

## VIII. APPENDIX I

### SAMPLING METHOD FOR ALLYL CHLORIDE

#### Atmospheric Sampling

Breathing zone samples should be taken as near as practical to the employee's breathing zone without interfering with his movement. A description of the sampling location and conditions, equipment used, date, time, and rate of sampling, and any other pertinent information shall be recorded at the time of sample collection. A sufficient number of samples should be taken to accurately characterize the employee's exposure during a work shift.

#### (a) Equipment

The sampling train consists of a charcoal tube and a vacuum pump.

(1) Charcoal tubes: Glass tubes with both ends flame-sealed, 7 cm long with a 6-mm OD and a 4-mm ID, containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of polyurethane foam. The primary adsorbing section contains 100 mg of charcoal, the backup section 50 mg. A 3-mm portion of polyurethane foam is placed between the outlet end of the tube and the backup section. A plug of silylated glass wool or polyurethane foam is placed in front of the adsorbing section. The pressure drop across the tube must be less than 1 inch of mercury at a flowrate of 1 liter/minute. Tubes with the above specifications are commercially available.

(2) Pump: A battery-operated pump, complete with clip for

attachment to the employee's clothing, capable of operation at 1 liter or less/minute.

(b) Calibration

Since the accuracy of an analysis can be no greater than the accuracy with which the volume of air is measured, the accurate calibration of a sampling pump is essential to the correct interpretation of the volume indicated. The frequency of calibration is dependent upon the use, care, and handling to which the pump is subjected. Ordinarily, pumps should be calibrated in the laboratory both before they are used in the field and after they have been used to collect a large number of field samples. Pumps should be recalibrated if they have been misused, or if they have just been repaired or received from a manufacturer. If the pump receives hard usage, more frequent calibration may be necessary. Regardless of use, maintenance and calibration should be performed on a regular schedule and records of these kept.

The accuracy of calibration is dependent upon the type of instrument used as a reference. The choice of calibration instrument will depend largely upon where the calibration is to be performed. For laboratory testing, primary standards such as a spirometer or soapbubble meter are recommended, although other standard calibration instruments such as a wet test meter or dry gas meter can be used. The actual setups will be similar for all instruments.

The calibration setup for personal sampling pumps using a soapbubble meter is shown in Figure XI-1. If another calibration device is selected, equivalent procedures should be used. Since the flowrate given by a pump is dependent on the pressure drop of the sampling device, in this case a

charcoal tube, the pump must be calibrated while operating with a representative charcoal tube in line. Calibration instructions using the soapbubble meter follow.

(1) Check the voltage of the pump battery with a voltmeter to ensure adequate voltage for calibration; charge the battery as needed.

(2) Break the tips of a charcoal tube to produce openings of at least 2 mm in diameter.

(3) Assemble the calibration train as shown in Figure XI-1.

(4) Turn on the pump and moisten the inside of the soapbubble meter by immersing the buret in the soap solution and drawing bubbles up the inside until they travel the entire buret length without bursting.

(5) Adjust the pump rotameter to provide the desired flowrate.

(6) Check the water manometer to ensure that the pressure drop across the sampling train does not exceed 13 inches of water at 1 liter/minute or 2.5 inches of water at 200 ml/minute.

(7) Start a soapbubble up the buret and measure the time it takes the bubble to move from one calibration mark to another. A stopwatch should be used for this measurement.

(8) Repeat the procedure in (7) above at least twice, average the results, and calculate the flowrate by dividing the volume between the preselected marks by the time required for the soapbubble to traverse the distance. If, for the pump being calibrated, the volume of air sampled is calculated as the product of the number of strokes times a stroke factor (given in units of volume/stroke), the stroke factor is the

quotient of the volume between the two preselected marks divided by the number of strokes.

(9) Record the following data: the volume measured, elapsed time or number of strokes, pressure drop, air temperature, atmospheric pressure; manufacturer, model, and serial number of the pump; date, and name of the person performing the calibration.

(c) Sampling Procedure

The following procedure is applicable except when condensation occurs in the tube during sampling. Under this condition, the efficiency of the method would be impaired.

