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AND

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In recent years there has been increasing concern about the possible harmful effects of organic compounds in the environment. An important class of pollutants are the polycyclic aromatic hydrocarbons (PAH) which have been shown to occur in air, water and food (see Table 1) *via* automobile and engine exhausts, the burning of fossil fuels, oil spills, food processing, tobacco smoking, and from natural sources. Moreover several PAH have been shown to possess carcinogenic (1-4) and mutagenic (5, 6) properties. This review is designed as an introduction to the general literature on PAH with particular emphasis on environmental analysis of these compounds.

NOMENCLATURE

Although several systems of nomenclature for polycyclic aromatic hydrocarbons have coexisted in the past (7, 8) the IUPAC system (9) is becoming generally accepted now.

Common names for the basic ring systems are retained (see Fig. 1 on page 2). For the construction of more highly condensed aromatic hydrocarbons the basic system is lettered (a, b, c, etc., (see Fig. 2 on page 3) and the "added" rings numbered in the fashion shown in Fig. 2.

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REACTIONS AND REACTIVITY

The standard reference books on the chemistry of polycyclic hydrocarbons are Clar's two volumes (10) and chemical-technical aspects of diphenyl and the terphenyls are discussed in an encyclopedia article (11). The analysis of PAH has been reviewed (12).

Most polycyclic hydrocarbons undergo the typical substitution reactions which are known from the parent compound, benzene.

In addition, many of the polycyclic hydrocarbons show a tendency for addition reactions (*cf* Fig. 3 on page 3) ("fixed double bonds").

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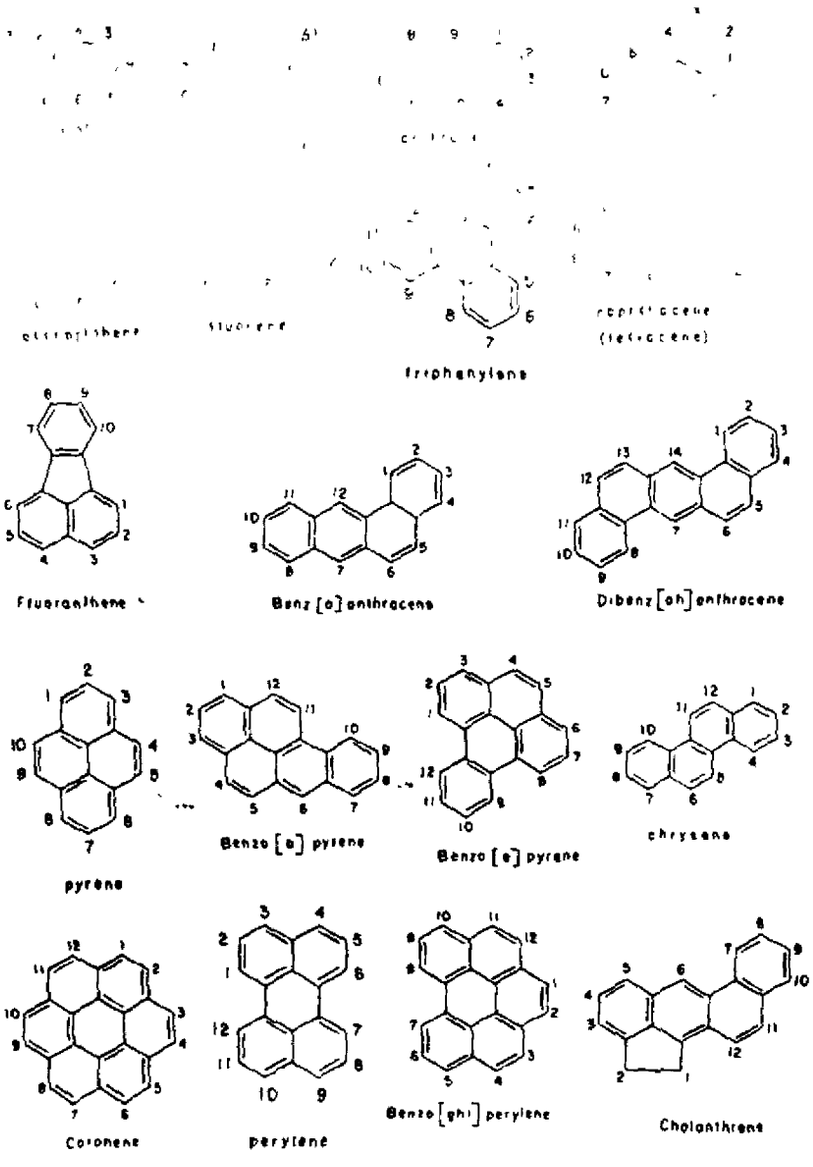

The reactivity of polycyclic hydrocarbons towards addition reactions can be explained and predicted qualitatively by Clar's π -sextett theory (13, 14). A quantum mechanical explanation of Clar's theory has been given (15, 16).

The stability of polycyclic aromatic hydrocarbons depends on the structure as well as on the number of rings. Hexabenzocoronene (Fig. 4) for example is an extremely

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Benzo [a] pyrene in city air (mcg/1000 m^3)	
Los Angeles	5
London	68
Bonn	133
Benzo [a] pyrene in food (mcg/kg)	
Vegetables	10
Smoked foods	1-10
Carcinogenic Polycyclic Hydrocarbons in water (mcg/m^3)	
Groundwater	1-10
Waste water	100,000
Benzo [a] pyrene in cigarette smoke	
1 mcg in the smoke of 40 cigarettes	

*Adapted from M. Zander, "Analysis of Polycyclic Aromatics" presented at the "Third Annual Symposium on Recent Advances in the Analytical Chemistry of Pollutants," Athens, Ga., May 1973.

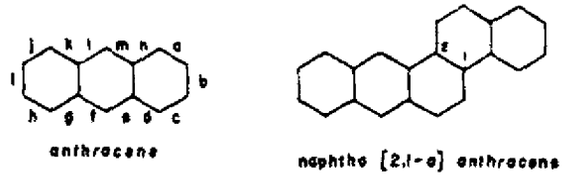


Fig. 2. Nomenclature for more highly condensed ring systems.

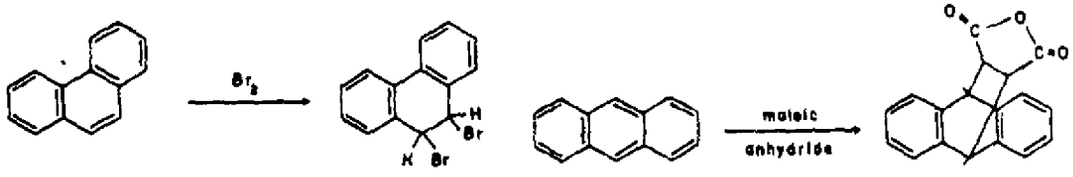
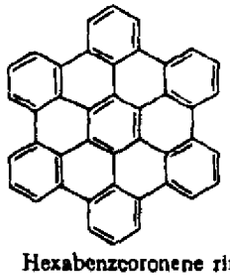


Fig. 3. Examples for addition reactions occurring with PAH.



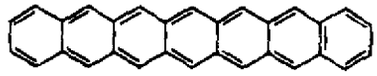


Fig. 5. Heptacene ring system.

Fig. 4. Hexabenzocoronene ring system.

stable hydrocarbon; even at 700°C neither decomposition nor melting takes place. Heptacene (Fig. 5) on the other hand, is extremely unstable with a reactivity that surpasses many free radicals.

The photochemical stability of a number of PAH has been investigated (17), the literature on the photodecomposition of the carcinogen benzo [a] pyrene is discussed in reference (18).

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PAH occur naturally in petroleum and are also synthesized by living organisms such as higher plants, algae and microorganisms (7, 18, 19).

PAH are formed as pyrolysis products at high temperatures (>300°) and can therefore be found in coal tar, automobile exhaust, emission from burning fossil fuels, and tobacco smoke.

A panel studying potential cancer-causing agents in the U.S. environment recently reported a strong correlation between commercial benzo [a] pyrene in the U.S. and [illegible] (50).

[illegible] PAH as [illegible]

[illegible] described in references (50-52).

Because of the direct uptake of human materials [illegible] to develop analytical methods and determine levels of polycyclic aromatic hydrocarbons in foods (20, 53-55). Levels are highest in smoked foods (occasionally values > 10 ppm total polycyclic hydrocarbon are observed), whereas levels in unsmoked food products are generally lower than 1 ppm.

A large number of polycyclic aromatic (including benzo [a] pyrene) and heteroaromatic hydrocarbons as well as related compounds have been identified in tobacco smoke (14-46).

Polycyclic hydrocarbons are also released into the environment from general oil pollution and the ever-increasing oil spills (47, 48). Analytical methods for the identification of hydrocarbon pollutants on seas and beaches are reviewed in reference (49). The uptake and effect of oil (including the polycyclic aromatic hydrocarbons) on marine life is of increasing concern (50-52).

ANALYSIS

The extraction, separation (clean-up) and analysis of PAH have been extensively investigated (53-56) and a review article on chromatographic procedures gives a useful comparison of the various methods (57).

As is general for the analysis of any trace component, the need is felt (97) for an extended collection of reference standards of polynuclear hydrocarbons and their alkyl and hydro derivatives. The later type of derivatives is of great importance since it is not ordinarily discovered by the conventional UV or fluorescence methods and is best identified and measured by MS. The alkyl derivatives are in many instances more carcinogenic than the parent compound.

The carcinogenic PAH benzo [a] pyrene has understandably been studied in some detail and a thorough comparison of the analytical methods used in the determination of this compound from air particulates has been reported by Sawicki (58). Analysis of benzo [a] pyrene in cigarette smoke (59), air (60), bitumen and plants (61) and water and other commodities (62) has recently been described.

Thin layer and paper chromatography — TLC and paper chromatography has been used successfully for the separation of polycyclic hydrocarbons (57, 63). Cellulose, acetylated cellulose and aluminum oxide (64) and silica are the preferred layers. A methanol-ether-water (4:1:1) mixture (65) has been recommended for acetylated cellulose layers. A typical chromatogram employing this system is shown in Fig. 6 (66). Paper chromatography on acetylated paper has been used for the chromatography of PAH with solvents similar to the TLC separation on acetylated cellulose powder (67).

Electron acceptor reagents can be used to visualize PAH on paper and thin layer chromatograms. The hydrocarbons can be recovered unchanged from the characteristically colored charge transfer complexes (see section on mass spectrometry). The native fluorescence or phosphorescence of PAH however, offers a much more sensitive method of detection (see section on luminescence spectroscopy).

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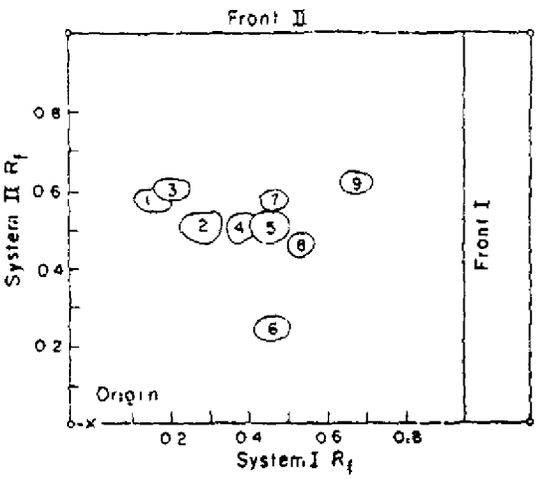

Fig 6. Two dimensional thin layer chromatogram. Layer: acetylated cellulose – aluminum oxide, 1:2. Solvents: System I, n-hexane, n-pentane, toluene (90.5 5). System II, methanol, ether, water 4.4:1. Compounds 1, dibenzo [a, e] pyrene, 2, dibenz [a, h] anthracene; 3, dibenz [a, c] anthracene; 4, perylene; 7, benzo [e] pyrene; 8, pyrene; 9, anthracene.

