Phosphorus Products

Organophosphorus compounds are the class of organic compounds containing carbon–phosphorus bonds. However, it is not necessary for the organophosphorus compounds to have direct phosphorus-carbon (P-C) bonds in order to be called an organophosphorus compound. Examples of phosphorus compounds are esters of organophosphorus acids ($P(=O)(OR)_3$), phosphonic esters ($RP(=O)(OR')_2$), phosphine oxides ($R_3P=O$), phosphites ($P(OR)_3$), organic fluorophosphate salts, organic phosphate salts, organophophorus acid halides, organophosphorus amides, organophosphorus complexes, and organophosphorus halides. Phosphines, phosphaalkenes, and phosphaalkynes are organophosphorus (III) compounds formed when phosphorus uses (1) three single bonds, (2) a double bond and a single bond and (3) a triple bond respectively for bonding.

Esters of Organophosphorus Acids

The organophosphorus esters are derived from their corresponding acids by reacting them with alcohols. Examples of organophosporus esters are phosphonates, RP(=O)(OR□)2, which are esters of phosphonic acid, phosphinates, R2P(=O)(OR'), which are the esters of phosphinic acid, phosphonites, P(OR)2R', which are esters of phosphonous acid, and phosphinites, P(OR)R'2, which are esters of phosphinous acid.

In organic synthesis, phosphonates are used in the Horner-Wadsworth-Emmons reaction. Phosphonates are well known for their effective metal chelation properties, which find use in water softening. Phosphonates are used in water cooling, desalination systems, in oil fields to inhibit scale formation, and in reverse-osmosis systems as anti-scalants. In the textile industry, as well as in pulp and paper manufacturing, phosphonates serve as a peroxide-bleach stabilizer. In detergents, they play the role of a bleach stabilizer, chelating agent, and scale inhibitor. In the medical field, phosphonates are used to treat disorders associated with bone formation and as carriers for radionuclides in bone cancer treatment. For a review on the functionalization of metal oxides with organophosphonates to obtain hybrid materials, see: Boissezon, R., et al., □Organophosphonates as anchoring agents onto metal oxide-based materials□, RSC Adv., 2014,4, 35690-35707.

Some phosphonites are used as ligands in hydrocyanation processes. Some phosphinite complexes are used in the catalytic asymmetric hydrogenation of activated keto compounds. Phosphinate esters are used in organic chemistry to prepare other phosphorus compounds. The deprotonation and subsequent alkylation of various H-phosphinate esters is a route to the access of some GABA analogues.

	39273	1,2-Bis(dimethoxyphosphoryl)benzene, 99%
	H66513	1,3-Bis[4-(7-chloro-4-quinolinyl)-1-piperazinyl]propane tetraphosphate tetrahydrate, 98%
	B22866	1-Naphthyl phosphate disodium salt hydrate, 99%
	A18254	1-Naphthyl phosphate monosodium salt monohydrate, 98+%
	B22730	2,2,2-Trimethoxy-4,5-dimethyl-1,3,2-dioxaphospholene, 97%
	H27609	(2-Hydroxyethyl)trimethylammonium dimethyl phosphate, 95%
	30139	Ammonium O,O'-diethyl dithiophosphate, typically 95%
	B22506	(±)-Benzyloxycarbonyl-alpha-phosphonoglycine trimethyl ester, 97%
	17723	Bis(2-ethylhexyl) phosphate, 95%
	44426	Cyclohexyl methyl methylphosphonate, 99%

	L08813	Dibenzyl phosphate, 98%
	L09858	Dibenzyl phosphite, 90+%
	H33242	Diethyl 10-undecyn-1-ylphosphonate, 95%
	H33866	Diethyl 11-hydroxyundecylphosphonate, 95%
	H33935	Diethyl 12-mercaptododecylphosphonate, 95%
	B23997	Diethyl 1-butylphosphonate, 99+%
	L13038	Diethyl 1-decylphosphonate, 97%
	L05286	Diethyl 1-naphthylmethylphosphonate, 90+%
	A17105	Diethyl 1-propylphosphonate, 97%
	B21426	Diethyl 1-tetradecylphosphonate, 98%
	A12461	Diethyl 2,2-diethoxyethylphosphonate, 96%
	L11025	Diethyl 2,2-dimethoxyethylphosphonate, 97%
	B21156	Diethyl 2-bromoethylphosphonate, 97%
	H65232	Diethyl 2-thienylmethylphosphonate, 95%
	H51874	Diethyl (3-aminopropyl)phosphonate, 95%
	H51873	Diethyl [3-(N-phthalimido)propyl]phosphonate, 97%
	B22279	Diethyl 4-aminobenzylphosphonate, 99%
	L00965	Diethyl 4-chlorobenzylphosphonate, 98+%
	L05226	Diethyl 4-methoxybenzylphosphonate, 98+%

A15190	Diethyl 4-methylbenzylphosphonate, 98+%
L13341	Diethyl 5-hydantoylphosphonate, 96%
H26896	Diethyl acetylmethylphosphonate, 97%
10365	Diethyl allylphosphonate, 96%
A10645	Diethyl benzylphosphonate, 99%
L16715	Diethyl (bromodifluoromethyl)phosphonate, 97%
B21108	Diethyl cinnamylphosphonate, 98%
A10218	Diethyl cyanomethylphosphonate, 96%
A11046	Diethyl ethylphosphonate, 98%
B21215	Diethyl hydroxymethylphosphonate, tech. 85%
A13697	Diethyl iodomethylphosphonate, 98+%
30357	Diethyl methylphosphonite
B24836	Diethyl phenylphosphonite, 98%
A13660	Diethyl phenylthiomethylphosphonate, 96%
43801	Diethyl phosphite, 96%
44000	Diethyl phosphite, 97+%
B21096	Diethyl (phthalimidomethyl)phosphonate, 97%
10306	Diethyl trichloromethylphosphonate, 98%
10368	Diethylvinylphosphonate, 97%

B22163	Diisopropyl cyanomethylphosphonate, 97%
A12904	Diisopropyl methylphosphonate, 95%
B23800	Diisopropyl phosphite, 98%
L00537	Dimethyl acetylmethylphosphonate, 97%
L10567	Dimethyl allylphosphonate, tech. 85%
44364	Dimethyl cyclohexylphosphonate
44642	Dimethyl ethylphosphonate, 97%
A14268	Dimethyl methylphosphonate, 97%
A14006	Dimethyl phenylphosphonite, 98%
L02840	Dimethyl (phthalimidomethyl)phosphonate, 97%
L04480	Di-n-butyl N,N-diethylcarbamoylphosphonate, 94%
43371	Di-n-butyl phosphate, 96%
A13468	Di-n-octyl phenylphosphonate, 97%
42092	Diphenyl methylphenyl phosphate, mixture of isomers, 94%
L02121	Diphenyl phosphate, 97%
44640	Dipinacolyl methylphosphonate, 97%
30233	Di-tert-butyl phosphite, 95%
B23367	Ethyl diethoxyphosphinylformate, 97+%

H37120	Fosinopril (sodium), 98%
A18531	Guanylurea phosphate, 98+%
32097	Methyl diphenylphosphite
L11941	mono-n-Dodecyl phosphate, tech. 90%
22404	n-Butyl phosphate, mixture of mono-n-butyl and di-n-butyl
44465	O,S-Diethyl methylphosphonothioate, 97%
B20358	Phosphoenolpyruvic acid monopotassium salt, 99%
H66105	S-[(6-Chloro-2-oxooxazolo[4,5-b]pyridin-3yl)methyl] O,O-dimethyl phosphorothioate, 95%
L03425	Sodium beta-glycerophosphate pentahydrate, 97%
B24784	Sodium phosphonoformate hexahydrate, 98+%
L09083	Tetrabenzyl pyrophosphate, 98%
A14206	Tetraethyl ethylenediphosphonate, 98%
A13484	Tetraisopropyl methylenediphosphonate, 98%
A13441	Tetramethyl methylenediphosphonate, 98+%
46746	Tetra-n-butylammonium phosphate, 98%, non-UV
17484	Triallyl phosphite
L17913	Triethyl 2-fluoro-2-phosphonoacetate, 96%
L09329	Triethyl 2-phosphonobutyrate, 97%

30413	Triethyl 2-phosphonopentanoate, 98%
B23261	Triethyl 2-phosphonopropionate, 98%
L10190	Triethyl 3-phosphonopropionate, 98%
L10488	Triethyl 4-phosphonobutyrate, 97%
40001	Triethyl phosphate, 99+%
L00339	Triethyl phosphite, 98%
A14120	Triethyl phosphonoacetate, 98+%
A15247	Triisopropyl phosphite, 90+%
A10595	Trimethyl phosphate, 98+%
30132	Trimethyl phosphite, 97%
A13301	Trimethyl phosphonoacetate, 98%
30395	Trimethyl thiophosphate
L14307	Tri-n-butyl phosphite, 94%
16801	Tri-n-hexyl phosphate, 90+%

Organophosphorus Acids/Amides

Organophosphorus acids are organic compounds containing oxoacids of phosphorus and at least one phosphorus-carbon bond. Alkyl and aryl phosphonic, phosphonous, phosphinous, and phosphinic acids are typical examples of this class. Generally two types of organophosphorus acids have been reported, one is saturated and the other one is unsaturated organophosphorus acids.

