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.

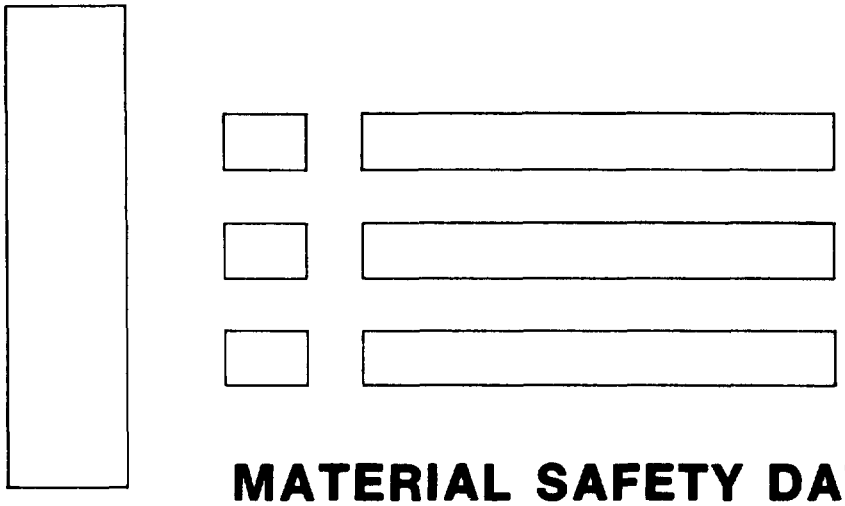
(i) Section IX. Special Precautions

"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 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.



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_2O=1)		VAPOR PRESSURE	
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H_2O, % 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 PROPERTIES OF CARBARYL

Appearance	White, crystalline solid
Empirical formula	C12H1102N
Formula weight	201.22
Flashpoint, open cup (Cleveland)	193 C
Melting point	142 C
Specific gravity	1.232 at 20 C
Vapor pressure	0.000041 mmHg at 25 C, 0.00015 mmHg at 40 C
Explosibility (minimum concentration of technical grade dust)	0.02 oz/cu ft (20.3 g/cu m)
Solubility in water	40 ppm at 30 C
Solubility in organic solvents	Moderately soluble in acetone, N,N-dimethyl formamide, isophorone and cyclohexanone
Stability	Stable to light, heat, and acids; hydrolyzed in alkalies

Adapted from Kirk-Othmer, [11] Merck Index, [12] Union Carbide Corporation, [13 (sec 16)] and HH Moorefield (written communication, February 1976)

TABLE XIII-2

SYNONYMS AND TRADE NAMES FOR CARBARYL

Atoxan
Caprolin
Carpolin
Compound 7744
Crag Sevin
Experimental insecticide 7744
Gamonil
N-methyl-alpha-naphthylcarbamate
N-methyl-alpha-naphthylurethan
N-methyl-1-napthyl carbamate
1-Naphthol N-methylcarbamate
Alpha-naftyl-N-methylkarbamat (Czech)
Alpha-naphthyl N-methylcarbamate
1-Naphthyl N-methylcarbamate
Panam
Sevidol
Sevin
Union Carbide 7,744

Compiled from the Registry of Toxic Effects of Chemical Substances, 1975 edition [14]

TABLE XIII-3

CONCENTRATIONS (MG/KG) OF CARBARYL
IN RABBIT TISSUES AND EXCRETORY FLUIDS AFTER
SINGLE ORAL DOSES OF 400 MG/KG OF CARBARYL

Sample	Hours after Administration						
	0.5	1	2.5	4	18	24	48
Brain	0.0075	0	0.03	0.054	0	0.215	0.03
Medulla oblongata	0.015	-	0.03	0.09	-	-	0
Cerebellum	0.021	-	0.03	-	-	-	0
Kidneys	0.03	0.75	0.75	0.18	1.125	0	0
Spleen	0.075	0.075	-	0.036	0	0	0
Liver	0.225	0.975	0.15	0.036	0.15	0	0.075
Heart	0.3	0	0.03	0.018	0	0	0
Lungs	0.003	0	0	0.015	0	0	0
Lumbar muscles	0.03	0.03	0	0.012	0	0	0
Femoral muscles	0.03	0	0	0	0	0	0
Bile	3.75	0.075	4.5	0.18	1.5	1.5	1.5
Urine	1.5	1.125	11.25	1.8	0	0.75	0
Testes	0.075	0	0	0.09	-	0	0
Kidney fat	1.25	-	0.6	0.036	-	0	0.03