Liquid chromatography – The behavior of 18 polycyclic hydrocarbons on two column materials (Durapak OPN and 40% cellulose acetate) were investigated using an ultraviolet detector (68). Although neither system could resolve all components of the mixture, the method was shown to be of potential utility A number of polynuclear aza-heterocyclic hydrocarbons were separated by high pressure liquid chromatography using Zipax packing impregnated with silver ions (69) and a chemically bonded phase (70). Polycyclic aromatic hydrocarbons were also separated by liquid chromatography using Corasil I impregnated with the complexing reagent 2, 4, 7-trinitrofluorenone (71). A number of column packings have been compared in the separation of polynuclear hydrocarbons in engine oils (72).

Gas chromatography – Ultraviolet absorption and luminescence analysis have dominated the analysis of polycyclic hydrocarbons for some time, more recently gas chromatography has played an important role in the separation, detection and identification of these compounds (57, 73-77).

The use of capillary gas chromatography with its great resolution potential has markedly increased the analytical potential of this technique. Application of capillary G. C have been reported in the analysis of polycyclic aromatic hydrocarbons and related compounds in anthracene oil (78), cigarette smoke (45, 79), air and car exhaust (80, 81), soot samples (75) as well as for quantitative determinations (82). Couw *et al.* (83) have shown that PAH can be separated effectively on short capillary columns (10 m). A typical capillary column chromatogram is shown in Fig. 7 (see Table 2).

Ultraviolet spectroscopy – U.V. spectra of PAH show in the spectral range accessible by commercial instruments three electronic transitions which are differentiated by oscillator-strength polarisation and temperature dependency. The most intense bands in the U V-spectra of PAH are the so-called β – or ^{1}Bb-bands which show a molar extinction coefficient of *ca* (10^5). The extinction coefficient for the para – or ^{1}La-bands and the γ – or ^{1}Lb-bands are *ca.* $10^4 - 10^5$ and ($10^2 - 10^4$) respectively. For analytical purposes, the para-bands are the most suitable

U. V. spectra are usually recorded in liquid solution at room temperature. It is sometimes advantageous, to measure the U. V. spectra in a solid matrix at low temperatures, frequently the bands are more intense and very narrow (84)

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No.	Compounds
1	Naphthalene
2	Acenaphthene
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Front II

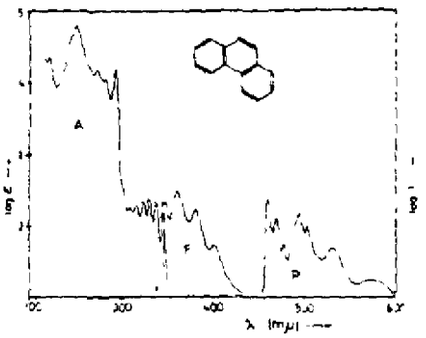

Fig. 8. Electronic spectra of phenanthrene. A, absorption (UV) spectrum (cyclohexane); F, fluorescence spectrum (benzene); P, phosphorescence spectrum (ethanol, isopentane, ether, 2:5:5; 77°K).

Luminescence spectroscopy – The fluorescence quantum yield for most PAH is relatively high to make fluorimetry a very sensitive and therefore widely used analytical method for these compounds. (For spectra of polycyclic hydrocarbons see (87) Fluorescence of individual members of a mixture can be observed when their absorption spectra differ and selective excitation wavelengths are used (88).

Fluorescence spectra are usually recorded in solution at room temperature. Spectra obtained at low temperature in a suitable matrix (n-alkanes, n-pentane to n-decane; cyclohexane) frequently give very characteristic spectra showing many bands (Shpol'skiispectra).

An interesting new technique is the so-called "quenchofluorimetry" (89) of multicomponent mixtures. This method is based on the fact that the fluorescence of some compounds is quenched more than of others if a "quencher" is added to the mixture. PAH with the fluoranthene ring system (89, quencher, nitromethane) and perylene (90; quencher, methyl iodide) for instance can be determined in complex PAH mixtures by this method.

Phosphorescence spectra which are measured in solid solution at low temperatures usually show a higher selectivity than fluorescence spectra Fig 8 shows the U.V.–fluorescence and phosphorescence spectrum of phenanthrene. A comparison of U. V.–fluorescence and phosphoresence spectroscopy is given in Table 3. For the analysis of PAH in the environment separation prior to analysis by U. V. or luminescence spectroscopy is necessary. The most commonly used combination is TLC fluorescence Samples for quantitative analysis can either be eluted from the TLC plates or more elegantly determined by *in situ* measurements (91).

Mass spectrometry–Mass spectrometric analysis plays an important role in the identification of polycyclic aromatic hydrocarbons (92-96) and this technique is particularly useful in combination with gas chromatography. The combined GC-MS

TABLE 3

Comparison* of U.V. fluorescence and phosphorescence spectroscopy

Method	Selectivity	Sensitivity	Reproducibility
U V.	+	+	++
Fluorescence	++	+++	++
Phosphorescence	+++	+++	++

+++ excellent
++ good
+ average

*Adapted from M. Zander, "Analysis of Polycyclic Aromatics" presented at the "third Annual Symposium on Recent Advances in the Analytical Chemistry of Pollutants," Athens, Ga., May 1973

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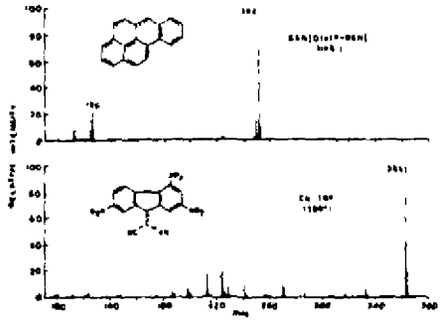

Fig. 9. 70 eV mass spectrum of benzo [a] pyrene 9-cyanomethylene-2, 4, 7-trinitrofluorene complex eluted from TLC at different sample temperatures (as indicated); (a), benzo [a] pyrene (b). CNTNF.

technique (97) has been used in studies in which the identity of the observed gas chromatographic peaks has been confirmed by the characteristic mass spectra of the components.

PAH may be located on TLC plates by the chamcteristic color they form with eleotron acceptor reagents. The complexes may be transferred directly to a mass spectrometer sample tube and individual spectra of the compounds be obtained by thermal dissociation and fractional sublimation in the ion source of a mass spectrometer (96). Mass spectra of benzo [a] pyrene and the complexing agent 9-dicyanomethylene-2, 4, 7-trinitrofluorene obtained at different sample temperatures from the complex are shown in Fig. 9.

The mass spectra of most polycyclic aromatic hydrocarbons exhibit several common fragmentation pathways; i.e :

1) The molecular ion is usually the most abundant ionic species and this greatly facilitates the determination of the molecular formula of the hydrocarbon.
2) In addition, the M^{+}-1, M^{+}-2 and M^{+}-3 species are also relatively intense.
3) Methyl substituted aromatic hydrocarbons exhibit M^{+}-15 ions.
4) Doubly-charged ions are observed for most of the aforementioned ionic species.

These characteristics indicate that mass spectrometry does not readily distinguish between isomeric polycycolic aromatic hydrocarbons since very few fragment ions are produced and the molecular ion tends to dominate the spectra. This characteristic can, however, be an advantage with the GC-MS technique since the separation of many isomeric hydrocarbons can readily be effected by gas chromatography and the resulting mass spectra gives confirmation of the GC assignments.

Infrared spectra – IR spectra are useful for identifying alkyl derivatives of naphthalene. IR spectra, do not, however, have any advantages over U.V. spectra in the identification of unsubstituted PAH, but are very useful in the structure determination of new compounds (12).

Proton magnetic resonance spectroscopy can be used for the identification of PAH and their alkyl derivatives (12, 14). Experimental difficulties exist with the highly condensed systems because of their low solubility.

220 MHz Proton magnetic resonance spectrum of benzo [a] pyrene has recently been published (99) and C-13 NMR spectra of several simple condensed systems have been recorded (100).

It is now generally accepted (101) that to be carcinogenic, polycyclic aromatic hydrocarbons undergo metabolic activation. Epoxides (102, 103) may be involved and reaction with nucleic acid components (99, 103, 104) have been suggested. The

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[illegible]	[illegible]		99%	15.00/10mg
[illegible]	[illegible]		99%	7.00/100mg
[illegible]	[illegible]		99%	10.00/10mg
[illegible]	[illegible]		[illegible]	7.00/10mg
[illegible]	[illegible]		[illegible]	[illegible]

[illegible]	[illegible]	2H-Benzo[b][1,4]oxazine See 2H-1,4-Benzoxazine	98%	7.00/100mg
[illegible]	[illegible]		95%	14.00/10mg
[illegible]	[illegible]		99%	12.00/100mg
[illegible]	[illegible]		95%	13.00/100mg
BNH1030	Benzo[b]naphtho[1,2-d]thiophene		95%	17.00/100mg
BNH1005	1,2-Benzofluorene		99%	10.00/10mg
BNH1031	2,3-Benzofluorene		99%	10.00/10mg
BNH1032	Benzo[g,h,i]perylene	1,12-Benzoperylene	99%	10.00/10mg
------	1,12-Benzoperylene	See Benzo[g,h,i]Perylene		
------	9,10-Benzophenanthrene	See Triphenylene		
BNH1033	Benzo[a]pyrene	3,4-Benzopyrene	98%	17.00/100mg
------	3,4-Benzopyrene	See Benzo[a]pyrene		
BNH1009	5,6-Benzoquinoline Benzo[f]quinoline	Benzo[f]quinoline or β-Naphthoquinoline See 5,6-Benzoquinoline	99%	10.00/100mg
BNH1010	1,1'-Binaphthyl		95%	10.00/100mg
BCS001	Biphenyl		99%	7.00/500mg
BNH1011	Carbazole		99%	7.00/100mg
PRH1012	Chrysene		99%	14.00/100mg
BNH1013	Coronene		98%	18.00/10mg
BNH1016	1,2,3,4-Dibenzanthracene	Dibenz[a,c]Anthracene	99%	10.00/10mg
BNH1017	1,2,5,6-Dibenzanthracene	Dibenz[a,h]Anthracene	99%	7.00/10mg
BNH1018	1,2,7,8-Dibenzanthracene	Dibenz[a,j]anthracene	95%	12.00/10mg
------	Dibenz[a,c]anthracene	See 1,2,3,4-Dibenzanthracene		
------	Dibenz[a,h]anthracene	See 1,2,5,6-Dibenzanthracene		
------	Dibenz[a,j]anthracene	See 1,2,7,8-Dibenzanthracene		
BNH1019	2,3,5,6-Dibenzfluoranthene		98%	14.00/10mg
BNH1020	3,4,5,6-Dibenzocarbazole		95%	8.00/10mg
BCS007	Dibenzofuran		99%	15.00/50mg
BCS070	Dibenzothiophene		99%	7.00/500mg
BNH1021	1,2,4,5-Dibenzopyrene		98%	17.00/100mg
BNH1034	Dibenzothiophene	Diphenylene sulfide	99%	7.00/100mg
BNH1015	1,2,8,9-Dibenzpentacene		99%	14.00/10mg
BNH1022	9,10-Dihydroanthracene		98%	17.00/100mg
---	16,15-Dihydro-5H-Diindolo[1,2,3-a:1',2',3'-c]Fluorene	See Trimeric Indole		