Specifically, alkene substituted phosphonous acids are commonly used as ingredients in detergents, wetting agents, and foam agents. Additionally, these acids can be converted to a number of derivatives suitable for the manufacture of oil additives, plasticizers, and various other useful compositions. In addition, there are several organophosphorous acids that have been developed in the pharmaceutical area owing to their desirable biological activities. For example, there are a number of bisphosphonic acid derivatives used in the prevention and treatment of osteoporosis.

Organophosphorus amides are organic compounds containing at least one phosphorous-nitrogen bond. They can be also referred to as amides of organophosphorous acids. These compounds are physically more stable in open air and soluble in many organic solvents. Organophosphorus amides have also attracted the development of new molecules with wide ranging applications. HMPT (hexamethylphosphorous triamide) is useful as a phosphorylating agent in synthetic chemistry and as a flame retardant in building materials. Hexamethylphosphoramide (HPMA) is useful as a specialty solvent and improves selectivity and the rate of reaction.

H33647	11-Hydroxyundecylphosphonic acid, 95%
H33104	12-Aminododecylphosphonic acid hydrochloride, 95%
H33784	12-Azidododecylphosphonic acid, 95%
B21092	1,2-Bis(dichlorophosphino)ethane, 96%
B21051	1,2-Bis(dimethylphosphino)ethane, 97%
H33714	12-Bromododecylphosphonic acid, 95%
L05828	1,2-Ethylenediphosphonic acid, 97%
H33969	12-Mercaptododecylphosphonic acid, 95%
B21054	1,5-Bis(diphenylphosphino)pentane, 97%
A17983	1-Butylphosphonic acid, 98%
L12019	1-Decylphosphonic acid, 98%
H26259	1-Dodecylphosphonic acid, 95%
43502	1-Hydroxyethylidenebis(phosphonic acid), 96%
20651	1-Octylphosphonic acid, 98%

L18586	1-Octylphosphonic acid, 99%
L19271	1-Propylphosphonic acid cyclic anhydride, 50+% soln. in DMF
L11911	1-Propylphosphonic acid cyclic anhydride, 50+% soln. in ethyl acetate
H66967	1-Propylphosphonic acid cyclic anhydride, 50+% w/w soln. in acetonitrile
H63583	1-Propylphosphonic acid cyclic anhydride, 50+% w/w soln. in dichloromethane
A17511	1-Tetradecylphosphonic acid, 98%
L13066	2-Methylbenzylphosphonic acid, 96%
L12036	2-Phosphonobutyric acid, 97%
L11588	2-Phosphonopropionic acid, 98+%
L09833	(Aminomethyl)phosphonic acid, 99%
A13850	Benzylphosphonic acid, 97%
B21112	Bis(diphenylphosphino)methane, 97%
L14339	Bis(triphenylphosphoranylidene)ammonium chloride, 97% (dry wt.), water <3%
B25421	(±)-Boc-alpha-phosphonoglycine trimethyl ester, 95%
A16859	cis-1,2-Bis(diphenylphosphino)ethylene, 97%
L11508	Cyclophosphamide monohydrate, 97+%
B22629	Dibenzyl diisopropylphosphoramidite, 90+%

17758	Diphenyldithiophosphonic acid
A16657	Diphenylphosphinamide, 98%
A11563	Diphenylphosphinic acid, 99%
L07155	Diphenyl phosphoramidate, 97%
H27380	Di-tert-butyl N,N-diethylphosphoramidite, 94%
B22559	Ethylphosphonic acid, 98+%
A12490	Hexaethyl phosphorous triamide, 97%
L15728	Hexafluorophosphoric acid, ca 60% w/w aq. soln.
A12571	Hexamethylphosphorous triamide, 97%
30279	Methylenediphosphonic acid, 97%
A14803	Methylenediphosphonic acid, 98+%
A12619	Methylphosphonic acid, 98%
44121	n-Hexylphosphonic acid
20645	n-Octadecylphosphonic acid, 97%
H27660	n-Propyl N,N,N',N'-tetraisopropylphosphorodiamidite
A17453	Phenylphosphinic acid, 98%
B22939	Phenylphosphonic acid, 98%
A13562	Phenyl phosphorodiamidate, 97%

	30277	Propylenediphosphonic acid, 98+%
	A14581	Tetraethyl (dimethylaminomethylene)diphosphonate, 97%
	A14532	Tetraethyl methylenediphosphonate, 98+%
	B22343	Tetraisopropyl 1,2-ethylenediphosphonate, 99%
	L00496	Tetraphenylphosphine imide, 97%
	A12399	Trimethyl 4-phosphonocrotonate, (E)+(Z), 90+%

Phosphine Oxides

Phosphine Oxides are normally classified as primary, secondary and tertiary oxides generally represented by the formula RPH2(O), R2PH(O) and R3P=O. The phosphine oxides are generally produced as a by-product of the Wittig reaction. Tertiary phosphine oxides are more stable than the primary and secondary phosphine oxides, and therefore least reactive of all phosphorus compounds. Phosphine oxides are employed as catalysts in the chlorination of alcohols and are also used as extractants for metals in its fluorometric determination. Generally with Lewis acids such as AlCl3 and BF3, tertiary phosphine oxides form complexes, which are useful as homogeneous catalysts in various chemical transformations (A Guide to Organophosphorus chemistry, by Quin, Louis D.).

The secondary phosphine oxides are versatile ligands, and therefore can be employed for the formation of C-C, C-N and C-S bonds in transition metal-catalyzed oxidative coupling reactions. The polymer resins such as epoxide, polyester, polyamide, and polycarbonates react with the derivatives of phosphine oxides, and the product formed can be used as flame retardants and cross linkers. Owing to its high solubility and increased response to photosensitization, the acyl derivatives of phosphine oxides are employed as photoinitiators in the polymerization of unsaturated compounds.

H60834	(2R,5R)-1-(2-[(2R,5R)-2,5-Dimethylphospholan-1-yl]phenyl)-2,5-dimethylphospholane 1-oxide, 97+%
H60788	(2S,5S)-1-(2-[(2S,5S)-2,5-Diethyl-1-phospholanyl]phenyl)-2,5-diethylphospholane 1-oxide, 97+%
H30653	(3-Bromo-2,6-dimethoxy-4-pyridyl)di-3,5-xylylphosphine oxide
H30930	(3-Bromo-2,6-dimethoxy-4-pyridyl)diphenylphosphine oxide
A11792	3-Methyl-1-phenyl-2-phospholene 1-oxide, 94%
H31441	4,4'-Bis(diphenylphosphinoyl)-2,2',6,6'-tetramethoxy-3,3'-bipyridine, 95%
H61320	Bis(3,5-dimethylphenyl)phosphine oxide, 98%
H35194	Bis(diphenylphosphinomethyl)phenylphosphine oxide, 95%
H61504	Bis(p-tolyl)phosphine oxide, 98%
L18013	Bis(tetramethylene)fluoroformamidinium hexafluorophosphate
L00698	Cyclohexyldiphenylphosphine oxide, 98+%
B21101	Diphenylphosphine oxide, 97%
L17582	(Diphenylphosphonimido)triphenylphosphorane, 98%
L00912	(Methoxymethyl)diphenylphosphine oxide, 98+%

