U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 77-33

ST. LUKE'S HOSPITAL OF KANSAS CITY
KANSAS CITY, MISSOURI

AUGUST 1977

Study Requested By: Ms. Karen Meek
Chairperson of the Laboratory Safety Committee

Study Prepared By: Raymond L. Hervin
Regional Industrial Hygienist
National Institute for Occupational
Safety and Health
Kansas City, Missouri

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 77-33

ST. LUKE'S HOSPITAL OF KANSAS CITY
KANSAS CITY, MISSOURI

AUGUST 1977

I. SUMMARY

Ms. Karen Meek, Chairperson of the Laboratory Safety Committee, requested assistance from NIOSH in evaluating the employees' exposure to xylene, diethyl ether, and other vapors in the cytology, hormone, and histology laboratories. The following determinations have been made based upon results of the environmental air samples collected on April 21 and 26, 1977, confidential employee interviews to elicit any symptomatology which may be due to the work environment, and available toxicity information:

A. Employees' exposure to benzene, ethyl alcohol, isopropanol, xylene, diethyl ether, and acetone did not pose a health hazard at the concentrations measured at the time of this evaluation.

B. Employees' exposure to chloroform did pose a health hazard at the concentrations measured in the hormone laboratory at the time of the survey.

C. Employees' exposure to formaldehyde did pose a health hazard at the concentrations measured in the gross room of the histology laboratory at the time of the survey.

Detailed information concerning the results of this survey are contained in the body of this report. Recommendations are included in this report which are designed to reduce employee exposure to a minimum.

II. BACKGROUND INFORMATION ON PROCESSES AND POTENTIAL EXPOSURES

A walk-through survey was conducted on April 20, 1977, to observe various operations and ascertain what chemicals are used in the laboratories. An environmental survey was subsequently performed on April 21 and 26, 1977, to further evaluate the exposure of employees to organic vapors. This survey included obtaining personal air samples, interviewing employees to ascertain any symptomatology which may be attributed to the work environment, and conducting a cursory ventilation survey. A SHEFS-I Report dated May 13, 1977, was distributed and is in essential agreement with this report.

The histology, cytology, and hormone laboratories are typical hospital laboratories involving several chemicals in conducting various laboratory tests (e.g., preparation of slides, tissues, sample preparations, etc.). The portion of the histology laboratory evaluated consisted of a main laboratory with a "back room" laboratory plus a separate gross room (e.g., cutting and examination of tissue by one or two physicians and assisted by one technologist). The main histology laboratory has approximately six or seven technologists. The cytology laboratory has five technologists and the hormone laboratory has four technologists. The request covered only the main organic solvents used in five different laboratories, and therefore, no attempt was made to ascertain exposure levels for all the chemical stains and dyes which may be used in the laboratories. Exposure to formaldehyde is considered the main concern in the gross room. Exposure to xylene, isopropanol, ethyl alcohol, and benzene (possible contaminant in xylene) was considered the main concern in the other histology and cytology laboratories, and exposure to diethyl ether, chloroform, and acetone was considered the main concern in the hormone laboratory.

The technologist in the gross room has an exposure of approximately 4 or 5 hours per day while assisting the physician(s) every day. It is my understanding that the physician(s) are rotated and work in the gross room a few times a week. The technologist also prepares the formaldehyde solutions. The other technologists in the histology laboratory have the highest exposure for approximately 2 hours per day during coverslipping operations. The primary exposure in the cytology laboratory is to the one technologist who does the coverslipping operation. This task in the cytology laboratory may be rotated at times during the week. The main exposures in the hormone laboratory are from the sample preparation (e.g., ethyl ether and acetone) and sample evaporation and ancillary activities by two technologists. In addition, chloroform is distilled approximately twice a week and exposure lasts approximately two hours per distillation.

III. EVALUATION METHODS, CRITERIA AND TOXICOLOGY

A. Evaluation Methods

Breathing zone samples were taken on most of the workers involved in the operations with emphasis on those receiving the highest exposures. Ethyl alcohol, chloroform, diethyl ether, acetone, benzene, isopropanol, and xylene were collected on organic vapor charcoal sampling tubes using Sipin pumps at 50 to 200 cubic centimeters (cc) per minute. These samples were analyzed by gas chromatography with a minimum detection limit of 0.01 milligrams of compound per sample. Bendix, MSA and/or Draeger detector tubes with respective pumps were used for evaluation of formaldehyde exposures in the gross room. Approximately 14 workers were interviewed concerning any symptomatology which may be attributed to the work environment.

B. Evaluation Criteria

1. Environmental Criteria

The three primary sources of environmental evaluation criteria considered in this report are: (a) NIOSH Criteria Documents with recommended standards for occupational exposure; (b) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's) with supporting documentation; and (c) Federal Occupational Health Standards as promulgated by the Occupational Safety and Health Administration, U.S. Department of Labor (29 CFR 1910.1000). For the substances evaluated during this study, the primary environmental criteria used were:

Substance	Standard or Guide mg/M^3*
Formaldehyde	1.2 (a)** 30 minute sampling period
Benzene	3.2 (a,c)***
Chloroform	9.78 (a)**** 60 minute sampling period
Xylene	434.0 (a,b,c)***** 868 mg/M^3 for 10 minute sampling period
Isopropanol	980.0 (a,b,c)
Diethyl ether	1200.0 (b,c)
Ethyl alcohol	1900.0 (b,c)
Acetone	2400.0 (b,c)

*Approximate milligrams of substance per cubic meter of air sampled.

**Reference letters in parentheses refer to the source(s) from the above discussion from which the standard or guide was obtained.

***The current ACGIH-TLV for benzene is 30 mg/M^3 with a reference that benzene is a chemical substance associated with industrial processes which are suspect of inducing cancer in man. However, recent studies from clinical as well as from epidemiological data are conclusive at this time that benzene is leukemogenic because it produces progressive, malignant disease of the blood-forming organs. Based on this more recent data NIOSH recommended to OSHA that an emergency standard for benzene be 3.2 mg/M^3. OSHA has recently published an emergency standard for benzene of 3.2 mg/M^3.