MONS 212609

Polynuclear Hydrocarbon Standards

Catalog #	Product	Synonym	Min Purity	Price
RNH023	Diindeno [1, 2, 3-cd-1, 2, 3-hi] Perylene	Periflanthene	98%	9.00/100mg
RNH024	3, 6-Dimethylphenanthrene		99%	7.00/10mg
RNH025	9, 10-Diphenylanthracene		99%	7.00/100mg
------	Diphenylenesulfide	See Dibenzothiophene		
[illegible]	[illegible]		99%	7.00/100mg
[illegible]	[illegible]	1, 2, 4, 5-Tetramethylbenzene	99.9%	7.00/100mg
[illegible]	[illegible]		99%	7.00/100mg
[illegible]	[illegible]		99%	14.00/100mg
[illegible]	[illegible]		99%	7.00/100mg
	Indeno [1, 2, 3-cd] pyrene	See o-Phenylenepyrene		
[illegible]	2-Methylanthracene		99%	8.00/100mg
[illegible]	3-Methylanthracene		99.99%	14.00/100mg
RNH041	4-Methyl Biphenyl	4-Phenyltoluene	98%	10.00/100mg
RNH042	4, 5-Methylenephenanthrene		99%	19.00/100mg
RNH043	2-Methylfluorene		95%	7.00/100mg
RNH044	1-Methylphenanthrene		99%	7.00/100mg
RNH045	2-Methyl phenanthrene		99%	7.00/100mg
RNH046	3-Methyl phenanthrene		95%	7.00/100mg
------	Naphthacene	See Tetracene		
RCS072	Naphthalene		99%	7.00/500mg
	β-Naphthoquinoline	See 5, 6-Benzoquinoline		
RNH047	Octadecahydrochrysene		95%	14.00/100mg
RNH048	Pentacene		98%	18.00/10mg
	Periflanthene	See Diindeno [1, 2, 3-cd-1, 2, 3'-hi] perylene		
RNH049	Perylene		99%	14.00/100mg
RNH050	Phenanthrene		99%	7.00/100mg
RNH051	Phenanthrenequinone		95%	14.00/100mg
RNH052	9-Phenylanthracene		98%	14.00/100mg
RNH053	o-Phenylenepyrene	Indeno [1, 2, 3-cd] pyrene	99%	7.00/10mg
RNH054	2-Phenylnaphthalene		99%	19.00/100mg
RNH055	4-Phenyltoluene	4-Methyl biphenyl	99%	
RNH056	Picene			12.00/100mg
RNH057	Pyrene		99%	7.00/100mg
RNH058	p-Quaterphenyl		98%	14.00/10mg
RNH059	m-Quinquephenyl		95%	32.00/10mg
RCS059	o-Terphenyl		99%	7.00/100mg
RCS060	m-Terpenyl		99%	7.00/100mg
RCS061	p-Terphenyl		99%	7.00/100mg
RNH060	Tetracene	Xaphtacene	99%	14.00/10mg
RNH061	Tetradecahydrophenanthrene		95%	18.00/100mg
RNH062	1, 2, 3, 4-Tetrahydrofluoranthene		99%	18.00/100mg
------	1, 2, 4, 5-Tetramethylbenzene	See Durene		
------	Tetraphene	See 1, 2-Benzanthracene		
RNH063	1, 2, 3, 4-Tetraphenylnaphthalene		97%	7.00/100mg
RNH064	Triphenylene	9, 10-Benzophenanthrene	99%	10.00/10mg
RNH065	Triptycene	9, 10-n-Benzeno-9, 10-dihydroanthracene	98%	18.00/10mg
RNH066	Trixene	10, 15-Dihydro-5H-diindeno [1, 2-a 1', 2'-c] fluorene	95%	14.00/100mg

MONS 212610

[illegible]

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Commercial PCB preparations consist of complicated mixtures of chlorobiphenyls with different chlorine content and their isomers. The composition of these technical products has only recently been established [1].

A knowledge of the solubilities of PCB components is necessary for experiments involving individual isomers and may also be useful for the evaluation of PCB distribution in natural waters.

Considerable differences in the solubilities of chlorobiphenyls with different numbers of chlorination as well as positional isomers were indicated by change in the GC peak pattern of Aroclor 1254 re-extracted from aqueous solutions with hexane[2]. Solubilities of five mono-and dichlorobiphenyls also vary widely[3].

We wish to present the results of our study on the solubilities of twenty-one chlorobiphenyls in water. Most of the compounds investigated are major components of commercial PCB preparations. Since water soluble humic substances were recently reported to act as carriers for lipophyhe compounds including pollutants[9, 10], the solubility of 4, 4'-dichlorobiphenyl in aqueous extracts of humic acid was also measured. The solubility of this compound was also determined in the presence of different concentrations of Tween 80. Aroclor preparations have an increased solubility in water in the presence of solubilizers[11] and the presence of the biologically relatively inert Tween 80 (e.g. 2% Tween 80 in nutrient solution showed no measurable growth inhibition in a number of microorganisms [12]) may allow the use of higher concentrations of chlorobiphenyl in many experiments.

EXPERIMENTAL

Instrumentation Gas chromatography (GC) was carried out on a Varian 1800 instrument using a glass column (5 ft. x 2 mm i.d.) packed with 1.5% XE-60 on Anakrom Q operated at temperatures of 160-190°C depending on the compound. Carrier gas was nitrogen at a flow rate of 30 ml/min. Injector and electron capture detector were kept at 220°C.

Chemicals Chlorobiphenyls (99% pure) were either Synthesized or obtained from Analabs Inc. (North Haven, Conn., U.S.A.). Humic acid was purchased from Aldrich Chem. Co. (Milwaukee, Wisc., U.S.A.).

Methods An example for the determination of the solubility of one chlorobiphenyl in water is given below.

A hexane solution of the chlorobiphenyl (1 mg) was pipetted into a 300 ml Erlenmeyer flask and the solvent evaporated to give a thin film of the compound. Water (100 ml) was added, the flask sealed with parafilm and the mixture shaken at 30°C for 10 days. After this time the aqueous suspension was allowed to equilibrate at 22-24°C for 3 hr. Contact of aqueous chlorobiphenyl solution with glass was kept to a minimum after this step because of the known adsorption effects[13]. An aliquot (10 ml) was drawn using a syringe carrying a small filter compartment and immediately

MONS 212611

[illegible] hexane (2 x 10 ml). The hexane extract w[illegible] to 10 ml and [illegible] were injected into the gas chromatograph. Q[illegible] evaluation was [illegible] by measuring the peak height using calibration [illegible] of known amounts of [illegible] standard in hexane. Sampling and analyses w[illegible] out in duplicate.

[illegible] problems with adsorption and low solubi[illegible] experiments were [illegible] solubility data is absolute physical [illegible] but were intended [illegible]

[illegible]

Solubility of chlorobiphenyls in water

Compound	Solubility (mg)	Solubility (ppm)
Monochlorobiphenyls		
2-	6.0	5.8
3-	3.35	3.6
4-	1.20	1.17
Dichlorobiphenyls		
2, 4-	1.40	1.40
2, 2'-	1.56	1.44
2, 4'-	1.90	1.85
4, 4'-	0.08	0.07
Trichlorobiphenyls		
2, 4, 4'-	0.085	0.085
3, 4, 2'-	0.075	0.080
Tetrachlorobiphenyls		
2, 2', 5, 5'-	0.046	0.046
2, 3, 2', 3'-	0.037	0.030
2, 3, 2', 5'-	0.170	0.170
2, 4, 2', 4'-	0.070	0.065
2, 4, 3', 4'-	0.055	0.060
2, 5, 3', 4'-	0.041	0.041
3, 4, 3', 4'-	0.175	0.175
Pentachlorobiphenyls		
2, 3, 4, 2', 5'-	0.021	0.023
2, 4, 5, 2', 5'-	0.035	0.028
Hexachlorobiphenyl		
2, 2', 4, 4', 5, 5'-	0.0068	0.0088
Octachlorobiphenyl		
2, 3, 4, 5, 2', 3', 4', 5'-	0.0068	0.0072
Decachlorobiphenyl	0.015	0.015
4, 4'-Dichlorobiphenyl		
+ Tween 10 0.1%	6.2	5.5
+ Tween 80 1%	10.0	10.0
+ Humic acid extract	0.075	0.06

MONS 212612

We thank Dr. Reed for supplying data prior to publication. P.R.W. expresses his gratitude to the Deutsche Forschungsgemeinschaft for financial support. Part of this work was carried out while G.H. was on leave at the Universität Landau. He and the latter would like to thank the Deutsche Akademische Austauschdienst for the [illegible] to Germany and financial aid.

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PROGRESS REPORTS ON PCB ISOMERS

By Michael Bolgu

Given the toxicity and persistence of the widely dispersed polychlorinated biphenyls (PCB's) it seems logical that the U.S. Interdepartmental Taskforce on PCB's in their 181-page May 1972 Report (Com-72-10419) would include as part of their recommendation (page 18) the following additional studies, (italics are ours)

1. *Toxicological evaluation of a select number of representative, purified PCB isomers as well as purified trace contaminants such as the chlorinated dibenzofurans*

2. Definitive mammalian elaboration of the kinetics, absorption, distribution, metabolism, and excretion of the technical PCBs as well as *a number of key isomers and the chlorinated dibenzofurans*

3. Elaboration of the subcellular and intracellular actions of the technical PCBs as well as *a number of representative isomers and chlorinated dibenzofurans.*

4. More definitive epidemiological studies of the PCBs with both more representative population sampling and standardization on the basis of lipid content of the tissues

In our list of biphenyls and 50 isomers of the 209 possible chlorobiphenyls we included a great number of the major components present in the commercial mixtures. For

MONS 212613

instance, Willis and Addison[1] report that the major components of Aroclor 1221 accounting for 92.3 weight per cent are biphenyl, 2-Cl, 4-Cl, 2, 2'-Cl_2, 2, 4'-Cl_2 (all available from Analabs stock). From Sissons and Welti's[2] list of the major components of the more important Aroclor 1254 (we list more than half). Methods have been developed[3] to recover PCB's present in waste and river water and to increase detectability by perchlorinating the samples sensitizing them to electron-capture detection by gas chromatography[4].

We have made the tools available (polyurethane foam plugs and perchlorination kits).

Assembled below is data of melting points taken of our pure isomers and taken from the literature. This list reveals interesting features of configuration/physical property correlation.

