

## IX. APPENDIX I

### SAMPLING PROCEDURE FOR COLLECTION OF DIOXANE

#### General Requirements

(a) Collect air samples representative of the breathing zones of workers to characterize the exposure from each job or specific operation in each work area.

(b) Collect samples to represent exposure of individual workers.

(c) Suggested records:

(1) The date and time of sample collection;

(2) Sampling rate and duration;

(3) Total sample volume;

(4) Location of sampling;

(5) Temperature, pressure, and relative humidity at time of sampling;

(6) Other pertinent information.

#### Sampling

(a) Collect samples as near as practicable to the face of workers without interfering with freedom of movement.

(b) Collect samples to permit determination of exposures for every job involving dioxane in sufficient numbers to express the variability of the exposures for the work situation.

(c) Apparatus for Charcoal Tube Sampling

(1) Pumps, battery-operated, complete with clips for attachment to the worker, capable of calibration to within 5% at operational flowrates.

(2) Charcoal Tubes

(A) The analytical method (Appendix II) is written for samples collected by use of glass tubes 7 cm long with outside diameter of 6 mm, and an inside diameter of 4 mm, that contain two sections of 20/40 mesh activated coconut-shell charcoal that was fired at 600 C. The first is the adsorbing section and contains 100 mg of charcoal. The second, or reserve section, contains 50 mg of charcoal. The sections are separated by 2 mm of urethane foam. 3 mm of urethane foam are placed between the end of the tube and the reserve section, and a plug of silted glass wool is placed between the other end of the tube and the adsorbing section.

(B) The pressure drop across the tube must be less than 1 inch of mercury at a flowrate of 1 liter/minute.

(C) Tubes meeting the specification in (A) and (B) are commercially available.

(d) Calibration of Sampling Instruments

(1) Calibrate air sampling instruments at operational flowrates with a representative charcoal tube in line. Positive-displacement diaphragm pumps require accurate determination of the stroke factor. Recalibrate pumps after making any repairs or modifications to the sampling system.

(2) Spot-check the volumetric flowrate through the sampling system and make adjustments before, and during, each study to ensure accurate airflow data.

(e) Collection and Handling of Samples

(1) Immediately before sampling, score and break both ends of the charcoal tube to provide openings at least one-half the internal diameter of the tube (2 mm).

(2) Position the smaller or reserve section of charcoal toward the sampling pump.

(3) Place the charcoal tube in a vertical position during sampling to prevent channeling, and to avoid consequent sample loss.

(4) Draw the air sample directly through the adsorbing section of charcoal without first passing it through any tubing; tubing may be used to connect the back of the tube to the pump.

(5) With pumps that operate at 200 ml/minute, it is recommended that 48 liters of air be sampled. With pumps that operate at about 1 liter/minute, it is recommended that 30 liters of air be sampled.

(6) Cap the charcoal tubes with inert plastic immediately after sampling. Under no circumstances should rubber caps be used.

(7) Prepare a charcoal tube to serve as an analytical blank. No air is sampled through this tube, but it is broken, sealed, and, if appropriate, transported in the same way as the sample charcoal tubes.

## X. APPENDIX II

### ANALYTICAL PROCEDURE FOR DETERMINATION OF DIOXANE

#### Principle of the Method

- (a) Draw a known volume of air through a charcoal tube to adsorb the dioxane vapor.
- (b) Desorb dioxane from the charcoal with carbon disulfide.
- (c) Inject an aliquot of the desorbed sample into a gas chromatograph.
- (d) Determine the area of the resulting peak and compare it with areas obtained from the injection of standards.

#### Range, Sensitivity, Precision, and Accuracy

(a) The lower limit of the range of the method has not been determined for dioxane. The method has been evaluated for dioxane at 220  $\mu\text{g}/\text{sample}$  by sampling 10 liters of air containing dioxane at 6.25 ppm or 22  $\text{mg}/\text{cu m}$  at 1 liter/minute. This is equivalent to sampling 60 liters of air containing approximately 1 ppm of dioxane. Under the conditions of the test, the method underestimated the nominal amount of dioxane by 0-20% at a 95% confidence level. The coefficient of variation for a single determination due to sampling and analytical errors was 9%, and the total error, including day-to-day variation within laboratories, was 17%.

