

TABLE XII - 1
 PROPERTIES AND USES OF ORGANOTIN COMPOUNDS

COMPOUND	FORMULA	Molecular Weight	Tin Content (%)	Appearance	Melting Point (C)	Boiling Point (C)	Solubility		Uses			
							H ₂ O	Organic Solvents	Catalyst	Stabilizer	Biocide	Other *
MONOORGANOTINS												
Bis(butyltin) trisulfide	$[(C_4H_9)_2Sn_2S_3]_2$	895.28	53.0							X		
Monobutyltin trichloride	$(C_4H_9)SnCl_3$	282.08	42.1						X			2,10,11
Monoethyltin trichloride	$(C_2H_5)SnCl_3$	254.11	46.7						X			
Monooctyltin trichloride	$(C_8H_{17})SnCl_3$	338.12	35.1	Colorless liquid	-63	98		Sol				11
Monophenyltin tribromide	$(C_6H_5)SnBr_3$	435.45	27.3						X			
Monophenyltin trichloride	$(C_6H_5)SnCl_3$	302.10	39.3						X			
DIORGANOTINS												
Bis(dibutylacetatotin) oxide	$[(C_4H_9)_2SnOOC_2H_3]_2O$	599.58	39.6						X	X		
Bis(dibutylchlorotin) oxide	$[(C_4H_9)_2SnCl_2O]_2$	1,104.88	43.0		110-112				X			
Bis(dimethylacetatotin) oxide	$[(CH_3)_2SnOOC_2H_3]_2O$	431.46	55.0		236					X		
Bis(dipropylchlorotin) oxide	$[(C_3H_7)_2SnCl_2O]_2$	992.80	47.8		121-122				X			
Bis(dipropylpropionatotin) oxide	$[(C_3H_7)_2SnOOC_2H_3]_2O$	543.54	43.7						X			
Dibutyltin bis(i-octylthioglycolate)	$(C_4H_9)_2Sn(SCH_2CO_2C_8H_{17-i})_2$	639.11	18.6	Slightly yellow liquid					X	X	X	1,3
Dibutyltin diacetate	$(C_4H_9)_2Sn(OOC_2H_3)_2$	350.81	33.8	Colorless liquid	10	142-145	Insol	Sol	X	X	X	3
Dibutyltin diacetylacetone	$(C_4H_9)_2Sn[(CH_3CO)_2CH]_2$	430.87	27.5							X		
Dibutyltin dibenzylsulfide	$(C_4H_9)_2Sn(SCH_2C_6H_5)_2$	479.03	24.8							X		
Dibutyltin dibromide	$(C_4H_9)_2SnBr_2$	392.74	30.2	Small needles	20	118-170	Insol		X			
Dibutyltin dibutoxide	$(C_4H_9)_2Sn(OC_4H_9)_2$	378.85	31.3						X			
Dibutyltin dicaprylate	$(C_4H_9)_2Sn(O_2CC_7H_{15-n})_2$	518.93	22.9		-22				X	X	X	
Dibutyltin dichloride	$(C_4H_9)_2SnCl_2$	303.83	39.1	White needles	113.6	142	Sol(hot)	Ether, benzene, alcohol	X	X	X	10
Dibutyltin diethoxide	$(C_4H_9)_2Sn(OC_2H_5)_2$	322.81	36.8						X	X		
Dibutyltin di(2-ethylhexoate)	$(C_4H_9)_2Sn(O_2CCH_2C_5H_9)_2$	518.93	22.9						X	X	X	

