

X. APPENDIX II

ANALYTICAL METHOD FOR CHLOROPRENE

The following analytical method for chloroprene is adapted from the Documentation of NIOSH Validation Tests draft [81].

Principle of the Method

A known volume of air is drawn through a charcoal tube to trap the chloroprene vapor present. The charcoal in the tube is transferred to a small, stoppered sample container, and the chloroprene is desorbed with carbon disulfide. An aliquot of the desorbed sample is injected into a gas-liquid chromatograph. The area of the resulting peak is determined and compared with those areas obtained from the injection of standards.

Range and Sensitivity

This method was validated over a range of 44.2-173.9 mg/cu m at an atmospheric temperature and pressure of 21 C and 760 mmHg, using a 3-liter sample. A maximum sample size of 3 liters is recommended. Sample at a flowrate between 10 and 50 ml/minute. Do not sample at a flowrate less than 10 ml/minute. The method is capable of measuring much smaller amounts if the desorption efficiency is adequate. Desorption efficiency must be determined over the range used.

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 chloroprene and other substances in the air. The charcoal tube consists of two sections of activated charcoal separated by a section of urethane foam (see Apparatus). If a particular atmosphere is suspected of containing a large amount of contaminant, a smaller sampling volume should be taken.

When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapor will not be trapped efficiently. Preliminary experiments with toluene [81] indicated that high humidity severely decreased the breakthrough volume. At a relative humidity of 91% (25 C), breakthrough did not occur after sampling for 4 hours at an average sampling rate of 0.045 liter/minute. The test was conducted at a concentration of 197 mg/cu m.

Interferences

It must be emphasized that any compound which has the same retention time as the chloroprene at the operating conditions described in this method constitutes an interference. Retention time data on a single column cannot be considered as proof of chemical identity. If the possibility of interference exists, separation conditions (column packing, temperature, etc) might be changed to circumvent the problem.

Precision and Accuracy

The Coefficient of Variation (CVT) for the total analytical and sampling method in the range of 44.2-173.9 mg/cu m (12.3-48.3 ppm) was 0.071. This value corresponds to a standard deviation of 6.4 mg/cu m at

the present standard level. Statistical information and details of the validation and experimental test procedures can be found in Documentation of NIOSH Validation Tests [81]. The average values obtained using the overall sampling and analytical method were 1.2% less than the "true" value at one-half, one, and two times the standard level. Storage stability studies [81] on samples collected from an atmosphere containing chloroprene at 86.0 mg/cu m indicated that collected samples were stable for at least 7 days at room temperature.

Advantages and Disadvantages of the Method

The sampling device is small, portable, and involves no liquids. Interferences are minimal, and most of those which do occur can be eliminated by altering chromatographic conditions. The tubes are analyzed by means of a quick, instrumental method, eg, gas-liquid chromatography. The method can also be used for the simultaneous analysis of two or more compounds suspected to be present in the same sample by simply changing gas-chromatographic conditions from isothermal to a temperature-programmed mode of operation, and determining relative retention times for all compounds under consideration.

One disadvantage of the method is that the amount of sample which can be taken is limited by the number of milligrams the tube will hold before overloading. When the sample value obtained for the backup section of the charcoal tube exceeds 25% of that found on the front section, the possibility of sample loss exists.

Furthermore, the precision of the method is limited by the reproducibility of the pressure drop across the tubes. This drop will

affect the flowrate and cause the volume to be imprecise, because the pump is usually calibrated for one tube only.

Apparatus

(a) Gas-liquid chromatograph equipped with a flame ionization detector.

(b) Stainless-steel column (4 feet x 1/4 inch) packed with 50/80 mesh Porapak Q.

(c) Electronic integrator or some other suitable method of determining peak size areas.

(d) Glass sample containers: 2-ml, with glass stoppers or Teflon-lined caps. If an automatic sample injector is used, the sample injector vials can be used.

(e) Microliter syringes: 10- μ l, and other convenient sizes for making standards.

(f) Pipets: 1.0-ml delivery type.

(g) Volumetric flasks: 10-ml or convenient sizes for making standard solutions.

(h) Microdistillation apparatus with provision for fractional vacuum distillation of pure chloroprene (for making standards).

(i) A stopwatch.