(b) The upper limit of the range of the method is dependent on the adsorptive capacity of the charcoal tube. This capacity varies with the concentrations of dioxane and other substances in the air. It is

estimated that 6 mg is the maximum amount of dioxane that can be collected on the front section of charcoal before dioxane will penetrate in significant amounts to the reserve section. This is equivalent to sampling 60 liters of air containing 100 mg/cu m (30 ppm).

#### Interferences

(a) Dioxane may not be trapped efficiently when the amount of water in the air is so great that condensation occurs in the charcoal sampling tube.

(b) Any compound which has the same retention time as dioxane with the chromatographic conditions described in this method will interfere with the analysis. Such interferences may be eliminated by altering the operating conditions of the gas chromatograph.

#### Advantages of the Method

(a) It provides one basic method for determining many different organic compounds.

(b) The sampling device is small, portable, and involves no liquids.

(c) The analysis of the tubes can be accomplished rapidly.

#### Disadvantages of the Method

(a) The amount of sample which can be taken is limited by the weight of dioxane which the tube will hold before overloading.

(b) When the sample value obtained for the reserve section of

charcoal exceeds 10% of that found on the front section, the possibility of sample loss exists.

(c) High concentrations of other organic compounds may displace dioxane from the charcoal.

#### Apparatus

- (a) Gas chromatograph equipped with a flame ionization detector.
- (b) Stainless steel column (20 ft x 1/8 in) with 10% free fatty acid polymer stationary phase on 80/100 mesh Chromosorb W (or equivalent), acid washed and treated with dimethyldichlorosilane.
- (c) Recorder, and some method for determining peak area.
- (d) Glass stoppered microtubes, 2 ml, or 2-ml vials that can be sealed with inert caps.
- (e) Microsyringe, 10  $\mu$ l, and convenient sizes for making standards.
- (f) Pipets, 0.5 ml, or 1.0 ml graduated in 0.1-ml increments.
- (g) Volumetric flasks, 10 ml, or convenient sizes for making standard solutions.

#### Reagents

- (a) Carbon disulfide, chromatographic quality.
- (b) Dioxane, analytical reagent grade.
- (c) Helium, purified.
- (d) Hydrogen, prepurified.
- (e) Air, filtered, compressed.

- (f) Decane, or other suitable internal standard (optional).

### Analysis of Samples

(a) Wash equipment used in the analysis in detergent followed by tap and distilled water rinses.

(b) Score the charcoal tube with a file in front of the first section of charcoal and break it open. Remove the glass wool and discard. Transfer the charcoal in the first (larger) section to a 2-ml stoppered test tube or container. Remove and discard the separating foam and transfer the charcoal in the second section to another similar test tube or container. Analyze the two sections of charcoal separately. Prior to analysis, pipette (not by mouth) 1.00 ml of carbon disulfide into each test tube to desorb dioxane from the charcoal. A desorption time of at least 30 minutes, with occasional agitation, is recommended.

EXTREME CAUTION MUST BE EXERCISED AT ALL TIMES WHEN USING CARBON DISULFIDE BECAUSE OF ITS HIGH TOXICITY AND FIRE AND EXPLOSION HAZARDS. IT CAN BE IGNITED BY HOT STEAM PIPES. ALL WORK WITH CARBON DISULFIDE MUST BE PERFORMED UNDER AN EXHAUST HOOD.

(c) Typical chromatographic operating conditons:

- (1) 30 ml/minute (60 psig) helium carrier gas flow;
- (2) 35 ml/minute (25 psig) hydrogen gas flow to detector;
- (3) 400 ml/minute (60 psig) air flow to detector;
- (4) 225 C injector temperature;
- (5) 250 C manifold temperature (detector);

(6) 75 C isothermal oven or column temperature.

(d) Injection

To eliminate difficulties arising from blowback or distillation within the syringe needle, the solvent flush injection technique can be used for injecting the sample into the gas chromatograph. With this technique, first flush the 10- $\mu$ l syringe with carbon disulfide several times to wet the barrel and plunger and then draw 3  $\mu$ l of carbon disulfide into the syringe. Remove the needle from the carbon disulfide solvent and pull the plunger back about 0.2  $\mu$ l to separate the solvent flush from the sample with a pocket of air to be used as a marker. Then immerse the needle in the sample and withdraw a 5- $\mu$ l aliquot. Take into consideration the volume of the needle, since the sample in the needle will be completely injected. After the needle is removed from the sample, and prior to injection, pull the plunger back a short distance to minimize evaporation of the sample from the tip of the needle. Make duplicate injections of each sample and standard. Using this technique, the maximum difference expected between results of duplicate injections is 3%.