TABLE XII - 1 (CONTINUED)
 PROPERTIES AND USES OF ORGANOTIN COMPOUNDS

COMPOUND	FORMULA	Molecular Weight	Tin Content (%)	Appearance	Melting Point (C)	Boiling Point (C)	Solubility		Uses			
							H ₂ O	Organic Solvents	Catalyst	Stabilizer	Biocide	Other *
Dibutyltin difluoride	(C ₄ H ₉) ₂ SnF ₂	270.77	43.8							X	X	
Dibutyltin diiodide	(C ₄ H ₉) ₂ SnI ₂	486.57	24.4									2
Dibutyltin dilaurate	(C ₄ H ₉) ₂ Sn(OOCC ₁₁ H ₂₃) ₂	631.55	18.8	Liquid or low-mp solid depending on type & purity	27		Insol	Insol	X	X	X	13
Dibutyltin dimethoxide	(C ₄ H ₉) ₂ Sn(OCH ₃) ₂	294.79	40.3						X			2,12
Dibutyltin di(methylmaleate)	(C ₄ H ₉) ₂ Sn(O ₂ CCH:CHCO ₂ CH ₃) ₂	490.87	24.2							X		
Dibutyltin distearate	(C ₄ H ₉) ₂ Sn(O ₂ CC ₁₇ H ₃₅) ₂	799.13	14.9						X	X	X	
Dibutyltin maleate	(C ₄ H ₉) ₂ SnO ₂ CCH:CHCO ₂	346.81	34.2	White powder			Insol	Insol in almost all	X	X		13
Dibutyltin methoxide acetate	(C ₄ H ₉) ₂ Sn(OOC ₂ H ₃)OCH ₃	322.80	36.8						X			
Dibutyltin oxide	(C ₄ H ₉) ₂ SnO	248.92	47.7	White powder			Insol	Insol	X	X		2,7,10,11
Diethyltin dibenzoate	(C ₂ H ₅) ₂ Sn(OOCC ₆ H ₅) ₂	418.89	28.3							X		
Diethyltin dicaprylate	(C ₂ H ₅) ₂ Sn(O ₂ CC ₇ H _{15-n}) ₂	462.89	25.6						X			
Diethyltin dichloride	(C ₂ H ₅) ₂ SnCl ₂	247.63	47.9						X	X		5
Diethyltin dimethoxide	(C ₂ H ₅) ₂ Sn(OCH ₃) ₂	238.75	49.7						X			
Diethyltin oxide	(C ₂ H ₅) ₂ SnO	192.81	61.6	White powder	Infusible		Insol	Insol [sol in HCl, conc alkali]	X		X	
Diethyltin sulfide	(C ₂ H ₅) ₂ SnS	208.79	56.8	Slightly yellow liquid					X	X	X	9,13
Dimethyltin dibutylsulfide	(CH ₃) ₂ Sn(SC ₄ H ₉) ₂	326.91	36.3						X	X	X	
Dimethyltin dihydride	(CH ₃) ₂ SnH ₂	150.71	78.8						X			
Dimethyltin dimethoxide	(CH ₃) ₂ Sn(OCH ₃) ₂	210.73	56.3		86							12
Dimethyltin oxide	(CH ₃) ₂ SnO	164.70	72.1	White powder	Infusible		Insol	Insol [sol in NaOH]	X			
Dimethyltin sulfide	(CH ₃) ₂ SnS	180.78	65.6		148					X		
Dioctyltin dichloride	(C ₈ H ₁₇) ₂ SnCl ₂	415.75	28.5						X			2
Dioctyltin oxide	(C ₈ H ₁₇) ₂ SnO	360.85	32.9						X	X		
Diphenyltin dibromide	(C ₆ H ₅) ₂ SnBr ₂	432.72	27.4	Colorless crystals	38	230		Alcohol, ether	X			
Diphenyltin dichloride	(C ₆ H ₅) ₂ SnCl ₂	343.81	34.5	"	42	333-337	Very slightly sol	Alcohol, ether, ligroin	X			13

TABLE XII - 1 (CONTINUED)
 PROPERTIES AND USES OF ORGANOTIN COMPOUNDS

COMPOUND	FORMULA	Molecular Weight	Tin Content (%)	Appearance	Melting Point (C)	Boiling Point (C)	Solubility		Uses			
							H ₂ O	Organic Solvents	Catalyst	Stabilizer	Biocide	*
Diphenyltin oxide	(C ₆ H ₅) ₂ SnO	288.90	41.1	Colorless powder	Infusible		Insol	Insol [sol in conc acids]		X		
TRIORGANOTINS												
Bis(tributyltin) oxide (Trade names: TBTO, Tributyl oxide)	[(C ₄ H ₉) ₃ Sn] ₂ O	595.62	39.9	Yellow liquid		254	Insol	Sol	X		X	2,8,10,12,13
Bis(triethyltin) oxide	[(C ₂ H ₅) ₃ Sn] ₂ O	427.50	55.5						X			
Bis(triisobutyltin) oxide	[(C ₄ H ₉) ₃ Sn] ₂ O	595.62	39.9								X	
Bis(triphenyltin) oxide	[(C ₆ H ₅) ₃ Sn] ₂ O	715.74	33.2						X			
Bis(tripropyltin) oxide	[(C ₃ H ₇) ₃ Sn] ₂ O	511.56	46.4								X	
N ₁ N-bis(tributyltin) diphenylurea	[(C ₄ H ₉) ₃ SnNC ₆ H ₅] ₂ CO	789.77	30.1						X	X	X	
N ₁ O-bis(tributyltin) N-phenylcarbamate	(C ₄ H ₉) ₃ SnNC ₆ H ₅ CO ₂ Sn(C ₄ H ₉) ₃	714.70	33.2						X	X	X	
Tributyltin acetate	(C ₄ H ₉) ₃ Sn(OOC ₂ H ₃)	349.08	34.0	White, waxy solid		80-83	Insol	Benzene, methyl alcohol			X	2,8,10,11
Tributyltin benzoate	(C ₄ H ₉) ₃ SnOOC ₆ H ₅	410.88	28.9								X	
Tributyltin borate	(C ₄ H ₉) ₃ SnBO ₂	332.62	35.7								X	8
Tributyltin butoxide	(C ₄ H ₉) ₃ SnOC ₄ H ₉	362.85	32.7						X			
Tributyltin fluoride	(C ₄ H ₉) ₃ SnF	308.81	38.4			341-342				X		
Tributyltin hydride	(C ₄ H ₉) ₃ SnH	290.81	40.8						X		X	5
Tributyltin iodide	(C ₄ H ₉) ₃ SnI	416.71	28.5								X	
Tributyltin isocyanate	(C ₄ H ₉) ₃ SnNCO	331.83	35.8						X		X	
Tributyltin isothiocyanate	(C ₄ H ₉) ₃ SnNCS	347.89	34.1			150-153			X		X	
Tributyltin laurate	(C ₄ H ₉) ₃ SnO ₂ CC ₁₁ H ₂₃	488.93	24.3						X	X	X	
Tributyltin methoxide	(C ₄ H ₉) ₃ SnOCH ₃	320.82	37.0						X		X	
Tributyltin oleate	(C ₄ H ₉) ₃ SnO ₂ C(CH ₂) ₇ CH:CHC ₈ H ₁₇	570.99	20.8						X			
Tributyltin phenoxide	(C ₄ H ₉) ₃ SnOC ₆ H ₅	382.87	31.0						X			
Tricyclohexyltin hydride	(C ₆ H ₁₁) ₃ SnH	368.87	32.2			147-150			X			
Tricyclohexyltin hydroxide (Trade names: Plictran, DOWCO-213)	(C ₆ H ₁₁) ₃ SnOH	384.87	30.8								X	