A11484	Methyldiphenylphosphine oxide, 98+%
A18760	Methyl methylphenylphosphinate, 98%
H31076	(R)-4,4'-Bis(di-3,5-xylylphosphinoyl)-2,2',6,6'-tetramethoxy-3,3'-bipyridine
H31485	(S)-4,4'-Bis(di-3,5-xylylphosphinoyl)-2,2',6,6'-tetramethoxy-3,3'-bipyridine
L16315	Tri(4-morpholinyl)phosphine oxide, 99%
30387	Tricyclohexylphosphine oxide
A10995	Triethyl 4-phosphonocrotonate, cis + trans, 94%
30391	Triethylphosphine oxide
30394	Trimethylphosphine oxide
A11062	Tri-n-octylphosphine oxide, 98%
A12455	Triphenylphosphine oxide, 99%

Phosphonium Chlorides

Phosphonium chloride (R4P+ Cl-) compounds are the chloride derivatives of phosphines (R3P). Examples of phosphonium chloride include tetraphenylphosphonium chloride, tetrakis(anilinomethyl)phosphonium chloride, tetrakis(hydroxymethyl)-phosphonium chloride, trihexyl(tetradecyl)phosphonium chloride, and benzyltriphenylphosphonium chloride. Generally, in alkene synthesis a precursor which is used for the preparation for Wittig reagent are the alkyl derivatives of phosphonium chlorides. The phosphonium chlorides are also employed in the Kirsanov and Appel reactions. In various chemical reactions, phosphonium chlorides are normally used as an interphasic transfer catalyst, a polymerization catalyst, and a trans-halogenation catalyst.

Tetrakis(hydroxymethyl)phosphonium chloride find its application as a precursor to fire-retardant materials, and also in the production of wrinkle-resistant and flame-retardant cotton materials and other cellulose fabrics in the textile industry. The trihexyl(tetradecyl)phosphonium chloride is proven to be an effective surface-active agent to recover oil. Benzyltriphenylphosphonium chloride is used as an element in printing inks and as a fluoropolymer cure accelerator. Tetrakis(hydroxymethyl)phosphonium chloride has been reported as a covalent cross-linking agent for cell encapsulation within protein-based hydrogels (Chung, C., Biomacromolecules, 2012, 13, 3912?3916). Chiral quaternary phosphonium salts used in chiral phase-transfer catalysis plays an important role in modern asymmetric synthesis and organic synthesis chemistry (Yu Lide, Y. et al., □Chiral Quaternary Phosphonium Salts in Asymmetric Catalysis□ Progress in Chemistry, 2013, 25(05), 744-751.

H25796	(1-Butyl)triphenylphosphonium chloride
L00666	(1-Naphthylmethyl)triphenylphosphonium chloride, 95%
A17651	(2,6-Dichlorobenzyl)triphenylphosphonium chloride, 98%
L00534	2-Butene-1,4-bis(triphenylphosphonium chloride), 98+%
L00502	(2-Butenyl)triphenylphosphonium chloride, 97%
B25609	(2-Carboxyethyl)triphenylphosphonium chloride, 98%
A10719	(2-Methylbenzyl)triphenylphosphonium chloride, 98+%
A11611	(3-Methylbenzyl)triphenylphosphonium chloride, 98%
A11769	(4-Chlorobenzyl)triphenylphosphonium chloride, 98+%
L12187	(4-Cyanobenzyl)triphenylphosphonium chloride, 99%
A10852	(4-Fluorobenzyl)triphenylphosphonium chloride, 98+%
L00594	(4-Methoxybenzyl)triphenylphosphonium chloride, 97%
B21729	(4-Methoxycarbonylbenzyl)triphenylphosphonium chloride, 97%
A12447	(4-Methylbenzyl)triphenylphosphonium chloride, 98+%

A14691	Acetonyltriphenylphosphonium chloride, 99%
A16012	Allyltriphenylphosphonium chloride, 99%
A14034	Benzyltriphenylphosphonium chloride, 99%
H26953	Chlorobis(4-fluorophenyl)phosphine, 98%
H54693	Chlorotri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 98+%
A13096	(Cyanomethyl)triphenylphosphonium chloride, 98+%
A19494	(Ethoxycarbonylmethyl)triphenylphosphonium chloride, 97%
B23015	Ethyltriphenylphosphonium chloride, 98%
A15733	(Formylmethyl)triphenylphosphonium chloride, 98+%
A17775	(Methoxycarbonylmethyl)triphenylphosphonium chloride, 97%
A14380	(Methoxymethyl)triphenylphosphonium chloride, 98+%
H56851	Methyltriphenylphosphonium chloride, 97%
L01334	p-Xylylenebis(triphenylphosphonium chloride), 97+%
L12245	(tert-Butoxycarbonylmethyl)triphenylphosphonium chloride, 98+%
A10575	Tetraphenylphosphonium chloride, 98%

Organic Fluorophosphate Salts

Organic fluorophosphate salts are salts of alkyl or aryl bonded fluorophosphates. Organic fluorophosphates have gained importance both as products and as reagents in several organic transformations. One of the most important applications is ionic liquids, which are alternate green solvents for a wide range of organic reactions; organic fluorophosphate salts are used as ionic liquids in several reactions due to their high electrochemical and thermal stability, while having low viscosity. Specifically, perfluoroalkylfluorophosphate anions are substantially inert and have greater stability as a reaction medium. They can be easily decomposed after completion of the reaction and hence they are environmentally friendly. Some of the examples of ionic liquids are 3-methyl-1-sulfonic acid imidazolium hexafluorophosphate(V), [P(C2F5)3F2(dmap)], [PPh4][P(C2F5)3F2OH], [HDMAP][P(C2F5)3F2OC(O)CH3], and [HDMAP][P(C2F5)3F2OPh].

Perfluoroalkyl fluorophosphate anions are used as high voltage electrolytes in lithium cells. Some organic fluorophosphates are used in ophthalmology as a miotic agent for the treatment of chronic glaucoma and as a miotic agent in veterinary medicine. Some examples of these organic fluorophosphates are diisopropyl fluorophosphates, methoxy arachidonyl fluorophosphonate, and isopropyl dodecylphosphonofluoridate. The fluorophosphates esters have been evaluated as probes for understanding the enzyme catalysed phosphoryl transfer (Alkherraz, A., Faraday Discuss., 2010,145, 281-299).

H27827	1-Butyl-2,3-dimethylimidazolium hexafluorophosphate, 99%
H54247	1-(Chloro-1-pyrrolidinylmethylene)pyrrolidinium hexafluorophosphate, 98%
H33746	(1-Cyano-2-ethoxy-2-oxoethylidenaminooxy)dimethylamino-morpholinocarbenium hexafluorophosphate, 98%
H27272	1-n-Hexyl-3-methylimidazolium hexafluorophosphate, 99%
H37697	Diethyl n-dodecylphosphonate, 97+%
H54035	O-(N-Succinimidyl)-N,N,N',N'-tetramethyluronium hexafluorophosphate, 98+%
H54277	S-(1-Oxido-2-pyridyl)-N,N,N',N'-tetramethylthiuronium hexafluorophosphate, 98+%
16256	Tetraethylammonium hexafluorophosphate, 98%
L03140	Triphenylcarbenium hexafluorophosphate, 98%

Organophosphorus Complexes

Metal complexes having organophosphorus compounds as ligands are called organophosphorus complexes. Phosphines form various complexes with rhodium, palladium, nickel, cobalt, etc., such as chlorotris(triphenylphosphine)- rhodium [(Rh(PPh3)Cl)], tetrakis(triphenylphosphine)palladium, bis(triphenyl-phosphine)nickel chloride, [NiCl2[P(C6H5)3]2], etc. These metal complexes are used as catalysts in a number of organic transformations, including hydrogenation of alkenes. The organophosphorus nickel complex is used most commonly in oligomerization of monoolefins or conjugated dienes. In Suzuki reactions, bis(triphenylphosphine)nickel chloride can be used as an alternative to the palladium catalyst. Organophosphorus cobalt complexes are used as a mediator in the formation of carbon-carbon bonds in a variation of the Reformatsky reaction.