****NIOSH previously recommended a workplace environmental limit of 10 ppm as a time-weighted average for up to a 10 hour workday and 50 ppm as a ceiling limit. The recommendation for a more stringent standard was made after additional information indicated that chloroform causes cancer in experimental animals. This information was provided by the National Cancer Institute Bioassay Program. It is noted that by increasing the sampling time, the standard should be lowered, but it is just as or more important to detect peaks above the limit than to reduce the above standard of 9.78 mg/M^3 by one half or even one fourth for chloroform.

*****In case of a mixture of air contaminants particularly with organic solvents, the overall effects are considered as additive. An employer shall compute the equivalent exposure as follows:

$$*Em = \frac{C_1}{L_1} + \frac{C_2}{L_2} \ldots \frac{C_n}{L_n}$$

Where:

Em is the equivalent exposure for the mixture.
C is the concentration of a particular contaminant.
L is the exposure limit for that contaminant, from Table Z-1, Z-2, or Z-3.

*The value of EM shall not exceed unity or 1.

Occupational health exposure limits for individual substances are generally established at levels designed to protect workers occupationally exposed on an eight hour per day, 40 hour per week basis over a normal working lifetime.

C. Evaluation Toxicology

Chloroform -- The narcotic effects on the central nervous system (e.g., anesthetic, etc.) have been well documented[1,2,3] as well as cardiac irregularities during anesthesia and local irritation when applied to the skin[4,5]. Although there have been reports of lassitude, depression, irritability, and painful urination[6], there have been no published reports of any association between chloroform and cancer in humans. However, animal studies[7,8,9] have shown necrosis of the liver as well as kidney impairment in animals after ingestion, inhalation and intravenous administration. The most recent study[7] (sent to requester under separate cover) on rats being fed chloroform resulted in significant increase in epithelial tumors of the kidney with most of the tumors reported as carcinomas. The concentration of 9.78 mg/M^3 of chloroform (60 minute sampling period) in the workers' breathing zone should protect the worker from the possible carcinogenic properties of chloroform and would eliminate any deleterious effects on the liver, kidneys, and central nervous system for the average healthy employee.

Formaldehyde -- Formaldehyde causes irritation on contact with the skin, eyes, nose, throat, or lungs.[10] Exposure may also cause sensitization in susceptible individuals. Because of hypersensitivity reactions, sensitized individuals should not be exposed to any formaldehyde whatsoever. Complaints of irritation, disturbing odor, and disturbed sleep after exposures to formaldehyde at 1.2 to 2.4 mg/M^3 form the basis for recommending a ceiling limit of 1.2 mg/M^3 in workplaces where exposure can occur. Ingestion of formaldehyde has resulted in headache, upper gastrointestinal pain, allergic reactions, damage to tissues of the upper gastrointestinal and respiratory tracts, systemic damage and death. At the low concentrations of formaldehyde normally encountered in the industrial environment, bis(chloromethyl) ether (BCME -- a known human carcinogen) is apparently not formed by the reaction of formaldehyde and chlorides (e.g., HCl). Although the NIOSH investigator did not find formaldehyde and HCl together at the time of the survey, it was noted that both compounds are used in the laboratories. Ingestion of formaldehyde has resulted in headache, upper gastrointestinal pain, allergic reactions, damage to tissues of the upper gastrointestinal and respiratory tracts, systemic damage and death.

Xylene -- Xylene has an irritant effect on the skin and mucous membranes and can have variable effects on the liver, kidneys, and gastrointestinal tract.[11] Another major problem of xylene toxicity is its narcotic effect on workers, causing symptoms such as muscular weakness, lack of coordination, and mental confusion which may pose a risk to the worker and others. Current evidence indicates that xylene is not toxic to the blood and blood-forming organs. However, unless highly purified xylene is used, benzene may be a serious contaminant and present more of a hazard than xylene.

Benzene -- Dermal contact with liquid benzene may cause erythema and blistering of the skin. A dry, scaly dermatitis may develop during prolonged or repeated exposure. Acute exposure produces an initial state of euphoria followed by giddiness, headache, nausea, a staggering gait, and, if not immediately removed from exposure, a state of unconsciousness. In chronic benzene poisoning at lower levels of exposure, symptoms of headaches and fatigue were prominent.[12] Other common troubles include nervousness, vertigo, sleeplessness, and shortness of breath. The unique aspect of chronic benzene poisoning is its effect on the blood-forming system, specifically aplastic anemia. Recent studies have reported cases of benzene-related blood dyscrasias and chromosomal aberrations. Although some investigators have observed acute forms of leukemia associated with benzene exposure, a recent connection with chronic leukemia has been shown. NIOSH recommends that the level of benzene in air be kept as low as possible less than 3.2 mg/M^3.

Ethyl Alcohol -- ethyl alcohol vapor, in significant concentrations, is irritating to the eyes and upper respiratory tract. This feature of ethyl alcohol is more important in setting the limits for exposure than the secondary effects from the absorbed alcohol.

Isopropyl alcohol -- Isopropyl alcohol is relatively non-toxic and is used widely for medicinal purposes such as massages and disinfecting. Concentrations in excess of 980 mg/M^3 may produce mild irritation of the mucous membranes. The evaluation criteria of 980 mg/M^3 will prevent narcosis. However, some workers may experience slight irritation to the mucous membranes.[13]

Acetone -- Maintaining worker exposure to acetone below 2400 mg/M^3 will prevent the narcotic action and eliminate any organic injury. The major problem when using acetone is its volatility. It should be considered as one of the least toxic of the common solvents but presents an extremely high fire risk.[14]

Diethyl ether -- Symptoms from exposure to diethyl ether in industry include loss of appetite, exhaustion, headache, sleepiness, dizziness and psychic disturbances. Such complaints are at the high concentrations, although exposure to lower levels may cause some dizziness or headache in highly sensitive individuals.[14] Regular exposure at 1,200 mg/M^3 of diethyl ether should cause no demonstrable injury to health nor produce irritation or signs of narcosis among workers.

