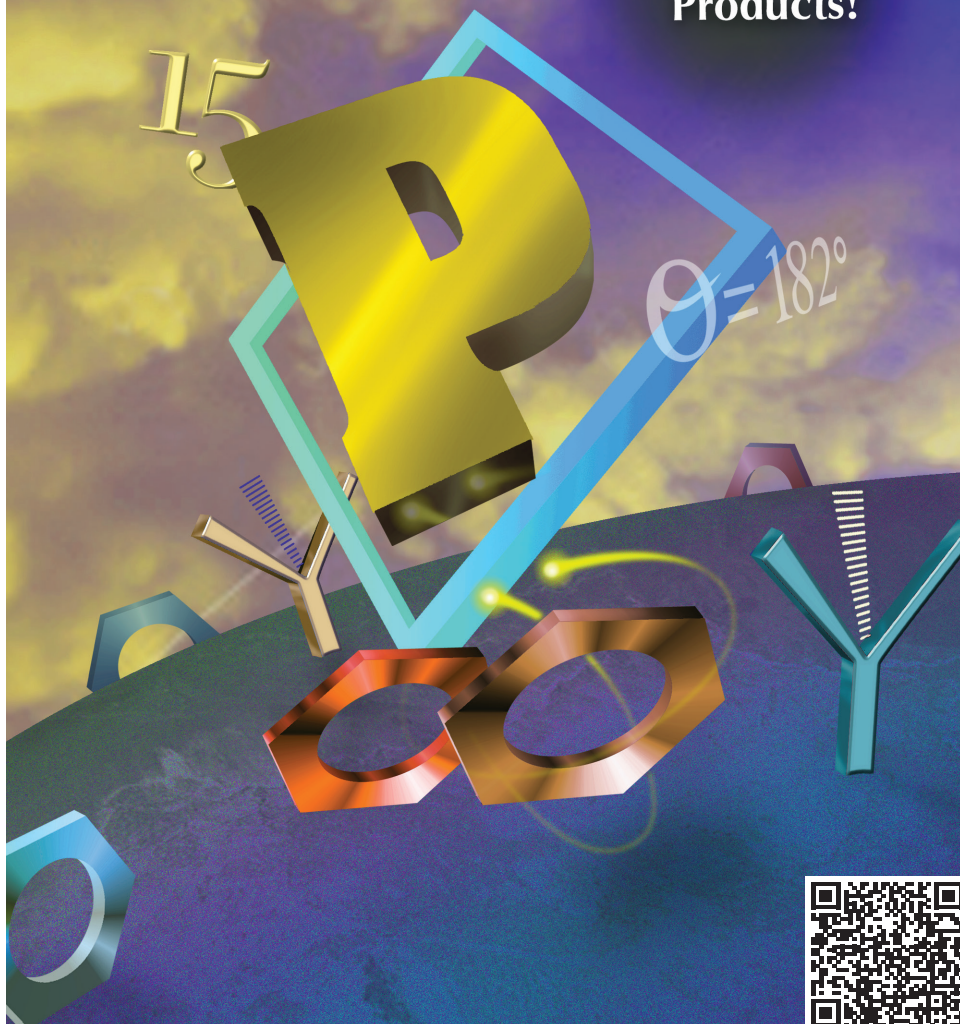


# Phosphorus Ligands and Compounds

Many  
New  
Products!



**TREM**

# Phosphorus Ligands and Compounds



Strem Chemicals has been providing fine chemicals for research and commercial production for over fifty years. Throughout this time we have offered a wide range of phosphorus-based ligands. We have continued to expand our product line as new applications have been found for this class of compounds. Our current offerings include monodentate, multidentate, achiral and chiral ligands. Some of these items are only commercially available at Strem. We have also included our phosphorus kits at the back of this booklet for customers interested in screening experiments.

At Strem, we also offer a wide variety of catalysts, nanomaterials and CVD/ALD precursors. Most of our products are of high purity, typically at 99%, while some are as high as 99.9999% metals purity. As an effort to expand our product line, we continually seek to provide new technologies from around the globe. We have licensing agreements with industry and academia, which allow easier access to these patent-protected products for our customers. We look forward to continued growth in order to best serve our customers' needs with the quality and service they can trust from Strem.

As part of our ongoing commitment to quality, we have achieved ISO 9001 certification for the Quality Management System (QMS) at our corporate headquarters in Newburyport, Massachusetts.

In addition, custom synthesis services are provided on a contract basis. For pharmaceutical applications, manufacturing is conducted under current Good Manufacturing Practices (cGMP) in FDA inspected kilo-lab suites. Complete documentation is available, including validation and stability studies. Active Drug Master Files (DMF's) are maintained in North America and Europe.

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Our other booklets, which focus on applications and product classes, are available in print per request and also on our website. Below is a list of current booklet titles that are available. Please also check our Product Resources section online to find additional literature offerings, such as the Strem Chemiker, our technical publication, and product literature sheets.

- Buchwald Ligands and Precatalysts
- Gold Elements & Compounds
- Heterogeneous Catalysts
- Kits
- Materials for Energy Applications
- Metal Catalysts for Organic Synthesis
- MOCVD, CVD & ALD Precursors
- Nanomaterials
- New Products
- Other Ligands
- Phosphorous Ligands and Compounds
- PURATREM: High Purity Inorganics

Ephraim S. Honig, Ph.D., M.B.A.  
Chief Executive Officer



PHOS 08/17  
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# Glossary of Terms

<b>[α]<sub>D</sub></b>	.....	Specific rotation
<b>AAS</b>	.....	Atomic Absorption Standard
<b>ACS</b>	.....	Conforms to American Chemical Society specifications
<b>air sensitive</b>	.....	Product may chemically react with atmospheric oxygen or carbon dioxide at ambient conditions. Handle and store under an inert atmosphere of nitrogen or argon.
<b>amp</b>	.....	Ampouled
<b>b.p.</b>	.....	Boiling point in °C at 760mm, unless otherwise noted
<b>d.</b>	.....	Density
<b>dec.</b>	.....	Decomposes
<b>elec. gr.</b>	.....	Electronic Grade, suitable for electronic applications
<b>f.p.</b>	.....	Flash point in °F
<b>gran.</b>	.....	Granular
<b>heat sensitive</b>	.....	Product may chemically degrade if stored for prolonged periods of time at ambient temperatures or higher. Store at 5°C or lower.
<b>hydrate</b>	.....	Unspecified water content which may vary slightly from lot to lot
<b>hygroscopic</b>	.....	Product may absorb water if exposed to the atmosphere for prolonged periods of time (dependent on humidity and temperature). Handle and store under an inert atmosphere of nitrogen or argon.
<b>light sensitive</b>	.....	Product may chemically degrade if exposed to light
<b>liq.</b>	.....	Liquid
<b>m.p.</b>	.....	Melting point in °C
<b>moisture sensitive</b>	.....	Product may chemically react with water. Handle and store under an inert atmosphere of nitrogen or argon.
<b>NMR grade</b>	.....	Suitable as a Nuclear Magnetic Resonance reference standard
<b>optical grade</b>	.....	For optical applications
<b>pwdr.</b>	.....	Powder
<b>primary standard</b>	.....	Used to prepare reference standards and standardize volumetric solutions
<b>PURATREM</b>	.....	Product has a minimum purity of 99.99% (metals basis)
<b>purified</b>	.....	A grade higher than technical, often used where there are no official standards
<b>P. Vol.</b>	.....	Pore volume
<b>pyrophoric reagent</b>	.....	Product may spontaneously ignite if exposed to air at ambient conditions
	.....	High purity material, generally used in the laboratory for detecting, measuring, examining or analyzing other substances
<b>REO</b>	.....	Rare Earth Oxides. Purity of a specific rare-earth metal expressed as a percentage of total rare-earths oxides.
<b>SA</b>	.....	Surface area
<b>store cold</b>	.....	Product should be stored at -18°C or 4°C, unless otherwise noted (see product details)
<b>subl.</b>	.....	Sublimes
<b>superconductor grade</b>	.....	A high purity, analyzed grade, suitable for preparing superconductors
<b>tech. gr.</b>	.....	Technical grade for general industrial use
<b>TLC</b>	.....	Suitable for Thin Layer Chromotography
<b>v.p.</b>	.....	Vapor pressure mm of Hg
<b>xtl.</b>	.....	Crystalline

## About Purity

<b>Chemical purity</b>	.....	is reported after the chemical name, e.g. Ruthenium carbonyl, 99%
<b>Metals purity</b>	.....	is reported in parentheses with the respective element, e.g. Gallium (III) bromide, anhydrous, granular (99.999%-Ga) PURATREM where 100% minus the metal purity is equal to the maximum allowable percentage of trace metal impurity

# Phosphorus Ligands and Compounds

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## Amination

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## Carbon-carbon bond formation-Cross coupling

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26-1120	(R)-(+)-1-[(R)-2-(2'-Dicyclohexylphosphinophenyl)ferrocenyl]ethylbis(3,5-trifluoromethylphenyl)phosphine, min. 97%.....	177
26-1170	(S)-(+)-1-[(R)-2-(Di-2-furylphosphino)ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97% .....	183
26-1175	(R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino) ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97%.....	199
26-1156	(R)-(+)-[(R)-2-Diphenylphosphinoferrocenyl](N,N-dimethylamino) (2-diphenylphosphinophenyl)methane, min. 97% .....	213
26-1155	(S)-(-)-[(S)-2-Diphenylphosphinoferrocenyl] (N,N-dimethylamino) (2-diphenylphosphinophenyl)methane, min. 97% TANIAPHOS .....	214
26-1201	(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% .....	216
26-1200	(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% .....	215
26-1210	(R)-(-)-1-[(S)-2-(Diphenylphosphino) ferrocenyl]ethyl-dicyclohexylphosphine ethanol adduct, min. 97% (R)-(S)-JOSIPHOS .....	216
26-1211	(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyl-dicyclohexylphosphine ethanol adduct, min. 97% (S)-(R)-JOSIPHOS .....	218
26-1255	(R)-(-)-1-[(S)-2-(Diphenylphosphino) ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97%.....	219
26-1300	(R)-(-)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylbis(di-3,5-tri-fluoromethylphenyl)phosphine, min. 97%.....	225
26-1310	(R)-(-)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyl-dicyclohexylphosphine, min. 97% .....	225
26-1315	(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyl-diphenylphosphine, min. 97%.	226
26-1320	(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyl-di(3,5-xylyl)phosphine, min. 97% .....	227
26-1555	(R)-(+)-1-[(R)-2-(Di-3,5-xylylphosphinophenyl)ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97%.	235
26-3575	1,2,3,4,5-Pentaphenyl-1'-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS .....	246
15-0038	Benzyl-di-1-adamantylphosphine, min. 85% [cataCXium® ABn] .....	3
15-0052	(R)-(-)-1,1'-Binaphthyl-2,2'-diyl hydrogenphosphate, min. 98% .....	6
15-1366	(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin, 98%, (99% ee).....	11

## Carbon-carbon bond formation-General

15-1376	(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	11
15-1377	(11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	11
15-0527	(11aR)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	12
15-0528	(11aS)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	12
15-0126	(R,R)-(-)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (R,R)-QuinoxP*.....	14
15-0127	(S,S)-(+)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (S,S)-QuinoxP*.....	15
15-0066	(R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPPOS®.....	26
15-0067	(S)-(+)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPPOS®.....	29
15-0042	(R)-(-)-2,2'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	29
15-0043	(S)-(+)-2,2'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	31
15-0044	(R)-(+)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	31
15-0045	(S)-(-)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	32
15-0185	(R)-(+)-2,2'-Bis[di(3,5-dimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, 98% (R)-ECNU-Phos.....	32
15-0652	(R)-(-)-2,2'-Bis[di(3,5-di-i-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	35
15-0653	(S)-(+)-2,2'-Bis[di(3,5-di-i-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	35
15-0112	(R)-(+)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	40
15-0113	(S)-(-)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	40
15-1368	(11bR)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	48
15-1369	(11bS)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	48
15-1373	(11bR)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	49
15-1374	(11bS)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee).....	49
15-0542	(11aR)-3,7-Bis(3,5-dimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	50
15-0543	(11aS)-3,7-Bis(3,5-dimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	51
15-0136	(R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-SEGPPOS®..	56
15-0137	(S)-(-)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-SEGPPOS®..	58
15-0140	(2R,3R)-(-)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (R,R)-NORPHOS...	58
15-0141	(2S,3S)-(+)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (S,S)-NORPHOS...	58
15-0433	racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP.....	59
15-0160	(2S,3S)-(-)-Bis(diphenylphosphino)butane (S,S)-CHIRAPHOS.....	65
15-0178	(R)-(+)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (R)-MeO-BIPHEP..	67
15-0179	(S)-(-)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (S)-MeO-BIPHEP...	68
15-2973	(S)-(-)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (S)-(-)-H <sub>8</sub> -BINAP...	75
15-0486	R-(-)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (R)-DIFLUORPHOS™.....	79
15-0490	R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94% (R)-SYNPHOS™.....	80

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15-0491	S(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97% (S)-SYNPHOS™ .....	82
15-0442	12,12'-Bis(diphenylphosphino)-9,9',10,10'-tetrahydro-11,11'-bi-9,10-ethenoanthracene, min. 98% CATPHOS .....	82
15-0654	(R)(+)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	86
15-0655	(S)(-)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	88
15-0156	(R)(+)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	99
15-0157	(S)(-)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	100
15-0158	(R)(+)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% ...	104
15-0159	(S)(-)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% ..	105
15-0478	(R)(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)(+)-DM-SEGPHOS® .....	105
15-0479	(S)(-)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)(-)-DM-SEGPHOS® .....	107
15-0488	(R)(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	108
15-0489	(S)(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	109
15-0522	(11bR)-N,N-Bis[(R)(-)-1-(2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2] dioxaphosphepin-4-amine, min. 98% .....	112
15-0523	(11bS)-N,N-Bis[(S)(+)-1-(2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2] dioxaphosphepin-4-amine, min. 98% .....	113
15-0518	N,N-Bis[(1R)(+)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine .....	114
15-0519	N,N-Bis[(1S)(-)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine .....	115
15-1395	(R)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) .....	121
15-1394	(S)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) .....	121
15-0340	(R)(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(R)-TIPSY] .....	121
15-0341	(S)(+)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(S)-TIPSY] .....	123
15-0483	Butyldi-1-adamantylphosphine, min. 95% [cataCXium® A] .....	125
15-1457	(11bR)(+)-4,4-Dibutyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1- c:1',2'-e]phosphepinium bromide, 99% R-MARUOKA CAT P-NB .....	137
15-1458	(11bS)(-)-4,4-Dibutyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1- c:1',2'-e]phosphepinium bromide, 99% S-Maruoka CAT P-NB .....	137
15-1464	(11bR)(+)-4,4-Di-t-butyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H- dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% R-MARUOKA CAT P-TB .....	138
15-1465	(11bS)(-)-4,4-Di-t-butyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H- dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% S-MARUOKA CAT P-TB .....	138
15-1725	Di-t-butyl(2-butenyl)phosphine (40% in xylene), 98% m-Crophos® .....	138
15-1729	Di-t-butyl(3-methyl-2-butenyl)phosphine (40% in xylene), 98% Crophos® .....	141
15-1049	2-Di-t-butylphosphino-2'-methyl-1,1'-biphenyl, 99% t-BuMePhos .....	150
15-1055	(R)(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (R)-Cl-MeO-BIPHEP .....	156
15-1056	(S)(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (S)-Cl-MeO-BIPHEP .....	158
15-1147	2-Dicyclohexylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl, min. 98% CPhos .....	161
15-6528	[2-Dicyclohexylphosphino-3-methoxy-N-methyl-N-phenylbenzamine, 98% Zheda-Phos ....	174
15-1082	11-Dicyclohexylphosphino-12-(2-methoxyphenyl)-9,10-ethenoanthracene dichloromethane adduct, min. 98% o-MeO-KITPHOS .....	174
15-1084	11-Dicyclohexylphosphino-12-phenyl-9,10-ethenoanthracene dichloromethane adduct, min. 98% KITPHOS .....	177



## Carbon-carbon bond formation-General

15-1255	(S)-(+)-(2,6-Dimethyl-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 98% .....	192
15-1505	(3aR,8aR)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3,2]dioxolo[4,5-e][1,3,2]dioxaphosphepin-6-yl)dimethylamine, min. 98% .....	195
15-7203	(2R)-1-(11bR)-(Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline, 98% .....	196
15-7204	(2R)-1-(11bS)-(Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline, 98% .....	197
15-1510	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl(methyl)amine, 99% .....	202
15-1521	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1S)-1-phenylethyl]amine, min. 95% .....	202
15-1520	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-phenylethyl]amine, dichloromethane adduct, min. 95% .....	203
15-1227	(S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)-5H-dibenz[b,f]azepine, min. 97% .....	204
15-1232	(R)-(-)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (R)-MONOPHOS .....	206
15-1233	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (S)-MONOPHOS .....	207
15-1525	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)[(1R)-1-phenylethyl]amine, min. 95% .....	207
15-1765	2-[2-(Diphenylphosphino)ethyl]pyridine, min. 97% .....	212
15-1775	(R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP .....	220
15-1776	(S)-(-)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (S)-MOP .....	221
15-1782	(R)-(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,R)-O-PINAP .....	223
15-1783	(S)-(-)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,S)-O-PINAP .....	223
15-1784	(R)-(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97% (R,R)-N-PINAP .....	223
15-1787	(R)-(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(S)-1-phenylethyl]-1-phthalazinamine, min. 97% (S,R)-N-PINAP .....	224
15-1786	(S)-(-)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97% (R,S)-N-PINAP .....	224
15-6525	[2,6-Di- <i>i</i> -propoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% GorlosPhosHBF <sub>4</sub> .....	230
15-1392	(11bR)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee) .....	239
15-1393	(11bS)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee) .....	239
15-1381	(11bR)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1382	(11bS)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1388	(11bR)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1389	(11bS)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1390	(11bR)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1391	(11bS)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	239
15-1386	(11bR)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	240
15-1387	(11bS)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	240

## Carbon-carbon bond formation-General

15-3495	(S)-(+)-(8,9,10,11,12,13,14,15-Octahydro-3,5-dioxo-4-phospha-cyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)dimethylamine, 99% .....	245
15-1383	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1384	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1378	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1379	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1396	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-1397	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-1370	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-1371	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-5162	(11aR)-(+)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (R)-SIPHOS-PE.....	254
15-5163	(11aS)-(-)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (S)-SIPHOS-PE.....	256
15-5156	(11aR)-(+)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (R)-ShiP .....	257
15-5157	(11aS)-(-)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (S)-ShiP.....	258
15-1363	(11aR)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% .....	259
15-1364	(11aS)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% .....	260
15-1517	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-diethylphenyl) tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	260
15-1518	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-diethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	261
15-1511	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	261
15-1512	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	262
15-1513	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-di-i-propylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	263
15-1514	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-di-i-propylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	264
15-5211	(S)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine, min. 95% CTH-(S)-Xylyl-P-Phos .....	265
15-5810	Tri-t-butylphosphine, 99% .....	271
15-5990	Tri-n-butylphosphonium tetrafluoroborate, 99% .....	273
15-6000	Tri-t-butylphosphonium tetrafluoroborate, 99% .....	274
15-6372	Tri-2-furylphosphine, 98+% .....	277
15-6520	[2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF <sub>4</sub> .....	280
15-7720	Tris(2,4-di-t-butylphenyl)phosphite, 98% .....	287

## Carbon-carbon bond formation-Heck Reaction

15-0045	(S)-(-)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	32
15-0150	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP.....	60
15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP .....	64

## Carbon-carbon bond formation-Heck Reaction

15-0490	R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94% (R)-SYNPHOS™ .....	80
15-0491	S-(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97% (S)-SYNPHOS™ .....	82
15-0152	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-ToIBINAP .....	95
15-0153	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-ToIBINAP .....	97
15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP .....	108
15-0483	Butyl-di-1-adamantylphosphine, min. 95% [cataCXium® A].....	125
15-1729	Di-t-butyl(3-methyl-2-butenyl)phosphine (40% in xylene), 98% Crophos® .....	141
15-1055	(R)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (R)-Cl-MeO-BIPHEP.....	156
15-1056	(S)-(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (S)-Cl-MeO-BIPHEP.....	158
15-1505	(3aR,8aR)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3]dioxolo[4,5-e][1,3,2]dioxaphosphepin-6-yl)dimethylamine, min. 98% .....	195
15-1821	(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (R)-iPr-PHOX.....	227
15-1822	(S)-(-)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (S)-iPr-PHOX.....	228
15-5810	Tri-t-butylphosphine, 99% .....	271
15-5811	Tri-t-butylphosphine, 99% (10 wt% in hexanes) .....	272
15-5812	Tri-t-butylphosphine, 99% (10 wt% in hexanes) (Sure/Seal™ bottle) .....	272
15-6000	Tri-t-butylphosphonium tetrafluoroborate, 99% .....	274
15-7720	Tris(2,4-di-t-butylphenyl)phosphite, 98% .....	287

## Carbon-heteroatom bond formation

26-0150	1,1'-Bis(di-t-butylphosphino)ferrocene, min. 98% DTBPF .....	20
26-0240	(S,S)-(+)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(dicyclohexylphosphino)ferrocene, min. 97% .....	42
26-0248	(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocene, min. 97% .....	43
26-0252	(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(diphenylphosphino)ferrocene, min. 97% .....	45
26-0244	(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-trifluoromethylphenyl)phosphino]ferrocene, min. 97% .....	46
26-0270	1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF .....	68
26-0275	1,1'-Bis(di-i-propylphosphino)ferrocene, min. 98% DiPPF .....	89
26-0975	(R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% .....	171
26-1200	(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% .....	215
26-3575	1,2,3,4,5-Pentaphenyl-1'-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS .....	246
15-5186	(R)-(+)-7-[4(S)-(Benzyl)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SiPHOX.....	5
15-1366	(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	11
15-1367	(11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	11
15-1376	(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	11
15-1377	(11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	11
15-0527	(11aR)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	12

## Carbon-heteroatom bond formation

15-0528	(11aS)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% .....	12
15-0066	(R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPHOS® .....	26
15-0067	(S)-(+)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPHOS® .....	29
15-0044	(R)-(+)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% ....	31
15-4320	(+)-1,13-Bis[di(3,5-dimethylphenyl)phosphino]-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97% (R,R,R)-(+)-Xyl-SKP .....	33
15-4321	(-)-1,13-Bis[di(3,5-dimethylphenyl)phosphino]-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97% (S,S,S)-(-)-Xyl-SKP .....	33
15-1368	(11bR)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	48
15-1369	(11bS)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	48
15-1373	(11bR)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	49
15-1374	(11bS)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) .....	49
15-4330	(+)-1,13-Bis[di(4-methylphenyl)phosphino]-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97% (R,R,R)-(+)-Tol-SKP .....	49
15-4331	(-)-1,13-Bis[di(4-methylphenyl)phosphino]-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97% (S,S,S)-(-)-Tol-SKP .....	50
15-0542	(11aR)-3,7-Bis(3,5-dimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% .....	50
15-0543	(11aS)-3,7-Bis(3,5-dimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% .....	51
15-0140	(2R,3R)-(-)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (R,R)-NORPHOS...	58
15-0141	(2S,3S)-(+)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (S,S)-NORPHOS...	58
15-0433	racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP .....	59
15-0150	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP .....	60
15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP .....	64
15-0145	2,2'-Bis(diphenylphosphino)-1,1'- biphenyl, 98% BIPHEP .....	64
15-4310	(+)-1,13-Bis(diphenyl)phosphino-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano [3,2-d]xanthene, 97% (R,R,R)-(+)-Ph-SKP .....	70
15-4311	(-)-1,13-Bis(diphenyl)phosphino-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano [3,2-d]xanthene, 97% (S,S,S)-(-)-Ph-SKP .....	71
15-0380	Bis(2-diphenylphosphinophenyl)ether, 98% DPEphos .....	77
15-0486	R(-)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (R)-DIFLUORPHOS™ .....	79
15-0442	12,12'-Bis(diphenylphosphino)-9,9',10,10'-tetrahydro-11,11'-bi-9,10-ethenoanthracene, min. 98% CATPHOS .....	82
15-0415	4,5-Bis-(di-i-propylphosphinomethyl)acridine, 98+% .....	90
15-0152	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP .....	95
15-0153	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP .....	97
15-0478	(R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPHOS® .....	105
15-0479	(S)-(-)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-DM-SEGPHOS® .....	107
15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP .....	107
15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP .....	108
15-0522	(11bR)-N,N-Bis[(R)-(-)-1-(2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-amine, min. 98% .....	112

## Carbon-heteroatom bond formation

15-0523	(11bS)-N,N-Bis[(S)(+)-1-(2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-amine, min. 98% .....	113
15-1395	(R)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) .....	121
15-1394	(S)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) .....	121
15-0340	(R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(R)-TiPSY] .....	121
15-0341	(S)(+)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(S)-TiPSY] .....	123
15-1090	2-(Di-1-adamantylphosphino) dimethylaminobenzene, 97% Me-DalPhos .....	131
15-1138	2-(Di-1-adamantylphosphino)-3,6-dimethoxy-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 95% AdBrettPhos .....	131
15-0961	(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 95% (S,S)-DACH-Phenyl Trost Ligand .....	132
15-0960	(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 98% (R,R)-DACH-Phenyl Trost Ligand .....	133
15-0963	(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N'-bis(2-diphenylphosphino-1-naphthoyl), min. 94% (R,R)-DACH-Naphthyl Trost Ligand .....	134
15-0964	(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N'-bis(2-diphenylphosphino-1-naphthoyl), min. 94% (S,S)-DACH-Naphthyl Trost Ligand .....	135
15-1157	2-Di[3,5-bis(trifluoromethyl)phenylphosphino]-3,6-dimethoxy-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% JackiePhos .....	136
15-1725	Di- <i>t</i> -butyl(2-butenyl)phosphine (40% in xylene), 98% m-Crophos® .....	138
15-1005	Di- <i>t</i> -butyl(2,2-diphenyl-1-methyl-1-cyclopropyl)phosphine cBRIDP .....	140
15-1065	Di- <i>t</i> -butyl(2,2-diphenyl-1-methylvinyl)phosphine, min. 98% vBRIDP .....	140
15-1017	Di- <i>t</i> -butylneopentylphosphine, min. 95% (DTBNpP) .....	142
15-1019	Di- <i>t</i> -butylneopentylphosphonium tetrafluoroborate, min. 95% .....	143
15-1043	racemic-2-Di- <i>t</i> -butylphosphino-1, 1'-binaphthyl, 98% TrixiePhos .....	144
15-1045	2-(Di- <i>t</i> -butylphosphino))-1,1'-biphenyl, 99% JohnPhos .....	145
15-1164	2-(Di- <i>t</i> -butylphosphino)-3,6-dimethoxy-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% t-BuBrettPhos .....	147
15-1048	2-Di- <i>t</i> -butylphosphino-2'-(N,N-dimethylamino))-1,1'-biphenyl, 98% tBuDavePhos .....	148
15-1168	2-(Di- <i>t</i> -butylphosphino)-3-methoxy-6-methyl-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% RockPhos .....	149
15-1063	2-Di- <i>t</i> -butylphosphino-4-methoxy-3,5,6-trimethyl-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% [~1:1 mixture with regioisomer, 2-Di- <i>t</i> -butylphosphino-5-methoxy-3,4,6-trimethyl-2',4',6'-tri- <i>i</i> -propylbiphenyl] .....	150
15-1049	2-Di- <i>t</i> -butylphosphino-2'-methyl)-1,1'-biphenyl, 99% t-BuMePhos .....	150
15-1051	2-Di- <i>t</i> -butylphosphino-3,4,5,6-tetramethyl-2',4',6'-tri- <i>i</i> -propyl)-1,1'-biphenyl, min. 98% Me <sub>4</sub> t-BuXPhos .....	152
15-1052	2-Di- <i>t</i> -butylphosphino-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% t-BuXPhos .....	153
15-1007	Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine Cy-cBRIDP .....	159
15-1062	Dicyclohexyl(2,2-diphenyl-1-methylvinyl)phosphine Cy-vBRIDP .....	159
15-1140	2-(Dicyclohexylphosphino))-1,1'-biphenyl, 98% CyJohnPhos .....	160
15-1147	2-Dicyclohexylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl, min. 98% CPhos .....	161
15-1152	2-(Dicyclohexylphosphino)-3,6-dimethoxy-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% BrettPhos .....	164
15-1145	2-(Dicyclohexylphosphino)-2'-(N,N-dimethylamino))-1,1'-biphenyl, 98% DavePhos .....	165
15-1154	2-Dicyclohexylphosphino-4'-(N,N-dimethylamino)-1,1'-biphenyl, 98% .....	167
15-1146	2-Dicyclohexylphosphino-2',6'-di- <i>i</i> -propoxy-1,1'-biphenyl, min. 98% RuPhos .....	167



## Carbon-heteroatom bond formation

15-1082	11-Dicyclohexylphosphino-12-(2-methoxyphenyl)-9,10-ethenoanthracene dichloromethane adduct, min. 98% o-MeO-KITPHOS.....	174
15-1148	2-Dicyclohexylphosphino-2'-methyl-)-1,1'-biphenyl, min. 98% MePhos.....	175
15-1084	11-Dicyclohexylphosphino-12-phenyl-9,10-ethenoanthracene dichloromethane adduct, min. 98% KITPHOS.....	177
15-1088	2-[2-(Dicyclohexylphosphino)phenyl]-1-methyl-1H-indole, min. 98% CM-Phos.....	178
15-1149	2-(Dicyclohexylphosphino)-2',4',6'-tri- <i>i</i> -propyl-1,1'-biphenyl, min. 98% XPhos.....	179
15-1248	[4-( <i>N,N</i> -Dimethylamino)phenyl]di- <i>t</i> -butylphosphine, min. 95% amphos.....	185
15-1242	9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS.....	186
15-1521	( <i>S</i> )-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)bis[(1 <i>S</i> )-1-phenylethyl]amine, min. 95%.....	202
15-1520	( <i>S</i> )-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)bis[(1 <i>R</i> )-1-phenylethyl]amine, dichloromethane adduct, min. 95%.....	203
15-1227	( <i>S</i> )-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)-5H-dibenz[ <i>b,f</i> ]azepine, min. 97%.....	204
15-1745	2-Diphenylphosphino-2'-( <i>N,N</i> -dimethylamino)-1,1'-biphenyl, 98% PhDavePhos.....	210
15-1748	1-Diphenylphosphino-2-( <i>N,N</i> -dimethylamino)-1H-indene, 99% (contains vinylic isomer).....	211
15-1802	1-Di- <i>i</i> -propylphosphino-2-( <i>N,N</i> -dimethylamino)-1H-indene, 99%.....	231
15-5184	(11 <i>aR</i> )-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1- <i>cd</i> :1',7'- <i>ef</i> ]phosphocin, min. 97% ( <i>R</i> )-SITCP.....	237
15-5185	(11 <i>aS</i> )-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1- <i>cd</i> :1',7'- <i>ef</i> ]phosphocin, min. 97% ( <i>S</i> )-SITCP.....	238
15-1392	(11 <i>bR</i> )-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 95%, (99% ee).....	239
15-1393	(11 <i>bS</i> )-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 95%, (99% ee).....	239
15-1381	(11 <i>bR</i> )-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1382	(11 <i>bS</i> )-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1388	(11 <i>bR</i> )-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1389	(11 <i>bS</i> )-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1390	(11 <i>bR</i> )-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1391	(11 <i>bS</i> )-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	239
15-1386	(11 <i>bR</i> )-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	240
15-1387	(11 <i>bS</i> )-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	240
15-2975	<i>N</i> -(2-Methoxyphenyl)-2-(di- <i>t</i> -butylphosphino)pyrrole, min. 95% [cataCXium® POMetB].....	240
15-1091	2-(2-Methoxyphenyl)-1-methyl-3-diphenylphosphino)-1H-indole, min. 98% PPh <sub>2</sub> -Andole-Phos..	242
15-1383	(11 <i>bR</i> )-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1384	(11 <i>bS</i> )-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1378	(11 <i>bR</i> )-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1379	(11 <i>bS</i> )-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	245
15-1396	(11 <i>bR</i> )-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1- <i>d</i> :1',2'- <i>f</i> ][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246

## Carbon-heteroatom bond formation

15-1397	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-1370	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-1371	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee).....	246
15-3550	N-Phenyl-2-(di-t-butylphosphino)indol, min. 98% [cataCXium® PlntB].....	247
15-3600	N-Phenyl-2-(di-t-butylphosphino)pyrrole, 95+% [cataCXium® PtB].....	248
15-3605	N-Phenyl-2-(dicyclohexylphosphino)indol, min. 95% [cataCXium® PlnCyl].....	249
15-5162	(11aR)-(+)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (R)-SIPHOS-PE.....	254
15-5163	(11aS)-(-)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (S)-SIPHOS-PE.....	256
15-1363	(11aR)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	259
15-1364	(11aS)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%.....	260
15-1517	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-diethylphenyl) tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	260
15-1518	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-diethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	261
15-1511	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	261
15-1512	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	262
15-1513	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-di-i-propylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	263
15-1514	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-di-i-propylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin.....	264
15-5811	Tri-t-butylphosphine, 99% (10 wt% in hexanes).....	272
15-5812	Tri-t-butylphosphine, 99% (10 wt% in hexanes) (Sure/Seal™ bottle).....	272
15-6520	[2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF <sub>4</sub> .....	280
15-7720	Tris(2,4-di-t-butylphenyl)phosphite, 98%.....	287

## Cyclization

26-1130	(R)-(+)-1-[(R)-2-[2'-Bis(3,5-dimethyl-4-methoxyphenyl)phosphinophenyl]ferrocenyl]ethylbis(di-3,5-tri fluoromethylphenyl) phosphine, min. 97%.....	48
26-0956	(R)-(+)-[(R)-2-Dicyclohexylphosphinoferrocenyl](N,N-dimethylamino) (2-dicyclohexylphosphinophenyl)methane, min. 97%.....	170
26-0955	(S)-(-)-[(S)-2-Dicyclohexylphosphinoferrocenyl](N,N-dimethylamino) (2-dicyclohexylphosphinophenyl)methane, min. 97%.....	170
26-1120	(R)-(+)-1-[(R)-2-(2'-Dicyclohexylphosphinophenyl)ferrocenyl]ethylbis(3,5-trifluoromethylphenyl)phosphine, min. 97%.....	177
26-1300	(R)-(-)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylbis(di-3,5-tri-fluoromethylphenyl)phosphine, min. 97%.....	225
26-1310	(R)-(-)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyldicyclohexylphosphine, min. 97%.....	225
26-1315	(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyldiphenylphosphine, min. 97%.....	226
26-1320	(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethyldi(3,5-xylyl)phosphine, min. 97%.....	227
26-1555	(R)-(+)-1-[(R)-2-(2'-Di-3,5-xylylphosphinophenyl)ferrocenyl]ethyldi-3,5-xylylphosphine, min. 97%.....	235
15-5186	(R)-(+)-7-[4(S)-(Benzyl)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOS.....	5
15-0066	(R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGHOS®.....	26

## Cyclization

15-0067	(S)-(+)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPPOS® .....	29
15-0044	(R)-(+)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	31
15-0045	(S)-(-)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	32
15-0136	(R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-SEGPHOS® ..	56
15-0137	(S)-(-)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-SEGPHOS® ..	58
15-0433	racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP .....	59
15-0490	R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94% (R)-SYNPHOS™ .....	80
15-0491	S-(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97% (S)-SYNPHOS™ .....	82
15-0478	(R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPHOS® .....	105
15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP .....	107
15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP .....	108
15-1055	(R)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (R)-Cl-MeO-BIPHEP .....	156
15-1056	(S)-(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (S)-Cl-MeO-BIPHEP .....	158
15-1505	(3aR,8aR)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3]dioxolo[4,5-e][1,3,2] dioxaphosphepin-6-yl)dimethylamine, min. 98% .....	195
15-1521	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)bis[(1S)-1- phenylethyl]amine, min. 95% .....	202
15-1520	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)bis[(1R)-1- phenylethyl]amine, dichloromethane adduct, min. 95% .....	203
15-1227	(S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a]dinaphthalen-4-yl)-5H-dibenz[b,f] azepine, min. 97% .....	204
15-5184	(11aR)-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1-cd:1',7'-ef]phosphocin, min. 97% (R)-SITCP .....	237
15-5185	(11aS)-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1-cd:1',7'-ef]phosphocin, min. 97% (S)-SITCP .....	238
15-5211	(S)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine, min. 95% CTH-(S)-Xylyl-P-Phos .....	265
15-6520	[2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF <sub>4</sub> .....	280

## Cyclopropanation

15-4310	(+)-1,13-Bis(diphenyl)phosphino-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1] benzopyrano [3,2-d]xanthene, 97% (R,R,R)-(+)-Ph-SKP .....	70
15-4311	(-)-1,13-Bis(diphenyl)phosphino-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1] benzopyrano [3,2-d]xanthene, 97% (S,S,S)-(-)-Ph-SKP .....	71

## Decarboxylation

15-0066	(R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPPOS® .....	26
15-0067	(S)-(+)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPPOS® .....	29
15-0044	(R)-(+)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	31
15-0478	(R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPHOS® .....	105

## Hydroboration

26-1150	(R)-(-)-1-((S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocenyl)ethyl-di- cyclohexylphosphine, min. 97% .....	47
26-0960	(R)-(-)-1-((S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl)ethyl-di- cyclohexylphosphine, min. 97% .....	101

## Hydroboration

26-0965	(R)-(-)-1-((S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl)ethyl-di-3,5-xylylphosphine, min. 97% .....	104
26-0650	(R)-(-)-1-((S)-2-[Bis(4-trifluoromethylphenyl) phosphino]ferrocenyl) ethyl-di-t-butylphosphine, min. 97%.....	117
26-1000	(R)-(-)-1-[(S)-2-(Dicyclohexylphosphino) ferrocenyl]ethyl-dicyclohexylphosphine, min. 97%.....	172
26-1001	(S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl-dicyclohexylphosphine, min. 97%.....	173
26-1230	(R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl-diphenylphosphine, min. 97%.....	173
26-1101	(S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl-diphenylphosphine, min. 97%.....	173
26-1170	(S)-(+)-1-[(R)-2-(Di-2-furylphosphino)ferrocenyl]ethyl-di- 3,5-xylylphosphine, min. 97% .....	183
26-1175	(R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino) ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97%.....	199
26-1201	(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% .....	216
26-1210	(R)-(-)-1-[(S)-2-(Diphenylphosphino) ferrocenyl]ethyl-dicyclohexylphosphine ethanol adduct, min. 97% (R)-(S)-JOSIPHOS .....	216
26-1211	(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyl-dicyclohexylphosphine ethanol adduct, min. 97% (S)-(R)-JOSIPHOS .....	218
26-1255	(R)-(-)-1-[(S)-2-(Diphenylphosphino) ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97% .....	219
15-1960	4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole, 98+% rac-AntPhos.....	1
15-1963	(R)-4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole,98+% (>99% ee) [(R)-AntPhos].....	2
15-1967	(S)-4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole,99+% (>99% ee) [(S)-AntPhos] .....	2
15-0150	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP.....	60
15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP .....	64
15-0152	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP .....	95
15-0153	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP .....	97
15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP .....	107
15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP .....	108

## Hydroformylation

15-0176	(S)-(+)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxonin, 95% (S)-C <sub>3</sub> -TUNEPHOS.....	66
15-0175	R-(-)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxonin, 97% (R)-C <sub>3</sub> -TUNEPHOS .....	66
15-0437	4,6-Bis(diphenylphosphino) phenoxazine, min. 98% NIXANTPHOS .....	76
15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP .....	107
15-0107	6,6'-[(3,3'-Di-t-butyl-5,5'-dimethoxy-1,1'-biphenyl-2,2'-diyl)bis(oxy)] bis(dibenzo[d,f][1,3,2]dioxaphosphepin) hemi ethyl acetate adduct, min. 95% BIPHEPHOS .....	139
15-1455	(+)-6,6'-{[(1R,3R)-1,3-Dimethyl-1,3-propanediyl]bis(oxy)}bis[4,8-bis(t-butyl)-2,10-dimethoxy-bibenzo[d,f][1,3,2]dioxaphosphepin], min. 95% (R,R)-Chiraphite.....	194
15-1456	(-)-6,6'-{[(1S,3S)-1,3-Dimethyl-1,3-propanediyl]bis(oxy)}bis[4,8-bis(t-butyl)-2,10-dimethoxy-bibenzo[d,f][1,3,2]dioxaphosphepin], min. 95% (S,S)-Chiraphite.....	194
15-1530	(S)-2-(1-Naphthyl)-8-diphenylphosphino-1-[(R)-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl]-1,2-dihydroquinoline toluene adduct, min. 97% (Ra,Sc)-(1-Nph)-Quinaphos .....	243

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26-0201	(-)-1,1'-Bis((2S,4S)-2,4-diethylphosphonato)ferrocene, min. 95% (S,S)-Et-FerroTANE@.....	39
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15-0112	(R)-(+)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	40
15-0113	(S)-(-)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	40
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15-0092	(+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)benzene, 98+% (S,S)-Me-DUPHOS.....	53
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15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP .....	64
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15-0176	(S)-(+)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzof[h,j][1,5]dioxonin, 95% (S)-C <sub>3</sub> -TUNEPHOS.....	66
15-0175	R-(-)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzof[h,j][1,5]dioxonin, 97% (R)-C <sub>3</sub> -TUNEPHOS .....	66
15-0178	(R)-(+)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (R)-MeO-BIPHEP	67
15-0179	(S)-(-)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (S)-MeO-BIPHEP	68
15-2972	(R)-(+)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (R)-(+)-H <sub>8</sub> -BINAP.	73
15-2973	(S)-(-)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (S)-(-)-H <sub>8</sub> -BINAP .	75
15-0425	(R)-(-)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (R)-PHANEPHOS .....	75
15-0426	(S)-(+)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (S)-PHANEPHOS .....	76
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15-0487	S-(+)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (S)-DIFLUORPHOS™ .....	80
15-0490	R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94% (R)-SYNPHOS™ .....	80
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15-0474	(+)-1,2-Bis((2S,5S)-2,5-diphenylphospholano)ethane, min. 98% (S,S)-Ph-BPE .....	86
15-0654	(R)-(+)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	86
15-0655	(S)-(-)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	88
15-0410	(+)-1,2-Bis((2R,5R)-2,5-di-i-propylphospholano)benzene, 98+% (R,R)-i-Pr-DUPHOS .....	91
15-0411	(-)-1,2-Bis((2S,5S)-2,5-di-i-propylphospholano)benzene, 98+% (S,S)-i-Pr-DUPHOS .....	94
15-0152	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP .....	95
15-0153	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP .....	97
15-0156	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	99
15-0157	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	100
15-0158	(R)-(+)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%...	104
15-0159	(S)-(-)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% ..	105
15-0478	(R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPHOS®	105
15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP .....	107
15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP .....	108
15-0488	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% .....	108
15-0489	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%.....	109
15-0730	(R)-(-)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclophane, min. 97% CTH-(R)-3,5-xylyl-PHANEPHOS.....	110
15-0731	(S)-(+)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclophane, min. 97% CTH-(S)-3,5-xylyl-PHANEPHOS .....	111
15-0710	(R)-4,12-Bis(4-methoxyphenyl)-[2.2]-paracyclophane R-An-Phanephos.....	113
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15-1053	(3S,3'S,4S,4'S,11bS,11'bS)-(+)-4,4'-Di- <i>t</i> -butyl-4,4',5,5'-tetrahydro-3,3'-bi-3H-dinaphtho[2,1-c:1',2'-e]phosphepin, 97% (S)-BINAPINE .....	155
15-1060	(1R,1'R,2S,2'S)-(+)-2,2'-Di- <i>t</i> -butyl-2,3,2',3'-tetrahydro-1,1'-bi-1H-isophosphindole, min. 98% (R,R,S,S)-DUANPHOS .....	156
15-1055	(R)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (R)-Cl-MeO-BIPHEP .....	156
15-1056	(S)-(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (S)-Cl-MeO-BIPHEP .....	158
15-1255	(S)-(+)-(2,6-Dimethyl-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 98% .....	192
15-1510	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl(methyl)amine, 99% .....	202
15-1521	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1S)-1-phenylethyl]amine, min. 95% .....	202
15-1520	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-phenylethyl]amine, dichloromethane adduct, min. 95% .....	203
15-1231	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)diethylamine, min. 97% .....	205
15-1232	(R)-(-)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (R)-MONOPHOS .....	206
15-1233	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (S)-MONOPHOS .....	207
15-1235	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)morpholine, min. 97% (S)-MorfPhos .....	207
15-1525	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)[(1R)-1-phenylethyl]amine, min. 95% .....	207
15-1234	(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)piperidine, min. 97% (S)-PipPhos .....	208
15-1821	(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (R)-iPr-PHOX .....	227
15-1822	(S)-(-)-2-[[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (S)-iPr-PHOX .....	228
15-1530	(S)-2-(1-Naphthyl)-8-diphenylphosphino-1-[(R)-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl]-1,2-dihydroquinoline toluene adduct, min. 97% (Ra,Sc)-(1-Nph)-Quinaphos .....	243
15-3495	(S)-(+)-(8,9,10,11,12,13,14,15-Octahydro-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, 99% .....	245
15-5162	(11aR)-(+)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (R)-SIPHOS-PE .....	254
15-5163	(11aS)-(-)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (S)-SIPHOS-PE .....	256
15-5156	(11aR)-(+)-10,11,12,13-Tetrahydrodiindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (R)-ShiP .....	257
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15-5186	(R)-(+)-7-[4(S)-(Benzyl)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOS.....	5
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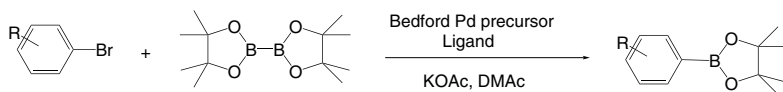
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# PHOSPHORUS - Ligands and Compounds

93-1501	<b>Allyltriphenylphosphonium bromide, 99% (1560-54-9)</b> (CH <sub>2</sub> =CHCH <sub>2</sub> )(C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> PBr; FW: 383.26; white xtl.; m.p. 222-225°	25g 100g
15-7143	<b>(R)-1-Amino-8-(diphenylphosphino)-1,2,3,4-tetrahydronaphthalene, min. 97% (960128-64-7)</b> C <sub>22</sub> H <sub>22</sub> NP; FW: 331.39; white solid <i>air sensitive</i>	250mg 1g
15-7144	<b>(S)-1-Amino-8-(diphenylphosphino)-1,2,3,4-tetrahydronaphthalene, min. 97% (1222630-45-6)</b> C <sub>22</sub> H <sub>22</sub> NP; FW: 331.39; white solid <i>air sensitive</i>	250mg 1g
15-7107	<b>(1R,2R)-2-Amino-1-phenylpropyldiphenylphosphine, min. 97% (799297-44-2)</b> C <sub>21</sub> H <sub>22</sub> NP; FW: 319.38; white solid <i>air sensitive</i>	100mg 500mg
15-7108	<b>(1S,2S)-2-Amino-1-phenylpropyldiphenylphosphine, min. 97% (341968-71-6)</b> C <sub>21</sub> H <sub>22</sub> NP; FW: 319.38; white solid <i>air sensitive</i>	100mg 500mg
15-7176	<b>(2-Ammonioethyl)di-t-butylphosphonium bis(tetrafluoroborate), min. 97% (1222630-51-4)</b> C <sub>10</sub> H <sub>25</sub> B <sub>2</sub> F <sub>8</sub> NP; FW: 363.89; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.	250mg 1g
15-7178	<b>(3-Ammoniopropyl)di-t-butylphosphonium bis(tetrafluoroborate), min. 97%</b> C <sub>11</sub> H <sub>27</sub> B <sub>2</sub> F <sub>8</sub> NP; FW: 377.92; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.	250mg 1g
15-1960	<b>4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole, 98+% rac-AntPhos (1268693-24-8)</b> C <sub>25</sub> H <sub>23</sub> O <sub>3</sub> P; FW: 370.42; pale yellow powdr. <i>air sensitive, (store cold)</i> Note: Sold in collaboration with Zejun for research purposes only. Patents ZL201310020371.1, CN 201610056390.	25mg 100mg 500mg

## Technical Notes:

- Ligand/palladium catalyst for general Miyaura borylation reactions.
- Ligand/palladium catalyst for general and sterically demanding Suzuki-Miyaura cross-coupling reactions.
- Ligand/palladium catalyst for aryl-alkyl Suzuki-Miyaura cross-coupling reactions.
- Ligand/nickel catalyst for intramolecular reductive cyclization.
- Ligand/palladium catalyst for Dearomative cyclization.

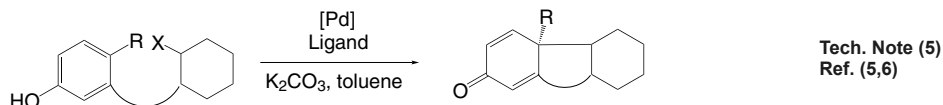
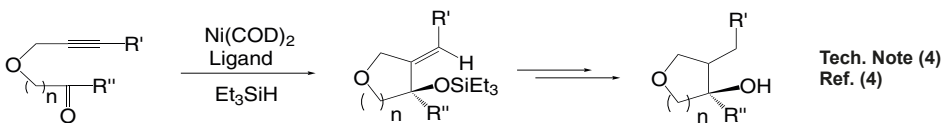
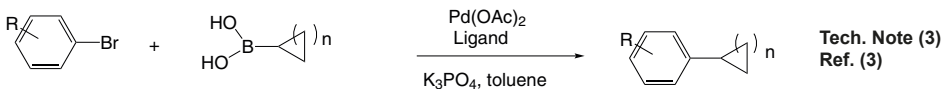
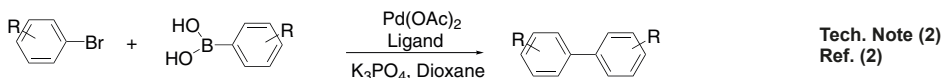


**Tech. Note (1)  
Ref. (1)**



# PHOSPHORUS - Ligands and Compounds

**15-1960** 4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole, 98+% *rac*-AntPhos  
(continued) (1268693-24-8)



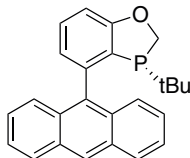
## References:

1. *Org. Lett.*, **2011**, 13, 1366.
2. *Chem. Eur. J.*, **2013**, 19, 2261.
3. *Org. Chem. Front.*, **2014**, 1, 225.
4. *Angew. Chem. Int. Ed.*, **2015**, 54, 2520.
5. *Angew. Chem. Int. Ed.*, **2015**, 54, 3033.
6. *Tetrahedron*, **2016**, 72, 1782.

**15-1963**

**NEW**

(R)-4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole, 98+% (>99% ee) [(R)-AntPhos] (1456816-37-7)  
C<sub>25</sub>H<sub>23</sub>O<sub>3</sub>P; FW: 370.42; light-yellow xtl.  
*air sensitive, (store cold)*  
Note: Sold in collaboration with Zejun for research purposes only. Patents ZL201310020371.1, CN 201610056390.