Metal phosphine complexes are widely employed in homogeneous catalysis owing to their stability in multiple oxidations states of the metal and good solubility in organic solvents. Wilkinson's catalyst (Rh(PPh3)3Cl), Grubbs' catalyst, and tetrakis(triphenylphosphine)palladium(0) are popular examples. Bidentate phosphines, like 1,2-bis(diphenylphosphino)ethane (dppe), form conformationally restricted complexes through chelation, and hence find use in asymmetric catalysis (e.g., Noyori asymmetric hydrogenation). Kumada coupling involves nickel complex of dichloro(1,3-bis(diphenylphosphino)propane).

Metal phosphonates are effective in decreasing metallic corrosion in areas such as cooling water treatment. In this the metal-phosphonate complex precipitates on to metallic surface forming a protective layer. A number of platinum group metal - aminophosphonate complexes are found to exhibit with excellent antitumor activity. Complexes of these ligands with transition and rare-earth metals like technetium, rhenium, samarium and gadolinium find application as therapeutic and diagnostic radiopharmaceuticals or as magnetic resonance imaging (MRI) contrast agents.

H26899 Borane-di-tert-butylphosphine complex, 98%

Phosphines

Phosphines (also referred to as phosphanes) are a class of organophosphorus compounds represented by the formula PR3 (R = hydrogen or alkyl or aryl). They are classified as primary, secondary and tertiary phosphines and are represented by the formula RPH2, R2PH and R3P. Examples include triphenylphosphine [(C6H5)3P], tri-n-butylphosphine, and BINAP (2,2'-bis(diphenylphosphino)-1,1'-binaphthyl), and triisopropylphosphine. Phosphines are used extensively in organophosphorous chemistry primarily as intermediates.

Phosphines are commonly used as ligands to form metal complexes such as Wilkinson's catalyst [Rh(PPh3)3Cl] and Grubbs' catalyst. Phosphine ligands are useful as catalysts in reactions involving alkynes, carbon monoxide, and alcohols. The nucleophilic catalysts used in the dimerization of enones for the Rauhut□Currier reaction are phosphines. Phosphines are also used in the conversion of azides to amines, and alcohols into esters, in the Staudinger reduction, and in the Mitsunobu reaction, respectively. Phosphines are also employed as a dopant and deposition precursor in the semiconductor industry. The organophosphines form coordination complexes with various metal ions, and therefore they can be used as catalysts in many chemical reactions. Metal complexes with chiral phosphines can be used as catalysts to achieve enantio- or diastereoselectivity.

	H37863	1,1,1-Tris(diphenylphosphinomethyl)ethane, 97+%
	H60395	1,1'-Binaphthyl-2,2'-diyl hydrogen phosphate, 99%
	H60364	(+)-1,1'-Bis[(2R,5R)-2,5-diethyl-1-phospholanyl]ferrocene, 97+%
	H60460	1,1'-Bis[(2R,5R)-2,5-diisopropyl-1-phospholanyl]ferrocene, 97+%
	H60470	(-)-1,2-Bis[(2R,5R)-2,5-diethyl-1-phospholanyl]benzene, 97+%
	H60447	(+)-1,2-Bis[(2R,5R)-2,5-diethyl-1-phospholanyl]ethane, 97+%
	H60227	1,2-Bis[(2R,5R)-2,5-diisopropyl-1-phospholanyl]benzene, 97+%
	H60592	1,2-Bis[(2R,5R)-2,5-dimethyl-1-phospholanyl]benzene, 97+%
	H60071	1,2-Bis[(2R,5R)-2,5-dimethyl-1-phospholanyl]ethane, 97+%
	H60046	(-)-1,2-Bis((2R,5R)-2,5-diphenylphospholano)ethane, 95%
	H60981	(+)-1,2-Bis[(2S,5S)-2,5-diethyl-1-phospholanyl]benzene, 97+%
	H60407	1,2-Bis[(2S,5S)-2,5-diisopropyl-1-phospholanyl]benzene, 97+%
	H60017	1,2-Bis[(2S,5S)-2,5-diisopropyl-1-phospholanyl]ethane, 97+%
	H60647	1,2-Bis[(2S,5S)-2,5-dimethyl-1-phospholanyl]benzene, 97+%

H60265	1,2-Bis[(2S,5S)-2,5-dimethyl-1-phospholanyl]ethane, 97+%
H60766	1,2-Bis[(2S,5S)-2,5-diphenyl-1-phospholanyl]ethane, 97+%
39269	1,2-Bis(dicyclohexylphosphino)ethane, 98%
39272	1,2-Bis(diethylphosphino)ethane, 98%
39276	1,2-Bis(dipentafluorophenylphosphino)ethane, 99%
B21106	1,2-Bis(diphenylphosphino)benzene, 98%
A11419	1,2-Bis(diphenylphosphino)ethane, 97+%
39279	1,2-Bis(phosphino)ethane, 99%
A12931	1,3-Bis(diphenylphosphino)propane, 97%
33589	1,3-Bis(phenylphosphino)propane
B21122	1,4-Bis(diphenylphosphino)butane, 97%
H55528	1,6-Bis(diphenylphosphino)hexane, 97%
H60084	(1R,2R)-(-)-2-(Diphenylphosphino)cyclohexylamine, 97+%
H63445	(1S,2S)-N,N'-Bis[2-(diphenylphosphino)benzyl]cyclohexane-1,2-diamine, 97%
H26226	(±)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 97+%
H31306	2,2'-Bis(diphenylphosphino)biphenyl, 98%
H27585	(±)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98%
H63117	2-[Bis(3,5-dimethylphenyl)phosphino]benzaldehyde, 97%
H63980	2-[Bis(3,5-di-tert-butyl-4-methoxyphenyl)phosphino]benzaldehyde, 97%

H51134	[2-(Dicyclohexylphosphino)ethyl]trimethylammonium chloride, 98%
H60435	2-(Diisopropylphosphino)ethylamine, 10% w/w soln. in THF
B22361	2-Diphenylphosphino-1-naphthoic acid, 97%
H61685	2-Diphenylphosphino-2'-methylbiphenyl, 98%
H61306	2-(Diphenylphosphino)benzaldehyde, 97%
H51903	2-(Diphenylphosphino)benzaldehyde oxime, 95%
B22389	2-(Diphenylphosphino)benzoic acid, 97%
H61640	2-(Diphenylphosphino)biphenyl, 97%
H27070	2-(Diphenylphosphino)ethylamine, 95%
H60337	2-(Diphenylphosphino)ethylammonium tetrafluoroborate, 97+%
H63183	2-(Di-p-tolylphosphino)benzaldehyde, 97%
H27742	2-(Di-tert-butylphosphino)-2'-methylbiphenyl, 99%
H27448	(2R,3R)-(+)-Bis(diphenylphosphino)butane, 98%
H60834	(2R,5R)-1-(2-[(2R,5R)-2,5-Dimethylphospholan-1-yl]phenyl)-2,5-dimethylphospholane 1-oxide, 97+%
H27586	(2S,3S)-(-)-Bis(diphenylphosphino)butane, 98%
H27321	(2S,4S)-1-Boc-4-diphenylphosphino-2-(diphenylphosphinomethyl)pyrrolidine
33668	(2S,4S)-(-)-2,4-Bis(diphenylphosphino)pentane, 99%

Phosphines

Phosphines (also referred to as phosphanes) are a class of organophosphorus compounds represented by the formula PR3 (R = hydrogen or alkyl or aryl). They are classified as primary, secondary and tertiary phosphines and are represented by the formula RPH2, R2PH and R3P. Examples include triphenylphosphine [(C6H5)3P], tri-n-butylphosphine, and BINAP (2,2'-bis(diphenylphosphino)-1,1'-binaphthyl), and triisopropylphosphine. Phosphines are used extensively in organophosphorous chemistry primarily as intermediates.