TABLE XII - 1 (CONTINUED)
 PROPERTIES AND USES OF ORGANOTIN COMPOUNDS

COMPOUND	FORMULA	Molecular Weight	Tin Content (%)	Appearance	Melting Point (C)	Boiling Point (C)	Solubility		Uses			
							H ₂ O	Organic Solvents	Catalyst	Stabilizer	Biocide	* Other
Tricyclopropyltin chloride	(C ₃ H ₅) ₃ SnCl	277.41	42.8								X	
Triethyltin acetate	(C ₂ H ₅) ₃ Sn(OOC ₂ H ₃)	264.77	44.8						X			8
Triethyltin azide	(C ₂ H ₅) ₃ SnN ₃	247.93	47.9								X	9
Triethyltin chloride	(C ₂ H ₅) ₃ SnCl	241.33	49.2	Colorless liquid	15.8	208-210	Sol	Sol	X	X		
Triethyltin hydride	(C ₂ H ₅) ₃ SnH	206.75	57.4						X			
Triethyltin isocyanate	(C ₂ H ₅) ₃ SnNCO	247.77	47.9						X	X		
Triethyltin methoxide	(C ₂ H ₅) ₃ SnOCH ₃	236.76	50.1							X		
Trihexyltin chloride	(C ₆ H ₁₃) ₃ SnCl	409.32	29.0									12
Triisobutyltin chloride	(C ₄ H ₉) ₃ SnCl	325.49	36.5		30.2	174					X	
Triisopropyltin chloride	(C ₃ H ₇) ₃ SnCl	283.41	41.9			134-137					X	
Triisopropyltin hydride	(C ₃ H ₇) ₃ SnH	248.78	47.7			68-70			X			
Trimethyltin bromide	(CH ₃) ₃ SnBr	243.70	48.7	Colorless crystals or liquid	27	165	Sol	Sol	X			
Trimethyltin chloride	(CH ₃) ₃ SnCl	199.24	59.6	Colorless crystals	37	154	Slightly sol	"	X			
Trimethyltin hydride	(CH ₃) ₃ SnH	164.80	72.0	Colorless, oily liquid		59-61	"	"	X			
Trimethyltin hydroxide	(CH ₃) ₃ SnOH	180.72	65.7		118				X	X		12
Triphenyltin acetate (Trade names: Brestan, Fertin acetate, Linostanol)	(C ₆ H ₅) ₃ Sn(OOC ₂ H ₃)	408.89	29.0								X	8
Triphenyltin bromide	(C ₆ H ₅) ₃ SnBr	429.92	27.6	Colorless crystals	120.5	249	Insol	Sol	X	X		
Triphenyltin chloride	(C ₆ H ₅) ₃ SnCl	385.46	30.8	"	106	240	"	"			X	13,14
Triphenyltin fluoride	(C ₆ H ₅) ₃ SnF	369.01	32.2	Fine prisms	357		"	Slightly sol			X	
Triphenyltin hydroxide (Trade names: DOWCO-186, Du-Ter, Fentin, TPTH)	(C ₆ H ₅) ₃ SnOH	367.02	32.3	White powder	118		"	Insol in nearly all	X	X		2,10
Triphenyltin isothiocyanate	(C ₆ H ₅) ₃ SnNCS	407.95	29.1		171-172							9
Triphenyltin methoxide	(C ₆ H ₅) ₃ OCH ₃	380.88	31.2								X	
Tripropyltin chloride	(C ₃ H ₇) ₃ SnCl	283.41	41.9	Colorless liquid	-23.5	123		Sol			X	
Tripropyltin fluoride	(C ₃ H ₇) ₃ SnF	266.96	44.5	Flat prisms	275						X	