IV. EVALUATION RESULTS

A. Hormone Laboratory

Table I shows the results of all nine personal and two general area air samples obtained during the survey. When considering the combined effects ($EM = \frac{C_1}{L_1} + \frac{C_2}{L_2} \ldots \frac{C_n}{L_n} = 1$) of all the organic compounds covered by this evaluation, employee exposure would be a maximum Em of 0.99 or ninety-nine percent of the environmental or health criteria of Em = 1. The maximum result for diethyl ether was sixteen percent of the environmental criteria of 1200 mg/M^3, and therefore, should not present a problem. However, the maximum result for chloroform was eighty-three percent of the environmental criteria of 9.78 mg/M^3 (one hour sampling period). It is noted that operations involving chloroform are sporatic (approximately twice a week) and lasts only a few hours per day. Therefore, although no short term samples were obtained, it is the opinion of the NIOSH investigator that the environmental standard of 9.78 mg/M^3 was probably exceeded when considering a one hour sampling period. The general area sample result of 16.7 mg/M^3 for chloroform (1.7 times the environmental criteria of 9.78 mg/M^3) indicates that the latter statement is a correct assumption.

All of the employees interviewed complained of almost daily headaches or irritated eyes. The majority of employees occasionally (once every week or two weeks) had some dizziness or lightheadedness. All employees attributed the main cause to exposure to ether and one employee said that chloroform gives a real "high" on occasions. The symptoms apparently

disappear within a few hours after they leave work. One employee takes aspirin on a daily basis for headaches while most take aspirin occasionally if the headache is really bad. The symptoms are apparently mild in nature and not severe.

B. Histology Laboratory

Table II shows the results of all thirteen personal and five general area air samples. All sample results were well below (less than fifty-five percent) the environmental criteria for each of the compounds (e.g., ethyl alcohol, isopropanol, benzene, and xylene) covered by this evaluation. When considering the combined effects of all the organic compounds involved in this evaluation, employee exposure would be less than sixty percent of the environmental criteria of Em = 1. The odor of xylene was noticeable during coverslipping operations which occur a few hours in the morning. This appears to be the period of maximum exposure. Several MSA detector tube samples were obtained at the breathing zone of a few employees during the coverslipping operations. These results varied from approximately 100 mg/M^3 to 450 mg/M^3 which is well below the environmental criteria of 868.0 mg/M^3 of xylene for a ten minute sampling period. Six (3 personal and 3 general area) out of the eighteen samples were positive for benzene. The maximum result (1.7 mg/M^3) was less than fifty-five percent of the environmental criteria of 3.2 mg/M^3 for benzene.

The primary exposure in the gross laboratory is to formaldehyde. Several MSA and Bendix detector tube samples were obtained during mixing and pouring operations and the dissection and examination of tissues. It is estimated that operations in the gross room are less than 5 hours per day. Breathing zone samples varied from 1.2 mg/M^3 to 9.6 mg/M^3 with an average of approximately 4.4 mg/M^3. General area samples in the room away from operations showed concentrations of formaldehyde to 1.2 mg/M^3. A number of samples were obtained to show that the employees' exposure to formaldehyde significantly exceeded the environmental criteria of 1.2 mg/M^3 for a 30 minute sampling period.

All of the employees say that the odor of xylene is objectionable and noticeable everyday during coverslipping operations. Two employees complained of occasional mild headaches occurring about once a week. One employee complained about her "skin tingles or itches" occasionally but this mainly occurs in the summer months.

Two technologists working in the gross room had complaints of irritated, watery eyes and irritation of the upper respiratory tract with dry throat. Occasionally (perhaps once a week) it is so bad she also gets a headache. Apparently the symptoms are less severe after a month or less of working in the gross room as one becomes acclimatized. The odor was very irritating to the upper respiratory tract and watery eyes were noted as symptoms of the NIOSH investigator during the survey. One employee complained of dermatitis (redness and peeling of skin on hands) when she first started to work in the gross room.

C. Cytology Laboratory

Table III shows the results of all nine personal and two general area samples obtained during the survey. When considering the combined effect of all the organic compounds covered by this request, employee exposure would be less than twenty-five percent of the environmental standard of EM = 1. The maximum exposure to xylene was about 21 percent of the environmental criteria of 434.0 mg/M^3 for xylene. Detector tube results for xylene during coverslipping operations (lasts a few hours per day) varied from approximately 100 mg/M^3 to 400 mg/M^3. No benzene was detected on any of the samples.

Normally only one technologist does the coverslipping operation in the morning. However, all the employees complained of headaches at least occasionally with the majority of employees saying headaches occur each time they coverslip. One employee said headache was severe. Two employees complained of red, irritated eyes with one of these employees complaining of poorer vision due to dry contact lenses. Three employees mentioned dryness of nasal passages or stuffy nose and irritated sinuses. Two employees mentioned a nauseous feeling while coverslipping. The only complaints were when the employees had to coverslip and there are apparently no problems on other operations.

D. Observations on Ventilation and Housekeeping

A cursory ventilation survey was made with Bendix smoke tubes and an Alnor Jr. velometer to determine the air flow within the laboratories covered by the request. The results of the survey are schematically depicted in Diagrams I, II, and III enclosed. Although not shown on the diagrams, the main exhaust in most of the laboratories (except hormone) is through the false ceiling into hidden ducts. Therefore, air flow is through the ceiling with separate supply air blown down which provides for some turbulence. The following is a summary of the main observations on ventilation:

1. General ventilation - Some air from the histology and cytology laboratories flows into the hallways. Air flow should be such that potentially contaminated air does not flow into a clean zone. Laboratories should be kept on a slight negative pressure with respect to hallways and offices to assure flow of air into the laboratory. The hormone laboratory shows a good flow of air which is due to the hoods in the room.

