

X. APPENDIX II

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 F (21.1 C); 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 Mine Safety and Health Administration 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 _____

XI. TABLES AND FIGURE

TABLE XI-1

SYNONYMS AND STRUCTURAL FORMULAS FOR THE KETONES

Ketone Name and Formula	Synonyms	Structural Formula
Acetone C_3H_6O	2-Propanone Aceton (German, Dutch, Polish) Dimethylketal Dimethyl ketone Beta-ketopropane Methyl ketone Pyroacetic ether Pyroacetic spirit	$\begin{array}{c} CH_3 \\ \\ C = O \\ \\ CH_3 \end{array}$
Methyl ethyl ketone C_4H_8O	2-Butanone or Butanone Methyl acetone Aethylmethylketon (German) Butanone Ethyl methyl cetone (French) Ethylmethylketon (Dutch) Ethyl methyl ketone MEETCO MEK Metiletchetone (Italian) Metyloetylketon (Polish)	$\begin{array}{c} CH_3 \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array}$
Methyl propyl ketone $C_5H_{10}O$	2-Pentanone Pentanone 2-Pentanon (German) Ethyl acetone Methyl propanone Methyl-propyl-cetone (French) Metylopropylketon (Polish) Methylpropyl ketone 2-Methyl cyclohexanone 2-Methyl-cyclohexanon (German, Dutch) 2-Metilcicloesanone (Italian)	$\begin{array}{c} CH_3 \\ \\ CH_2 \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array}$

TABLE XI-1 (CONTINUED)

SYNONYMS AND STRUCTURAL FORMULAS FOR THE KETONES

Ketone Name and Formula	Synonyms	Structural Formula
Methyl n-butyl ketone $C_6H_{12}O$	2-Hexanone n-Butyl methyl ketone MBK Methyl butyl ketone MNBK Methyl 2-butyl ketone Methyl butanone	$ \begin{array}{c} CH_3 \\ \\ CH_2 \\ \\ CH_2 \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array} $
Methyl amyl ketone $C_7H_{14}O$	2-Heptanone Amyl-methyl-cetone (French) n-Amyl methyl ketone	$ \begin{array}{c} CH_3 \\ \\ CH_2 \\ \\ CH_2 \\ \\ CH_2 \\ \\ CH_2 \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array} $

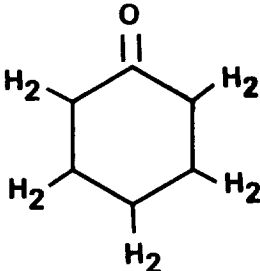
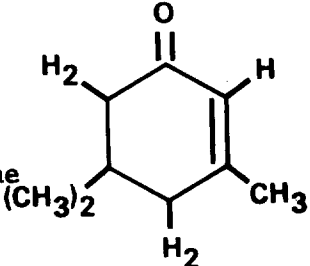
TABLE XI-1 (CONTINUED)

SYNONYMS AND STRUCTURAL FORMULAS FOR THE KETONES

Ketone Name and Formula	Synonyms	Structural Formula
Methyl isobutyl ketone $C_6H_{12}O$	4-Methyl pentanone 4-Methylpentan-2-one Hexon (Czech) Hexone Isobutyl methyl ketone Methyl-isobutyl-cetone (French) Methylisobutylketon (Dutch, German) Metyloizobutyloketon (Polish) 2-Methyl-4-pentanone Metilisobutilchetone (Italian) MIK MIBK	$\begin{array}{c} (CH_3)_2 \\ \\ CH \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array}$
Methyl isoamyl ketone $CH_3COC_5H_{11}$	5-Methyl-2-hexanone Isoamyl methyl ketone Isopentyl methyl ketone 2-Methyl-5-hexanone MIAK	$\begin{array}{c} (CH_3)_2 \\ \\ CH \\ \\ CH_2 \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array}$
Diisobutyl ketone $C_9H_{18}O$	2,6-Dimethyl-4-heptanone Di-isobutyl ketone Isobutyl ketone Isovalerone Valerone Diisobutilchetone (Italian) Di-isobutylcetone (French) Diisobutylketon (Dutch, German) Diisopropylacetone 2,6-Dimethyl-heptan-4-on	$\begin{array}{c} (CH_3)_2 \\ \\ CH \\ \\ CH_2 \\ \\ C = O \\ \\ CH_2 \\ \\ CH \\ \\ (CH_3)_2 \end{array}$

TABLE XI-1 (CONTINUED)