Other injection techniques, such as use of automatic sample injectors, are acceptable if their reproducibility is at least as good as the solvent flush technique.

(e) Measurement of area

Measure the area of the sample peak and read the preliminary results from a standard curve prepared as discussed below.

Determination of Desorption Efficiency

It is necessary to determine percentages of dioxane on the charcoal



that are removed in the desorption process. These desorption efficiencies may vary with the amount of dioxane adsorbed on the charcoal and with the adsorption characteristics of the batch of charcoal. These variables necessitate determination of a desorption efficiency curve for each batch of charcoal, as described below. Charcoal from the batch used in preparing the sample tubes can be obtained from unused ones of the same batch. Measure 100 mg quantities of it into glass tubes 2.5 inches long, 4 mm inside diameter, and flame-sealed at one end. Inject known amounts of dioxane directly into the charcoal with a microliter syringe, and cap the tubes with inert plastic.

At least five tubes with different amounts of added dioxane are prepared in this manner and allowed to stand at least overnight to ensure complete adsorption of dioxane onto the charcoal. Preparation of replicate tubes with each amount of added dioxane is recommended. These tubes will be referred to as the desorption samples. Prepare a parallel blank tube in the same manner, except for addition of dioxane. Desorb and analyze the desorption samples and blanks in exactly the same manner as previously described.

Prepare desorption standards by injecting the same volumes of dioxane into 1.00 ml of carbon disulfide with the same syringe used in the preparation of the desorption samples. Replicate standards are recommended with each amount of added dioxane. These are analyzed with the desorption samples.

The desorption efficiency at each added amount of dioxane equals the difference between the average area of the gas chromatographic peaks due to dioxane recovered from the charcoal and the corresponding area due to the

charcoal blank divided by the average area due to dioxane added directly to the carbon disulfide or,

$$\text{desorption efficiency} = \frac{\text{area of sample} - \text{area of blank}}{\text{area of standard}}$$

The desorption efficiency versus weight of dioxane found is plotted, and the curve is used for correction of losses due to adsorption.

### Calibration and Standards

It is convenient to prepare standards in terms of milligrams (mg) of dioxane/1.00 ml of carbon disulfide because samples are desorbed in this amount of carbon disulfide. To minimize error due to variability of carbon disulfide, 10 times the weight of dioxane can be injected into 10 ml of carbon disulfide. For example, to prepare 0.2 mg/1.00 ml of standard, inject 2.0 mg of dioxane into exactly 10 ml of carbon disulfide in a glass-stoppered flask. Use the density of dioxane (1.0356 at 20 C) to convert mg into  $\mu\text{l}$  for easy measurement with a microliter syringe. Prepare a series of standards, varying the amount of added dioxane over the range of interest, and analyze them under the same gas chromatographic conditions and during the same time period as the unknown samples. Establish curves by plotting average peak area versus milligrams of dioxane/1.00 ml of carbon disulfide.

Alternately, carbon disulfide containing a predetermined amount of an internal standard can be used, and the dioxane concentration in mg/ml can be plotted versus the area ratio of dioxane to the internal standard. However, it needs to be established whether the concentration in solution is changed by adsorption on the charcoal.

### Calculations

(a) Read from the standard curve the weight in mg corresponding to the peak area. No volume corrections are needed, because the standard curve is based on mg dioxane/1.00 ml carbon disulfide, and the volume of sample injected is identical to the volume of the standards injected.

(b) Separately determine the weights of dioxane on the front and reserve sections of the charcoal tube.

(c) Make corrections to the dioxane weights determined on both the front and reserve sections for the weights of the respective sections of the blank charcoal tube:

(1) Subtract the weight of dioxane found on the front section of the blank charcoal tube from the weight of dioxane found on the front section of the sample charcoal tube to give a corrected front section weight.

(2) Subtract the weight of dioxane found on the reserve section of the blank charcoal tube from the weight of dioxane found on the reserve section of the sample charcoal tube to give a corrected reserve section weight.

(3) Add the corrected amounts of dioxane present on the front and reserve sections of the sample tube to determine the total measured dioxane in the sample, and divide this total weight by the appropriate desorption efficiency to obtain M, the total mg per sample.