2. Operations which give rise to excessive exposures of employees to various contaminants are not provided with adequate ventilation. Local exhaust ventilation (e.g., exhaust hood, welding type hood with slot ventilation, etc.) is the preferred method of control and probably the least costly particularly for the control of chloroform-diethyl ether operations in the hormone laboratory and formaldehyde operations in the gross room. Local exhaust

is also not provided for the main part of the coverslipping operations in the cytology and histology laboratories. The provision of local exhausts for these operations may be sufficient to assure a slight negative pressure (e.g., cytology, histology, and gross room) for the laboratories to preclude air flowing into the laboratory from the hallways.

3. If local exhaust ventilation is impractical, dilution ventilation may be necessary. While 10-20 room air changes may be adequate for preventing accumulation of organic vapors, the required exhaust volumes will depend on the quantities of materials evaporating and the volume of the room.

4. The ceiling exhaust duct is almost over one dissecting/ examination station in the gross room. This provides for maximum exposure of the physician or technologist at the stations as the formaldehyde fumes pass through the breathing zone of the employee.

The housekeeping of the various laboratories as well as the facilities appeared to be above average in comparison to other similar hospital facilities. Both management and employees were most interested in the performance of their jobs in a professional and safe manner.

V. CONCLUSIONS AND RECOMMENDATIONS

In view of the above information it is concluded that:

A. Employees working in the gross room are exposed to concentrations of formaldehyde which are considered toxic.

B. One or more employees in the hormone laboratory are exposed to concentrations of chloroform which are considered at least potentially toxic or toxic.

C. Employees in the histology and cytology laboratories are exposed to concentrations of xylene which are not toxic, but may be considered as excessive or potentially toxic due to the symptomatology (e.g., headaches, irritation, etc.) of the employees during coverslipping operations. Employees not involved in coverslipping operations are not exposed to concentrations of xylene which are considered as toxic or even potentially toxic.

D. One or more employees in the hormone laboratory are exposed to concentrations of diethyl ether which are not toxic, but may be considered as excessive due to the symptomatology (e.g., headaches, dizziness, etc.) of the employee(s) in the near vicinity of the ether sample preparation and evaporation operations.

E. The general air flow of most laboratories is inadequate and local exhaust for several operations is non-existent.

In view of these conclusions, the following recommendations are submitted to management to obviate observed and potential hazards and to provide a more desirable working environment for all personnel:

A. Ventilation - Local ventilation in the form of a hood, modified welding type booth, or other means should be provided for the following operations:

1. Two dissecting/examining stations and formaldehyde mixing station in the gross room;

2. Sample preparation station using diethyl ether and chloroform operation in the hormone laboratory. Also the exhaust from the vacuum pump used for evaporation of samples should be vented to a hood and not the general room air;

3. Coverslipping operations in the cytology and histology laboratories.

The installation of the above local exhausts may well improve the overall general flow of air into the laboratories and may be sufficient to maintain the laboratories at a negative pressure to hallways and offices. If local exhaust ventilation is not practical, dilution ventilation should be provided for the above operations, although dilution ventilation may cost more initially and/or in the long term consideration of cost. General air flow should be maintained into the laboratories and not from laboratories into hallways. Also, all ventilation in these areas should have a periodic inspection, maintenance and repair program.

B. Respirators - Until proper engineering controls can be implemented (e.g., local ventilation), appropriate respirators should be worn for most operations involving formaldehyde in the gross room and chloroform in the hormone laboratory. Please refer to references 10, 5, and 13 for selection of appropriate respirators. The respirator must be chosen for the type of chemical hazard, it must fit properly, and must be properly worn and maintained. Respiratory protection against formaldehyde and chloroform is probably best and most feasibly provided by a chemical-cartridge type respirator. The face piece can either be a quarter, half, or full type face piece and the cartridges should be designed for protection against organic vapors (NIOSH has published a list of "certified" respirators.[15] Facial hair can cause poor respirator fit which will result in the breathing of contaminated air. Cartridges should be changed as often as necessary if it becomes hard to breathe through them or if the solvent odors are detected (cartridges may have to be changed as often as every four hours when high solvent vapor concentrations are encountered). If the wearing of respirators is impractical, engineering controls (e.g. ventilation) should be implemented as soon as possible.

C. Hazard Awareness - The worker should be aware of the health hazards associated with an operation and materials used. It is of value to

know the early symptoms and most commonly experienced health effects associated with exposure to the materials. Product labels often contain warnings, component information, and specify precautions for safe use. These instructions should be followed when appropriate. Material Safety Data Sheets (Form OSHA-20) should be requested from distributors or manufacturers of products which are used. These sheets, when properly completed, provide information on hazardous ingredients, physical data, fire and explosion hazard data, health hazard data, and spill and cleanup procedures. Based on information supplied on labels, the Material Safety Data Sheets, and other sources, operations can be performed in a manner which prevents excessive exposure by all routes.

D. Personal Protective Equipment - Impervious gloves and long sleeve clothing should be worn when the potential for skin contact with chemicals (e.g., formaldehyde, etc.) exists. Other devices (e.g., face shields, chemical goggles, etc.) may be necessary to avoid eye irritation or splashes (e.g., formaldehyde - gross room) of chemicals on the face.

E. Emergency Showers and Eye Wash Facilities - Adequate emergency showers and/or eye wash facilities should be provided.

F. The various recommendations (e.g., medical monitoring, environmental monitoring, employee education, work practices, etc.) contained in various NIOSH criteria documents, particularly chloroform and formaldehyde, should be implemented.

G. Although perhaps not practical, consideration should be given to replacing chloroform and formaldehyde with a different compound which is less toxic.

H. The data contained in this report, although indicative of some exposure to benzene (probably as a minor impurity in xylene) at levels less than the environmental criteria or guide, is not sufficient to provide assurance that employees' exposure to benzene may or may not be potentially toxic for different grades or suppliers of xylene or other compounds which may contain benzene as a impurity. Therefore, it is suggested that solvents which may be contaminated with benzene be replaced with those found to be benzene free.