MELTING POINTS OF POLYCHLORINATED BIPHENYLS

Chlorine Position	*Melting Points*
Mono	
2-Cl	32.0-32.5°C
3-Cl	Oil
4-Cl	75.5-77.0°C
Di	
2, 3-Cl_2	Oil (Lit. 27.7-28.2°C)
2, 4-Cl_2	Oil (Lit. 24-25°C)
2, 5-Cl_2	Oil (Lit. 22-23°C)
2, 6-Cl_2	34-35°C
3, 4-Cl_2	47-48°C
3, 5-Cl_2	Oil (Lit. 31-32°C)
2, 2'-Cl_2	60-61°C
3, 3'-Cl_2	25-26°C
4, 4'-Cl_2	148-149°C
2, 3'-Cl_2	Lit. Oil
2, 4'-Cl_2	42.5-43.5°C
3, 4'-Cl_2	Lit. Oil
Tri	
2, 3, 4-Cl_3	101-102°C
2, 3, 5-Cl_3	Lit. 41°C
2, 3, 6,-Cl_3	58-60°C
2, 4, 5-Cl_3	76-78°C
2, 4, 6-Cl_3	62.0-63.5°C
2, 3, 2'-Cl_3	Lit. 28-29°C
2, 3, 4'-Cl_3	Lit. 73°C
2, 4, 4'-Cl_3	57.0-57.5°C
2, 5, 2'Cl_3	43-44°C
2, 5, 3'-Cl_3	40.0-40.5°C
2, 5, 4'-Cl_3	63.5-64.5°C
3, 4, 2'-Cl_3	60.0-60.5°C
3, 4, 4'-Cl_3	Lit. 87-88°C
3, 5, 2'-Cl_3	Lit. 58°C
3, 5, 4'-Cl_3	Lit. 88°C

MONS 212614

MELTING POINTS OF POLYCHLORINATED BIPHENYLS

Tetra	
2, 3, 4, 5-Cl_4	91.5-92.5°C
2, 3, 5, 6-Cl_4	77.0-77.5°C
2, 3, 4, 4'-Cl_4	Lit. 141-142°C
2, 4, 5, 4'-Cl_4	Lit. 125°C
2, 3, 2' 3'-Cl_4	119.5-121.5°C
2, 3, 2' 5'-Cl_4	46.5-47.0°C
2, 4, 2' 4'-Cl_4	41-42°C
2, 4, 2' 5'-Cl_4	64-66°C
2, 4, 3' 4'-Cl_4	127-128°C
2, 5, 2' 5'-Cl_4	88-87°C
2, 5, 3' 4'-Cl_4	104-107°C
2, 6, 2', 6'-Cl_4	190-200°C (sublimes)
3, 4, 3', 4'-Cl_4	182-184°C
3, 5, 3', 5'-Cl_4	Lit 164°C
Penta	
2, 3, 4, 5, 6,-Cl_5	123-125°C
2, 3, 4, 5, 4'-Cl_5	Lit. 98-99°C
2, 3, 4, 2', 5'-Cl_5	111.5-113.0°C
2, 3, 4, 3' 4'-Cl_5	Lit. 101-105°C
2, 3, 6, 2' 5'-Cl_5	97-98°C
2, 4, 5, 2' 3'-Cl_5	81-82°C
2, 4, 5, 2' 5'-Cl_5	76 5-77 5°C
2, 4, 5, 3' 4'-Cl_5	Lit 105-107°C
Hexa	
2, 3, 4, 5, 6, 2'-Cl_6	Lit 134-137°C
2, 3, 4, 5, 6, 3'-Cl_6	Lit 97-100°C
2, 3, 4, 5, 6, 4'-Cl_6	Lit. 160-165°C
2, 3, 4, 5, 2' 4'-Cl_6	Lit. 77-78°C
2, 3, 4, 5, 2' 5'-Cl_6	89-91°C
2, 3, 5, 6, 2' 5'-Cl_6	100-101°C
2, 3, 4, 2' 3' 4'-Cl_6	155-8°C
2, 3, 4, 2' 4' 5'-Cl_6	78 5-80 0°C
2, 3, 5, 2' 3' 5'-Cl_6	Lit. 128-129°C
2, 3, 6, 2' 3' 6'-Cl_6	115-117°C
2, 3, 6, 2' 4' 5'-Cl_6	Lit Oil
2, 4, 5, 2' 4' 5'-Cl_6	102-104°C
2, 4 5, 2' 4' 6'-Cl_6	Lit. Oil
2, 4, 6, 2' 4' 6'-Cl_6	113.5-114.5°C
3, 4, 5, 3', 4' 5'-Cl_6	Lit. 198

MONS 212615

Chlorine Position	*Melting Points*
Hepta	
2, 3, 4, 5, 6, 2' 5'-Cl_7	147-150°C
2, 3, 4, 5, 6, 3', 4'-Cl_7	Lit. 116-118°C
2, 3, 4, 5, 2', 3', 4'-Cl_7	Lit. 134.5-135.5°C
2, 3, 4, 5, 2' 3' 6'-Cl_7	Lit. 130 5-130.7°C
2, 3, 4, 5, 2' 4' 5'-Cl_7	Lit. 109-110°C
2, 3, 4, 5, 2' 4' 6'-Cl_7	Lit. 152-153°C
2, 3, 4, 5, 3' 4' 5'-Cl_7	Lit. 162-163°C
Octa	
2, 3, 4, 5, 2' 3' 4' 5'-Cl_8	158-159°C
2, 3, 4, 6, 2' 3' 4' 6'-Cl_8	Lit. 132°C
2, 3, 5, 6, 2' 3' 5' 6'-Cl_8	161-162°C
Nona	
2, 3, 4, 5, 6, 2' 3' 4' 5'-Cl_9	204.5-206.5°C
Deca	
2, 3, 4, 5, 6, 2' 3' 4' 5' 6'-Cl_{10}	300-310°C (sublimes)

All melting Points taken on a Fischer-Johns melting point stage

REFERENCES

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MONS 212616

99% Pure PCB Isomers

For clarity we have kept the position numbering separate for each ring For Chemical Abstracts nomenclature transpose numbers listing lowest number first

RCS-001	Biphenyl	$7.00/500mg
RCS-002	2-Chlorobiphenyl	7.00/100mg
RCS-003	3-Chlorobiphenyl	7.00/100mg
RCS-004	4-Chlorobiphenyl	7.00/100mg
RCS-005	2, 2'-Dichlorobiphenyl	18.00/100mg
RCS-006	3, 3'-Dichlorobiphenyl	18.00/100mg
RCS-007	4, 4'-Dichlorobiphenyl	18.00/100mg
RCS-008	2, 4'-Dichlorobiphenyl	32.00/50mg
RCS-009	2, 3-Dichlorobiphenyl	14.00/100mg
RCS-010	2, 4-Dichlorobiphenyl	14.00/100mg
RCS-011	2, 5-Dichlorobiphenyl	14.00/100mg
RCS-012	2, 6-Dichlorobiphenyl	14.00/100mg
RCS-013	3, 4-Dichlorobiphenyl	14.00/100mg
RCS-014	3, 5-Dichlorobiphenyl	14.00/100mg
RCS-015	2, 4, 4'-Trichlorobiphenyl	26.00/20mg
RCS-052	2, 4, 3', 4'-Tetrachlorobiphenyl	32.00/20mg
RCS-016	2, 5, 2'-Trichlorobiphenyl	28.00/50mg
RCS-017	2, 5, 3'-Trichlorobiphenyl	28.00/50mg
RCS-018	2, 5, 4'-Trichlorobiphenyl	28.00/50mg
RCS-019	3, 4, 2'-Trichlorobiphenyl	28.00/50mg
RCS-020	2, 3, 4-Trichlorobiphenyl	26.00/50mg
RCS-021	2, 3, 6-Trichlorobiphenyl	36 00/50mg
RCS-022	2, 4, 5-Trichlorobiphenyl	22.00/100mg
RCS-023	2, 4, 6-Trichlorobiphenyl	26 00/100mg
RCS-024	2, 3, 2', 3'-Tetrachlorobiphenyl	28.00/100mg
RCS-025	2, 4, 2', 4'-Tetrachlorobiphenyl	28.00/100mg
RCS-026	2, 5, 2', 5'-Tetrachlorobiphenyl	28.00/100mg
RCS-027	2, 6, 2', 6'-Tetrachlorobiphenyl	28.00/100mg
RCS-028	3, 4, 3', 4'-Tetrachlorobiphenyl	28.00/100mg
RCS-029	2, 3, 2', 5'-Tetrachlorobiphenyl	35.00/50mg
RCS-030	2, 4, 2', 5'-Tetrachlorobiphemyl	22.00/20mg
RCS-031	2, 5, 3', 4'-Tetrachlorobiphenyl	35 00/50mg
RCS-032	2, 3, 4, 5,-Tetrachlorobiphenyl	20.00/50mg
RCS-033	2, 3, 5, 6-Tetrachlorobiphenyl	20.00/50mg
RCS-034	2, 3, 4, 2', 5'-Pentachlorobiphenyl	25.00/20mg
RCS-035	2, 3, 6, 2', 5'-Pentachlorobiphenyl	22.00/10mg
RCS-036	2, 4, 5, 2', 3'-Pentachlorobiphenyl	22.00/10mg
RCS-036	2, 4, 5, 2', 5'-Pentachlorobiphenyl	35.00/50mg
RCS-039	2, 3, 4, 5, 6-Pentachlorobiphenyl	28.00/100mg
RCS-040	2, 3, 4, 2', 3', 4'-Hexachlorobiphenyl	32.00/20mg
RCS-041	2, 3, 4, 2', 4', 5'-Hexachlorobiphenyl	28.00/10mg
RCS-042	2, 3, 6, 2', 3', 6'-Hexachlorobiphenyl	36.00/20mg
RCS-043	2, 4, 5, 2', 4', 5'-Hexachlorobiphenyl	36.00/100mg
RCS-044	2, 4, 6, 2', 4', 6'-Hexachlorobiphenyl	32.00/50mg
RCS-045	2, 3, 4, 5, 2', 5'-Hexachlorobiphenyl	28.00/10mg
RCS-046	2, 3, 5, 6, 2', 5'-Hexachlorobiphenyl	28.00/10mg
RCS-047	2, 3, 4, 5, 6, 2', 5'-Heptachlorobiphenyl	36.00/10mg
RCS-048	2, 3, 4, 5, 2', 3', 4', 5'-Octachlorobiphenyl	26.00/20mg
RCS-049	2, 3, 5, 6, 1', 3', 5', 6'-Octachlorobiphenyl	26.00/20mg
RCS-050	2, 3, 4, 5, 6, 2', 3', 4', 5'-Nonachlorobiphenyl	36 00/10mg
RCS-051	2, 3, 4, 5, 6, 2', 3', 4', 5', 6'-Decachlorobiphenyl	7.00/100mg

Discount on single order of any 5 PCB's-10% 10 PCB's-15%
Bibliography on PCB Literature available on request

MONS 212617

POLYURETHANE-FOAM PLUGS

For complete extraction of pesticides and PCB's from environmental water samples (for instance – river water).
References:

1. The extraction and recovery of polychlorinated biphenyls (PCB) using porous polyurethane foam H D. Gesser, A. Chow, F C Davis, J. F Uthe, and J Reinke. Anal Lett., 4, 883-6 (1971)

2 Extraction of organochlorine pesticides from water by porous polyurethane J F Uthe, J Reinke and H Gesser, Environmental Letters, 3, 117-135 (1972)

Written procedure for extraction of pesticides and PCB's from water samples will be supplied with each order or on request.