SYNONYMS AND STRUCTURAL FORMULAS FOR THE KETONES

Ketone Name and Formula	Synonyms	Structural Formula
Cyclohexanone $C_6H_{10}O$	Cicloesanone (Italian) Cyclohexanon (Dutch) Cykloheksanon (Polish) Hexanon Nytro-0 Ketoexamethylene Nadone Pimelic ketone Pimelin ketone	
Mesityl oxide $C_6H_{10}O$	4-Methyl-3-penten-2-one Isopropylidene acetone Isobutenyl methyl ketone Mesityloxid (German) Mesityloxyde (Dutch) Ossido di mesitile (Italian) Oxyde de mesityle (French)	$\begin{array}{c} (CH_3)_2 \\ \\ C \\ \\ CH \\ \\ C = O \\ \\ CH_3 \end{array}$
Diacetone alcohol $C_6H_{12}O_2$	4-Hydroxy-4-methyl-2-pentenone Diacetonol (Dutch) Diacetonalcool (Italian) Diacetonalkohol (German) Diketone alcohol 4-Hydroxy-2-keto-4-methylpentane Tyranton	$\begin{array}{c} (CH_3)_2 \\ \\ COH \\ \\ CH_2 \\ \\ C = O \\ \\ CH_3 \end{array}$
Isophorone $C_9H_{14}O$	3,5,5-Trimethyl-2-cyclohexen-1-one Isoacetophorone Isoforon Isoforone (Italian) Isophoron Izoforon 1,1,3-Trimethyl-3-cyclohexene-5-one 3,5,5-Trimethyl-2-cyclohexen-1-on (German)	

Adapted from references 9,11,100,157,158,162,165,180-183

TABLE XI-2

CHEMICAL AND PHYSICAL PROPERTIES OF KETONES

Compound	Formula Weight	Boiling Point (C)	Melting Point (C)	Specific Gravity (20/20 C)	Refractive Index (20 C)	Vapor Pressure (mmHg at 25 C)	Air Saturation (%)	Evaporation Rate (ether=1)	Flash-point*	Flammable Limits (% v/v)	Water Solubility	Conversion Factors (mg/cu n = 1 ppm)
Acetone	58.08	56.1	-95.6	0.7911	1.3589	226.3	29.8	1.9	0	2.15-13	Yes	2.37
Methyl ethyl ketone	72.11	79.6	-86.6	0.8072 (25/25 C)	1.3814 (15 C)	100	13.2	2.7	22 (20)	1.8 -12.0	25.57	2.95
Methyl n-propyl ketone	86.11	102.2	-83.5	0.8064 (20/4 C)	1.3895	16.0	2.1	1.62**	45 (58)	1.55-8.15	5.51	3.52
Methyl n-butyl ketone	100.16	127.5	-56.9	0.8072 (25/4 C)	1.3969 (17.4 C)	3.8	0.5	8.1	73	1.22- 8.0	1.64	4.10
Methyl n-amyl ketone	114.18	150.6	-26.9	0.8166	1.4073	1.6	0.21	17.4	120 (117)	-	0.43	4.67
Methyl iso-butyl ketone	100.16	115.8	-83.5	0.8020	1.3959	7.5	1.0	5.6	64 (74)	1.35- 7.6	1.91 g/100 g	4.10
Methyl iso-amyl ketone	114.18	144	-	0.8132	1.4062	1.52 (20 C)	-	0.4***	(110)	-	Slight	4.67
Diisobutyl ketone	142.24	168.1	-5.9	0.8089	1.421 (15 C)	2.4	0.32	30.8	30.8 (120)	-	Very slight	5.82
Cyclohexanone	98.14	155.6	-45	0.9478 (20/4 C)	1.4500	4.5	0.60	40.6	143 (116)	1.1 (lower)	Slight	4.01
Mesityl oxide	98.14	129.55	-46.4	0.8569	1.444	9.5	1.25	8.4	90 (84)	1.3 - 8.8	Very Slight	4.01
Diacetone alcohol	116.16	169.2	-42.8	0.9406	1.4242	1.2	0.16	60	- (142)	1.8 - 6.9	Yes	4.75
Isophorone	138.21	215.2	-8.1	0.9229	1.4789 (21.5 C)	0.44	0.06	200	184 (205)	0.8 - 3.8	Very Slight	5.65

*Flashpoint, Tag closed cup value (F) with open cup value (F) in parentheses.