(1) Break both ends of the charcoal tube to provide openings of at least one-half the ID (2 mm) of the tube. A smaller opening causes a limiting orifice effect which reduces the flow through the tube. Place the smaller section of charcoal, which is used as a backup section, nearest the sampling pump. Use tubing to connect the back of the tube to the pump. Support the tube in a vertical position in the worker's breathing zone.

(2) Sample a maximum of 100 liters of air at a flowrate of 1 liter or less/minute. For example, to determine 8-hour TWA concentrations, two 4-hour or four 2-hour samples are suggested.

(3) Measure and record the temperature and pressure of the atmosphere being sampled.

(4) Treat one charcoal tube (the analytical blank) in the same manner as the sample tubes (break, seal, ship) except that no air is drawn through it.

(5) Immediately after sampling, cover the ends of the charcoal tubes with polyethylene or polypropylene caps. Under no circumstances should rubber caps be used. To minimize breakage during transport, capped tubes should be padded and packed tightly in a shipping container. If needed, a bulk sample (usually no more than 1 oz) of the suspected compound should be submitted to the laboratory in a glass container with a teflon-lined cap. Label the bulk sample so that it can be identified with the proper air samples. The bulk sample should not be transported, mailed, or shipped in the same container as the air sample or blank tubes. If the bulk sample is to be mailed, it should be packaged so as to prevent breakage.

## IX. APPENDIX II

### ANALYTICAL METHOD FOR ALLYL CHLORIDE

#### Principle of the Method

Allyl chloride vapor trapped on charcoal from a known volume of air is desorbed with benzene. Carbon disulfide is a suitable substitute for benzene but, if the desorption solvent is changed, modification of this method is needed. An aliquot of the desorbed sample is injected into a gas chromatograph. The area of the resulting peak is determined and compared with areas obtained from the injection of standards.

#### Range and Sensitivity

This method was validated over the range of 1.80-7.19 mg/cu m (0.58-2.29 ppm) with a 100-liter sample at 24 C and 759 mmHg. With a sample size of 100 liters, the probable useful range of this method is 0.5-10 mg/cu m (0.16-3.20 ppm). 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 allyl chloride and other substances in the air. The first section of the charcoal tube was found to hold 1.5 mg of allyl chloride when a test atmosphere containing 7.56 mg/cu m (2.42 ppm) of allyl chloride in air was sampled at a flowrate of 0.945 liter/minute for 210 minutes. Under these conditions, 3% of the total allyl chloride sampled

was found on the backup section of the charcoal tube. If a particular atmosphere is suspected of containing a large concentration of contaminant, a sampling volume smaller than the suggested maximum of 100 liters should be taken.

### Interferences

When the amount of water in the air is so great that condensation actually occurs in the charcoal tube, organic vapors will not be trapped. The capacity of the charcoal tube for allyl chloride may also be reduced by the presence of other organic vapors in high concentrations.

Any compound which has the same retention time as allyl chloride under the gas chromatographic conditions described in this method will interfere with the analysis. Substances suspected of being present in the sample should be injected to determine their retention time and, thus, the likelihood of interference. This type of interference may be overcome by changing the operating conditions of the instrument, the packing material of the column, or the column temperature. Retention time data on a single column cannot be considered proof of chemical identity. A mass spectrometer, a minimum of two different columns, or other suitable methods must be used to determine chemical identity.

When two or more compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

### Precision and Accuracy

The coefficient of variation for the total analytical and sampling method in the range of 1.80-7.19 mg/cu m was 0.071. This value corresponds to a 0.071-ppm (0.21-mg/cu m) standard deviation at 1 ppm (3.13 mg/cu m).

### Advantages and Disadvantages of the Method

The sampling device is small, portable, and involves no liquids. Interferences are minimal and most can be eliminated by altering the chromatographic conditions. The analysis is accomplished by using a rapid instrumental method, which also can be used for the simultaneous analysis of two or more compounds present in the same sample.

One disadvantage of the sampling method is that the sample amount is limited by the capacity of the charcoal tube before overloading. When the sample value obtained for the backup section of the charcoal trap exceeds 25% of that found on the front section, the possibility of sample loss exists. In the analytical method, the presence of other compounds with the same retention time may either mask the allyl chloride peak or increase the size of the peak. However, this can generally be overcome by altering the operating conditions of the gas chromatograph.