VI. REFERENCES

1. Lehmann, K.B. and Hasegawa. Studies of the absorption of chlorinated hydrocarbons in animals and humans. Arch. Hyg., 72:327-42, 1910.

2. Lehmann, K.B. and Schmidt-Kehl, L. The thirteen most important chlorinated aliphatic hydrocarbons from the standpoint of industrial hygiene. Arch Hyg., 116:131-200, 1936.

3. Heilbrunn, G., Liebert, E., Szanto, P.B. Chronic chloroform poisoning -- Clinical and pathological report of a case. Arch. Neurol. Psych., 53:68-72, 1945.

4. Bomski, H., Sobolewska, A., and Strakowski, A. Toxic damage of the liver by chloroform in chemical industry workers. Arch. Gewerbepathol. Gewerbehyg., 24:127-34, 1967.

5. U.S. DHEW/PHS/CDC/NIOSH. Criteria Document: Recommendations for an occupational exposure standard to chloroform. HEW (NIOSH) 75-114, 1974.

6. Challen, P.J.R., Hickish, D.E., Bedford, J. Chronic chloroform intoxication. Br. J. Ind. Med., 15:243-49, 1958.

7. Carcinogenesis Program; Division of Cancer Cause and Prevention; National Cancer Institute; National Institutes of Health; Bethesda, Maryland. Report on Carcinogenesis Bioassay of Chloroform; March 1, 1976.

8. Whipple, G.H. and Sperry, J.A. Chloroform poisoning -- Liver necrosis and repair. Bull. Johns Hopkins Hospital, 20:278-89, 1909.

9. Eschenbrenner, A.B. Induction of hepatomas in mice by repeat oral administration of chloroform, with observations on sex differences. J. Nat'l. Cancer Institute, 5:251-55, 1945.

10. U.S. DHEW/PHS/CDC/NIOSH. Criteria Document: Recommendations for an occupational exposure standard to formaldehyde. HEW (NIOSH) 77-126; December 1976.

11. U.S. DHEW/PHS/CDC/NIOSH. Criteria Document: Recommendations for an occupational exposure standard to xylene. HEW (NIOSH) 75-168; 1975.

12. U.S. DHEW/PHS/CDC/NIOSH. Criteria Document: Recommendations for an occupational exposure standard to benzene. HEW (NIOSH) 74-137; 1974.

13. American Conference of Governmental Industrial Hygienists: Documentation of Threshold Limit Values for Substances in Workroom Air, Third Edition, 1971, pages 103 & 141.

14. American Conference of Governmental Industrial Hygienists: Documentation of Threshold Limit Values for Substances in Workroom Air. Third Edition, 1971, pages 3 & 106.

15. NIOSH Certified Equipment. December 15, 1975, and June 1976 (Cumulative Supplement). HEW Publication No. (NIOSH) 76-145. Single copies are available from: Division of Technical Services, Publications, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

VII. ACKNOWLEDGEMENTS

Report Prepared By: Raymond L. Hervin
Regional Industrial Hygienist
NIOSH; Kansas City, Missouri

Originating Office: Jerome P. Flesch, Chief
Hazard Evaluation and Technical Assistance Branch/NIOSH
Cincinnati, Ohio

Laboratory Analysis: James Perkins
Utah Biomedical Laboratory
Salt Lake City, Utah

TABLE I

RESULTS OF GENERAL AREA (GA) AND PERSONAL (P) AIR SAMPLES (CHARCOAL TUBES) FOR ORGANIC SOLVENTS OBTAINED DURING THE ENVIRONMENTAL SURVEY CONDUCTED ON APRIL 21, 1977 (DENOTED BY SAMPLE C-NUMBER) AND APRIL 26, 1977 (DENOTED BY SAMPLE B-NUMBER) AT THE HORMONE LABORATORY; ST. LUKE'S HOSPITAL OF KANSAS CITY; KANSAS CITY, MISSOURI; TA REPORT NO. 77-33. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED)

JOB OR LOCATION	SAMPLE NUMBER	TIME	DIETHYL ETHER mg/M^3	ACETONE mg/M^3	CHLOROFORM mg/M^3
P-Technologist A	C-7	8:09-12:42	Void - tube broken	-----	-------
P-Technologist A	C-7-1	12:43--3:41	186.6	6.9	8.1
P-Technologist B	C-5	8:08-12:40	140.1	ND	4.5
P-Technologist B	C-5-1	12:41--3:41	164.1	4.9	5.7
P-Technologist C	C-8	8:06-11:46	8.4	ND	4.3
P-Technologist C	C-8-1	11:47--3:15	46.8	1.4	0.9
GA- between A & B	C-101	8:43-11:58	79.5	1.0	16.7
GA- between A & B	C-Z-1*	12:00--2:37	119.4	7.0	6.7
GA- between A & B	C-Z-2*	12:00--2:37	ND	ND	ND
P-Technologist A	B-21	8:00-11:46	12.3	ND	8.0
P-Technologist B	B-41	8:00-11:46	55.0	ND	0.7
P-Technologist D	B-51	7:26-11:46	2.6	ND	ND
Environmental Criteria----------			1,200.0----------	2,400.0----------	9.78 (one hour sampling period)

*NOTE: Sample C-Z-1 was a large charcoal tube sample which was in series or followed by a small charcoal tube, Sample C-Z-2.