(d) Convert the liters of air sampled (V) to volume (V') at standard conditions of 25 C and 760 mm Hg, as follows:

$$V' = \frac{298VP}{760(T+273)} \quad \frac{0.392VP}{(T+273)}$$

Where:

V' = volume of sampled air in liters at 25 C and 760 mm Hg

V = measured volume of sampled air in liters

P = barometric pressure in mm Hg, measured at time of  
sampling

T = temperature of air in degree Celsius, measured at time of  
sampling

(e) The concentration of dioxane in the sampled air can be expressed in various ways using M, the weight of dioxane obtained in (c)(4), and V', the standardized sample volume, obtained in (d), as follows:

(1)  $\text{mg/liter} = M/V'$

(2)  $\text{mg/cu m} = \mu\text{g/liter} = 1,000 M/V'$

(3)  $\text{ppm} = 278 M/V'$

## XI. APPENDIX III - MATERIAL SAFETY DATA SHEET

General instructions for preparing a Material Safety Data Sheet (MSDS) are presented in this chapter. The examples used in the text are for illustrative purposes and are not intended to apply to any specific compound or product. Applicable information about a specific product or material shall be supplied in the appropriate block of the MSDS.

The product designation is inserted in the block in the upper left corner of the first page to facilitate filing and retrieval. Print in upper case letters as large as possible. It should be printed to read upright with the sheet turned sideways. The product designation is that name or code designation which appears on the label, or by which the product is sold or known by employees. The relative numerical hazard ratings and key statements are those determined by the guidelines in Chapter V, Part B, of the NIOSH publication, An Identification System for Occupationally Hazardous Materials. The company identification may be printed in the upper right corner if desired.

### (a) Section I. Product Identification

The manufacturer's name, address, and regular and emergency telephone numbers (including area code) are inserted in the appropriate blocks of Section I. The company listed should be a source of detailed backup information on the hazards of the material(s) covered by the MSDS. The listing of suppliers or wholesale distributors is discouraged. The trade name should be the product designation or common name associated with the material. The synonyms are those commonly used for the product, especially formal chemical nomenclature. Every known chemical designation

or competitor's trade name need not be listed.

(b) Section II. Hazardous Ingredients

The "materials" listed in Section II shall be those substances which are part of the hazardous product covered by the MSDS and individually meet any of the criteria defining a hazardous material. Thus, one component of a multicomponent product might be listed because of its toxicity, another component because of its flammability, while a third component could be included both for its toxicity and its reactivity. Note that a MSDS for a single component product must have the name of the material repeated in this section to avoid giving the impression that there are no hazardous ingredients.

Chemical substances should be listed according to their complete name derived from a recognized system of nomenclature. Where possible, avoid using common names and general class names such as "aromatic amine," "safety solvent," or "aliphatic hydrocarbon" when the specific name is known.

The "%" may be the approximate percentage by weight or volume (indicate basis) which each hazardous ingredient of the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, "10-40% vol" or "10% max wt" to avoid disclosure of trade secrets.

Toxic hazard data shall be stated in terms of concentration, mode of exposure or test, and animal used, ie, "100 ppm LC50 rat," "25 mg/kg LD50-skin-rabbit," "75 ppm LC man," or "permissible exposure from 29 CFR 1910.1000," or, if not available, from other sources of publications such as the American Conference of Governmental Industrial Hygienists or the American National Standards Institute Inc. Flammability or reactivity data

could be flashpoint, shock sensitivity, or other brief data indicating nature of the hazard.

(c) Section III. Physical Data

The data in Section III should be for the total mixture and should include the boiling point and melting point in degrees Fahrenheit (Celsius in parenthesis); vapor pressure, in conventional millimeters of mercury (mm Hg); vapor density of gas or vapor (air = 1); solubility in water, in parts/hundred parts of water by weight; specific gravity (water = 1); percent volatiles (indicated if by weight or volume) at 70 degrees Fahrenheit (21.1 degrees Celsius); evaporation rate for liquids or sublimable solids, relative to butyl acetate; and appearance and odor. These data are useful for the control of toxic substances. Boiling point, vapor density, percent volatiles, vapor pressure, and evaporation are useful for designing proper ventilation equipment. This information is also useful for design and deployment of adequate fire and spill containment equipment. The appearance and odor may facilitate identification of substances stored in improperly marked containers, or when spilled.

(d) Section IV. Fire and Explosion Data

Section IV should contain complete fire and explosion data for the product, including flashpoint and autoignition temperature in degrees Fahrenheit (Celsius in parentheses); flammable limits, in percent by volume in air; suitable extinguishing media or materials; special firefighting procedures; and unusual fire and explosion hazard information. If the product presents no fire hazard, insert "NO FIRE HAZARD" on the line labeled "Extinguishing Media."

