

X. APPENDIX II

ANALYTICAL METHOD FOR CARBON DISULFIDE

This analytical method for carbon disulfide is adapted from NIOSH Method No. S248 and has been validated at the present OSHA standard of 20 ppm (62 mg/cu m). This method has been validated at 2.5 ppm and appears to be adaptable to the recommended limit.

Principle of the Method

Carbon disulfide vapor trapped on charcoal from a known volume of air is desorbed with benzene; xylene also can be used for desorption, but NIOSH has not validated the use of xylene in this method. An aliquot of the desorbed sample is injected into a gas chromatograph with a sulfur detector. The area under the resulting peak is determined and compared with those obtained from injection of standards.

Range and Sensitivity

This method was validated over the range of 45.6-182.3 mg/cu m (14.7-58.8 ppm) at an atmospheric temperature and pressure of 22 C and 766 mmHg, using a 6-liter sample. For a 6-liter sample, the probable useful range of this method is 16-280 mg/cu m (5-90 ppm). The method is capable of measuring much smaller amounts if the desorption efficiency is adequate. A NIOSH Sampling Data Sheet [130] reported carbon disulfide detection as low as 3 mg/cu m (1 ppm), using a 10-liter sample. Desorption efficiency

must be determined over the range used.

The capacity of the charcoal tube varies with the concentrations of carbon disulfide and other substances in the air. The first section of the charcoal tube was found to hold 6.0 mg of carbon disulfide when a test atmosphere containing 188 mg/cu m (60.3 ppm) of carbon disulfide in air was sampled at 0.196 liter/minute for 162 minutes; breakthrough was observed at this time, ie, 0.056 mg of carbon disulfide had broken through the front section of the charcoal tube. If a particular atmosphere is suspected of containing a large amount of contaminant, a smaller sampling volume should be taken.

Interferences

When the amount of water in the air is so great that condensation occurs in the tube, carbon disulfide vapor may not be trapped efficiently. Experiments showed that there was increasing loss of carbon disulfide with an increase in relative humidity. In order to correct this problem, it is necessary to use a desiccant to remove the moisture. It must be emphasized that any compound which has the same retention time as the analyte under the operating conditions described in this method will interfere. Retention-time data on a single column cannot be considered proof of chemical identity. If the possibility of interference exists, separation conditions (column packing, temperature, etc) must be changed to circumvent the problem. McCammon et al [97] reported that sampling efficiency was not affected by the presence of hydrogen sulfide or elevated temperatures.

Precision and Accuracy

The coefficient of variation (standard deviation/mean x 100) for the total analytical and sampling method in the range of 45.6-182.3 mg/cu m (14.7-58.8 ppm) is 0.059. This value corresponds to a 5.6 mg/cu m (1.8 ppm) standard deviation at 93 mg/cu m (30 ppm). On the average, the concentrations obtained at 93 mg/cu m (30 ppm) using the overall sampling and analytical method were 0.7% higher than the true concentrations for a limited number of laboratory experiments. Any difference between the found and true concentrations may not represent a bias in the sampling and analytical method, but rather a random variation from the experimentally determined true concentration.

Apparatus

(a) Drying tubes: Glass tube with both ends open, 7 cm long with a 6-mm OD and a 4-mm ID. To add the desiccant to the tube, a plug of silylated glass wool is placed in one end of the tube, and the tube is filled with 270 mg of anhydrous sodium sulfate. Another plug of silylated glass wool is placed over the sodium sulfate, and the tube is capped at both ends.

(b) Gas chromatograph equipped with a flame photometric detector, with a sulfur filter.

(c) Column (6 ft x 1/4 in OD, glass) packed with 5% OV-17 on 80/100 mesh Gas Chrom Q or equivalent.

(d) An electronic integrator or some other suitable method for measuring peak areas.

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

(f) Pipets: 10-ml delivery pipets.

(g) Volumetric flasks: 25 ml or convenient sizes for preparing standard solution.

(h) Sample containers: 25 ml, stoppered.

Reagents

(a) Chromatographic-quality carbon disulfide.

(b) Benzene, reagent grade.