25mg  
100mg  
500mg

## Technical Note:

1. See 15-1960 (page 1)

**15-1967**

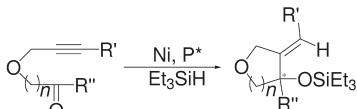
**NEW**

(S)-4-(Anthracen-9-yl)-3-(t-butyl-2,3-dihydrobenzo[d][1,3]oxaphosphole, 99+% (>99% ee) [(S)-AntPhos] (1807740-34-6)  
C<sub>25</sub>H<sub>23</sub>O<sub>3</sub>P; FW: 370.42; light yellow xtl.  
*air sensitive, (store cold)*  
Note: Sold in collaboration with Zejun for research purposes only. Patents ZL201310020371.1, CN 201610056390.

25mg  
100mg  
500mg

## Technical Note:

1. Ligand for the enantioselective nickel-catalyzed intramolecular reductive cyclization of alkyones.



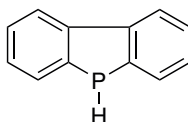
Tech. Note (1)  
Ref. (1)

## References:

1. *Angew. Chem. Int. Ed.*, **2015**, 54, 2520.

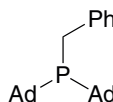
# PHOSPHORUS - Ligands and Compounds

**15-0033** **5H-Benzo[b]phosphindole, 99% (244-87-1)**  
 $C_{12}H_9P$ ; FW: 184.17; white powdr.  
*air sensitive*



250mg  
1g

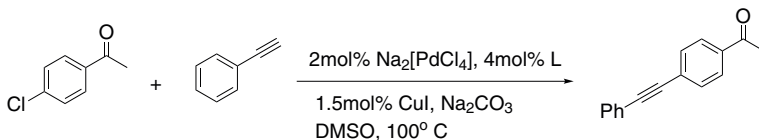
**15-0038** **Benzyl-di-1-adamantylphosphine, min. 85%**  
**[cataCXium® ABn] (395116-70-8)**  
 $C_6H_5CH_2(C_{10}H_{15/2}P)$ ; FW: 392.56; yellow powdr.;  
 m.p. 183°  
*air sensitive*  
 Note: Sold in collaboration with Solvias for research purposes only. Patent WO 0210178. Solvias cataCXium® Ligand Kit component.



500mg  
2g

**Technical Note:**

- Useful ligand for Sonogashira coupling reaction.

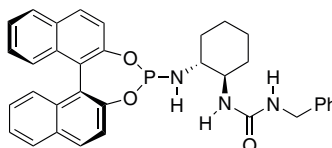


**Tech. Note (1)**  
**Ref. (1)**

**References:**

- Angew. Chem. Int. Ed.*, **2003**, 42, 1056.
- Synthesis*, **2004**, 935. (general overview)

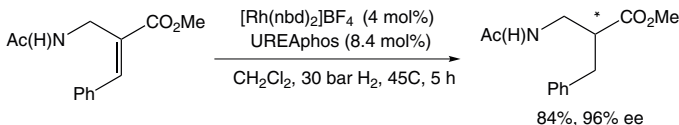
**15-2208** **1-Benzyl-3-((1R,2R)-2-[[11bS]-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-ylamino]cyclohexyl)urea, min. 97%**  
*(1198080-57-7)*  
 $C_{34}H_{32}N_3O_3P$ ; FW: 561.61;  
 white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559.  
 UREAPhos and METAMORPhos Ligand Kit component.



50mg  
250mg

**Technical Note:**

- The UREAPhos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



**References:**

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

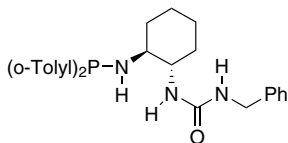
**15-0040** **Benzylidiphenylphosphine, 99% (7650-91-1)**  
 $(C_6H_5CH_2)(C_6H_5)_2P$ ; FW: 276.32; white powdr.; m.p. 74-75°  
*air sensitive*

1g  
5g

# PHOSPHORUS - Ligands and Compounds

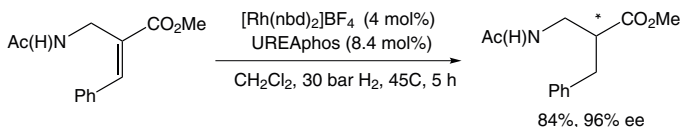
**15-2210** **1-Benzyl-3-[(1*S*,2*S*)-2-(*di*-*o*-tolylphosphinoamino)cyclohexyl]urea, min. 97% (1858223-87-6)**  
 $C_{28}H_{34}N_2O$ ; FW: 459.56; white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCaT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component.

50mg  
250mg



## Technical Note:

- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.

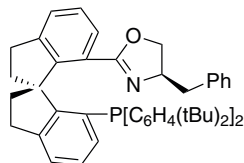


## References:

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

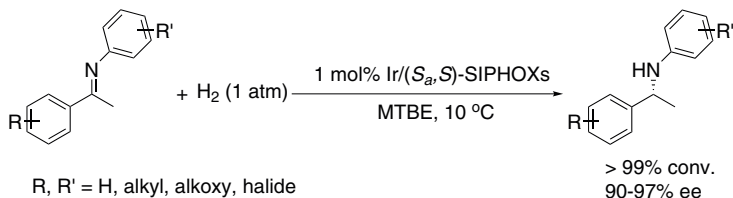
**15-5190** **(*R*)-(+)-7'-[4(*S*)-(Benzyl)oxazol-2-yl]-7-di(3,5-di-*t*-butylphenyl)phosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (*R*<sub>a</sub>,*S*)-DTB-Bn-SIPHOX**  
 $C_{55}H_{66}NOP$ ; FW: 788.09; white solid; m.p. 120-121°  
*moisture sensitive*

25mg  
100mg

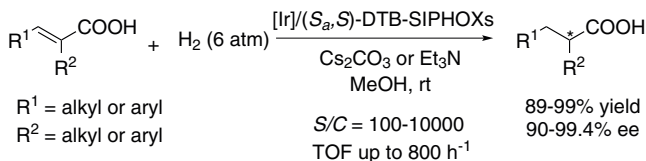


## Technical Notes:

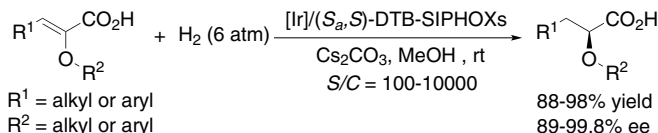
- Chiral ligands for the iridium-catalyzed, asymmetric hydrogenation of imines.
- Chiral ligands for the iridium-catalyzed, asymmetric hydrogenation of  $\alpha$ - $\beta$  unsaturated carboxylic acids.
- Chiral ligands for iridium-catalyzed, asymmetric hydrogenation of  $\alpha$ ,-oxy- $\alpha$ , $\beta$ -unsaturated carboxylic acids.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (3)**  
**Ref. (3)**

## References:

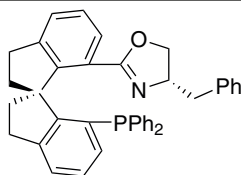
- J. Am. Chem. Soc.*, **2006**, 128, 12886.
- J. Am. Chem. Soc.*, **2008**, 130, 8584.
- J. Am. Chem. Soc.*, **2010**, 132, 1172.

# PHOSPHORUS - Ligands and Compounds

**15-5191** (S)-(-)-7-[4(S)-(Benzyl)oxazol-2-yl]-7-di(3,5-di-t-butylphenyl)phosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Sa,S)-DTB-Bn-SIPHOX (1040274-10-9)  
 $C_{55}H_{66}NOP$ ; FW: 788.09; white solid; m.p. 159-161°  
*moisture sensitive*

25mg  
100mg

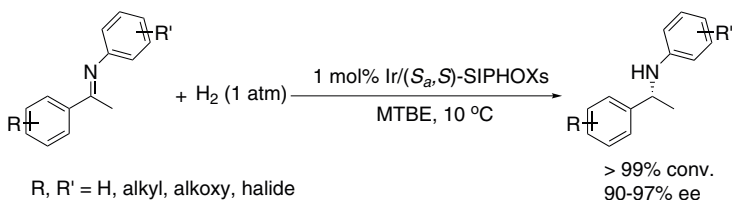
**15-5186** (R)-(+)-7-[4(S)-(Benzyl)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOX  
 $C_{36}H_{34}NOP$ ; FW: 563.67; white solid; m.p. 100-102°  
*moisture sensitive*



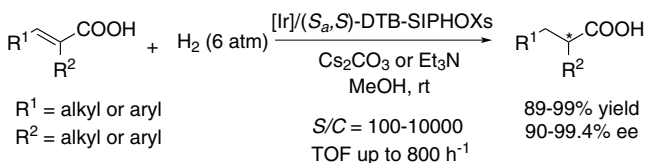
25mg  
100mg

## Technical Notes:

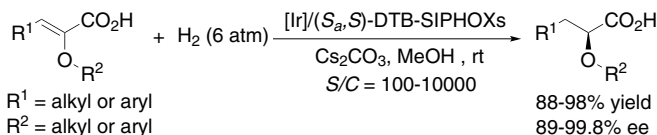
1. Chiral ligands for the iridium-catalyzed, asymmetric hydrogenation of imines.
2. Chiral ligands for the iridium-catalyzed, asymmetric hydrogenation of  $\alpha,\beta$  unsaturated carboxylic acids.
3. Chiral ligands for iridium-catalyzed, asymmetric hydrogenation of  $\alpha,\text{-oxy-}\alpha,\beta$  unsaturated carboxylic acids.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)

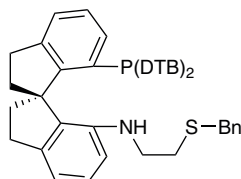
## References:

1. *J. Am. Chem. Soc.*, **2006**, *128*, 12886.
2. *J. Am. Chem. Soc.*, **2008**, *130*, 8584.
3. *J. Am. Chem. Soc.*, **2010**, *132*, 1172.

**15-5187** (S)-(-)-7-[4(S)-(Benzyl)oxazol-2-yl]-7-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Sa,S)-Ph-Bn-SIPHOX (913829-88-6)  
 $C_{36}H_{34}NOP$ ; FW: 563.67; white solid; m.p. 164-166°  
*moisture sensitive*

25mg  
100mg

**15-1613** (R)-(+)-7-[N-(2-Benzylthio)ethylamino]-7'-[bis(3,5-di-t-butylphenyl)phosphino]-7'-[bis(3,5-di-t-butylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, 97+% (>99% ee) [(R)-DTB-SpiroSAP-Bn] (1809609-52-6)  
 $C_{54}H_{68}NPS$ ; FW: 794.16; off-white solid  
*air sensitive*



25mg  
100mg

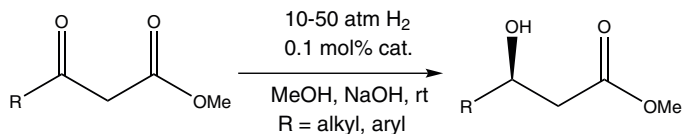
This technical note is for the iridium complex 77-2510. This is an analogous ligand included in the reference below.

# PHOSPHORUS - Ligands and Compounds

**15-1613** (R)-(+)-7-[N-(2-Benzylthio)ethylamino]-7'-[bis(3,5-di-*t*-butylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spiroindane, 97+% (>99% ee) [(R)-DTB-SpiroSAP-Bn] (1809609-52-6)  
(continued)

Technical Note:

- Catalyst used for the asymmetric hydrogenation of  $\beta$ -alkyl-  $\beta$ -ketoesters.

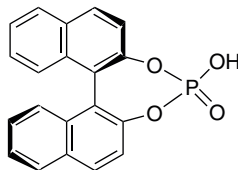


Tech. Note (1)  
Ref. (1)

References:

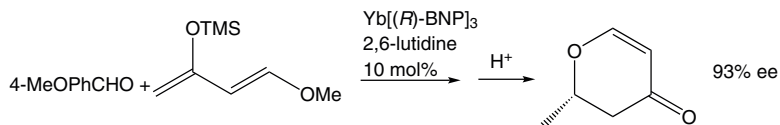
- Angew. Chem. Int. Ed.*, **2015**, *54*, 8791

<b>93-1573</b>	<b>Benzyltriphenylphosphonium chloride, 99% (1100-88-5)</b>	25g
HAZ	(C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> )(C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> PCl; FW: 388.88; white xtl.; m.p. 288°	100g
<b>15-0052</b>	<b>(R)-(-)-1,1'-Binaphthyl-2,2'-diyl hydrogenphosphate, min. 98% (39648-67-4)</b>	1g
	C <sub>20</sub> H <sub>13</sub> O <sub>4</sub> P; FW: 348.30; white powdr.	5g

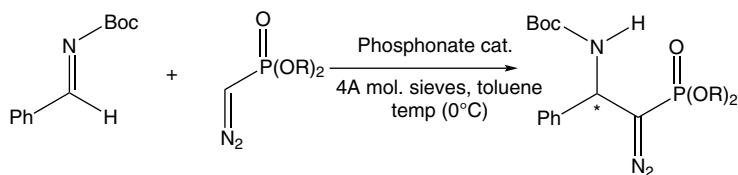


Technical Notes:

- Asymmetric hetero Diels-Alder reaction catalyzed by chiral lanthanide(III) complex.
- Highly efficient Mannich reaction
- Acidic Resolving agent for certain amine/racemic mixtures. (Ref. 3,4)



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

References:

- Org. Lett.*, **2000**, *2*, 49.
- Org. Lett.*, **2012**, *14*, 2126.
- J. Org. Chem.*, **1991**, *56*, 485.
- US 6,162,919.

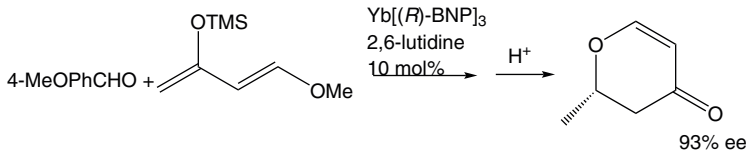
# PHOSPHORUS - Ligands and Compounds

**15-0053** (S)-(+)-1,1'-Binaphthyl-2,2'-diyl hydrogenphosphate, min. 98%  
(35193-64-7)  
C<sub>20</sub>H<sub>13</sub>O<sub>4</sub>P; FW: 348.30; white powder.

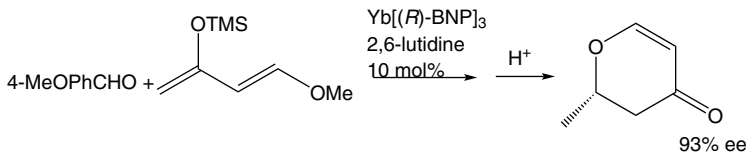
1g  
5g

## Technical Notes:

1. Asymmetric hetero Diels-Alder reaction catalyzed by chiral lanthanide(III) complex.
2. Highly efficient Mannich reaction
3. Acidic Resolving agent for certain amine/racemic mixtures. (Ref. 3,4)



Tech. Note (1)  
Ref. (1)

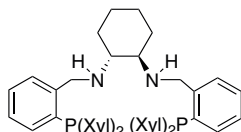


Tech. Note (2)  
Ref. (2)

## References:

1. *Org. Lett.*, **2000**, 2, 49.
2. *Org. Lett.*, **2012**, 14, 2126.
3. *J. Org. Chem.*, **1991**, 56, 485.
4. US 6,162,919.

**15-7320** (1*R*,2*R*)-*N,N*-Bis[2-[bis(3,5-dimethylphenyl)phosphino]benzyl]cyclohexane-1,2-diamine, min. 97%  
(1150113-66-8)  
C<sub>52</sub>H<sub>60</sub>N<sub>2</sub>P<sub>2</sub>; FW: 774.99; yellow solid  
*air sensitive*

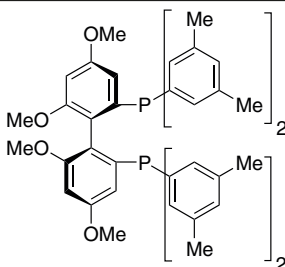


100mg  
500mg

**15-7321** (1*S*,2*S*)-*N,N*-Bis[2-[bis(3,5-dimethylphenyl)phosphino]benzyl]cyclohexane-1,2-diamine, min. 97%  
C<sub>52</sub>H<sub>60</sub>N<sub>2</sub>P<sub>2</sub>; FW: 774.99; yellow solid  
*air sensitive*

100mg  
500mg

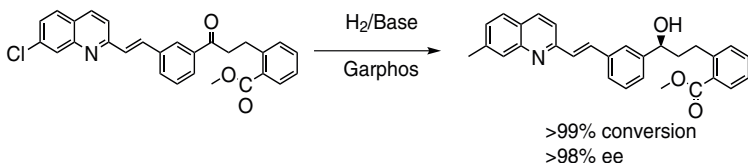
**15-1661** (R)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97%  
(R)-Xyl-Garphos™ (1365531-89-0)  
C<sub>48</sub>H<sub>52</sub>O<sub>4</sub>P<sub>2</sub>; FW: 754.87; white xtl.  
*air sensitive*  
Note: Sold in collaboration with KCT.  
Patent US App No. 61/381,493.  
Garphos™ Ligand Kit component.



100mg  
500mg

## Technical Note:

1. Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.

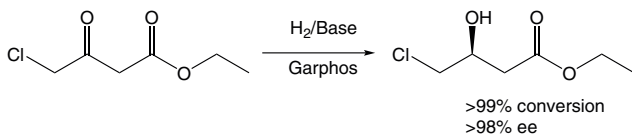


Tech. Note (1)  
Ref. (1)

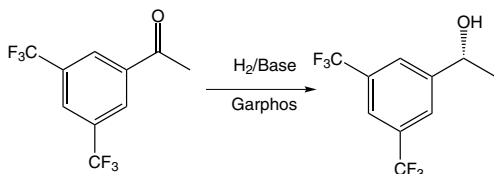


# PHOSPHORUS - Ligands and Compounds

**15-1661** (R)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (continued) **(R)-Xyl-Garphos™** (1365531-89-0)



Tech. Note (2)  
Ref. (1)



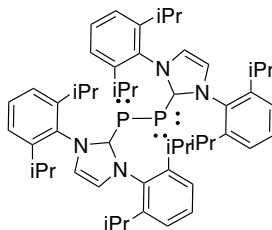
S:C = 100.000:1  
>99% conversion  
>99% ee

Tech. Note (3)  
Ref. (1)

## References:

1. US Patent Application No. 61/381,493.

<b>15-1662</b>	<b>(S)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97%</b> <b>(S)-Xyl-Garphos™</b> (1365531-90-3) C <sub>48</sub> H <sub>52</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 754.87; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
<b>15-7125</b>	<b>1,2-Bis[1,3-bis(2,6-di-i-propylphenyl)imidazol-2-ylidene]diphosphine, min. 95%</b> (1080030-13-2) C <sub>54</sub> H <sub>72</sub> N <sub>4</sub> P <sub>2</sub> ; FW: 839.12; orange-red xtl. <i>air sensitive</i> Note: Sold under license from the University of Georgia Research Foundation, Inc. for research purposes only. US Patent 8,278,456.	50mg 250mg



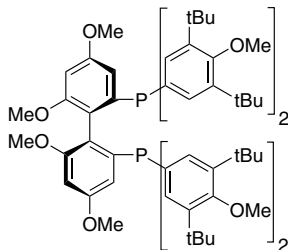
## Technical Note:

1. A carbene-stabilized diphosphorus.

## References:

1. *Inorg. Chem.*, **2011**, *50*, 12326.
2. *J. Am. Chem. Soc.*, **2008**, *130*, 14970.

<b>15-1672</b>	<b>(R)-2,2'-Bis[bis(4-methoxy-3,5-di-t-butylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97%</b> <b>(R)-DTBM-Garphos™</b> (1365531-98-1) C <sub>76</sub> H <sub>108</sub> O <sub>8</sub> P <sub>2</sub> ; FW: 1211.61; white xtl. <i>air sensitive, light sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
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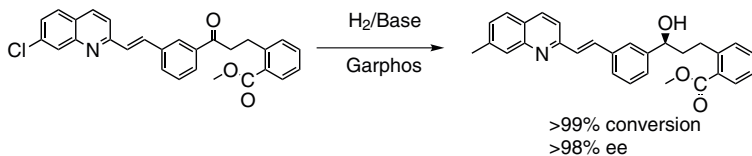


## Technical Note:

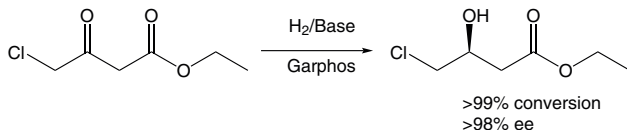
1. Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.

# PHOSPHORUS - Ligands and Compounds

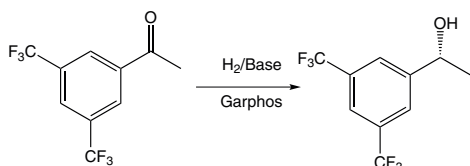
**15-1672** (R)-2,2'-Bis[bis(4-methoxy-3,5-di-t-butylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-DTBM-Garphos™ (1365531-98-1)



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (1)



S:C = 100.000:1  
>99% conversion  
>99% ee

Tech. Note (3)  
Ref. (1)

## References:

- US Patent Application No. 61/381,493.

<b>15-1673</b>	<b>(S)-2,2'-Bis[bis(4-methoxy-3,5-di-t-butylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (S)-DTBM-Garphos™ (1365531-99-2)</b>	100mg 500mg
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$C_{76}H_{106}O_8P_2$ ; FW: 1211.61; white xtl.

*air sensitive, light sensitive*

Note: Sold in collaboration with KCT. Patent US App No. 61/381,493.

Garphos™ Ligand Kit component.

<b>15-1666</b>	<b>(R)-2,2'-Bis[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-DMM-Garphos™ (1365531-93-6)</b>	100mg 500mg
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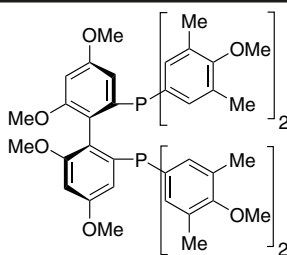
$C_{52}H_{60}O_8P_2$ ; FW: 874.98; white xtl.

*air sensitive*

Note: Sold in collaboration with KCT.

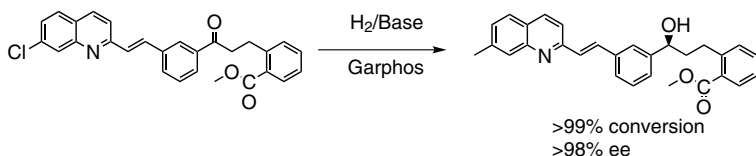
Patent US App No. 61/381,493.

Garphos™ Ligand Kit component.



## Technical Note:

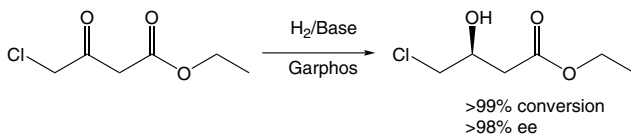
- Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.



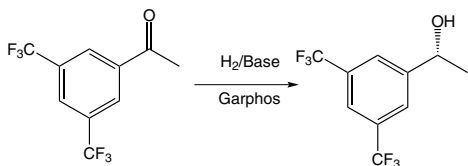
Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

**15-1666** **R)-2,2'-Bis[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-DMM-Garphos™**



**Tech. Note (2)**  
**Ref. (1)**



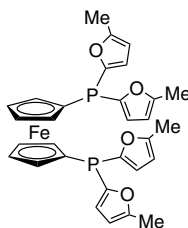
S:C = 100.000:1  
>99% conversion  
>99% ee

**Tech. Note (3)**  
**Ref. (1)**

## References:

- US Patent Application No. 61/381,493.

<b>15-1667</b>	<b>(S)-2,2'-Bis[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (S)-DMM-Garphos™ (1365531-94-7)</b> C <sub>52</sub> H <sub>60</sub> O <sub>8</sub> P <sub>2</sub> ; FW: 874.98; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
<b>26-0320</b>	<b>1,1'-Bis[bis(5-methyl-2-furanyl)phosphino]ferrocene, 98% HiersoPHOS-3 (756824-22-3)</b> C <sub>30</sub> H <sub>28</sub> FeO <sub>4</sub> P <sub>2</sub> ; FW: 570.33; orange xtl.	100mg 500mg



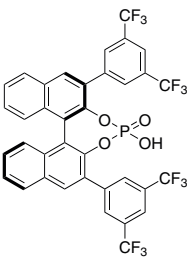
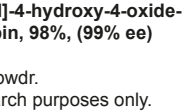
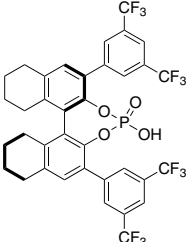
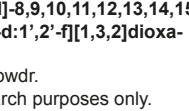
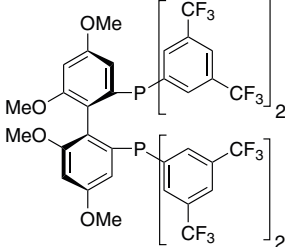
## Technical Note:

- Used in various comparative studies for palladium-promoted catalytic transformations involving polydentate ferrocenylphosphines ligands:
  - Palladium coupling of aniline derivatives with bromo- and chloroarenes <sup>[1]</sup>
  - Palladium-catalyzed formation of secondary and tertiary amines from aryl dihalides <sup>[2]</sup>
  - Palladium-catalyzed arylation of phenols with chloro heteroarenes <sup>[3]</sup>
  - Palladium-catalyzed C–H Bond activation of heteroaromatics furan, thiophene, and thiazole and benzoxazolheterocycles <sup>[4]</sup>

## References:

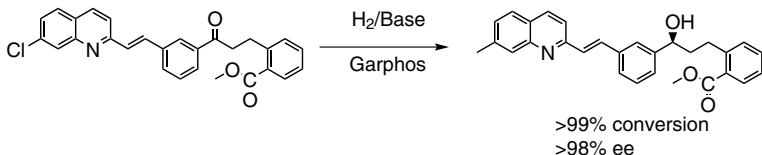
- ChemCatChem*, **2010**, *2*, 296.
- Adv. Synth. Catal.*, **2011**, *353*, 3403
- Catal. Commun.*, **2014**, *51*, 10
- Catal., Sci. Technol.*, **2014**, *4*, 2072

# PHOSPHORUS - Ligands and Compounds

15-1366 <b>NEW</b>	<p><b>(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (791616-62-1) C<sub>36</sub>H<sub>17</sub>F<sub>12</sub>O<sub>4</sub>P; FW: 772.5; white to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1367 <b>NEW</b>	<p><b>(11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (878111-17-2) C<sub>36</sub>H<sub>17</sub>F<sub>12</sub>O<sub>4</sub>P; FW: 772.5; White to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1376 <b>NEW</b>	<p><b>(11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (1011465-24-9) C<sub>36</sub>H<sub>25</sub>F<sub>12</sub>O<sub>4</sub>P; FW: 780.5; White to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.</p>		25mg 100mg
15-1377	<p><b>(11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> C<sub>36</sub>H<sub>25</sub>F<sub>12</sub>O<sub>4</sub>P; FW: 780.5; White to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.</p>		25mg 100mg
15-1663	<p><b>(R)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-BTFM-Garphos™</b> (1365531-84-5) C<sub>48</sub>H<sub>28</sub>F<sub>24</sub>O<sub>4</sub>P<sub>2</sub>; FW: 1186.64; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.</p>		100mg 500mg

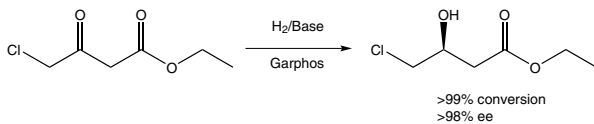
## Technical Note:

- Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.

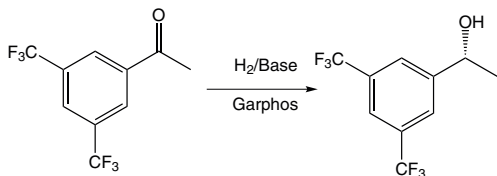


# PHOSPHORUS - Ligands and Compounds

**15-1663** (R)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-BTFM-Garphos™ (1365531-84-5)



Tech. Note (2)  
Ref. (1)



Tech. Note (3)  
Ref. (1)

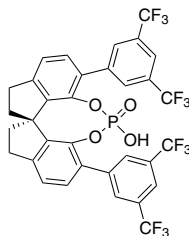
S:C = 100.000:1  
>99% conversion  
>99% ee

## References:

- US Patent Application No. 61/381,493.

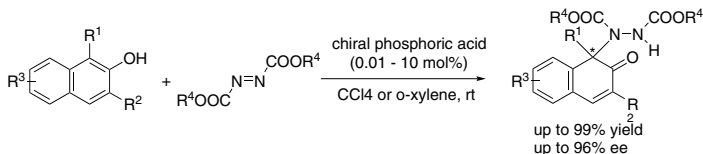
<b>15-1664</b>	<b>(S)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (S)-BTFM-Garphos™</b> (1365531-85-6) C <sub>48</sub> H <sub>28</sub> F <sub>24</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 1186.64; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
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<b>15-0527</b> <b>NEW</b>	<b>(11aR)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%</b> (1297613-76-3) C <sub>33</sub> H <sub>19</sub> F <sub>12</sub> O <sub>4</sub> P; FW: 738.46; white to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.	25mg 100mg
------------------------------	--	---------------



## Technical Note:

- Asymmetric dearomatization of  $\beta$ -naphthols through an amination reaction catalyzed by a chiral phosphoric acid.



Tech. Note (1)  
Ref. (1)

## References:

- Angew. Chem. Int. Ed.*, **2015**, *54*, 647.

<b>15-0528</b> <b>NEW</b>	<b>(11aS)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%</b> (1258327-07-9) C <sub>33</sub> H <sub>19</sub> F <sub>12</sub> O <sub>4</sub> P; FW: 738.46; white to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.	25mg 100mg
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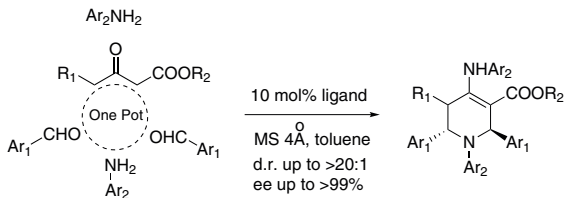
## Technical Notes:

- Organocatalytic asymmetric multicomponent reactions of aromatic aldehydes and anilines with  $\beta$ -ketoesters: facile and atom-economical access to chiral tetrahydropyridines.

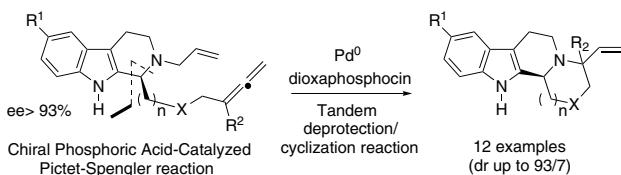
## PHOSPHORUS - Ligands and Compounds

**15-0528** (11aS)-3,7-Bis[3,5-bis(trifluoromethyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-  
(continued) diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% (1258327-07-9)

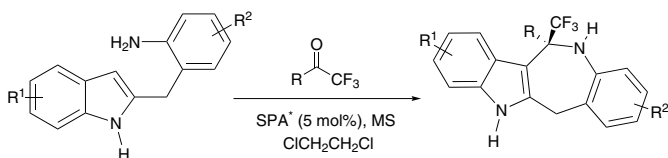
- Pd(0)-catalyzed tandem deprotection/cyclization of tetrahydro- $\beta$ -carbolines on allenes: application to the synthesis of indolo[2,3- $\alpha$ ]quinolizidines.
- Enantioselective synthesis of benzazepinoindoles bearing trifluoromethylated quaternary stereocenters, catalyzed by chiral spirocyclic phosphoric acids.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

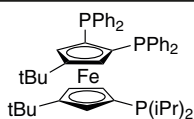


**Tech. Note (3)**  
**Ref. (3)**

### References:

- Chem Commun.*, **2013**, 49, 1401.
- Org. Lett.*, **2014**, 16, 1924.
- Chem Commun.*, **2014**, 50, 7538.

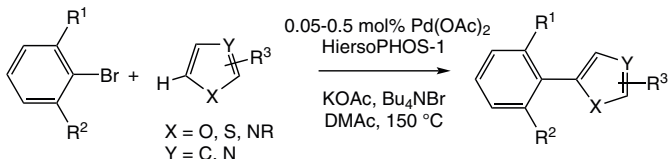
**26-0315** 1',4-Bis(*t*-butyl)-1,2-bis(diphenylphosphino)-3'-(di-*i*-propylphosphino)ferrocene, **98% HiersoPHOS-1** (1313012-94-0)  
C<sub>48</sub>H<sub>57</sub>FeP<sub>3</sub>; FW: 782.73; orange xtl.



100mg  
500mg

### Technical Notes:

- Direct Arylation of Heteroaromatics with Congested, Functionalised Aryl Bromides at Low Palladium Loading (0.05-0.5 mol%): furans, thiophenes, thiazoles, pyrroles functionalized with alkyl, nitrile, aldehyde, keto, and ester groups coupling with ortho- and di-ortho-substituted aryl bromides (phenyl, naphthyl, anthracenyl) bearing alkyl, aryl, alcohol, nitrile, carbonitrile, and ethoxy groups.
- Etherification of Functionalized Phenols with Chloroheteroarenes at Low Palladium Loading (0.2-0.5 mol%): para-, meta- and ortho- mono and di-substituted phenols (bearing methyl, isopropyl, methoxy, fluoro, amino, and ester groups) coupling with chloro-pyridines, -quinolines, -hydroxypyridines, -pyrimidines, -thiazoles bearing electron-withdrawing or -donating cyano and methoxy groups.

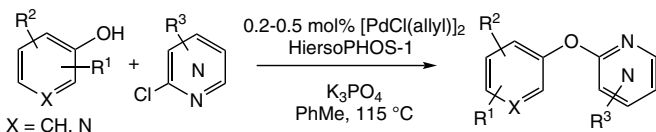


**Tech. Note (1)**  
**Ref. (1)**



# PHOSPHORUS - Ligands and Compounds

**26-0315** **1',4-Bis(t-butyl)-1,2-bis(diphenylphosphino)-3'-(di-i-propylphosphino)ferrocene, 98%**  
**(continued)** **HiersoPHOS-1 (1313012-94-0)**



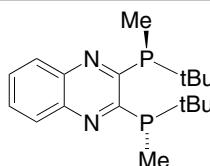
**Tech. Note (2)**  
**Ref. (2)**

X = CH, N

References:

1. *Chem. Eur. J.*, **2011**, *17*, 6453.
2. *Adv. Synth. Catal.*, **2011**, *353*, 3403.

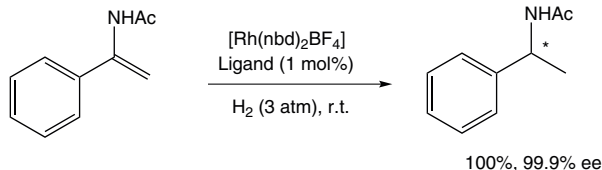
**15-0126** **(R,R)-(-)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (R,R)-QuinoxP\*** (866081-62-1)  
 $C_{18}H_{28}N_2P_2$ ; FW: 334.38; orange powdr.;  
 m.p. 102-103°  
 Note: Sold in collaboration with JCI for research purposes only. US 7,608,709, JP4,500,289.



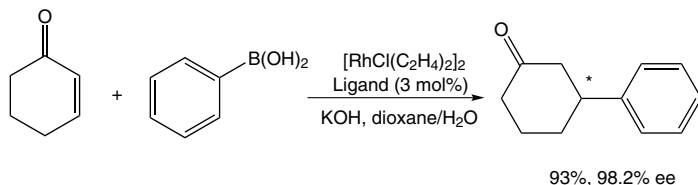
100mg  
 500mg

Technical Notes:

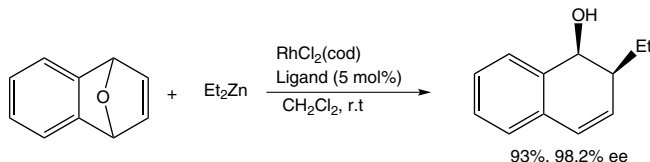
1. Ligand for the rhodium-catalyzed, asymmetric hydrogenation of dehydroamino acid esters and  $\alpha$ -enamides.
2. Ligand for the rhodium-catalyzed, asymmetric 1,4-addition of arylboronic acids to  $\alpha,\beta$ -unsaturated carbonyl compounds.
3. Ligand for the rhodium-catalyzed, asymmetric alkylative ring opening reaction
4. Ligand for the palladium-catalyzed asymmetric allylic alkylation and amination of racemic substrates.
5. Ligand for the ruthenium-catalyzed asymmetric hydrogenation of ketones.
6. Ligand for the rhodium-catalyzed, asymmetric hydroacylation of 1,1-disubstituted alkenes with aldehydes.
7. Ligand for the silver-catalyzed asymmetric nitroso aldol reaction.
8. Cu-catalyzed enantioconvergent allylic borylation.
9. Cu-catalyzed enantioselective cyclopropylation.



**Tech. Note (1)**  
**Ref. (1)**



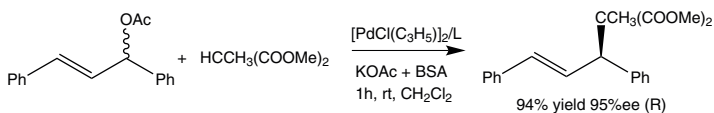
**Tech. Note (2)**  
**Ref. (1)**



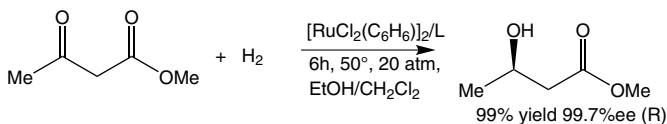
**Tech. Note (3)**  
**Ref. (1)**

# PHOSPHORUS - Ligands and Compounds

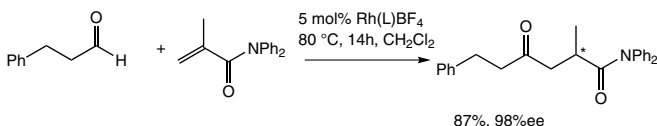
**15-0126** (R,R)-(-)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (R,R)-QuinoxP\*  
(continued) (866081-62-1)



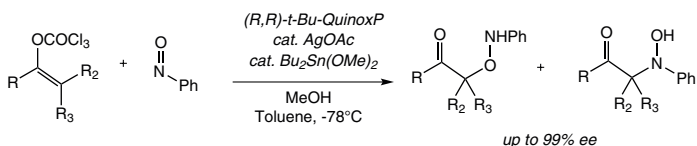
Tech. Note (4)  
Ref. (2)



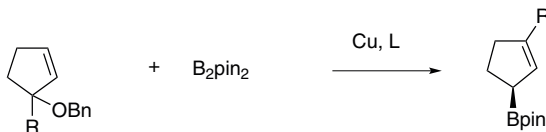
Tech. Note (5)  
Ref. (2)



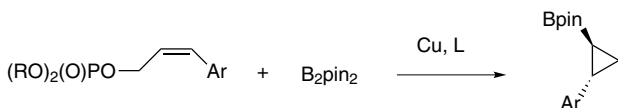
Tech. Note (6)  
Ref. (3)



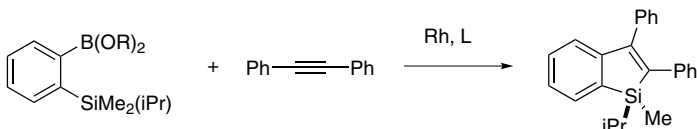
Tech. Note (7)  
Ref. (4)



Tech. Note (8)  
Ref. (5)



Tech. Note (9)  
Ref. (6)



Tech. Note (10)  
Ref. (7)

## References:

1. *J. Am. Chem. Soc.*, **2005**, *127*, 11934.
2. *J. Org. Chem.*, **2007**, *72*, 7413.
3. *J. Am. Chem. Soc.*, **2009**, *131*, 12552.
4. *J. Am. Chem. Soc.*, **2009**, *132*, 5328.
5. *Nat. Chem.* **2010**, *2*, 972.
6. *J. Am. Chem. Soc.*, **2010**, *132*, 11440.
7. *J. Am. Chem. Soc.*, **2012**, *134*, 19477.

**15-0127** (S,S)-(+)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98%  
(S,S)-QuinoxP\* (1107608-80-9)

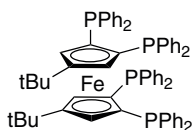
C<sub>18</sub>H<sub>28</sub>N<sub>2</sub>P<sub>2</sub>; FW: 334.38; orange powdr.; m.p. 102-103°

Note: Sold in collaboration with JCI for research purposes only. US  
7,608,709, JP4,500,289.

100mg  
500mg

## PHOSPHORUS - Ligands and Compounds

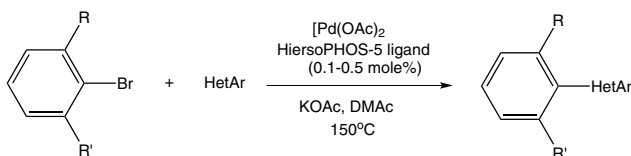
**26-0326** **4,4'-Bis(t-butyl)-1,1',2,2'-tetrakis(diphenylphosphino)ferrocene, 98% HiersoPHOS-5**  
(403815-19-0)  
 $C_{66}H_{62}FeP_4$ ; FW: 1034.94; orange xtl.



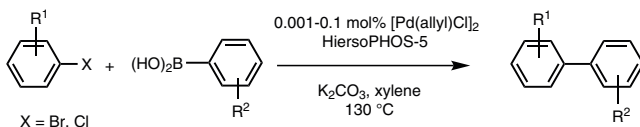
100mg  
500mg

### Technical Notes:

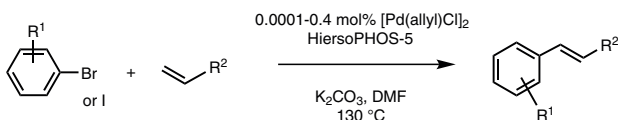
- Ligand/palladium complex used in the direct arylation of heteroaromatic compounds with congested, functionalized aryl bromides.
- Suzuki-Miyaura Coupling of Aryl Bromides and Chlorides bearing alkyl, methoxy, keto, nitrile, etc. substitution to phenyl- and methoxybenzene boronic acids at Low Palladium Loading.
- Heck Coupling of Functionalized Aryl Bromides to n-butyl acrylate, styrene and n-butyl vinyl ether at Low Palladium Loading.
- Additional catalyzed reaction include Allylic Amination of Monoterpene Derivatives including geranylacetate, nerylacetate, linalylacetate and perillylacetate at Low Palladium Loading (0.001-1.0 mol%, Ref.2), and Sonogashira Cross-Coupling of Aryl Bromides by using stabilizing new copper-tetraphosphane adducts (Ref. 3).



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

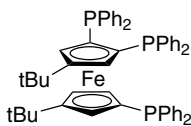


**Tech. Note (3)**

### References:

- Chemistry – A European Journal*, **2011**, 17, 23, 6453
- Organometallics*, **2003**, 22, 4490
- Appl. Organometal. Chem.*, **2006**, 20, 845
- Organometallics*, **2008**, 27, 1506

**26-0318** **1',4-Bis(t-butyl)-1,2,3'-tris(diphenylphosphino) ferrocene, 98% HiersoPHOS-2**  
(1159850-42-6)  
 $C_{54}H_{53}FeP_3$ ; FW: 850.77; orange xtl.



100mg  
500mg

### Technical Notes:

- Direct Arylation of Heteroaromatics with Functionalized Aryl Chlorides at Low Palladium Loading (0.1-0.5 mol%): furans, thiophenes, thiazoles, pyrroles functionalized with alkyl, ester, nitrile, and aldehyde groups coupling with para-, meta- and ortho-substituted chloroarenes bearing alkyl, formyl, nitriles, nitro, keto and ester groups.
- Additional catalyzed reactions include Sonogashira Cross-Coupling of Aryl Bromides and Chlorides at Low Palladium and Copper Iodide Loading (0.05 to 0.4 mol%) by using stabilizing new copper-triphosphane adducts (Ref. 2).

# PHOSPHORUS - Ligands and Compounds

26-0318 1',4-Bis(t-butyl)-1,2,3'-tris(diphenylphosphino) ferrocene, 98% HiersoPHOS-2  
(continued) (1159850-42-6)



X = O, S, N-R<sup>5</sup>

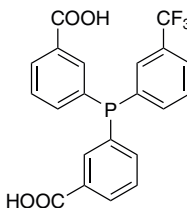
References:

1. *Angew. Chem. Int. Ed.*, **2010**, 49, 6650.
2. *Organometallics*, **2010**, 29, 2815.

Tech. Note (1)  
Ref. (1)

15-0270 Bis(3-carboxyphenyl)(3-trifluoromethyl-phenyl)phosphine, min. 97%  
**m-Miran2phos** (1808959-39-8)

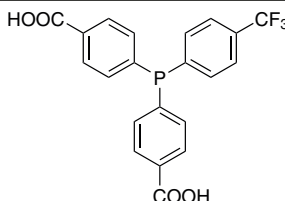
C<sub>21</sub>H<sub>14</sub>F<sub>3</sub>O<sub>4</sub>P; FW: 418.30; white powdr.  
Note: Sold under license from UAB for research purposes only. Spanish Patent Application P201231702.



100mg  
500mg

15-0268 Bis(4-carboxyphenyl)(4-trifluoro-methylphenyl)phosphine, min. 97%  
**p-Miran2phos**

C<sub>21</sub>H<sub>14</sub>F<sub>3</sub>O<sub>4</sub>P; FW: 418.30; white solid  
Note: Sold under license from UAB for research purposes only. Spanish Patent Application P201231702.



100mg  
500mg

15-0075 Bis(2-cyanoethyl)phenylphosphine, min. 97% (15909-92-9)

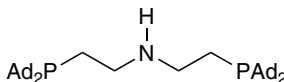
(NCCH<sub>2</sub>CH<sub>2</sub>)<sub>2</sub>(C<sub>6</sub>H<sub>5</sub>)P; FW: 216.22; colorless xtl.; m.p. 72-73°; b.p. 176-178°/0.5 mm  
*air sensitive*

1g  
5g

15-7312 Bis[2-(di-1-adamantylphosphino)ethyl]amine, min. 97%

(1086138-36-4)  
C<sub>44</sub>H<sub>69</sub>NP<sub>2</sub>; FW: 673.97; white solid  
*air sensitive*

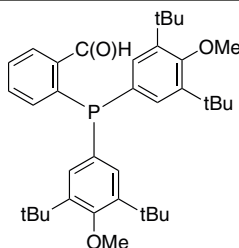
Note: Sold under license from Kanata for research purposes only.  
WO 2004096735.



250mg  
1g

15-7338 2-[Bis(3,5-di-t-butyl-4-methoxyphenyl)phosphino]benzaldehyde, min. 97%

(1202865-21-1)  
C<sub>37</sub>H<sub>51</sub>O<sub>3</sub>P; FW: 574.77; yellow solid



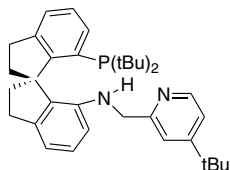
100mg  
500mg

# PHOSPHORUS - Ligands and Compounds

15-5147

NEW

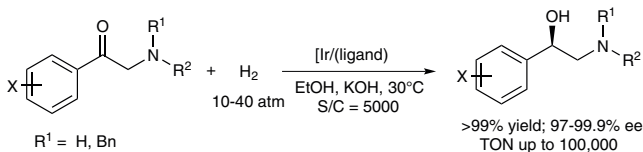
(R)-(+)-7-Bis(3,5-di-*t*-butylphenyl)phosphino-7'-[(4-*t*-butylpyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (>99% ee) (R)-DTB-SpiroPAP-4-*t*-Bu (1298133-38-6)  
 $C_{55}H_{71}N_2P$ ; FW: 791.14; white solid; m.p. 86-88°  
*air sensitive*



25mg  
100mg

Technical Note:

- Enantioselective synthesis of chiral 1,2-amino alcohols via asymmetric hydrogenation of  $\alpha$ -amino ketones with chiral spiro iridium catalysts.



Tech. Note (1)  
Ref. (1)

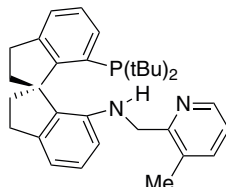
References:

- Synthesis*, **2014**, *46*, 2910.

15-5158

NEW

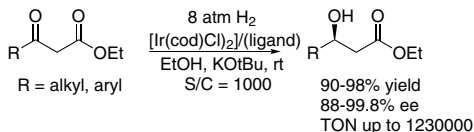
(R)-(+)-7-Bis(3,5-di-*t*-butylphenyl)phosphino-7'-[(3-methylpyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (>99% ee) (R)-DTB-SpiroPAP-3-Me (1298133-36-4)  
 $C_{52}H_{65}N_2P$ ; FW: 749.06; white to off-white solid; m.p. 160-161°  
*air sensitive*



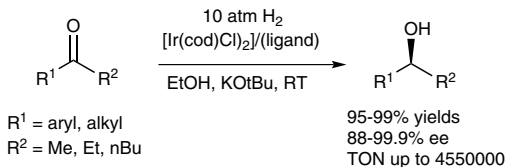
25mg  
100mg

Technical Notes:

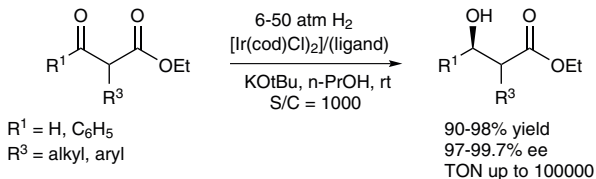
- Iridium/ligand catalyst for the highly efficient, asymmetric hydrogenation of  $\beta$ -aryl and  $\beta$ -ketoesters.
- Extremely efficient chiral iridium catalyst used for the asymmetric hydrogenation of ketones.
- Iridium/ligand catalyst for the highly efficient, asymmetric hydrogenation of  $\beta$ -aryl and  $\beta$ -ketoesters.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)

References:

- Angew. Chem Int. Ed.*, **2011**, *50*, 7329.
- Angew. Chem Int. Ed.*, **2012**, *51*, 201.
- Org. Lett.*, **2012**, *14*, 6158.

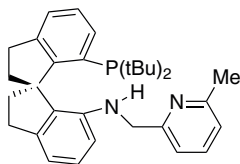
# PHOSPHORUS - Ligands and Compounds

15-5148

NEW

(R)-(+)-7-Bis(3,5-di-t-butylphenyl) phosphino-7'-[(6-methylpyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (>99% ee) (R)-DTB-SpiroPAP-6-Me (1298133-26-2)

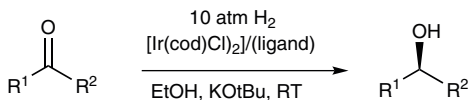
C<sub>52</sub>H<sub>65</sub>N<sub>2</sub>P; FW: 749.06; white solid; m.p. 153-155°  
air sensitive



25mg  
100mg

Technical Note:

- Extremely efficient chiral iridium catalyst used for the asymmetric hydrogenation of ketones.