(j) A manometer.

Reagents

- (a) Carbon disulfide, chromatographic grade.
- (b) Chloroprene, distilled from xylene solution (31 C at 354 mmHg), in pentane solution.
- (c) n-Pentane, reagent grade.
- (d) n-Hexane, reagent grade.
- (e) Nitrogen, purified.
- (f) Hydrogen, prepurified.
- (g) Compressed air, filtered.

Analysis of Samples

(a) All glassware used for the analysis should be detergent-washed, thoroughly rinsed with tap water and distilled water, and dried.

(b) Preparation: Score each charcoal tube with a file in front of the first section of charcoal and break open. Remove and discard the glass wool. Transfer the charcoal in the first (larger) section to a 2-ml stoppered sample container or automatic sample injector vial. Remove and discard the separating section of foam and transfer the second section to another sample container or vial. Analyze these two sections separately.

(c) Desorption of samples: Prior to analysis, pipet 1.0 ml of carbon disulfide into each sample container.

PERFORM ALL WORK WITH CARBON DISULFIDE IN A HOOD BECAUSE OF ITS HIGH TOXICITY.

For further precautions, see the NIOSH criteria document on occupational exposure to carbon disulfide [104].

Cap the sample vials as soon as the solvent is added to minimize volatilization. Agitate the vials occasionally during the desorption period. Desorption is complete in 30 minutes if the sample vial is shaken occasionally.

(d) Typical gas-liquid chromatographic conditions:

- (1) 50 ml/minute (60 psig) nitrogen carrier gas flow.
- (2) 50 ml/minute (24 psig) hydrogen gas flow to detector.
- (3) 500 ml/minute (50 psig) airflow to detector.
- (4) 200 C injector temperature.
- (5) 250 C manifold temperature (detector).
- (6) 125 C column temperature.

A retention time of approximately 10 minutes is to be expected for chloroprene under these conditions and using the column recommended. The carbon disulfide retention time will be shorter.

(e) Injection: The first step in the analysis is the injection of the sample into the gas-liquid chromatograph. To eliminate difficulties arising from blowback or evaporation within the syringe needle, use the solvent-flush injection technique. First, flush the 10- μ l syringe with carbon disulfide several times to wet the barrel and plunger. Draw 3 μ l of solvent into the syringe to increase the accuracy and reproducibility of the injected sample volume. Remove the needle from the solvent, and pull the plunger back about 0.2 μ l to separate the solvent flush from the sample with a pocket of air that will serve as a marker. Immerse the needle in the sample and withdraw a 5- μ l portion, taking into consideration the volume of the needle since the sample in the needle will be completely injected. After removing the needle from the sample and prior to injection

into the gas-liquid chromatograph, pull the plunger back 1.2 μl to minimize evaporation of the sample from the tip of the needle. Observe that the sample occupies 4.9-5.0 μl in the barrel of the syringe. Make duplicate injections of each sample and of the standard. No more than a 3% difference in peak areas is to be expected. An automatic sample injector can be used if it is shown to give reproducibility at least as good as the solvent-flush technique. In this case, 2- μl injections are satisfactory.

(f) Measurement of the area: Measure the area of the sample peak with an electronic integrator or some other suitable form of area measurement, and read preliminary results from a standard curve prepared as discussed below (see Calibration and Standards).

Determination of Desorption Efficiency

The desorption efficiency of a particular compound can vary from one laboratory to another and also from one batch of charcoal to another. Thus, it is necessary to determine at least once the percentage of chloroprene that is removed in the desorption process, provided that the same batch of charcoal is used.

Activated charcoal equivalent to the amount in the first section of the sampling tube (100 mg) is measured into a 64-mm, 4-mm I.D. glass tube, flame sealed at one end. This charcoal must be from the same batch as that used in collecting the samples and can be obtained from unused charcoal tubes. The open end is capped with Parafilm. A known amount of freshly prepared pentane solution of chloroprene containing 67.5 $\mu\text{g}/\mu\text{l}$ is injected directly into the activated charcoal with a microliter syringe, and the tube is capped with more Parafilm. When using an automatic sample

injector, the sample vials, capped with Teflon-faced septa, may be used in place of the glass tubes. The amount injected is equivalent to that present in a 3-liter air sample at the selected level. It is not practical to inject the neat liquid directly because the amounts to be added would be too small to measure accurately.