(c) Purified oxygen.

(d) Purified nitrogen.

(e) Prepurified hydrogen.

(f) Filtered compressed air.

Analysis of Samples

All glassware used for the laboratory analysis should be washed in detergent and rinsed with tap and distilled water.

(a) Preparation of samples: In preparation for analysis, 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 25-ml stoppered sample container. Remove the separating section of foam and discard; transfer the charcoal in the second section to another stoppered container. These two sections are analyzed separately.

(b) Desorption of samples: Prior to analysis, pipet 10 ml of benzene into each sample container. (All work with benzene should be performed in a hood because of its high toxicity.) Desorb the sample for 30 minutes, agitating occasionally. Another, and probably preferable, procedure is to place the charcoal within a vial with a septal closure and to inject the desorbing solvent (benzene or xylene) through the septum. This procedure has not been validated by NIOSH, however.

(c) Gas chromatography conditions: The typical operating conditions for the gas chromatograph are:

- (1) Nitrogen carrier-gas flow, 20 ml/minute.
- (2) Hydrogen gas flow to detector, 150 ml/minute.
- (3) Airflow to detector, 35 ml/minute.
- (4) Oxygen gas flow to detector, 20 ml/minute.
- (5) Injector temperature, 150 C.
- (6) Detector temperature, 145 C.
- (7) Column temperature, 40 C.

(d) Injection: The first step in the analysis is the injection of the sample into the gas chromatograph. To eliminate difficulties arising from blowback or evaporation of solvent within the syringe needle, the solvent flush injection technique is used. Flush the 10- μ l syringe with solvent 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 to be used as a marker. Immerse the needle in the sample and withdraw a 5- μ l aliquot, taking into consideration the volume of

the needle because the sample in the needle will be completely injected. After removing the needle from the sample, and prior to injection, pull the plunger back 1.2 μ l to minimize evaporation of the sample from the tip of the needle. Make sure that the sample occupies 4.9-5.0 μ l in the barrel of the syringe. Duplicate injections of each sample and standard should be made. No more than a 3% difference in area is to be expected.

The gas chromatograph is equipped with a valve to vent the solvent peak after it passes through the column. To avoid exposing the detector to benzene, open the venting valve 2-3 minutes after sample injection to elute benzene and close it after the benzene is eluted.

(e) Measurement of area: The area under the sample peak is measured by an electronic integrator or some other suitable form of area measurement. Preliminary results are read from a standard curve prepared as discussed below.

Determination of Desorption Efficiency

(a) Importance of determination: 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 for each batch of charcoal the fraction of carbon disulfide that is removed in the desorption process. Desorption efficiency is also a function of tube loading. Desorption efficiencies should be determined, therefore, at loadings similar to those found in the actual samples.

(b) Procedure for determining desorption efficiency: Measure activated charcoal equivalent to the amount in the first section of the sampling tube (100 mg) into a 64-mm, 4-mm ID glass tube, flame sealed at

one end. This charcoal, which must be from the same batch as that used in collecting the samples, can be obtained from unused charcoal tubes. Cap the open end with a Parafilm paraffin membrane or equivalent.

Inject a known amount of a benzene solution of carbon disulfide containing 0.14 mg/ μ l directly into the activated charcoal with a microliter syringe, and cap the tube with more Parafilm.

One μ l of this solution is equivalent to that amount of carbon disulfide present in a 20-liter air sample at 3.0 mg/cu m (1.0 ppm). Prepare six tubes in this manner and allow them to stand at least overnight to assure complete adsorption of the analyte onto the charcoal. Treat a parallel blank tube in the same manner except that no carbon disulfide is added to it.

Prepare two or three standards by injecting the same volume of carbon disulfide into 10 ml of benzene with the same syringe used in the preparation of the samples. These are analyzed with the samples.

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

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

Calibration and Standards

It is convenient to express the concentrations of standards in mg/10 ml of benzene, because samples are desorbed in this amount of benzene. The density of the carbon disulfide is used to convert mg into μ l for easy measurement with a microliter syringe. Prepare a series of standards, varying in concentration over the range of interest, and analyze them under

the same gas chromatograph conditions and during the same period as the unknown samples. Curves are established by plotting concentration in mg/10 ml of benzene versus the square of the peak area. This curve should be a linear plot.