R<sup>1</sup> = aryl, alkyl  
R<sup>2</sup> = Me, Et, nBu

95-99% yields  
88-99.9% ee  
TON up to 4550000

Tech. Note (1)  
Ref. (1)

References:

- Angew. Chem. Int. Ed., 2011, 50, 7329.

15-5159

NEW

(S)-(-)-7-Bis(3,5-di-t-butylphenyl)phosphino-7'-[(3-methylpyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (>99% ee) (S)-DTB-SpiroPAP-3-Me

C<sub>52</sub>H<sub>65</sub>N<sub>2</sub>P; FW: 749.06; white to off-white solid; m.p. 162-164°  
air sensitive

25mg  
100mg

Technical Note:

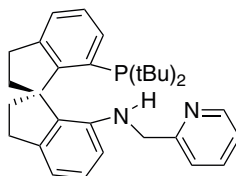
- See 15-5158 (page 18)

15-5166

NEW

(R)-(+)-7-Bis(3,5-di-t-butylphenyl) phosphino-7'-[(pyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (>99% ee) (R)-DTB-SpiroPAP (1298133-21-7)

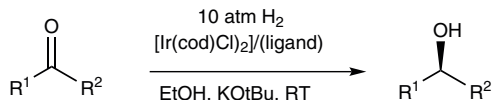
C<sub>51</sub>H<sub>63</sub>N<sub>2</sub>P; FW: 735.03; white solid; m.p. 172-174°  
air sensitive



25mg  
100mg

Technical Note:

- Extremely efficient chiral iridium catalyst used for the asymmetric hydrogenation of ketones.



R<sup>1</sup> = aryl, alkyl  
R<sup>2</sup> = Me, Et, nBu

95-99% yields  
88-99.9% ee  
TON up to 4550000

Tech. Note (1)  
Ref. (1)

References:

- Angew. Chem. Int. Ed., 2011, 50, 7329



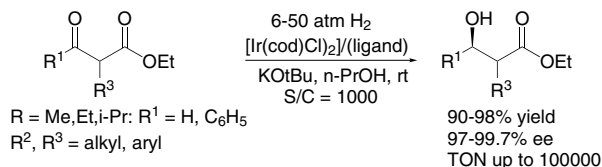
# PHOSPHORUS - Ligands and Compounds

<b>15-5167</b>	<b>(S)-(-)-7-Bis(3,5-di-<i>t</i>-butylphenyl)phosphino-7'-[(pyridine-2-ylmethyl)amino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 98% (&gt;99% ee)</b> <b>(S)-DTB-SpiroPAP (1415636-82-6)</b> $C_{51}H_{63}N_2P$ ; FW: 735.03; white solid; m.p. 170-171° <i>air sensitive</i>	25mg 100mg
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**NEW**

Technical Note:

- Iridium/ligand catalyst for the highly efficient, asymmetric hydrogenation of  $\beta$ -aryl and  $\beta$ -ketoesters.



**Tech. Note (1)  
Ref. (1)**

References:

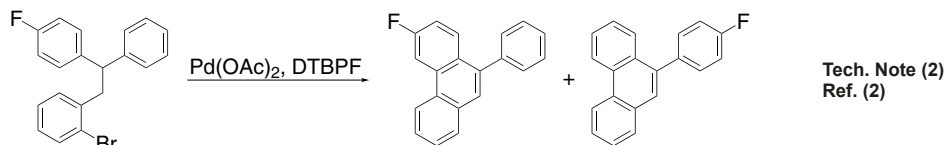
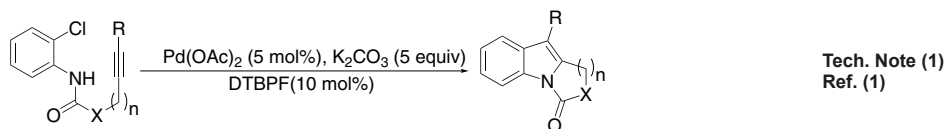
- Org. Lett.*, **2012**, *14*, 6158.

<b>15-7309</b>	<b>Bis[2-(di-<i>t</i>-butylphosphino)ethyl]amine, min. 97% (10wt% in hexanes)</b> <b>(944710-34-3)</b> $C_{20}H_{45}NP_2$ ; FW: 361.53; colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO 2004096735.		5g 25g
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<b>26-0150</b>	<b>1,1'-Bis(di-<i>t</i>-butylphosphino)ferrocene, min. 98% DTBPF (84680-95-5)</b> $[(C_4H_9)_2PC_5H_4]_2Fe$ ; FW: 474.42; orange to red xtl. Note: 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit component.		500mg 2g 10g
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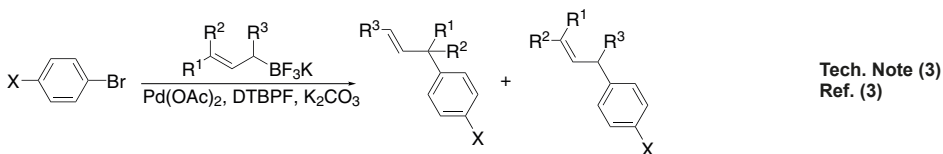
Technical Notes:

- Ligand for synthesis of polycyclic indoles via Pd-catalyzed intramolecular heteroannulation.
- Ligand for the palladium-catalyzed intramolecular arylation of aryl bromides under mild conditions.
- Ligand for cross-coupling reactions between bromoarenes and potassium allyltrifluoroborates promoted by a catalyst prepared from Pd(OAc)<sub>2</sub> and DTBPF selectively providing  $\gamma$ -coupling products.
- Ligand for the copper-catalyzed system for the  $\beta$ -boration of a variety of  $\alpha,\beta$ -unsaturated amides.
- Ligand for the synthesis of Paucifloral F and related indanone analogues via palladium-catalyzed  $\alpha$ -arylation.
- Ligand for the Pd-carbon monoxide complex catalyzed hydroxycarbonylation of aryl halides.
- Ligand for the palladium-catalyzed b-C-glycosylation by decarboxylative allylation to normal pyran systems, and cis-2,6-disubstituted tetrahydropyrans.
- Pd-catalyzed dearomative indole bisfunctionalization via a diastereoselective arylation.
- Ligand for the copper- DTBPF catalyzed C-H activation and carboxylation of terminal alkynes.

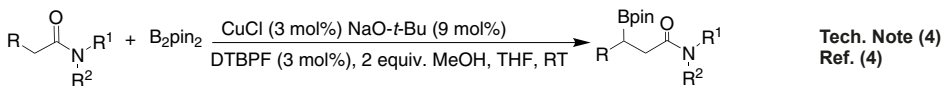


# PHOSPHORUS - Ligands and Compounds

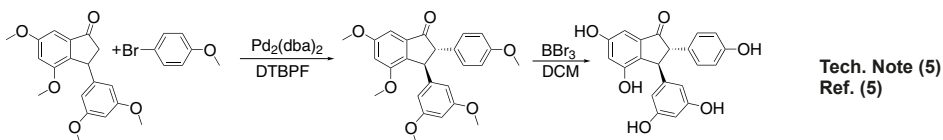
26-0150 1,1'-Bis(di-*t*-butylphosphino)ferrocene, min. 98% DTBPF (84680-95-5)  
(continued)



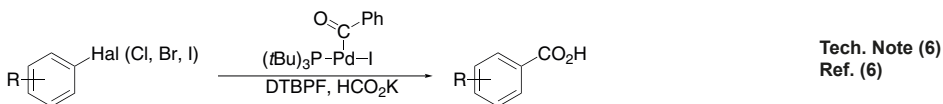
Tech. Note (3)  
Ref. (3)



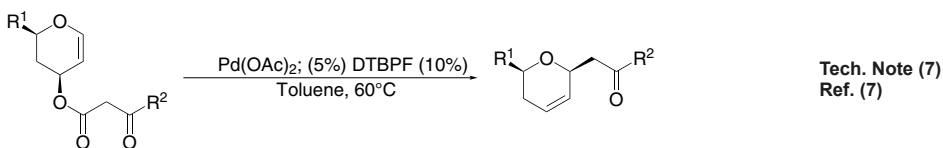
Tech. Note (4)  
Ref. (4)



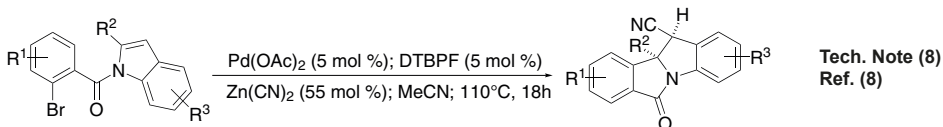
Tech. Note (5)  
Ref. (5)



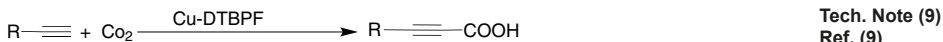
Tech. Note (6)  
Ref. (6)



Tech. Note (7)  
Ref. (7)



Tech. Note (8)  
Ref. (8)

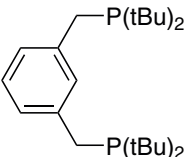
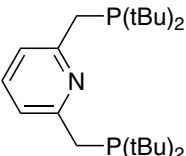
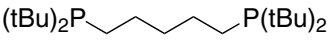
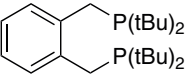
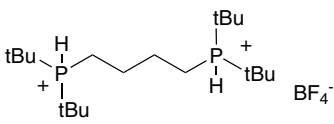
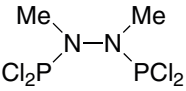


Tech. Note (9)  
Ref. (9)

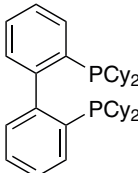
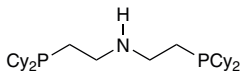
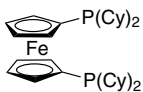
## References:

1. *Org. Lett.*, **2006**, *8*, 3573.
2. *Tetrahedron*, **2008**, *64*, 6021.
3. *Organometallics*, **2009**, *28*, 152.
4. *Adv. Synth. Catal.*, **2009**, *351*, 855.
5. *J. Org. Chem.*, **2011**, *76*, 1902.
6. *J. Am. Chem. Soc.*, **2013**, *135*, 2891.
7. *Chem. Eur. J.*, **2014**, *20*, 405.
8. *Org. Lett.*, **2015**, *17*, 4838.
9. *Dalton Trans.*, **2015**, *44*, 20874.

## PHOSPHORUS - Ligands and Compounds

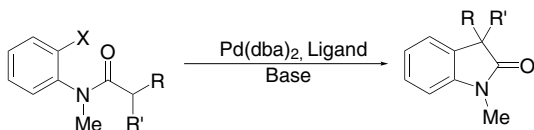
15-0065	<b>1,3-Bis(di-t-butylphosphinomethyl) benzene, 99%</b> (149968-36-5) C <sub>6</sub> H <sub>4</sub> [CH <sub>2</sub> P(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ] <sub>2</sub> ; FW: 394.56; white powdr. <i>air sensitive</i>		250mg 1g
15-0063	<b>2,6-Bis(di-t-butylphosphinomethyl) pyridine, 99%</b> (338800-13-8) C <sub>5</sub> H <sub>4</sub> N[CH <sub>2</sub> P(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ] <sub>2</sub> ; FW: 395.54; white to light-yellow powdr. <i>air sensitive</i>		250mg 1g
15-0061	<b>1,5-Bis(di-t-butylphosphino)pentane, min. 97%</b> (65420-68-0) (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> P(CH <sub>2</sub> ) <sub>5</sub> P(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ; FW: 360.54; colorless, viscous liq. <i>air sensitive</i>		500mg 2g
Technical Note:			
1. Ligand used in the preparation of an iridium compound capable of oxidatively adding ammonia to form a stable, monomeric amido hydride complex.			
References:			
1. <i>Science</i> , <b>2005</b> , 307, 1080.			
15-0072	<b>α, α'-Bis(di-t-butylphosphino)-o-xylene, min. 97%</b> (121954-50-5) C <sub>6</sub> H <sub>4</sub> [CH <sub>2</sub> P(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ] <sub>2</sub> ; FW: 394.56; white xtl.; m.p. 59-62° <i>air sensitive</i>		500mg 2g
15-9582	<b>1,4-Bis(di-t-butylphosphonium)butane bis(tetrafluoroborate), min. 97%</b> (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> PH <sup>+</sup> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> PH <sup>+</sup> (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> (BF <sub>4</sub> ) <sub>2</sub> ; FW: 522.14; white solid; m.p. 257-259°		1g 5g
15-0069	<b>1,2-Bis(dichlorophosphino)benzene, min. 97%</b> (82495-67-8) C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> P <sub>2</sub> ; FW: 279.85; colorless to pale yellow liq. <i>moisture sensitive</i>		500mg 2g
15-0076	<b>1,2-Bis(dichlorophosphino)-1, 2-dimethylhydrazine, min. 98%</b> (37170-64-2) Cl <sub>2</sub> PN(CH <sub>3</sub> )N(CH <sub>3</sub> )PCl <sub>2</sub> ; FW: 261.84; colorless to slightly cloudy liq. <i>air sensitive, moisture sensitive</i>		2g 10g
Technical Notes:			
1. Nucleophilic substitution reactions on 15-0076 are so versatile that careful control of the basicity and steric effects of the phosphorus centers are achievable by systematic tuning of the substituents.			
2. The reaction of bis(hydrazido)phosphines with transition metal/organometallic precursors have generated a wide spectrum of coordination compounds. Mononuclear chelates of W(O), Mo(O), Pt(II) and Pd(II) can be prepared.			
3. The N-N bond demonstrates remarkable thermal and hydrolytic stability.			
References:			
1. <i>Inorg. Chem.</i> , <b>1994</b> , 33, 2695.			
2. <i>Chem. Ber.</i> , <b>1994</b> , 127, 1335.			
3. <i>Inorg. Chem.</i> , <b>1995</b> , 34, 5483			

# PHOSPHORUS - Ligands and Compounds

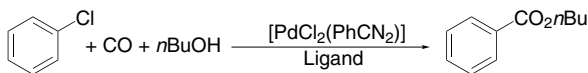
<b>15-0082</b>	<b>1,2-Bis(dichlorophosphino)ethane, min. 97%</b> (28240-69-9)	2g
amp	$\text{Cl}_2\text{PCH}_2\text{CH}_2\text{PCl}_2$ ; FW: 231.81; colorless to pale yellow liq.;	10g
HAZ	b.p. 70°/1 mm; d. 1.536	50g
	<i>air sensitive, moisture sensitive</i>	
<b>15-0081</b>	<b>Bis(dichlorophosphino)methane, min. 90%</b> (28240-68-8)	2g
amp	$\text{Cl}_2\text{PCH}_2\text{PCl}_2$ ; FW: 217.78; colorless liq.; b.p. 101-105°/22mm; d. 1.601	10g
HAZ	<i>air sensitive, moisture sensitive</i>	
<b>15-0116</b>	<b>Bis(dichlorophosphino)methylamine, min. 97%</b> (17648-16-7)	500mg
amp	$\text{CH}_3\text{N}(\text{PCl}_2)_2$ ; FW: 232.80; colorless to pale yellow liq.	2g
HAZ	<i>moisture sensitive</i>	
<b>15-9560</b>	<b>2,2'-Bis(dicyclohexylphosphino)-1,1'-biphenyl, min. 97%</b> (255897-36-0)	250mg
	$\text{C}_{36}\text{H}_{52}\text{P}_2$ ; FW: 546.75; white to pale yellow powder.	1g
		
<b>15-9585</b>	<b>1,2-Bis(dicyclohexylphosphino)ethane, min. 98%</b> (23743-26-2)	1g
	$(\text{C}_6\text{H}_{11})_2\text{PCH}_2\text{CH}_2\text{P}(\text{C}_6\text{H}_{11})_2$ ; FW: 422.61; white xtl.; m.p. 96-97°	5g
	<i>air sensitive</i>	
<b>15-7310</b>	<b>Bis[2-(dicyclohexylphosphino)ethyl]amine, min. 97%</b> (550373-32-5)	250mg
	$\text{C}_{26}\text{H}_{53}\text{NP}_2$ ; FW: 465.67; white solid	1g
	<i>air sensitive</i>	
	Note: Sold under license from Kanata for research purposes only. WO 2004096735.	
		
<b>26-0155</b>	<b>1,1'-Bis(dicyclohexylphosphino)ferrocene, min. 98%</b> (146960-90-9)	500mg
	$[(\text{C}_6\text{H}_{11})_2\text{P}(\text{C}_6\text{H}_4)]_2\text{Fe}$ ; FW: 578.57; orange powder;	2g
	m.p. 138°	10g
	Note: 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit component.	
		

## Technical Notes:

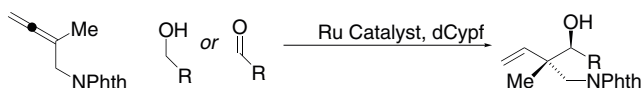
- Ligand for palladium-catalyzed synthesis of oxindoles by amide  $\alpha$ -arylation
- Ligand for palladium-catalyzed alkoxycarbonylation of aryl chlorides.
- Ligand for ruthenium-catalyzed alcohol-allene C-C coupling reaction via hydrohydroxyalkylation of 1,1-disubstituted allenes employing alcohols.
- Ligand for nickel-catalyzed cross-coupling reaction of arylboronic acids with aryl carbonates.
- Ligand for palladium-catalyzed regiodivergent hydroesterification of aryl olefins with phenyl formate to form linear structured phenyl arylpropanoates.
- Ligand for palladium-catalyzed direct borylation of benzyl alcohol and its analogues in the absence of bases.



**Tech. Note (1)**  
**Ref. (1)**



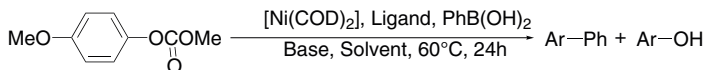
**Tech. Note (2)**  
**Ref. (2)**



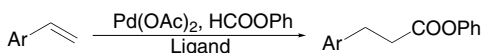
**Tech. Note (3)**  
**Ref. (3)**

# PHOSPHORUS - Ligands and Compounds

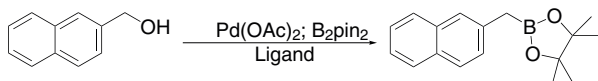
**26-0155** 1,1'-Bis(dicyclohexylphosphino)ferrocene, min. 98% (146960-90-9)  
(continued)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)

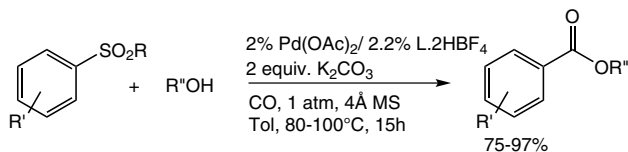
## References:

1. *J. Org. Chem.*, **2001**, 66, 3402.
2. *J. Organometal. Chem.*, **2002**, 641, 30.
3. *J. Am. Chem. Soc.*, **2011**, 133, 1141.
4. *Chem. Lett.*, **2011**, 40, 913
5. *Org. Chem. Front.*, **2015**, 2, 1505.
5. *Org. Lett.*, **2015**, 17, 3544.

<b>15-9590</b>	<b>Bis(dicyclohexylphosphino)methane, min. 97%</b> (137349-65-6) (C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> PCH <sub>2</sub> P(C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> ; FW: 408.59; white xtl. <i>air sensitive</i>		1g 5g
<b>15-0048</b>	<b>Bis(2-dicyclohexylphosphinophenyl)ether, 98%</b> (434336-16-0) C <sub>36</sub> H <sub>52</sub> O <sub>2</sub> ; FW: 562.75; white powdr.		500mg 2g
<b>15-9562</b>	<b>1,4-Bis(dicyclohexylphosphonium)butane bis(tetrafluoroborate), min. 97%</b> (1389309-54-9) (C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> PH <sup>+</sup> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> PH <sup>+</sup> (C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> (BF <sub>4</sub> ) <sub>2</sub> ; FW: 626.29; white solid; m.p. 236-238°		1g 5g
<b>15-9558</b>	<b>1,2-Bis(dicyclohexylphosphonium)ethane bis(tetrafluoroborate), min. 97%</b> (1779389-90-0) C <sub>26</sub> H <sub>50</sub> B <sub>2</sub> F <sub>8</sub> P <sub>2</sub> ; FW: 598.23; white solid; m.p. 236-239°		1g 5g
<b>15-9593</b>	<b>1,3-Bis(dicyclohexylphosphonium)propane bis(tetrafluoroborate), min. 97%</b> (1002345-50-7) [(C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> ] <sub>2</sub> ·2HBF <sub>4</sub> ; FW: 612.26; white powdr. <i>hygroscopic</i>		1g 5g

## Technical Notes:

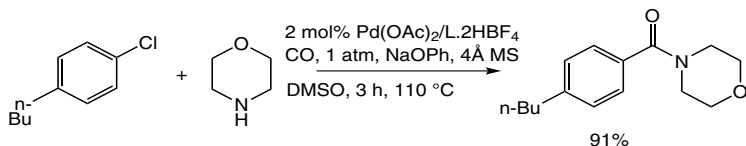
1. Ligand for palladium-catalyzed carbonylation of aryl tosylates and mesylates
2. Ligand for palladium-catalyzed aminocarbonylation of aryl chlorides at atmospheric pressure.



Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

**15-9593** 1,3-Bis(dicyclohexylphosphonium)propane bis(tetrafluoroborate), min. 97%  
(continued) (1002345-50-7)



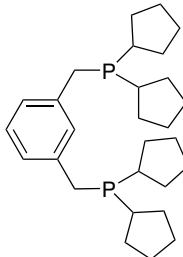
Tech. Note (2)  
Ref. (2)

References:

1. *J. Am. Chem. Soc.*, **2008**, *130*, 2754.
2. *Angew. Chem. Int. Ed.*, **2007**, *46*, 8460.

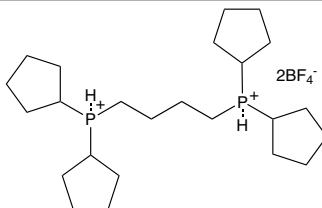
**15-9595** 1,3-Bis(dicyclopentylphosphinomethyl)benzene, 99% (255874-48-7)  
C<sub>6</sub>H<sub>4</sub>[CH<sub>2</sub>P(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>]<sub>2</sub>; FW: 442.60;  
white, waxy solid  
air sensitive

250mg  
1g



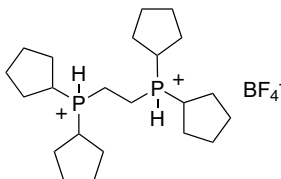
**15-9574** 1,4-Bis(dicyclopentylphosphonium)butane bis(tetrafluoroborate), min. 97% (1799401-51-6)  
(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>P<sup>+</sup>HCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>P<sup>+</sup>H(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>(BF<sub>4</sub>)<sub>2</sub>;  
FW: 570.18; white solid;  
m.p. 195-197°

1g  
5g



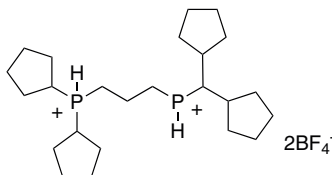
**15-9568** 1,2-Bis(dicyclopentylphosphonium)ethane bis(tetrafluoroborate), min. 97% (1799401-52-7)  
(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>P<sup>+</sup>HCH<sub>2</sub>CH<sub>2</sub>P<sup>+</sup>H(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>(BF<sub>4</sub>)<sub>2</sub>;  
FW: 542.13; white solid; m.p. 230-233°

1g  
5g



**15-9572** 1,3-Bis(dicyclopentylphosphonium)propane bis(tetrafluoroborate), min. 97% (1799401-53-8)  
(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>P<sup>+</sup>HCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>P<sup>+</sup>H(C<sub>5</sub>H<sub>9</sub>)<sub>2</sub>(BF<sub>4</sub>)<sub>2</sub>;  
FW: 556.15; white powdr.;  
m.p. 141-143°

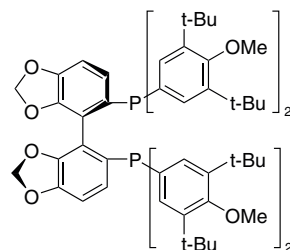
1g  
5g



# PHOSPHORUS - Ligands and Compounds

15-0066

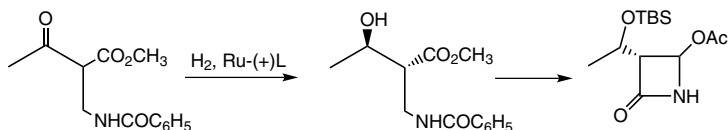
(R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%  
**(R)-(-)-DTBM-SEGPHOS®** (566940-03-2)  
 $C_{74}H_{100}O_8P_2$ ; FW: 1179.53; off-white powdr.;  
 m.p. 126-128°  
 Note: Manufactured under license of Takasago patent. Takasago SEGPHOS® Ligand Kit component.



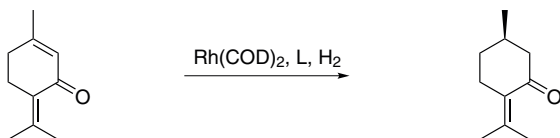
250mg  
 1g  
 5g

## Technical Notes:

- Biaryl bisphosphine ligand with narrow dihedral angle. The DTBM SEGPHOS® ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity through dynamic kinetic resolution in the asymmetric hydrogenation of  $\alpha$ -substituted- $\beta$ -ketoesters useful in the synthesis of carbapenem antibiotics.<sup>1</sup>
- With rhodium, preferential enantioselective hydrogenation of more reactive olefin of extended enone structure.<sup>2</sup>
- Rhodium catalyzed chemo-, regio, and entantioselective [2 + 2 + 2] cycloaddition of alkynes with isocyanates.<sup>3</sup>
- With copper, enantioselective cross Aldol-type reaction of acetonitrile.<sup>4</sup>
- With copper, enantioselective vinylsilane alkenylation of aldehydes.<sup>5</sup>
- Gold carbene mediated stereoselective cyclopropanation of propargyl esters.<sup>6</sup>
- With copper, enantioselective 1,2-reduction of ketones, and 1,4-reduction of a  $\alpha,\beta$ -unsaturated esters.<sup>7</sup>
- With copper, catalytic enantioselective Mannich-type reaction.<sup>8</sup>
- Enantioselective fluorination of  $\beta$ -keto esters, tert-butoxycarbonyl lactones and lactams with Sodeoka's Pd-aqua complex and a fluorinating reagent.<sup>9</sup>
- Rh-catalyzed intramolecular olefin or carbonyl hydroacylation.<sup>10</sup>
- Pd-catalyzed  $\gamma$ -arylation of  $\beta,\gamma$ -unsaturated ketones.
- Involved in numerous conjugate alkylation, and ring-opening alkylation of azabenzonorbomadienes.<sup>12</sup>
- Involved in asymmetric hydroamination of bicyclic alkenes/dienes, 1,3a diamination of conjugated dienes, 1,3b and hydroalkoxylation/hydrosulfonylation of allenes.<sup>13c</sup>
- Used in cycloaddition reactions such as 1,3-dipolar cycloaddition of azomethine ylides,<sup>14a</sup> and Au-catalyzed [2+2] cycloaddition of allenes.<sup>14b</sup>
- Asymmetric conjugate addition of nitroalkanes to  $\alpha,\beta$ -unsaturated thioamides.<sup>15</sup>
- Asymmetric synthesis of isothiazoles through Cu catalyzed conjugate addition of allyl cyanide to  $\alpha,\beta$ -unsaturated thioamides.<sup>16</sup>
- Asymmetric Ag-catalyzed cycloadditions.<sup>17</sup>
- Rhodium-catalyzed C-C bond cleavage to generate acyclic, asymmetric quaternary centers.<sup>18</sup>
- Iridium-catalyzed intermolecular hydroamidation of olefins.<sup>19</sup>
- Iridium-catalyzed intermolecular hydroamidation of olefins.<sup>20</sup>
- CuH-catalyzed asymmetric hydroamination of olefins.<sup>21</sup>



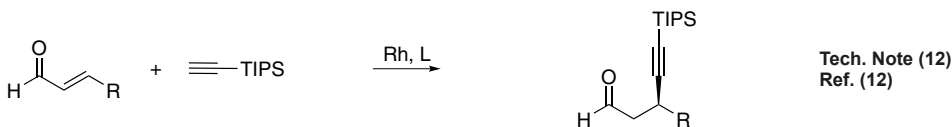
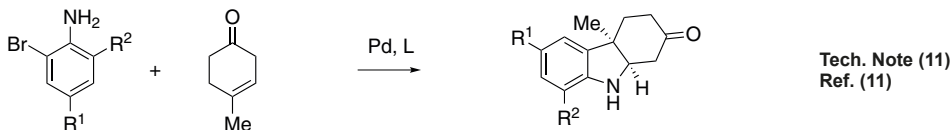
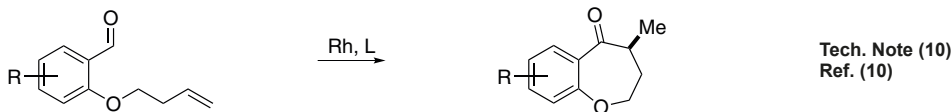
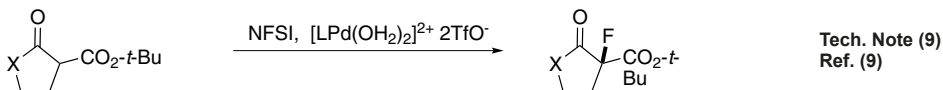
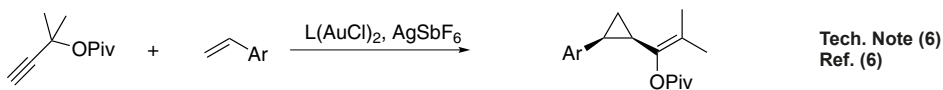
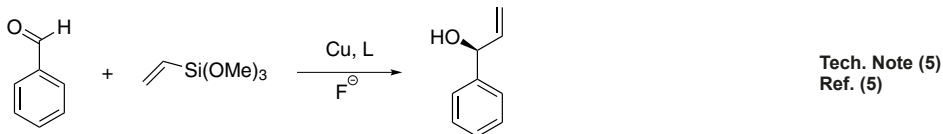
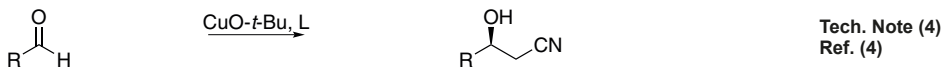
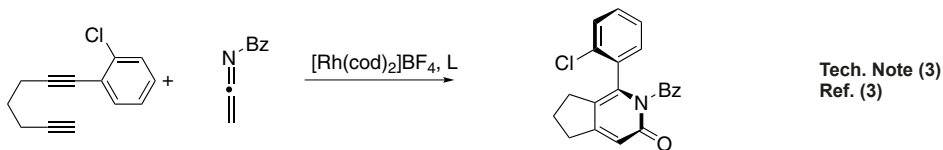
Tech. Note (1)  
 Ref. (1)



Tech. Note (2)  
 Ref. (2)

# PHOSPHORUS - Ligands and Compounds

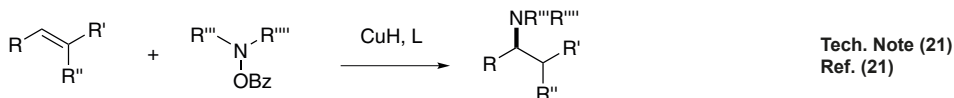
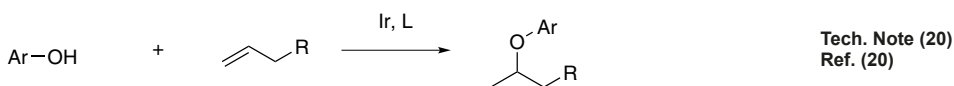
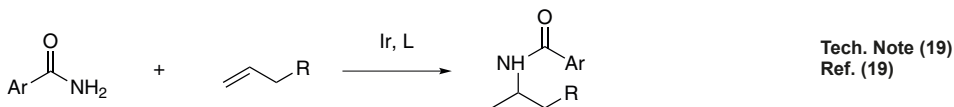
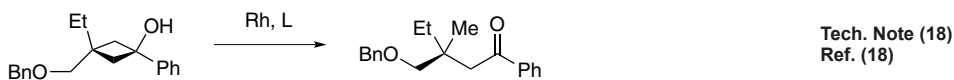
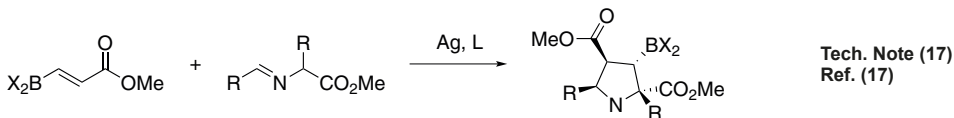
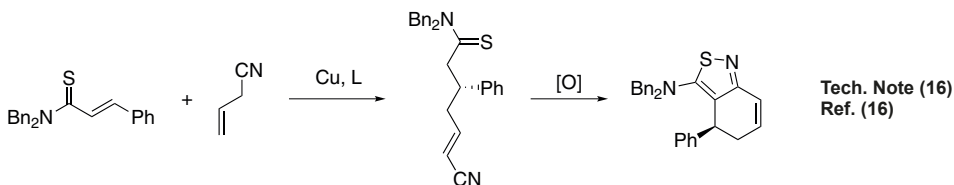
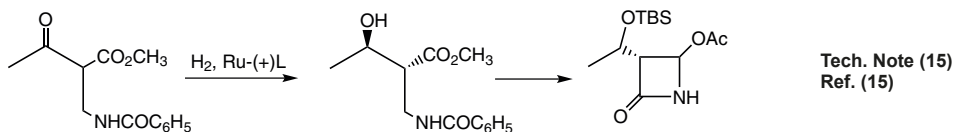
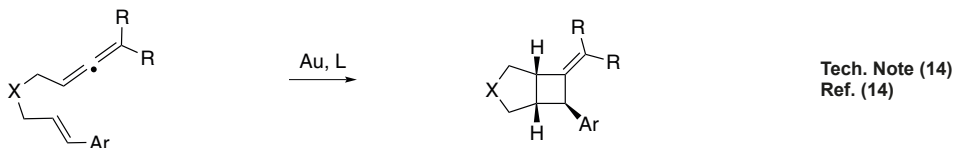
15-0066 (R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, (continued) min. 98% (R)-(-)-DTBM-SEGPHOS® (566940-03-2)





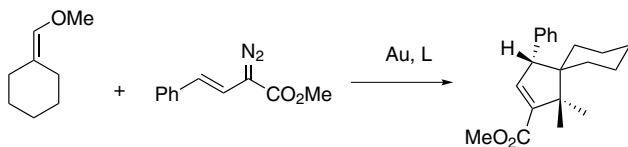
# PHOSPHORUS - Ligands and Compounds

15-0066 (R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, (continued) min. 98% (R)-(-)-DTBM-SEGPHOS® (566940-03-2)

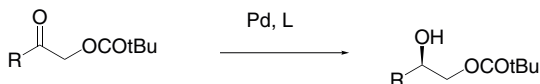


# PHOSPHORUS - Ligands and Compounds

**15-0066** (R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, (continued) min. 98% (R)-(-)-DTBM-SEGPHOS® (566940-03-2)



Tech. Note (22)  
Ref. (22)



Tech. Note (23)  
Ref. (23)

## References:

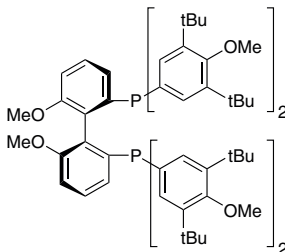
1. *Adv. Synth. Cat.*, **2001**, 343, 264.
2. U.S. Pat. 6342644.
3. *Org. Lett.*, **2005**, 7, 4737.
4. *Org. Lett.*, **2005**, 7, 3757.
5. *J. Am. Chem. Soc.*, **2005**, 127, 4138.
6. *J. Am. Chem. Soc.*, **2005**, 127, 18002.
7. (a) *J. Am. Chem. Soc.*, **2004**, 126, 8352. (b) *Org. Lett.*, **2002**, 4, 4045.
8. *J. Am. Chem. Soc.*, **2009**, 131, 9610.
9. (a) *J. Am. Chem. Soc.*, **2002**, 124, 14530. (b) *J. Org. Chem.*, **2007**, 72, 246.
10. *J. Am. Chem. Soc.*, **2008**, 130, 2916.
11. *Angew. Chem. Int. Ed.*, **2008**, 47, 177.
12. (a) *Angew. Chem. Int. Ed.*, **2009**, 48, 8057. (b) *Org. Lett.*, **2008**, 10, 4057.
13. (a) *J. Am. Chem. Soc.*, **2008**, 130, 12220. (b) *Org. Lett.*, **2008**, 10, 4231. (c) *Chem. Commun.*, **2009**, 3528.
14. (a) *Angew. Chem. Int. Ed.*, **2009**, 48, 340. (b) *J. Am. Chem. Soc.*, **2007**, 129, 12402.
15. *Org. Lett.*, **2012**, 14, 110.
16. *Angew. Chem. Int. Ed.*, **2011**, 50, 7910.
17. (a) *J. Org. Chem.*, **2011**, 76, 1945. (b) *J. Am. Chem. Soc.*, **2010**, 132, 3263.
18. *J. Am. Chem. Soc.*, **2010**, 132, 5340.
19. *J. Am. Chem. Soc.*, **2012**, 134, 11960.
20. *J. Am. Chem. Soc.*, **2013**, 135, 9303.
21. *J. Am. Chem. Soc.*, **2013**, 135, 15746.
22. *J. Am. Chem. Soc.*, **2013**, 135, 13314.
23. *Angew. Chem. Int. Ed.*, **2013**, 52, 11632.

**15-0067** (S)-(+)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPHOS® 250mg  
1g  
5g

( $C_{74}H_{100}O_8P_2$ ; FW: 1179.53; off-white powdr.; m.p. 126-128°  
Note: Manufactured under license of Takasago patent. Takasago  
SEGPHOS® Ligand Kit component.

**15-0042** (R)-(-)-2,2'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (352655-61-9) 100mg  
500mg  
2g  
10g

( $C_{74}H_{104}O_8P_2$ ; FW: 1151.60; white xtl.  
Note: Sold in collaboration with  
Solvias for research purposes only.  
Solvias (R)-MeO BIPHEP Ligand Kit  
component.



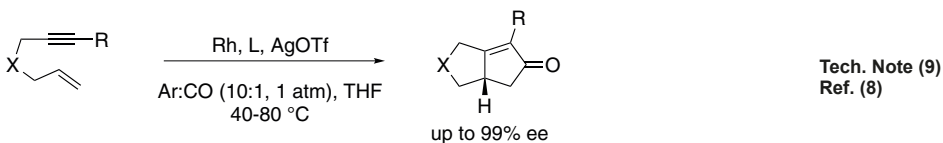
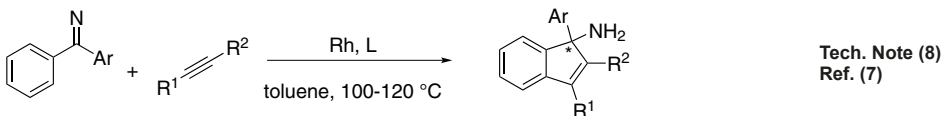
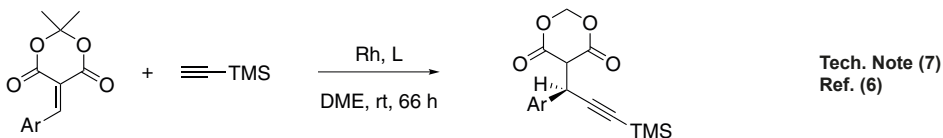
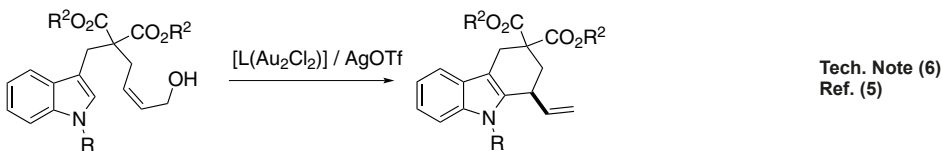
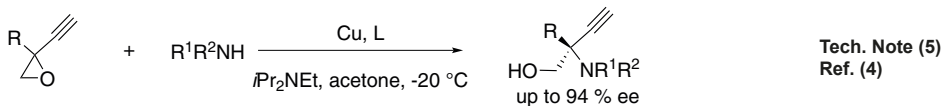
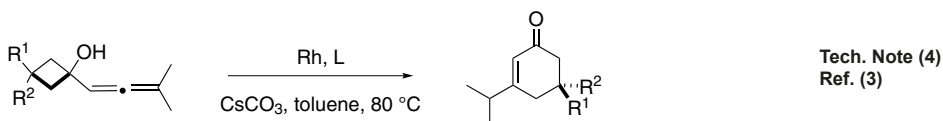
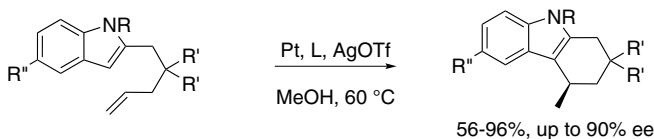
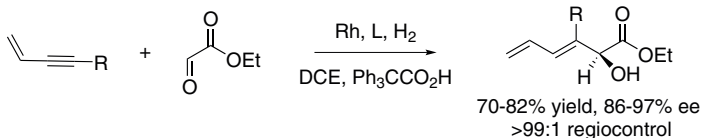
## Technical Notes:

1. See 15-0178.
2. Rh-catalyzed reductive coupling of acetylene to aldehydes and ketones.
3. Pt-catalyzed intramolecular hydroarylation of unactivated alkenes with indoles.
4. Enantioselective C-C bond activation of allenyl cyclobutanes.
5. Enantioselective ring-opening of rac-ethynyl epoxides.

# PHOSPHORUS - Ligands and Compounds

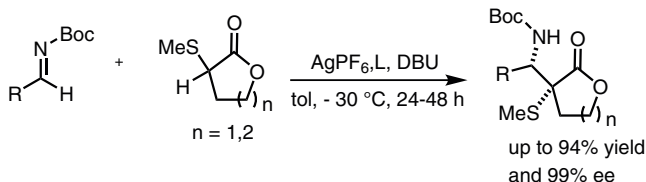
**15-0042** (R)-(-)-2,2'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, (continued) min. 97% (352655-61-9)

- Enantioselective Au-catalyzed allylic alkylation of indoles with alcohols
- Enantioselective Rh-catalyzed conjugate alkylation with TMS-acetylene.
- Enantioselective Rh-catalyzed [3+2] annulation of aromatic ketimines.
- Asymmetric Rh-catalyzed Pausan-Khand reaction.

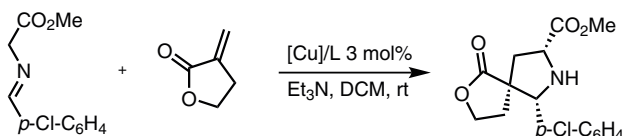


# PHOSPHORUS - Ligands and Compounds

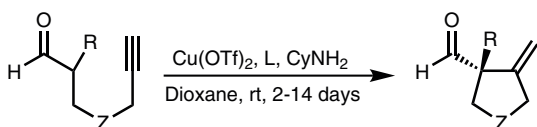
**15-0042** (R)-(-)-2,2'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (352655-61-9)



Tech. Note (10)  
Ref. (9)



Tech. Note (11)  
Ref. (10)



Tech. Note (12)  
Ref. (10)

## References:

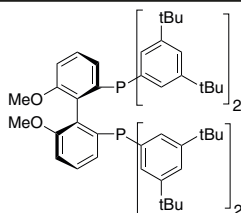
1. *Org. Lett.*, **2007**, 9, 3745.
2. *Org. Lett.*, **2006**, 8, 3801.
3. *Angew. Chem. Int. Ed.*, **2008**, 47, 9294.
4. *J. Org. Chem.*, **2009**, 74, 7603.
5. *Angew. Chem. Int. Ed.*, **2009**, 48, 9533.
6. *J. Am. Chem. Soc.*, **2009**, 131, 14608.
7. *Angew. Chem. Int. Ed.*, **2011**, 50, 11098.
8. *Adv. Synth. Catal.*, **2010**, 352, 2032.
9. *Org. Lett.*, **2013**, 15, 2632.
10. *Chem. Commun.*, **2013**, 49, 9642.
11. *Chem. Commun.*, **2012**, 48, 6559.

<b>15-0043</b>	(S)-(+)-2,2'-Bis[di(3,5-di- <i>t</i> -butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (910134-30-4)	100mg
	C <sub>74</sub> H <sub>104</sub> O <sub>6</sub> P <sub>2</sub> ; FW: 1151.60; white xtl.	500mg
	Note: Sold in collaboration with Solvias for research purposes only.	2g
	Solvias (S)-MeO BIPHEP Ligand Kit component.	10g

## Technical Note:

1. See 15-0042 (page 29)

<b>15-0044</b>	(R)-(+)-2,2'-Bis[di(3,5-di- <i>t</i> -butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (192138-05-9)	100mg
	C <sub>70</sub> H <sub>96</sub> O <sub>6</sub> P <sub>2</sub> ; FW: 1031.49; white powdr.	500mg
	Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component.	2g
		10g



## Technical Notes:

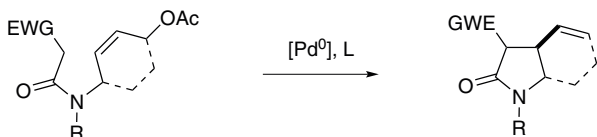
1. See 15-0178, 15-0066 and 15-0042.
2. Pd-catalyzed enantioselective Heck reaction.
3. Used in enantioselective lactam synthesis via Pd-catalyzed intramolecular allylic alkylation.
4. Used in enantioselective Au-catalyzed polycyclization reactions.



Tech. Note (2)  
Ref. (1)

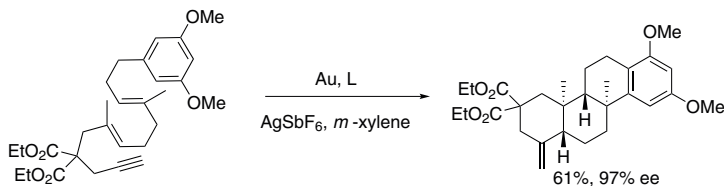
# PHOSPHORUS - Ligands and Compounds

**15-0044** (R)-(+)-2,2'-Bis[di(3,5-di-*t*-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (continued) (192138-05-9)



EWG = CO<sub>2</sub>Me, CN, COMe, SPh, SO<sub>2</sub>Ph, R = Bn, PMB

Tech. Note (3)  
Ref. (2)



Tech. Note (4)  
Ref. (3)

## References:

1. *Organometallics*, **1999**, 18, 670.
2. *Synlett*, **2009**, 1441.
3. *J. Am. Chem. Soc.*, **2010**, 132, 8277.

<b>15-0045</b>	(S)-(-)-2,2'-Bis[di(3,5-di- <i>t</i> -butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (167709-31-1) C <sub>70</sub> H <sub>96</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 1031.49; white powdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component.	100mg 500mg 2g 10g
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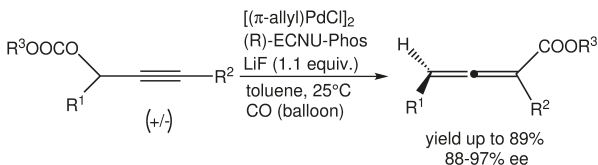
## Technical Note:

1. See 15-0044 (page 31)

<b>15-0185</b> <b>NEW</b>	(R)-(+)-2,2'-Bis[di(3,5-dimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, 98% (R)-ECNU-Phos (1448722-98-2) C <sub>46</sub> H <sub>48</sub> O <sub>10</sub> P <sub>2</sub> ; FW: 822.82; white solid; m.p. 236-237° <i>air sensitive, (store cold)</i> Note: Sold under license from ECNU for research purposes only. Patent CN201310135176.3.	25mg 100mg
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## Technical Note:

1. Efficient ligand for the highly enantioselective synthesis of optically active 2,3-allenoates via carbonylation of racemic propargylic carbonates.



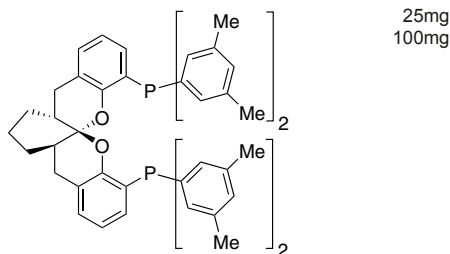
Tech. Note (1)  
Ref. (1)

## References:

1. *J. Am. Chem. Soc.*, **2013**, 135, 11517.

# PHOSPHORUS - Ligands and Compounds

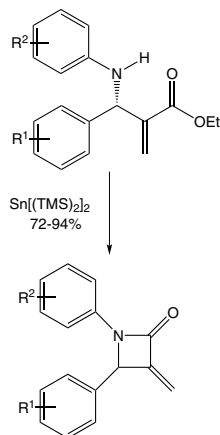
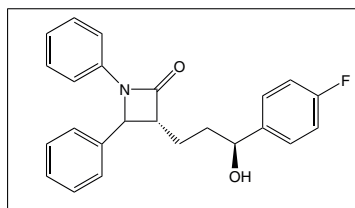
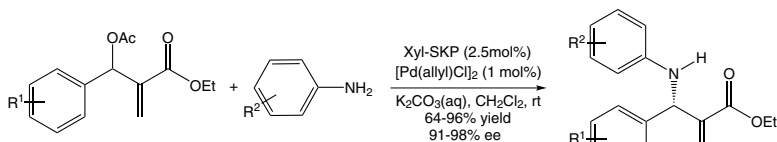
**15-4320** (+)-1,13-Bis[di(3,5-dimethylphenyl)phosphino]-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97%  
(R,R,R)-(+)-Xyl-SKP (1429939-35-4)  
C<sub>52</sub>H<sub>54</sub>O<sub>2</sub>P<sub>2</sub>; FW: 772.93; white solid; m.p. 102-103°  
*air sensitive*  
Note: Sold in collaboration with SIOC for research purposes only. Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.



25mg  
100mg

## Technical Notes:

- Efficient ligand for the palladium-catalyzed, asymmetric allylic amination of racemic Morita-Baylis-Hillman adducts.
- See also 15-4311.



Tech. Note (1)  
Ref. (1,2)

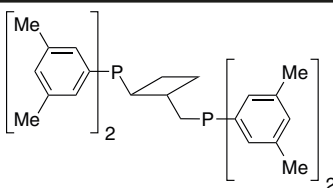
## References:

- Angew. Chem. Int. Ed., 2012, 51, 9276.
- Angew. Chem. Int. Ed., 2012, 51, 936.