Phosphines are commonly used as ligands to form metal complexes such as Wilkinson's catalyst [Rh(PPh3)3Cl] and Grubbs' catalyst. Phosphine ligands are useful as catalysts in reactions involving alkynes, carbon monoxide, and alcohols. The nucleophilic catalysts used in the dimerization of enones for the Rauhut□Currier reaction are phosphines. Phosphines are also used in the conversion of azides to amines, and alcohols into esters, in the Staudinger reduction, and in the Mitsunobu reaction, respectively. Phosphines are also employed as a dopant and deposition precursor in the semiconductor industry. The organophosphines form coordination complexes with various metal ions, and therefore they can be used as catalysts in many chemical reactions. Metal complexes with chiral phosphines can be used as catalysts to achieve enantio- or diastereoselectivity.

H60788	(2S,5S)-1-(2-[(2S,5S)-2,5-Diethyl-1-phospholanyl]phenyl)-2,5-diethylphospholane 1-oxide, 97+%
H60672	3-(Diphenylphosphino)propylamine, 97+%
H34253	3-(Di-tert-butylphosphonium)propane sulfonate, 97%
H26241	4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene, 97%
H27420	4,5-Bis(di-tert-butylphosphino)-9,9-dimethylxanthene, 99%
H27330	4,6-Bis(diphenylphosphino)phenoxazine, 98+%
H63864	5-Di-tert-butylphosphino-1',3',5'-triphenyl-1'H-1,4'-bipyrazole, 97%
H52780	5'-O-[(Diisopropylamino)-(2-cyanoethoxy)phosphinyl]-3'-O-(4,4'-dimethoxytrityl)-2'-deoxyinosine, 97%
H52782	5'-O-[(Diisopropylamino)-(2-cyanoethoxy)phosphinyl]-3'-O-(4,4'-dimethoxytrityl)thymidine, 97%
H54378	(7-Aza-1H-benzotriazol-1-yloxy)tri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 99+%
30303	Allyldiphenylphosphine, 96%
39267	Benzyldiphenylphosphine, 99%
39268	Bis(2-cyanoethyl)phenylphosphine
H60853	Bis(2-[di(1-adamantyl)phosphino]ethyl)amine, 97+%

	H60269	Bis[2-(dicyclohexylphosphino)ethyl]amine, 97+%
	H60468	Bis[2-(diisopropylphosphino)ethyl]amine, 10% w/w soln. in THF
	H60250	Bis[2-(diphenylphosphino)ethyl]ammonium chloride, 97+%
	L18481	Bis[(2-diphenylphosphino)phenyl] ether, 98%
	H60493	Bis[2-(di-tert-butylphosphino)ethyl]amine, 10% w/w soln. in THF
	10427	Bis(3-aminopropyl)phenylphosphine
	B21019	Bis(diethylamino)chlorophosphine, 94%
	30307	Bis(dimethylamino)chlorophosphine
	39275	Bis(dimethylphosphino)methane, 98%
	39277	Bis(diphenylphosphino)acetylene, 97%
	H35194	Bis(diphenylphosphinomethyl)phenylphosphine oxide, 95%
	A11014	Bis(pentafluorophenyl)phenylphosphine, 97%
	A13730	Bis(triphenylphosphine)copper(I) borohydride
	H61550	Bis(triphenylphosphine)iminium trifluoroacetate, 98%
	44845	Bis(tri-tert-butylphosphine)palladium(0)
	30204	Chloro(diethyl)phosphine
	30160	Chloro(dimethyl)phosphine, 97%
	A14241	Chlorodiphenylphosphine, 97%

41352	Chlorodiphenylphosphine, 98+%
H54693	Chlorotri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 98+%
36708	Cyclohexyldiphenylphosphine, 98%
H25934	Dichloro(diethylamino)phosphine, 97%
H27856	Dichloro(dimethylamino)phosphine, 98%
A10284	Dichlorophenylphosphine, 97%
18329	Dichloropropylphosphine, 98%
H61914	Dicyclohexyl(2,4,6-triisopropylphenyl)phosphine, 97%
33571	Dicyclohexylchlorophosphine, 98+%
H26992	Dicyclohexylphenylphosphine, 98%
10180	Diethylphenylphosphine, 97%
H27353	Dimethyl isopropenyl phosphate, 95%
A17975	Dimethylphenylphosphine, 96%
A18325	Di-n-pentylphenylphosphine, 97%
B21013	(+)-DIOP, 98%
H56029	Diphenyl-2-pyridylphosphine, 98%
L02402	Diphenyl-n-propylphosphine, 97%
H27503	Diphenyl(o-tolyl)phosphine

56169	Diphenylphosphine
B20998	Di-tert-butylchlorophosphine, 96%
L17671	DL-2-Amino-4-phosphonobutyric acid, 95%
A18292	Ethyldiphenylphosphine, 98%
A15087	Ethyl diphenylphosphinite, 98%
H27565	Isopropyldiphenylphosphine, 99%
H30928	Methyl 2-diphenylphosphino-1-naphthoate, 98%
30211	Methyldichlorophosphine, 97+%
A10644	Methyl diethylphosphonoacetate, 97%
H27159	Methyldiphenylphosphine, 99%
A11555	Methyl diphenylphosphinite, 98+%
H51695	N-[2-(Diphenylphosphino)benzylidene]cyclohexylamine, 97%
H52807	N-Benzoyl-5'-O-[(diisopropylamino)-(2-cyanoethoxy)phosphinyl]-3'-O-(4,4'-dimethoxytrityl)-2'-deoxyadenosine, 97%
H52732	N-Benzoyl-5'-O-[(diisopropylamino)-(2-cyanoethoxy)phosphinyl]-3'-O-(4,4'-dimethoxytrityl)-2'-deoxycytidine, 97%
H63006	N-Fmoc-O-benzylphospho-L-threonine, 97%
H66040	N-Fmoc-O-benzylphospho-L-tyrosine, 95%
H52411	N-Isobutyryl-5'-O-[(diisopropylamino)-(2-cyanoethoxy)phosphinyl]-3'-O-(4,4'-dimethoxytrityl)-2'-deoxyguanosine, 97%
H52168	O-Benzylphospho-N-Fmoc-L-serine, 95%

A11422	(Pentafluorophenyl)diphenylphosphine, 98%
30155	Phenylphosphine
L14149	(R)-(-)-1,1'-Binaphthyl-2,2'-diyl hydrogen phosphate, 98+%
B21078	(R)-(+)-1,2-Bis(diphenylphosphino)propane, 98%
H60173	(R)-(+)-1-[2-(Diphenylphosphino)phenyl]ethylamine, 97+%
44613	(R)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine
H60112	(R)-2,2'-Bis[bis(3,5-di-tert-butyl-4-methoxyphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H60561	(R)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H60684	(R)-2,2'-Bis[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H27680	(R)-(+)-2,2'-Bis(di-3,5-xylylphosphino)-1,1'-binaphthyl, 98%
B23785	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98%
42119	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98%
44620	(R)-(+)-2,2'-Bis(N-diphenylphosphinoamino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl, CTH-(R)-BINAM, 95%
H60508	(R)-2-Amino-1-diphenylphosphino-3,3-dimethylbutane, 97+%
H60004	(R)-2-Amino-1-diphenylphosphino-3-methylbutane, 97+%
H27032	(R)-(+)-2'-Diphenylphosphino-1,1'-binaphth-2-ol, 96%
H60639	(R,R)-(-)-2-Amino-1-phenylpropyldiphenylphosphine, 97+%
L14137	(S)-(+)-1,1'-Binaphthyl-2,2'-diyl hydrogen phosphate, 98+%

H60122	(S)-(-)-1-[2-(Diphenylphosphino)phenyl]ethylamine, 97+%
H60488	(S)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethylamine, 97+%
44614	(S)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine
H60865	(S)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H60315	(S)-2,2'-Bis[bis(3,5-di-tert-butyl-4-methoxyphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H60604	(S)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H60832	(S)-2,2'-Bis[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, 97+%
H26970	(S)-(-)-2,2'-Bis(di-3,5-xylylphosphino)-1,1'-binaphthyl, 98%
B23872	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 97%
42120	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98%
H60921	(S)-2,2'-Bis(di-p-tolylphosphino)-4,4',6,6'-tetramethoxybiphenyl, 97+%
44619	(S)-(-)-2,2'-Bis(N-diphenylphosphinoamino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl, CTH-(S)-BINAM, 95%
H60980	(S)-2-Amino-1-diphenylphosphino-3-methylbutane, 97+%
H60404	(S)-2-Diphenylphosphino-1-phenylethylamine, 97+%