Calculations

(a) Read the weight in mg corresponding to the square of each peak area from the standard curve. No volume corrections are needed since the standard curve is based on mg/10 ml of benzene, and the volume of sample injected is identical to the volume of the standards injected.

(b) Make corrections for the blank for each sample:

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

where:

mg sample = mg found in sample tube
mg blank = mg found in blank tube

(c) Add the weights from the front and backup sections to get the total weight in the sample. Large amounts of carbon disulfide in the back-up section of the charcoal tube can indicate that breakthrough has occurred and that some of the sample was lost. If more than 20% of the total sample is found on the back-up section, the sample should be considered suspect. Results of these samples should be reported as greater than or equal to the concentration found.

(d) Divide the total weight by the desorption efficiency (DE) to obtain the corrected mg/sample.

$$\text{Corrected mg/sample} = \frac{\text{Total Weight}}{\text{DE}}$$

(e) The concentration of carbon disulfide in the air sampled can be expressed in mg/cu m or in ppm:

$$\text{mg/cu m} = \frac{\text{Corrected mg/sample} \times 1,000}{\text{Air volume sampled (liters)}}$$

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

where:

- P = pressure (mmHg) of air sampled
- T = temperature (C) of air sampled
- 24.45 = molar volume (liter/mole) at 25 C and 760 mmHg
- MW = molecular weight (g/mole) of analyte
- 760 = standard pressure (mmHg)
- 298 = standard temperature (K)

XI. APPENDIX III

METHOD OF BIOLOGIC MONITORING FOR CARBON DISULFIDE:

IODINE-AZIDE TEST

The iodine-azide test is a biologic monitoring method, developed by Vasak et al [108] and Djuric et al [109], which is used to monitor the body-burden of carbon disulfide based on urine collected from workers after exposure.

Principle of the Method

After absorption into the body, carbon disulfide is metabolized and excreted in the urine. This metabolite, probably a thiazolidone, catalyzes the reaction:



The time required for the iodine color to disappear is considered an indication of the amount of carbon disulfide metabolite present in the urine and therefore an index of the concentration of carbon disulfide at which the worker has been exposed. The time is inversely and exponentially related to the concentration of the metabolite. Using creatinine concentration as an estimate of the dilution of the urine sample, an exposure coefficient can be established:

$$E = C(\log t),$$

where E is the exposure coefficient, C is the concentration of creatinine

in mg/liter, and t is the time in seconds required for the color to disappear following mixture of the iodine-azide reagent solution with the urine.

Range and Sensitivity

This method has been shown to be sensitive to carbon disulfide at concentrations of 50 mg/cu m (16 ppm) and above. An exposure coefficient (E) of approximately 6.5 corresponds to 50 mg/cu m (16 ppm). Exposure at a concentration of 200 mg/cu m (64 ppm) has produced an E of 1; 200 mg/cu m (20 ppm), an E of approximately 6; and lower than 50 mg/cu m (16 ppm) an E of above 6.5. At very low concentrations, the color may not disappear, and therefore an E value cannot be determined.

Interferences

The iodine-azide test depends on a metabolite of carbon disulfide, and it is possible that similar compounds can also catalyze this reaction. Workers with sulfur-rich diets and those who are undergoing disulfiram treatment for alcoholism may have accelerated iodine-azide reactions. Disulfiram has metabolites in common with carbon disulfide, and interference can be expected if the exposed worker is being treated with disulfiram.

Precision and Accuracy

The iodine-azide test is effective as an inexpensive and simple test to estimate concentrations at which workers have been exposed. It must not

be regarded as a precise method of monitoring, but rather as an indicator of overexposure. Exposure coefficients are not considered quantitative estimates of exposure but are qualitative indications of exposure based on the 50 mg/cu m (16 ppm) cutoff. Personal monitoring of air concentrations must accompany such biologic monitoring for more precise determination of carbon disulfide concentrations.