Adapted from Bukin and Filatov [86]

TABLE XIII-4

CARBARYL METABOLITES FROM MAMMALIAN* URINE

Metabolites	Labeled Forms of Carbaryl**			Unlabeled Carbaryl***
	14C-Naphthyl	14C-Methyl	14C-Carbonyl	
Unidentified neutrals	R G M P S D	R G M P S D	R	R Ho Hi
1-Naphthyl methylcarbamate N-glucuronide	G	G		R
Unidentified metabolite (A)	R G D	R G M D	R	R Ho
1-Naphthyl methylimido-carbonate-o-glucuronide	R G M P S D	R G M P S D	R	R Ho
Unidentified metabolite (B)	G D	G D		
4-(Methylcarbamoyloxy)-1-naphthyl glucuronide	R G M P S	R G M P S	R	R Ho
1-Naphthyl glucuronide	R G P S			R Ho Hi
4-(Methylcarbamoyloxy)-1-naphthyl sulfate	R G M S	R G M S	R	R
1-Naphthyl sulfate	R G M S			R Ho Hi
Unidentified metabolite (C)		S		
Unidentified metabolite (D)	S	S		

*Rat (R), guinea pig (G), monkey (M), swine (P), sheep (S), dog (D), and human (H)
**Analysis by radiometric techniques; rats and guinea pigs treated ip, all others orally
***Analysis by fluorometric techniques; rats treated orally, humans orally (o) and by inhalation (i)

\dapted from Knaak et al [33,34] and Knaak and Sullivan [87]

TABLE XIII-5

EFFECTS OF CARBARYL EXPOSURE ON HUMANS

Routes of Exposure	Subjects	Exposure Concentration and Duration	Effects	Reference
Respiratory and possibly dermal	59 workers	0.03 - 40 mg/cu m 16 mo (hourly exposure not stated) 8 mo (hourly exposure not stated)	Whole blood ChE* activities inhibited but within normal range; urinary 1-naphthol 1,000 μg/100 ml** or higher in 41% of samples (conc low on Mon, rising during workweek, in substudy of 7 workers)	28
"	Agricultural workers (number unknown)	2 - 4 mg/cu m 4 - 6 hr/d, 3 - 4 d	Whole blood ChE activities inhibited 11-30%; other clinical tests negative	39
"	10 sprayers	Insecticide (unknown conc) single application	Rash in 1 splashed worker; plasma ChE slightly inhibited on d 1, normal on d 5 after application in all 10	35
"	95 exposed villagers	Insecticide (unknown conc) 1 wk	Plasma ChE activity still inhibited 1 wk after spraying	35
"	1 man (with respirator)	40.6 - 49.3 mg/cu m for 2 d	Urinary 1-naphthol 2,340 and 8,975 μg/100 ml	13 (sec 9, 10)
"	1 man (no respirator)	45.2 - 50.9 mg/cu m for 2 d	Urinary 1-naphthol 2,340 and 3,619 μg/100 ml	13 (sec 9, 10)
"	1 man	Carbaryl-sulfur mixture (unknown conc and duration)	Weakness, dizziness, shortness of breath on day of exposure and 2 d later	38