TABLE XII - 1 (CONTINUED)
 PROPERTIES AND USES OF ORGANOTIN COMPOUNDS

COMPOUND	FORMULA	Molecular Weight	Tin Content (%)	Appearance	Melting Point (C)	Boiling Point (C)	Solubility		Uses			
							H ₂ O	Organic Solvents	Catalyst	Stabilizer	Biocide	* Other
Tripolytin hydride	(C ₃ H ₇) ₃ SnH	248.78	47.7						X			
Tris(2-cyanoethyl)tin acetate	(NCCH ₂ CH ₂) ₃ Sn(OOC ₂ H ₃)	339.80	34.9							X	X	
Tris(tributyltin) borate	[(C ₄ H ₉) ₃ Sn] ₃ BO ₃	928.24	38.4								X	8
Tris(tripropyltin) borate	[(C ₃ H ₇) ₃ Sn] ₃ BO ₃	802.15	44.4								X	8
TETRAORGANOTINS												
Allyltriphenyltin	(C ₆ H ₅) ₃ Sn(CH ₂ CHCH ₂)	390.90	30.4						X			
Tetraallyltin	(CH ₂ :CHCH ₂) ₄ Sn	282.81	41.9						X			
Tetrabenzyltin	(C ₆ H ₅ CH ₂) ₄ Sn	483.23	24.6	Colorless prisms	42-43		Insol	Sol in some	X			
Tetrabutyloxyacetatoditin oxide	Sn ₄ C ₄₀ H ₈₀ O ₈ [(Bu ₂ SnOAc)O(Bu ₂ SnOH)] ₂	1,163.16	40.8						X	X		
Tetraethyltin	(C ₂ H ₅) ₄ Sn	234.94	50.5	Colorless liquid	-112	181	Slightly sol	Sol	X			2,3
Tetraisopropyltin	(C ₃ H ₇) ₄ Sn	291.05	40.8						X			
Tetramethyltin	(CH ₃) ₄ Sn	178.85	66.4	Colorless liquid	-54.8	78	Insol	Sol in some	X			1
Tetra-n-butyltin	(C ₄ H ₉) ₄ Sn	347.21	34.2	Colorless liquid (distinct unpleasant odor)	-97	145 (11 mmHg)	"	Sol	X	X	X	1,2,4, 5,7
Tetra-n-octyltin	(C ₈ H ₁₇) ₄ Sn	571.59	20.8	Liquid		268	"					1
Tetraphenyltin	(C ₆ H ₅) ₄ Sn	427.12	27.8	Colorless, tetragonal crystals	226	420	"	Sol in benzene, pyradine, chloroform, acetic acid; slightly sol in alcohol	X	X		5,6
Tetrapropyltin	(C ₃ H ₇) ₄ Sn	291.05	40.8	Colorless liquid		222-225	"	Sol	X			3
Tetravinyltin	(CH:CH ₂) ₄ Sn	226.87	52.3	"		55-57			X			
Trimethylphenyltin	(CH ₃) ₃ Sn(C ₆ H ₅)	240.92	49.3			62-63						6

* Other Uses: 1 - solvent, 2 - in flame resistant polyester, 3 - metal plating agent, 4 - gasoline additive, 5 - effect on spreading coefficient of solder, 6 - anti fogging agent, 7 - improves adhesion of polychloroprene, 8 - wood preservative, 9 - antiwear additive, 10 - curing agent, 11 - thermal or electrical coating, 12 - water repellent coating, 13 - antioxidant or corrosion inhibitor, 14 - film additive.

TABLE XII-2

ESTIMATED DEDI DOSES AND EFFECTS ON HUMANS
TREATED ORALLY WITH STALINON

Subjects		Estimated Total DEDI (mg)	Total No. Capsules	Symptom Lag Time* (days)	Outcome	Reference
Sex	Age					
M	31	750	50	14	Fatal	22
F	15	675	45	-	Nonfatal	24
F	27	450 - 600	30 - 40	-	Fatal	22
M	22	525	35	19	"	22
F	26	450	30	2 - 3**	Nonfatal	22
F	15	420	28	10	Fatal	22
M	12	395	25	-	"	24
F	12	380	24	-	"	24
F	24	330	22	7	Nonfatal	22
M	17	300	20	14	"	26
M	5	225	15	-	"	24
F	3.5	210	12	1	"	26
M	22	175	120***	-	"	25
F	9	45	3	-	"	24