Apparatus

- (a) Test tubes, 10 ml.
- (b) Stopwatch.
- (c) Volumetric flasks, 100 ml.
- (d) Pipets: 10-ml delivery pipets.
- (e) Spectrophotometry tubes, 10 ml.
- (f) Spectrophotometer.

Reagents

- (a) Iodine-azide reagent: 50 ml of 0.2 N iodine solution and 3 g of sodium azide; fill volumetric flask to 100 ml with distilled water.
- (b) Buffer solution: 100 g of sodium dihydrogenphosphate; fill volumetric flask to 100 ml with distilled water.
- (e) Picric acid, 0.04 M solution.
- (d) Sodium hydroxide, 0.75 N solution.

Procedure

(a) Measure the concentration of creatinine in the urine sample. The method described below is based on that of Bonsnes and Taussky [131]. However, other methods of equal reliability and validity may also be used.

(1) Measure 3 ml of urine into spectrophotometry tube.

(2) Add 1 ml picric acid and then 1 ml sodium hydroxide to the tube.

(3) Mix solution and allow 15 minutes for development of color.

(4) Measure the optical density of the solution using a spectrophotometer.

(5) Compare the observed density with a standard curve of spectrophotometric readings versus amount of creatinine and determine the concentration of creatinine in mg/liter of urine sample.

(6) Urine samples containing creatinine concentrations of less than 1 mg/liter or more than 3 mg/liter should be discarded.

(b) Measure 1 ml of urine and 0.2 ml of the buffer solution into a test tube and swirl to mix.

(c) Add 1 ml of the iodine-azide reagent and begin timing the reaction; mix well.

(d) Stop timing when the reaction is complete, ie, when the color disappears and the foam is white.

Calculation of Exposure Coefficient (E)

Using the formula $E = C(\log t)$, compute the exposure coefficient.

Example: disappearance of color required 2 minutes and 10 seconds ($t=130$);
creatinine concentration was 2.0 mg/liter; therefore:

$$E = 2.0(\log 130) = 4.2$$

XII. APPENDIX IV
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 _____

XIII. TABLES AND FIGURE

TABLE XIII-1

PHYSICAL AND CHEMICAL PROPERTIES OF CARBON DISULFIDE

Molecular formula	CS ₂
Formula weight	76.14
Melting point	-111.53 C
Boiling point	46.25 C
Specific gravity	1.26
Vapor density (air=1)	2.63
Flammable limits (in air)	1.25-50%
Flashpoint (closed cup)	-30 C
Autoignition temperature	100 C
Color	Clear, colorless (when pure)
Odor	Odorless (when pure); disagreeable in presence of sulfur compounds
Vapor pressure	100 mmHg at -5 C 200 mmHg at 10.6 C 400 mmHg at 27.8 C
Conversion factors	1 mg/cu m = 0.321 ppm 1 ppm = 3.11 mg/cu m

Adapted from references 1-3

TABLE XIII-2

OCCUPATIONS WITH POTENTIAL EXPOSURE TO CARBON DISULFIDE

Acetylene workers	Painters
Ammonium salt makers	Paintmakers
Bromine processors	Paint-remover makers
Carbanilide makers	Paraffin workers
Carbon disulfide workers	Pesticide makers
Carbon tetrachloride makers	Phosphorus processors
Cellophane makers	Preservative makers
Cementers, rubbershoe	Putty makers
Coal tar distillers	Rayon makers
Degreasers	Resin makers
Drycleaners	Rocket-fuel makers
Dyestuff makers	Rubber-cement makers
Electroplaters	Rubber dryers
Enamellers	Rubber makers
Enamel makers	Rubber reclaimers
Explosive workers	Selenium processors
Fat processors	Smokeless-powder makers
Flotation-agent makers	Soil fumigators
Fumigant workers	Sulfur processors
Glassmakers	Tallowmakers
Glue workers	Textile makers
Iodine processors	Vacuum-tube makers
Laboratory workers, chemical	Varnish makers
Lacquer makers	Varnish-remover makers
Matchmakers	Veterinarians
Oil processors	Vulcanizers
Optical glassmakers	Wax processors