Prepare at least six tubes at each of three levels (one-half, one, and two times the standard) in this manner and allow to stand overnight to assure complete adsorption of the chloroprene onto the charcoal. These six tubes are referred to as the samples. Treat a parallel blank tube in the same manner, but add no chloroprene to it. Two or three standards are prepared by injecting the same volume of chloroprene into 1 ml of carbon disulfide with the same syringe used in the preparation of the samples. Desorb and analyze the standards and sample and blank tubes in exactly the same manner as the sampling tube described in Analysis of Samples.

Determine the weight of chloroprene found in each tube from the standard curve (see Calibration and Standards). Desorption efficiency (DE) equals the difference between the average peak area of the samples and that of the blank divided by the average peak area of the standards, or:

$$DE = \frac{\text{average weight recovered (mg)}}{\text{weight added (mg)}}$$

The desorption efficiency is dependent on the amount of chloroprene collected on the charcoal. Plot the desorption efficiency versus the weight of chloroprene found. This curve is used (see Calculations) to correct for adsorption losses.

Calibration and Standards

A series of standards, varying in concentration over the range, is prepared and analyzed under the same gas-liquid chromatograph conditions and during the same time period as the unknown samples. Curves are established by plotting concentration in mg/ml versus peak area. Standard solutions must be analyzed at the same time that sample analysis is done to minimize the effect of known variations in the response of the flame ionization detector from day to day and from hour to hour within a single day.

Calculations are based on a molecular weight of 88.54 and a density of 0.958 for pure chloroprene. Since chloroprene polymerizes readily, special precautions must be taken in the preparation and storage of standards.

Stock Standard Solution: Pure chloroprene is obtained by fractionally distilling commercially available 50% chloroprene in xylene solution under vacuum (Note 1). A stock standard solution is prepared from freshly distilled chloroprene. Exactly 1.0 ml (0.958 g at 20 C) of pure chloroprene is delivered from a delivery type pipet under the surface of pentane in a partially filled 10-ml volumetric flask, and then the solution is made up to exactly 10 ml with pentane. This solution may be stable for 1 day or even longer if stored at -15 C (Note 2).

Note 1. The chloroprene used in the laboratory validation study was distilled at 31 C at a pressure of 354 mmHg.

Note 2. Since chloroprene tends to polymerize, even in solutions, it may be necessary to monitor its concentrations in the standard solutions.

Working Standard Solutions: Aliquots of the stock standard solution are delivered below the surface of carbon disulfide in partially filled 10-ml volumetric flasks. Each solution is diluted to exactly 10 ml with carbon disulfide and carefully mixed. A calibration curve should be prepared for the concentration range representing 0.1-3 times the recommended environmental limit.

Solutions for Desorption Efficiency Tests: An appropriate aliquot of the stock standard solution is delivered from appropriate pipets below the surface of pentane in a 10-ml volumetric flask partially filled with pentane. Appropriate aliquots are used for desorption efficiency tests after dilution to volume with pentane.

Standards should be prepared immediately from freshly distilled chloroprene and stored at -15 C when not in use. A reference standard of hexane in carbon disulfide in a sealed vial with septum cap can be used to monitor the stability of the chloroprene standards. The concentration of the hexane reference standard should be chosen so that its flame ionization detector response is close to that of the chloroprene standards. When the ratio of the concentration of chloroprene standards to reference standard appears to decrease, new standards should be prepared.

Calculations

Read the weight in milligrams corresponding to each peak area from the standard curve. No volume corrections are needed because the standard curve is also based on mg/ml of carbon disulfide and the volume of sample injected is identical to the volume of the standards injected.

Make corrections for the blank for each sample by subtracting the

amounts of chloroprene found on the front section of the blank from the amounts found in the front section of the sample tube, or:

$$\text{mg} = \text{mg sample} - \text{mg blank}$$

where:

$$\text{mg sample} = \text{mg found in front section of sample tube}$$

$$\text{mg blank} = \text{mg found in front section of blank tube}$$

A similar procedure is followed for the backup sections.