TABLE II

RESULTS OF GENERAL AREA (GA) AND PERSONAL (P) AIR SAMPLES (CHARCOAL TUBES) FOR ORGANIC SOLVENTS OBTAINED DURING THE ENVIRONMENTAL SURVEY CONDUCTED ON APRIL 21, 1977 (DENOTED BY SAMPLE C-NUMBER) AND APRIL 26, 1977 (DENOTED BY SAMPLE B-NUMBER) AT THE HISTOLOGY LABORATORY; ST. LUKE'S HOSPITAL OF KANSAS CITY; KANSAS CITY, MISSOURI; TA REPORT NO. 77-33. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED)

JOB OR LOCATION	SAMPLE NUMBER	TIME	BENZENE mg/M^3	ISOPROPANOL mg/M^3	XYLENE mg/M^3
P-Technologist A	C-1	7:36-11:03	ND	54.9	25.1
P-Technologist A	C-1-1	11:04--2:20	ND	33.1	13.5
P-Technologist B	C-2	7:40-11:02	ND	21.4	26.1
P-Technologist B	C-2-1	11:03--3:15	ND	6.0	8.4
P-Technologist C	C-6	7:44-11:04	ND	28.7	114.9
P-Technologist C	C-6-1	11:05--3:30	ND	21.5	16.9
P-Technologist D	C-11	8:53-11:01	ND	ND	123.8
P-Technologist D	C-11-1	11:01--4:29	0.2	3.6	16.6
P-Technologist F	C-12	8:52-11:38	0.6	11.1	32.2
P-Technologist F	C-12-1	11:39--4:31	ND	ND	6.9
GA-Main laboratory	C-103	8:48--2:20	ND	12.0	23.0
GA-Back laboratory	C-105	9:12--2:20	0.10	8.2	19.0
GA-Gross Laboratory	C-A	7:59--2:14	0.1	2.5	22.3
P-Technologist C	B-121	7:15-11:48	1.0	4.2	67.9
P-Technologist A	B-11	7:11-11:28	ND	23.6	19.9

JOB OR LOCATION	SAMPLE NUMBER	TIME	BENZENE mg/M^3	ISOPROPANOL mg/M^3	XYLENE mg/M^3
P-Technologist E	B-31	8:05-11:50	ND	22.9	17.0
GA-Gross Laboratory	B-111	9:04-12:22	ND	2.7	8.2
GA-Histology	B-101	7:33-11:28	1.7	10.0	18.3
Environmental Criteria			3.2	980.0	434.0

NOTE: Above samples were also analyzed for ethyl alcohol and no ethyl alcohol was detected.

TABLE III

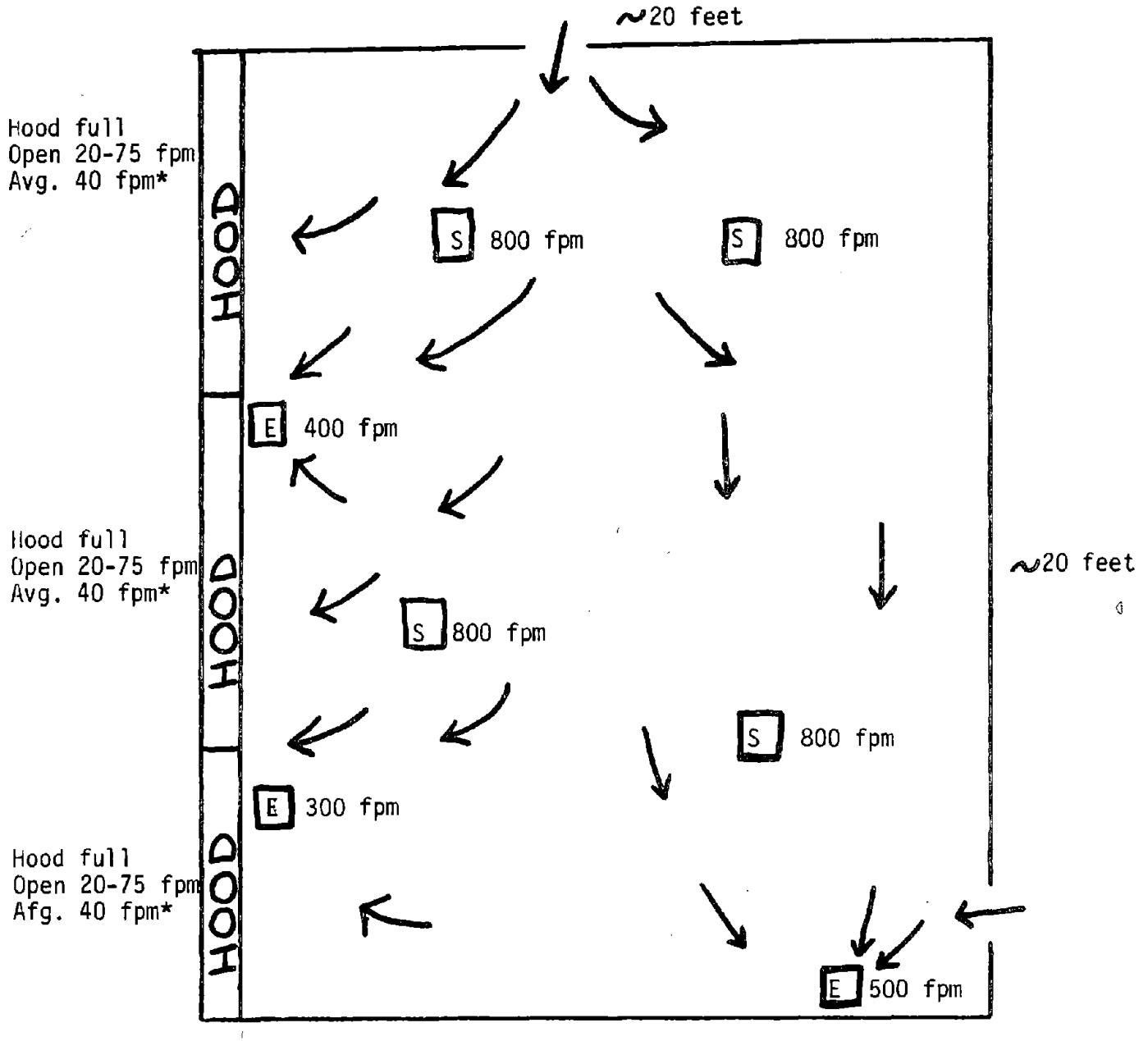
RESULTS OF GENERAL AREA (GA) AND PERSONAL (P) AIR SAMPLES (CHARCOAL TUBES) FOR ORGANIC SOLVENTS OBTAINED DURING THE ENVIRONMENTAL SURVEY CONDUCTED ON APRIL 21, 1977 (DENOTED BY SAMPLE C-NUMBER) AND APRIL 26, 1977 (DENOTED BY SAMPLE B-NUMBER) AT THE CYTOLOGY LABORATORY; ST. LUKE'S HOSPITAL OF KANSAS CITY; KANSAS CITY, MISSOURI; TA REPORT No. 77-33. (RESULTS EXPRESSED AS mg/M^3 - MILLIGRAMS OF COMPOUND PER CUBIC METER OF AIR SAMPLED).