**15-4321** (-)-1,13-Bis[di(3,5-dimethylphenyl)phosphino]-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97%  
(S,S,S)-(-)-Xyl-SKP (1429939-31-0)  
C<sub>52</sub>H<sub>54</sub>O<sub>2</sub>P<sub>2</sub>; FW: 772.93; white solid; m.p. 102-103°  
*air sensitive*  
Note: Sold in collaboration with SIOC for research purposes only. Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.

25mg  
100mg

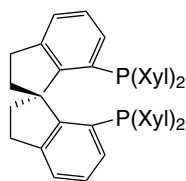
**15-5172** racemic-trans-1,2-Bis[di(3,5-dimethylphenyl)phosphinomethyl]cyclobutane, min. 95%  
(1226906-44-0)  
C<sub>38</sub>H<sub>46</sub>P<sub>2</sub>; FW: 564.72; white solid



250mg  
1g

# PHOSPHORUS - Ligands and Compounds

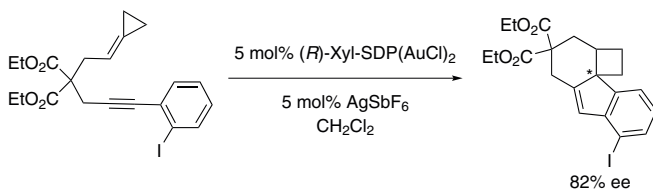
**15-5168** (R)-(+)-7,7'-Bis[di(3,5-dimethylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (R)-Xyl-SDP (917377-75-4)  
 $C_{49}H_{50}P_2$ ; FW: 700.87; off-white to pale yellow solid  
*air sensitive*  
 Note: Spiro Bisphosphine Ligand Kit component.



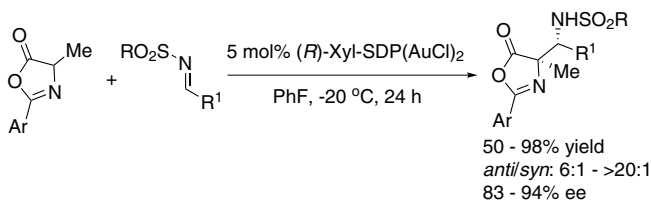
25mg  
100mg

## Technical Notes:

- Chiral ligands for gold-catalyzed asymmetric ring expanding cycloisomerization.
- Chiral ligands for gold-catalyzed asymmetric Mannich reactions of azlactones.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

## References:

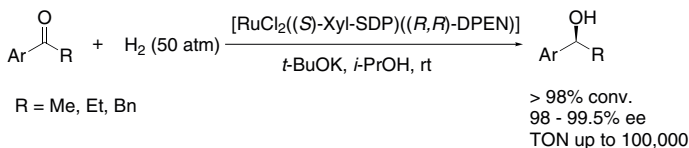
- Org. Lett.*, **2008**, *10*, 4315.
- J. Am. Chem. Soc.*, **2011**, *133*, 3517.

**15-5169** (S)-(-)-7,7'-Bis[di(3,5-dimethylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (S)-Xyl-SDP (528521-89-3)  
 $C_{49}H_{50}P_2$ ; FW: 700.87; off-white to pale yellow solid  
*air sensitive*  
 Note: Spiro Bisphosphine Ligand Kit component.

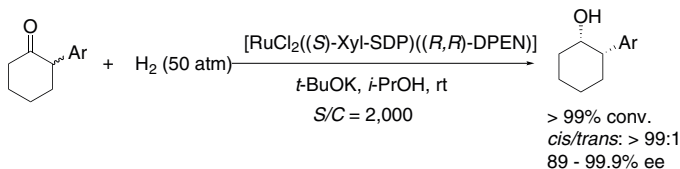
25mg  
100mg

## Technical Notes:

- Chiral ligands for ruthenium-catalyzed asymmetric hydrogenation of simple ketones.
- Chiral ligands for ruthenium-catalyzed asymmetric hydrogenation of racemic  $\alpha$ -aryl cyclic ketones via dynamic kinetic resolution



Tech. Note (1)  
Ref. (1)



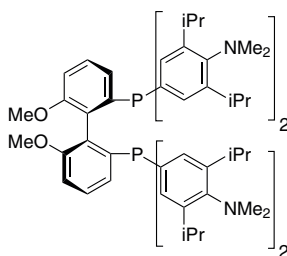
Tech. Note (2)  
Ref. (2)

## References:

- J. Am. Chem. Soc.*, **2003**, *125*, 4404.
- J. Org. Chem.*, **2005**, *125*, 2967.

## PHOSPHORUS - Ligands and Compounds

**15-0652** (R)-(-)-2,2'-Bis[di(3,5-di-*i*-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (352655-40-4)  
 $C_{70}H_{100}N_4O_2P_2$ ; FW: 1091.55; white powdr.  
 (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.  
 Solvias (R)-MeO BIPHEP Ligand Kit component.

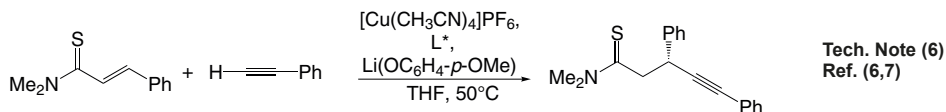
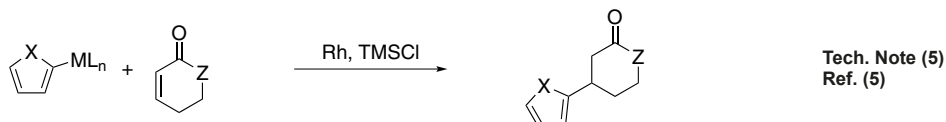
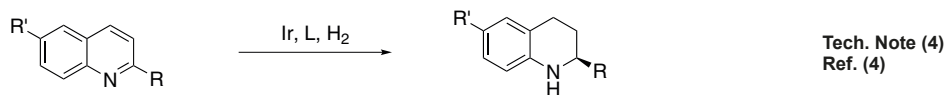
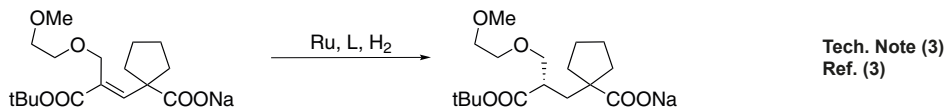


100mg  
 500mg  
 2g  
 10g

In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR2 group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

### Technical Notes:

1. See 15-0042
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
5. Conjugate addition using 2-heteroaryl titanates and zinc reagents.
6. Conjugate addition of terminal alkynes to  $\alpha,\beta$ -unsaturated thioamides.



### References:

1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Dev.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. *Chem. Asian J.*, **2011**, 6, 1778.
7. *J. Am. Chem. Soc.*, **2010**, 132, 10275.

**15-0653** (S)-(+)-2,2'-Bis[di(3,5-di-*i*-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (919338-66-2)  
 $C_{70}H_{100}N_4O_2P_2$ ; FW: 1091.55; white powdr.  
 (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component.

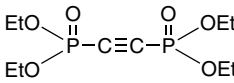
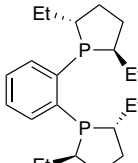
100mg  
 500mg  
 2g  
 10g

### Technical Note:

1. See 15-0652 (page 35)

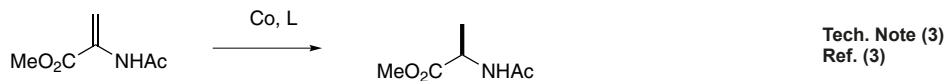
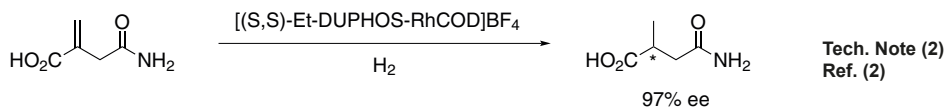


# PHOSPHORUS - Ligands and Compounds

<b>15-0119</b>	<b>Bis(diethoxyphosphoryl)acetylene, 99%</b> (4851-53-0) $C_{10}H_{20}O_4P_2$ ; FW: 298.21; yellow liq.; b.p. 181.5-182.5(2.5mm); d. 1.12 <i>moisture sensitive</i>		500mg 2g
<b>15-0084</b>	<b>Bis(diethylamino)chlorophosphine, min. 97%</b> (685-83-6) amp HAZ [( $C_2H_5$ ) <sub>2</sub> N] <sub>2</sub> PCl; FW: 210.68; colorless to light yellow liq. (may contain trace insolubles); b.p. 124-125°/15 mm; d. 1.002 <i>air sensitive, moisture sensitive</i>		1g 5g
<b>15-0083</b>	<b>1,2-Bis(diethylphosphino)ethane, 98%</b> (6411-21-8) amp HAZ ( $C_2H_5$ ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> P( $C_2H_5$ ) <sub>2</sub> ; FW: 206.25; colorless liq.; b.p. 124-126°/10 mm; d. 0.884 (25°) <i>air sensitive</i>		1g 5g
<b>15-0097</b>	<b>(-)-1,2-Bis((2R,5R)-2,5-diethylphospholano)benzene, 98+%</b> (R,R)-Et-DUPHOS (136705-64-1) $C_{22}H_{36}P_2$ ; FW: 362.48; colorless oil; d. 1.01 <i>air sensitive</i>		100mg 500mg 2g

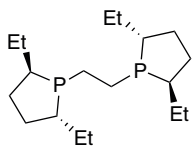
## Technical Notes:

- See 15-0096.
- Ligand used in rhodium catalyzed asymmetric hydrogenation of 2-methylenesuccinamic acid.
- Cobalt-catalyzed asymmetric hydrogenation.



## References:

- Encyclopedia of Reagents for Organic Synthesis*, 1995, Vol. 1, 489
- Org. Proc. Res. Dev.*, 2003, 7, 407.
- Science.*, 2013, 342, 1076.

<b>15-0098</b>	<b>(+)-1,2-Bis((2S,5S)-2,5-diethylphospholano)benzene, 98+%</b> (S,S)-Et-DUPHOS (136779-28-7) $C_{22}H_{36}P_2$ ; FW: 362.48; colorless oil; d. 1.010 <i>air sensitive</i>		100mg 500mg 2g
<b>15-0101</b>	<b>(+)-1,2-Bis((2R,5R)-2,5-diethylphospholano)ethane, 98+%</b> (R,R)-Et-BPE (136705-62-9) ( $C_8H_{16}$ )PCH <sub>2</sub> CH <sub>2</sub> P( $C_8H_{16}$ ); FW: 314.43; colorless to pale-yellow liq.; b.p. 104-106°/0.05mm; d. 0.939 <i>air sensitive</i>		100mg 500mg 2g

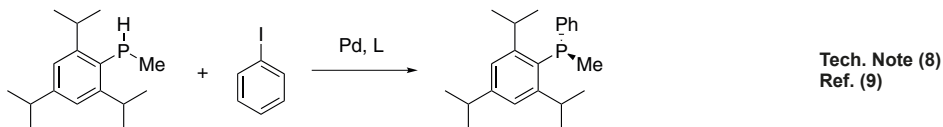
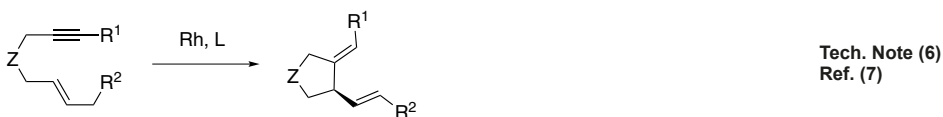
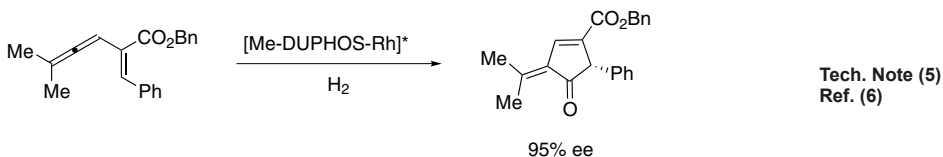
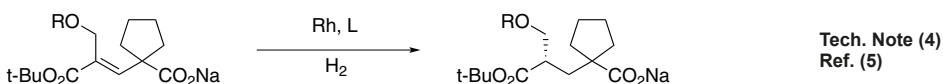
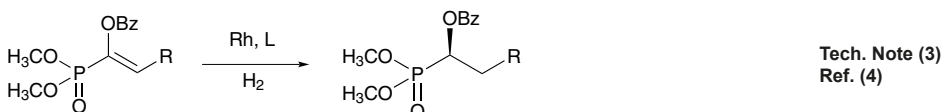
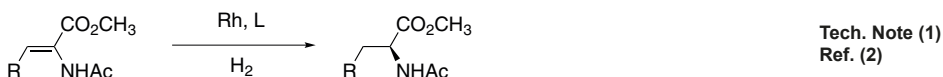
## Technical Notes:

- The DUPHOS family of catalysts is highly efficient for the asymmetric hydrogenation of various substituted acetamidoacrylates and enol acetates yielding products of high enantiomeric excesses.<sup>1</sup> Efficient ligand for the asymmetric hydrogenation of tetrasubstituted enamides.<sup>2</sup>
- Asymmetric hydrogenation of vinyl alcohols.<sup>2</sup>
- Catalyst used for the asymmetric hydrogenation of enol phosphonates.<sup>4</sup>
- Asymmetric hydrogenation of allylic alcohols.<sup>5</sup>
- Ligand for the catalytic asymmetric [4+1] cycloaddition of vinylallenes with CO.<sup>5</sup>
- Ligand for the Rh-catalyzed asymmetric enyne cycloisomerization.<sup>6</sup>

# PHOSPHORUS - Ligands and Compounds

15-0101 (+)-1,2-Bis((2R,5R)-2,5-diethylphospholano)ethane, 98+% (R,R)-Et-BPE (136705-62-9)  
(continued)

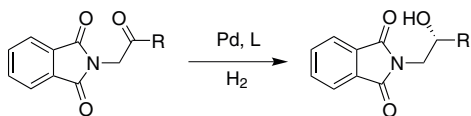
- Catalytic enantioselective addition of dialkylzinc to N-Diphenylphosphinoylimines.<sup>8</sup>
- Palladium catalyzed asymmetric phosphination.<sup>9</sup>
- Palladium-catalyzed 1,4 arylation of  $\alpha$ ,  $\beta$ -unsaturated ketones.<sup>11</sup>
- Asymmetric, Ir-catalyzed, [2+2+2] cycloaddition.<sup>12</sup>
- Asymmetric palladium-catalyzed synthesis of 2-methyl-indolines via C-H activation.<sup>13</sup>
- Copper-catalyzed monoborylation of 1,3-Dienes.<sup>14</sup>
- Rhodium-catalyzed enantioselective transmetalation.<sup>15</sup>
- CuH-catalyzed hydroamination of styrenes.<sup>16</sup>



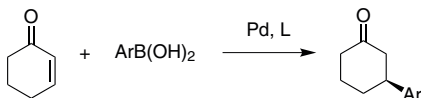
# PHOSPHORUS - Ligands and Compounds

15-0101 (+)-1,2-Bis((2R,5R)-2,5-diethylphospholano)ethane, 98+% (R,R)-Et-BPE (136705-62-9)

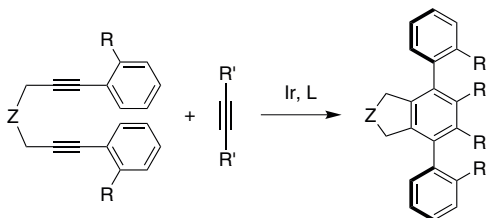
(continued)



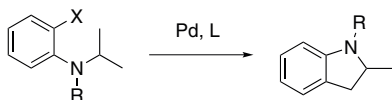
Tech. Note (9)  
Ref. (10)



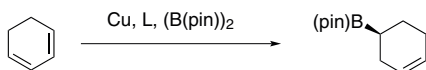
Tech. Note (10)  
Ref. (11)



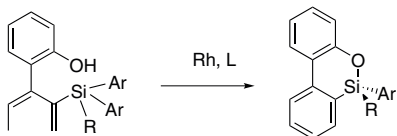
Tech. Note (11)  
Ref. (12)



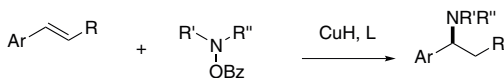
Tech. Note (12)  
Ref. (13)



Tech. Note (13)  
Ref. (14)



Tech. Note (14)  
Ref. (15)



Tech. Note (15)  
Ref. (16)

## References:

1. (a) Burk, M.J., *Handbook of Chiral Chemicals*, Abel, Ager, D.J., Ed. (Marcel Dekker, Inc., New York, 1999) Ch 18, p 339. (review). (b) *Acc. Chem. Res.*, **2000**, 33, 363. (review)
2. (a) *J. Am. Chem. Soc.*, **1993**, 115, 10125. (b) *J. Am. Chem. Soc.*, **1992**, 114, 6266. (c) *J. Am. Chem. Soc.*, **1996**, 118, 5142. (d) *Tetrahedron Lett.*, **1999**, 40, 6685. (e) *J. Am. Chem. Soc.*, **1995**, 117, 9375.
3. *J. Am. Chem. Soc.*, **1991**, 113, 8518.
4. *Org. Lett.*, **1999**, 1, 387.
5. *J. Org. Chem.*, **1999**, 64, 3290.
6. *J. Am. Chem. Soc.*, **1999**, 121, 4130.
7. *Angew. Chem. Int. Ed.*, **2000**, 39, 4104.
8. *J. Am. Chem. Soc.*, **2003**, 125, 1692.
9. *J. Am. Chem. Soc.*, **2002**, 124, 13356.
10. *Org. Lett.*, **2005**, 7, 3235.
11. *Org. Lett.*, **2005**, 7, 5309.
12. *J. Am. Chem. Soc.*, **2004**, 126, 8382.
13. *Chem. Commun.*, **2011**, 47, 11483.
14. *J. Am. Chem. Soc.*, **2010**, 132, 1226.
15. *J. Am. Chem. Soc.*, **2012**, 134, 16955.
16. *Angew. Chem. Int. Ed.*, **2013**, 52, 10830.

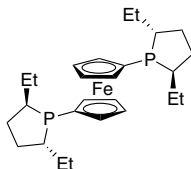
# PHOSPHORUS - Ligands and Compounds

<b>15-0102</b>	<b>(-)-1,2-Bis((2S,5S)-2,5-diethylphospholano)ethane, 98+% (S,S)-Et-BPE (136779-27-6)</b> $(C_8H_{16})PCH_2CH_2P(C_8H_{16})$ ; FW: 314.43; colorless to pale-yellow liq.; b.p. 104-106°/0.05mm <i>air sensitive</i>	100mg 500mg 2g
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Technical Note:

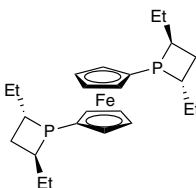
- See 15-0101 (page 36)

<b>26-1625</b>	<b>1,1'-Bis((2R,5R)-2,5-diethylphospholano)ferrocene, min. 97% (147762-89-8)</b> $C_{26}H_{40}FeP_2$ ; FW: 470.39; yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	250mg 1g
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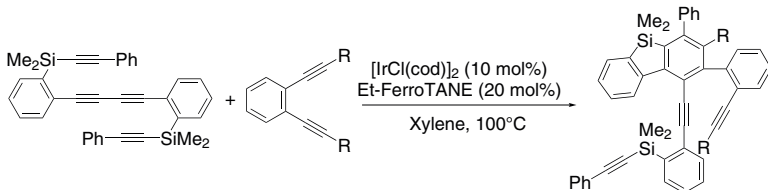
<b>26-1626</b>	<b>1,1'-Bis((2S,5S)-2,5-diethylphospholano)ferrocene, min. 97% (436863-50-2)</b> $C_{26}H_{40}FeP_2$ ; FW: 470.39; yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	250mg 1g
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<b>26-0201</b>	<b>(-)-1,1'-Bis((2S,4S)-2,4-diethylphosphono)ferrocene, min. 95% (S,S)-Et-FerroTANE® (290347-66-9)</b> $[C_5H_4(C_7H_{14}P)]_2Fe$ ; FW: 442.35; yellow-orange powdr.; m.p. 76° <i>air sensitive</i> Note: **Limited quantities available** Sold in collaboration with Chirotech for research purposes only. US Patent no. 5936109.	100mg
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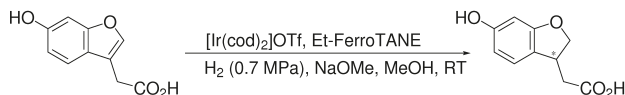


Technical Notes:

- Ligand for Ir-catalyzed [2+2+2] cycloaddition for enantioselective synthesis of silahelicenes.
- Ligand for the preparation of (2,3-dihydrobenzofuran-3-yl)-acetic acid derivatives via Rh-catalyzed asymmetric hydrogenation.



**Tech. Note (1)  
Ref. (1)**



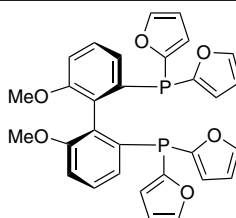
**Tech. Note (2)  
Ref. (2)**

References:

- Chem. Commun.*, **2012**, 48, 1311.
- Bull. Chem. Soc. Jpn.*, **2014**, 87, 539.

# PHOSPHORUS - Ligands and Compounds

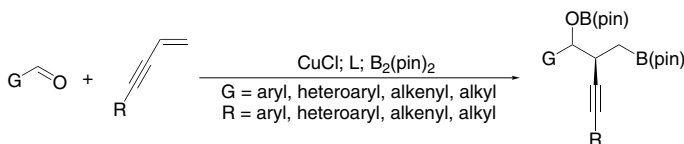
**15-0112** (R)-(+)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (145214-57-9)  
 $C_{30}H_{24}O_8P_2$ ; FW: 542.47; off-white powder.  
 (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component.



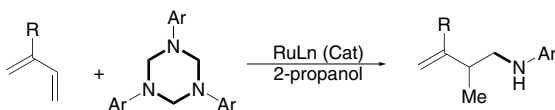
100mg  
 500mg  
 2g  
 10g

## Technical Notes:

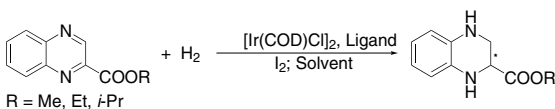
- Ligand for the copper-catalyzed diastereo- and enantioselective reactions of bis(pinacolato)diboron, 1,3-enynes and aldehydes.
- Ligand for ruthenium-catalyzed enantioselective hydroaminomethylation of dienes and isoprene with 1,3,5-tris(aryl)-hexahydro-1,3,5-triazines.
- Ligand for iridium-catalyzed asymmetric hydrogenation of quinoxaline-2-carboxylates.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (3)**  
**Ref. (3)**

## References:

- J. Am. Chem. Soc.*, **2014**, *136*, 11304.
- Chem. Sci.*, **2016**, *7*, 136.
- Tetrahedron*, **2016**, *72*, 1375.

**15-0113** (S)-(-)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (145214-59-1)  
 $C_{30}H_{24}O_8P_2$ ; FW: 542.47; off-white powder.  
 (store cold)

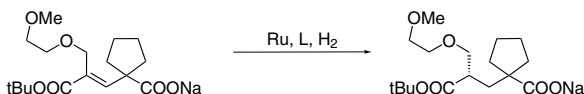
Note: Sold in collaboration with Solvias for research purposes only.  
 Solvias (S)-MeO BIPHEP Ligand Kit component.

100mg  
 500mg  
 2g  
 10g

In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR<sub>2</sub> group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

## Technical Notes:

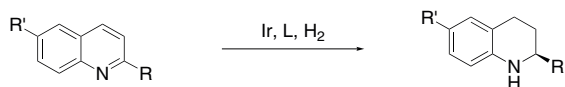
- See 15-0042.
- Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
- Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
- Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
- Conjugate addition using 2-heteroaryl titanates and zinc reagents.
- Pd-catalyzed asymmetric allylation reactions.



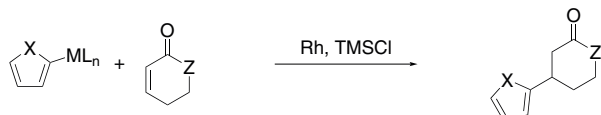
**Tech. Note (3)**  
**Ref. (3)**

# PHOSPHORUS - Ligands and Compounds

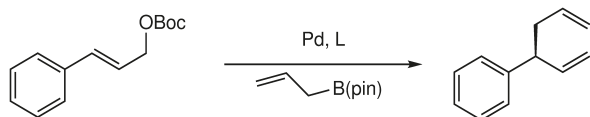
**15-0113** (S)-(-)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  
(continued) (145214-59-1)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)

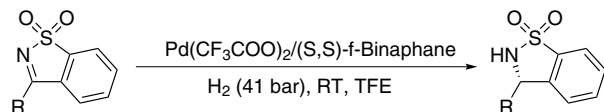
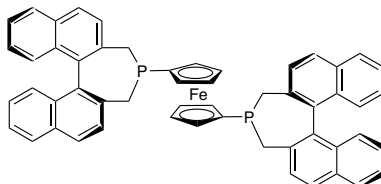
## References:

1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Devel.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. (a) *J. Am. Chem. Soc.*, **2010**, 132, 10686.  
(b) *J. Am. Chem. Soc.*, **2011**, 133, 9716.  
(c) *J. Am. Chem. Soc.*, **2011**, 133, 16778.

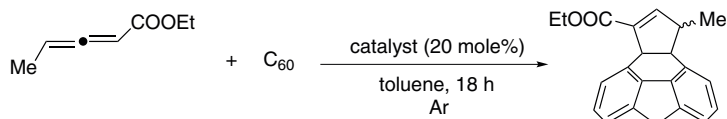
**26-0243** **1,1'-Bis[(S)-4,5-dihydro-3H-binaphtho[1,2-c:2',1'-e]phosphino]ferrocene, min. 98% (S,S)-f-Binaphane (544461-38-3)** 100mg  
C<sub>54</sub>H<sub>40</sub>FeP<sub>2</sub>; FW: 806.69; yellow-brown powdr. 500mg  
*air sensitive, light sensitive*  
Note: Sold in collaboration with Chiral Quest for research purposes only.  
US Patent No. 6,525,210, US6828271.

## Technical Notes:

1. Ligand for enantioselective Pd-catalyzed hydrogenation of enesulfonamides [5] and cyclic N-sulfonylimines<sup>[6]</sup>
2. Enantioselective, asymmetric organocatalyst for [3+2] cycloaddition of allenoates to C60 fullerene (conversion >90%, ee up to 90%)
3. Ligand for Iridium-mediated direct asymmetric reductive amination of acetophenone with phenylhydrazide (conversion >99%; yield >94%; ee >94%)
4. Ligand used for the palladium-catalyzed, asymmetric, decarboxylative generation and asymmetric allylation of α-imino anions.
5. Ligand used in iridium-catalyzed, asymmetric hydrogenation of 6-substituted 3-hydroxypyridinium salts to trans 6-substituted piperidin-3-ols with high enantioselectivities (up to 95% ee).



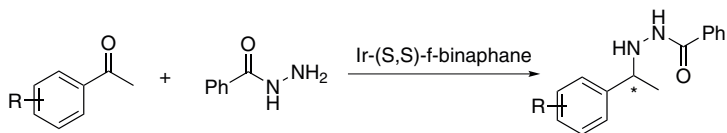
Tech. Note (1)  
Ref. (1)



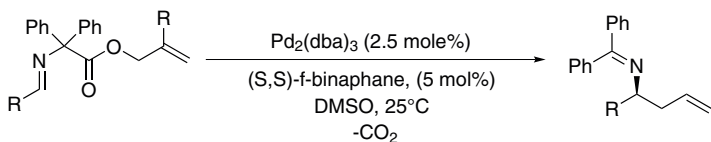
Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

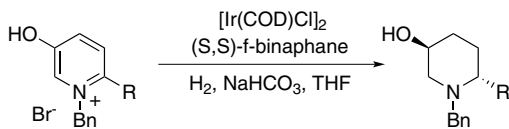
26-0243 1,1'-Bis[(S)-4,5-dihydro-3H-binaphtho[1,2-c:2',1'-e]phosphino]ferrocene, min. 98%  
(continued) (S,S)-f-Binaphane (544461-38-3)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

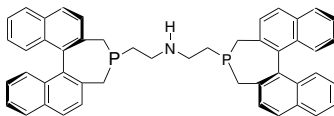


Tech. Note (5)  
Ref. (5)

## References:

1. *J. Org. Chem.*, **2009**, *74*, 5633.
2. *Angew. Chem. Int. Ed.*, **2013**, *53*, 5115.
3. *Org. Lett.*, **2013**, *15*, 4354.
4. *Org. Lett.*, **2014**, *16*, 5228.
5. *ACS Catal.*, **2016**, *6*, 2368.

**15-7301** Bis(2-[(11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-ylethyl)amine, min. 97%  
(851870-89-8)  
C<sub>48</sub>H<sub>41</sub>NP<sub>2</sub>; FW: 693.79; white solid  
*air sensitive*  
Note: Sold under license from Kanata for research purposes only.  
WO2004096735.

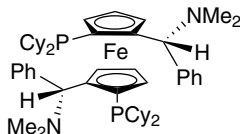


100mg  
500mg

**15-0089** 1,2-Bis(dimethoxyphosphoryl)benzene, 99% (15104-46-8)  
C<sub>6</sub>H<sub>4</sub>[P(O)(OCH<sub>3</sub>)<sub>2</sub>]<sub>2</sub>; FW: 294.18; white xtl.; m.p. 80-82°

5g  
25g

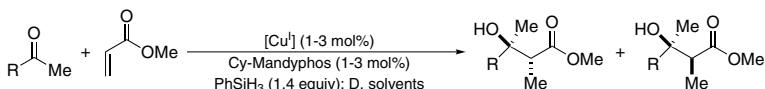
**26-0240** (S,S)-(+)-2,2'-Bis[(R)-(N,N-dimethyl-amino)(phenyl)methyl]-1,1'-bis(dicyclohexylphosphino)ferrocene, min. 97%  
(494227-35-9)  
C<sub>52</sub>H<sub>74</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 844.95;  
orange-red solid  
(store cold)  
Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component.



100mg  
500mg  
2g  
10g

## Technical Notes:

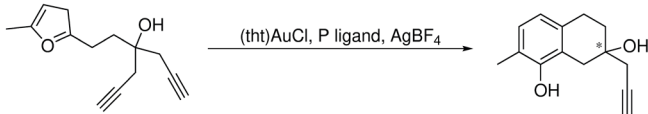
1. Ligand for a copper-catalyzed domino conjugated reduction/aldol reaction of methyl acrylate with various alkyl aryl ketones.
2. Ligand for gold catalyzed Phenol synthesis from furyldialkyne
3. Ligand for asymmetric palladium-catalyzed cross-coupling of aryl triflates with [(η<sup>6</sup>-benzylamine)Cr(CO)<sub>3</sub>]



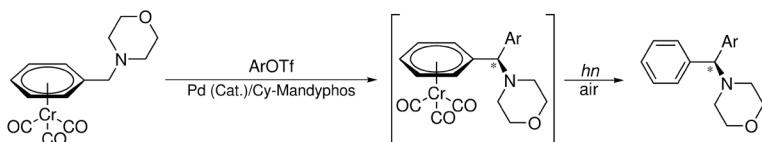
Tech. Note (1)

# PHOSPHORUS - Ligands and Compounds

**26-0240** (S,S)-(+)-2,2'-Bis[(R)-(N,N-dimethyl-amino)(phenyl)methyl]-1,1'-bis(dicyclohexylphosphino)ferrocene, min. 97% (494227-35-9)



Tech. Note (2)



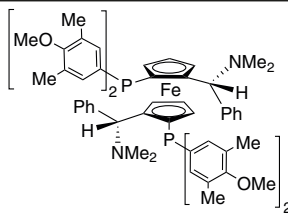
Tech. Note (3)

Ar=4-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub> 91% yield, 86% ee  
 Ar=4-tBuC<sub>6</sub>H<sub>4</sub> 76% yield, 88% ee  
 Ar=4-MeOC<sub>6</sub>H<sub>4</sub> 63% yield, 85% ee  
 Ar=3-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub> 87% yield, 91% ee

## References:

1. *Angew. Chem. Int. Ed.*, **2006**, 45, 1292.
2. *Chem. Eur. J.*, **2009**, 15, 13318.
3. *Angew. Chem. Int. Ed.*, **2012**, 51, 11510.

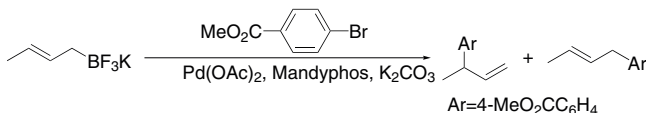
**26-0248** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocene, min. 97% (494227-37-1)  
 C<sub>64</sub>H<sub>74</sub>FeN<sub>2</sub>O<sub>4</sub>P<sub>2</sub>; FW: 1053.08;  
 yellow to orange-red solid  
 (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.  
 Solvias MandyPhos™ Ligand Kit component.



100mg  
 500mg  
 2g  
 10g

## Technical Note:

1. Ligand for palladium catalyzed asymmetric coupling of potassium crotyltrifluoroborate with methyl 4-Bromobenzoate



Tech. Note (1)  
 Ref. (2)

## References:

1. *Organometallics*, **2009**, 28, 152.

**26-0245** (R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(3,5-dimethylphenyl)phosphino)ferrocene, min. 97% (847997-73-3)  
 C<sub>60</sub>H<sub>66</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 932.99; orange pwdr.  
 (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.

100mg  
 500mg  
 2g  
 10g

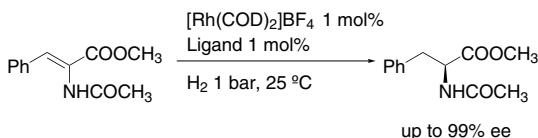
## Technical Notes:

1. Ligand for Rh-catalyzed asymmetric hydrogenation of α-acetamidoacrylates.
2. Ligand for Rh-catalyzed hydrogenation of α- and α-enamides, acrylic acid derivatives, itaconates, α-ketoesters and 1,3-diketones.
3. Ligand for Rh-catalyzed asymmetric hydrogenation of furyl-substituted (Z)-dehydroamino acid derivatives.
4. Ligand for Ir-catalyzed asymmetric transfer hydrogenation of ketones.
5. Ligand for Cu-catalyzed enantioselective hydroboration of α- and α-unsaturated esters and nitriles.

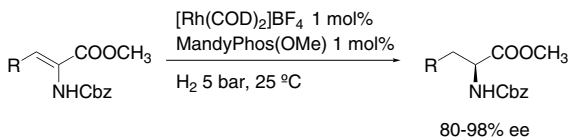


## PHOSPHORUS - Ligands and Compounds

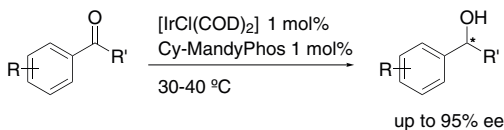
**26-0245** (R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(3,5-dimethylphenyl)phosphino)ferrocene, min. 97% (847997-73-3)



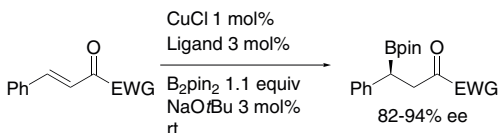
Tech. Note (1)  
Ref. (2)



Tech. Note (3)  
Ref. (4)



Tech. Note (4)  
Ref. (5)



Tech. Note (5)  
Ref. (6)

### References:

1. *Chem. Eur. J.*, **1998**, *4*, 950.
2. *Tetrahedron-Asymmetry*, **1999**, *10*, 375.
3. *Tetrahedron-Asymmetry*, **2004**, *15*, 2299.
4. *Chem. Eur. J.*, **2006**, *12*, 5376.
5. *Chem. Eur. J.*, **2008**, *14*, 10388.
6. *Angew. Chem. Int. Ed.*, **2008**, *47*, 145.

**26-0246** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(3,5-dimethylphenyl)phosphino)ferrocene, min. 97% (793718-16-8)  
C<sub>60</sub>H<sub>66</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 932.99; orange powder.  
(store cold)  
Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component.

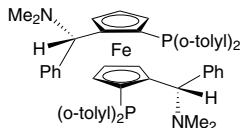
100mg  
500mg  
2g  
10g

### Technical Note:

1. See 26-0245 (page 43)

**26-0253** (R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(2-methylphenyl)phosphino)ferrocene, min. 97% (831226-39-2)  
C<sub>58</sub>H<sub>58</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 876.88; orange powder.  
(store cold)

Note: Sold in collaboration with Solvias for research purposes only.



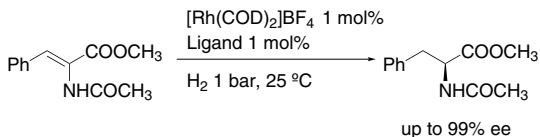
100mg  
500mg

### Technical Notes:

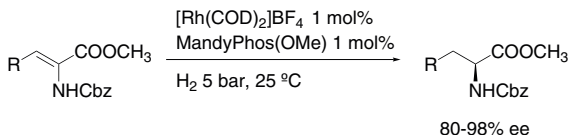
1. Ligand for Rh-catalyzed asymmetric hydrogenation of  $\alpha$ -acetamidoacrylates.
2. Ligand for Rh-catalyzed hydrogenation of  $\alpha$ - and  $\alpha$ -enamides, acrylic acid derivatives, itaconates,  $\alpha$ -ketoesters and 1,3-diketones.
3. Ligand for Rh-catalyzed asymmetric hydrogenation of furyl-substituted (Z)-dehydroamino acid derivatives.
4. Ligand for Ir-catalyzed asymmetric transfer hydrogenation of ketones.
5. Ligand for Cu-catalyzed enantioselective hydroboration of  $\alpha$ - and  $\alpha$ -unsaturated esters and nitriles.

## PHOSPHORUS - Ligands and Compounds

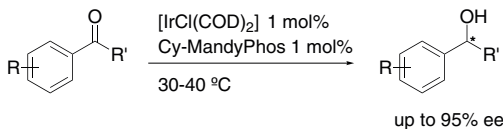
**26-0253** (R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(2-methylphenyl)phosphino)ferrocene, min. 97% (831226-39-2)



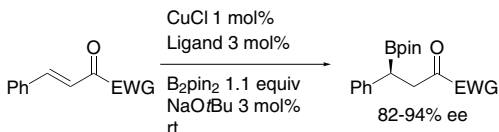
Tech. Note (1)  
Ref. (2)



Tech. Note (3)  
Ref. (4)



Tech. Note (4)  
Ref. (5)



Tech. Note (5)  
Ref. (6)

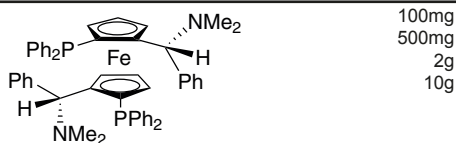
### References:

1. *Chem. Eur. J.*, **1998**, *4*, 950.
2. *Tetrahedron-Asymmetr.*, **1999**, *10*, 375.
3. *Tetrahedron-Asymmetr.*, **2004**, *15*, 2299.
4. *Chem. Eur. J.*, **2006**, *12*, 5376.
5. *Chem. Eur. J.*, **2008**, *14*, 10388.
6. *Angew. Chem. Int. Ed.*, **2008**, *47*, 145.

**26-0252** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(diphenylphosphino)ferrocene, min. 97% (174467-31-3)

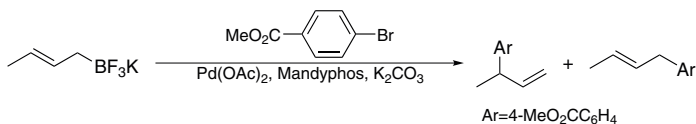
C<sub>52</sub>H<sub>50</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 820.76;  
orange-red solid  
(store cold)

Note: Sold in collaboration with Solvias  
for research purposes only. Solvias  
MandyPhos™ Ligand Kit component.



### Technical Notes:

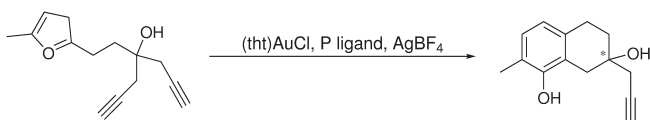
1. Ligand used for the palladium-catalyzed asymmetric coupling of potassium crotyltrifluoroborate with methyl 4-bromobenzoate.
2. Ligand used for the gold-catalyzed phenol synthesis from furyldialkyne.
3. Ligand for asymmetric palladium-catalyzed cross-coupling of aryl triflates with [(h6-benzylamine)Cr(CO)<sub>3</sub>].
4. Ligand used for the palladium-catalyzed asymmetric synthesis of α-allyl-α-aryl α-amino acids by tandem alkylation/π-allylation of α-iminoesters



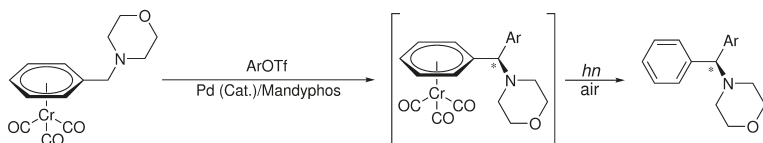
Tech. Note (1)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

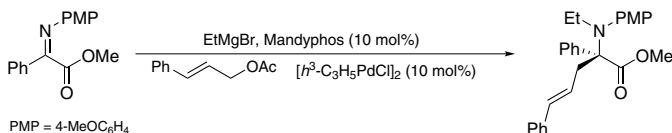
**26-0252** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl) methyl]-1,1'-bis(diphenylphosphino) ferrocene, min. 97% (174467-31-3)



Tech. Note (3)  
Ref. (4)



Tech. Note (4)  
Ref. (5)



Tech. Note (5)  
Ref. (6)

PMP = 4-MeOC₆H₄

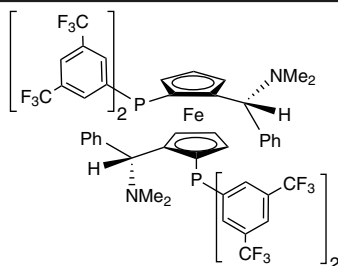
References:

1. *Organometallics*, **2009**, 28, 152.
2. *Chem. Eur. J.*, **2009**, 15, 13318.
3. *Angew. Chem. Int. Ed.*, **2012**, 51, 11510.
4. *Org. Lett.*, **2014**, 16, 1948.

**26-0244** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-trifluoromethylphenyl)phosphino]ferrocene, min. 97% (494227-36-0)

C<sub>60</sub>H<sub>42</sub>F<sub>24</sub>FeN<sub>2</sub>P<sub>2</sub>; FW: 1364.74; orange-red solid (store cold)

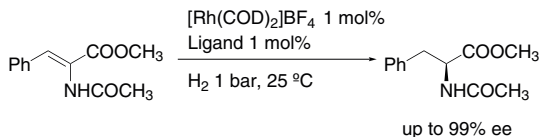
Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component.



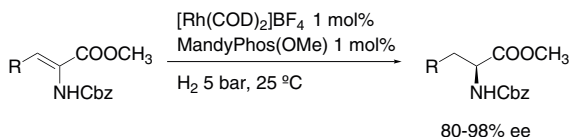
100mg  
500mg  
2g  
10g

Technical Notes:

1. Ligand for Rh-catalyzed asymmetric hydrogenation of  $\alpha$ -acetamidoacrylates.
2. Ligand for Rh-catalyzed hydrogenation of  $\alpha$ - and  $\alpha$ -enamides, acrylic acid derivatives, itaconates,  $\alpha$ -ketoesters and 1,3-diketones.
3. Ligand for Rh-catalyzed asymmetric hydrogenation of furyl-substituted (Z)-dehydroamino acid derivatives.
4. Ligand for Ir-catalyzed asymmetric transfer hydrogenation of ketones.
5. Ligand for Cu-catalyzed enantioselective hydroboration of  $\alpha$ - and  $\alpha$ -unsaturated esters and nitriles.



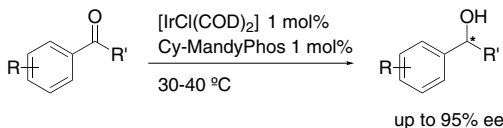
Tech. Note (1)  
Ref. (2)



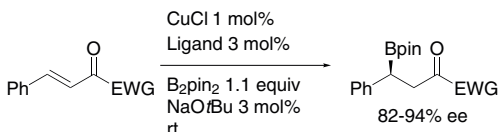
Tech. Note (3)  
Ref. (4)

# PHOSPHORUS - Ligands and Compounds

**26-0244** (S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-trifluoromethyl-phenyl)phosphino]ferrocene, min. 97% (494227-36-0)



Tech. Note (4)  
Ref. (5)



Tech. Note (5)  
Ref. (6)

## References:

1. *Chem. Eur. J.*, **1998**, *4*, 950.
2. *Tetrahedron-Asymmetr.*, **1999**, *10*, 375.
3. *Tetrahedron-Asymmetr.*, **2004**, *15*, 2299.
4. *Chem. Eur. J.*, **2006**, *12*, 5376.
5. *Chem. Eur. J.*, **2008**, *14*, 10388.
6. *Angew. Chem. Int. Ed.*, **2008**, *47*, 145.

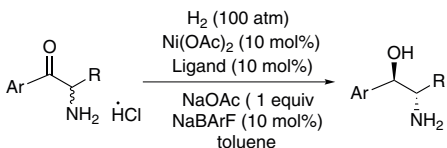
<b>15-0087</b>	<b>Bis(dimethylamino)phosphoryl chloride, 95+% (1605-65-8)</b>	10g
HAZ	[(CH <sub>3</sub> ) <sub>2</sub> N] <sub>2</sub> P(O)Cl; FW: 170.58; colorless liq.; b.p. 85°/0.35 mm; f.p. >230°F; d. 1.17 <i>moisture sensitive</i>	50g

<b>15-0111</b>	<b>Bis(3,5-dimethyl-4-methoxyphenyl)chlorophosphine, min. 98%</b>	500mg
HAZ	(136802-85-2) C <sub>18</sub> H <sub>22</sub> ClO <sub>2</sub> P; FW: 336.79; colorless, viscous liq. <i>moisture sensitive</i>	2g

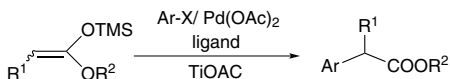
<b>26-1150</b>	<b>(R)-(-)-1-[(S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocenyl]ethylidicyclohexylphosphine, min. 97%</b>	100mg
	(360048-63-1) C <sub>42</sub> H <sub>56</sub> FeO <sub>2</sub> P <sub>2</sub> ; FW: 710.71; orange powder. Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.	500mg

## Technical Notes:

1. Homogeneous chiral nickel-catalyzed asymmetric hydrogenation of substituted aromatic  $\alpha$ -aminoketone hydrochlorides through dynamic kinetic resolution.
2. Pd/Josiphos-catalyzed enantioselective  $\alpha$ -arylation of silyl ketene acetals.
3. Ligand used in the cobalt-catalyzed asymmetric addition of silylacetylenes to 1,1-disubstituted allenes.



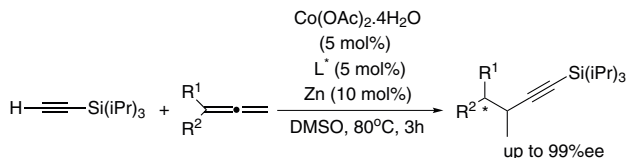
Tech. Note (2)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

**26-1150** (R)-(-)-1-((S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocenyl)ethylidene-cyclohexylphosphine, min. 97% (360048-63-1)

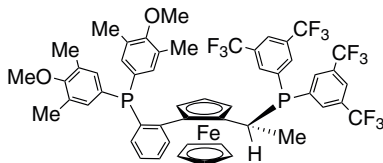


**Tech. Note (3)**  
**Ref. (3)**

## References:

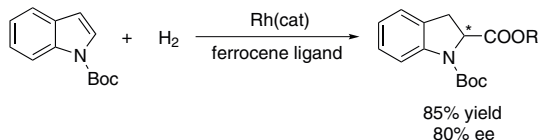
1. *ChemCatChem* **2009**, *1*, 237.
2. *Organometallics* **2011**, *30*, 6323.
3. *J. Org. Chem.*, **2013**, *78*, 8986

**26-1130** (R)-(+)-1-((R)-2-[2'-Bis(3,5-dimethyl-4-methoxyphenyl)phosphino-phenyl]ferrocenyl) ethylbis(di-3,5-tri fluoromethylphenyl) phosphine, min. 97% (494227-30-4) 100mg  
500mg  
 $\text{C}_{57}\text{H}_{44}\text{F}_{12}\text{FeO}_2\text{P}_2$ ; FW: 1046.68; orange powdr.  
 Note: Sold in collaboration with Solvias for research purposes only.  
 Solvias Walphos Ligand Kit component.



## Technical Note:

1. Ligand for Rh-catalyzed hydrogenation of vinylboronic esters

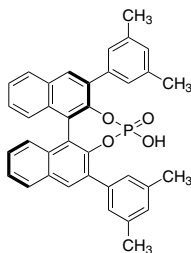


**Tech. Note (2)**  
**Ref. (2)**

## References:


1. *Tetrahedron Asymm.*, **2010**, *21*, 2010.

**15-1368** **NEW** (11bR)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (861909-53-7) 100mg  
 $\text{C}_{36}\text{H}_{29}\text{O}_4\text{P}$ ; FW: 556.6; White to light-yellow powdr.  
 Note: Sold in collaboration with Daicel for research purposes only.



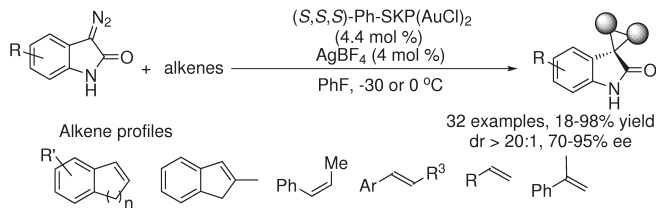
**15-1369** **NEW** (11bS)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (1170736-59-0) 100mg  
 $\text{C}_{36}\text{H}_{29}\text{O}_4\text{P}$ ; FW: 556.6; White to light-yellow powdr.  
 Note: Sold in collaboration with Daicel for research purposes only.

# PHOSPHORUS - Ligands and Compounds

15-1373 <b>NEW</b>	<b>(11bR)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (1065214-95-0) $C_{36}H_{37}O_3P$ ; FW: 564.7; White to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.		25mg 100mg
15-1374 <b>NEW</b>	<b>(11bS)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> $C_{36}H_{37}O_3P$ ; FW: 564.7; White to light-yellow powder. Note: Sold in collaboration with Daicel for research purposes only.		25mg 100mg
15-0088 amp HAZ 	<b>Bis(3,5-dimethylphenyl)phosphine, 98% (71360-06-0)</b> $[(CH_3)_2C_6H_3]_2PH$ ; FW: 242.30; colorless liq. <i>pyrophoric</i>		100mg 500mg
15-6185 amp	<b>Bis(3,5-dimethylphenyl)phosphine, 98% (10wt% in hexanes)</b> (71360-06-0) $[(CH_3)_2C_6H_3]_2PH$ ; FW: 242.30; colorless liq. <i>air sensitive</i>		1g 5g
15-4330	<b>(+)-1,13-Bis[di(4-methylphenyl)phosphino]-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97% (R,R,R)-(+)-Tol-SKP</b> (1429939-32-1) $C_{48}H_{46}O_2P_2$ ; FW: 716.83; white solid; m.p. 90-92° <i>air sensitive</i> Note: Sold in collaboration with SIOC for research purposes only. Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.		25mg 100mg

## Technical Notes:

- Efficient ligand for the Au(I)-catalyzed, highly stereoselective, olefin cyclopropanation of diazooxindoles.
- See also 15-4320.