Add the weights present in the front and backup sections of the same sample tube to determine the total weight of chloroprene in the sample. Read the desorption efficiency (DE) from the curve for the amount of chloroprene found in the front section, and divide the total weight by this desorption efficiency to obtain the corrected mg/sample:

$$\text{corrected mg/sample} = \frac{\text{total weight}}{\text{DE}}$$

For personal sampling pumps with rotameters only, the following correction should be made.

$$\text{corrected volume} = f \times t \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

where:

f = flowrate sampled

t = sampling time

P1 = pressure during calibration of sampling pump (mmHg)

P2 = pressure of air sampled (mmHg)

T1 = temperature during calibration of sampling pump (degrees K)

T2 = temperature of air sampled (degrees K)

The concentration of chloroprene in the air sampled can be expressed in mg/cu m, which is numerically equal to $\mu\text{g/liter}$ of air:

$$\text{concentration (mg/cu m)} = \frac{\text{corrected mg} \times 1,000 \text{ (liters/cu m)}}{\text{air volume sampled (liters)}}$$

Another method of expressing concentration is ppm:

$$\text{concentration (ppm)} = \text{mg/cu m} \times \frac{24.45}{\text{MW}} \times \frac{760}{\text{P}} \times \frac{\text{T} + 273}{298 \text{ K}}$$

where:

P = pressure (mmHg) of air sampled

T = temperature (degrees C) of air sampled

24.45 = molar volume (liter/mole) at 25 C and 760 mmHg

MW = molecular weight (g/mole) of chloroprene

760 = standard pressure (mmHg)

298 = standard temperature (degrees K)

XI. APPENDIX III
MATERIAL SAFETY DATA SHEET

The following items of information which are applicable to a specific product or material shall be provided in the appropriate block of the Material Safety Data Sheet (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 rules 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, eg, "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. Flashpoint, shock sensitivity

or similar descriptive data may be used to indicate flammability, reactivity, or similar hazardous properties of the material.

(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 parentheses); vapor pressure, in conventional millimeters of mercury (mmHg); 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 TWA concentration, as a permissible exposure, or by some other indication of an acceptable standard. 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, possibly mild irritation.

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 employees.

(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 employees 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 antipollution ordinances" are proper but not sufficient. Specific procedures shall 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. Respirators shall be specified as to type and NIOSH or US Bureau of Mines approval class, ie, "Supplied air," "Organic vapor canister," 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) 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 employees exposed to the hazardous substance. 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 in 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 ₂ O=1)		VAPOR PRESSURE
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H ₂ 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				

VI REACTIVITY DATA	
CONDITIONS CONTRIBUTING TO INSTABILITY	
INCOMPATIBILITY	
HAZARDOUS DECOMPOSITION PRODUCTS	
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION	
VII SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	
NEUTRALIZING CHEMICALS	
WASTE DISPOSAL METHOD	
VIII SPECIAL PROTECTION INFORMATION	
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 AND FIGURE

TABLE XII-1

PHYSICAL AND CHEMICAL PROPERTIES OF CHLOROPRENE

Appearance	Colorless
Odor	Pungent, ethereal
Molecular formula	$\text{CH}_2\text{C}(\text{Cl})\text{CHCH}_2$
Formula weight	88.5
Boiling point	59.4 C at 760 mmHg
Freezing point	-130 C
Specific gravity	0.9583 at 20 C
Solubility	Soluble in ethanol, diethyl ether, acetone, benzene, and organic solvents; very slightly soluble in water
UV maximum absorption	223 nm (log extinction = 4.15)
Viscosity	0.394 centipoise at 25 C
Critical temperature	261.7 C
Flashpoint	-20 C (open cup)
Explosive limits	4-20%
Relative vapor density	3.0 (air = 1.0)
Vapor pressure	188 mmHg at 20 C
Saturation concentration (20 C)	25,000 ppm (90,000 mg/cu m)
Conversion factors (760 mmHg and 25 C)	1 ppm = 3.6 mg/cu m 1 mg/liter = 278 ppm 1 mg/cu m = 0.278 ppm

Adapted from references 3 and 4

TABLE XII-2

WORKERS WITH POTENTIAL EXPOSURE TO CHLOROPRENE

Chloroprene chemical workers
Chloroprene derivative workers
Neoprene latex sheet operators
Chloroprene maintenance workers
Neoprene latex handlers
Neoprene workers
Railroad tank car cleaners
Rubberized tapestry workers
Shoe gluers