JOB OR LOCATION	SAMPLE NUMBER	TIME	BENZENE mg/M^3	ISOPROPANOL mg/M^3	XYLENE mg/M^3
P-Technologist A	C-4	7:24-11:30	ND	20.8	48.3
P-Technologist A	C-4-1	11:32--3:14	ND	2.5	22.8
P-Technologist B	C-3	7:32-11:40	ND	2.9	15.0
P-Technologist B	C-3-1	11:41--3:57	ND	5.6	4.6
P-Technologist C	C-9	8:17-11:35	ND	ND	5.4
P-Technologist C	C-9-1	11:36--4:36	ND	ND	4.0
P-Technologist D	C-10	8:19-12:36	ND	5.9	5.9
P-Technologist D	C-10-1	12:38--4:31	ND	36.4	21.8
GA-Main laboratory	C-102	8:47--2:20	ND	7.7	3.8
P-Technologist A	B-71	7:20-11:56	ND	11.6	88.2
GA-Main Laboratory	B-81	7:21-11:45	ND	9.5	14.5
Environmental Criteria			3.2	980.0	434.0

NOTE: The above samples were also analyzed for ethyl alcohol and no ethyl alcohol was detected.

ST. LUKE'S HOSPITAL OF KANSAS CITY
TA 77-33

DIAGRAM I



SCHEMATIC OF HORMONE LABORATORY

Legend:

S Supply air - louvered ceiling duct ~1 foot

E Exhaust air - louvered ceiling duct ~1 foot

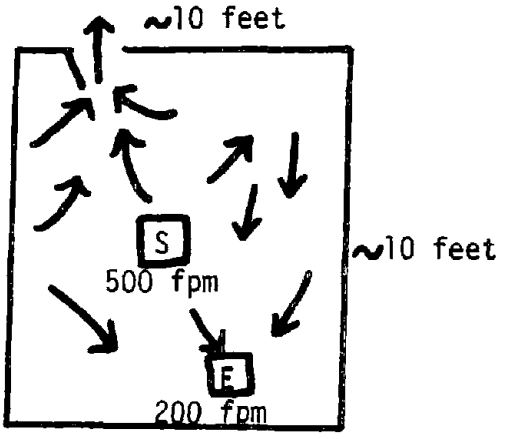
↑ Indicates general movement of air in room

* Hood can be closed 1/2 to 2/3 and flow is 100-150 fpm (feet per minute) average. Exhaust dusts behind false ceiling not shown above.

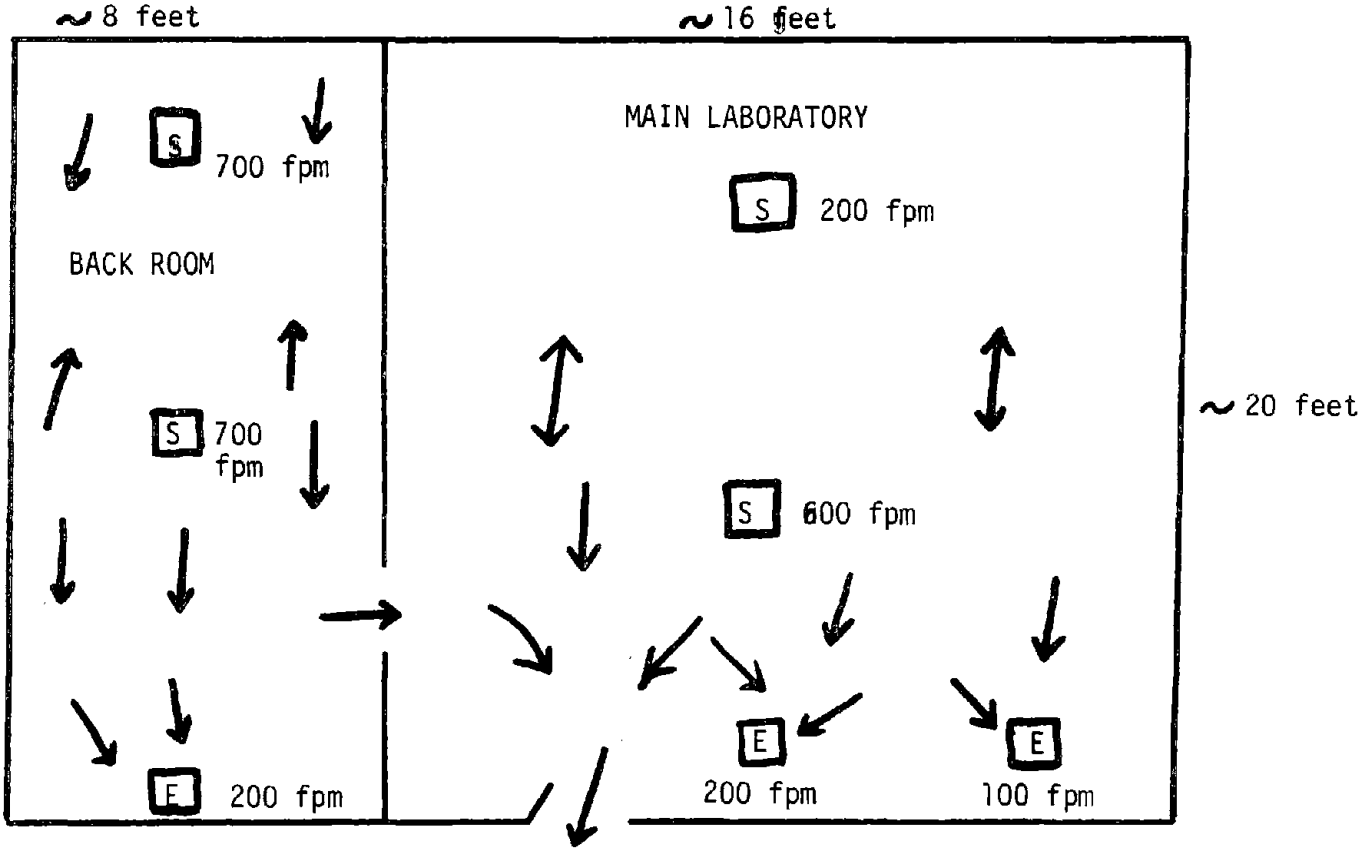
Air exhausts through false ceiling and hoods. Room flow of air is good.