**Tech. Note (1)  
Ref. (1)**

## References:

- J. Am. Chem. Soc.*, **2013**, *135*, 8197.
- Angew. Chem., Int. Ed.* **2012**, *51*, 936.

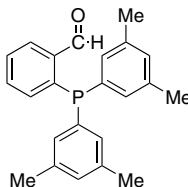
## PHOSPHORUS - Ligands and Compounds

<b>15-4331</b>	<p><b>(-)-1,13-Bis[di(4-methylphenyl)phosphino]-(5aS,8aS,14aS)-5a,6,7,8, a,9-hexahydro-5H-[1]benzopyrano[3,2-d]xanthene, 97%</b>  <b>(S,S,S)-(-)-Tol-SKP (1548897-80-8)</b>  <math>C_{48}H_{46}O_2P_2</math>; FW: 716.83; white powdr.; m.p. 90-92°  <i>air sensitive</i></p> <p>Note: Sold in collaboration with SIOC for research purposes only.            Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.</p>	<p>25mg 100mg</p>
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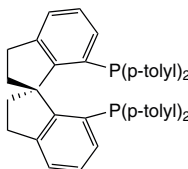
Technical Note:

1. See 15-4330 (page 49)

<b>15-7340</b>	<p><b>2-[Bis(3,5-dimethylphenyl)phosphino] benzaldehyde, min. 97%</b> (669091-00-3)  <math>C_{23}H_{23}OP</math>; FW: 346.40; yellow solid</p>	<p>100mg 500mg</p>
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<b>15-5180</b>	<p><b>(R)-(+)-7,7'-Bis[di(4-methylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97%</b> (R)-Tol-SDP (528521-87-1)  <math>C_{45}H_{42}P_2</math>; FW: 644.76; white solid; m.p. 150-152°  <i>air sensitive</i></p> <p>Note: Spiro Bisphosphine Ligand Kit component.</p>	<p>25mg 100mg</p>
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Technical Notes:

1. Ligands used for the ruthenium-catalyzed hydrogenation of simple and cyclic ketones with high activity and enantioselectivity.
2. Ligands used for palladium-catalyzed asymmetric allylic alkylations.

References:

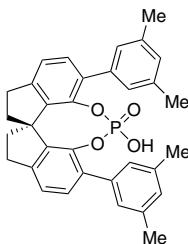
1. *J. Am. Chem. Soc.*, **2003**, *125*, 4404.
2. *J. Org. Chem.*, **2005**, *70*, 2967.
3. *Adv. Synth. Catal.*, **2004**, *346*, 625.

<b>15-5181</b>	<p><b>(S)-(-)-7,7'-Bis[di(4-methylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97%</b> (S)-Tol-SDP (817176-80-0)  <math>C_{45}H_{42}P_2</math>; FW: 644.76; white solid; m.p. 150-152°  <i>air sensitive</i></p> <p>Note: Spiro Bisphosphine Ligand Kit component.</p>	<p>25mg 100mg</p>
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Technical Note:

1. See 15-5180 (page 50)

<b>15-0542</b> <b>NEW</b>	<p><b>(11aR)-3,7-Bis(3,5-dimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98%</b> (1297613-75-2)  <math>C_{33}H_{31}O_3P</math>; FW: 522.57; white to light-yellow powdr.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>	<p>25mg 100mg</p>
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Technical Note:

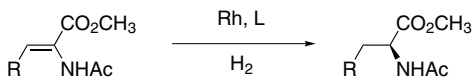
1. Spinol-based phosphoric acid (SBPA) as a highly enantioselective catalyst for asymmetric organocatalysis.



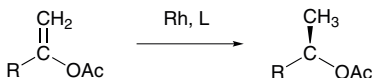


# PHOSPHORUS - Ligands and Compounds

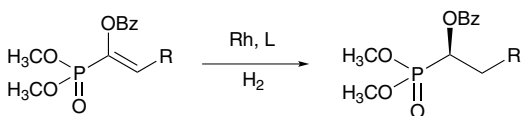
15-0096 (-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene, 98+%  
 (continued) (R,R)-Me-DUPHOS (147253-67-6)



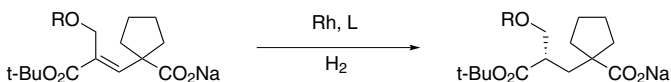
Tech. Note (1)  
 Ref. (2)



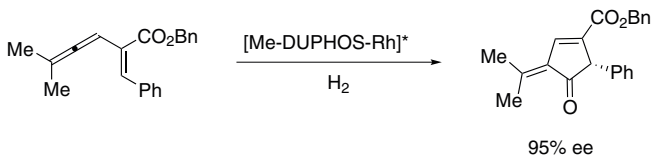
Tech. Note (2)  
 Ref. (3)



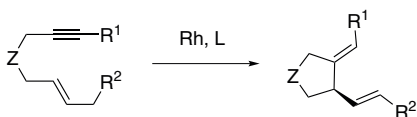
Tech. Note (3)  
 Ref. (4)



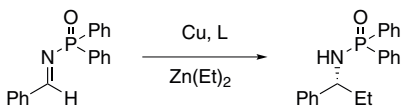
Tech. Note (4)  
 Ref. (5)



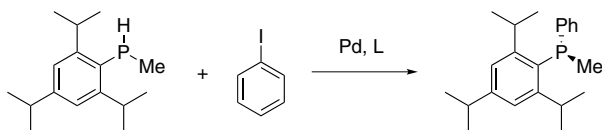
Tech. Note (5)  
 Ref. (6)



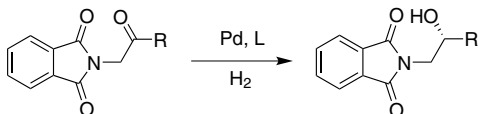
Tech. Note (6)  
 Ref. (7)



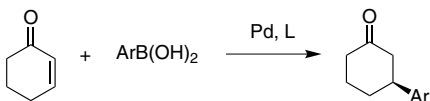
Tech. Note (7)  
 Ref. (8)



Tech. Note (8)  
 Ref. (9)



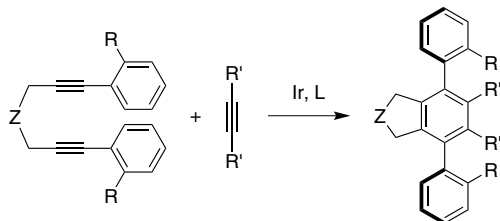
Tech. Note (9)  
 Ref. (10)



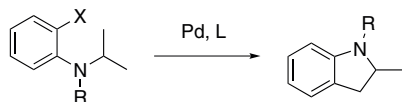
Tech. Note (10)  
 Ref. (11)

# PHOSPHORUS - Ligands and Compounds

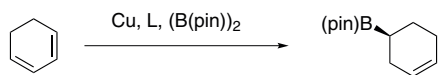
15-0096 (-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene, 98+%  
(continued) (R,R)-Me-DUPHOS (147253-67-6)



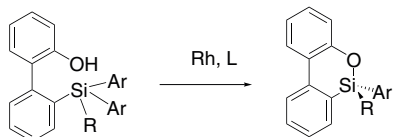
Tech. Note (11)  
Ref. (12)



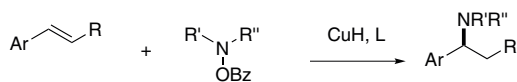
Tech. Note (12)  
Ref. (13)



Tech. Note (13)  
Ref. (14)



Tech. Note (14)  
Ref. (15)



Tech. Note (15)  
Ref. (16)

## References:

- (a) Burk, M.J., *Handbook of Chiral Chemicals*, Abel, Ager, D.J., Ed. (Marcel Dekker, Inc., New York, 1999) Ch 18, p 339. (review). (b) *Acc. Chem. Res.*, **2000**, 33, 363. (review)
- (a) *J. Am. Chem. Soc.*, **1993**, 115, 10125. (b) *J. Am. Chem. Soc.*, **1992**, 114, 6266. (c) *J. Am. Chem. Soc.*, **1996**, 118, 5142. (d) *Tetrahedron Lett.*, **1999**, 40, 6685. (e) *J. Am. Chem. Soc.*, **1995**, 117, 9375.
- J. Am. Chem. Soc.*, **1991**, 113, 8518.
- Org. Lett.*, **1999**, 1, 387.
- J. Org. Chem.*, **1999**, 64, 3290
- J. Am. Chem. Soc.*, **1999**, 121, 4130.
- Angew. Chem. Int. Ed.*, **2000**, 39, 4104.
- J. Am. Chem. Soc.*, **2003**, 125, 1692.
- J. Am. Chem. Soc.*, **2002**, 124, 13356.
- Org. Lett.*, **2005**, 7, 3235.
- Org. Lett.*, **2005**, 7, 5309.
- J. Am. Chem. Soc.*, **2004**, 126, 8382.
- Chem. Commun.*, **2011**, 47, 11483.
- J. Am. Chem. Soc.*, **2010**, 132, 1226.
- J. Am. Chem. Soc.*, **2012**, 134, 16955.
- Angew. Chem. Int. Ed.*, **2013**, 52, 10830.

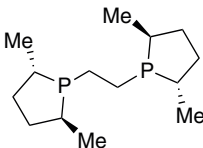
15-0092	(+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)benzene, 98+% (S,S)-Me-DUPHOS (136735-95-0) C <sub>16</sub> H <sub>28</sub> P <sub>2</sub> ; FW: 306.37; white xtl.; m.p. 82-84° <i>air sensitive</i>	100mg 500mg 2g
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## Technical Note:

- See 15-0096 (page 51)

# PHOSPHORUS - Ligands and Compounds

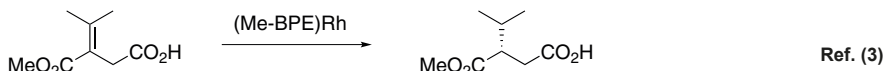
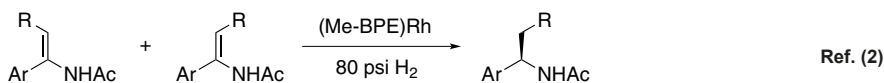
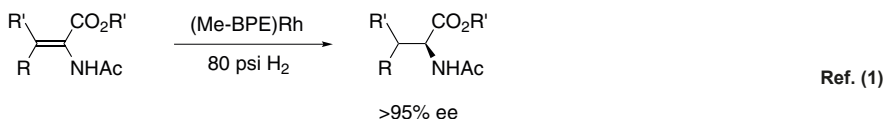
**15-0104** (+)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)ethane, 98+% (R,R)-Me-BPE (129648-07-3)  
 (C<sub>6</sub>H<sub>12</sub>)PCH<sub>2</sub>CH<sub>2</sub>P(C<sub>6</sub>H<sub>12</sub>); FW: 258.33; colorless to pale-yellow liq.; b.p. 64-67°/0.06mm; d. 0.940  
*air sensitive*



100mg  
 500mg  
 2g

## Technical Notes:

- The DUPHOS family of catalysts is highly efficient for the asymmetric hydrogenation of various substituted acetamidoacrylates and enol acetates yielding products of high enantiomeric excesses. Efficient ligand for the asymmetric hydrogenation of tetrasubstituted enamides.<sup>1</sup>
- Silver-catalyzed asymmetric [3+2] cycloaddition reaction.<sup>4</sup>



## References:

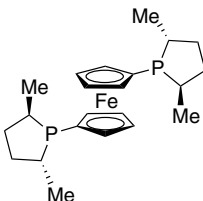
- J. Am. Chem. Soc.*, **1995**, *117*, 9375
- J. Am. Chem. Soc.*, **1996**, *118*, 5142.
- Angew. Chem. Int. Ed.*, **1998**, *37*, 1931.
- J. Am. Chem. Soc.*, **2012**, *134*, 12936.

**15-0105** (-)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)ethane, 98+% (S,S)-Me-BPE (136779-26-5)  
 (C<sub>6</sub>H<sub>12</sub>)PCH<sub>2</sub>CH<sub>2</sub>P(C<sub>6</sub>H<sub>12</sub>); FW: 258.33; colorless to pale-yellow liq.; b.p. 64-67°/0.06mm; d. 0.938  
*air sensitive*

## Technical Note:

- See 15-0104 (page 54)

**26-1618** 1,1'-Bis((2R,5R)-2,5-dimethylphospholano)ferrocene, min. 97% (540475-45-4)  
 C<sub>22</sub>H<sub>32</sub>FeP<sub>2</sub>; FW: 414.28; yellow solid  
*air sensitive*  
 Note: Sold under license from Kanata for research purposes only.



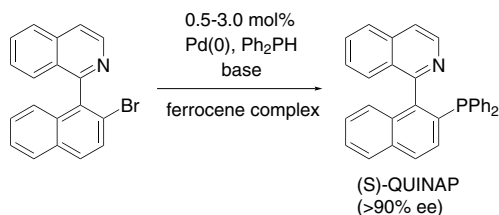
250mg  
 1g

## Technical Notes:

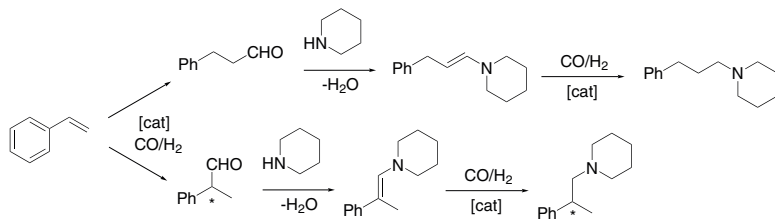
- Ligand for the palladium-catalyzed, atroposelective C–P coupling process for the asymmetric synthesis of QUINAP and its derivatives.
- Ligand for rhodium driven hydroaminomethylation involving styrene and piperidine.

# PHOSPHORUS - Ligands and Compounds

**26-1618** 1,1'-Bis((2R,5R)-2,5-dimethylphospholano)ferrocene, min. 97% (540475-45-4)  
(continued)



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

## References:

1. *J. Am. Chem. Soc.*, **2013**, *135*, 16829.
2. *ACS Catal.*, **2014**, *4*, 435.

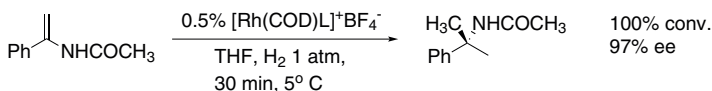
<b>26-1619</b>	<b>1,1'-Bis((2S,5S)-2,5-dimethylphospholano)ferrocene, min. 97%</b> (162412-87-5) C <sub>22</sub> H <sub>32</sub> FeP <sub>2</sub> ; FW: 414.28; yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	250mg 1g
<b>15-0099</b>	<b>Bis(4,6-dimethyl-3-sulfonatophenyl)(2,4-dimethylphenyl)phosphine, disodium salt hydrate, min. 95%</b> <b>TXPDS</b> C <sub>24</sub> H <sub>25</sub> Na <sub>2</sub> O <sub>6</sub> PS <sub>2</sub> ; FW: 550.54; white powdr. Note: Water soluble phosphine.	250mg 1g
<b>15-0094</b>	<b>1,2-Bis(dipentafluorophenyl)phosphino)ethane, 99%</b> (76858-94-1) (C <sub>6</sub> F <sub>5</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> F <sub>5</sub> ) <sub>2</sub> ; FW: 758.26; off-white xtl.; m.p. 188-190°	1g 5g
<b>15-0100</b>	<b>Bis(diphenylphosphino)acetylene, 97%</b> (5112-95-8) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PC≡CP(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 394.39; white xtl.; m.p. 85-87°	1g 5g
<b>15-0110</b>	<b>N,N-Bis(diphenylphosphino)amine, min. 98%</b> (2960-37-4) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PNHP(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 385.38; white xtl.; m.p. 143-145°	1g 5g
<b>15-0402</b>	<b>(S)-(-)-2,2'-Bis(N-diphenylphosphinoamino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl, min. 95%</b> <b>CTH-(S)-BINAM</b> (229177-79-1) C <sub>44</sub> H <sub>42</sub> N <sub>2</sub> P <sub>2</sub> ; FW: 660.77; white solid Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent US 5919981 and patents arising therefrom.	100mg 500mg

## Technical Note:

1. Ligand used in the enantioselective, rhodium-catalyzed hydrogenation of  $\alpha$ -phenylenamides.

# PHOSPHORUS - Ligands and Compounds

**15-0402** (S)-(-)-2,2'-Bis(N-diphenylphosphinoamino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl, (continued) min. 95% CTH-(S)-BINAM (229177-79-1)

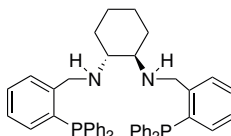


References:

1. *J. Am. Chem. Soc.*, **1998**, *120*, 5808.

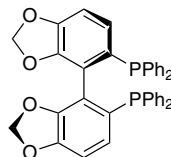
**15-0130** **1,2-Bis(diphenylphosphino)benzene, 98%** (13991-08-7) 1g  
 $\text{o-C}_6\text{H}_4[\text{P}(\text{C}_6\text{H}_5)_2]_2$ ; FW: 446.47; white xtl.; m.p. 185-187° 5g

**15-7325** **(1R,2R)-N,N-Bis[2-(diphenylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%** 250mg  
 (174758-63-5) 1g  
 $\text{C}_{44}\text{H}_{44}\text{N}_2\text{P}_2$ ; FW: 662.78; yellow solid  
*air sensitive*



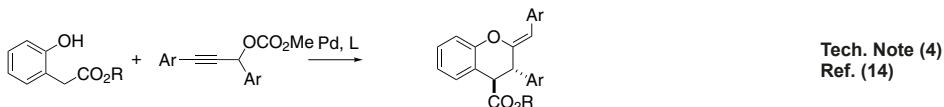
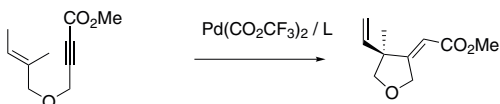
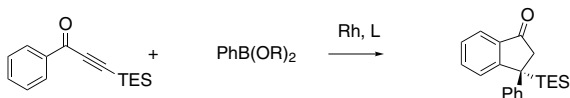
**15-7326** **(1S,2S)-N,N-Bis[2-(diphenylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%** (174677-83-9) 250mg  
 $\text{C}_{44}\text{H}_{44}\text{N}_2\text{P}_2$ ; FW: 662.78; yellow solid  
*air sensitive* 1g

**15-0136** **(R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98%** (R)-(+)-SEGPHOS® 250mg  
 (244261-66-3) 1g  
 $\text{C}_{38}\text{H}_{28}\text{O}_4\text{P}_2$ ; FW: 610.57; off-white powdr.; m.p. 168-172° 5g  
 Note: Manufactured under license of Takasago patent.  
 Takasago SEGPHOS® Ligand Kit component.

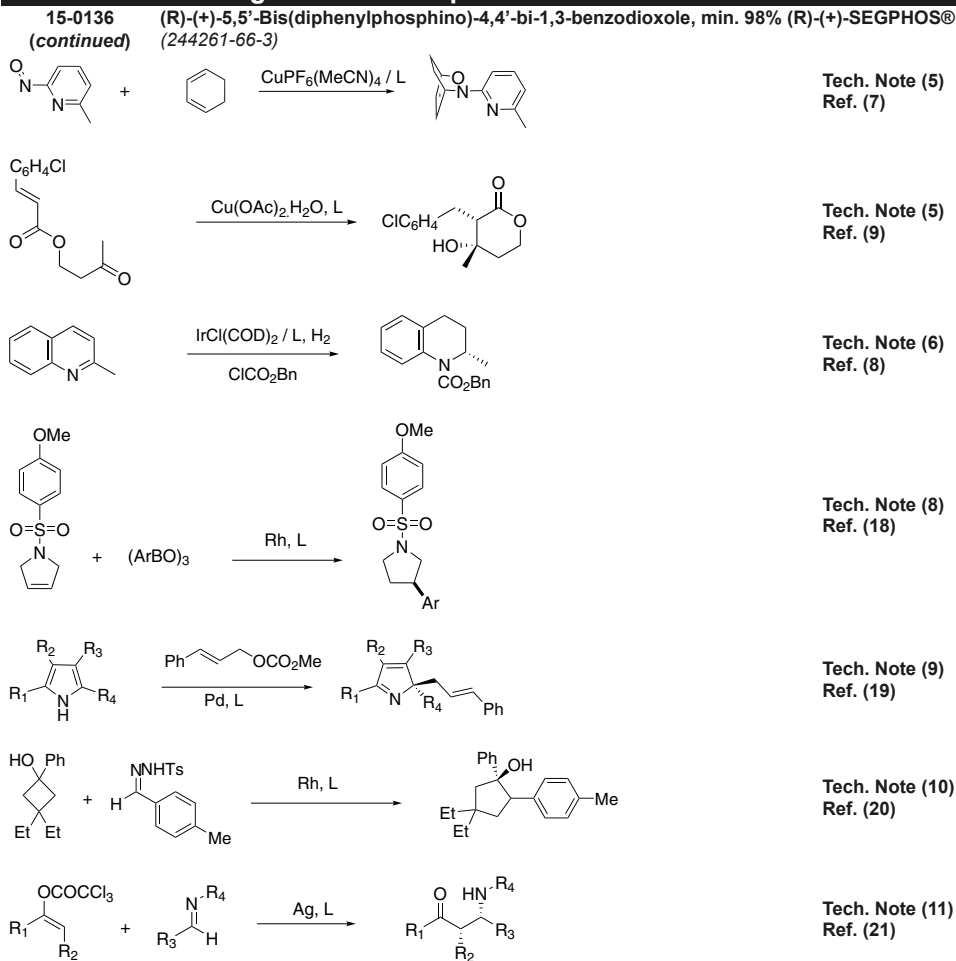


Technical Notes:

- Biaryl bisphosphine ligand with narrow dihedral angle. The SEGPHOS® ligand has been applied to a variety of metal catalyzed reactions. In many cases, yields and enantioselectivities, exceed results obtained earlier using BINAP.<sup>1,2</sup>
- As ruthenium complex, SEGPHOS® generally gives higher levels of chiral induction in asymmetric hydrogenations of  $\alpha,\beta$ , and  $\gamma$ -functionalized ketones. See ruthenium complexes 44-0096, 44-0518, 44-0168.
- Used in Rh-catalyzed transformations such as: (a) 1,4-addition of boronic acids to coumarins, 4 (b) addition of titanium reagents to imines, 6 (c) cotrimerization of alkenes and acetylenes, 10 (d) double [2+2] cycloaddition, 11 (e) indanone formation.<sup>12a,b</sup>
- Used in Pd-catalyzed transformations such as: (a) cycloaddition of 1,6-enyne,<sup>5</sup> (b) arylyative cyclization of allenyl aldehydes with boronic acids,<sup>13</sup> (c) synthesis of chromans.<sup>14</sup>
- Used in Cu-catalyzed transformations such as: (a) nitroso Diels-Alder,<sup>7</sup> (b) reductive aldol condensation,<sup>9</sup> (c) conjugate reduction of unsaturated sulfones,<sup>15</sup> and phosphonates.<sup>16</sup>
- Iridium-catalyzed asymmetric hydrogenation of quinolines activated by chloroformates.<sup>17</sup>
- Iridium-catalyzed asymmetric transfer hydrogenation used in polyketide construction.<sup>17</sup>
- Rhodium-catalyzed asymmetric hydroarylation of 3-pyrrolines.<sup>18</sup>
- Palladium-catalyzed regio- and enantioselective dearomatization of pyrroles to 2H-pyrroles.<sup>19</sup>
- Rhodium-catalyzed asymmetric synthesis of cyclopentanols.<sup>20</sup>
- Silver-catalyzed asymmetric Mannich-type reaction.<sup>21</sup>



# PHOSPHORUS - Ligands and Compounds



## References:

1. *Tetrahedron*, **2005**, *61*, 5405.
1. *Org. Lett.*, **2008**, *10*, 2825.
2. *Topics Organometal. Chem.*, **2004**, *6*, 63.
3. *Org. Lett.*, **2003**, *5*, 5043.
4. *Org. Lett.*, **2005**, *7*, 2285.
5. *Angew. Chem. Int. Ed.*, **2001**, *40*, 249.
6. *Angew. Chem. Int. Ed.*, **2004**, *43*, 6125.
7. *J. Am. Chem. Soc.*, **2004**, *126*, 4128.
8. *Angew. Chem. Int. Ed.*, **2006**, *45*, 2260.
9. *Org. Lett.*, **2005**, *7*, 4225.
10. *Org. Lett.*, **2008**, *10*, 2849.
12. (a) *Angew. Chem. Int. Ed.*, **2007**, *46*, 3735. (b) *Org. Lett.*, **2006**, *8*, 3379.
13. *Org. Lett.*, **2008**, *10*, 1047.
14. *Org. Lett.*, **2009**, *11*, 4752.
15. *Angew. Chem.*, **2007**, *119*, 3393.
16. *Tetrahedron Lett.*, **2009**, *50*, 6720.
17. *J. Am. Chem. Soc.*, **2011**, *133*, 12795.
18. *J. Am. Chem. Soc.*, **2013**, *135*, 10990.
19. *J. Am. Chem. Soc.*, **2014**, *136*, 6590.
20. *J. Am. Chem. Soc.*, **2014**, *136*, 7217.
21. *Org. Lett.*, **2014**, *16*, 86.

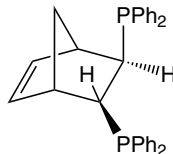
# PHOSPHORUS - Ligands and Compounds

**15-0137** (S)-(-)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% 250mg  
 (S)-(-)-SEGPHOS® (210169-54-3) 1g  
 $C_{38}H_{28}O_4P_2$ ; FW: 610.57; off-white powder; m.p. 168-172° 5g  
 Note: Manufactured under license of Takasago patent. Takasago  
 SEGPHOS® Ligand Kit component.

Technical Note:

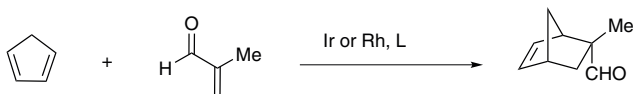
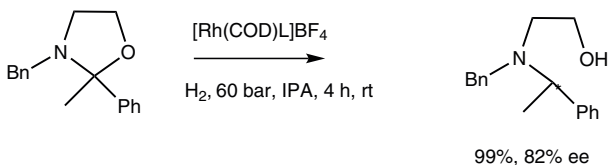
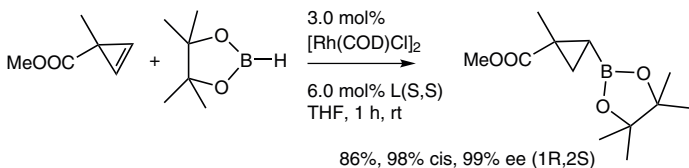
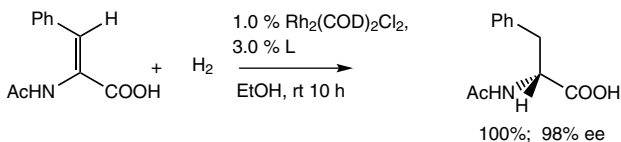
1. See 15-0136 (page 56)

**15-0140** (2R,3R)-(-)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% 250mg  
 (R,R)-NORPHOS (71042-55-2) 1g  
 $C_{31}H_{28}P_2$ ; FW: 462.51; white xtl.; m.p. 116-119°  
*air sensitive*



Technical Notes:

1. Ligand used in the enantioselective rhodium catalyzed hydrogenation of  $\alpha$ -dehydroaminoesters and enamides.
2. Ligand used in the enantioselective rhodium catalyzed hydroboration of cyclopropenes.
3. Ligand used in the asymmetric rhodium catalyzed cleavage of racemic 1,3-oxazolidines.
4. Iridium or Rhodium-catalyzed asymmetric Diels-Alder reaction.<sup>4</sup>



References:

1. *Angew. Chem.*, **1979**, *91*, 655.
2. *J. Am. Chem. Soc.*, **2003**, *125*, 7198.
3. *Adv. Synth. Catal.*, **2003**, *345*, 239.
4. *Organometallics*, **2011**, *30*, 6661.

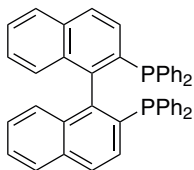
**15-0141** (2S,3S)-(+)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% 250mg  
 (S,S)-NORPHOS (71042-54-1) 1g  
 $C_{31}H_{28}P_2$ ; FW: 462.51; white xtl.; m.p. 112-115°  
*air sensitive*

Technical Note:

1. See 15-0140 (page 58)

# PHOSPHORUS - Ligands and Compounds

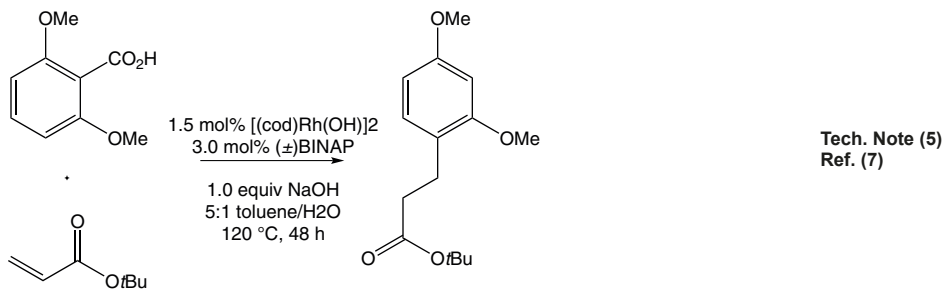
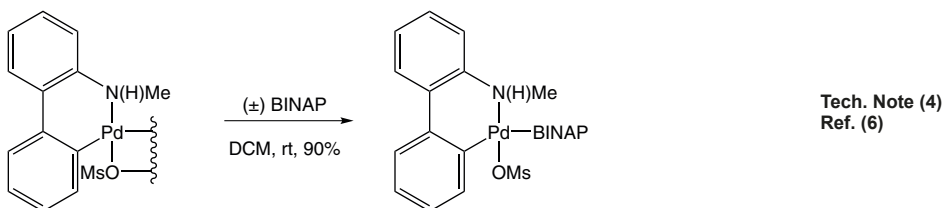
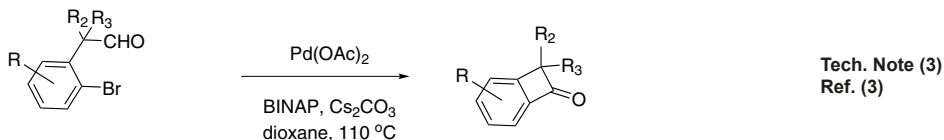
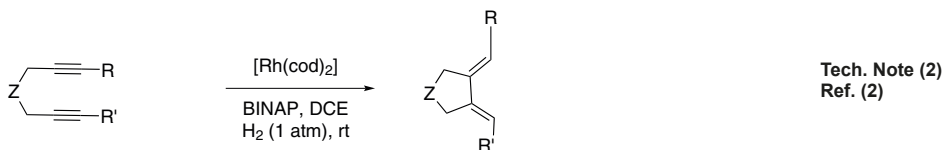
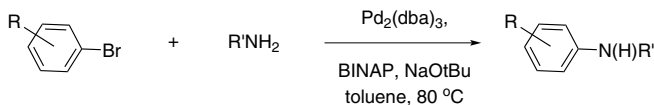
**15-0433** racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP  
(98327-87-8)  
C<sub>44</sub>H<sub>32</sub>P<sub>2</sub>; FW: 622.70; white to light-yellow xtl.  
Note: Phosphine Ligand Kit component.



1g  
5g  
25g  
100g

## Technical Notes:

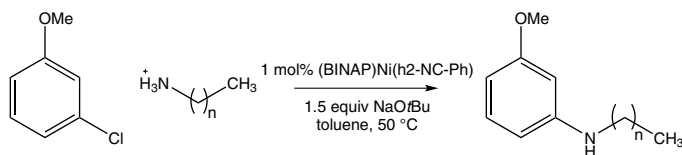
- Useful ligand for palladium-catalyzed carbon-nitrogen bond formation.
- Useful ligand for rhodium-catalyzed C-C bond formation.
- Useful ligand for palladium-catalyzed intramolecular acylation of aryl bromides via C-H activation.
- Used in the preparation of Buchwald third generation precatalyst.
- Used in methoxy directed Rhodium migration.
- Used in Nickel catalyzed C-N cross-coupling reactions.





# PHOSPHORUS - Ligands and Compounds

**15-0433** racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP (98327-87-8)  
(continued)

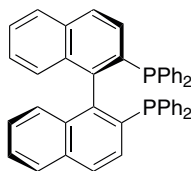


**Tech. Note (6)**  
**Ref. (8)**

## References:

1. *J. Org. Chem.*, **2000**, *65*, 1144.
2. *Acc. Chem. Rec.*, **1998**, *31*, 805. (review article)
3. *Chem. Rev.*, **2003**, *3*, 169. (review article)
4. *J. Am. Chem. Soc.*, **2004**, *126*, 7875.
5. *J. Am. Chem. Soc.*, **2010**, *132*, 466.
6. *J. Org. Chem.*, **2014**, *79*, 4161.
7. *J. Am. Chem. Soc.*, **2013**, *135*, 17270.
8. *J. Am. Chem. Soc.*, **2014**, *136*, 1617.

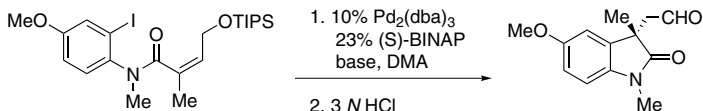
**15-0150** (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)  
C<sub>44</sub>H<sub>32</sub>P<sub>2</sub>; FW: 622.70; white to off-white powdr.; m.p. 240.5-242°  
Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component.



250mg  
1g  
5g

## Technical Notes:

1. (R)-BINAP or (R)-Tol-BINAP can be combined with dichloro(1,5-cyclooctadiene)ruthenium to form precursors to NOYORI CATALYST SYSTEMS. These systems exhibit very high catalytic activity and enantioselectivity in the hydrogenation of a wide range of substrates. NOYORI CATALYST SYSTEMS have been shown to effect highly enantioselective hydrogenation of functionalized ketones where the substituents are dialkylamino, hydroxy, siloxy, carbonyl, ester, amide or thioester.
2. Useful ligand in asymmetric Heck processes.
3. Ligand employed in palladium-catalyzed asymmetric arylation of ketones.
4. Ligand employed in rhodium-catalyzed 1,4-additions to enones.
5. Ligand employed in palladium-catalyzed hydroamination of styrene derivatives.
6. Ligand employed in silver-catalyzed asymmetric Sakuri-Hosomi allylation and Mukaiyama aldol reaction.
7. Ligand employed in rhodium-catalyzed kinetic resolution of enynes.
8. Ligand employed in asymmetric rhodium-catalyzed hydroboration of cyclopropenes.
9. Ligand employed in silver-catalyzed α-hydroxylation of stannyl enol ethers.
10. Ligand employed in palladium-catalyzed synthesis of chiral allenes.
11. Ligand for palladium-catalyzed enantioselective hetero Michael addition to form β-amino acid derivatives.
12. Ligand employed in rhodium-catalyzed asymmetric rearrangement of alkynyl alkenyl carbinols.
13. Ligand employed in rhodium-catalyzed 1,2-addition of aluminium organyl compounds to cyclic enones.
14. Ligand employed in iridium-catalyzed transfer hydrogenative allylation of benzylic alcohols.
15. Ligand employed in rhodium-catalyzed asymmetric C-Si bond formation by conjugate silyl transfer using a Si-B linkage.
16. Ligand employed in the iridium-catalyzed asymmetric cyclopropane-mediated carbonyl allylation of primary alcohols.
17. Ligand employed in the nickel-catalyzed asymmetric α-arylation of tetralones.
18. Ligand employed in the copper-catalyzed asymmetric propargylation of ketones.
19. Ligand employed in the cobalt-catalyzed asymmetric reductive coupling of alkynes with alkenes.
20. Ligand employed in the rhodium-catalyzed asymmetric 1,4-addition of arylalanes on trisubstituted enones.
21. Ruthenium-catalyzed asymmetric hydrocyanation of imines.
22. Palladium-catalyzed asymmetric intermolecular cyclization.

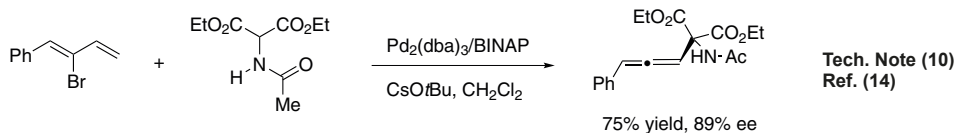
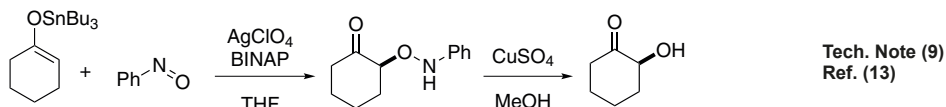
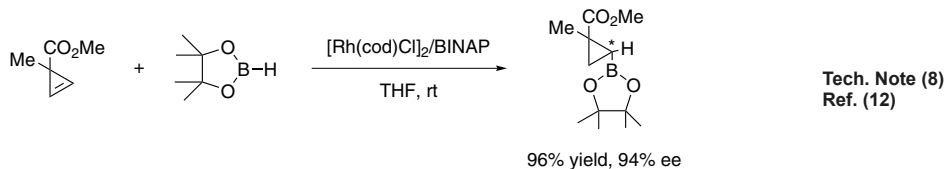
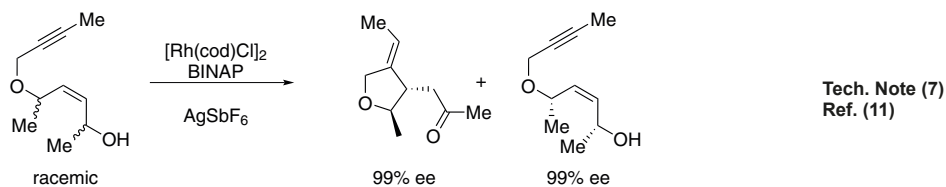
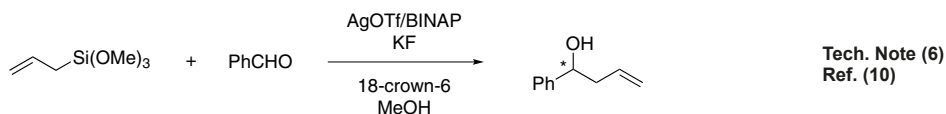
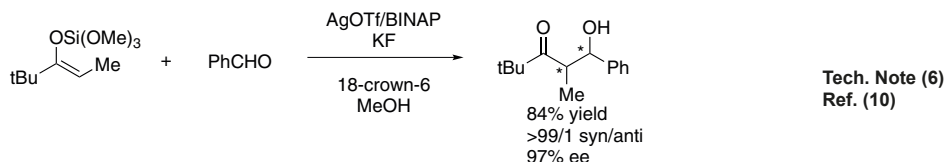
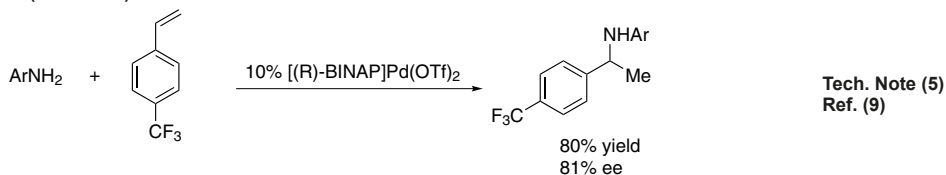


**Tech. Note (2)**  
**Ref. (5)**

# PHOSPHORUS - Ligands and Compounds

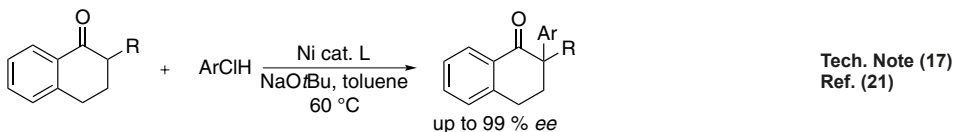
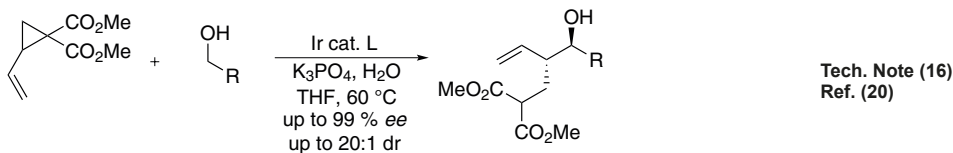
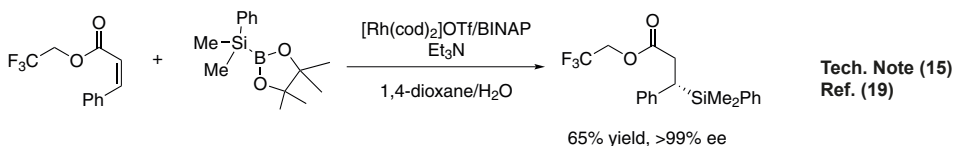
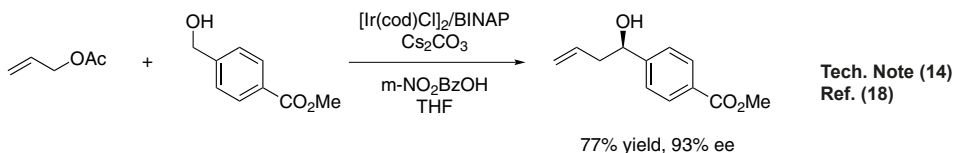
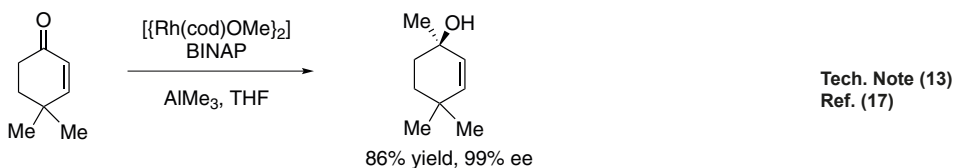
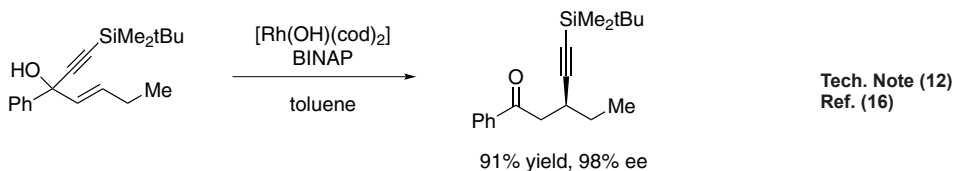
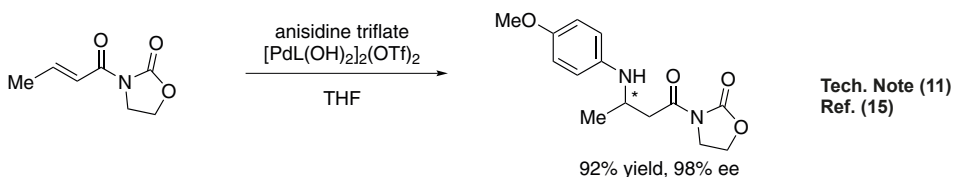
15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)

(continued)



# PHOSPHORUS - Ligands and Compounds

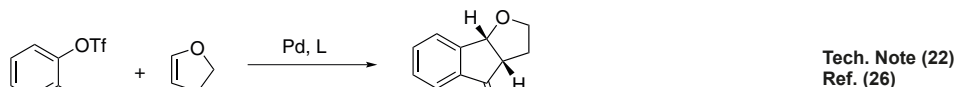
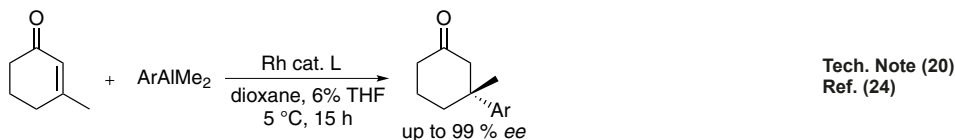
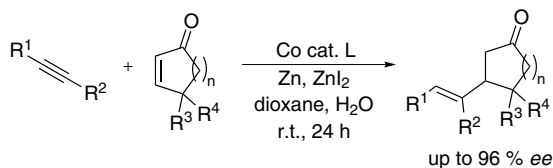
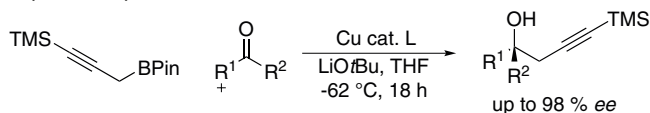
15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)  
(continued)



# PHOSPHORUS - Ligands and Compounds

15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)

(continued)



## References:

1. *CHEMTECH*, **1992**, 360.
2. *Asymmetric Catalysis in Organic Synthesis*, **1993**, 61.
3. *J. Am. Chem. Soc.*, **1988**, *110*, 629.
4. *Science*, **1990**, *248*, 1194.
5. *J. Am. Chem. Soc.*, **1998**, *120*, 6477.
6. *Encyclopedia of Reagents for Organic Synthesis*, **1995**, Vol. 1, 509.
7. *J. Am. Chem. Soc.*, **1998**, *120*, 1918.
8. *J. Am. Chem. Soc.*, **1998**, *120*, 5579.
9. *J. Am. Chem. Soc.*, **2000**, *122*, 9547.
10. *J. Org. Chem.*, **2003**, *68*, 5593.
11. *J. Am. Chem. Soc.*, **2003**, *125*, 11472.
12. *J. Am. Chem. Soc.*, **2003**, *125*, 7198.
13. *J. Am. Chem. Soc.*, **2003**, *125*, 6038.
14. *J. Am. Chem. Soc.*, **2001**, *123*, 2089.
15. US Patent Application US2006/0205968.
16. *J. Am. Chem. Soc.*, **2007**, *129*, 14158.
17. *Angew. Chem. Int. Ed.*, **2007**, *46*, 7122.
18. *J. Am. Chem. Soc.*, **2008**, *130*, 14891.
19. *Angew. Chem. Int. Ed.*, **2008**, *47*, 3818.
20. *J. Am. Chem. Soc.*, **2011**, *133*, 18618.
21. *J. Am. Chem. Soc.*, **2011**, *133*, 16330.
22. *J. Am. Chem. Soc.*, **2011**, *133*, 10332.
23. *J. Am. Chem. Soc.*, **2011**, *133*, 6942.
24. *Angew. Chem. Int. Ed.*, **2010**, *49*, 7769.
25. *Org. Lett.*, **2012**, *14*, 882.
26. *Angew. Chem., Int. Ed.*, **2013**, *52*, 8676.

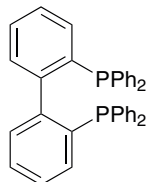
# PHOSPHORUS - Ligands and Compounds

<b>15-0151</b>	<b>(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98%</b> <b>(S)-(-)-BINAP (76189-56-5)</b> C <sub>44</sub> H <sub>32</sub> P <sub>2</sub> ; FW: 622.70; white to off-white powdr.; m.p. 241-242° Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component.	250mg 1g 5g
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Technical Note:

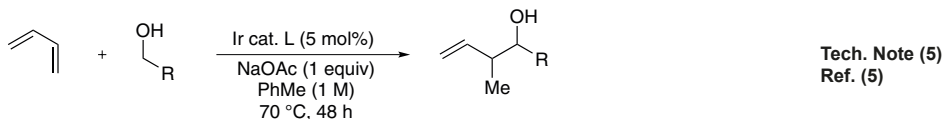
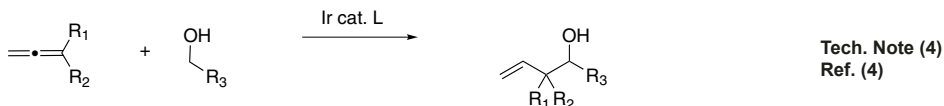
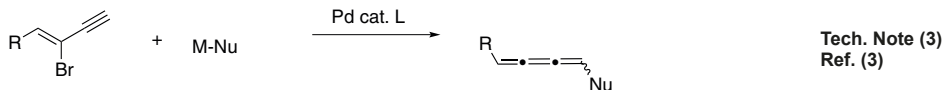
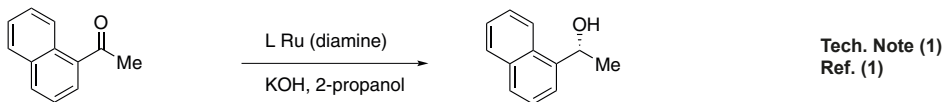
1. See 15-0150 (page 60)

<b>15-0145</b>	<b>2,2'-Bis(diphenylphosphino)-1,1'- biphenyl, 98%</b> <b>BIPHEP (84783-64-2)</b> C <sub>36</sub> H <sub>28</sub> P <sub>2</sub> ; FW: 522.57; white xtl.; m.p. 210-214°	250mg 1g 5g
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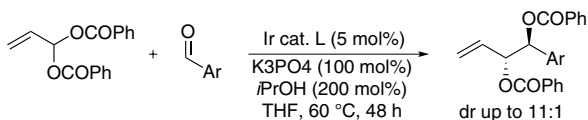
Technical Notes:

1. Supporting ligand in a chiral diamine-ruthenium system for the enantioselective hydrogenation of ketones.
2. Useful ligand for palladium-catalyzed amination and Kumada cross-coupling reactions
3. Useful ligand for palladium-catalyzed synthesis of butatrienes.
4. Useful ligand for iridium-catalyzed C-C cross-coupling of allenes with primary alcohols via transfer hydrogenation.
5. Useful ligand for iridium-catalyzed C-C cross-coupling of dienes with primary alcohols via transfer hydrogenation.
6. Useful ligand for iridium-catalyzed C-C cross-coupling of allylic gem-dicarboxylates with aldehydes via transfer hydrogenation.
7. Useful ligand for the palladium-catalyzed synthesis of chiral allenylsilanes.
8. Ruthenium-catalyzed synthesis of indoles.
9. Ruthenium-catalyzed oxidative cyclization.
10. Rhodium-catalyzed boron arylation.