(e) Section V. Health Hazard Information

The "Health Hazard Data" should be a combined estimate of the hazard of the total product. This can be expressed as a time-weighted average (TWA) concentration, as a permissible exposure, or by some other indication of an acceptable limit. Other data are acceptable, such as lowest LD50 if multiple components are involved.

Under "Routes of Exposure," comments in each category should reflect the potential hazard from absorption by the route in question. Comments should indicate the severity of the effect and the basis for the statement if possible. The basis might be animal studies, analogy with similar products, or human experiences. Comments such as "yes" or "possible" are not helpful. Typical comments might be:

Skin Contact--single short contact, no adverse effects likely; prolonged or repeated contact, irritation, and cracking. Readily absorbed through the skin with severe systemic effects.

Eye Contact--some pain and mild transient irritation; no corneal scarring.

"Emergency and First Aid Procedures" should be written in lay language and should primarily represent first-aid treatment that could be provided by paramedical personnel or individuals trained in first aid.

Information in the "Notes to Physician" section should include any special medical information which would be of assistance to an attending physician including required or recommended preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed workers.



(f) Section VI. Reactivity Data

The comments in Section VI relate to safe storage and handling of hazardous, unstable substances. It is particularly important to highlight instability or incompatibility to common substances or circumstances such as water, direct sunlight, steel or copper piping, acids, alkalies, etc. "Hazardous Decomposition Products" shall include those products released under fire conditions. It must also include dangerous products produced by aging, such as peroxides in the case of some ethers. Where applicable, shelf life should also be indicated.

(g) Section VII. Spill or Leak Procedures

Detailed procedures for cleanup and disposal should be listed with emphasis on precautions to be taken to protect workers assigned to cleanup detail. Specific neutralizing chemicals or procedures should be described in detail. Disposal methods should be explicit including proper labeling of containers holding residues and ultimate disposal methods such as "sanitary landfill," or "incineration." Warnings such as "comply with local, state, and federal anti-pollution ordinances" are proper but not sufficient. Specific procedures should be identified.

(h) Section VIII. Special Protection Information

Section VIII requires specific information. Statements such as "Yes," "No," or "If Necessary" are not informative. Ventilation requirements should be specific as to type and preferred methods. Specify respirators as to type and NIOSH or MESA approval class, ie, "Supplied-air," "Organic vapor canister," "Suitable for dusts not more toxic than lead," etc. Protective equipment must be specified as to type and materials of construction.

(i) Section IX. Special Precautions

"Precautionary Statements" shall consist of the label statements selected for use on the container or placard. Additional information on any aspect of safety or health not covered in other sections should be inserted in Section IX. The lower block can contain references to published guides or in-house procedures for handling and storage. Department of Transportation markings and classifications and other freight, handling, or storage requirements and environmental controls can be noted.

(j) Section X. Signature and Filing

Finally, the name and address of the responsible person who completed the MSDS and the date of completion are entered. This will facilitate correction of errors and identify a source of additional information.

The MSDS shall be filed in a location readily accessible to workers potentially exposed to the hazardous material. The MSDS can be used as a training aid and basis for discussion during safety meetings and training of new employees. It should assist management by directing attention to the need for specific control engineering, work practices, and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff in planning a safe and healthful work environment and suggesting appropriate emergency procedures and sources of help in the event of harmful exposure of employees.

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## MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION		
MANUFACTURER'S NAME	REGULAR TELEPHONE NO. EMERGENCY TELEPHONE NO.	
ADDRESS		
TRADE NAME		
SYNONYMS		
II HAZARDOUS INGREDIENTS		
MATERIAL OR COMPONENT	%	HAZARD DATA
III PHYSICAL DATA		
BOILING POINT, 760 MM HG		MELTING POINT
SPECIFIC GRAVITY (H <sub>2</sub> O=1)		VAPOR PRESSURE
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H <sub>2</sub> O, % BY WT
% VOLATILES BY VOL		EVAPORATION RATE (BUTYL ACETATE=1)
APPEARANCE AND ODOR		