TABLE XIII-5 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON HUMANS

Routes of Exposure	Subjects	Exposure Concentration and Duration	Effects	Reference
Respiratory and possibly dermal	14 exposed male workers	Dust (unknown conc) 8 - 16 hr	Urinary 1-naphthol 2,443 µg/100 ml for 7 asymptomatic workers; 1,417 for 7 symptomatic workers, all with dizziness, nausea, 1 with headache, 1 with overheating, perspiration	13 (sec 7)
"	Workers (number unknown)	Dust (unknown conc)	Urinary 1-naphthyl glucuronide and 1-naphthyl sulfate higher during exposure than 72 hr after exposure	34
Dermal	6 men	4 µg/sq cm 14C-carbaryl in acetone to forearm	Recovery in urine, 73.9% of dose over 5 d	30
"	6 men	4 µg/sq cm 14C-carbaryl in acetone to angle of jaw	Recovery in urine, 70% of dose over 5 d	31
Oral	2 men	2 mg/kg	Recovery in urine, 26-27% of dose in 24 hr as metabolites, 1-naphthyl sulfate, 1-naphthyl glucuronide, 4-(methylcarbamoyloxy) -1 naphthyl glucuronide	33 32
"	2 men 2 men 2 men	0.5 mg/kg 1.0 mg/kg 2.0 mg/kg (single doses)	No change in plasma or whole blood ChE; no toxic symptoms	32

TABLE XIII-5 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON HUMANS

Routes of Exposure	Subjects	Exposure Concentration and Duration	Effects	Reference
Oral	5 men	0.06 mg/kg/d 6 wk	Urinary rise of aa/cr***	32
"	5 men	0.12 mg/kg/d 6 wk	Urinary rise of aa/cr***	32
"	1 man	2.8 mg/kg (form unstated)	Epigastric pain, sweating; recovery in 2 hr with atropine therapy	21
"	1 child (19 mo old)	Solution (unknown conc)	Miosis, salivation, incoordination; recovery in 12 hr with atropine therapy	28
"	1 man	Solution (unknown conc; ate watermelon sprayed with 80% carbaryl)	Nausea, vomiting hyperreflexia, pallor, intestinal colic, nasal discharge; recovery in 18 hr with deoxycorticosterone	41
"	1 man	80% solution (several ml)	Nausea, salivation, headache, tremors, lacrimation; recovery in 1.5 hr with deoxycorticosterone	41
"	1 man	80% solution 0.5 liter	Whole blood ChE strongly inhibited; death in 6 hr; carbaryl present in gastrointestinal tract, blood, liver, kidneys, and urine	40

*Cholinesterase
**Normal range, 150-400 μg/100 ml urine
***Amino acid nitrogen to creatinine ratio

TABLE XIII-6

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Respiratory	Guinea pigs	6	390 mg/cu m (dust) 4 hr	Nasal and eye irritation; hemorrhagic areas in lungs	27
"	"	6	230 mg/cu m (dust) 4 hr	Slight initial weight loss; recovery by d 14	27
"	Rats	-	10 mg/cu m (dust) 7 hr/d 5 d/wk for 90 d	No effects	27
"	Dogs	-	75 mg/cu m (dust) (duration unknown)	Typical signs of ChE** inhibition within 5 hr	27
"	Cats	4	82 mg/cu m (dust) 6 hr	Signs of toxicity observed; ChE inhibited, normal after 72 hr	39
"	"	4	37 mg/cu m (dust) 6 hr	ChE inhibited, normal after 48 hr	39
"	"	4	20 mg/cu m (dust) 6 hr	ChE inhibited, normal after 24 hr	39
"	"	4	63 mg/cu m (dust) 6 hr/d for 1 mo	Salivation; ChE inhibited 31-40% (serum), 41-58% (erythrocyte); 1 death at d 20	39
"	"	4	40 mg/cu m (dust) 6 hr/d for 2 mo	Up to 50% erythrocyte ChE inhibition; deterioration of conditioned reflexes (undefined)	39
"	"	4	16 mg/cu m (dust) 6 hr/d for 4 mo	No effects	39

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Ocular	Rabbits	5	0.5 ml of 10% suspension applied to 1 eye of each animal	Mild irritation in 1 eye after 24 hr	27
"	"	5	50 mg dust	Traces of corneal necrosis	27
"	"	5	25% suspension in water	No injury	27
"	"	-	10% suspension in water, or 50 mg powder	Transient miosis, hyperemia	39
Dermal	"	5	0.01 ml of 10% soln in acetone	No irritation	27
"	"	6	500 mg/kg (form unspecified)	Inhibition of serum and erythrocyte ChE in 1st 24 hr	39
"	Rats	10 M 10 F	Various doses in xylene	LD50 greater than 4,000 mg/kg in both sexes	49
Intracutaneous	Guinea pigs	16	0.1 ml (0.1% in propylene glycol) 8 alternate days (3 wk after last dose, another challenge dose injected)	Weak sensitization in 4 animals	27
Subcutaneous	Rats	5-9 per group	10 mg/kg/wk 2 - 5 wk	Behavioral changes; decreased motivation and response to electroshock	57