*Estimated time of appearance of first symptoms from beginning of treatment, except where otherwise noted

**From completion of treatment

***Treatment consisted of drops rather than capsules.

TABLE XII-3

PERCENT MORTALITY IN MICE AFTER
 INHALATION* ADMINISTRATION OF SIX ORGANOTINS

Compound	Concentration (mg/l)	% Mortality in 10 Days
Triethyltin bromide	3.4	100(3 d)
	1.6	65
Tripropyltin bromide	3.2	60
	1.7	5
Tributyltin bromide	5.2	100(4 d)
	2.7	100(5 d)
	2.0	70
	1.0	10
Tributyltin iodide	1.3	7
	0.9	0
Tributyltin hydride	2.0	0
	1.5	0
Tetramethyltin	10.8	100(1 d)
	2.5	25

*Single 10-minute exposure

From Glass et al [16]

TABLE XII-4a

PERCENT MORTALITY IN MICE
AFTER ORAL ADMINISTRATION OF TETRABUTYL TIN

Dose (mM/kg)	Percentage of Mortality after:									
	Hours					Days				
	3	4	6	10	12	1	2	3	4	30
2	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	10	30	30
8	0	0	0	0	20	20	40	50	80	80
10	0	0	20	30	30	30	100	100	100	100
40	0	50	50	50	50	100	100	100	100	100

From Caujolle et al [50]

TABLE XII-4b

PERCENT MORTALITY IN MICE
AFTER ORAL ADMINISTRATION OF TETRAISOBTYLTIN

Dose (mM/kg)	Percentage of Mortality after:											
	Hours				Days							
	1	2	6	12	1	2	3	4	6	8	10	30
0.5	0	0	0	0	0	0	0	0	0	0	0	0
1	0	10	10	10	10	40	40	40	40	40	40	40
3	0	10	10	10	20	60	70	70	80	80	80	80
4	0	0	0	0	0	0	30	50	70	70	70	70
10	0	0	0	0	0	40	40	80	90	90	90	90
20	0	0	50	50	70	80	80	80	80	80	100	100

From Caujolle et al [50]

TABLE XII-4c

PERCENT MORTALITY IN MICE
AFTER ORAL ADMINISTRATION OF TETRAAMYLIN

Dose (mM/kg)	Percentage of Mortality after:													
	Hours						Days							
	3	4	6	10	12	18	1	2	3	4	6	8	30	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	20	20
4	0	0	0	0	0	0	0	0	0	30	50	50	50	50
8	0	0	0	0	0	0	0	0	0	10	20	80	80	80
10	0	0	0	0	0	20	40	40	100	100	100	100	100	100
20	0	0	0	10	10	10	50	100	100	100	100	100	100	100
40	0	30	40	50	50	70	100	100	100	100	100	100	100	100

From Caujolle et al [50]

TABLE XII-4d

PERCENT MORTALITY IN MICE
AFTER ORAL ADMINISTRATION OF TETRAISOAMYLIN

Dose (mM/kg)	Percentage of Mortality after:									
	Hours		Days							
	10	12	1	2	3	4	6	8	10	30
0.25	0	0	0	0	0	0	0	0	0	0
0.50	0	0	0	0	0	0	0	0	10	10
1	0	0	0	0	0	20	30	30	30	30
2	0	0	10	40	40	40	40	40	40	40
3	0	0	40	50	50	50	50	50	50	50
4	0	10	10	30	30	40	40	40	40	40
10	0	0	0	20	40	80	80	80	80	80
20	0	10	30	30	80	80	80	80	80	80
25	0	20	20	40	100	100	100	100	100	100

From Caujolle et al [50]