Polyurethane-foam plugs (22mm x 38mm)

RCS-083	Untreated	$10.00/50
RCS-084	Washed	12.00/12
RCS-085	Treated with 0.5% DC-200	12.00/12

Chromatographic Tubes (20mm ID, 400mm long)

RCS-086	Tube without fritted disc	$13.00/2 tubes
RCS-087	....Tube with fritted disc	11.00/each

Perchlorination Kits for Analysis of Polychlorinated Aromatics

References:

1. Analysis of chlorinated aromatic hydrocarbons by exhaustive chlorination· Qualitative and structural aspects of the perchloro derivatives of biphenyl, naphthalene, terphenyl, dibenzofuran, dibenzodioxin and DDE. O. Hutzinger, S. Safe, and V. Zitko.
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3. Screening method for the detection of chlorodibenzo-p-dioxins in the presence of chlorobiphenyls, chloronaphthalenes, and chlorodibenzofurans. D. T. Williams and B. J. Blanchfield, JAOAC. 55, 93-5 (1972)

RCS079	Perchlorination reagents A_1 and A_2	$10.00
For PCB's, PCDD's, PCF's, and p,p'-DDE (in equal volumes).		
RCS080	Perchlorination reagent B	6 00
For PCB, PCT and p,p'-DDE		
RCS081	Perchlorination reagent C	6 00
For PCN's		
RCS082	Perchlorination kit (A_1, A_2, B, C)	16.00

Detailed perchlorination procedures will be supplied on request and with each order

MONS 212618

RCS060 PCB Kit [illegible] $ 00 kit

Number of Chlorines	1	2	3	4	5	6	7	8
% of Chlorine	21 67	36 49	46 00	53 36	59 07	63 6	67 2	70 3

Reference: Behavior of chlorinated naphthalenes in analytical methods for organochlorinated pesticides and polychlorinated biphenyls J A. Armour and J A. Burke, JAOAC, 54, 175-7 (1971).

RCS053	1-Chlorodibenzo-p-dioxin	20/50 mg
RCS054	2-Chlorodibenzo-p-dioxin	20/50 mg
RCS067	Dibenzo-p-dioxin	$15 00/50 mg
RCS055	2, 3-Dichlorodibenzo-p-dioxin	25/50 mg
RCS066	2, 7-Dichlorodibenzo-p-dioxin	25 00/50 mg
RCS069	1, 2, 3, 4, 6, 7, 8, 9-Octachlorodibenzo-p-dioxin	20 00/50 mg
RCS056	1, 2, 4-Trichlorodibenzo-p-dioxin	25/50 mg
RCS057	1, 2, 3, 4-Tetrachlorodibenzo-p-dioxin	25/50 mg

References:

1. Thin-layer chromatographic separation of two chlorodibenzo-p-dioxins from some polychlorinated biphenyls and organochlorine pesticides. D. T. Williams and B J. Blanchfield, JAOAC, 54, 1429-31 (1971).
2. Determination of polychlorodibenzo-p-dioxins in chlorophenols and lipids. D. Firestone, Paper presented at the 162nd National ACS Meeting, Pesticide Div., Sept. 12-17, 1971.

[illegible] POLYCHLORINATED DIBENZOFURANS

RCS070	Dibenzofuran	$ 7.00/500 mg
RCS058	3, 6-Dichlorodibenzofuran	36/20 mg
RCS071	1,2,3,4,5,6,7,8-Octachlorodibenzofuran	15.00/50 mg

Reference: Identification and toxicological evaluation of chlorinated dibenzofuran and chlorinated naphthalene in two commercial polychlorinated biphenyls. J G. Vos, J. H Koeman, H L. van der Maas, M C Ten Noever de Brauw and R. H. de Vos, Food Cosmet Toxicol., 8, 625 633 (1970)

RCS077	Hexachlorophene [2,2-Methylenebis-(3,4,6-trichlorophenol)]	$ 5 00/1 mg
RCS078	Perchlorinated p,p'-DDE	20 00/50 mg

MONS 212619

The list of pesticide standards that follows is possibly the most extensive compilation offered for your convenience we have also listed the synonyms and a cross reference for different trade names If the pesticide you need is not listed please inquire Custom mixes and requests for concentrations of 1 to 1000 PPM in quantities of 1ml

RSP000	Alkyl Alcohol		Alkyl Alcohol		1 ml/g
RSP001	Aldrin		Hexachlorohexahydrodimethanonaphthalene	95%	1 ml/g
RSP002	Ametryn, tech		2-Methylamino-4-ethylamino-6-isopropylamino-S-triazine	Tech	0.05 g
RSP003	Aminocarb	See Matacil			
RSP004	Amitraz		3-Amino-1,2,4-triazole	97%	20/40/100 mg
RSP005	Amitrole, tech		3-Amino-1,2,4-triazole		0.05 g
RSP006	Ammate		Diammonium dithiocarbamate solutions contained	12%	12.00 g
RSP007	Ammonium	See Baygon			
RSP008	Arsenate		2-Hydroxy-Bis(phenylmercury) propanol 2-(4-morpholinyl)ethanol	82	20/40/100mg
RSP009	Asulam	See Asulox			
RSP010	Atrazine	Crisatrine	2-Chloro-4-ethylamino-6-isopropylamino-S-triazine	97%	10/25/50g
RSP011	Azinphos-methyl		2-Chloro-4-ethylamino-6-isopropylamino-S-triazine		0.05/g
RSP012	Azodrin	Monocrotophos	S,2,3-Dicarbomethoxy-1-N-methylcarbamoyl-1-propen-2-yl dimethyl phosphate	Tech	12.00/g
RSP013	Azinphosmethyl	Carfathion Guthion Methyl-gusathion	O,O-Dimethyl S-4-oxo-1,2,3-benzotriazin-3-(4H)-ylmethyl phosphorodithioate	99%	10.00 g
RSP014	Azinphosmethyl oxide		O,O-Dimethyl S-(4-oxo-1,2,3-benzotriazin-3-(4H)-yl)-methyl phosphorothioate		0.05 g
RSP015	Azodrin		Dimethyl-1-methoxycarbonyl-1-propen-2-yl phosphate	98%	12.00/10mg
RSP016	Bandane		2-methylthiocarbamoyloxyimino-2-(methylthio)-propionaldehyde O-(methylcarbamoyl)oximes	Tech	12.00/10mg
RSP017	Banvel-D	Dicamba	3,6-Dichloro-o-anisic acid	98%	20/40/100mg
RSP018	Baron	See Jacbon			
RSP019	Bayadan	See Dasanon			
RSP020	Baygon	Agroxarb Unden	2-Isopropoxyphenyl methylcarbamate	Tech	10.00/g
RSP021	Benzyl Benzoate		Benzyl Benzoate	98%	10.00/g
RSP022	BHC mix		Hexachlorocyclohexane isomers	Tech	0.05/g
RSP023	α BHC		Alpha-1,2,3,4,5,6-Hexachlorocyclohexane	99%	20.00/100mg
RSP024	β BHC		Beta-1,2,3,4,5,6-Hexachlorocyclohexane	99%	20.00/100mg
RSP025	γ BHC	See Lindane			
RSP026	δ BHC		Delta-1,2,3,4,5,6-Hexachlorocyclohexane	99%	20.00/100mg
RSP027	Bromacil	Acanex Hyvar-X	5-Bromo-3-sec-butyl-6-methyluracil 3-bromo-sec-butyl-6-methyluracil	98%	10.00/g
RSP028	Bufencarb		2-(1-Methylbutyl)-phenyl methylcarbamate	Tech	10.00/g
RSP029	Butacarb	See Sevin-xl			
RSP030	Butonate	Tandex			
RSP031	Butoxycarboxim	Butoxycarb Marvel	3-(Methylthio)butanone O-(methylcarbamoyl)oxime	98%	10.00/g
RSP032	Butylate	Sutan	S-Ethyl-N,N-dibutylthiocarbamate	Tech	10.00/g
RSP033	Cacodylic Acid	Phytar 560	Dimethylarsinic acid	99%	10.00/g
RSP034	Calcium Arsenate		Tricalcium orthoarsenate	98%	10.00/g
RSP035	Captafol	Difolatan	N-(1,1,2,2-Tetrachloroethylthio)-4-cyclohexene-1,2-dicarboximide	98%	10.00/g
RSP036	Captan	Merpan	N-(Trichloromethylthio)-4-cyclohexene-1,2-dicarboximide	98%	10.00/g
RSP037	Carbaryl	Sevin	1-Naphthyl methylcarbamate	99%	10.00/g
RSP038	Carbofuran	Furadan	2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate	98%	10.00/g
RSP039	Carbofuran phenol		2,3-Dihydro-2,2-dimethyl-7-benzofuranol	98%	10.00/g
RSP040	Carbophenothion	Trithion	S-[[(p-Chlorophenyl)thio]methyl]-O,O-diethyl phosphorodithioate	98%	10.00/g
RSP041	Chlorbenside		1-Chloro-4-[(p-chlorobenzyl)thio]benzene	98%	10.00/g
RSP042	Chlordane		1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene	98%	10.00/g
RSP043	Chlordane, cis		cis-1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene	98%	10.00/g
RSP044	Chlordane, trans		trans-1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene	98%	10.00/g
RSP045	Chlordecone	Kepone	1,1a,3,3a,4,5,5,5a,5b,6-Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta[cd]pentalen-2-one	98%	10.00/g
RSP046	Chlorfenvinphos	Birlane	2-Chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate	98%	10.00/g
RSP047	Chlorobenzilate		Ethyl 4,4'-dichlorobenzilate	98%	10.00/g
RSP048	Chloroneb	Demosan	1,4-Dichloro-2,5-dimethoxybenzene	98%	10.00/g
RSP049	Chloropropylate		Isopropyl 4,4'-dichlorobenzilate	98%	10.00/g
RSP050	Chlorothalonil	Bravo Daconil 2787	Tetrachloroisophthalonitrile	98%	10.00/g
RSP051	Chlorpyrifos	Dursban Lorsban	O,O-Diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate	98%	10.00/g
RSP052	Chlorpyrifos methyl	Reldan	O,O-Dimethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate	98%	10.00/g
RSP053	Chlorthiophos		O-[4-Methylthio-3-methylphenyl]-O,O-dimethyl phosphorothioate	98%	10.00/g
RSP054	Cinerin I		2-Allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of chrysanthemic acid	98%	10.00/g
RSP055	Cinerin II		2-Allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one ester of pyrethric acid	98%	10.00/g
RSP056	Clofentezine		3,6-Bis(2-chlorophenyl)-1,2,4,5-tetrazine	98%	10.00/g
RSP057	Coumaphos	Co-Ral Muscatox	O,O-Diethyl O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate	98%	10.00/g
RSP058	Crotoxyphos	Ciodrin	1-Phenylethyl 3-hydroxycrotonate dimethyl phosphate	98%	10.00/g
RSP059	Crufomate	Ruelene	4-tert-Butyl-2-chloro-methylphosphoramidate	98%	10.00/g
RSP060	Cryolite	Kryocide	Sodium aluminum fluoride	98%	10.00/g
RSP061	Cyanazine	Bladex	2-[[4-Chloro-6-(ethylamino)-S-triazin-2-yl]amino]-2-methylpropionitrile	98%	10.00/g
RSP062	Cyanophos	Cyanox	O,O-Dimethyl O-4-cyanophenyl phosphorothioate	98%	10.00/g
RSP063	Cycloate	Ro-Neet	S-Ethyl-N-cyclohexyl-N-ethylthiocarbamate	Tech	12.00/g
RSP064	Cyhexatin	Plictran	Tricyclohexylhydroxystannane	98%	10.00/g
RSP065	Cypermethrin	Ripcord Cymbush	(RS)-alpha-cyano-3-phenoxybenzyl (1RS,3RS;1RS,3SR)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate	98%	10.00/g
RSP066	Cyromazine	Trigard	N-Cyclopropyl-S-triazine-2,4,6-triamine	98%	10.00/g
RSP067	2,4-D		2,4-Dichlorophenoxyacetic acid	98%	10.00/g
RSP068	2,4-D Acid		2,4-Dichlorophenoxyacetic acid	98%	10.00/g
RSP069	2,4-D Butoxyethanol Ester		2-Butoxyethyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP070	2,4-D Butyl Ester		Butyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP071	2,4-D Dimethylamine		Dimethylamine 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP072	2,4-D Ethyl Ester		Ethyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP073	2,4-D Isooctyl Ester		Isooctyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP074	2,4-D Isopropyl Ester		Isopropyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP075	2,4-D Methyl Ester		Methyl 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP076	2,4-D Sodium Salt		Sodium 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP077	2,4-D Triethylamine		Triethylamine 2,4-dichlorophenoxyacetate	98%	10.00/g
RSP078	2,4-DB		4-(2,4-Dichlorophenoxy)butyric acid	98%	10.00/g
RSP079	2,4-DB Butyl Ester		Butyl 4-(2,4-dichlorophenoxy)butyrate	98%	10.00/g
RSP080	2,4-DB Dimethylamine		Dimethylamine 4-(2,4-dichlorophenoxy)butyrate	98%	10.00/g
RSP081	2,4-DB Isooctyl Ester		Isooctyl 4-(2,4-dichlorophenoxy)butyrate	98%	10.00/g
RSP082	2,4-DB Sodium Salt		Sodium 4-(2,4-dichlorophenoxy)butyrate	98%	10.00/g
RSP083	2,4-DB Triethylamine		Triethylamine 4-(2,4-dichlorophenoxy)butyrate	98%	10.00/g
RSP084	DDD	TDE	1,1-Dichloro-2,2-bis(p-chlorophenyl)ethane	98%	10.00/g
RSP085	DDE		1,1-Dichloro-2,2-bis(p-chlorophenyl)ethylene	98%	10.00/g
RSP086	DDT		1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane	98%	10.00/g
RSP087	Decamethrin	Deltamethrin	(S)-alpha-cyano-3-phenoxybenzyl (1R,3R)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate	98%	10.00/g
RSP088	Demeton	Systox	O,O-Diethyl O-2-ethylthioethyl thiophosphate mixture with O,O-diethyl S-2-ethylthioethyl thiophosphate	98%	10.00/g
RSP089	Demeton-S-methyl	Metasystox	O,O-Dimethyl S-2-ethylthioethyl thiophosphate	98%	10.00/g
RSP090	Diallate	Avadex BW	S-2,3-Dichloroallyl N,N-diisopropylthiocarbamate	Tech	12.00/g
RSP091	Diazinon	Basudin Dizinon Knoxout	O,O-Diethyl O-2-isopropyl-6-methyl-4-pyrimidinyl phosphorothioate	98%	10.00/g
RSP092	Dicamba	Banvel-D	3,6-Dichloro-o-anisic acid	98%	20.00/100mg
RSP093	Dichlofenthion	Nemafos Nemaphos	O-2,4-Dichlorophenyl O,O-diethyl phosphorothioate	98%	10.00/g
RSP094	Dichlone	Phygon	2,3-Dichloro-1,4-naphthoquinone	98%	10.00/g
RSP095	Dichlorophen	Anchor Mycidin	2,2'-Dihydroxy-5,5'-dichlorodiphenylmethane	98%	10.00/g
RSP096	Dichlorvos	DDVP Vapona	O,O-Dimethyl O-2,2-dichlorovinyl phosphate	98%	10.00/g
RSP097	Dicofol	Kelthane	2,2,2-Trichloro-1,1-bis(p-chlorophenyl)ethanol	98%	10.00/g
RSP098	Dicofol, o,p'		2,2,2-Trichloro-1-(o-chlorophenyl)-1-(p-chlorophenyl)ethanol	98%	10.00/g
RSP099	Dicofol, p,p'		2,2,2-Trichloro-1,1-bis(p-chlorophenyl)ethanol	98%	10.00/g
RSP100	Dicrotophos	Bidrin	2-Dimethylcarbamoyl-1-methylvinyl dimethyl phosphate	98%	10.00/g
RSP101	Dieldrin		1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,exo-5,8-dimethanonaphthalene	98%	10.00/g
RSP102	Diethatyl		N-(Chloroacetyl)-N-(2,6-diethylphenyl)glycine	98%	10.00/g
RSP103	Diethatyl Ethyl		Ethyl N-(chloroacetyl)-N-(2,6-diethylphenyl)glycinate	98%	10.00/g