IV FIRE AND EXPLOSION DATA				
FLASH POINT (TEST METHOD)			AUTOIGNITION TEMPERATURE	
FLAMMABLE LIMITS IN AIR, % BY VOL.		LOWER		UPPER
EXTINGUISHING MEDIA				
SPECIAL FIRE FIGHTING PROCEDURES				
UNUSUAL FIRE AND EXPLOSION HAZARD				
V HEALTH HAZARD INFORMATION				
HEALTH HAZARD DATA				
ROUTES OF EXPOSURE				
INHALATION				
SKIN CONTACT				
SKIN ABSORPTION				
EYE CONTACT				
INGESTION				
EFFECTS OF OVEREXPOSURE				
ACUTE OVEREXPOSURE				
CHRONIC OVEREXPOSURE				
EMERGENCY AND FIRST AID PROCEDURES				
EYES				
SKIN:				
INHALATION				
INGESTION				
NOTES TO PHYSICIAN				

<b>VI REACTIVITY DATA</b>	
CONDITIONS CONTRIBUTING TO INSTABILITY	
INCOMPATIBILITY	
HAZARDOUS DECOMPOSITION PRODUCTS	
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION	
<b>VII SPILL OR LEAK PROCEDURES</b>	
STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	
NEUTRALIZING CHEMICALS	
WASTE DISPOSAL METHOD	
<b>VIII SPECIAL PROTECTION INFORMATION</b>	
VENTILATION REQUIREMENTS	
SPECIFIC PERSONAL PROTECTIVE EQUIPMENT	
RESPIRATORY (SPECIFY IN DETAIL)	
EYE	
GLOVES	
OTHER CLOTHING AND EQUIPMENT	

**IX SPECIAL PRECAUTIONS**

PRECAUTIONARY  
STATEMENTS

OTHER HANDLING AND  
STORAGE REQUIREMENTS

PREPARED BY \_\_\_\_\_

ADDRESS \_\_\_\_\_

DATE \_\_\_\_\_

XII. TABLES

TABLE XII-1

SELECTED PHYSICAL AND CHEMICAL PROPERTIES OF DIOXANE

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Chemical Abstract serial number	00012391
Common synonyms	1,4-Dioxane p-Dioxane Diethylene dioxide Diethylene 1,4-dioxide Diethylene ether Glycol ethylene ether
Molecular formula	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>
Formula weight	88.10
Boiling point	101.32 C (214.4 F) at
Melting point	11.8 C (53.2 F)
Vapor density	Approximately 3 (air = 1)
Specific gravity	1.0356 (20 C), (water = 1.000 at 4 C)
Solubility	Miscible with water, alcohol, ether, acetone, benzene, acetic acid and other organic solvents; forms a constant boiling mixture with water that contains 81.6% dioxane and boils at 87.8 C, 760 mm Hg.
Density of saturated vapor	Approximately 1.1 (air = 1)
Concentration of saturated vapor	5.26% by volume at 25 C
Flammable (explosive) limits	Explosive mixtures with air at 100 C: upper limit = 22.25 volumes % lower limit = 1.97 volumes %

TABLE XII-1 (CONTINUED)

## SELECTED PHYSICAL AND CHEMICAL PROPERTIES OF DIOXANE

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Flashpoint	11 C (52 F) (closed cup)		
Odor Threshold:			
Detection threshold	2.8 ppm		
Identification threshold	5.7 ppm		
Vapor pressure	Temp F	Temp C	mm Hg
	-1.2	29.8	10
	12	53.6	20
	25.2	77.4	40
	33.8	92.8	60
	45.1	113.2	100
	62.3	144.1	200
	81.8	179.2	400
Conversion factors, (25 C, 760 mm Hg)	1 mg/liter = 278 ppm		
	1 mg/cu m = 0.278 ppm		
	1 ppm = 3.6 mg/cu m		
	1 ppm = 3.6 $\mu$ g/liter		

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Adapted from references 1-3,9,26,28



TABLE XII-2

## OCCUPATIONS WITH POTENTIAL EXPOSURE TO DIOXANE

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Adhesive workers	Oil processors
Cellulose acetate workers	Painters
Cellulose ester workers	Paint makers
Cement workers	Paint remover workers
Cosmetic makers	Plastic makers
Degreasers	Polish makers
Deodorant makers	Printers
Detergent workers	Resin makers
Dioxane workers	Shoe cream makers
Dye makers	Solvent workers
Emulsion makers	Stainers
Fat processors	Stain makers
Fumigant workers	Textile makers
Glue makers	Varnish makers
Histology technicians	Varnish remover makers
Lacquerers	Varnish removers
Lacquer makers	
Metal cleaners	

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Adapted from reference 18

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