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 chromatograph equipped with a flame ionization detector.
- (b) Column (4 feet x 1/4 inch, stainless steel) packed with 50/80 mesh Porapak, Type Q. Other columns which achieve the desired separation may also be used.
- (c) An electronic or mechanical integrator for determining peak areas.
- (d) Small glass-stoppered test tubes or equivalent.
- (e) Syringes: 10- $\mu$ l, and other convenient sizes for preparation of standards.

### Reagents

- (a) Benzene, chromatquality.
- (b) Hexane, chromatquality
- (c) Allyl chloride, reagent grade.
- (d) Purified nitrogen.
- (e) Purified hydrogen.
- (f) Purified air.
- (g) Compressed air (industrial grade), if needed as dictated by instrument design.

### Analysis of Samples

- (a) Wash all glassware in detergent and rinse thoroughly in distilled water.

(b) Score each charcoal tube, including the blank from field samples, with a file and break open in front of the first section of charcoal. Remove and discard the glass wool. Transfer the charcoal in the first (larger) section into a small, stoppered test tube. Remove and discard the separating foam section, and transfer the second section of charcoal to another test tube. The two charcoal sections are then analyzed separately.

(c) Prior to analysis, pipet 1.0 ml of benzene into each test tube to desorb the allyl chloride from the charcoal. Desorption is complete in 30 minutes if the sample is stirred occasionally.

CAUTION MUST BE EXERCISED AT ALL TIMES WHEN USING BENZENE BECAUSE OF ITS HIGH TOXICITY AND FLAMMABILITY. ALL WORK WITH BENZENE MUST BE PERFORMED UNDER AN EXHAUST HOOD.

(d) Typical gas chromatographic operating conditions:

- (1) 50 cc/min (60 psig) nitrogen carrier gas flow.
- (2) 65 cc/min (24 psig) hydrogen gas flow to detector.
- (3) 500 cc/min (50 psig) airflow to detector.
- (4) 185 C injector temperature.
- (5) 250 C manifold temperature (detector).
- (6) 160 C isothermal oven or column temperature.

(e) Inject the sample into the gas chromatograph using the solvent flush injection technique. This eliminates difficulties arising from blowback or distillation within the syringe needle, thus increasing the accuracy and reproducibility of the injected sample volume. Flush the 10-

$\mu\text{l}$  syringe with solvent several times to wet the barrel and plunger, then draw 3.0  $\mu\text{l}$  of solvent into the syringe. Next, remove the needle from the solvent and pull the plunger back about 0.2  $\mu\text{l}$  to separate the solvent flush from the sample with an air pocket to be used as a marker. Then immerse the needle in the sample and withdraw a 5.0- $\mu\text{l}$  aliquot. After removing the needle from the sample and prior to injection into the gas chromatograph, pull back the plunger a short distance to minimize sample evaporation from the needle tip. Make duplicate injections for each sample and for the standard. There should be no more than a 3% difference in the peak areas.

(f) Determine the area of the sample peak with an electronic integrator or some other suitable form of area measurement, and read the preliminary sample results from a standard curve prepared as outlined below.

#### Determination of Desorption Efficiency

The desorption efficiency of a particular compound can vary from one batch of charcoal to another and also from one laboratory to another. Thus, it is necessary to determine the percentage of allyl chloride recovered in the desorption process at least once. This procedure should be repeated for each new batch of charcoal used.

Activated charcoal, equivalent to the amount in the first section of the sampling tube (100 mg), is measured into a 5-cm, 4-mm ID glass tube, flame-sealed at one end. This charcoal must be from the same batch as that used for the samples and can be obtained from unused charcoal tubes. The open end is capped. A known amount of hexane solution containing a known

amount of allyl chloride is injected directly into the activated charcoal with a microliter syringe, and the tube is capped. The known amount injected is usually equivalent to that present in a 100-liter air sample at the selected level.

At least six tubes are prepared in this manner and allowed to stand overnight or longer to assure complete adsorption of the analyte onto the charcoal. These six tubes are referred to as the samples. A parallel blank tube should be treated in the same manner except that no sample is added to it. The samples and blanks are desorbed and analyzed in exactly the same manner as described above for unknown air samples.

