was working with the pathologist during gross tissue examination. This latter work was undoubtedly the highest portion of this sample and was probably higher than 1 ppm for that 43 minute portion of the sample period. The third sample was collected over a 134 minute period while he was disposing of old specimens (about 20 minutes) and doing miscellaneous work not related to the use of formaldehyde. The pathologist's formaldehyde exposure, while he conducted the gross examination of tissue, was 1.26 ppm.

As stated earlier under the criteria section, the 1981 position taken by NIOSH is that formaldehyde is a potential carcinogen and as such should be controlled to the lowest feasible level.

One technician stated that his eyes and nose burned and he squinted his eye when disposing of specimens. During this time his average formaldehyde exposure was 2.58 ppm. As soon as he completed this task the symptoms ceased. The pathologist stated that when he was examining tissue his eyes and nose did not burn. His exposure that day was 1.26 ppm, however he stated it was a light day (small specimens and not much formaldehyde). On heavy days his eyes and nose will burn. The other technicians did not report any symptoms during the sampling periods.

VII. CONCLUSION

On the basis of the data collected for the investigation NIOSH determined that the one technician's and the pathologist's exposure to formaldehyde is potentially toxic. This is based on the sample results that show exposure in excess of 1 ppm over a 30 minute period and the 1981 NIOSH position that formaldehyde is a potential carcinogen and should be controlled to the lowest feasible level. The other two technicians also have formaldehyde exposures up to 0.27 ppm which is also feasible to reduce. The background levels of formaldehyde in the room are definitely elevated by two procedures which are the disposing of the old specimens and gross tissue examination. The use of good local exhaust ventilation on these two procedures will greatly reduce the formaldehyde exposure incurred by the one technician and the pathologist and at the same time reduce the background level in the room. The workers' exposure to xylene was not toxic as measured.

VIII. RECOMMENDATIONS

1. A new exhaust system should be designed and installed. In the interim, changes can be made to the existing system to make better use of the exhausted air.

2. When installing a new exhaust hood or modifing the existing system the following items should be taken into consideration.

a. Enclose the hood on all sides as much as possible. The object is to take all the available exhaust air and have it enter the hood over the point of work. This concept gives a greatly increased capture efficiency.

b. The hood can be constructed out of quarter inch clear acrylic plastic that permits light to enter and also provides visibility.

c. The air entering any open hood area should have a velocity of 100 - 150 fpm. As an example the current hood has about 10 square feet of open area. The current air volume is 250 cfm so the average face velocity of 25 fpm. To meet the 100 fpm minimum guidelines the total open face area should be 2.5 square feet.

d. Hinged lids can be provided to increase the versatility of the hood.

3. Gross examination of tissue should be done in a hood where all the vapors are drawn away from the pathologist and into the hood with none of the vapors escaping into the room atmosphere.

4. All disposal of old specimens should be done in a sink that is provided with a well-designed, local exhaust venilation system that will capture all vapors released.

5. The specimen being disposed should be thoroughly rinsed with water and placed in a container that is under an exhaust hood or into a closed container.

6. Keep all containers of xylene and formaldehyde covered when not being used.

7. All specimen containers should have screw lids that completely seal the container so that no vapors are released while they are in storage on the shelf.

8. Until adequate local exhaust ventilation can be installed, the disposal of specimans should be done after all other personnel in the room have left for the day. The person doing this work should then be provided with a NIOSH approved full face cartridge type respirator. The cartridge should be an organic vapor cartridge.

9. Employees should be informed as to the hazard of formaldehyde, its control, and appropriate personal hygiene procedures.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods. Vol 1, 2nd ed. Cincinnati, OH: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-157-A).

2. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to formaldehyde. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-126).

3. NIOSH Current Intelligent Bulletin #34
April 15, 1981 Formaldehyde: Evidence of Carcinogenicity.

4. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to xylene. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1975. (DHEW publication no. (NIOSH) 75-168).

5. State of Washington, Department of Labor and Industries: Chapter 296-62 WAC, General Occupational Health Standards

6. Patty FA. Patty's Industrial Hygiene and Toxicology. Vol II--toxicology, 3rd revised ed. New York: John Wiley & Sons, 1978.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Originating Office: Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. Olympic Medical Laboratories, Bremerton Washington
2. Washington State Department of Labor, Olympia Washington
3. the National Institute for Occupational Safety and Health (NIOSH) Region X
4. the Occupational Safety and Health Administration (OSHA) Region X

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

FORMALDEHYDE AND XYLENE BREATHING ZONE
AIR CONCENTRATIONS

OLYMPIC MEDICAL LABORATORIES
BREMERTON, WASHINGTON
HETA 82-242

JOB	DATE	SAMPLE TIME Min	TIME OF DAY	FORMALDEHYDE CONCENTRATION PPM	XYLENE CONC. PPM
Lab Tech # 1 - Slicing Specimens, Preparing Blocks	7/13/82	186	8:11A - 11:17A	0.23	9
Slide Preparation,etc.	7/13/82	124*	11:20A - 2:00P	0.27	11
Lab Tech #3 - Disposal of Specimens	7/13/82	30	11:26A - 11:56A	2.58	3
Lab Tech #3 - Log Specimens in, Assist in Gross Exam, Miscellaneous work	7/13/82	82*	11:56A - 2:00P	0.93	
Pathologist - Gross Examination of Tissue	7/13/82	43	1:15P - 1:58P	1.26	--
Lab Tech #1 - Slicing Preparations, Slide Preparations	7/21/82	152	8:32A - 11:04A	0.08	4
Lab Tech #1 - Slicing Specimens,Slide Preparations	7/21/82	141*	11:04A - 2:00P	0.14	4
Lab Tech #2 - Slicing Specimens, Slide Preparations	7/21/82	152	8:32A - 11:04A	0.18	9
Lab Tech #2 - Slicing Specimens, Slide Preparations	7/21/82	141*	11:04A - 2:00P	0.22	14
Lab Tech #3 - Disposal of Specimens,Logged in New Specimen, Misc. Work	7/21/82	134*	11:06A - 2:00P	0.43	--

*Sampling Equipment Off During Lunch Period