TABLE XII-5

COMPARISON OF CHEMICAL STRUCTURE AND TOXICITY
IN ORGANOTIN COMPOUNDS OF THE GENERAL FORMULA R_3SnR' OR R_3SnX

Compound A (LD50 in mg/kg)	Compound B (LD50 in mg/kg)	Change in Structure	Average Change in Toxicity (B:A)*
Triparaxylyltin bromide [(CH ₃) ₂ C ₆ H ₃] ₃ SnBr (34.0)	Trimesityltin bromide [(CH ₃) ₃ C ₆ H ₂] ₃ SnBr (92.0)	Substitute R ₃ = [(CH ₃) ₃ C ₆ H ₂] ₃ for R ₃ = [(CH ₃) ₂ C ₆ H ₃] ₃	2.6
"	Trinaphthyltin bromide (C ₁₀ H ₈) ₃ SnBr (193.0)	Substitute R ₃ = (C ₁₀ H ₈) ₃ for R ₃ = [(CH ₃) ₂ C ₆ H ₃] ₃	5.7
"	p-Tetraxylyltin [(CH ₃) ₂ C ₆ H ₃] ₃ Sn [(CH ₃) ₂ C ₆ H ₃] (2,290.0)	Substitute R' = [(CH ₃) ₂ C ₆ H ₃] for X = Br	62.7
Trimesityltin bromide [(CH ₃) ₃ C ₆ H ₂] ₃ SnBr (92.0)	Trinaphthyltin bromide (C ₁₀ H ₈) ₃ SnBr (193.0)	Substitute R ₃ = (C ₁₀ H ₈) ₃ for R ₃ = [(CH ₃) ₃ C ₆ H ₂] ₃	2.1
"	Trimesityltin iodide [(CH ₃) ₃ C ₆ H ₂] ₃ SnI (152.0)	Substitute X = I for X = Br	1.7
"	Trimesitylmethyltin [(CH ₃) ₃ C ₆ H ₂] ₃ SnCH ₃ (greater than 3,000)	Substitute R' = CH ₃ for X = Br	Greater than 50
"	Trimesitylmethyltin [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₂ H ₅ (1,870.0)	Substitute R' = C ₂ H ₅ for X = Br	20.3
"	Trimesityl-n-octyltin [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₈ H ₁₇ (2,000.0)	Substitute R' = C ₈ H ₁₇ for X = Br	21.7

TABLE XII-5 (CONTINUED)

COMPARISON OF CHEMICAL STRUCTURE AND TOXICITY
IN ORGANOTIN COMPOUNDS OF THE GENERAL FORMULA R₃SnR' OR R₃SnX

Compound A (LD50 in mg/kg)	Compound B (LD50 in mg/kg)	Change in Structure	Average Change in Toxicity (B:A)*
Trimesityltn bromide [(CH ₃) ₃ C ₆ H ₂] ₃ SnBr (92.0)	Trimesitylisoamyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₅ H ₁₁ (660.0)	Substitute R' = C ₅ H ₁₁ for X = Br	30
Trimesitylisoamyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₅ H ₁₁ (660.0)	Trimesitylmethyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnCH ₃ (greater than 3,000)	Substitute R' = CH ₃ for R' = C ₅ H ₁₁	7
"	Trimesitylethyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₂ H ₅ (1,870.0)	Substitute R' = C ₂ H ₅ for R' = C ₅ H ₁₁	2.8
Trimesitylethyltn [(CH ₃) ₃ C ₆ H ₈] ₃ SnC ₂ H ₅ (1,870.0)	Trimesitylmethyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnCH ₃ (greater than 3,000)	Substitute R' = CH ₃ for R' = C ₂ H ₅	3
Trimesityl-n-octyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₈ H ₁₇ (2,000.0)	"	Substitute R' = CH ₃ for R' = C ₈ H ₁₇	2.5
"	Trimesitylethyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₂ H ₅ (1,870.0)	Substitute R' = C ₂ H ₅ for R' = C ₈ H ₁₇	0
"	Trimesitylisoamyltn [(CH ₃) ₃ C ₆ H ₂] ₃ SnC ₅ H ₁₁ (660.0)	Substitute R' = C ₅ H ₁₁ for R' = C ₈ H ₁₇	3

*Statistical analysis using the Litchfield and Wilcoxon method

From Kolla and Zalesov [52]

TABLE XII-6

COMPARATIVE ORAL TOXICITY OF DIALKYL TIN DICHLORIDES* IN RATS

Alkyl Group	Effects at Each Dose Level		
	40 mg/kg	80 mg/kg	160 mg/kg
Methyl	No weight loss; no bile-duct lesion	No weight loss; no bile-duct lesion	Death on d 4 with marked weakness in both; no bile-duct lesion
Ethyl	"	One death; lung congestion; no effect on one; no bile-duct lesion	Death in both on d 4; no lesions
Propyl	"	One ill, killed d 5, no lesion; no effect in one	One died d 2; pulmonary congestion, weight loss in one; recovery, slight bile-duct lesion
Isopropyl	No weight loss; very slight bile-duct lesion	Slight weight loss, mild bile-duct lesion	Some weight loss, bile-duct lesion
Butyl	One death; bile-duct lesion; weight loss in one	Death, bile-duct lesion in both; severe liver lesion in one	Both very ill with weight loss; severe bile-duct lesion
Pentyl	Weight loss in both; some bile-duct damage	One died d 5, no necropsy; one with weight loss, adrenals red, bile-duct lesion	Weight loss in both, adrenals very dark at necropsy, slight bile-duct lesion
Hexyl	Weight loss in one resulting in death, no bile-duct lesion; one unaffected	Weight loss in both; recovery; adrenals very dark at necropsy; no bile-duct lesion	Weight loss in both; one death; no bile-duct lesion

TABLE XII-6 (CONTINUED)

COMPARATIVE ORAL TOXICITY OF DIALKYL TIN DICHLORIDES* IN RATS

Alkyl Group	Effects at Each Dose Level		
	40 mg/kg	80 mg/kg	160 mg/kg
Octyl	No weight loss or bile-duct lesion (50 mg/kg)	No weight loss; bile duct lesion (100 mg/kg)	Weight loss in one, no cause found (200 mg/kg)
2-Ethyl- hexyl	No ill effects	No weight loss; bile-duct lesion	No ill effects

*Compounds were administered orally to pairs of female rats on normal diet according to the following schedule: 40 mg/kg given on 1st and 4th days; 80 mg/kg on 1st and 4th days, except hexyl given only on 1st day; 160 mg/kg given on 1st day only, except butyl and octyl given also on 4th day. Rats were observed for 10 days from first dose.