Two or three standards are prepared by injecting identical volumes of allyl chloride into 1.0 ml benzene with the same syringe used in the preparation of the sample. These are analyzed with the samples.

The desorption efficiency (DE) equals the average weight in mg recovered from the tube divided by the weight in mg added to the tube, or

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

The desorption efficiency is dependent on the amount of analyte collected on the charcoal. The desorption efficiency versus the weight of the analyte found should be plotted.

#### Calibration and Standards

It is convenient to express the concentration of standards in terms of mg allyl chloride/1.0 ml benzene, because samples are desorbed in this amount of benzene. The density of the allyl chloride is used to convert

milligrams into microliters for easy measurement with a microliter syringe. A series of standards, varying in concentration over the range of interest, is prepared and analyzed under the same gas chromatographic conditions and during the same time period as the unknown samples. Curves are established by plotting concentration in mg/1.0 ml benzene versus average peak area. Note: Since no internal standard is used in the method, standard solutions must be analyzed when the sample analysis is done. This will minimize the effect of known day-to-day variations and variations during the same day because of changes in instrument sensitivity and column response.

#### Calculations

The weight in mg, corresponding to the total peak area, is read from the standard curve. No volume corrections are needed, because the standard curve is based on mg allyl chloride/1.0 ml benzene and the volume of sample injected is identical to the volume of the standards injected.

Corrections for the blank from the field sampling are made for each sample by subtracting the amounts of allyl chloride found on the front and back sections of the blank from the amounts found in the respective sections of the sample:

$$\text{corrected amount} = \text{amount on sample} - \text{amount on blank}$$

The corrected amounts present in the front and backup sections of the same sample tube are added to determine the total amount of allyl chloride in the sample. This total amount is divided by the desorption efficiency to obtain the adjusted total amount of allyl chloride in the sample:

$$\text{adjusted total amount} = \frac{\text{total amount}}{\text{desorption efficiency}}$$

The concentration of allyl chloride in the air sampled, expressed in mg/cu m (which is numerically equal to  $\mu\text{g/liter}$  of air), is given by the quotient of the adjusted amount in  $\mu\text{g}$  divided by the volume of air sampled in liters:

$$\text{concentration (mg/cu m)} = \frac{\text{adjusted amount (mg)} \times 1,000 \text{ liter/cu m}}{\text{volume (liters)}}$$

Another method of expressing concentration is ppm:

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

where:

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

MW = molecular weight of allyl chloride (g/mole)

760 = standard pressure

P = pressure (mmHg) of air sampled

T = temperature (degrees C) of air sampled

298 = standard room temperature (degrees K)

or

$$\text{concentration (ppm)} = \frac{\text{mg/cu m} \times 0.815 (\text{T} + 273)}{\text{P}}$$

X. 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, 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. 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 replacement 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 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 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		
<b>TRADE NAME</b>		
<b>SYNONYMS</b>		
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		

<b>IV FIRE AND EXPLOSION DATA</b>				
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				
<b>V HEALTH HAZARD INFORMATION</b>				
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 \_\_\_\_\_



XI. TABLES AND FIGURE

TABLE XI-1

CHEMICAL AND PHYSICAL PROPERTIES OF ALLYL CHLORIDE

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Synonyms	3-chloropropene; 3-chloro,1-propene; chlorallylene; 1-chloro, 2-propene; 3-chloropropylene
Chemical formula	CH <sub>2</sub> CHCH <sub>2</sub> Cl
Molecular weight	76.53
Specific gravity (20/4 C)	0.938
Vapor density (air = 1)	2.64
Freezing point	-136.4 C
Boiling point	45.0 C
Flammable limits (% in air)	3.3-11.2
Vapor pressure (mmHg) at 25 C	368
Flashpoint (open cup)	-28.9 C
Solubility (in water) at 20 C	0.30 g/100 g
Conversion factors (760 mmHg and 25 C)	1 ppm = 3.13 mg/cu m 1 mg/cu m = 0.32 ppm

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Adapted from references 1, 22, and 54

TABLE XI-2

OCCUPATIONS WITH POTENTIAL ALLYL CHLORIDE EXPOSURE

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Allyl chloride manufacturers