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Catalog #	Product	Synonym	Active Ingredient	% A.I.	Price
RSP079	Captan	Orthocide	N-Trichloromethylthio-4-cyclohexene 1, 2-dicarboximide	99%	16.00/g
———	Carbaryl	See Sevin			
———	Carbophenothion	See Trithion			
———	Carbophos	See Malathion			
———	Cardiba	See Ethyl Hexane Diol			
RSP080	Chlorbenside	Sulfide Chlorparacide Chloroniphacide Mitox	p-chlorobenzyl-p-chlorophenyl	99%	12.00/100mg
RSP004 •	Chlordane	Octachlor	1, 2, 3, 4, 5, 6, 7, 8, 8-Octachloro-3a, 4, 7 7a tetrahydro-4, 7-methane indene	Tech	14.00/g
RSP081	Chloroacetic acid	Monochloro-acetic Acid	Chloroacetic Acid	99%	6.00/g
RSP082	Chlorobenzilate		Ethyl 4, 4-dichlorobenzilate	99%	18.00/g
RSP083	Chlorobenzilate, tech		Ethyl-4, 4-dichlorobenzilate	45%	4.00/g
———	Chlorophos	See Trichlorfon			
———	Chloropicrin	See Trichloronitromethane			
———	Chloroniphacide	See Chlorbenside			
———	Chlorparacide	See Chlorbenside			
RSP084	Clodrin		α-Methyl benzyl-3-(dimethoxyphosphinyloxy)-cis-crotonate	85%	16.00/g
RSP005 •	Co-Ral	Coumaphos	O, O-Diethyl-O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate	99%	23.00/100mg
RSP085	Co-Ral, tech		O, O-Diethyl-O-(3-chloro-4-methyl 2-oxo-2H-1-benzopyran-7-yl phosphorothioate		8.00/g
———	Coumadene	See Warfarin			
———	Coumaphor	See Co-Ral			
RSP086	Cycloheximide	Acti-dione	3-[2-(3, 5-Dimethyl 2-oxycyclohexyl)-2-hydroxyethyl] glutarimide	Tech	12.00/g
———	Cygon	See Dimethoate			
———	Cymen	See Zinophos			
RSP087	Cyprex	Dodine	n-dodecylguanidine acetate	99%	20.00/100mg
RSP088	Cyprex, tech		n-dodecylguanidine acetate		6.00/g
RSP006 •	2, 4-D Acid		2-(2, 4-Dichlorophenoxy) acetic acid	99%	12.00/100mg
RSP007 •	2, 4-D Acid-Methyl Ester		2-(2, 4-Dichlorophenoxy) acetic acid methyl ester	99%	16.00/100mg
RSP089	Dacthal	DCPA	Dimethyl-2, 3, 5, 6-tetrachloroterephthalate	99%	16.00/g
RSP090	Dalapon		2, 2-Dichloropropionic Acid	99%	20.00/100mg
———	Dalf	See Methyl Parathion			
RSP091	Dazomet	Mylone	3, 5-Dimethyl 1, 3, 5, 2H tetrahydrothiadiazine-2-thione	95%	12.00/g
———	DCPA	See Dacthal			
RSP008	DDD mix	TDE mix	1, 1-Dichloro-2, 2-(chlorophenyl) ethane	Tech (isomer mix)	3.00/g
RSP092 •	p-DDD	o, p-TDE	1, 1-Dichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethane	99%	12.00/100mg
RSP009 •	p, p-DDD	p, p-TDE	1, 1-Dichloro-2, 2-bis (p-chlorophenyl) ethane	99%	20.00/100mg
RSP047	o, p-DDE	o, p-DDX	1, 1-Dichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethylene	99%	20.00/100mg
RSP010 •	p, p-DDE	p, p-DDX	1, 1-Dichloro-2, 2-bis (p-chlorophenyl) ethylene	99%	25.00/g
RSP011 •	DDT mix		1, 1, 1-Trichloro-2, 2-bis (chlorophenyl) ethylene	Tech (isomer mix)	2.00/g
RSP012 •	o, p-DDT		1, 1, 1-Trichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethane	99%	25.00/g
RSP013 •	p, p-DDT		1, 1, 1-Trichloro-2, 2-bis (p-chlorophenyl) ethane	99%	12.00/g
——— •	DDVP	See Dichlorvos			
———	o, p-DDX	See o, p-DDE			
———	p, p-DDX	See p, p-DDE			
RSP093	DFET	Delphene Detamide	N, N-Diethyl-m-toluamide	95%	12.00/g