ST. LUKE'S HOSPITAL OF KANSAS CITY
TA 77-33

DIAGRAM II



GROSS ROOM



SCHEMATIC OF HISTOLOGY LABORATORY

Legend:

S Supply air - louvered ceiling duct ~1 foot

E Exhaust air - louvered ceiling duct ~1 foot

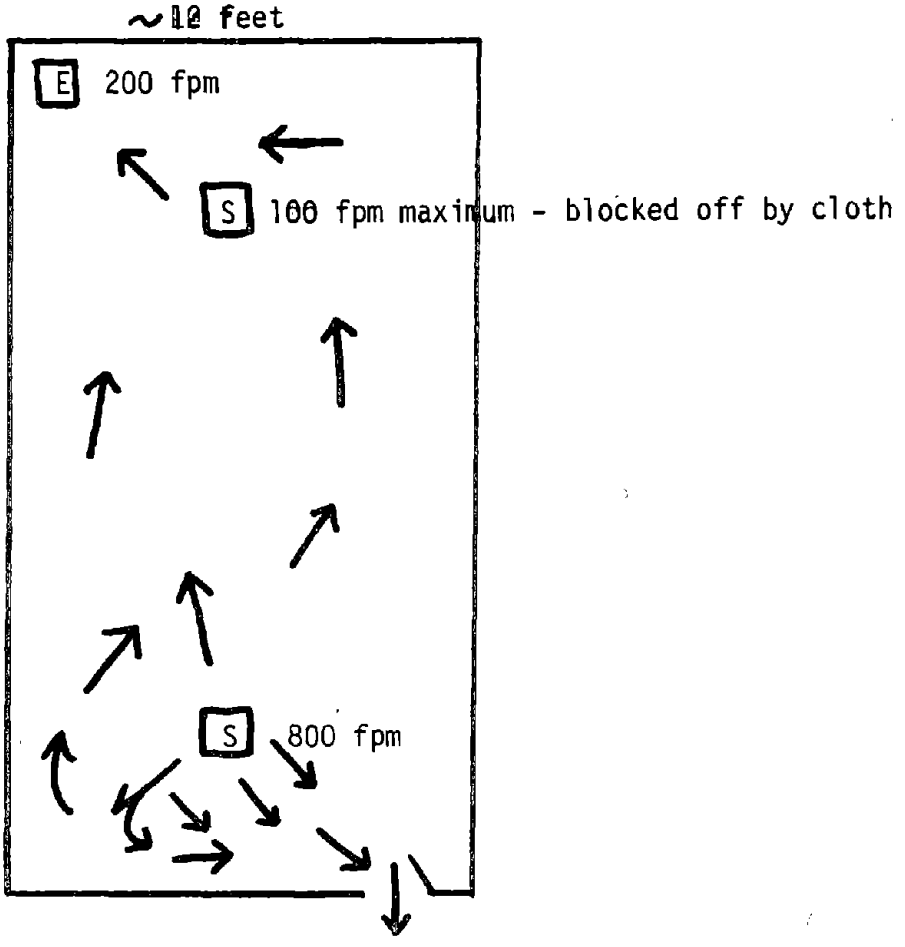
↑ Indicates general movement of air in room

Air exhausts through false ceiling.

Exhaust ducts behind false ceiling not shown above.

ST. LUKE'S HOSPITAL OF KANSAS CITY
TA 77-33

DIAGRAM III



SCHEMATIC OF CYTOLOGY LABORATORY

Legend:

S Supply air - louvered ceiling duct ~1 foot

E Exhaust air - louvered ceiling duct ~1 foot

↑ Indicates general movement of air in room

Air exhausts through false ceiling.
Exhaust ducts behind false ceiling not shown above.

BIBLIOGRAPHIC DATA SHEET	1. Report No. NIOSH-TR-TA-77-33	2.	3. Recipient's Accession No.

4. Title and Subtitle: HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT NO. TA 77-33 ST. LUKE'S HOSPITAL OF KANSAS CITY KANSAS CITY, MISSOURI

5. Report Date: Aug. 1977

6.

7. Author(s): Raymond L. Hervin

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

Same as box 9.

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

A Hazard Evaluation and Technical Assistance survey was conducted by NIOSH on April 21 and 26, 1977, at the cytology, hormone, and histology laboratories of the St. Luke Hospital, Kansas City, Missouri. The survey was prompted by a request from the management regarding the exposure of the approximately 20 "affected" employees to xylene, diethyl ether, and other vapors. Environmental sampling, employee interviews, and available toxicity information revealed that employee exposure to benzene, ethyl alcohol, isopropanol, xylene, diethyl ether, and acetone did not pose a health hazard, while exposure to chloroform in the hormone laboratory, and formaldehyde in the histology laboratory did pose a health hazard at the time of the survey. Recommendations are made to reduce employee exposure to minimum.

17. Key Words and Document Analysis. 17a. Descriptors

Environmental surveys
Industrial hygiene
Medical personnel
Hospitals
Medical laboratories
Organic solvents
Halohydrocarbons
Chloromethanes
Air pollution
Toxicology

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 06/J

18. Availability Statement: Release unlimited

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 22

22. Price A02-A01