Epichlorohydrin synthesizers

Glycerol synthesizers

DADM (diallyldimethyl ammonium chloride)  
synthesizers

Allyl alcohol producers

Medicinal product producers

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Adapted from reference 4

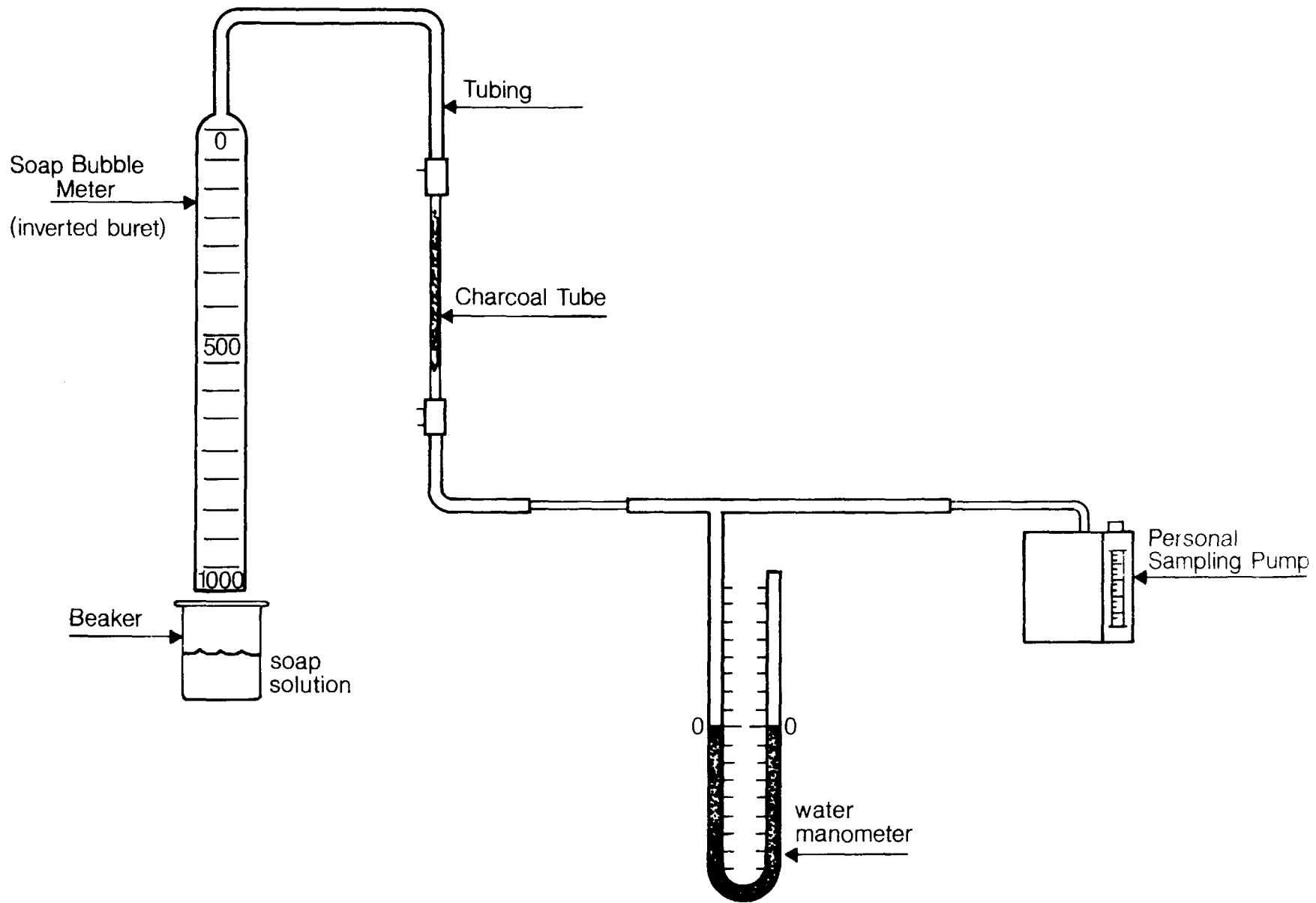


FIGURE X-1

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  
4675 COLUMBIA PARKWAY CINCINNATI, OHIO 45226

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OFFICIAL BUSINESS  
PENALTY FOR PRIVATE USE, \$300



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