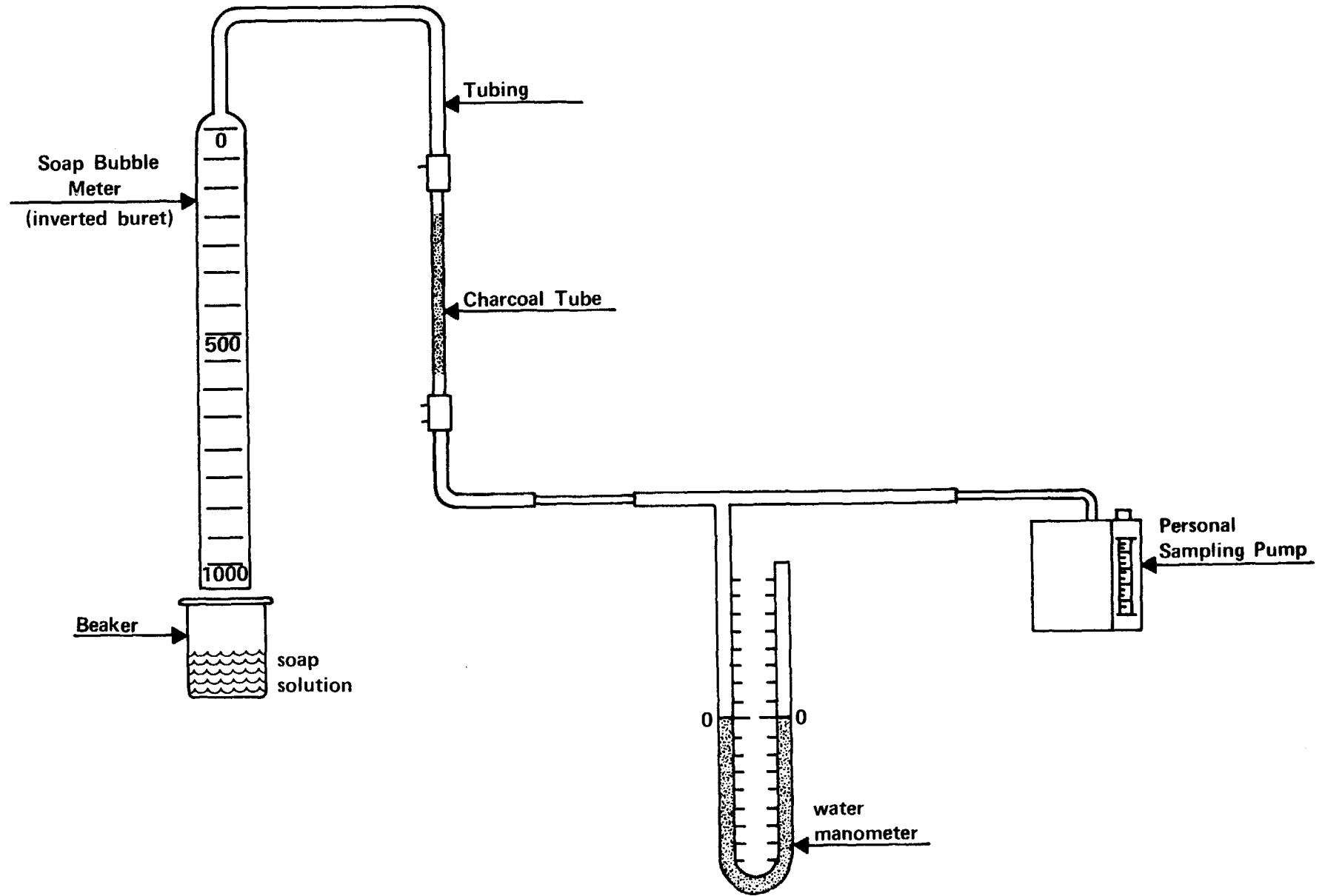


FIGURE XII-1

CALIBRATION SETUP FOR PERSONAL SAMPLING PUMP WITH CHARCOAL TUBE

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300



POSTAGE AND FEES PAID
U.S. DEPARTMENT OF H.E.W.
HEW 399