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Subcutaneous	Mice	60 M	10 mg/mouse/wk in 0.25% agar 5 mo	No increases in tumors, infections, or mortality compared to control animals	27
"	Chickens	13	0.25 - 3 g/kg (suspended in lard)	Leg weakness observed at 2 g/kg; no effects at doses of 1 g/kg or less	27
"	Chickens (atropinized)	-	0.8 - 1.6 g/kg	Leg weakness; recovery by d 24	43
ip	Rats	-	0.56 mg/kg and 2.24 mg/kg	Decreased physical activity; reversed with atropine therapy	58
iv	Dogs	6	10 and 15 mg/kg in ethyl alcohol	No change in erythrocyte or plasma ChE activity	27
"	"	5	30 mg/kg	Lacrimation, salivation, tremors	55
"	Miniature pigs	8 M	20 mg/kg	Tremors, ataxia, incoordination, paraplegia	55
Oral	Guinea pigs (pregnant)	26 F	300 mg/kg/d in gelatin capsule d 11 - 20 of gestation	Maternal mortality 38%; fetal mortality 17.5% in survivors' litters (9.5% in controls); 11 terata in fetuses of treated	71

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Guinea pigs (pregnant)	40 F	300 mg/kg in capsule single dose d 11 - 20 of gestation	Maternal mortality 12.5%; fetal mortality 6.5% (controls 9.5%); 9 malformed fetuses in litters of treated	71
"	"	150 F	100, 200, 300 mg/kg in diet 1- to 15-d intervals during d 10 - 24 of gestation	Weight gains less than controls; no significant increase in terata compared to controls	72
"	"	150 F	50, 100, 200 mg/kg by intubation 1- to 15-d intervals during d 10 - 24 of gestation	Increased fetal anomalies at 50 mg/kg only (15.7% vs 9.1% in controls)	72
"	Rabbits (pregnant)	17 F	50, 100, 200 mg/kg in capsules on d 5 - 15 of gestation	No terata or dose-related mortality compared to controls	71
"	Rats (pregnant)	18 F	500 mg/kg/d in diet during various intervals of gestation or until weaning of pups	Weight gain of offspring reduced; 2/3 mortality of pups within 4 d after birth	70
"	"	36 F	20 and 100 mg/kg/d in diet during various intervals of gestation or until weaning of pups	No effect on viability of pups compared to controls	70

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Rats	- F	610 mg/kg (gavage)	LD50	27
"	"	-	510 mg/kg (gavage)	LD50	27
"	"	- M	850 mg/kg (gavage)	LD50	43
"	"	- M	600 mg/kg (gavage)	Lowest lethal dose	43
"	"	- F	500 mg/kg (gavage)	LD50	43
"	"	- F	100 mg/kg (gavage)	Lowest lethal dose	43
"	"	10 M,F	2,250 ppm in diet 96 d	Cloudy swelling of kidney tubules in 4	27
"	"	20 F	400 ppm in diet 2 yr	Cloudy swelling of hepatic cords; cloudy swelling of kidney tubules present after 1 yr; incidence not significant compared to controls after 2 yr	27
"	"	60 F 80 M	50, 100, 200 ppm in diet, 2 yr	Effects seen similar to controls	27
"	"	48 M 48 F	14 and 70 mg/kg/d 12 mo	Increased gonadotropic hormone, adrenal cortex activity; growth inhibition; blood ChE inhibited after 3 mo; testicular changes; estrus cycle prolonged	77