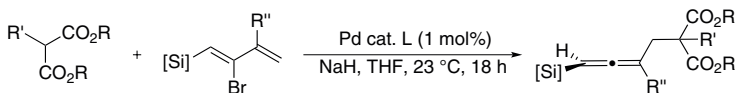


# PHOSPHORUS - Ligands and Compounds

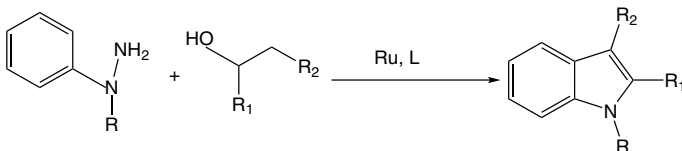
**15-0145** 2,2'-Bis(diphenylphosphino)-1,1'-biphenyl, 98% BIPHEP (84783-64-2)  
(continued)



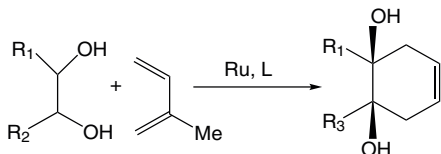
Tech. Note (6)  
Ref. (6)



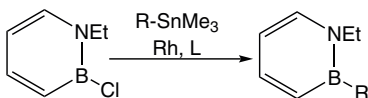
Tech. Note (7)  
Ref. (7)



Tech. Note (8)  
Ref. (8)



Tech. Note (9)  
Ref. (9)



Tech. Note (10)  
Ref. (10)

## References:

1. *Angew. Chem. Int. Ed.*, **1999**, 38, 495.
2. *Organometallics*, **2000**, 19, 1567.
3. *Chem. Lett.*, **2000**, 776.
4. *J. Am. Chem. Soc.*, **2007**, 129, 15134.
5. *Adv. Synth. Catal.*, **2010**, 352, 2416.
6. *J. Am. Chem. Soc.*, **2010**, 132, 1760.
7. *Org. Lett.*, **2010**, 12, 5736.
8. *Org. Lett.*, **2012**, 14, 6112.
9. *J. Am. Chem. Soc.*, **2013**, 135, 3796.
10. *Angew. Chem. Int. Ed.*, **2013**, 52, 9316.

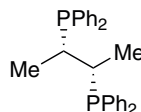
**15-0160** (2S,3S)-(-)-Bis(diphenylphosphino)butane

(S,S)-CHIRAPHOS (64896-28-2)

(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>PCH(CH<sub>3</sub>)CH(CH<sub>3</sub>)P(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>; FW: 426.48; white

xtl.; m.p. 108-109°

air sensitive



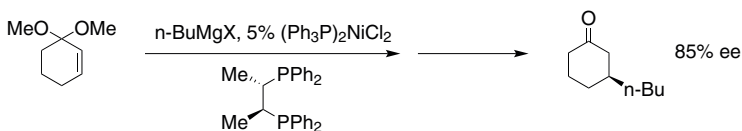
250mg

1g

5g

## Technical Note:

1. Useful as a ligand in the Ni-catalyzed asymmetric additions to allylic ketals.

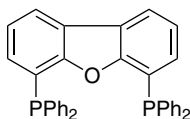


## References:

1. *J. Am. Chem. Soc.*, **1998**, 120, 7649.

## PHOSPHORUS - Ligands and Compounds

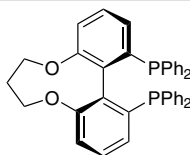
15-0170	<b>1,4-Bis(diphenylphosphino)butane, 98% DPPB (7688-25-7)</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 426.48; white xtl.; m.p. 132-134°	2g 10g 50g
15-0183	<b>4,6-Bis(diphenylphosphino) dibenzofuran, 98% DBFphos</b> (133850-81-4) C <sub>36</sub> H <sub>26</sub> OP <sub>2</sub> ; FW: 536.54; white powdr.	100mg 500mg 2g
15-0176	<b>(S)-(+)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxonin, 95% (S)-C<sub>3</sub>-TUNEPHOS (486429-99-6)</b> C <sub>39</sub> H <sub>32</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 594.62; white powdr. <i>air sensitive</i> Note: Sold in collaboration with Chiral Quest for research purposes only. US Patent No. 6,521,769; additional patents pending. Chiral Quest Catalyst and Ligand Toolbox Kit component.	100mg 500mg



### Technical Note:

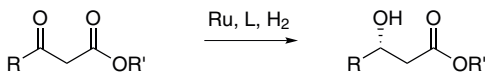
- See 15-0175 (page 66)

15-0175	<b>R-(-)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxonin, 97% (R)-C<sub>3</sub>-TUNEPHOS (301847-89-2)</b> C <sub>39</sub> H <sub>32</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 594.62; white powdr. <i>air sensitive</i> Note: Sold in collaboration with Chiral Quest for research purposes only. US Patent No. 6,521,769; additional patents pending. Chiral Quest Catalyst and Ligand Toolbox Kit component.	100mg 500mg
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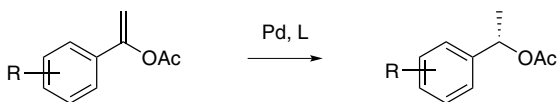


### Technical Notes:

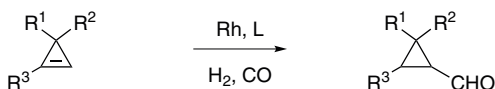
- New generation of chiral biaryl phosphine ligands with tunable dihedral angles. The ability to modify the dihedral angle allows for the fine tuning of the catalyst system and optimization of enantioselectivity.
- Ru-C<sub>3</sub>-TUNEPHOS complexes are used for asymmetric hydrogenation of β-ketoesters<sup>1</sup>, enol acetates<sup>2</sup>, cyclic β-amino acids<sup>3</sup>, α-phthalimide ketones<sup>4</sup>, and α-keto esters<sup>5</sup>.
- Rh-catalyzed hydroformylation of cyclopropenes.



Tech. Note (2)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



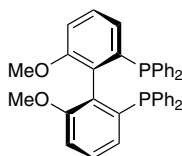
Tech. Note (3)  
Ref. (6)

### References:

- J. Org. Chem.*, **2000**, 65, 6223.
- Org. Lett.*, **2002**, 4, 4495.
- J. Am. Chem. Soc.*, **2003**, 125, 9570.
- J. Am. Chem. Soc.*, **2004**, 126, 1626.
- Synlett.*, **2006**, 126, 1169.
- J. Am. Chem. Soc.*, **2008**, 130, 13804.

# PHOSPHORUS - Ligands and Compounds

**15-0178** (R)-(+)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (R)-MeO-BIPHEP (133545-16-1)  
 $C_{38}H_{32}O_2P_2$ ; FW: 582.53; off-white xtl.  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO-BIPHEP Ligand Kit component.

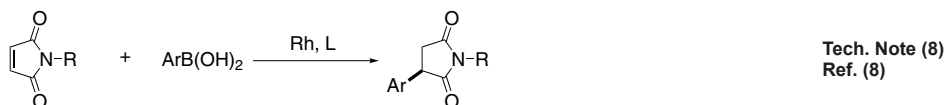
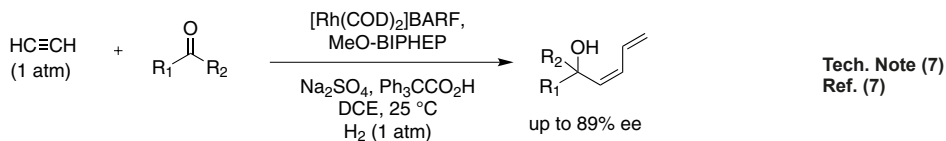
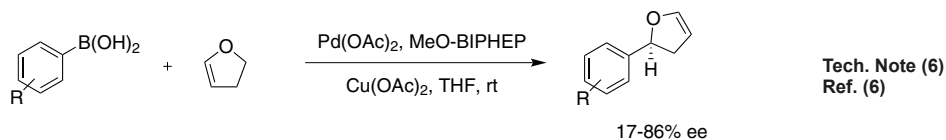
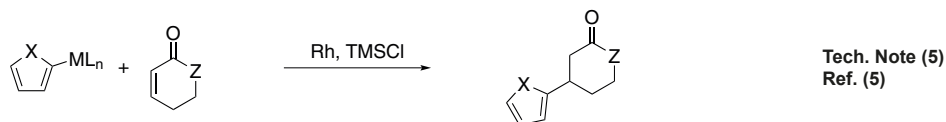
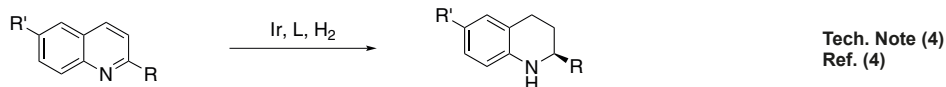
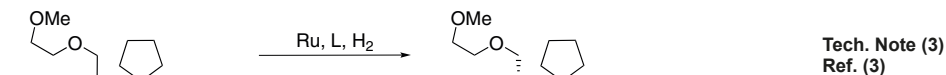


100mg  
 500mg  
 2g  
 10g

In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR<sub>2</sub> group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions

Technical Notes:

1. See 15-0042.
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
5. Conjugate addition using 2-heteroaryl titanates and zinc reagents.
6. Enantio- and regioselective heck-type reaction of aryl boronic acids with 2,3-dihydrofuran
7. Rhodium-catalyzed carbonyl Z-dienylation.
8. Rhodium-catalyzed asymmetric 1,4 addition of arylboronic acids to maleimides and enones.



References:

1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Dev.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. *J. Org. Chem.*, **2007**, 72, 3875.
7. *J. Am. Chem. Soc.*, **2006**, 128, 16040.
8. *J. Org. Chem.*, **2011**, 76, 6925.

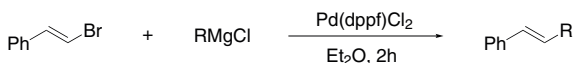


# PHOSPHORUS - Ligands and Compounds

<b>15-0179</b>	<b>(S)-(-)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</b> <b>(S)-MeO-BIPHEP (133545-17-2)</b> $C_{38}H_{32}O_2P_2$ ; FW: 582.53; white xtl. Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component.	100mg 500mg 2g 10g
Technical Note: 1. See 15-0178 (page 67)		
<b>15-0200</b>	<b>1,2-Bis(diphenylphosphino)ethane, 99% DIPHOS (1663-45-2)</b> $(C_6H_5)_2PCH_2CH_2P(C_6H_5)_2$ ; FW: 398.43; white pwdr.; m.p. 143-145°	5g 25g 100g
<b>15-0205</b>	<b>1,2-Bis(diphenylphosphino)ethane monooxide, min. 97% (984-43-0)</b> $(C_6H_5)_2PCH_2CH_2P(O)(C_6H_5)_2$ ; FW: 414.42; white pwdr.	1g 5g
<b>15-7306</b>	<b>Bis[(2-diphenylphosphino)ethyl] ammonium chloride, min. 97%</b> <b>(66534-97-2)</b> $C_{28}H_{30}ClNP_2$ ; FW: 477.95; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WQ2004096735.	500mg 2g
<b>15-0250</b>	<b>cis-1,2-Bis(diphenylphosphino)ethylene, min. 98% (983-80-2)</b> cis- $(C_6H_5)_2PCH=CHP(C_6H_5)_2$ ; FW: 396.41; white xtl.; m.p. 125-126°	1g 5g
<b>15-0383</b> <b>NEW</b>	<b>[Bis(2-diphenylphosphino)ethyl] ether, min. 98% (50595-38-5)</b> $C_{28}H_{28}OP_2$ ; FW: 442.47; pale yellow oil <i>air sensitive</i>	1g 5g 25g
<b>15-0350</b>	<b>Bis(2-diphenylphosphino-ethyl)phenylphosphine, 97% TRIPHOS (23582-02-7)</b> $(C_6H_5)_2PCH_2CH_2P(C_6H_5)CH_2CH_2P(C_6H_5)_2$ ; FW: 534.56; white pwdr.; m.p. 130-134°	1g 5g
<b>26-0270</b>	<b>1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF (12150-46-8)</b> $(C_6H_5)_2PC_5H_4FeC_5H_4P(C_6H_5)_2$ ; FW: 554.39; yellow to orange xtl.; m.p. 180° Note: Phosphine Ligand Kit component. 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit component.	1g 5g 25g 250g

## Technical Notes:

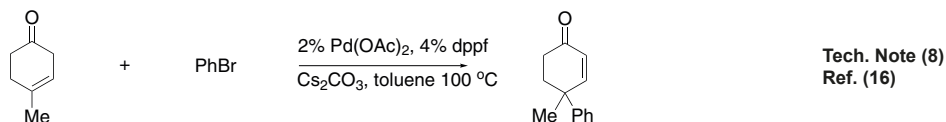
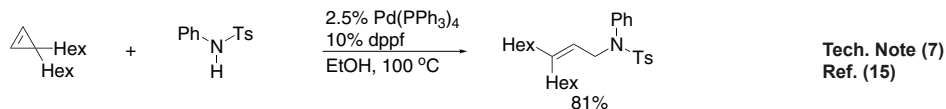
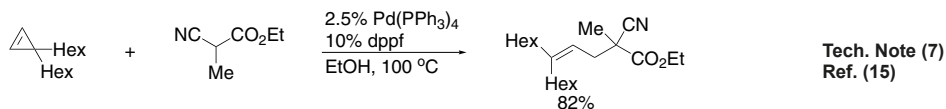
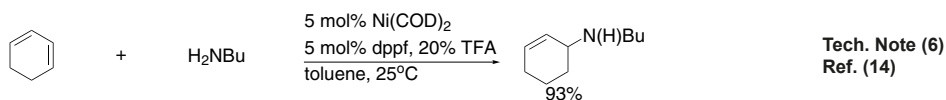
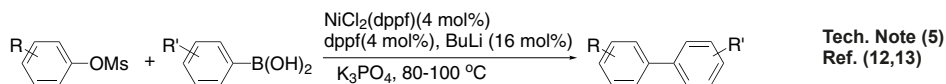
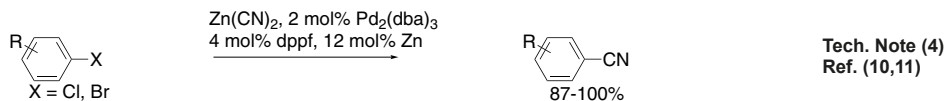
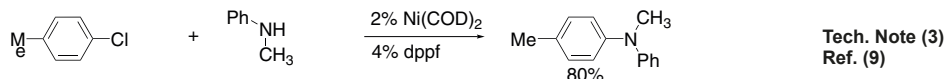
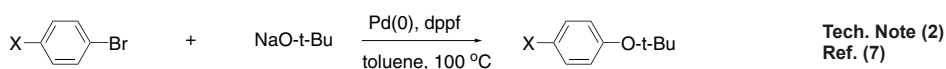
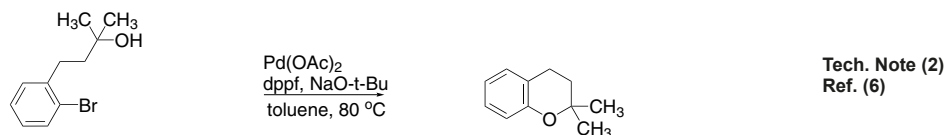
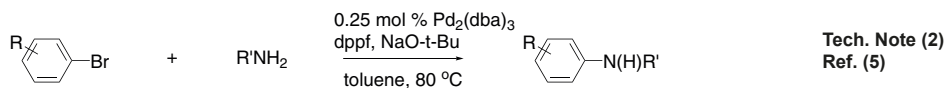
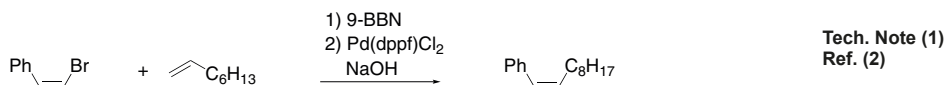
- Ligand for Pd-catalyzed cross-coupling.
- Useful ligand for Pd-catalyzed carbon-nitrogen and carbon-oxygen bond forming procedures.
- Ligand for Ni-catalyzed amination of aryl chlorides.
- Ligand for Pd-catalyzed conversion of aryl halides to aryl nitriles.
- Ligand for Ni-catalyzed Suzuki reactions.
- Ni-catalyzed hydroamination of 1,3-dienes.
- Pd-catalyzed hydrocarbonylation and hydroamination of 3,3-dihexylcyclopropene.
- Pd-catalyzed  $\gamma$ -arylation of  $\beta,\gamma$ -unsaturated ketones.
- Ligand for Ru-catalyzed reduction of nitriles to primary amines.
- Ligand for Rh-catalyzed alkyne head-to-tail dimerization.
- Ligand for Rh-catalyzed cross-coupling (Ref. 21).
- Ligand for Rh-catalyzed olefin isomerization (Ref. 22).
- Ligand for Ni or Rh-catalyzed borylation (Ref. 23, 24)
- Ligand for regioselective Pd-catalyzed hydrophosphinylation of terminal alkynes to form branched alkenes.



Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

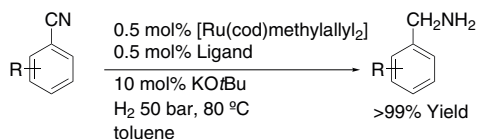
26-0270 1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF (12150-46-8)  
(continued)



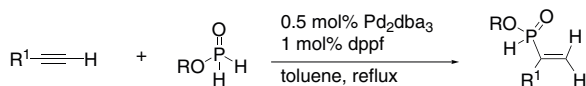
# PHOSPHORUS - Ligands and Compounds

26-0270 1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF (12150-46-8)

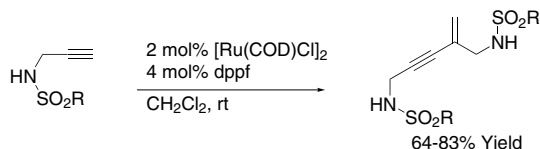
(continued)



Tech. Note (9)  
Ref. (18)



Tech. Note (10)  
Ref. (20)



Tech. Note (14)  
Ref. (25)

## References:

1. *Pure Appl. Chem.*, **1980**, 52, 669.
2. *J. Am. Chem. Soc.*, **1989**, 111, 314.
3. *Palladium Reagents in Organic Synthesis (R.F. Heck)*, **1985**, Chapter 6.
4. *Comprehensive Organic Synthesis*, **1991**, Vol. 3, Chapter 2.
5. *Acc. Chem. Res.*, **1998**, 31, 852. (review)
6. *J. Am. Chem. Soc.*, **1996**, 118, 10333.
7. *J. Am. Chem. Soc.*, **1996**, 118, 13109.
8. *Encyclopedia of Reagents for Organic Synthesis*, **1995**, Vol. 1, 518.
9. *J. Am. Chem. Soc.*, **1997**, 119, 6054.
10. *Tetrahedron Lett.*, **2000**, 41, 3271. (for ArCl)
11. *Tetrahedron Lett.*, **1999**, 40, 8193. (for ArBr)
12. *Tetrahedron Lett.*, **1998**, 54, 13079.
13. *J. Org. Chem.*, **1995**, 60, 1060.
14. *J. Am. Chem. Soc.*, **2002**, 124, 3669.
15. *J. Org. Chem.*, **2003**, 68, 2297.
16. *Angew. Chem. Int. Ed.*, **2008**, 47, 177.
17. *Coordination Chem. Rev.*, **2007**, 251, 2017. (review)
18. *Chem. Eur. J.*, **2008**, 14, 9491.
19. *Dalton T.*, **2009**, 36, 4926.
20. *Adv. Synth. Catal.*, **2009**, 9, 1371.
21. *J. Org. Chem.*, **2009**, 74, 2794.
22. *J. Am. Chem. Soc.*, **2009**, 131, 10822.
23. *J. Am. Chem. Soc.*, **2012**, 134, 115.
24. *J. Am. Chem. Soc.*, **2010**, 132, 1800.
25. *J. Organomet. Chem.*, **2011**, 1, 106.

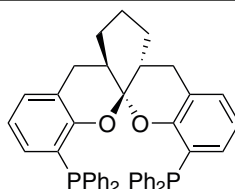
15-4310

(+)-1,13-Bis(diphenyl)phosphino-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano [3,2-d] xanthene, 97% (R,R,R)-(+)-Ph-SKP (1360823-43-3)

C<sub>44</sub>H<sub>38</sub>O<sub>2</sub>P<sub>2</sub>; FW: 660.72; white solid; m.p. 101-103°

air sensitive

Note: Sold in collaboration with SIOC for research purposes only. Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.



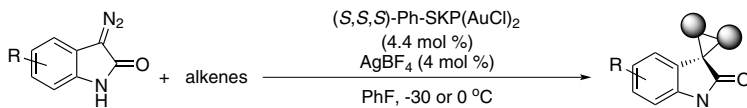
25mg  
100mg

# PHOSPHORUS - Ligands and Compounds

**15-4310** (+)-1,13-Bis(diphenyl)phosphino-(5aR,8aR,14aR)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano [3,2-d]xanthene, 97% (R,R,R)-(+)-Ph-SKP (1360823-43-3)

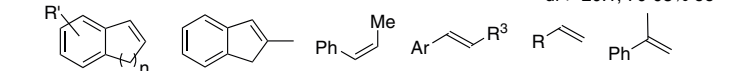
## Technical Notes:

- Efficient ligand for the Au(I)-catalyzed, highly stereoselective, olefin cyclopropanation of diazooindoles.
- Palladium-catalyzed asymmetric allylic amination of Morita-Baylis-Hillman adducts. Exceptionally high efficiency and new mechanism.
- See also 15-4320.

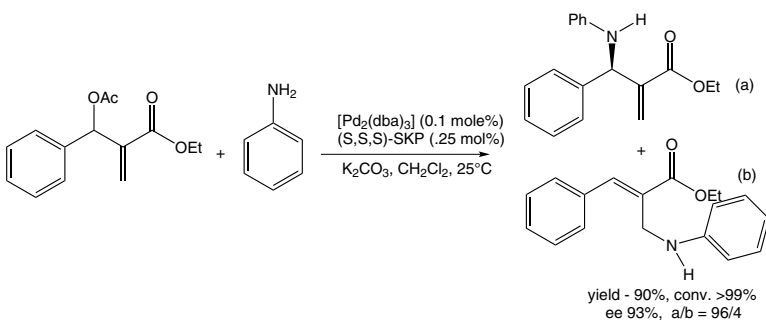


**Tech. Note (1)**  
**Ref. (1)**

### Alkene profiles



32 examples, 18-98% yield  
dr > 20:1, 70-95% ee



**Tech. Note (2)**  
**Ref. (2)**

yield - 90%, conv. >99%  
ee 93%, a/b = 96/4

## References:

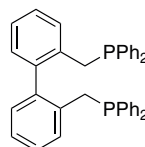
- J. Am. Chem. Soc.*, **2013**, *135*, 8197.
- J. Am. Chem. Soc.*, **2014**, *136*, 405.
- Angew. Chem., Int. Ed.* **2012**, *51*, 936.

<b>15-4311</b>	(-)-1,13-Bis(diphenyl)phosphino-(5aS,8aS,14aS)-5a,6,7,8,8a,9-hexahydro-5H-[1]benzopyrano [3,2-d]xanthene, 97% (S,S,S)-(-)-Ph-SKP (1439556-82-7) C <sub>44</sub> H <sub>38</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 660.72; white solid; m.p. 101-103° <i>air sensitive</i> Note: Sold in collaboration with SIOC for research purposes only. Patents PCT/CN2013/071091, CN202110253896.5. SKP Ligand Kit component.	25mg 100mg
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## Technical Note:

- See 15-4310 (page 70)

<b>15-0400</b>	<b>Bis(diphenylphosphino)methane, 97%</b> (2071-20-7) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 384.40; white xtl.; m.p. 116-119°	1g 5g 25g
<b>15-2988</b>	<b>2,2'-Bis(diphenylphosphinomethyl)-1,1'-biphenyl, 99%</b> <b>BISBI</b> (111982-81-1) C <sub>38</sub> H <sub>32</sub> P <sub>2</sub> ; FW: 550.61; white solid; m.p. 84-86° <i>air sensitive</i>	250mg 1g

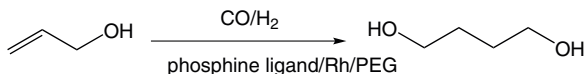


# PHOSPHORUS - Ligands and Compounds

**15-2988** 2,2'-Bis(diphenylphosphinomethyl)-1,1'-biphenyl, 99% BISBI (111982-81-1)  
(continued)

## Technical Note:

- Ligand/rhodium complex used in the high chemo and regioselective formation of alcohols from the hydrocarbonylation of alkenes using cooperative ligand effects.

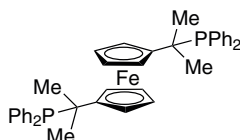


**Tech. Note (1)**  
**Ref. (1)**

## References:

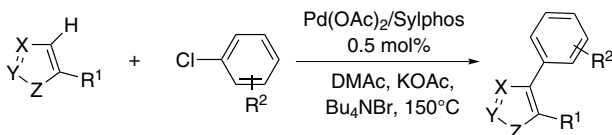
- Chem. Commun.*, **2010**, 46, 2194.

<b>15-2970</b>	<b>(4R,5R)-(-)-4,5-Bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane, 99.5% (R,R)-DIOP (32305-98-9)</b> C <sub>31</sub> H <sub>32</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 498.55; white powder; m.p. 87-91° <i>air sensitive</i>	250mg 1g
<b>15-2960</b>	<b>(4S,5S)-(+)-4,5-Bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane, 99.5% (S,S)-DIOP (37002-48-5)</b> C <sub>31</sub> H <sub>32</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 498.55; white powder; m.p. 87-91° <i>air sensitive</i>	250mg 1g
<b>26-0290</b>	<b>1,1'-Bis(1-diphenylphosphino-1-methylethyl)ferrocene ethanol adduct, 97% HiersoPHOS-6 (Sylphos) (109313-83-9)</b> C <sub>40</sub> H <sub>40</sub> FeP <sub>2</sub> ·CH <sub>3</sub> CH <sub>2</sub> OH; FW: 638.54 (684.61); orange solid	100mg 500mg



## Technical Note:

- Ligand used in the palladium-catalyzed direct arylation of heteroaromatics with activated aryl chlorides.

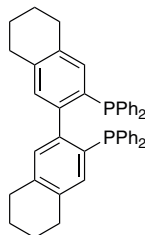
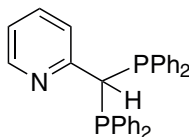


**Tech. Note (1)**  
**Ref. (1)**

## References:

- ACS Catalysis*, **2012**, 21, 1033

<b>15-1779</b>	<b>2-[Bis(diphenylphosphino)methyl]pyridine, 98% (60398-55-2)</b> C <sub>30</sub> H <sub>25</sub> NP <sub>2</sub> ; FW: 461.47; white powder.	100mg 500mg
<b>15-0502</b>	<b>3,3'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro [2,2']binaphthalene chloroform adduct, 99% (1067889-87-5)</b> C <sub>44</sub> H <sub>40</sub> P <sub>2</sub> ·0.5CHCl <sub>3</sub> ; FW: 630.74 (690.43); white to pale yellow powder. Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.	100mg 500mg



## Technical Note:

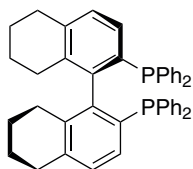
- Ligand used in the platinum-catalyzed asymmetric carbonyl-ene reaction.

## References:

- Org. Lett.*, **2007**, 9, 4925.

# PHOSPHORUS - Ligands and Compounds

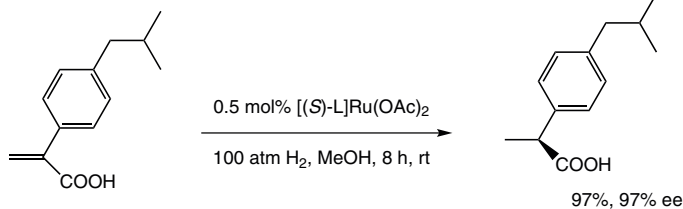
**15-2972** (R)-(+)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl  
**(R)-(+)-H<sub>8</sub>-BINAP** (139139-86-9)  
 C<sub>44</sub>H<sub>40</sub>P<sub>2</sub>; FW: 630.74; off-white powdr.;  
 m.p. 207-208°  
 Note: Manufactured under license of Takasago patent.



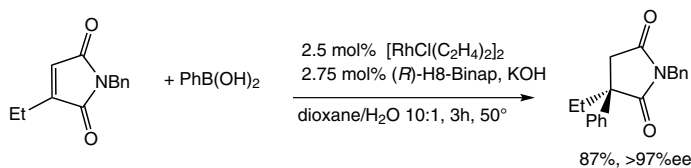
50mg  
250mg

## Technical Notes:

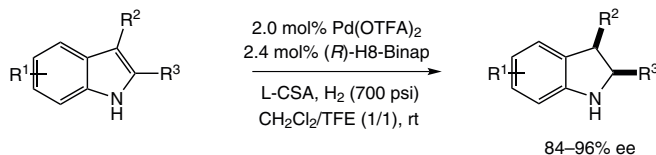
1. Biaryl bisphosphine ligand. The H8-BINAP ligand, as the ruthenium complex, catalyzes hydrogenation of unsaturated carboxylic acids to a higher ee than does BINAP. (Ref. 1,2)
2. The ruthenium catalyzed hydrogenation of aryl propenoic acid to produce the drug Ibuprofen.
3. Rhodium catalyzed asymmetric regioselective 1,4-addition of arylboronic acids to 3-substituted maleimides.
4. Ligand for palladium-catalyzed enantioselective hydrogenation of substituted indoles.
5. Rhodium-catalyzed enantioselective cyclization of  $\gamma$ -alkynylaldehydes with acyl phosphonates.
6. Enantioselective synthesis of axially chiral 1-arylisquinolines by Rh-catalyzed [2+2+2] cycloaddition.
7. Enantioselective synthesis of 2,3-disubstituted indolines through Bronsted acid/Pd-complex-promoted tandem reactions.
8. Dehydration triggered asymmetric hydrogenation of 3-( $\alpha$ -hydroxyalkyl)indoles
9. Iridium-catalyzed [2+2+2] cycloaddition of  $\alpha,\omega$ -diynes with arylisocyanates
10. Asymmetric hydrogenation of 3-(toluenesulfonamidoalkyl)-indoles
11. Asymmetric Rh(I)-catalyzed intramolecular [3+2] cycloaddition of 1-yne-vinylcyclopropanes for bicyclo[3.3.0] compounds with a chiral quaternary carbon stereocenter.
12. Enantioselective intermolecular [2+2+2] cycloadditions of ene-allenes with allenates.
13. Rh-catalyzed one-pot intermolecular [2+2+2] trimerization/asymmetric intramolecular [4+2] cycloaddition of two aryl ethynyl ethers and 5-alkynals.
14. Rh-catalyzed regio-, diastereo-, and enantioselective [2+2+2] cycloaddition of 1,6-enynes with acrylamides.



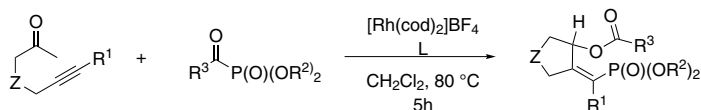
Tech. Note (1,2)  
Ref. (1,2)



Tech. Note (3)  
Ref. (3)



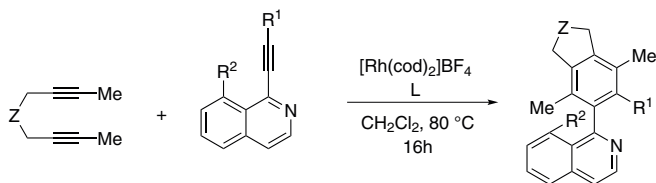
Tech. Note (4)  
Ref. (4)



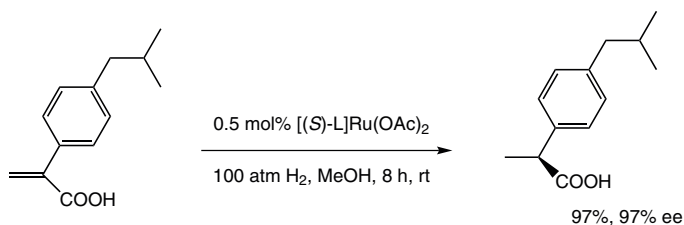
Tech. Note (5)  
Ref. (5)

# PHOSPHORUS - Ligands and Compounds

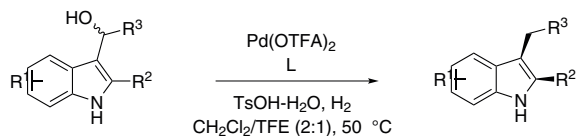
15-2972 (continued) (R)-(+)-2,2'-Bis(diphenylphosphino)- 5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (R)-(+)-H<sub>8</sub>-BINAP (139139-86-9)



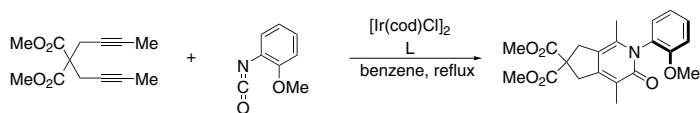
Tech. Note (6)  
Ref. (6)



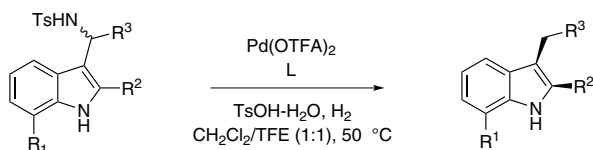
Tech. Note (7)  
Ref. (7)



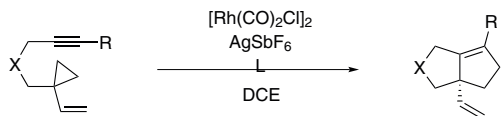
Tech. Note (8)  
Ref. (8)



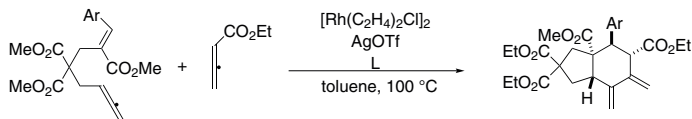
Tech. Note (9)  
Ref. (9)



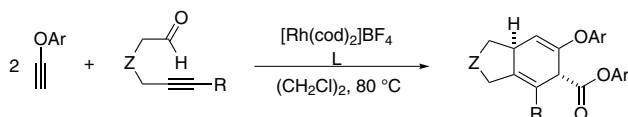
Tech. Note (10)  
Ref. (10)



Tech. Note (11)  
Ref. (11)



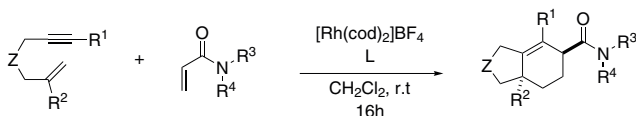
Tech. Note (12)  
Ref. (12)



Tech. Note (13)  
Ref. (13)

# PHOSPHORUS - Ligands and Compounds

**15-2972** (R)-(+)-2,2'-Bis(diphenylphosphino)- 5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (R)-(+)-H<sub>8</sub>-BINAP (139139-86-9)



Tech. Note (14)  
Ref. (14)

## References:

1. *J. Org. Chem.*, **1996**, 61, 5510.
2. *Topics Organometal. Chem.* **2004**, 6, 63 (review).
3. *J. Am. Chem. Soc.*, **2006**, 128, 5628.
4. *J. Am. Chem. Soc.*, **2010**, 132, 8909.
5. *J. Am. Chem. Soc.* **2011**, 133, 6918.
6. *Chem. Eur. J.* **2011**, 17, 1428.
7. *Chem. Eur. J.* **2011**, 17, 7193.
8. *Chem. Sci.*, **2011**, 2, 803.
9. *J. Org. Chem.*, **2012**, 77, 908.
10. *Org. Biomol. Chem.*, **2012**, 10, 1235.
11. *J. Am. Chem. Soc.*, **2012**, 134, 398.
12. *Org. Lett.*, **2012**, 14, 6096.
13. *Org. Lett.*, **2012**, 14, 5856.
14. *Angew. Chem. Int. Ed.*, **2012**, 51, 13031.

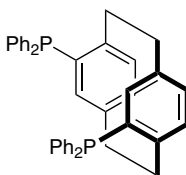
**15-2973** (S)-(-)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro- 1,1'-binaphthyl (S)-(-)-H<sub>8</sub>-BINAP (139139-93-8) 50mg  
C<sub>44</sub>H<sub>40</sub>P<sub>2</sub>; FW: 630.74; off-white powdr.; m.p. 207-208° 250mg  
Note: Manufactured under license of Takasago patent.

## Technical Note:

1. See 15-2972 (page 73)

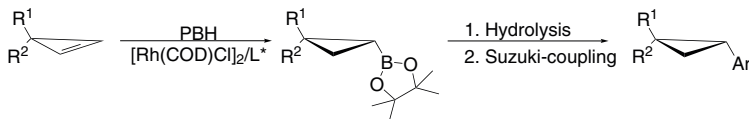
**15-0420** 1,8-Bis(diphenylphosphino)octane, 99% (41625-30-3) 1g  
C<sub>32</sub>H<sub>36</sub>P<sub>2</sub>; FW: 482.58; white powdr. 5g

**15-0425** (R)-(-)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (R)-PHANEPHOS (364732-88-7) 100mg  
C<sub>40</sub>H<sub>34</sub>P<sub>2</sub>; FW: 576.65; white solid; 500mg  
m.p. 222-225°  
Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No 5874629 and patents arising therefrom.

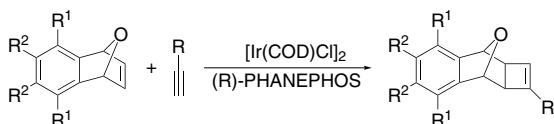


## Technical Notes:

1. Ligand for rhodium-catalyzed enantioselective hydroboration of cyclopropenes.
2. Ligand for iridium-catalyzed enantioselective [2+2] cycloaddition of oxabicyclic alkenes with terminal alkynes.
3. Ligand for the palladium-catalyzed enantioselective hydroxycarbonylation and alkoxy carbonylation of alkenes.
4. Ligand for the palladium-catalyzed amides synthesis via C(sp<sup>3</sup>)-H bond functionalization and CO insertion.
5. Ligand for iridium-catalyzed diene hydrohydroxymethylation.



Tech. Note (1)  
Ref. (1)

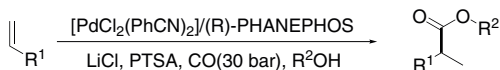


Tech. Note (2)  
Ref. (2)

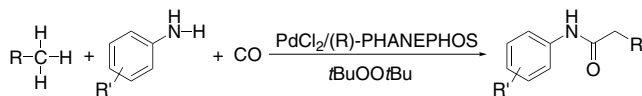


# PHOSPHORUS - Ligands and Compounds

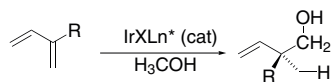
**15-0425** (R)-(-)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (R)-PHANEPHOS  
(continued) (364732-88-7)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)

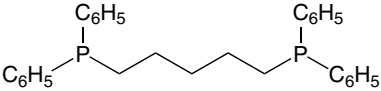
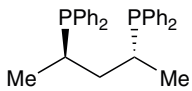
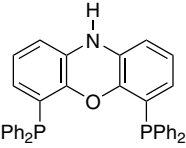
## References:

1. *J. Am. Chem. Soc.*, **2003**, *125*, 7198.
2. *Org. Lett.*, **2010**, *12*, 304.
3. *Angew. Chem. Int. Ed.*, **2010**, *49*, 9197.
4. *Chem. Commun.*, **2014**, *50*, 341.

<b>15-0426</b>	<b>(S)-(+)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (S)-PHANEPHOS</b> (192463-40-4) C <sub>40</sub> H <sub>34</sub> P <sub>2</sub> ; FW: 576.65; white solid; m.p. 222-225° Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No 5874629 and patents arising therefrom.	100mg 500mg
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## Technical Note:

1. See 15-0425 (page 75)

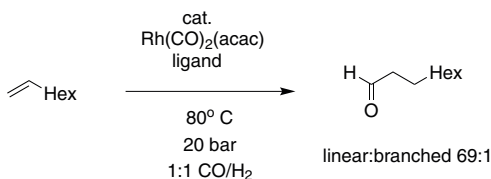
<b>15-0430</b>	<b>1,5-Bis(diphenylphosphino) pentane, min. 98%</b> (27721-02-4) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P(CH <sub>2</sub> ) <sub>5</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 440.51; white to off-white solid; m.p. 46-49°		1g 5g
<b>15-0432</b>	<b>(2R,4R)-(+)-2,4-Bis(diphenylphosphino) pentane, 99% (R,R)-BDPP</b> (96183-46-9) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH(CH <sub>3</sub> )CH <sub>2</sub> CH(CH <sub>3</sub> )P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 440.49; white xtl.; m.p. 78° <i>air sensitive</i>		500mg 2g
<b>15-0431</b>	<b>(2S,4S)-(-)-2,4-Bis(diphenylphosphino)pentane, 99% (S,S)-BDPP</b> (77876-39-2) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH(CH <sub>3</sub> )CH <sub>2</sub> CH(CH <sub>3</sub> )P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 440.49; white xtl.; m.p. 81° <i>air sensitive</i>		250mg 1g 5g
<b>15-0437</b>	<b>4,6-Bis(diphenylphosphino) phenoxazine, min. 98% NIXANTPHOS</b> (261733-18-0) C <sub>36</sub> H <sub>27</sub> NOP <sub>2</sub> ; FW: 551.55; white to off-white powdr.		500mg 2g

## Technical Notes:

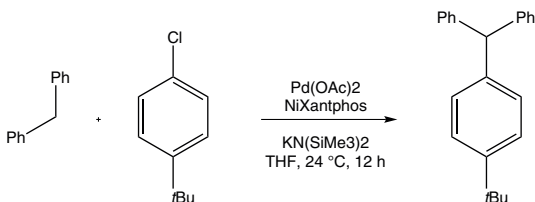
1. A large bite-angle chelating bisphosphine that provides high levels of linear-to-branched selectivity in the hydroformylation of alkenes
2. A Deprotonatable Ligand for Room-Temperature Palladium-Catalyzed Cross-Couplings of Aryl Chlorides.

# PHOSPHORUS - Ligands and Compounds

15-0437 4,6-Bis(diphenylphosphino) phenoxazine, min. 98% NIXANTPHOS (261733-18-0)  
(continued)



Tech. Note (1)  
Ref. (1)

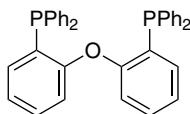


Tech. Note (2)  
Ref. (2)

## References:

1. *Organometallics*, **2000**, 19, 872.
2. *J. Am. Chem. Soc.*, **2014**, 136, 6276.

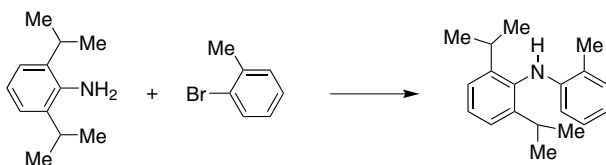
**15-0380 Bis(2-diphenylphosphinophenyl)ether, 98%  
DPEphos (166330-10-5)**  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>PC<sub>6</sub>H<sub>4</sub>OC<sub>6</sub>H<sub>4</sub>P(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>; FW: 538.56;  
off-white powdr.; m.p. 181-184°  
Note: Phosphine Ligand Kit component.



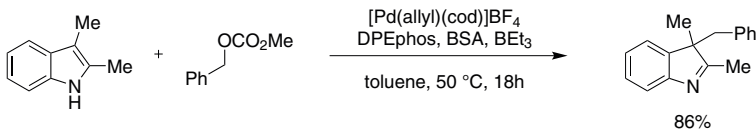
5g  
25g  
100g

## Technical Notes:

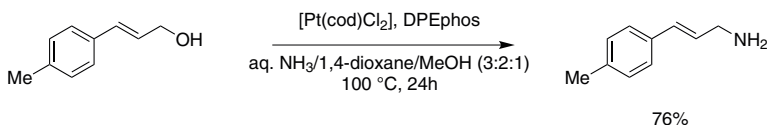
1. Useful as a ligand in the Pd-catalyzed formation of diaryl amines.
2. Has been recently applied to the C3 benzylation of indoles.
3. Has been recently applied to the monoallylation of ammonia.
4. Ligand used in the palladium-catalyzed, aerobic oxidation coupling of acyl chlorides with arylboronic acids.
5. Ligand used in carbonylation of aryl iodides.
6. Ligand used in the direct C-H arylation of benzothiadiazoles.
7. Ligand used in stereo-retentive azacyclization of propargylic carbonates.
8. Ligand used in palladium catalyzed benzyne trimerization.



Tech. Note (1)  
Ref. (1)



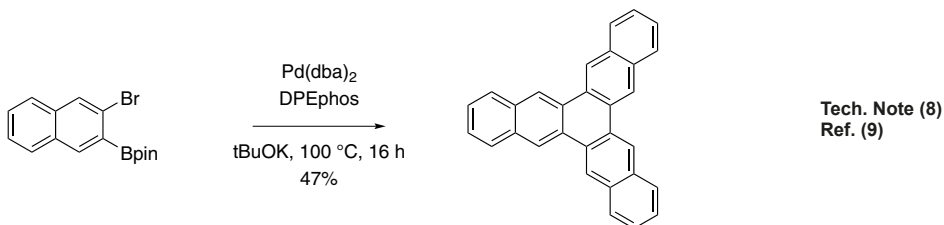
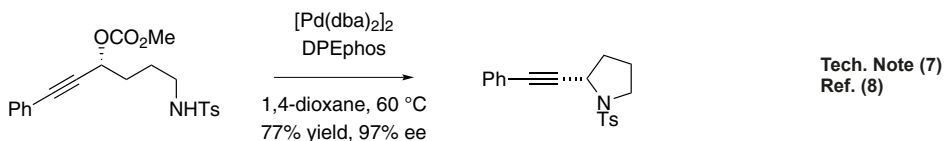
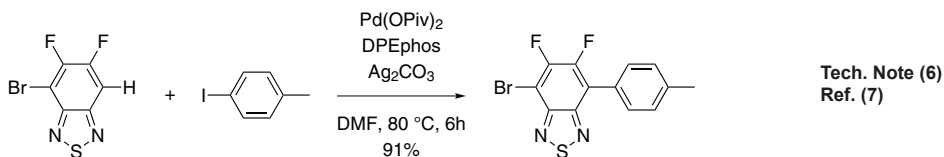
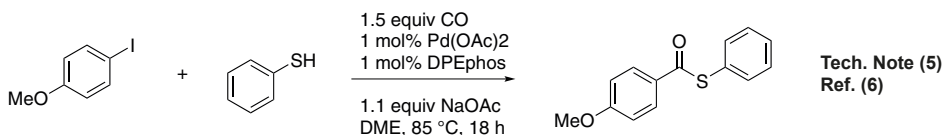
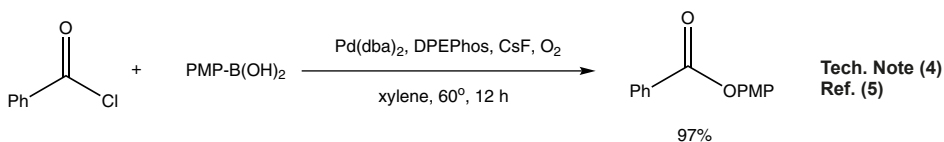
Tech. Note (2)  
Ref. (3)



Tech. Note (3)  
Ref. (4)

# PHOSPHORUS - Ligands and Compounds

**15-0380** Bis(2-diphenylphosphinophenyl)ether, 98% DPEphos (166330-10-5)  
(continued)



## References:

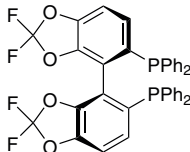
1. *Tetrahedron Lett.*, **1998**, 39, 5327.
2. *Organometallics*, **1995**, 14, 3081.
3. *J. Am. Chem. Soc.*, **2012**, 134, 111.
4. *Angew. Chem. Int. Ed.*, **2012**, 51, 150.
5. *Adv. Synth. Catal.*, **2012**, 354(11), 2117.
6. *Org. Lett.*, **2013**, 15, 948.
7. *J. Org. Chem.*, **2014**, 79, 1712.
8. *Angew. Chem. Int. Ed.*, **2014**, 53, 1915.
9. *Org. Lett.*, **2014**, 16, 1338.

<b>15-0450</b>	<b>1,3-Bis(diphenylphosphino)propane, 98% DPPP (6737-42-4)</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 412.45; white xtl.; m.p. 60-63°	10g 50g
<b>15-0440</b>	<b>R-(+)-1,2-Bis(diphenylphosphino)propane, 99% (R)-PROPHOS (67884-32-6)</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH(CH <sub>3</sub> )CH <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ; FW: 412.45; white xtl.; m.p. 69-71° (sealed tube) <i>air sensitive</i>	250mg 1g

# PHOSPHORUS - Ligands and Compounds

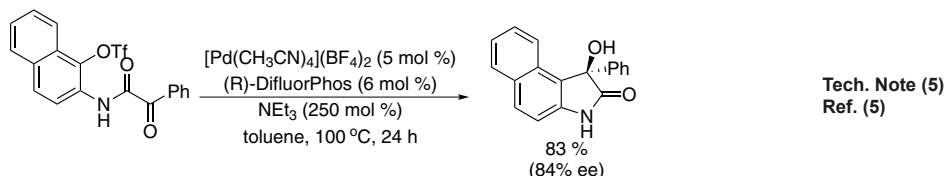
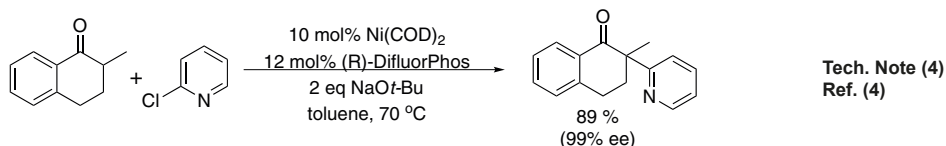
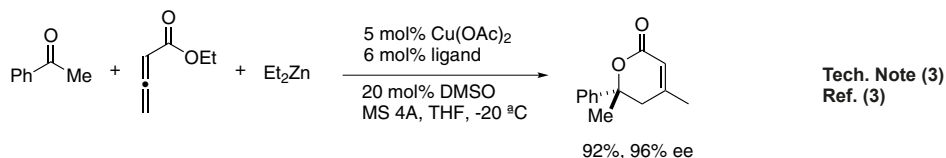
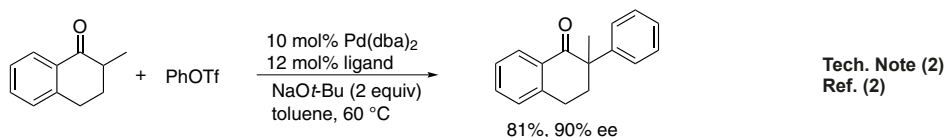
**15-0449** 1,3-Bis(diphenylphosphino)propane monooxide, min. 97% (85685-99-0) 1g  
5g  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>PCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>P(O)(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>; FW: 428.44; white powdr.