From Barnes and Stoner [60]

TABLE XII-7

COMPARATIVE TOXICITY OF DIALKYL TIN DICHLORIDES
APPLIED PERCUTANEOUSLY TO RATS*

Alkyl Group	Skin Lesions and General Effects	Bile-Duct Lesion
Methyl	Necrosis of superficial layers of skin with black eschar formation; no deep-seated inflammation; slight weight loss	None
Ethyl	Slight superficial necrosis with patchy eschar; generalized deep-seated edema and subcutaneous inflammation	"
Propyl	Weight loss; 2/3 died; white patchy necrosis of skin with deeper inflammation and edema	Slight
Isopropyl	Some weight loss; dry necrosis of skin; no eschar; deeper edema and inflammation	Moderate
Butyl	Little superficial damage to skin but some edema of subcutaneous tissues; death in 1/3	Marked
Pentyl	Irritability; no obvious skin lesions or subcutaneous edema; dark adrenals in one rat	Slight
Hexyl	No weight loss; no skin lesions	None
Octyl	"	"

*The tin salts, 80 mg/kg, were dissolved in 0.1 ml dimethylphthalate and applied on 5 successive days to the clipped skin of groups of three rats. Rats were observed for 12 days, and at necropsy the skin lesions and condition of the bile duct were examined.

From Barnes and Stoner [60]

TABLE XII-8

EFFECTS OF DIALKYL TIN DICHLORIDES
ADMINISTERED INTRAVENOUSLY TO RATS*

Alkyl Group	Number of Deaths at Each Dose Level				Effects
	5 mg/kg	10 mg/kg	20 mg/kg	40 mg/kg	
Methyl	-	0	0	2	No obvious cause of death; no bile-duct lesions in survivors
Ethyl	-	0	1	4	Death in 2-24 hr; no obvious cause; slight bile-duct lesions in survivors
Propyl	0	3	4	-	Death usually within 12 hr; some pleural effusion; moderate bile-duct lesions in survivors
Isopropyl	0	0	4	-	Death in 2-72 hr; weight loss; moderate bile-duct lesions in survivors
Butyl	0	4	4	-	Death in 1-18 hr; considerable lung damage; severe bile-duct lesions in survivors
Pentyl	0	1	4	-	Death in 1-18 hr; pleural effusion often marked; moderate bile-duct lesions in survivors
Hexyl	0	2	4	-	Death in 2-4 hr; moderate bile-duct lesions in survivors
Octyl	0	4	4	-	Death usually within 4 hr; no gross lung damage; no bile-duct lesions in survivors

TABLE XII-8 (CONTINUED)

EFFECTS OF DIALKYL TIN DICHLORIDES
ADMINISTERED INTRAVENOUSLY TO RATS*

Alkyl Group	Number of Deaths at Each Dose Level				Effects
	5 mg/kg	10 mg/kg	20 mg/kg	40 mg/kg	
2-Ethyl- hexyl	0	4	2**	-	Death in 4-18 hr; no bile- duct lesions
Trimethyl- hexyl	0	4	2**	-	"

*Intravenous injections in 0.05 ml Tween 80 into female rats in groups of four, except where otherwise noted

**Only two rats in these groups

From Barnes and Stoner [60]

TABLE XII-9

TIN CONCENTRATIONS IN ORGANS OF MALE RATS
FED DI-N-OCTYLTIN OXIDE FOR 2 YEARS

DOTO in Diet (ppm)	Tin Concentration (ppm)					
	Liver	Kidneys	Heart	Testes	Lean Muscle	Fat
Control	*	*	*	*	*	*
9.6	**	0.1	*	*	*	*
24	**	0.1	*	*	*	*
39	0.2	0.4	*	**	*	*
72	0.2	0.2	**	0.3	*	*
98	0.8	0.4	0.1	0.1	*	*
295	2.0	1.6	0.3	0.2	0.1	*

*Probably 0.05 ppm, based on sensitivity of method

**Probably 0.05-0.08 ppm, based on sensitivity of method

From Banks et al [84]