H35716	(S)-An-Phanephos
H60331	(S,S)-(+)-2-Amino-1-phenylpropyldiphenylphosphine, 97+%
H27360	tert-Butyldichlorophosphine, 98%
L17651	tert-Butyl diethylphosphonoacetate, 95%
L08508	trans-1,2-Bis(diphenylphosphino)ethylene, 98%
H61778	Tri(1-aziridinyl)phosphine sulfide, 98%
42304	Tri(1-naphthyl)phosphine, 97%
L13329	Tri(2-furyl)phosphine, 97%
10173	Tribenzylphosphine
30386	Tricyclohexylphosphine, 96%
41952	Tricyclohexylphosphine, 98%
44854	Tricyclohexylphosphine, technical grade
30177	Triethylphosphine, 97%
33572	Triisopropylphosphine, 90+%
41684	Triisopropylphosphine, 98%
B21116	Trimesitylphosphine, 98%
30143	Trimethylphosphine, 98%
A15372	Tri(m-tolyl)phosphine, 98+%

14114	Tri-n-butylphosphine, 94%
A12649	Tri-n-butylphosphine, 95%
L15744	Tri-n-octylphosphine, tech. 90%
A12093	Tri(o-tolyl)phosphine, 98+%
10258	Tri(o-tolyl) phosphite, typically C 71%, H 6%
39538	Triphenylphosphine-3,3',3''-trisulfonic acid trisodium salt hydrate, tech. 85%
14112	Triphenylphosphine, 99+%
A11552	Triphenylphosphine dibromide, 96%
A14089	Triphenylphosphine, flake, 99%
L14290	Triphenylphosphine hydrobromide, 97%
L02502	Triphenylphosphine, powder, 99%
A14021	Tri(p-tolyl)phosphine, 98%
L15162	Tris(2,6-dimethoxyphenyl)phosphine, 98%
H51864	Tris(2-carboxyethyl)phosphine hydrochloride, 95%, 0.5M soln. in water
40587	Tris(2-carboxyethyl)phosphine hydrochloride, 98%
30165	Tris(2-cyanoethyl)phosphine, 94%
A11096	Tris(2-methoxyphenyl)phosphine, 98%
A13379	Tris(2-thienyl)phosphine, 98+%

	L06941	Tris[3,5-bis(trifluoromethyl)phenyl]phosphine, 94%
	A11203	Tris(3-chlorophenyl)phosphine, 98%
	A15117	Tris(3-fluorophenyl)phosphine, 97%
	A17949	Tris(3-methoxyphenyl)phosphine, 98%
	A12487	Tris(4-chlorophenyl)phosphine, 97%
	A14813	Tris(4-fluorophenyl)phosphine, 98%
	A15596	Tris(4-methoxyphenyl)phosphine, 98%
	A12885	Tris[4-(trifluoromethyl)phenyl]phosphine, 98%
	L02748	Tris(pentafluorophenyl)phosphine, 95%
	30218	Tris(trimethylsilyl)phosphine
	10178	Tri-tert-butylphosphine, 98%

Phosphoranes

Phosphoranes, also known as lamda5-phosphanes (PR5 and R3P=CR2), generally consist of pentavalent phosphorus with a P-C single bond or a P=C double bond. The latter are frequently encountered in organic chemistry. The phosphorus□carbon double bonded compounds, for example methylenetriphenylphosphorane (Ph3P=CH2), are used as reagents in the Wittig reaction for reducing agents and bases. Other examples include (cyanomethylene)trimethylphosphorane and (cyanomethylene)tributylphosphorane. The oxyphosphorane and thiophosphorane molecules act as model intermediates in RNA transphosphorylation. In constructing combinatorial libraries, (cyanomethylene)-phosphoranes are employed as carbonyl 1,1-dipole synthons. In a Mitsunobu-type reaction, the pentacoordinate phosphoranes with reversed apicophilicity are employed as stable intermediates.

Phosphoranes have various synthetic and biological applications. The phosphorus□carbon double bonded compounds are employed as reagents in the preparation of substances such as olefins, acetylenes, cyclic, and heterocyclic compounds. They are also employed in the synthesis of naturally occurring compounds such as pheromones, steroids and carotenoids, and pharmaceutically and biologically active compounds such as antibiotics and prostaglandins. Phosphoranes have been reported to show acetylcholinesterase inhibitory activity. The phosphorus ylides are useful in the preparation of pharmaceutical substances such as leukotrienes, prostaglandins, antibiotics and vitamins, and also in the preparation of steroids, pheromones, juvenoids, pyrethyroids and in industrial applications.

A15619	(1-Ethoxycarbonylethylidene)triphenylphosphorane, 97%
A11410	(Acetylmethylene)triphenylphosphorane, 99%
A12184	(Benzoylmethylene)triphenylphosphorane, 98+%
A12896	(Ethoxycarbonylmethylene)triphenylphosphorane, 98+%
A11709	(Formylmethylene)triphenylphosphorane, 97%, may cont. up to ca 3% water
A14020	(Methoxycarbonylmethylene)triphenylphosphorane, 98%
A16301	(Methoxycarbonylmethyl)triphenylphosphonium bromide, 98+%
L15144	(tert-Butoxycarbonylmethylene)triphenylphosphorane, 98%

Organic Phosphate Salts

Organic compounds with phosphate groups are called organic phosphates. Also referred to as an ester of phosphoric acid salt, the phosphate group is attached to the carbon atom through one of its oxygens. Organic phosphates are known to be involved in energy transfer reactions. Phosphate groups in organic compounds are hypervalent, containing five bonds, and can form salts through ionic bonds between the cation and one of the oxygen anions.

A14417	2-Carboxyphenyl phosphate, 98%
A12310	4-Nitrophenyl phosphate disodium salt hexahydrate, 96%
H55562	Bis(2,2,2-trifluoroethyl) phosphite, tech. 90%
H33820	Diethyl chlorophosphate, 97+%
A12385	Phosphoenolpyruvic acid mono(cyclohexylammonium) salt, 98%
A12323	Pyridoxal-5-phosphate hydrate, 98%
19261	Tetra-n-butylammonium phosphate, 99+%
A16084	Tri-n-butyl phosphate, 98%
A17433	Tritolyl phosphate, mixture of isomers

Organophosphorus Halides

Organophosphorus compounds or halophosphines containing halogens of the formula RPX2 and R2PX are grouped under organophosphorus halides. Halophosphines are very significant starting materials and intermediates for the synthesis of various functional groups, such as their corresponding esters, free acids, and amides.

One of the main approaches to synthesizing various substituted phosphines involves the displacement of a halogen atom from the phosphorus compound by an organometallic reagent such as Grignard, lithium species, organozinc, organolead, organomercury, or aluminum-based reagents. Symmetrical and unsymmetrical functionalized aryl phosphines can be synthesized from chlorophosphines and organozinc reagents (Gall, L. et al., Synlett., 2006, 6,954-956). They are useful precursors for the synthesis of many compounds which are useful as plant protection compounds, stabilizers, or catalysts. Substituted diphenylchlorophosphines have increased in importance as they are now employed as metal complexes for asymmetric transformations. Di-tert-butylchlorophosphine and dicyclohexylchlorophosphine are used as ligands in various metal-catalyzed coupling reactions like C-C, C-N, and C-O bond forming reactions. Chlorophosphines react with protected nucleosides to produce phosphoramidites, which are stable for storage and useful in nucleotide coupling reactions. The diastereoisomers of menthylphosphinite boranes are popular synthetic intermediates for enantiopure P-stereogenic compounds. The diastereomeric phosphinites, prepared from alkyldichlorophosphines, are separated and reacted with carbon nucleophiles to give the phosphine-borane with high enantiomeric excess (Review: Wauters, I., et al., □Preparation of phosphines through C□P bond formation□, Beilstein J. Org. Chem. 2014, 10, 1064□1096).