**15-0486** R-(-)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (R)-DIFLUORPHOS™ (503538-69-0) 100mg  
500mg  
C<sub>38</sub>H<sub>24</sub>F<sub>4</sub>O<sub>4</sub>P<sub>2</sub>·XCH<sub>2</sub>Cl<sub>2</sub>; FW: 682.54; white powdr.  
*air sensitive*  
Note: Sold under license from SYNKEM for research purposes only-not for drug use. Patent application WO 03/029259. US Patent No. 6.878.665 B2. For directions of use and safety see SDS available at [www.strem.com](http://www.strem.com). Optical purity: 99.5+%



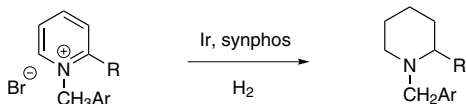
## Technical Notes:

- Ligand used for the enantioselective hydrogenation of olefins, and especially electron-poor ketones.
- Ligand used for the enantioselective  $\alpha$ -arylation of ketones.
- Ligand used for enantioselective alkylation of aldol reactions.
- Nickel-catalyzed asymmetric  $\alpha$ -heteroarylation of ketones with chloroarenes.
- Palladium-catalyzed asymmetric intramolecular arylation of  $\alpha$ -keto amides.
- Ligand for Iridium-catalyzed asymmetric hydrogenation of pyridinium salts.
- Ligand for Hg(II)-Catalyzed Cyclopropanation of Diazoindoles and Alkenes.
- Ligand for Rhodium-Catalyzed Asymmetric 1,4-Addition Reactions.

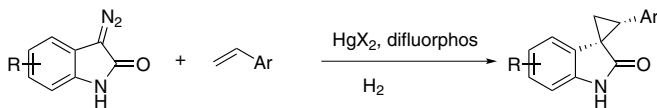


## PHOSPHORUS - Ligands and Compounds

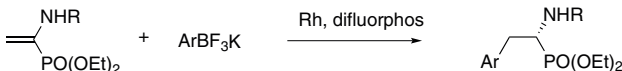
**15-0486** R-(-)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (R)-DIFLUORPHOS™ (503538-69-0)



Tech. Note (6)  
Ref. (6)



Tech. Note (7)  
Ref. (7)



Tech. Note (8)  
Ref. (8)

### References:

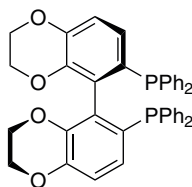
1. *Angew. Chem. Int. Ed.*, **2004**, 43, 320.
2. *J. Am. Chem. Soc.*, **2008**, 130, 195.
3. *J. Am. Chem. Soc.*, **2007**, 129, 7439.
4. *J. Am. Chem. Soc.*, **2011**, 133, 16330.
5. *Angew. Chem. Int. Ed.*, **2011**, 50, 7620.
6. *Angew. Chem. Int. Ed.*, **2012**, 51, 10181.
7. *Organic Letters*, **2013**, 15, 42.
8. *Organic Letters*, **2013**, 15, 4274.

<b>15-0487</b>	<b>S-(+)-5,5'-Bis(diphenylphosphino)-2,2,2',2'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (S)-DIFLUORPHOS™ (503538-70-3)</b> <i>C</i> <sub>38</sub> <i>H</i> <sub>24</sub> <i>F</i> <sub>4</sub> <i>O</i> <sub>4</sub> <i>P</i> <sub>2</sub> ·XCH <sub>2</sub> Cl <sub>2</sub> ; FW: 682.54; white powdr. <i>air sensitive</i> Note: Sold under license from SYNKEM for research purposes only-not for drug use. Patent application WO 03/029259. US Patent No. 6.878.665 B2. For directions of use and safety see SDS sheet available at <a href="http://www.strem.com">www.strem.com</a> . Optical purity: 99.5+%	100mg 500mg
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### Technical Note:

1. See 15-0486 (page 79)

<b>15-0490</b>	<b>R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94% (R)-SYNPHOS™ (445467-61-8)</b> <i>C</i> <sub>40</sub> <i>H</i> <sub>32</sub> <i>O</i> <sub>4</sub> <i>P</i> <sub>2</sub> ; FW: 638.63; white powdr. Note: Sold under license from SYNKEM for research purposes only - not for drug use. Patent application WO 03/029259. US Patent No. 6.878.665 B2. For directions of use and safety see SDS sheet available at <a href="http://www.strem.com">www.strem.com</a>	100mg 500mg
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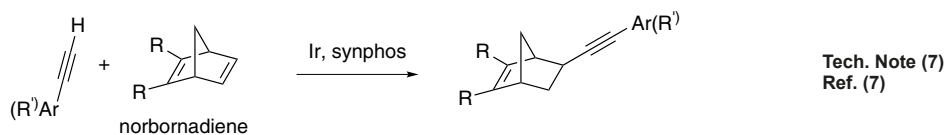
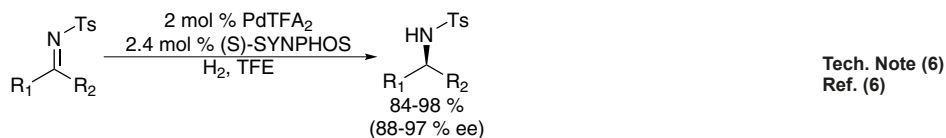
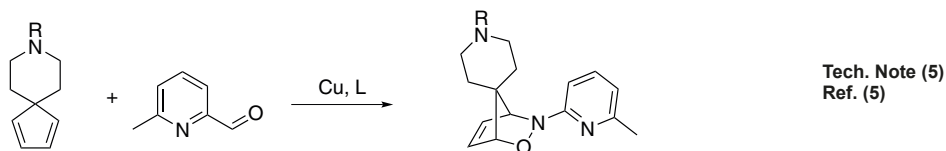
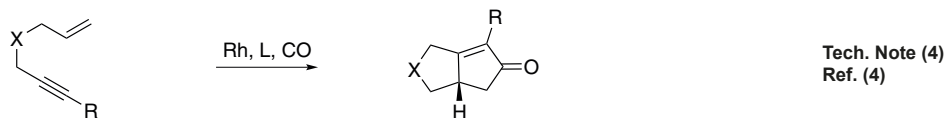
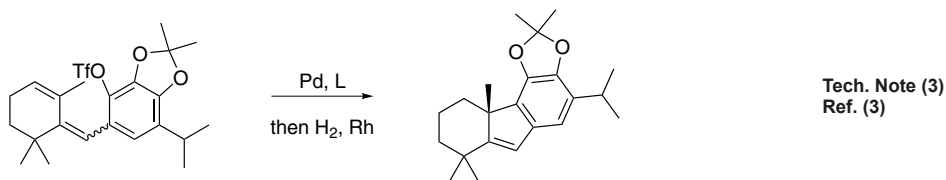
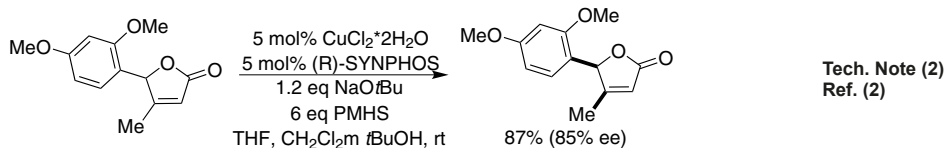
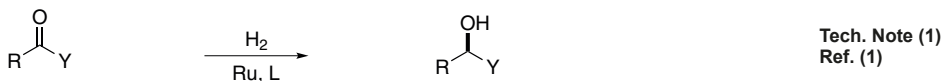


### Technical Notes:

1. A chiral diphosphine ligand used in the highly-enantioselective hydrogenation of ketoesters, hydroxyketones, ketophosphonates and succinates.
2. A ligand used for the dynamic kinetic resolution of  $\alpha,\beta$ -unsaturated lactones via asymmetric copper-catalyzed conjugate reduction.
3. Used in the intramolecular Heck reaction for the synthesis of diterpenoids.
4. Used in asymmetric Pauson-Khand reaction.
5. Used in asymmetric iminonitroso Diels-Alder reaction.
6. Palladium catalyzed asymmetric hydrogenation of N-tosyl ketimines.
7. Ligand for asymmetric hydroalkynylation of norbornadienes

# PHOSPHORUS - Ligands and Compounds

15-0490 R-(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 94%  
(continued) (R)-SYNPHOS™ (445467-61-8)



## References:

1. *Tetrahedron Lett.*, **2003**, 44, 823.
2. *Angew. Chem. Int. Ed.*, **2005**, 44, 6177.
3. *J. Org. Chem.*, **2010**, 75, 190.
4. *Adv. Synth. Catal.*, **2007**, 349, 1999.
5. *Tetrahedron Lett.*, **2009**, 50, 5879.
6. *J. Org. Chem.*, **2007**, 72, 3729.
7. *Angew. Chem. Int. Ed.*, **2012**, 51, 7821.

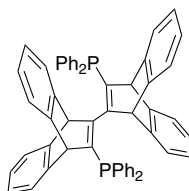
## PHOSPHORUS - Ligands and Compounds

<b>15-0491</b>	<b>S-(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97% (S)-SYNPHOS™ (503538-68-9)</b> C <sub>40</sub> H <sub>32</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 638.63; white powdr. Note: Sold under license from SYNKEM for research purposes only - not for drug use. Patent application WO 03/029259. US Patent No. 6.878.665 B2. For directions of use and safety see SDS sheet available at <a href="http://www.strem.com">www.strem.com</a>	100mg 500mg
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Technical Note:

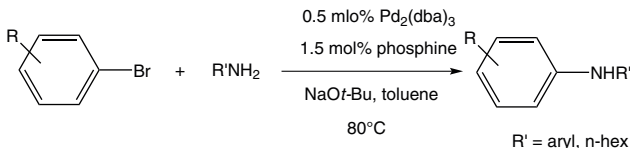
1. See 15-0490 (page 80)

<b>15-0442</b>	<b>12,12'-Bis(diphenylphosphino)-9,9',10,10'-tetrahydro-11,11'-bi-9,10-ethenoanthracene, min. 98% CATPHOS (1020670-88-5)</b> C <sub>56</sub> H <sub>40</sub> P <sub>2</sub> ; FW: 774.86; white xtl.	250mg 1g
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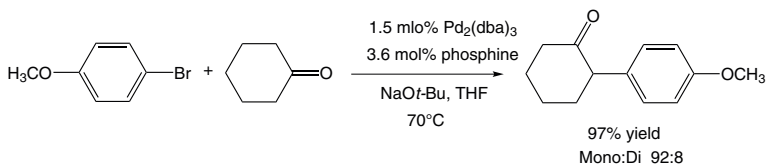


Technical Notes:

1. Useful ligand for the palladium-catalyzed amination reaction, notably with sterically demanding and electron-rich substrates.
2. Useful ligand for the palladium-catalyzed  $\alpha$ -arylation of ketones.



Tech. Note (1)  
Ref. (1)

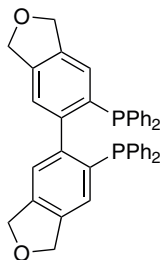


Tech. Note (2)  
Ref. (1)

References:

1. *Organometallics*, **2008**, 27, 1679.

<b>15-0504</b>	<b>6,6'-Bis(diphenylphosphino)-1,1',3,3'-tetrahydro[5,5']biisobenzofuran, 99% (959864-38-1)</b> C <sub>40</sub> H <sub>32</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 606.63; white to off-white powdr. Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.	100mg 500mg
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Technical Note:

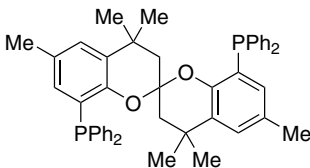
1. Ligand used in the platinum-catalyzed asymmetric carbonyl-ene reaction.

References:

1. *Org. Lett.*, **2007**, 9, 4925.

# PHOSPHORUS - Ligands and Compounds

<b>15-5165</b>	<b>racemic-8,8'-Bis(diphenylphosphino)-3,3',4,4'-tetrahydro-4,4',4',6,6'-hexamethyl-2,2'-spirobi[2H-1-benzopyran], min. 95% SPANphos (556797-94-5)</b> C <sub>47</sub> H <sub>46</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 704.81; white powder.	100mg 500mg
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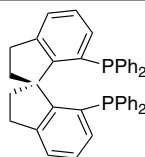
## Technical Note:

1. A binucleating diphosphine ligand used as a trans-spanning ligand which rigidly links mutually trans coordination sites via phosphorous atoms separated by a large distance to form a cavity over the face of square planar mono and di-metallic complexes, e.g. in MCl<sub>2</sub>(SPANphos) (M = Pd, Pt), Rh<sub>2</sub>(μ-Cl)<sub>2</sub>(CO)<sub>2</sub>(SPANphos), the latter useful in, for example, the homogeneous catalytic carbonylation of methanol to acetic acid.

## References:

1. *Angew. Chem. Int. Ed.*, **2003**, *42*, 1284.
2. *Angew. Chem. Int. Ed.*, **2005**, *44*, 4385.

<b>15-5174</b>	<b>(R)-(+)-7,7'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (R)-SDP (917377-74-3)</b> C <sub>41</sub> H <sub>34</sub> P <sub>2</sub> ; FW: 588.66; white solid; m.p. 200-202° <i>air sensitive</i> Note: Spiro Bisphosphine Ligand Kit component.	25mg 100mg
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## Technical Notes:

1. Ligands used for the ruthenium-catalyzed hydrogenation of simple and cyclic ketones with high activity and enantioselectivity.
2. Ligands used for palladium-catalyzed asymmetric allylic alkylations.

## References:

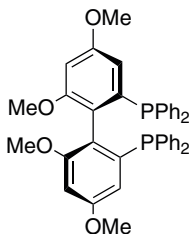
1. *J. Am. Chem. Soc.*, **2003**, *125*, 4404.
2. *J. Org. Chem.*, **2005**, *70*, 2967.
3. *Adv. Synth. Catal.*, **2004**, *346*, 625.

<b>15-5175</b>	<b>(S)-(-)-7,7'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (S)-SDP (528521-86-0)</b> C <sub>41</sub> H <sub>34</sub> P <sub>2</sub> ; FW: 588.66; white solid; m.p. 206-208° <i>air sensitive</i> Note: Spiro Bisphosphine Ligand Kit component.	25mg 100mg
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## Technical Note:

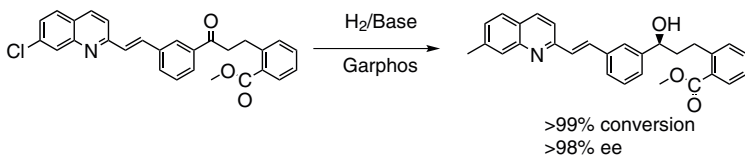
1. See 15-5174 (page 83)

<b>15-1653</b>	<b>(R)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-Ph-Garphos™ (1365531-75-4)</b> C <sub>40</sub> H <sub>36</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 642.66; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
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## Technical Note:

1. Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.

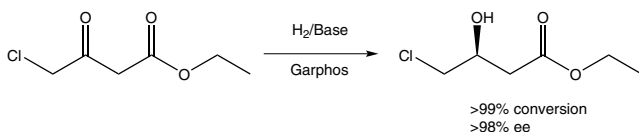


**Tech. Note (1)  
Ref. (1)**

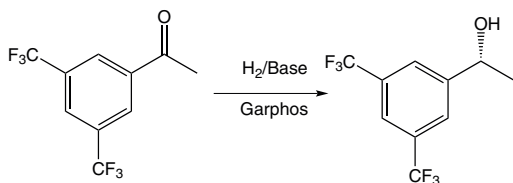


# PHOSPHORUS - Ligands and Compounds

**15-1653** (R)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-Ph-Garphos™ (1365531-75-4)



Tech. Note (2)  
Ref. (1)



S:C = 100.000:1  
>99% conversion  
>99% ee

Tech. Note (3)  
Ref. (1)

## References:

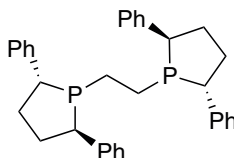
- US Patent Application No. 61/381,493.

<b>15-1654</b>	(S)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (S)-Ph-Garphos™ (1365531-76-5) C <sub>40</sub> H <sub>36</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 642.66; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	100mg 500mg
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## Technical Note:

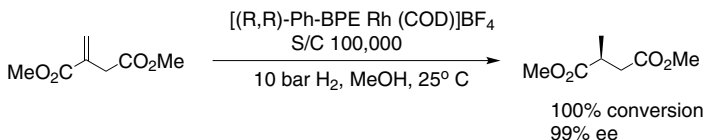
- See 15-1653 (page 83)

<b>15-0473</b>	(-)-1,2-Bis((2R,5R)-2,5-di-phenylphospholano)ethane, min. 95% (R,R)-Ph-BPE (528565-79-9) (C <sub>16</sub> H <sub>16</sub> )PCH <sub>2</sub> CH <sub>2</sub> P(C <sub>16</sub> H <sub>16</sub> ); FW: 506.60; white solid; m.p. 144° <i>air sensitive</i>	100mg 500mg 2g
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## Technical Notes:

- Phenyl-BPE exhibits enhanced activity and selectivity over existing members of the BPE ligand family in rhodium catalysed asymmetric hydrogenation.
- This ligand is highly efficient for the hydrogenation of N-acyl aryl-enamides.
- Molar substrate/catalyst ratios of up to 100,000/1 are achieved with excellent reactivity and enantioselectivity using commercial grade substrates and solvents.
- Ligand in the rhodium-catalyzed asymmetric hydroformylation of olefins.
- Ligand for asymmetric addition of allyl cyanide to ketones.
- Ligand for catalytic enantio- and diastereoselective aldol reaction of thioamides.
- Organocatalytic 3+2 cycloaddition.
- Site selective allenylation.
- Asymmetric Phophonate addition.
- Hydroboration of enamines

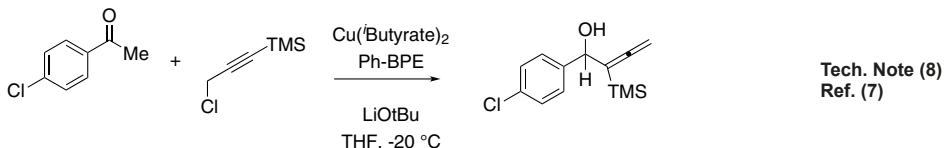
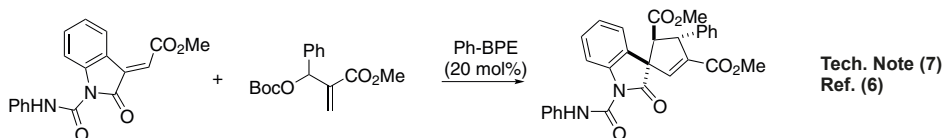
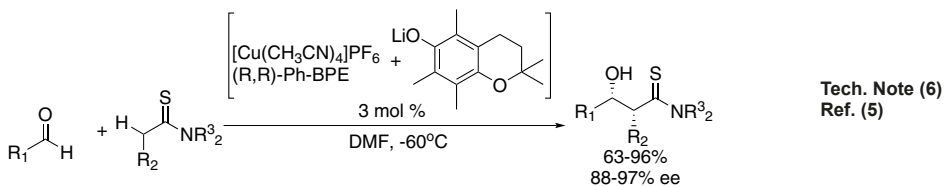
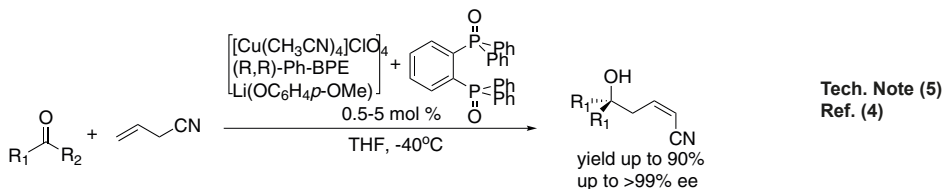
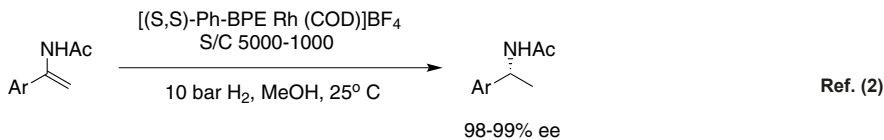
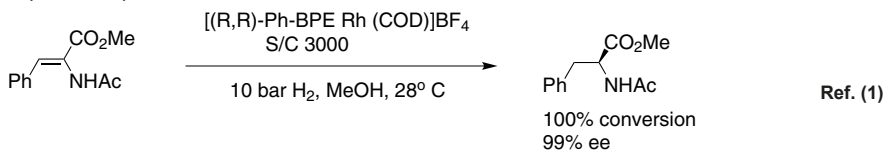


Ref. (1)

# PHOSPHORUS - Ligands and Compounds

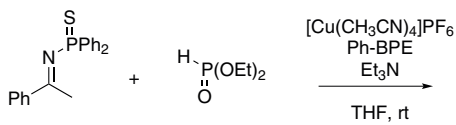
15-0473 (-)-1,2-Bis((2R,5R)-2,5-diphenylphospholano)ethane, min. 95% (R,R)-Ph-BPE (528565-79-9)

(continued)

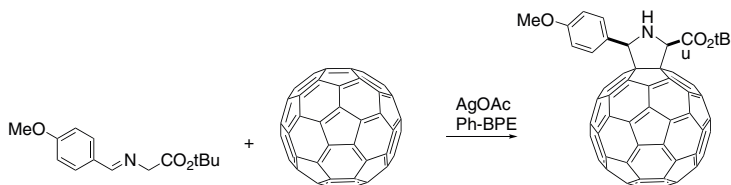


# PHOSPHORUS - Ligands and Compounds

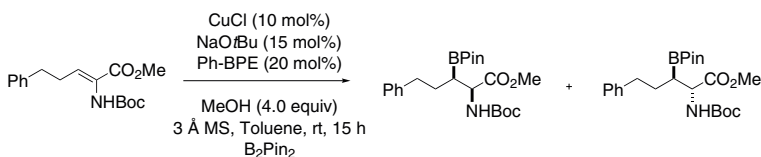
15-0473 (-)-1,2-Bis((2R,5R)-2,5-diphenylphospholano)ethane, min. 95% (R,R)-Ph-BPE (528565-79-9) (continued)



Tech. Note (9)  
Ref. (8)



Tech. Note (10)  
Ref. (9)



Tech. Note (11)  
Ref. (10)

## References:

1. *Org. Lett.*, **2003**, 5, 1273.
2. *Tetrahedron Lett.*, **2004**, 45, 9277
3. *Angew. Chem. Int. Ed.*, **2005**, 44, 5834.
4. *J. Am. Chem. Soc.*, **2010**, 132, 5522.
5. *J. Am. Chem. Soc.*, **2011**, 133, 5554.
6. *J. Am. Chem. Soc.*, **2011**, 133, 4672.
7. *Org. Lett.*, **2013**, 15, 1214.
8. *J. Am. Chem. Soc.*, **2013**, 135, 10338.
9. *J. Am. Chem. Soc.*, **2014**, 136, 705.
10. *Org. Lett.*, **2014**, 16, 1426.

15-0474	(+)-1,2-Bis((2S,5S)-2,5-diphenylphospholano)ethane, min. 98% (S,S)-Ph-BPE (824395-67-7) (C <sub>16</sub> H <sub>16</sub> )PCH <sub>2</sub> CH <sub>2</sub> P(C <sub>16</sub> H <sub>16</sub> ); FW: 506.60; white solid; m.p. 144° <i>air sensitive</i>	100mg 500mg 2g
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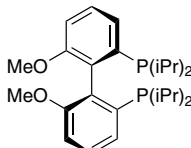
## Technical Note:

1. See 15-0473 (page 84)

15-0448	Bis(di- <i>i</i> -propylamino)chlorophosphine, min. 97% (56183-63-2) HAZ [(C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> N] <sub>2</sub> PCl; FW: 266.80; white to off-white pwdr. <i>air sensitive, moisture sensitive</i>	5g 25g
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15-0650	1,4-Bis(di- <i>i</i> -propylphosphino)butane, min. 98% (80499-19-0) amp HAZ (C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> P(C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> ; FW: 290.41; colorless to pale yellow liq. <i>air sensitive</i>	100mg 500mg
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15-0654	(R)-(+)-2,2'-Bis(di- <i>i</i> -propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (150971-45-2) C <sub>26</sub> H <sub>40</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 446.56; white pwdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component.	100mg 500mg 2g 10g
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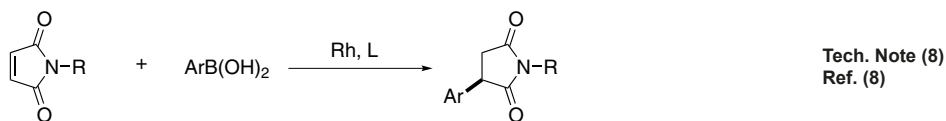
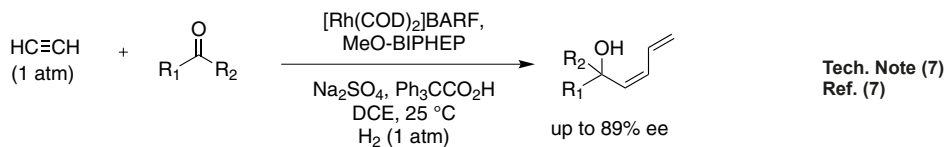
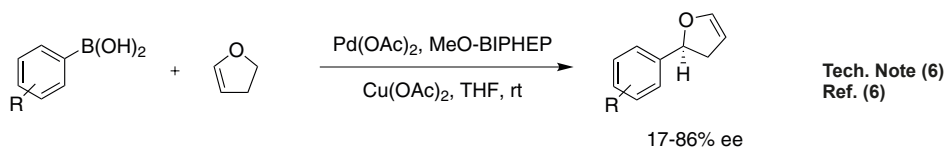
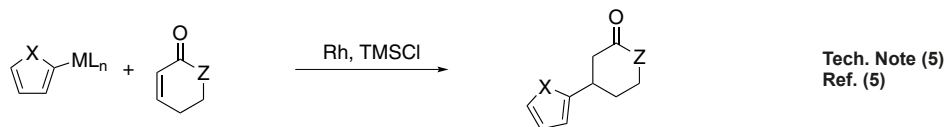
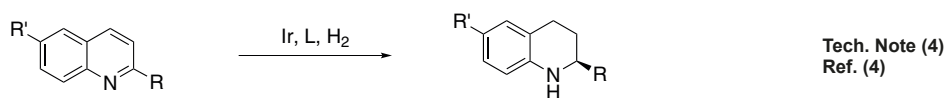
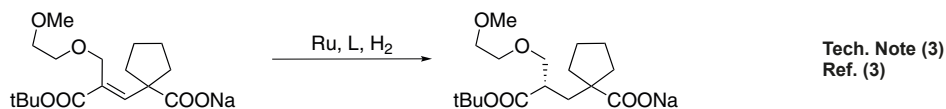
In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR2 group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

# PHOSPHORUS - Ligands and Compounds

**15-0654** (R)-(+)-2,2'-Bis(di-*i*-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  
(continued) (150971-45-2)

## Technical Notes:

1. See 15-0042.
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
5. Conjugate addition using 2-heteroaryl titanates and zinc reagents.
6. Enantio- and regioselective heck-type reaction of aryl boronic acids with 2,3-dihydrofuran
7. Rhodium-catalyzed carbonyl Z-dienylation.
8. Rhodium-catalyzed asymmetric 1,4 addition of arylboronic acids to maleimides and enones.



## References:

1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Devel.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. *J. Org. Chem.*, **2007**, 72, 3875.
7. *J. Am. Chem. Soc.*, **2006**, 128, 16040.
8. *J. Org. Chem.*, **2011**, 76, 6925.

# PHOSPHORUS - Ligands and Compounds

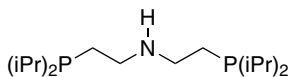
<b>15-0655</b>	<b>(S)-(-)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl</b> , min. 97% (150971-43-0) C <sub>26</sub> H <sub>40</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 446.56; white pwdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component.	100mg 500mg 2g 10g
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Technical Note:

1. See 15-0654 (page 86)

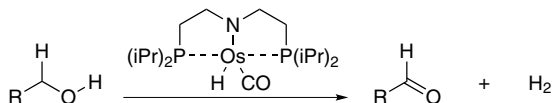
<b>15-0610</b>	<b>1,2-Bis(di-i-propylphosphino)ethane, 98%</b> (87532-69-2) amp C <sub>14</sub> H <sub>32</sub> P <sub>2</sub> ; FW: 262.35; colorless to pale yellow liq. HAZ <i>air sensitive</i>	100mg 500mg
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<b>15-7304</b>	<b>Bis[(2-di-i-propylphosphino)ethyl] amine, min. 97% (10 wt% in tetrahydrofuran)</b> (131890-26-1) C <sub>16</sub> H <sub>37</sub> NP <sub>2</sub> ; FW: 305.42; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO2004096735.	5g 20g
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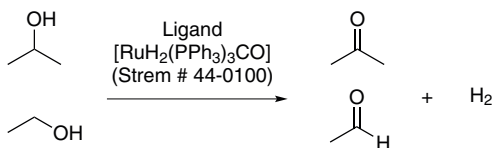


Technical Notes:

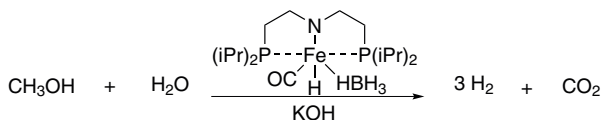
1. Ligand for the osmium dehydrogenation of alcohols
2. Ligand for the ruthenium dehydrogenation of alcohols
3. Ligand for the iron catalyzed production of hydrogen from methanol
4. Ligand for the iron catalyzed hydrogenation of esters to alcohols



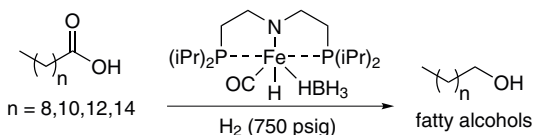
**Tech. Note (1)**  
Ref. (1)



**Tech. Note (2)**  
Ref. (2)



**Tech. Note (3)**  
Ref. (3)



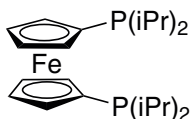
**Tech. Note (4)**  
Ref. (4)

References:

1. *Organometallics*, **2011**, 30, 3479
2. *Angew. Chem. Int. Ed.*, **2011**, 50, 9593
3. *Angew. Chem. Int. Ed.*, **2013**, 50, 14162
4. *J. Am. Chem. Soc.*, **2014**, 136, 7869

# PHOSPHORUS - Ligands and Compounds

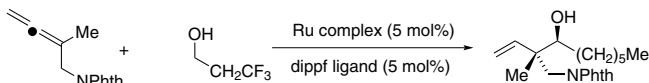
**26-0275** **1,1'-Bis(di-*i*-propylphosphino)ferrocene**,  
**min. 98% DiPPF (97239-80-0)**  
 $[(C_3H_7)_2PC_5H_4]_2Fe$ ; FW: 418.33;  
 orange-yellow powdr.  
 Note: 1,1'-Bis(dialkyl/diarylphosphino)  
 ferrocene Ligand Kit component. .



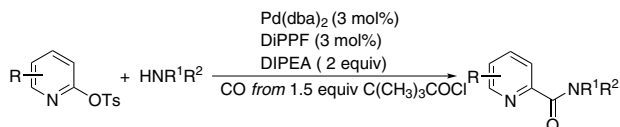
500mg  
 2g  
 10g

## Technical Notes:

1. Ruthenium-catalyzed hydrohydroxyalkylation of 1,1-disubstituted allenes
2. Ligand for palladium-catalyzed aminocarbonylation of Pyridyl Tosylates by means of ex situ generation of CO.
3. Pd-catalyzed carbonylative  $\alpha$ -arylation of ketones with aryl iodides
4. Ligand for palladium-catalyzed alkoxy carbonylation of aryl bromides for the preparation of tertiary esters
5. Ligand for stereoselective palladium-catalyzed decarboxylative allylation  $\beta$ -C-glycosylation
6. Ligand for ruthenium-catalyzed C—C coupling reactions of fluorinated alcohols with allenes.
7. Ligand for cobalt-catalyzed intermolecular formal hydroacylation reaction of olefins using N-3-picolin-2-yl aldimines as aldehyde equivalents.



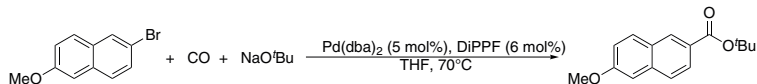
**Tech. Note (1)**  
**Ref. (2)**



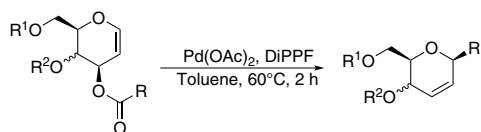
**Tech. Note (2)**  
**Ref. (2)**



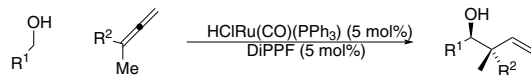
**Tech. Note (2)**  
**Ref. (3)**



**Tech. Note (2)**  
**Ref. (4)**

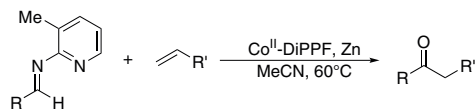


**Tech. Note (3)**  
**Ref. (5)**



**Tech. Note (6)**  
**Ref. (6)**

$R^1 = CH_2F, CH_2CF_3, (CH_2)_2CF_3, HC=CHCF_3$   
 $R^2 = Ph, CH_2NPhth, 4-MeOC_6H_4, 3,5-Cl_2C_6H_3$



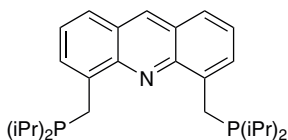
**Tech. Note (7)**  
**Ref. (7)**

## References:

1. *J. Am. Chem. Soc.* **2011**, 133, 1141
2. *J. Am. Chem. Soc.* **2011**, 133, 6061
3. *Angew. Chem. Int. Ed.* **2012**, 51, 798
4. *Org. Lett.*, **2012**, 14, 284
5. *Angew. Chem. Int. Ed.* **2013**, 52, 5134
6. *Angew. Chem. Int. Ed.* **2015**, 54, 5465
7. *ACS Catal.* **2015**, 5, 3054

# PHOSPHORUS - Ligands and Compounds

**15-0415** **4,5-Bis-(di-*i*-propylphosphino-nomethyl)acridine, 98+%**  
 (1101230-28-7)  
 $C_{27}H_{39}NP_2$ ; FW: 439.55; yellow xtl.  
*air sensitive*  
 Note: Patents: US provisional  
 61/087,708, PCT/IL2009/000778.



50mg  
250mg

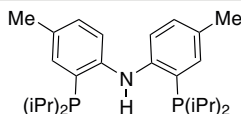
Technical Note:

- Ligand used to make (44-0525 Milstein Acridine Catalyst).

References:

- See 44-0525.

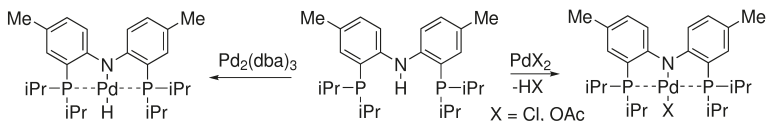
**15-0670** **Bis[2-(di-*i*-propylphosphino)-4-methylphenyl]amine, min. 98%**  
 (NEW)  
 $C_{26}H_{41}NP_2$ ; FW: 429.56; white powdr.  
*air sensitive*



100mg  
500mg

Technical Note:

- Ligand for PNP pincer complexes of palladium

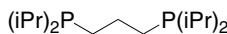


**Tech. Note (1)**  
**Ref. (1)**

References:

- Organometallics*, **2004**, 23, 326

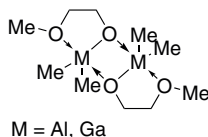
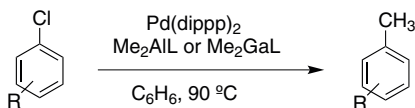
**15-0680** **1,3-Bis(di-*i*-propylphosphino)propane, min. 98%**  
 HAZ  
 (dipp) (91159-11-4)  
 $(C_3H_7)_2PCH_2CH_2CH_2P(C_3H_7)_2$ ; FW: 276.38; colorless  
 to pale yellow liq.  
*air sensitive*



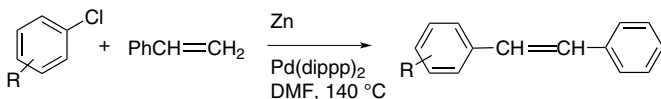
100mg  
500mg  
2g

Technical Notes:

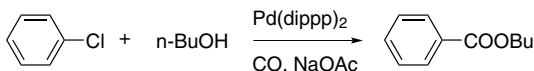
- Catalyst for the cross-methylation of aryl chlorides using stabilized dimethylaluminum or dimethylgallium reagents.
- Catalyst used in base-free olefin arylation.
- Catalyst for the efficient carbonylation of aryl chlorides.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



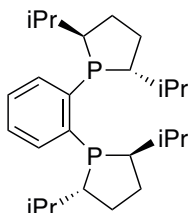
**Tech. Note (3)**  
**Ref. (3,4)**

References:

- Synthesis*, **2000**, 4, 571.
- Organometallics*, **1993**, 12, 4734.
- J. Am. Chem. Soc.*, **1989**, 111, 8742.
- J. Chem. Soc. Chem. Comm.*, **1989**, 1816.

# PHOSPHORUS - Ligands and Compounds

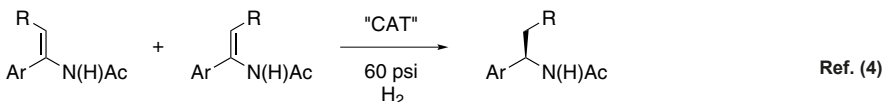
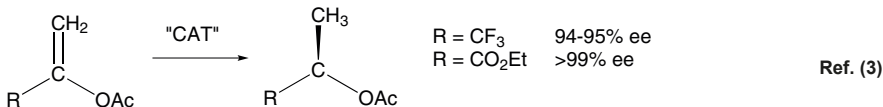
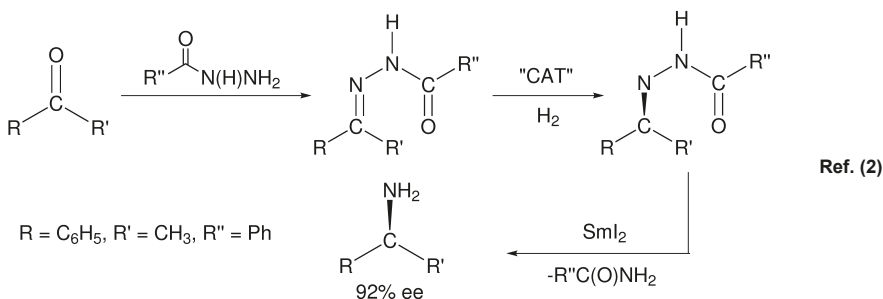
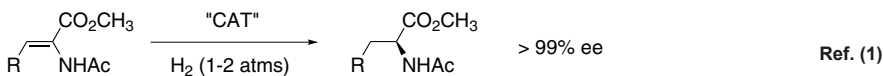
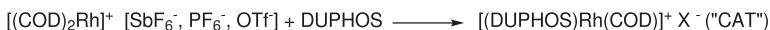
**15-0410** (+)-1,2-Bis((2R,5R)-2,5-di-i-propylphospholano)benzene, **98+%**  
**(R,R)-i-Pr-DUPHOS** (136705-65-2)  
 $C_{26}H_{44}P_2$ ; FW: 418.58; white xtl.; m.p. 40°  
*air sensitive*



100mg  
 500mg  
 2g

## Technical Notes:

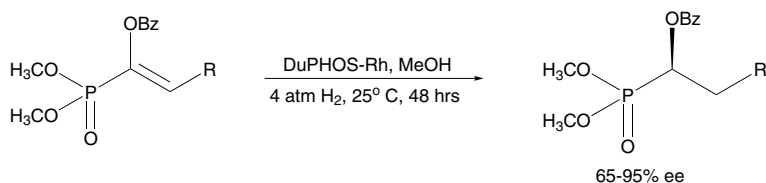
1. The DUPHOS family of catalysts is highly efficient for the asymmetric hydrogenation of various substituted acetamidoacrylates and enol acetates yielding products of high enantiomeric excesses. Efficient ligand for the asymmetric hydrogenation of tetrasubstituted enamides.<sup>5</sup>
2. Forms superior catalysts for asymmetric reductive aminations.
3. Catalyst used for the asymmetric hydrogenation of enol phosphonates.
4. A novel enantioselective synthesis of  $\beta$ -amino alcohols and 1,2-diamines.
5. Ligand for the catalytic asymmetric [4+1] cycloaddition of vinylallenes with CO.
6. Ligand for the Rh-catalyzed asymmetric enyne cycloisomerization.
7. Catalytic enantioselective addition of dialkylzinc to N-Diphenylphosphinoylimines.
8. Catalytic enantioselective addition of dialkylzinc to N-Diphenylphosphinoylimines.
8. Palladium catalyzed asymmetric phosphination.
9. Catalytic enantioselective allylation of ketones.
10. Enantioselective synthesis of cyclopropylborates.
11. Ligand used in gold catalyzed rearrangement of cyclopropylidene.



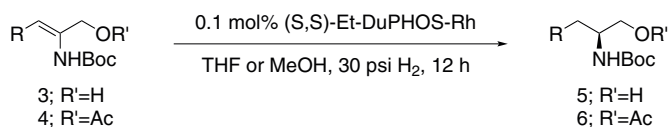


# PHOSPHORUS - Ligands and Compounds

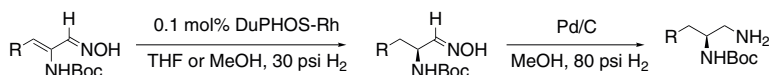
15-0410 (+)-1,2-Bis((2R,5R)-2,5-di-*i*-propylphospholano)benzene, 98+%  
 (continued) (R,R)-*i*-Pr-DUPHOS (136705-65-2)



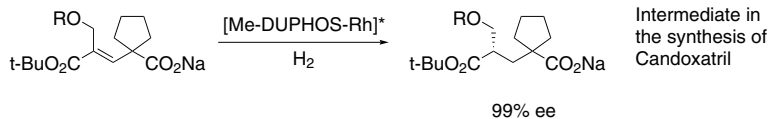
Tech. Note (3)  
Ref. (7)



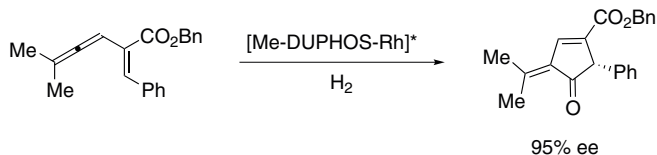
Tech. Note (4)  
Ref. (8)



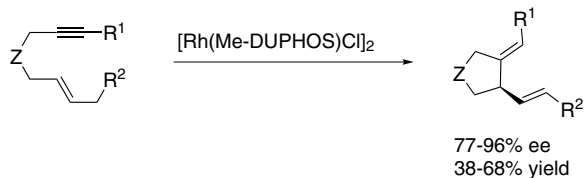
Tech. Note (4)  
Ref. (8)



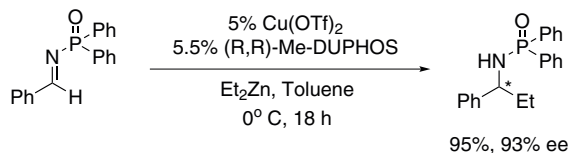
Ref. (7)



Tech. Note (5)  
Ref. (8)



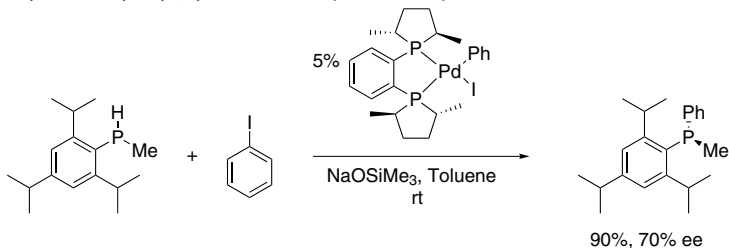
Tech. Note (6)  
Ref. (9)



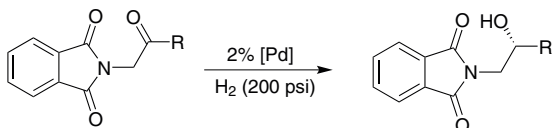
Tech. Note (7)  
Ref. (13)

# PHOSPHORUS - Ligands and Compounds

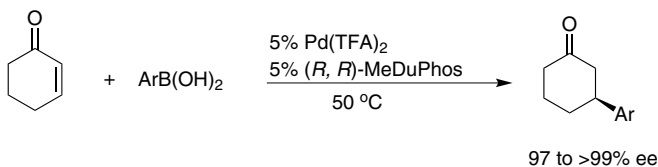
15-0410 (+)-1,2-Bis((2*R*,5*R*)-2,5-di-*i*-propylphospholano)benzene, 98+%  
 (continued) (*R,R*)-*i*-Pr-DUPHOS (136705-65-2)



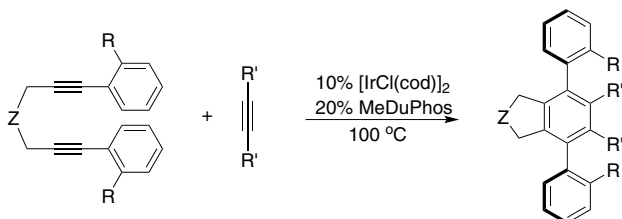
Tech. Note (8)  
 Ref. (14)



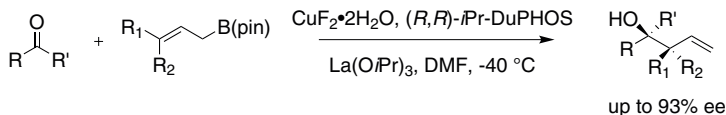
Ref. (15)



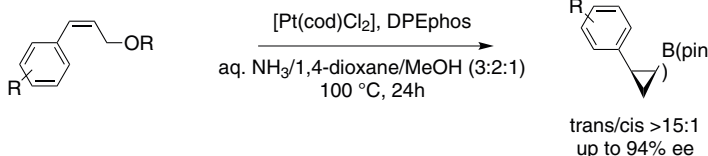
Ref. (16)



Ref. (17)



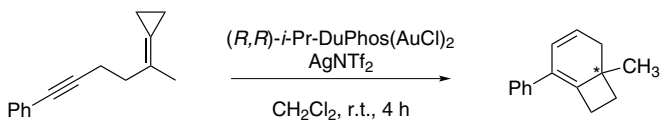
Tech. Note (9)  
 Ref. (18)



Tech. Note (10)  
 Ref. (19)

# PHOSPHORUS - Ligands and Compounds

**15-0410** (+)-1,2-Bis((2*R*,5*R*)-2,5-di-*i*-propylphospholano)benzene, 98+%  
(continued) (R,R)-*i*-Pr-DUPHOS (136705-65-2)



Tech. Note (11)  
Ref. (20)

60% ee

## References:

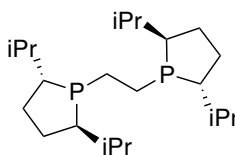
1. *J. Am. Chem. Soc.*, **1993**, *115*, 10125.
2. *J. Am. Chem. Soc.*, **1992**, *114*, 6266.
3. *J. Am. Chem. Soc.*, **1991**, *113*, 8518.
4. *J. Am. Chem. Soc.*, **1996**, *118*, 5142.
5. Burk, M.J., *Handbook of Chiral Chemicals*, Abel, Ager, D.J., Ed. (Marcel Dekker, Inc., New York, 1999) Ch 18, p 339. (review article)
6. *Organic Lett.*, **1999**, *1*, 387.
7. *Tetrahedron Lett.*, **1999**, *40*, 6685.
8. *J. Org. Chem.*, **1999**, *64*, 3290.
9. *J. Am. Chem. Soc.*, **1999**, *121*, 4130.
10. *Angew. Chem. Int. Ed.*, **2000**, *39*, 4104.
11. *Acc. Chem. Res.*, **2000**, *33*, 363-372. (review)
12. *J. Am. Chem. Soc.*, **2003**, *125*, 1692.
13. *J. Am. Chem. Soc.*, **2002**, *124*, 13356.
14. *Org. Lett.*, **2005**, *7*, 3235.
15. *Org. Lett.*, **2005**, *7*, 5309.
16. *J. Am. Chem. Soc.*, **2004**, *126*, 8382.
17. *J. Am. Chem. Soc.*, **2004**, *126*, 8910.
18. *J. Am. Chem. Soc.*, **2010**, *132*, 11440.
19. *Org. Lett.*, **2014**, *16*, 2272.