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Rats	24 M 24 F	7 mg/kg/d 12 mo	Increased gonadotropic hormone, adrenal cortex activity	77
"	Mice	20 M	50 - 1,000 mg/kg/d 5 d (gavage)	Death in 1 of 10 at 1,000 mg/kg; no evidence for dominant lethal mutagenicity after mating	59
"	Rats	60 (F0)	2,000, 5,000, 10,000 ppm in diet 3 generations	Weight below controls for all treated weanlings; average litter size and survival of offspring decreased at 5,000- and 10,000-ppm levels	78
"	"	16 (F0)	200 mg/kg/d in diet 3 generations	Initial decrease in weight gain in F0; lengthened gestation period in F1 and F2 compared to controls	72
"	"	48 (F0)	7, 25, 100 mg/kg/d in diet 3 generations	No effects compared to controls in all generations	72
"	"	16 (F0)	100 mg/kg/d by gavage 3 generations	Increased fetal mortality; sporadic adverse effects on litter size, adult survival time, fetal resorption in all generations	72
"	"	32 (F0)	3, 7, 25 mg/kg/d by gavage 3 generations	No effects compared to controls in all generations	72

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Rats	- F	2 and 5 mg/kg/d in sunflower oil 4 generations (F2 to F5) 6 mo each	Fertility decreasing progressively, dose-related (F2 to F4); reduced estrus time in F3 and F4	73
"	"	- M	2 and 5 mg/kg/d in sunflower oil 3 generations (F2 to F4) 6 mo each	Sperm motility, spermatogenesis, duration of sperm survival reduced compared to controls	73
"	Gerbils	108 (F0)	2,000 - 10,000 ppm in diet 3 generations	Decreased fertility, litter size, pup viability in all generations; at and above 4,000 ppm, weanling weights less than controls	78
"	Hamsters (pregnant)	6 F	250 mg/kg/d (gavage) d 7 - 8 of gestation	Signs of ChE inhibition; salivation, diarrhea, incoordination; 2 deaths; fetal mortality 30.3% (control 5.5%), no teratologic defects in fetuses	71
"	"	8 F	125 mg/kg/d (gavage) d 6 - 8 of gestation	Fetal mortality 10% (control 5.5%), no teratologic defects in fetuses	71

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Mice (pregnant)	20 F	30 mg/kg/d in diet from d 6 of gestation to delivery	Minor abnormalities in 9 fetuses (controls, 2)	75
"	"	20 F	10 mg/kg/d in diet from d 6 of gestation to delivery	No effects compared to controls	75
"	"	36 M 36 F	4.64 mg/kg/d 18 mo (from d 7 of age)	No significant increase in tumors compared to controls	79
"	Dogs (pregnant)	55 F	3.125 - 50 mg/kg/d (diet) throughout gestation	Dystocia in 1/3 of dams, none in controls; 11.6% terata at doses of 6.25 mg/kg or more	66
"	Rhesus monkeys	10 F	20.0 mg/kg/d by gavage throughout gestation	Abortions 3 in 6 pregnancies (1 abortion in 5 pregnancies for 7 controls)	67
"	"	4 F	2.0 mg/kg/d by gavage throughout gestation	Abortions 2 in 2 pregnancies	67
"	"	16	20 mg/kg/d in capsules d 20 - 38 of gestation	Abortions 3 in 15 pregnancies, no terata	69
"	"	16	2 mg/kg/d in capsules d 20 - 38 of gestation	Abortions 1 in 16 pregnancies, no terata	69

TABLE XIII-6 (CONTINUED)

EFFECTS OF CARBARYL EXPOSURE ON ANIMALS

Routes of Exposure	Species	No.	Exposure Concentration and Duration*	Effects	Reference
Oral	Rhesus monkeys	16	0.2 mg/kg/d in capsules d 20 - 38 of gestation	Abortions 2 in 16 pregnancies, no terata (4 abortions, 1 stillborn in 31 pregnancies for 31 controls; no terata)	69
"	Pigs	1 M 1 F	150 mg/kg/d in diet until death	First signs of toxicity at d 45 and 62; ataxia, incoordination, tremors, vascular degeneration, myopathy, cerebral edema; death on d 72 (M) and 83 (F)	52
"	"	2 M 1 F	150 mg/kg/d in diet for 28 d, 300 mg/kg/d until death	First signs of toxicity at d 37, 39, 42; ataxia, incoordination, tremors; vascular degeneration, myopathy, cerebral edema; death on d 46 (2 M) and 85 (F)	52
"	Miniature pigs	5 M	125 mg/kg/d in diet 6 - 8 wk	Spastic paresis of posterior extremities	55