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Catalog #		Product	Synonym	Active Ingredient	% A.I.	Price
RSP015	•	DEF		S S S-Tributyl phosphorotrithioate	94%	22.00/100mg
———		Delphene	See DEET			
RSP016	•	Demeton	Systox	Mix of O,O-Diethyl-O-2-(ethyl thio) ethyl phosphorothioate and O,O-Diethyl-S-2-(ethylthio) ethyl phosphothioate	Tech	30.00/100mg
———		Detamide	See DEET			
RSP094		Dexon		p-Dimethylamino benzenediazo sodium sulfonate	94%	12.00/100mg
———		DFA	See Diphenylamine			
———		Di-Allate	See Avadex			
RSP017	•	Diazinon	Basudin	O,O-Diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	99%	12.00/100mg
RSP095		Diazinon tech		O,O-Diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	46%	8.00/g
RSP018	•	Dibrom	Naled	1,2-Dibromo-2,2-dichloroethyl dimethyl phosphate	93%	12.00/100mg
RSP088		Dibutylphthalate		Dibutylphthalate	98%	12.00/g
———		Dicamba	See Banvel D			
———		Dicaptan	See Dicaptheon			
RSP097		Dicaptheon	Dicaptan	O-(2-Chloro-4-nitrophenyl)-O,O-dimethyl phosphorothioate	99.8%	12.00/100mg
———		Dichlone	See Phygon			
RSP098		o-Dichlorobenzene		o-Dichlorobenzene	99%	8.00/g
RSP099		p-Dichlorobenzene		p-Dichlorobenzene	99%	8.00/g
RSP100		2,4-Dichlorophenol		2,4-Dichlorophenol	99%	8.00/g
———		Dichloroprop	See 2,4-DP Acid			
RSP014		Dichlorvos	DDVP Herkol Vapona	O,O-Dimethyl-O-(2,2-dichlorovinyl) phosphate	99%	12.00/100mg
———		Dicofol	See Kelthane			
RSP019	•	Dieldrin	Hexd	1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,exo-5,8-dimethanonaphthalene	85%	10.00/g
RSP101		Dilatan		N-(1,1,2,2-Tetrachloroethylsulfenyl) cis-Δ4-cyclohexene-1,2-dicarboximide	99%	12.00/100mg
———		Dimeton	See Phosphamidon			
RSP102		Dimethoate	Rogor Cygon Fortion	O,O-Dimethyl S-(N-Methyl carbamoyl-methyl) phosphorodithioate	98%	22.00/g
RSP103		Dimethyl Phthalate		Dimethyl Phthalate	99%	12.00/g
———		Dimmap	See Karathane			
RSP104		Dinosb	DNBP	2,4-Dinitro-6-sec-butyl phenol	99%	12.00/100mg
RSP105		Diphacin	Diphacinone	2-Diphenyl-acetyl-1,3-indandione	Tech	12.00/100mg
———		Diphacinone	See Diphacin			
RSP106		Diphenamid	Dymid Enid	N,N-Dimethyl 2,2-diphenylacetamide	Tech	12.00/g
RSP107		Diphenyl-Amine	DFA	Diphenylamine	99%	12.00/g
———		Diptrex	See Trichlorfon			
———		Diptrex	See Trichlorfon			
———		Disulfoton	See Di-Syston			
RSP108		Di-Syston	Disulfoton	O,O-Diethyl S-2-(ethylthio) ethyl phosphorodithioate	97%	10.00/g
———		Dithane-Manganese	See Maneb			
———		Dithane-Zinc	See Zineb			
———		DMPA	See Zytron			
———		DNBP	See Dinosb			
———		DNTP	See Parathion			
———		Dodine	See Cyprex			
———		Dowco 136	See Barlene			
RSP109		2,4-DP Acid	Dichloroprop	2-(2,4-Dichlorophenoxy) propionic acid	99%	12.00/100mg
———		DTMC	See Kelthane			
———		Dupher	See Trithion			
RSP110		Dursban		O,O-Diethyl-O-(3,5,6-trichloro-2-pyridyl) phosphorothioate	98%	12.00/100mg

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PESTICIDE STANDARDS

Catalog #		Product	Synonym	Active Ingredient	% A.I.	Price
------		Dyfonate	See Trichlorfon			
------		Dymid	See Diphenamid			
------		Endosulfan	See Thiodan			
RSP080	•	Endrin		1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene	100%	10.00/g
RSP111		Endrin tech		1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethanonaphthalene	97%	6.00/g
------		Fuid	See Diphenamid			
RSP021	•	EPN		O-Ethyl-O-p-nitrophenyl phenylphosphorothionate	97%	12.00/100mg
RSP112		Erbon	Baron	2-(2,4,5-Trichlorophenoxy)ethyl-2,2-dichloropropionate	Tech	6.00/g
------		Esfenvalle	See Ovex			
RSP022	•	Ethion	Nialate	O,O,O',O-Tetraethyl-S,S'-methylene bisphosphorodithioate	95%	22.00/100mg
RSP113		Ethyl Hexanediol	Cutrilin	3-Ethyl-1,3-Hexanediol	Tech	12.00/g
------		Ethion	See Parathion			
RSP115		Eugenol		Eugenol	99%	12.00/g
RSP114		Fenitrothion	Folithion Sumithion	O,O-Dimethyl-O-(4-nitro-m-tolyl) phosphorothioate	99%	20.00/100mg
RSP053		Fenitrothion tech		O,O-Dimethyl-O-(4-nitro-m-tolyl) phosphorothioate	95%	12.00/g
RSP116		Fenthion		O,O-Dimethyl O-(4-methylthio) m-tolyll phosphorothioate	Tech	18.00/100mg
------		Fenuron	See Silvex			
------		Folidol	See Parathion			
------		Folithion	See Fenitrothion			
------		Folpet	See Phaltan			
------		Forstan	See Morestan			
------		Fostion	See Dimethoate			
RSP117		Fumagone		1,2-Dibromo-3-chloropropane	Tech	6.00/g
------		Genidrom	See Prometone			
------		Genosil	See Propazine			
------		Genoprim	See Atrazine			
------		Genogard	See Prometryne			
------		Genotop	See Simazine			
------		Guesthion	See Azinphosmethyl			
------		Guthion	See Azinphosmethyl			
------		HCB	See Hexachlorobenzene			
------		HEDD	See Dieldrin			
RSP034	•	Heptachlor	Methanotetradene	1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindan heptene	97.4%	18.00/g
RSP035	•	Heptachlor		1,4,5,6,7,8,8-Heptachloro-2,3-epoxy-3a,4,7,7a-tetrahydro-4,7-methanoindan	86%	35.00/100mg
------		Herbol	See Dichlorvos			
RSP081		Hexachlorobenzene	HCB	Hexachlorobenzene	99%	16.00/g
RSP118		Imidan		O,O-Dimethyl-S phthalimidomethyl phosphorodithioate	95%	18.00/g
RSP119		IPC		Isopropyl N-phenylcarbamate	Tech	6.00/g
------		Isocathane	See Karathane			
RSP180		Karathane	Acethane Dinocap Isocathane Mildex	2-(1-Methyl-n-heptyl)-4,6-dinitrophenyl crotonate	95%	20.00/g
------		Karbofos	See Malathion			
RSP020	•	Kelthane	Dicofol DTMC	1,1-bis(4-Chlorophenyl)-2,2,2-trichloroethanol	80%	17.00/g
RSP131		Kelthane tech		1,1-bis(4-Chlorophenyl)-2,2,2-trichloroethanol		8.00/g
RSP045		Lannate	Methomyl	S-Methyl-N-[(Methylcarbamoyl)oxy]thioacetimidate	90%	16.00/g
RSP132		Lethane 384		2-(2-Butoxyethoxy)ethyl thiocyanate	53%	12.00/g

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Catalog #	Product	Synonym	Active Ingredient	% A.I.	Price
RSP027	• Lindane	Gamma BHC (γ BHC)	Gamma-1,2,3,4,5,6-Hexachlorocyclohexane	99%	20.00/g
RSP028	• Malathion	Carbophos Karbofos	S-[1,2-bis (Ethoxycarbonyl) ethyl]-O, O-dimethyl phosphorodithioate	99%	20.00/g
RSP123	Malathion, tech		S-[1,2-bis (Ethoxycarbonyl) ethyl]-O, O-dimethyl phosphorodithioate	95%	6.00/g
------	Multi	See Thiodan			
RSP124	Maneb	Dithane manganese Manzate	Ethyl ethylidithiocarbamate manganese	99%	12.00/100mg
------	Manzate	See Maneb			
RSP125	Mareil	Aminocarb	4-Dimethylamino-3-tolyl-N-methylcarbamate	99%	12.00/100mg
RSP126	Mennol		(N-Methylmercuri) 1,4,5,6,7,7-hexachlorobicyclo-12,2,11-hept-5-ene-2,3-dicarboximide	99.7%	20.00/100mg
RSP127	Metasystox-R	Oxydemeton methyl	O,O-Dimethyl-S-[2-(ethylsulfinyl) ethyl] phosphorothioate	50%	12.00/g
------	Methomyl	See Lannate			
RSP029	• Methoxychlor	Methoxy DDT DMDT	1,1,1-Trichloro-2,2-bis (p-methoxyphenyl) ethane	98%	17.00/g
RSP128	Methoxychlor, tech		1,1,1-Trichloro-2,2-bis (p-methoxyphenyl) ethane	89.5%	8.00/g
------	Methoxy Propazine	See Prometone			
------	Methyl Guthion	See Azinphosmethyl			
RSP129	Methyl Paraoxon		O,O-Dimethyl-O-p-nitrophenyl phosphate	98%	12.00/g
RSP052	Methyl Parathion	Dalf Nitrox	O,O-Dimethyl-O-p-nitrophenyl phosphorothioate	99%	12.00/100mg
RSP130	Methyl Parathion, tech		O,O-Dimethyl-O-p-nitrophenyl phosphorothioate	85%	6.00/g
------	Mevinphos	See Phosdrin			
------	Mildex	See Karathane			
------	Mintacol	See Para-oxon			
RSP080	Mirex		Dodecachlorooctahydro-1,3,4-metheno-2H-cyclobuta (cd) pentalene	98%	18.00/g
------	Mitox	See Chlorbenzide			
------	Monochloroacetic Acid	See Chloroacetic Acid			
RSP131	Morestan, tech	Forstan	6-Methyl-2-oxo-1,3-dithio (4,5-b) quinoxaline	87%	12.00/g
------	Morocide	See Binapacryl			
------	Naled	See Dibrom			
------	Negavon	See Trichlorfon			
------	Nemafos	See Zinophos			
------	Nialate	See Ethion			
------	Niran	See Parathion			
------	Nitrostigmine	See Parathion			
------	Nitrox	See Methyl Parathion			
------	NPA	See Alanap			
------	Octachlor	See Chlordane			
------	Octalene	See Aldrin			
------	OMPA	See Schradan			
------	Orthocide	See Captan			
RSP132	Ovex	Estomate Ovochlor Ovotran	p-Chlorophenyl p-chlorobenzene sulfonate	99%	12.00/g
RSP133	Ovex, tech		p-Chlorophenyl p-chlorobenzene sulfonate		4.00/g
------	Ovochlor	See Ovex			
------	Ovotran	See Ovex			
------	Oxydemetonmethyl	See Metasystox-R			
RSP134	Panogen		Methylmercuric dicyandiamide	[illegible] 90%	12.00/g
RSP030	• Paraoxon	Mintacol	O,O-Diethyl-o-p-nitrophenyl phosphate (oxygen analog of parathion)	99%	12.00/100mg
RSP135	Paraquat Dichloride		1,1-Dimethyl-4,4-dipyridinium dihydrochloride	99%	12.00/100mg