**All of the ketones are soluble in inorganic solvents.

***Butyl acetate=1

TABLE XI-3

OCCUPATIONS WITH POTENTIAL EXPOSURE TO KETONES

Acetic acid makers	Leather workers, artificial
Acetic anhydride makers	Lubricating oil dewaxer
Acetone workers	Mesityl oxide makers
Acetylene cylinder fillers	Metal cleaners
Adhesive makers	Methyl isobutyl ketone makers
Adipic acid makers	Methyl methacrylate workers
Benzene workers	Nylon makers
Bronzers	Oil processors
Butanone workers	Organic chemical synthesizers
Celluloid makers	Painters
Cellulose acetate makers	Paintmakers
Cellulose cementmakers	Paint remover workers
Chloroform makers	Paraffin processors
Cleaning compound makers	Perfume makers
Colorless synthetic resin makers	Pentanone workers
Cosmetic makers	Pesticide makers
Dewaxers	Petroleum refinery workers
Diacetone alcohol makers	Photographic film makers
Dope workers	Printers
Drug makers	Raincoat makers
Dyemakers	Resin makers
Electronic equipment cleaners	Rubber cement workers
Electronic equipment dryers	Rubber workers
Explosive makers	Shoemakers
Fungicide makers	Solvent workers
Garage mechanics	Smokeless powder makers
Glycol makers	Stain makers
Iodoform makers	Textile makers
Ketone manufacturers	Varnish makers
Lacquerers	Varnish remover workers
Lacquer makers	Vinyl raincoat makers
Lacquer remover workers	Wax makers

Adapted from references 181,186

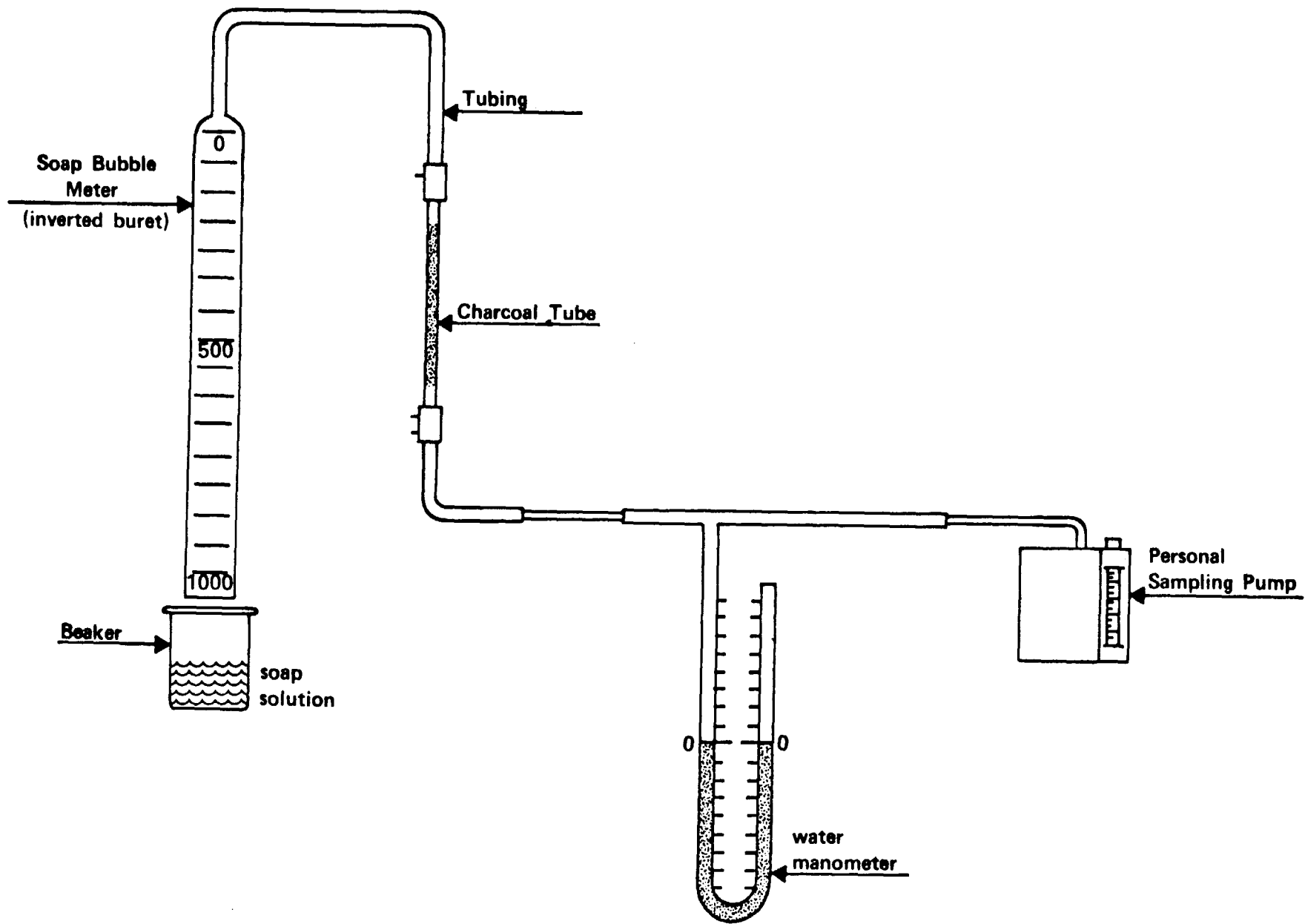


FIGURE XI-1

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
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