	L18587	1-Octylphosphonic dichloride, 97%
	A11505	2-Chlorophenyl phosphorodichloridate, 98+%
	L18575	2-Cyanoethyl diisopropylchlorophosphoramidite, 95%
	A15507	4-Chlorophenyl phosphorodichloridate, 98+%
	L02630	Bis(2-chlorophenyl) phosphorochloridate, 97%
	L08775	Bis(2-oxo-3-oxazolidinyl)phosphinic chloride, 97%
	H25882	Bis(3,5-di-tert-butyl-4-methoxyphenyl)chlorophosphine, 94%
	B21519	Bis(diethylamino)phosphorochloridate, 97%
	H25894	Chlorobis(2-methoxyphenyl)phosphine, 98+%
	H25883	Chlorobis[3,5-bis(trifluoromethyl)phenyl]phosphine, 97%, maycontain suspended amine hydrochloride crystals
	H25885	Chlorobis(3,5-dimethylphenyl)phosphine, tech. 90%
	H25886	Chlorobis(4-chlorophenyl)phosphine, 97%
	H25887	Chlorobis(4-methoxyphenyl)phosphine, 96%
	H25888	Chlorobis[4-(trifluoromethyl)phenyl]phosphine, 97%

H25893	Chlorodi(1-naphthyl)phosphine, 95%
H25890	Chlorodi(o-tolyl)phosphine, 98%
H25889	Chlorodi(p-tolyl)phosphine, 95%
L09919	Diethyl chlorophosphite, 97%
H26972	Diethylphosphoramidic dichloride, 96%
A11721	Diphenylphosphinic chloride, 97+%
A17869	Ethylphosphonic dichloride, 98%
B21179	Ethyl phosphorodichloridite, 98%
H27109	Isopropylphosphonic dichloride, tech. 90%
A18349	Methylphenylphosphinic chloride, 97%
L07231	N,N-Dimethylphosphoramidodichloridate, 97%
A13777	Phenylphosphonic dichloride, 90+%
A10479	Phenyl phosphorodichloridate, 97%
A18986	Phosphonitrilic chloride trimer, 98%

Phosphine Sulfides and Salts

Phosphine sulfides are generally classified as primary [RH2P(=S)], secondary [R2HP(=S)] and tertiary phosphine [R3P(=S)] sulfides. Examples of primary phosphine sulfides include dialkyl-, dicycloalkyl, diaryl-, diaralkyl, and dialkarylphosphinesulfides. Secondary phosphine sulfides include tetramethylenephosphine sulfide and pentamethylenephosphine sulfide.

Phosphine sulfides are used in organic and inorganic n-semiconductors with high triplet energies; more specifically dibromo dibenzophosphole sulfides are employed in electron-transporting semiconductors in OLEDs and single-crystal field-effect transistors. In additives of anti-knock fluids and leaded gasolines, the tertiary phosphine sulfides are used.

The phosphine sulfide alkyl derivatives are employed as receptors of transition and heavy metal ions (Castillo, M., et al., □Combinatorial synthesis of fluorescent trialkylphosphine sulfides as sensor materials for metal ions of environmental concern□, Arkivoc, 2003, (xi), 193-202). The sulfide□phosphine ligands can form complexes with Pd, and it can be used in the copolymerization of olefins with carbon monoxide. The organophosphine sulfides are used as photographic sensitizers and sulfur sensitizers. Phosphine sulfide copper(I) complexes are used as a sensing material in photoluminescence oxygen sensors.

	44711	Phenyl phosphate disodium salt hydrate, 98%
	A16762	Trimethylphosphine sulfide, 97%
	A16884	Triphenylphosphine sulfide, 98%

Phosphorus & Compounds

Phosphorus exists as an element primarily in two forms, white phosphorus and red phosphorus, and has high reactivity. The most important property of phosphorus is that it emits a glow when exposed to oxygen. White phosphorus gives a glow during oxidation and this process is referred to as chemiluminescence.

Phosphorus compounds include inorganic phosphorus compounds, organophosphorus, phosphanes, phosphates, phosphides, phosphine oxides, phosphorus oxoanions, quaternary phosphonium compounds, and thiophosphoryl compounds. Organophosphorus compounds include organophosphorus acids, organophosphorus acid halides, organophosphorus amides, organophosphorus halides, organophosphorus complexes, phosphonic esters (RP(=O)(OR')2), phosphites (P(OR)3), phosphine oxides (R3P=O), and fluorophosphate salts. Organophosphorus compounds play a vital role in detergents and nerve agents, and in the field of pharmaceuticals are used as antibacterial, antileukemic, antiparasitic, antiviral, anti-inflammatory, antitumor, antihypertensive, and antioxidant agents.

H60395	1,1'-Binaphthyl-2,2'-diyl hydrogen phosphate, 99%
H59548	1-Benzyl-3-methylimidazolium hexafluorophosphate, 97%
H60228	1-Ethyl-2,3-dimethylimidazolium hexafluorophosphate, 98%
H59990	1-Methyl-3-n-octylimidazolium hexafluorophosphate, 95%
H59893	1-n-Butyl-3-methylimidazolium di-n-butyl phosphate, 96%
H60435	2-(Diisopropylphosphino)ethylamine, 10% w/w soln. in THF
H26481	3-Diethoxyphosphoryloxy-1,2,3-benzotriazin-4(3H)-one, 98%
H60672	3-(Diphenylphosphino)propylamine, 97+%
H61917	4-Hydroxymethyl-2,6,7-trioxa-1-phosphabicyclo[2.2.2]octane 1-oxide, 98%
H32592	Ammonium O,O'-dimethyldithiophosphate, 95%
H60269	Bis[2-(dicyclohexylphosphino)ethyl]amine, 97+%
H60468	Bis[2-(diisopropylphosphino)ethyl]amine, 10% w/w soln. in THF
H60493	Bis[2-(di-tert-butylphosphino)ethyl]amine, 10% w/w soln. in THF

	L18588	Diethyl 1-octylphosphonate, 98%
	A14772	Diethyl methylphosphonate, 97%
	H28374	(R,R)-DIPAMP, 90%
	H28037	(S,S)-DIPAMP, 97%
	H27881	Triallylphosphine, 97+%

Organophophorus Acid Halides, etc.

Organophosphorus acid halides are those organophosphorus acids in which the hydroxyl group is replaced by a halogen atom. In these compounds, halide atoms are labile which make them suitable substrates for the preparation of the corresponding acids themselves, their esters, and amides. There are several types of acid halides reported, but the most well-known are unsaturated organophosphorous acid halides. As they are very sensitive to moisture, these acid halides have a tendency of slowly hydrolyzing themselves in the air and are also soluble in many organic solvents. A couple examples are vinlyphosphonic dichloride and 2-chloro-3-butenylphosphonic dichloride.

Some of the organophosphorus acid halides serve as halogenating agents. In general, these acid halide compounds have been utilized for preparing various amides and halide compounds, which possess good stability, and also for preparing various target compounds. These organophosphorus acid halides are studied for their polymerization with many diamines. Methylphosphonic dichloride is used to protect oligonucleosides. These oligonucleoside methylphosphonates have the ability to be taken up by mammalian cells and are resistant to hydrolysis by enzyme nucleases.

39274	Bis(dimethylamino)phosphorochloridate, 94%
A18456	Chloromethylphosphonothioic dichloride, 98%
30292	Dimethylphosphinic chloride, 97+%
A13546	Diphenyl phosphorochloridate, 97%
22362	Pyrophosphoryl chloride

Other Phosphonium Salts

Phosphonium salts refers to a quaternary organic derivative of phosphorus such as tetramethylphosphonium iodide, $[P(CH_3)_4]^+I^-$. Phosphonium salts are used as ionic liquids with higher thermal stability, for example, trialkyl(2,3-dihydroxypropyl)phosphonium salts (Bellina, F.; Chiappe, C.; Lessi, M. Synthesis and properties of trialkyl(2,3-dihydroxypropyl)phosphonium salts, a new class of hydrophilic and hydrophobic glyceryl-functionalized ILs. *Green Chem.* **2012,** *14,* 148-155). Phosphonium salts are known for their use as reagents and catalysts in organic synthesis. Phosphonium salts are used as a precursor for the Wittig reagent, more specifically alkyltriphenylphosphonium salts are used in the preparation of Wittig reagents which are useful in pharmaceuticals, agrochemicals, functional chemicals, and their intermediates. Phosphonium salts are also useful as a precursor for various organometallic compounds. Stable phosphonium salts are precursors for phosphine ligands and are transformed to phosphines in situ when required. The phosphonium phenylthioacetates are known as efficient co-initiators for the photo-induced free-radical polymerization of vinyl polymers.