Adapted from Gafner [11]

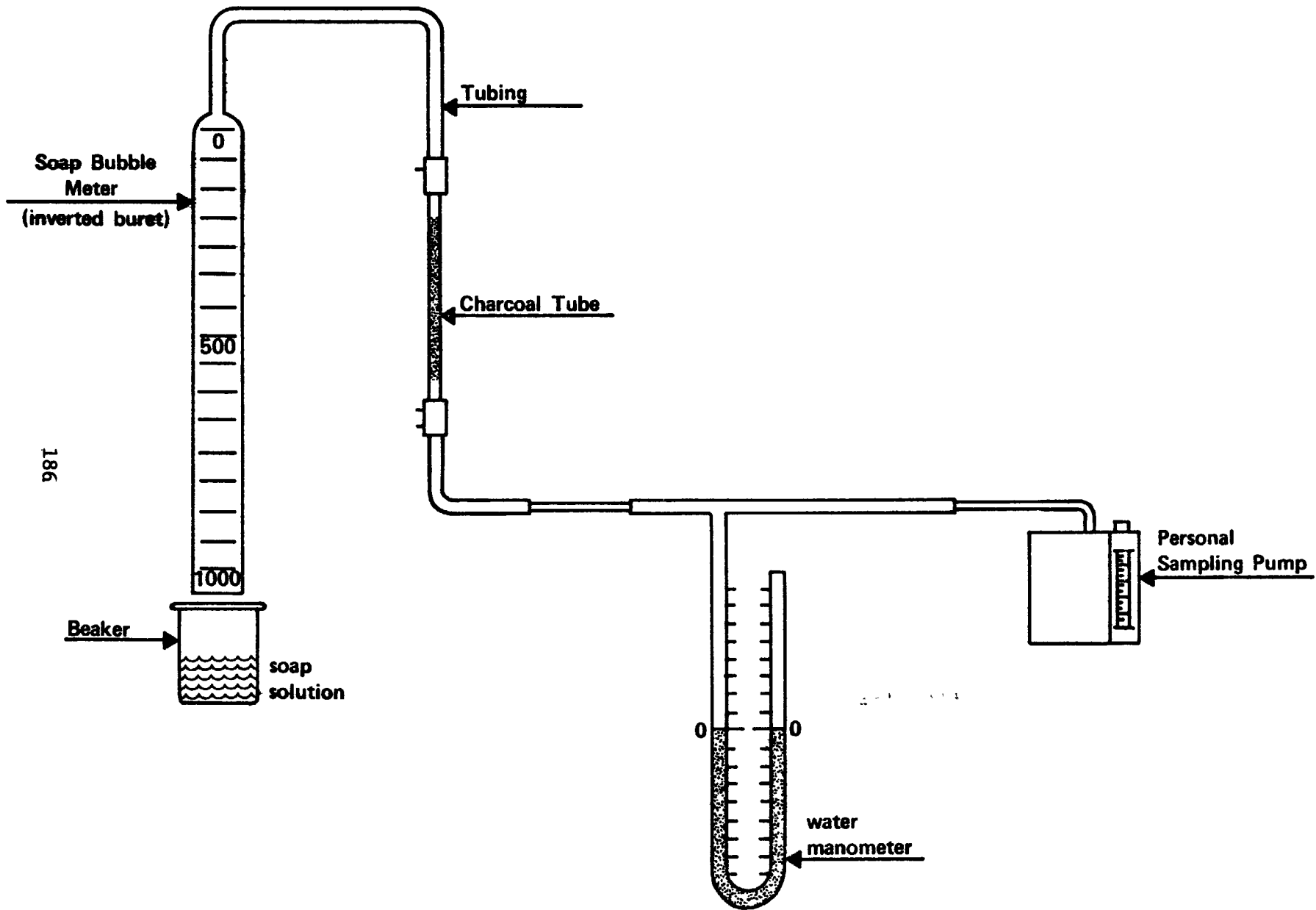


FIGURE XIII-1. CALIBRATION SETUP FOR PERSONAL SAMPLING PUMP WITH CHARCOAL TUBE

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