MONS 212624

PESTICIDE STANDARDS

Catalog #	Product	Synonym	Active Ingredient	% A.I.	Price
RSP031	Parathion	Folidol Niran Ettion Rhodiatox Thiophos Nitrostigmine Alkron AAT SNP DNTP.	O, O-Diethyl-o-p-nitrophenyl phosphorothioate	99.7%	15.00/100mg
RSP136	Parathion, tech		O, O-Diethyl-o-p-nitrophenyl phosphorothioate	Tech.	12.00/g
RSP137	Paris Green		Copper acetoarsenite	91.7%	6.00/g
RSP138	Parnon		Bis (p-chlorophenyl)-3-pyridine methanol	Tech	12.00/100mg
------	Parzate	See Zineb			
RSP139	PCNB		Pentachloronitrobenzene	99%	8.00/g
------	PCP	See Pentachlorophenol			
RSP140	Pentachlorophenol	PCP Santobrite	Pentachlorophenol	99%	20.00/g
RSP141	Perthane		1, 1-dichloro-2, 2-bis (p-ethylphenyl) ethane	95%	12.00/g
------	Pestos	See Schradan			
RSP142	Phaltan	Folpel Thiophol	N-Trichloromethylthiophthalimide	99%	12.00/100mg
RSP143	Phaltan, tech		N-Trichloromethylthiophthalimide		
------	Phenacide	See Tozaphene		93.3%	6.00/g
------	Phenatox	See Tozaphene			
RSP038 •	Phenothiazine		Phenothiazine	Fract	12.00/g
------	Phorate	See Thimet			
RSP033 •	Phosdrin	Mevinphos	2-Carbomethoxy-1-propen-2-yl dimethyl phosphate	60%	18.00/g
RSP144	Phosphamidon	Dimecron	1-chlorodiethyl carbamoyl-1-propen-2-yl-dimethyl phosphate	99%	15.00/g
RSP145	Phosphamidon		1-chlorodiethyl carbamoyl-1-propen-2-yl-dimethyl phosphate	87.8%	8.00/g
RSP146	Phygon	Dichlone	2, 3-Dichloro-1, 4-naphthoquinone	Tech	12.00/g
RSP147	Piperonyl Butoxide	Butoxide	1, 2 (2-n-Butoxyethoxy)-ethoxy-4, 5-methylene dioxy-2-propyltoluene	90%	16.00/g
RSP148	Plantvox		2, 3-Dihydro-5-carboxanilide-6-methyl-1, 4-oxathiin-4, 4-dioxide	97%	22.00/g
RSP149	Pramex		N, N-Di-n-butyl-p-chlorobenzene sulfonamide	Tech.	8.00/g
------	Preventol I	See 2, 4, 5-Trichlorophenol			
RSP150	Prolan		2-Nitro-1, 1-bis (p-chlorophenyl) propane	99%	16.00/100mg
RSP155	Prometone	Methoxypropazine Gesafram	2, 4-Bis-(isopropylamino)-6-methoxy-5-triazine	99%	14.00/g
RSP034 •	Prometryne	Caparol Gesagard	2-Methyl-mercapto-4, 6-bis (isopropyl amino) 5-triazine	99%	15.00/100mg
RSP035 •	Propazine	Gesamil	2-Chloro-4, 6-bis (isopropyl amino) -5-triazine	98.7%	14.00/100mg
RSP151	Propylisome		Di-n-propyl-3-methyl-6, 7-methylene-dioxy 1, 2, 3, 4-tetrahydroxyphthalene-1, 2-dicarboxylate	Tech.	18.00/g
RSP152	Randox	CDAA	2-Chloro-N, N-diallyl acetamide	Tech	8.00/g
------	Rhodiatox	See Parathion			
------	Rogor	See Dimethoate			
RSP038 •	Ronnel		Dimethyl 2, 4, 5-trichlorophenyl phosphorothionate	99%	14.00/g
RSP152	Ronnel, tech		Dimethyl 2, 4, 5-trichlorophenyl phosphorothionate	Tech.	6.00/g
RSP054	Ruelene	Dowco 132	4-tert-Butyl 2-chlorophenyl methylmethyl phosphoramidite	99%	12.00/100mg
RSP154	Ruelene, tech		4-tert-Butyl 2-chlorophenyl methylmethyl phosphoramidite		8.00/g
------	Santobrite	See Pentachlorophenol			

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PESTICIDE STANDARD

Catalog #	Product	Synonym	Active Ingredient	% A.I.	Price
RSP038 •	Schradan	OMPA Pestox Sytem	Octamethylpyrophosphoramide	99.8%	11.00/g
RSP173	Schradan, tech		Octamethylpyrophosphoramide	95%	8.00/g
RSP170 •	Sevin	Carbaryl	1-Naphthyl N-methyl carbamate	99%	21.00/100mg
RSP171	Silvex	Fenoprop	2-(2,4,5-Trichlorophenoxy) propionic Acid	99%	16.00/100mg
RSP172	Silvex, tech		2-(2,4,5-Trichlorophenoxy) propionic Acid		8.00/g
RSP039 •	Simazine	Gesatop	2-chloro-4,6-bis (ethylamino)-S-triazine	99.3%	11.00/100mg
------	SNP	See Parathion			
RSP174	Spergon	Chloranil	Tetrachloro-p-benzoquinone	Tech	8.00/g
RSP176	Strobane		Terpene polychlorinates	65% Chlorine	16.00/g
------	Sulfo-Cide	See Sulfoxide			
RSP178	Sulfoxide	Sulfoxyl Sulfo-cide	1,2-Methylenedioxy-4-(2-(octyl sulfinyl) propyl) benzene	88%	12.00/g
------	Sulfoxyl	See Sulfoxide			
------	Sumathion	See Fenitrothion			
------	Systox	See Demeton			
------	Sytem	See Schradan			
RSP177	2,4,5-T-acid		2,4,5-Trichlorophenoxyacetic Acid	99%	16.00/100mg
RSP176	2,4,5-T-acid		2,4,5-Trichlorophenoxyacetic Acid	Tech	6.00/g
------	TCDS	See Tedion			
------	TDE mix	See DDD mix			
------	o,p-TDE	See o,p-DDD			
------	p,p-TDE	See p,p-DDD			
RSP156	Tedion	Duphar Tetradifon TCDS	p-Chlorophenyl 2,4,5-trichlorophenyl sulfone	99%	16.00/g
RSP157	2,3,4,6-Tetrachlorophenol		2,3,4,6-Tetrachlorophenol	99%	12.00/100mg
------	Tetradifon	See Tedion			
RSP158	Thimet	Phorate	O,O-Diethyl S-(ethylthio) methyl phosphorodithioate	98.8%	16.00/g
RSP159	Thimet, tech		O,O-Diethyl S-(ethylthio) methyl phosphorodithioate	91%	6.00/g
RSP040 •	Thiodan	Endosulfan Malix	6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide	98%	23.00/100mg
------	Thionazin	See Zinophos			
------	Thiophal	See Phaltan			
------	Thiophos	See Parathion			
RSP041 •	Toxaphene	Phenacide Phenatox	Polychlorinated camphene	Tech	17.00/g
RSP042 •	Trichlorfon	Tugon Chlorophos Dipterex Dylox Neguvon Dipterex	O,O-Dimethyl (1-hydroxy-2,2,2-trichloroethyl) phosphonate	98%	12.00/g
RSP160	Trichloro-nitromethane	Chloropicrin Acquinite	Trichloronitromethane	99%	12.00/g
RSP161	2,4,5-Trichlorophenol	Preventol I	2,4,5-Trichlorophenol	99%	10.00/100mg
RSP162	2,4,6-Trichlorophenol		2,4,6-Trichlorophenol	99%	10.00/100mg
RSP055	Trithion	Carbophenothion	S-(1-p-Chlorophenyl) thiol methyl O,O-diethyl phosphorodithioate	95%	16.00/g
------	Tugon	See Trichlorfon			
------	Undeu	See Baygon			
------	Vapona	See Dichlorvos			
RSP163	Vitrex		Methyl isothiocyanate	29%	12.00/g
RSP043 •	Warfarin	Coumafene	3-(α-Acetonylbenzyl)-4-hydroxycoumarin	Tech	10.00/100mg

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PESTICIDE STANDARDS

Catalog #	Product	Synonym	Active Ingredient	% A.I.	Price
RSP184	Zectran		4-dimethyl amino-3, 5-xylyl-N-Methyl carbamate	99%	18.00/g
RSP185	Zectran tech		4-dimethyl amino-3, 5-xylyl-N-Methyl carbamate	95%	8.00/g
RSP186	Zineb	Dithane-zinc Panzate	Zinc ethylene bisdithiocarbamate	75%	20.00/g
RSP187	Zinophos	Timonazan Cynea Nemafos	O, O-Diethyl O-2-pyrazinyl phosphorothioate	99%	16.00/100mg
RSP188	Zytron	DNBPA	O-(2, 4-Dichlorophenyl)-O-methyl isopropyl phosphoramidothioate	99%	12.00/100mg
RSP189	Zytron, tech		O-(2, 4-Dichlorophenyl)-O-methyl isopropyl phosphoramidothioate	Tech	6.00/g

PRECOATED TLC PLATES from ANALABS

Analabs TLC plates are of precision quality. They are precoated using procedures developed by leading chromatographic investigators.

The prescored 20 x 20 cm plate can be snapped in sections for two 10 x 20 cm, or four 5 x 20 cm plates. Scoring on the uncoated side makes snapping the plates easy. A clear edge on the plate allows the plate to be grasped without disturbing the coating. Separation information can be marked in this area.

ORDERING INFORMATION
20 x 20 cm PRECOATED PLATES 250μ thick 25 PLATES/BOX

NUMBER CATALOG	*TLC PLATE TYPE*	*PRESCORED PRICE*		*UNSCORED PRICE*
		5 x 20 cm	10 x 20 cm	20 x 20 cm
TLP-001	Anasil G	$30	$26	$22
TLP-002	Anasil GF (254)	$30	$26	$22
TLP-003	Anasil H	$30	$26	$22
TLP-004	Anasil HF (254)	$30	$26	$22
TLP-005	Silica Gel G	$30	$26	$22
TLP-006	Silica Gel GF (254)	$30	$26	$22
TLP-007	Microcrystalline Cellulose (Avicel)	$31	$27	$23
TLP-008	Microcrystalline Cellulose, F (254) (Avicel)	$31	$27	$23

Analabs precoated plates are guaranteed to arrive at your laboratory in condition for immediate use. Any plates that arrive damaged will be replaced at no cost to you and no troublesome paperwork.

MONS 212627

CEP[illegible] 2187

PESTICIDEGRADE SOLVENTS

Pesticidegrade Solvents are certified to contain no interfering substance greater than that equivalent to 10 parts per trillion of a chlorinated pesticide.

Catalog #	*Solvent*		*Unit*	*Price*
SSP001	Acetone, Presticidgrade Water	0.05% max.	1 Liter	$14.00
SSP002	Acetonitrile, Pesticidegrade Water	0.05% max	1 Liter	15.00
SSP003	Benzene, Pesticidegrade Water	0.03% max.	1 Liter	12.00
SSP004	2-Butanone, Pesticidegrade Water	0.05% max.	1 Liter	13.00
SSP005	Butyl Alcohol, Pesticidegrade Water	0.05% max.	1 Liter	12.00
SSP006	iso-Butyl Alcohol, Pesticidegrade Water	0.05% max.	1 Liter	15.00
SSP007	Carbon Tetrachloride, Pesticidegrade Water	0.02% max.	1 Liter	16.00
SSP008	Chloroform, Pesticidegrade Water	0.02% max.	1 Liter	17.00
SSP009	Cyclohexane, Pesticidegrade Water	0.02% max.	1 Liter	16.00
SSP010	Dichloromethane, Pesticidegrade Water	0.02% max.	1 Liter	16.00
SSP011	N, N-Dimethylformamide, Pesticidegrade Water	0.05% max.	1 Liter	19.00
SSP012	p-Dioxane, Pesticidegrade Water	0.05% max.	1 Liter	17.00
SSP013	Ether, Pesticidegrade Water	0.05% max.	1 Liter	12.00
SSP014	Ethyl Acetate, Pesticidegrade Water	0.05% max.	1 Liter	13.00
SSP015	Ethyl Alcohol, Pesticidegrade Completely Denatured Water	0.05% max.	1 Liter	12.00
SSP016	Heptane, Pesticidegrade Water	0.03% max.	1 Liter	13.00
SSP017	Hexane, Pesticidegrade Water	0.02% max.	1 Liter	12.00
SSP018	Methanol, Pesticidegrade Water	0.05% max.	1 Liter	11.00
SSP019	Methylsulfoxide, Pesticidegrade Water	0.05% max.	1 Liter	21.00
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MONS 212628

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A POLLUTION CHEMICAL
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