B25251	1H-Benzotriazol-1-yloxytri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 98%
H54378	(7-Aza-1H-benzotriazol-1-yloxy)tri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 99+%
H26609	7-Aza-1H-benzotriazol-1-yloxytris(dimethylamino)phosphonium hexafluorophosphate, 98+%
H26904	Di-tert-butylphenylphosphonium tetrafluoroborate, 99%
17426	Ethyltriphenylphosphonium acetate, 70% in methanol
A17533	Ethyltriphenylphosphonium iodide, 98+%
A12881	Isopropyltriphenylphosphonium iodide, 98+%
A15644	Methyltriphenylphosphonium iodide, 98%
41718	Tetra-n-butylphosphonium hydroxide, 40% w/w aq. soln.
A16792	Tetra-n-butylphosphonium iodide, 98%
A11539	Tetraphenylphosphonium iodide, 98+%
H27428	Tricyclohexylphosphonium tetrafluoroborate, 99%
L00788	(Trimethylsilylmethyl)triphenylphosphonium iodide, 98%

Phosphonium Bromides

Phosphonium bromide refers to a cationic quaternary organic phosphorus derivative with a bromide anion. Examples of phosphonium bromides include bromotriphenylphosphonium bromide, triphenyl(tetradecyl)phosphonium bromide, ethyltriphenylphosphonium bromide, etc. The alkylated phosphonium bromides are used as a precursor for the Wittig reagent, which is routinely used in alkene synthesis. The phosphonium bromides are also employed in the Kirsanov reaction to produce organophosphorus compounds normally employed as ligands and reagents. Phosphonium bromides are also involved in the Appel reaction, which converts alcohols into halides.

Phosphonium bromides, such as ethyltriphenylphosphonium bromide and tetrabutylphosphonium bromide, are employed as phase transfer catalysts (PTC) in the production of epoxy resins and powder coatings. They are also useful as pharmaceutical intermediates in several synthetic processes. Tetrabutylphosphonium bromide is also used in flavours and fragrances. Tetrabutylphosphonium bromide (TBPB) analogs are found to be muscarinic acetylcholine receptor (mAChRs) agonists. These receptors play a vital role in CNS and peripheral functions such as memory and attention mechanisms, motor control, nociception, regulation of sleep wake cycles, cardiovascular function, renal and gastrointestinal function (Nekoei, M., □A quantitative structure□activity relationship study of tetrabutylphosphonium bromide analogs as muscarinic acetylcholine receptors agonists□, J. Serb. Chem. Soc., 2011, 76 (8) 1117□1127).

	L00956	1,2-Vinylenebis(triphenylphosphonium bromide) monohydrate, 98%
	A18882	(1,3-Dioxolan-2-ylmethyl)triphenylphosphonium bromide, 98%
	A10504	(1-Butyl)triphenylphosphonium bromide, 99%
	A14295	(1-Dodecyl)triphenylphosphonium bromide, 98+%
	A13023	(1-Ethoxycarbonylethyl)triphenylphosphonium bromide, 97%
	B25424	(1-Heptyl)triphenylphosphonium bromide, 98+%
	A15180	(1-Hexadecyl)triphenylphosphonium bromide, 98+%
	A13826	(1-Hexyl)triphenylphosphonium bromide, 98%
	L02341	(1-Nonyl)triphenylphosphonium bromide, 98+%
	L02412	(1-Octyl)triphenylphosphonium bromide, 97%
	A12534	(1-Pentyl)triphenylphosphonium bromide, 98%
	A12968	(1-Propyl)triphenylphosphonium bromide, 99%
	L04311	(1-Tetradecyl)triphenylphosphonium bromide, 97%
	L04909	[2-(1,3-Dioxan-2-yl)ethyl]triphenylphosphonium bromide, 98+%

	B24833	(2-Bromoethyl)triphenylphosphonium bromide, 98%
	L01532	(2-Butyl)triphenylphosphonium bromide, 96%
	L00553	(2-Carboxyethyl)triphenylphosphonium tribromide, 98+%
	L00538	(2-Chloroethyl)triphenylphosphonium bromide, 98+%
	L00917	(2-Dimethylaminoethyl)triphenylphosphonium bromide, 98%
	L00778	(2-Hydroxybenzyl)triphenylphosphonium bromide, 98+%
	L00679	(2-Hydroxyethyl)triphenylphosphonium bromide, 98+%
	L05650	(2-Nitrobenzyl)triphenylphosphonium bromide monohydrate, 98+%
	B24845	2-(Triphenylphosphonio)propiophenone bromide, 98+%
	L00513	(3,3-Dimethylallyl)triphenylphosphonium bromide, 98+%
	H55754	(3-Benzyloxypropyl)triphenylphosphonium bromide, 97+%
	A19302	(3-Carboxypropyl)triphenylphosphonium bromide, 97%
	A12669	(3-Phenylpropyl)triphenylphosphonium bromide, 97+%
	A15220	(4-Bromobenzyl)triphenylphosphonium bromide, 98%
	B23040	(4-Bromobutyl)triphenylphosphonium bromide, 98%
	A17563	[4-(Bromomethyl)benzyl]triphenylphosphonium bromide, 98%
	A12023	(4-Carboxybutyl)triphenylphosphonium bromide, 98%
	L09423	(4-Methoxycarbonylbenzyl)triphenylphosphonium bromide, 98%
	L01562	(4-Methylbenzyl)triphenylphosphonium bromide, 98+%

	A15288	(4-Nitrobenzyl)triphenylphosphonium bromide, 98%
	L01950	(4-Pentenyl)triphenylphosphonium bromide, 97%
	B22421	(4-Phthalimidobutyl)triphenylphosphonium bromide, 97%
	H51917	4-(Triphenylphosphoniomethyl)benzeneboronic acid pinacol ester bromide, 95%
	B20588	(5-Carboxypentyl)triphenylphosphonium bromide, 97%
	B25034	(6-Phthalimidohexyl)triphenylphosphonium bromide, 94%
	L00794	(9-Fluorenyl)triphenylphosphonium bromide, 98%
	B22434	Acetonyltriphenylphosphonium bromide, 98+%
	A14490	Allyltriphenylphosphonium bromide, 99%
	B24567	Benzyltriphenylphosphonium bromide, 98%
	L19384	Bromotri(1-pyrrolidinyl)phosphonium hexafluorophosphate, 97%
	H26708	Bromotris(dimethylamino)phosphonium hexafluorophosphate, 98+%
	A14298	Cyclohexyltriphenylphosphonium bromide, 98+%
	A14647	Cyclopentyltriphenylphosphonium bromide, 98%
	L01145	(Cyclopropylmethyl)triphenylphosphonium bromide, 98+%
	B25102	Cyclopropyltriphenylphosphonium bromide, 98%
	A16347	(Ethoxycarbonylmethyl)triphenylphosphonium bromide, 98+%

A12190	Ethylenebis(triphenylphosphonium bromide), 98+%
B23096	Ethyltriphenylphosphonium bromide, 98+%
A17881	Isobutyltriphenylphosphonium bromide, 98+%
A11322	Isopentyltriphenylphosphonium bromide, 98%
A10443	Methyl 4-(triphenylphosphonio)crotonate bromide, 98%
A15878	Methyltriphenylphosphonium bromide, 98+%
L01335	(n-Hexadecyl)tri-n-butylphosphonium bromide, 98+%
L03103	o-Xylylenebis(triphenylphosphonium bromide), 98+%
L00997	Pentamethylenebis(triphenylphosphonium bromide), 98+%
A12753	Propargyltriphenylphosphonium bromide, 97%
A18241	p-Xylylenebis(triphenylphosphonium bromide), 96%
L15165	(tert-Butoxycarbonylmethyl)triphenylphosphonium bromide, 98%
A14214	Tetramethylenebis(triphenylphosphonium bromide), 98+%
A17907	Tetramethylphosphonium bromide, 97%
A10868	Tetra-n-butylphosphonium bromide, 99%
A14929	Tetra-n-octylammonium bromide, 98+%