*Single dose unless duration is specified
**Cholinesterase

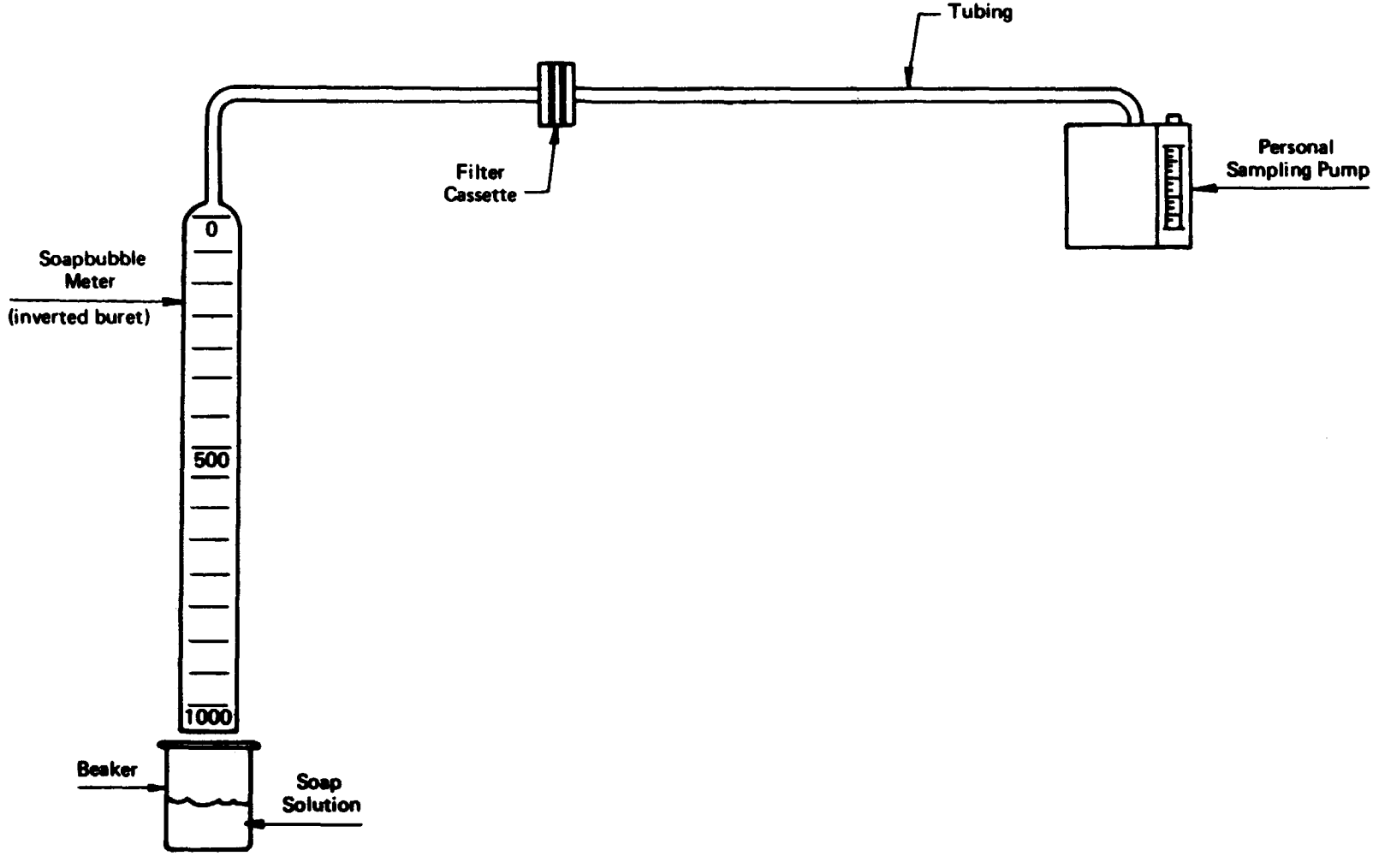


FIGURE XIII-1 CALIBRATION SETUP FOR PERSONAL SAMPLING PUMP WITH FILTER CASSETTE

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