TABLE XII-10

TIN CONCENTRATIONS IN ORGANS OF MALE DOGS
FED DI-N-OCTYLTIN OXIDE FOR 2 YEARS

DOTO in Diet (ppm)	Tin Concentration (ppm)							
	Liver	Brain	Kidneys	Heart	Fat	Lean Muscle	Blood	Urine
Control	0.3	*	*	*	**	**	**	**
9.6	8.2	0.4	0.5	0.2	0.2	*	-	-
24	11.0	0.5	0.6	0.2	0.2	0.1	-	-
39	13.4	0.4	0.7	0.2	0.3	0.1	-	-
72	25.1	1.6	1.4	0.7	0.7	0.2	0.1	*
98	26.9	1.6	1.3	0.4	0.4	0.2	-	-
295	34.5	3.3	2.3	0.9	0.8	0.4	0.2	0.1

*Probably 0.05-0.08 ppm, based on sensitivity of method

**Probably 0.05 ppm, based on sensitivity of method

From Banks et al [84]

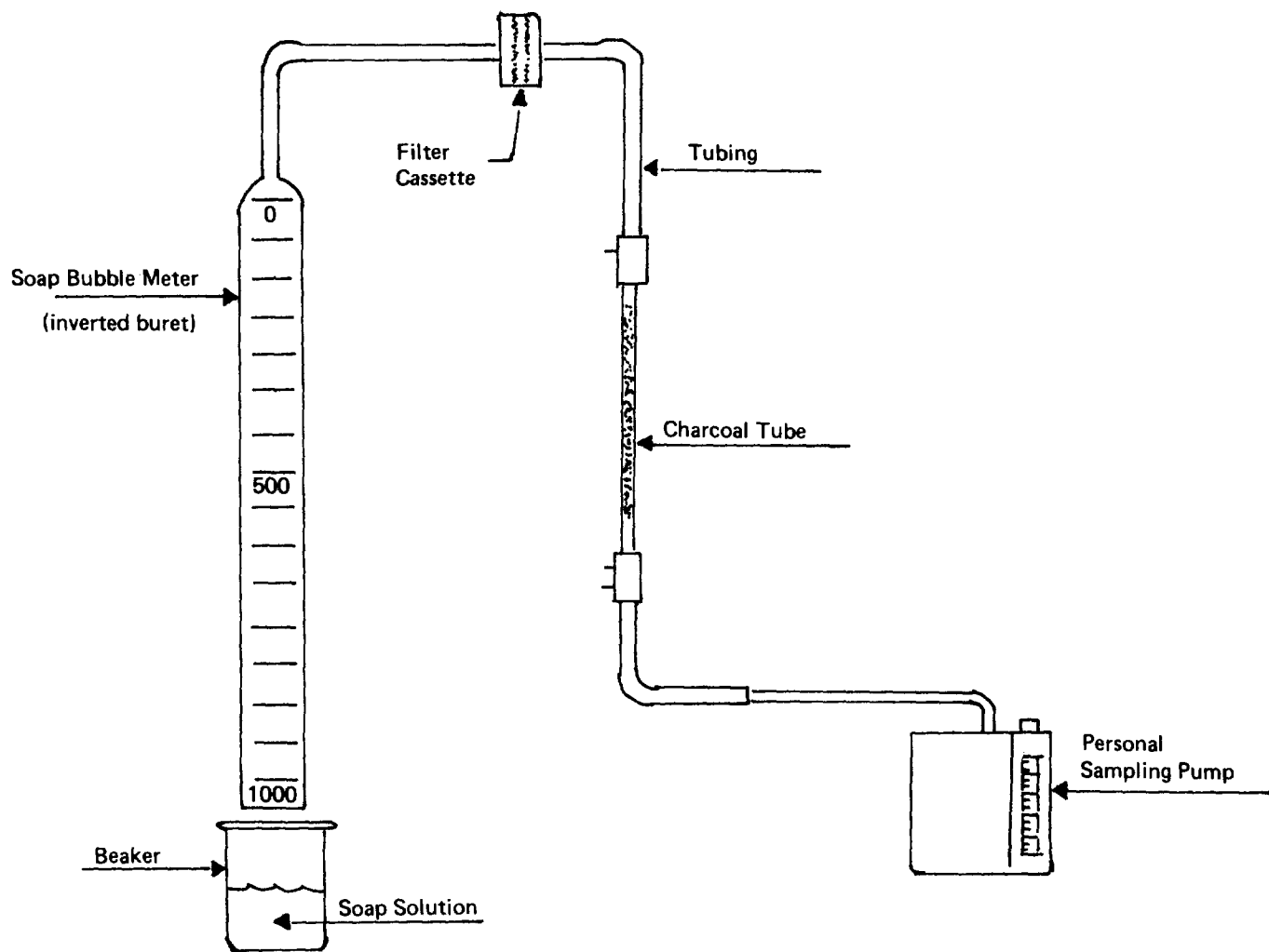


FIGURE XII-1 - CALIBRATION SETUP FOR PERSONAL SAMPLING PUMP WITH FILTER CASSETTE AND CHARCOAL TUBE

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