<b>15-0411</b>	(-)-1,2-Bis((2 <i>S</i> ,5 <i>S</i> )-2,5-di- <i>i</i> -propylphospholano)benzene, 98+% (S,S)- <i>i</i> -Pr-DUPHOS (147253-69-8) C <sub>26</sub> H <sub>44</sub> P <sub>2</sub> ; FW: 418.58; white xtl.; m.p. 40° <i>air sensitive</i>	100mg 500mg 2g
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## Technical Note:

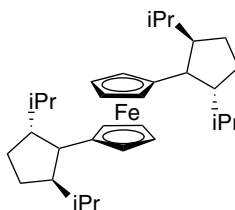
1. See 15-0410 (page 91)

<b>15-7357</b> amp	<b>1,2-Bis((2<i>R</i>,5<i>R</i>)-2,5-di-<i>i</i>-propylphospholano)ethane, 96%</b> (136705-63-0) C <sub>22</sub> H <sub>44</sub> P <sub>2</sub> ; FW: 370.53; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	100mg 500mg
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<b>15-7358</b>	<b>1,2-Bis((2<i>S</i>,5<i>S</i>)-2,5-di-<i>i</i>-propylphospholano)ethane, min. 97%</b> (528854-34-4) C <sub>22</sub> H <sub>44</sub> P <sub>2</sub> ; FW: 370.53; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	100mg 500mg
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<b>26-1610</b>	<b>1,1'-Bis((2<i>R</i>,5<i>R</i>)-2,5-di-<i>i</i>-propylphospholano)ferrocene, min. 97%</b> (849950-54-5) C <sub>30</sub> H <sub>48</sub> FeP <sub>2</sub> ; FW: 526.49; yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	100mg 500mg
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# PHOSPHORUS - Ligands and Compounds

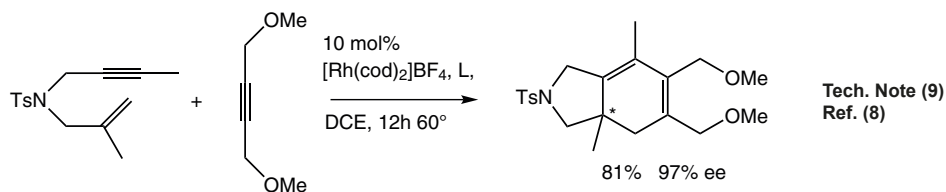
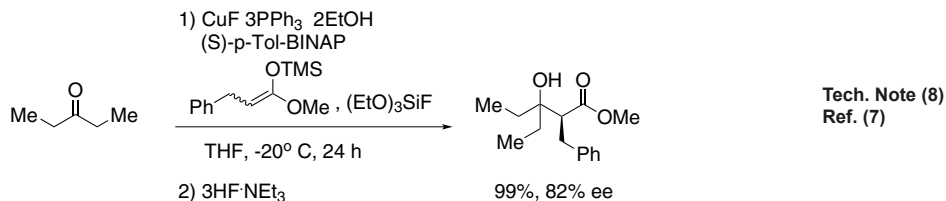
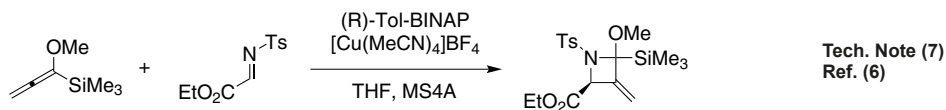
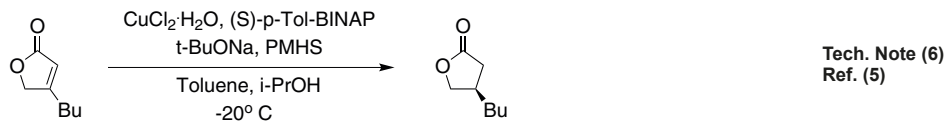
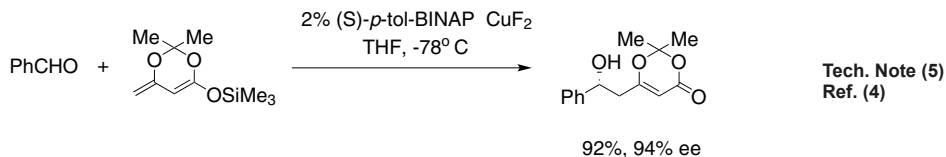
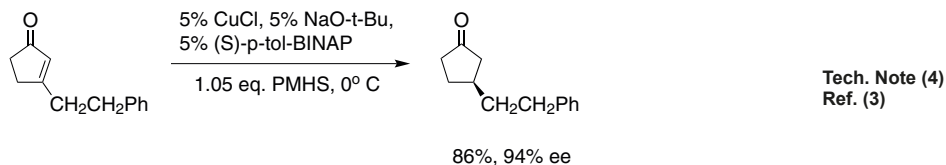
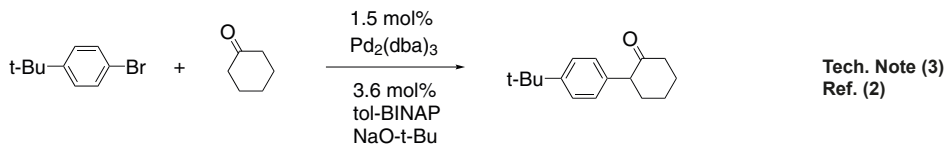
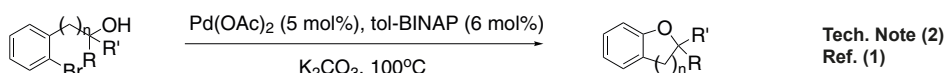
26-1611	<b>1,1'-Bis(2S,5S)-2,5-di-i-propylphospholano</b> ferrocene, min. 97% (540475-73-8) $C_{30}H_{48}FeP_2$ ; FW: 526.49; yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	100mg 500mg
15-0683	<b>1,2-Bis(di-2-pyridylphosphino)ethane</b> , min. 98% (106308-26-3) $C_{22}H_{20}N_4P_2$ ; FW: 402.37; white pwdr.	100mg 500mg
15-0155	<b>1,2-Bis(di-4-sulfonatophenyl-phosphino)benzene tetrasodium salt DMSO adduct</b> $C_8H_4[P(C_6H_4SO_3^-)]_2 \cdot 4Na^+(CH_3SOCH_3)$ ; FW: 854.65; off-white pwdr.	1g 5g
15-7328	<b>(1R,2R)-N,N-Bis[2-(di-p-tolylphosphino)benzyl]cyclohexane-1,2-diamine</b> , min. 97% (1150113-65-7) $C_{48}H_{52}N_2P_2$ ; FW: 718.89; yellow solid <i>air sensitive</i>	250mg 1g
15-7329	<b>(1S,2S)-N,N-Bis[2-(di-p-tolylphosphino)benzyl]cyclohexane-1,2-diamine</b> , min. 97% (1224727-08-5) $C_{48}H_{52}N_2P_2$ ; FW: 718.89; yellow solid <i>air sensitive</i>	250mg 1g
15-0152	<b>(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl</b> , 98% (R)-(+)-TolBINAP (99646-28-3) $C_{48}H_{40}P_2$ ; FW: 678.79; white pwdr.; m.p. 255-257° Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component.	250mg 1g 5g

## Technical Notes:

- See 15-0150.
- Useful ligand for palladium-catalyzed carbon-oxygen bond formation.
- Ligand for palladium-catalyzed  $\alpha$ -arylation of ketones.
- Ligand for Cu-catalyzed asymmetric conjugate reduction.
- Ligand for Cu-catalyzed asymmetric dienolate addition to aldehydes.
- Enantioselective conjugate reduction of lactones and lactams.
- Ligand used in the enantioselective cycloaddition of allenylsilanes with  $\alpha$ -imino esters.
- Catalytic Aldol reaction to ketones.
- Ligand with rhodium catalyses [2+2+2] cycloaddition reaction of alkenes and alkynes.
- Ligand used in the copper-catalyzed asymmetric conjugate addition of alkyl Grignard reagents on  $\alpha,\beta$ -unsaturated esters.
- Ligand used in the copper-catalyzed asymmetric synthesis of cyclopropanes via tandem conjugate addition and intramolecular enolate trapping.

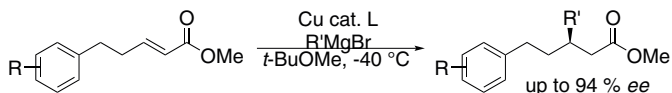
# PHOSPHORUS - Ligands and Compounds

15-0152 (continued) (R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP (99646-28-3)

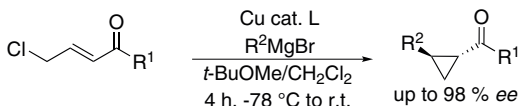


# PHOSPHORUS - Ligands and Compounds

**15-0152** (R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-ToBINAP (99646-28-3)  
(continued)



Tech. Note (10)  
Ref. (9)



Tech. Note (11)  
Ref. (10)

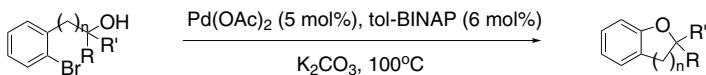
## References:

1. *J. Am. Chem. Soc.*, **1996**, *118*, 10333.
2. *J. Am. Chem. Soc.*, **1997**, *119*, 11108.
3. *J. Am. Chem. Soc.*, **2000**, *122*, 6797.
4. *J. Am. Chem. Soc.*, **1998**, *120*, 837.
5. *J. Am. Chem. Soc.*, **2003**, *125*, 11253.
6. *Org. Lett.*, **2003**, *5*(20), 3691.
7. *J. Am. Chem. Soc.*, **2003**, *125*, 5644.
8. *Org. Lett.*, **2005**, *7*(22), 4955.
9. *Chem. Commun.*, **2010**, *46*, 8694.
10. *J. Am. Chem. Soc.*, **2010**, *132*, 14349.

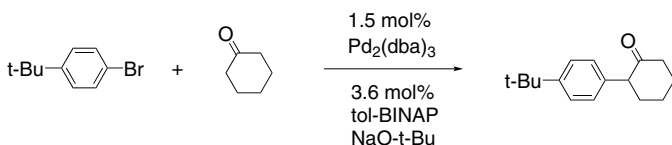
<b>15-0153</b>	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-ToBINAP (100165-88-6) C <sub>48</sub> H <sub>40</sub> P <sub>2</sub> ; FW: 678.79; white powdr.; m.p. 255-257° Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component.	250mg 1g 5g
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## Technical Notes:

1. See 15-0150.
2. Useful ligand for palladium-catalyzed carbon-oxygen bond formation.
3. Ligand for palladium-catalyzed  $\alpha$ -arylation of ketones.
4. Ligand for Cu-catalyzed asymmetric conjugate reduction.
5. Ligand for Cu-catalyzed asymmetric dienolate addition to aldehydes.
6. Enantioselective conjugate reduction of lactones and lactams.
7. Ligand used in the enantioselective cycloaddition of allenylsilanes with  $\alpha$ -imino esters.
8. Catalytic Aldol reaction to ketones.
9. Ligand with rhodium catalyses [2+2+2] cycloaddition reaction of alkenes and alkynes.
10. Ligand used in the iridium-catalyzed enantioselective C-H bond activation of 2-(alkylamino)-pyridine with alkenes.
11. Iridium-catalyzed regio-, diastereo-, and enantioselective tert-(hydroxyl)-prenylation of alcohols.
12. Rhodium-catalyzed cross cyclotrimerization.



Tech. Note (2)  
Ref. (1)

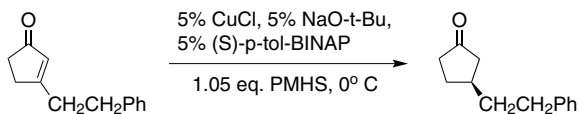


Tech. Note (3)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

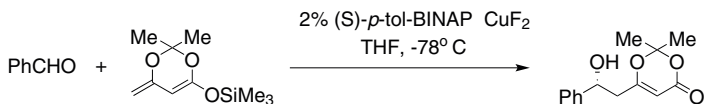
15-0153 (S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP (100165-88-6)

(continued)



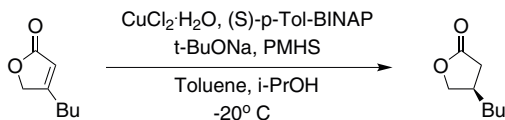
86%, 94% ee

Tech. Note (4)  
Ref. (3)

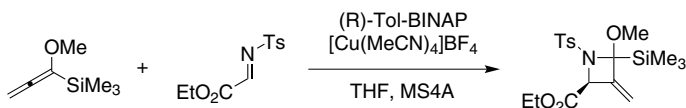


92%, 94% ee

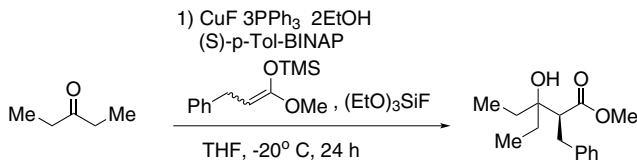
Tech. Note (5)  
Ref. (4)



Tech. Note (6)  
Ref. (5)



Tech. Note (7)  
Ref. (6)



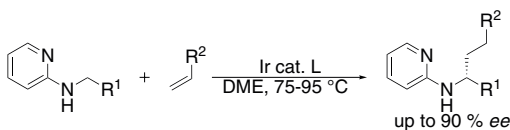
99%, 82% ee

Tech. Note (8)  
Ref. (7)

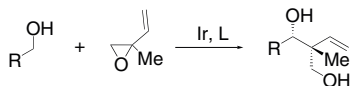


81% 97% ee

Tech. Note (9)  
Ref. (8)



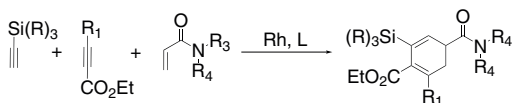
Tech. Note (10)  
Ref. (9)



Tech. Note (11)  
Ref. (10)

# PHOSPHORUS - Ligands and Compounds

15-0153 (S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-ToIBINAP (100165-88-6)  
(continued)

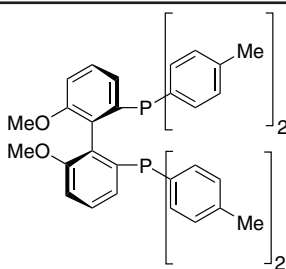


Tech. Note (12)  
Ref. (11)

## References:

1. *J. Am. Chem. Soc.*, **1996**, *118*, 10333
2. *J. Am. Chem. Soc.*, **1997**, *119*, 11108
3. *J. Am. Chem. Soc.*, **2000**, *122*, 6797
4. *J. Am. Chem. Soc.*, **1998**, *120*, 837
5. *J. Am. Chem. Soc.*, **2003**, *125*, 11253
6. *Org. Lett.*, **2003**, *5*, 20, 3691
7. *J. Am. Chem. Soc.*, **2003**, *125*, 5644
8. *Org. Lett.*, **2005**, *7*, 22, 4955
9. *Org. Lett.*, **2011**, *13*, 4692
10. *J. Am. Chem. Soc.*, **2014**, *136*, 8911
11. *Angew. Chem., Int. Ed.*, **2014**, *53*, 2956

**15-0156** (R)-(+)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (133545-24-1)  
C<sub>42</sub>H<sub>40</sub>O<sub>2</sub>P<sub>2</sub>; FW: 638.73;  
white to pale yellow solid  
Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component.

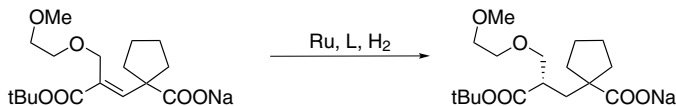


100mg  
500mg  
2g  
10g

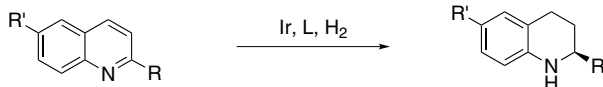
In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR<sub>2</sub> group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

## Technical Notes:

1. See 15-0042.
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
5. Conjugate addition using 2-heteroaryl titanates and zinc reagents.
6. Enantio- and regioselective heck-type reaction of aryl boronic acids with 2,3-dihydrofuran
7. Rhodium-catalyzed carbonyl Z-dienylation.
8. Rhodium-catalyzed asymmetric 1,4 addition of arylboronic acids to maleimides and enones.



Tech. Note (3)  
Ref. (3)

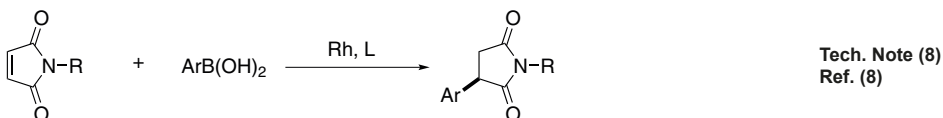
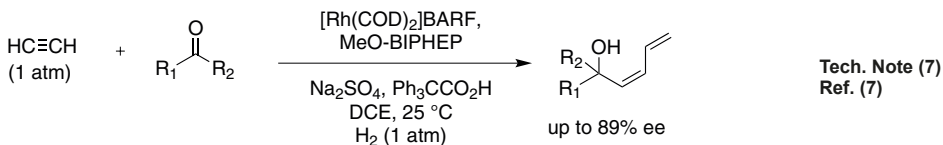
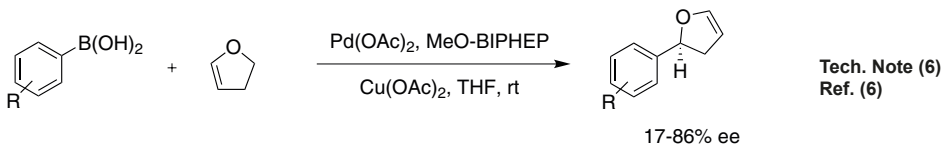
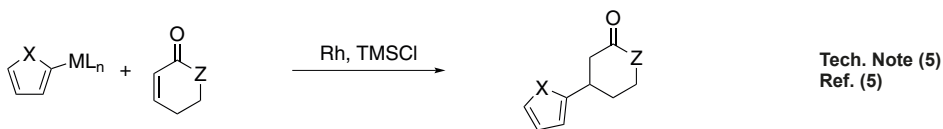


Tech. Note (4)  
Ref. (4)



# PHOSPHORUS - Ligands and Compounds

**15-0153** (R)-(+)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (133545-24-1)  
(continued)



## References:

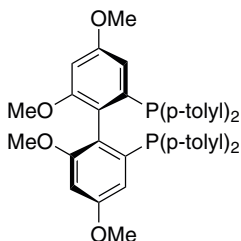
1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Devel.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. *J. Org. Chem.*, **2007**, 72, 3875.
7. *J. Am. Chem. Soc.*, **2006**, 128, 16040.
8. *J. Org. Chem.*, 2011, 76, 6925.

**15-0157** (S)-(-)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (133545-25-2) 100mg  
500mg  
C<sub>42</sub>H<sub>40</sub>O<sub>2</sub>P<sub>2</sub>; FW: 638.73; white powdr. 2g  
Note: Sold in collaboration with Solvias for research purposes only. 10g  
Solvias (S)-MeO BIPHEP Ligand Kit component.

## Technical Note:

1. See 15-0156 (page 99)

**15-1657** (R)-2,2'-Bis(di-p-tolylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97% (R)-Tol-Garphos™ (1365531-81-2) 100mg  
500mg  
C<sub>44</sub>H<sub>44</sub>O<sub>4</sub>P<sub>2</sub>; FW: 698.77; white xtl.  
air sensitive  
Note: Sold in collaboration with KCT.  
Patent US App No. 61/381,493.  
Garphos™ Ligand Kit component.

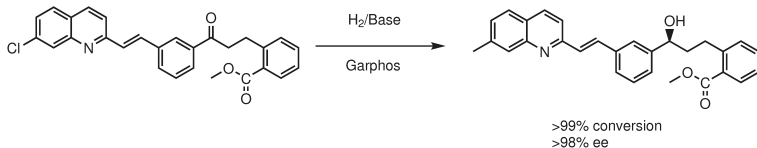


## Technical Note:

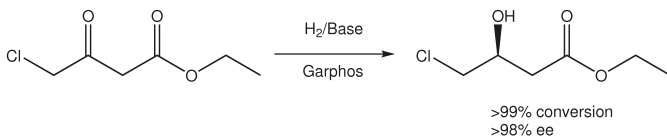
1. Chiral ligand used in the preparation of hydrogenation catalysts with exceptionally high activity and selectivity.

# PHOSPHORUS - Ligands and Compounds

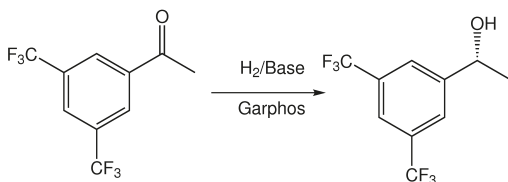
**15-1657** (R)-2,2'-Bis(di-p-tolylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97%  
(continued) (R)-Tol-Garphos™ (1365531-81-2)



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (1)**



**Tech. Note (3)**  
**Ref. (1)**

S:C = 100.000:1  
>99% conversion  
>99% ee

## References:

- US Patent Application No. 61/381,493.

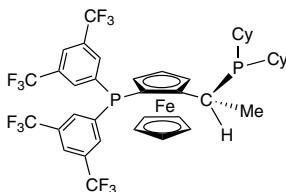
<b>15-1658</b>	<b>(S)-2,2'-Bis(di-p-tolylphosphino)-4,4',6,6'-tetramethoxy-1,1'-biphenyl, min. 97%</b> (S)-Tol-Garphos™ (1365531-82-3)	100mg 500mg
	C <sub>44</sub> H <sub>44</sub> O <sub>4</sub> P <sub>2</sub> ; FW: 698.77; white xtl. <i>air sensitive</i> Note: Sold in collaboration with KCT. Patent US App No. 61/381,493. Garphos™ Ligand Kit component.	

## Technical Note:

- See 15-1657 (page 100)

<b>15-0114</b> HAZ	<b>Bis(3,5-di(trifluoromethyl)phenyl)chlorophosphine, min. 98%</b> (142421-57-6)	500mg 2g
	C <sub>16</sub> H <sub>8</sub> ClF <sub>12</sub> P; FW: 492.63; colorless liq.; m.p. 25-29° <i>moisture sensitive</i>	

<b>26-0960</b>	<b>(R)-(-)-1-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl]ethyl-dicyclohexylphosphine, min. 97%</b> (292638-88-1)	100mg 500mg 2g 10g
	C <sub>40</sub> H <sub>40</sub> F <sub>12</sub> FeP <sub>2</sub> ; FW: 866.56; orange powdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.	



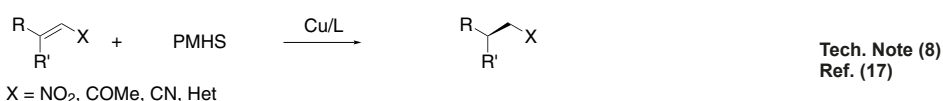
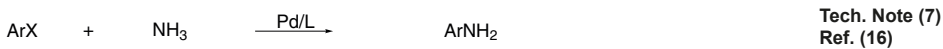
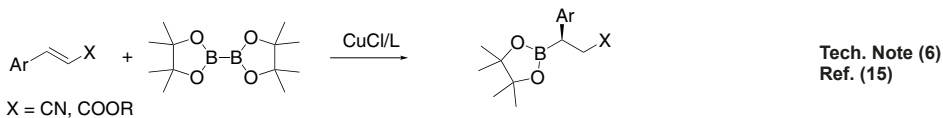
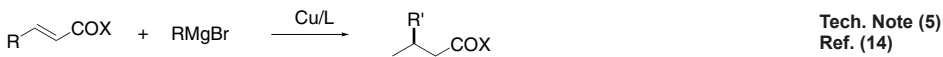
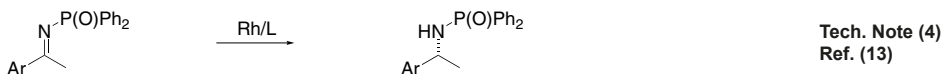
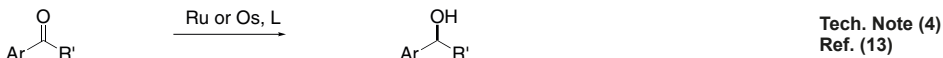
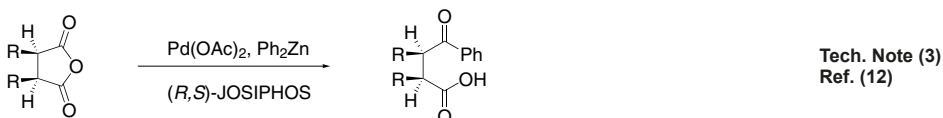
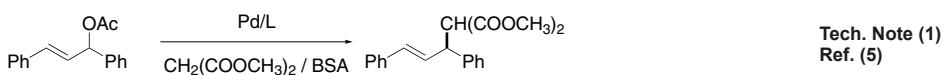
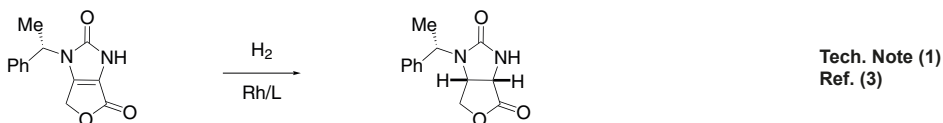
## Technical Notes:

- Ferrocenylphosphine ligands of the type cpFecp(PR<sub>2</sub>)<sub>2</sub>(\*CH(CH<sub>3</sub>)PR'<sub>2</sub>) are a class of asymmetric ligands developed at Solvias in Basel, Switzerland<sup>1</sup>. Ligands of this type are currently used industrially in the stereoselective synthesis of commercial products<sup>2,3</sup>. A unique feature of these bidentate ligands is the presence of a fixed phosphine moiety and a stereogenic, functionalized side chain, which can be easily modified to accommodate electronic and steric requirements. Based on a versatile synthetic procedure starting with optically active ferrocenes of the type cpFecp(PR<sub>2</sub>)>(\*CH(CH<sub>3</sub>)X) [X = OAc or NR<sub>2</sub>], a variety of donor atoms can be introduced into the side chain.<sup>4</sup> These ferrocene based phosphine ligands have wide application in the stereoselective hydrogenation of substituted acetamidoacrylates, enol acetates, β-ketoesters and simple alkenes<sup>5-9</sup>.

# PHOSPHORUS - Ligands and Compounds

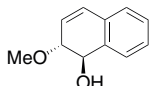
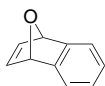
26-0960 (R)-(-)-1-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl]ethylidene-cyclohexylphosphine, min. 97% (292638-88-1)

- Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.
- Pd-catalyzed enantioselective alkylative desymmetrization of meso-succinic anhydrides.
- Asymmetric hydrogenation of ketones and phosphinylketimines.
- Michael addition of Grignard reagents to  $\alpha,\alpha$ -unsaturated esters and thioesters.
- Boration of  $\alpha,\alpha$ -unsaturated esters and nitriles.
- Reaction of aryl halides with ammonia.
- Cu-catalyzed reduction of activated C=C bonds with PMHS.
- Regio- and enantioselective hydroboration of vinyl arenes.
- Rh-catalyzed asymmetric ring-opening reactions of oxabicyclic alkenes.
- 1,2-Migrations in Pd-catalyzed Negishi couplings with JosiPhos ligands.
- Catalyst for the homodimerization of ketoketenes.
- Ligand for the Rh catalyzed synthesis of lactones.
- Ligand for the Cu-catalyzed synthesis of syn and anti  $\gamma$ -amino alcohols.



# PHOSPHORUS - Ligands and Compounds

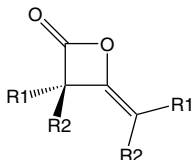
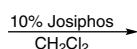
**26-0960** (R)-(-)-1-((S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl)ethyldi-cyclohexylphosphine, min. 97% (292638-88-1)



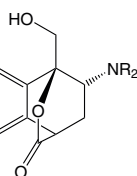
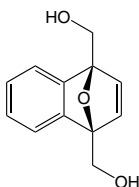
Tech. Note (10)  
Ref. (20)



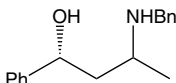
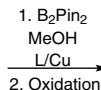
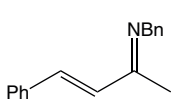
Tech. Note (11)  
Ref. (21)



Tech. Note (12)  
Ref. (22)



Tech. Note (13)  
Ref. (23)



syn or anti (99% ee)

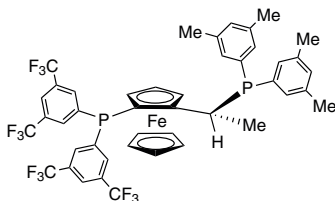
Tech. Note (14)  
Ref. (25)

## References:

- Solvias owns the patent rights for Strem products 26-1000, 26-1001, 26-1200, 26-1201, 26-1230, 26-1101, and for the Ir and Rh complexes of the aforementioned products, including the complexes of 26-1210 and 26-1211.
- C&E News, July 22, 1996, 38
- Angew. Chem. Int. Ed., 1996, 35, 1475
- J. Org. Chem., 1972, 37, 3052
- J. Am. Chem. Soc., 1994, 116, 4062
- Inorg. Chim. Acta., 1994, 222, 213
- Organometallics, 1996, 15, 860
- Helv. Chim. Acta., 1995, 78, 883
- European Patents; EP 624587 A2, 941117, EP, 612758, A1, 940831, EP, 564406, A1, 931006
- Comprehensive Asymmetric Catalysis, 1999, Chapter, 6.1, pg, 199, 207
- Topics in Catalysis, March 2002, 19, review
- J. Am. Chem. Soc., 2004, 126, 10248
- (a) Angew. Chem. Int. Ed., 2007, 46, 7651, b, Adv, Synth, Catal, 2002, 343, 68
- Angew. Chem. Int. Ed., 2005, 44, 2752
- Angew. Chem. Int. Ed., 2007, 47, 145
- J. Am. Chem. Soc., 2006, 128, 10028
- (a) Angew. Chem. Int. Ed., 2003, 42, 4793. (b) Angew. Chem, Int, Ed, 2006, 45, 2785. (c) J. Am. Chem. Soc., 2009, 131, 10386.
- Angew. Chem. Int. Ed., 2006, 45, 17674, review
- J. Am. Chem. Soc., 2004, 126, 9200
- Proc. Natl. Acad. Sci. U.S.A., 2004, 101, 5455
- J. Org. Chem., 2009, 74, 135
- J. Org. Chem. 2011, 76, 7901
- Angew. Chem. Int. Ed. 2011, 50, 7346
- Review: Privileged Ligands and Catalysts, 2011, 93
- Angew. Chem. Int. Ed. 2011, 353, 376

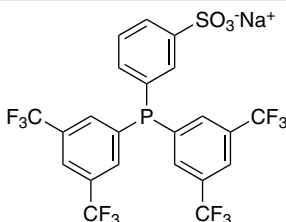
# PHOSPHORUS - Ligands and Compounds

**26-0965** (R)-(-)-1-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyl]ethylidene-3,5-xylylphosphine, min. 97% (166172-63-0)  
 $C_{44}H_{36}F_{12}FeP_2$ ; FW: 910.57;  
 orange powder.  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.



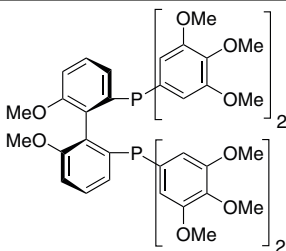
100mg  
 500mg  
 2g  
 10g

**15-0572** Bis(3,5-di-trifluoromethylphenyl)(3-sulfonatophenyl)phosphine, sodium salt, min. 97% DAN2PHOS (1289463-91-7)  
 $C_{22}H_{10}F_{12}NaO_3PS$ ; FW: 636.32;  
 white solid  
 Note: Sold under license from UAB for research purposes only. PCT/EP2010/06553.



100mg  
 500mg

**15-0158** (R)-(+)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (256390-47-3)  
 $C_{50}H_{56}O_{14}P_2$ ; FW: 942.94;  
 off-white powder.  
*air sensitive, (store cold)*  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO-BIPHEP Ligand Kit component.

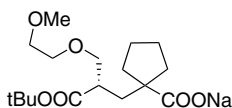
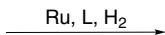
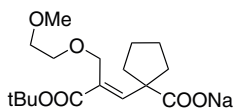


100mg  
 500mg  
 2g  
 10g

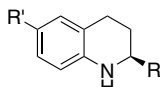
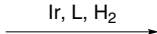
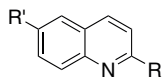
In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR<sub>2</sub> group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

Technical Notes:

1. See 15-0042.
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Ir catalyzed enantioselective hydrogenation of heteroaromatic compounds.
5. Conjugate addition using 2-heteroaryl titanates and zinc reagents.
6. Enantio- and regioselective heck-type reaction of aryl boronic acids with 2,3-dihydrofuran
7. Rhodium-catalyzed carbonyl Z-dienylation.
8. Rhodium-catalyzed asymmetric 1,4 addition of arylboronic acids to maleimides and enones.



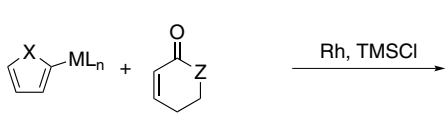
Tech. Note (3)  
 Ref. (3)



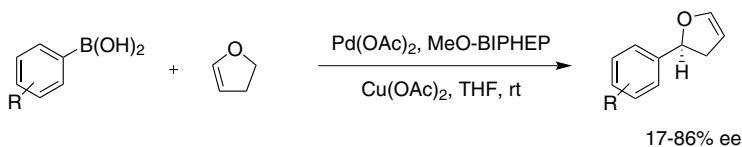
Tech. Note (4)  
 Ref. (4)

# PHOSPHORUS - Ligands and Compounds

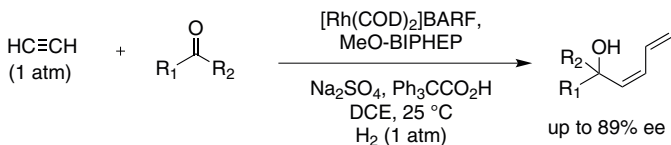
**15-0158** (R)-(+)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (256390-47-3)



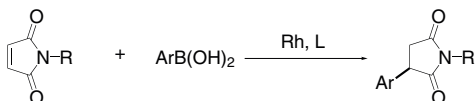
Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)



Tech. Note (7)  
Ref. (7)



Tech. Note (8)  
Ref. (8)

## References:

1. *Adv. Synth. Catal.*, **2004**, 346, 842.
2. *Org. Lett.*, **2006**, 8, 4573.
3. *Org. Process Res. Devel.*, **2001**, 5, 438.
4. *J. Am. Chem. Soc.*, **2003**, 125, 10536.
5. *Org. Lett.*, **2009**, 11, 4200.
6. *J. Org. Chem.*, **2007**, 72, 3875.
7. *J. Am. Chem. Soc.*, **2006**, 128, 16040.
8. *J. Org. Chem.*, **2011**, 76, 6925.

**15-0159** (S)-(-)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (256235-61-7)  
 $C_{50}H_{56}O_{14}P_2$ ; FW: 942.94; off-white powdr.  
*air sensitive, (store cold)*  
 Note: Sold in collaboration with Solvias for research purposes only.  
 Solvias (S)-MeO BIPHEP Ligand Kit component.

100mg  
500mg  
2g  
10g

## Technical Note:

1. See 15-0158 (page 104)

**15-0478** (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%  
 (R)-(+)-DM-SEGPHOS® (850253-53-1)  
 $C_{46}H_{44}O_4P_2$ ; FW: 722.79; off white to pale yellow powdr.; m.p. 256-261°  
 Note: Manufactured under license of Takasago patent. Takasago SEGPHOS® Ligand Kit component.

250mg  
1g  
5g

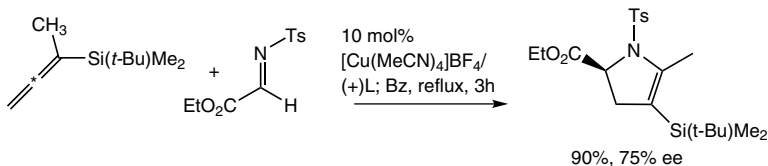
## Technical Notes:

1. Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPHOS ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of  $\alpha$ -substituted- $\beta$ -ketoesters. See 15-0066.
2. Copper catalyzed enantioselective [3 + 2] cycloaddition as a route to  $\gamma$ -amino ketones and 3-pyrrolidinones.

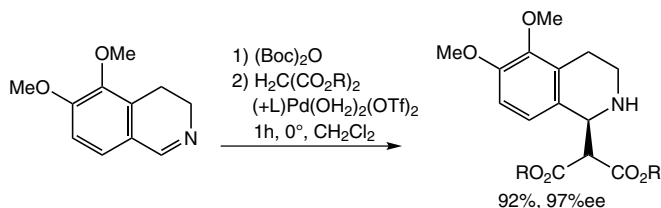
# PHOSPHORUS - Ligands and Compounds

15-0478 (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%  
(continued) (R)-(+)-DM-SEGPHOS® (850253-53-1)

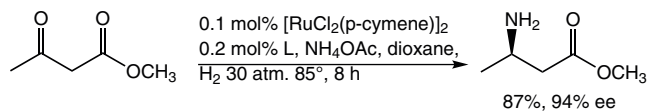
- Palladium catalyzed enantioselective addition of malonates to dihydroisoquinolines.
- Ruthenium catalyzed enantioselective synthesis of  $\beta$  amino acids by hydrogenation.
- Ruthenium catalyzed asymmetric hydrogenation of 3-quinuclidinone. See 44-0098 for Ru catalyst.
- Diastereo- and enantioselective ruthenium-catalyzed hydrohydroxyalkylation of 2-silyl-butadienes.
- Asymmetric [2+2+2] cycloaddition.
- Linear selective C-H activation.



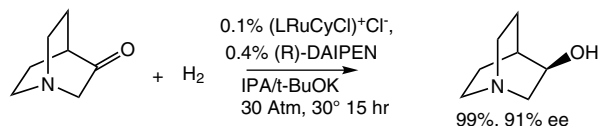
Tech. Note (2)  
Ref. (1)



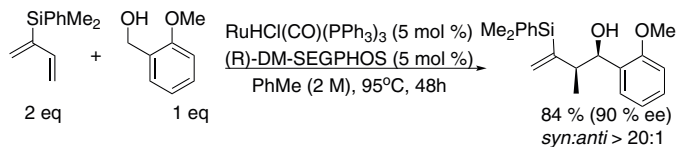
Tech. Note (3)  
Ref. (2)



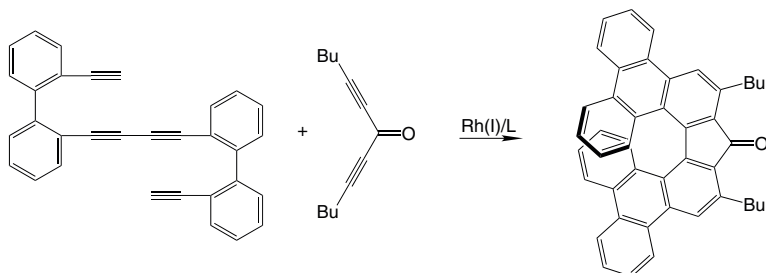
Tech. Note (4)  
Ref. (3)



Tech. Note (5)  
Ref. (4)



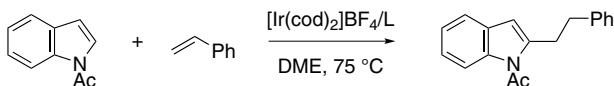
Tech. Note (6)  
Ref. (5)



Tech. Note (7)  
Ref. (6)

# PHOSPHORUS - Ligands and Compounds

**15-0478** (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%  
 (continued) (R)-(+)-DM-SEGPHOS® (850253-53-1)



Tech. Note (8)  
Ref. (7)

References:

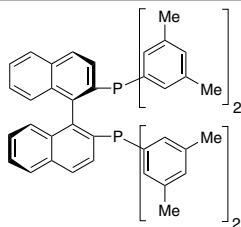
1. *Org. Lett.*, **2005**, 7, 1051.
2. *J. Am. Chem. Soc.*, **2006**, 128, 14010.
3. *WIPO Pat.* WO2005028419.
4. *U.S. Pat. App.* 2006047122.
5. *J. Am. Chem. Soc.*, **2011**, 133, 10582.
6. *J. Am. Chem. Soc.*, **2012**, 134, 4080.
7. *J. Am. Chem. Soc.*, **2012**, 134, 17474.

**15-0479** (S)-(-)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% 250mg  
 (S)-(-)-DM-SEGPHOS® (210169-57-6) 1g  
 $C_{48}H_{44}O_2P_2$ ; FW: 722.79; off-white to pale yellow pwdr.; m.p. 256-261° 5g  
 Note: Manufactured under license of Takasago patent. Takasago SEGPHOS®  
 Ligand Kit component.

Technical Note:

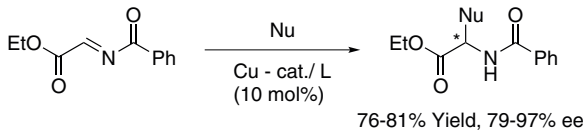
1. See 15-0478 (page 105)

**15-0476** (R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% 250mg  
 (R)-(+)-XylBINAP (137219-86-4) 1g  
 $C_{52}H_{48}P_2$ ; FW: 734.90; white to pale yellow xtl.; m.p. 203-206° 5g  
 Note: Manufactured under license of Takasago patent. Takasago BINAP  
 Ligand Kit component.

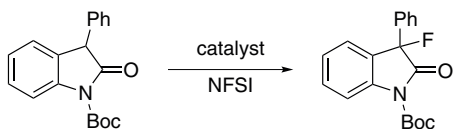


Technical Notes:

1. See 15-0150.
2. See 15-0477.
3. Ligand used in copper-catalyzed asymmetric Mannich-type reactions of N-acylimino esters.
4. Ligand used in the enantioselective fluorination of oxindoles.
5. Ligand used in [2+2+2] cycloaddition of tetraynes and hexaynes.
6. Ligand used in the asymmetric reduction of ketone via ruthenium-catalyzed transfer hydrogenation.
7. Asymmetric hydroboration of unsaturated imines.



Tech. Note (3)  
Ref. (1)

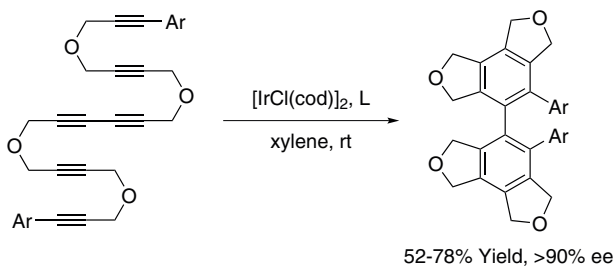


Tech. Note (4)  
Ref. (2)

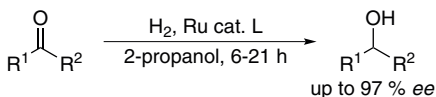


# PHOSPHORUS - Ligands and Compounds

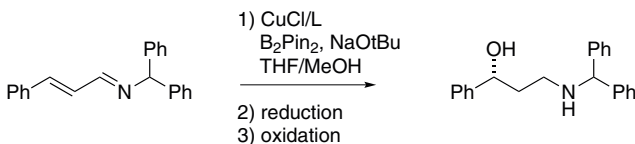
**15-0476** (R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98%  
(continued) (R)-(+)-XylBINAP (137219-86-4)



Tech. Note (5)  
Ref. (3)



Tech. Note (6)  
Ref. (4)



Tech. Note (7)  
Ref. (5)

## References:

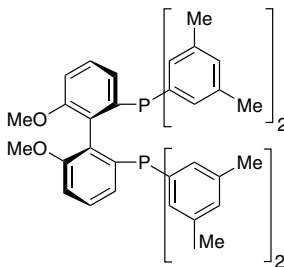
1. *J. Am. Chem. Soc.*, **2003**, *125*, 2507.
2. *J. Am. Chem. Soc.*, **2005**, *127*, 10164
3. *Tetrahedron*, **2008**, *64*, 821.
4. *J. Am. Chem. Soc.*, **2011**, *133*, 10696.
5. *Org. Lett.*, **2013**, *15*, 4810.

<b>15-0477</b>	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP (135139-00-3) C <sub>52</sub> H <sub>48</sub> P <sub>2</sub> ; FW: 734.90; white to pale yellow xtl.; m.p. 203-206° Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component.	250mg 1g 5g
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## Technical Note:

1. See 15-0476 (page 107)

<b>15-0488</b>	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (394248-45-4) C <sub>46</sub> H <sub>48</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 694.84; white powdr. (store cold) Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component.	100mg 500mg 2g 10g
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In many respects the catalytic profile of the MeOBIPHEP ligands is similar to that of other atropisomeric diphosphines such as binap and its many analogs. The nature of the PR<sub>2</sub> group strongly influences the catalytic performance of the metal complexes. The rhodium and ruthenium MeO-BIPHEP catalysts are highly effective for the hydrogenation of various C=O, C=C and C=N bonds and several synthetically useful C-C coupling reactions.

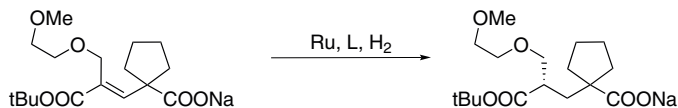
## Technical Notes:

1. See 15-0042.
2. Ru and Ir catalyzed dynamic kinetic resolution for the synthesis of hydroxy, amino acid derivatives.
3. Ru-catalyzed asymmetric hydrogenation of ketones and alkenes.
4. Enantioselective copper-catalyzed asymmetric hydrosilylation of aryl ketones.

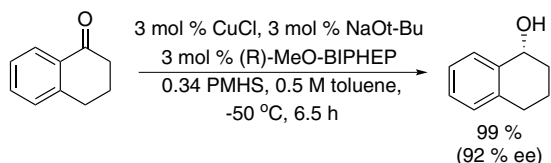
# PHOSPHORUS - Ligands and Compounds

**15-0488** (R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (continued) (394248-45-4)

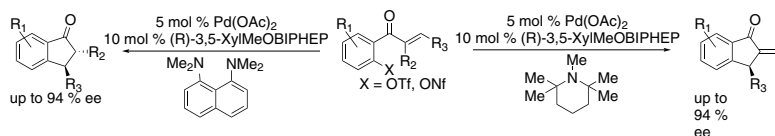
- Synthesis of chiral 3-substituted indanones via an enantioselective reductive-Heck reaction.
- Gold(I)-catalyzed enantioselective ring expansion of allenylcyclopropanols.
- Conjugate addition using 2-heteroaryl titanates and zinc reagents.



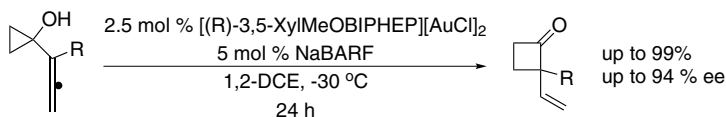
Tech. Note (3)  
Ref. (3)



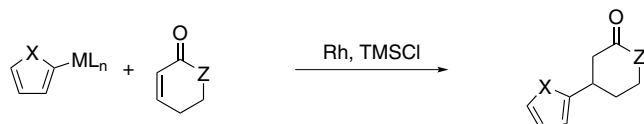
Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)



Tech. Note (7)  
Ref. (7)

## References:

- Adv. Synth. Catal.*, **2004**, 346, 842.
- Org. Lett.*, **2006**, 8, 4573.
- Org. Process Res. Devel.*, **2001**, 5, 438.
- J. Am. Chem. Soc.*, **2001**, 123, 12917.
- J. Org. Chem.*, **2007**, 72, 9253.
- J. Am. Chem. Soc.*, **2009**, 131, 9178.
- Org. Lett.*, **2009**, 11, 4200.

**15-0489** (S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (362634-22-8)

C<sub>46</sub>H<sub>48</sub>O<sub>2</sub>P<sub>2</sub>; FW: 694.84; white powder.

(store cold)

Note: Sold in collaboration with Solvias for research purposes only.  
Solvias (S)-MeO BIPHEP Ligand Kit component.

100mg  
500mg  
2g  
10g

## Technical Note:

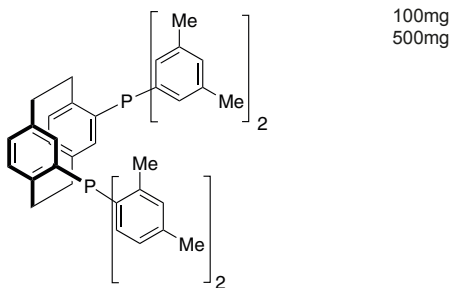
- See 15-0488 (page 108)

# PHOSPHORUS - Ligands and Compounds

15-0730

(R)-(-)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclophane, min.  
97% CTH-(R)-3,5-xylyl-PHANEPHOS  
(325168-89-6)

C<sub>48</sub>H<sub>50</sub>P<sub>2</sub>; FW: 688.86; white powdr.  
Note: Sold in collaboration with Johnson Matthey for research purposes only.  
US patent Application No 5874629 and patents arising therefrom.



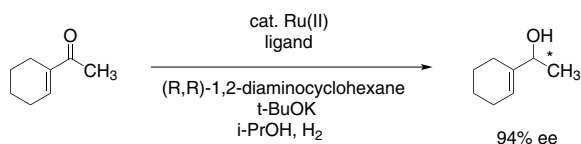
100mg  
500mg

## Technical Notes:

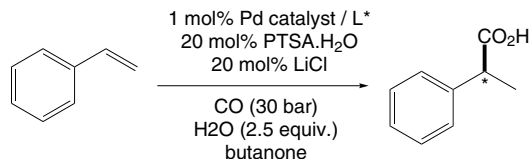
1. See 15-0425.
2. Chiral ligand employed in the enantioselective hydrogenation of various ketones.
3. Chiral ligand employed in the enantioselective hydroxycarbonylation and alkoxycarbonylation of alkenes.
4. Chiral ligand employed in the enantioselective [2+2] cycloaddition of oxabicyclic alkenes with terminal alkynes.
5. Chiral ligand employed in the gold-catalyzed enantioselective Cope rearrangement of achiral 1,5-dienes.



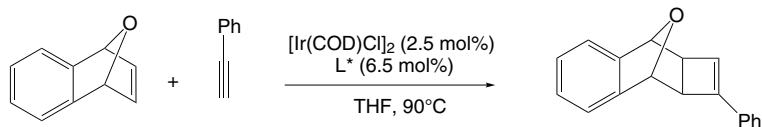
Tech. Note (2)  
Ref. (1)



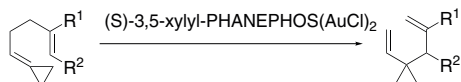
Tech. Note (2)  
Ref. (1)



Tech. Note (3)  
Ref. (2)



Tech. Note (4)  
Ref. (3)



Tech. Note (5)  
Ref. (4)

## References:

1. *Org. Lett.*, **2000**, 2, 4173.
2. *Angew. Chem. Int. Ed.*, **2010**, 49, 9197.
3. *Org. Lett.*, **2010**, 12, 304.
4. *Nature Chemistry*, **2012**, 4, 405.

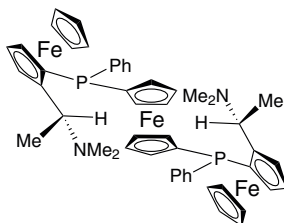
# PHOSPHORUS - Ligands and Compounds

<b>15-0731</b>	<b>(S)-(+)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclophane, min. 97%</b> <b>CTH-(S)-3,5-xylyl-PHANEPHOS (325168-88-5)</b> C <sub>48</sub> H <sub>50</sub> P <sub>2</sub> ; FW: 688.86; white powdr. Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No 5874629 and patents arising therefrom.	100mg 500mg
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Technical Note:

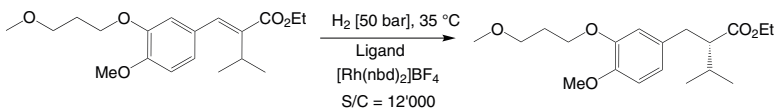
- See 15-0730 (page 110)

<b>26-1261</b>	<b>1,1'-Bis{1-[(R)-ferrocenyl-2-(S)-ethyl-1-(diethylamino) phenyl]- (R)-phosphino} ferrocene, min. 97% Trifer (899811-43-9)</b> C <sub>59</sub> H <sub>54</sub> Fe <sub>3</sub> N <sub>2</sub> P <sub>2</sub> ; FW: 912.46; orange powdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg 500mg 2g 10g
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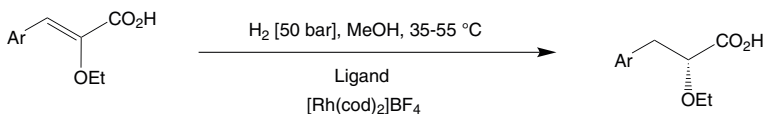


Technical Notes:

- Ligand used for the Rh-catalyzed asymmetric hydrogenation of  $\alpha$ -substituted acrylic acids.
- Ligand used for the Rh-catalyzed asymmetric hydrogenation of 3-aryl-2-ethoxy-acrylic acids.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (1)**

References:

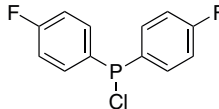
- Angew. Chem. Int. Ed. 2007, 46, 4141.

<b>26-1260</b>	<b>1,1'-Bis{1-[(S)-ferrocenyl-2-(R)-ethyl-1-(dimethylamino) phenyl]- (S)-phosphino} ferrocene, min. 97% Trifer (900505-82-0)</b> C <sub>59</sub> H <sub>54</sub> Fe <sub>3</sub> N <sub>2</sub> P <sub>2</sub> ; FW: 912.46; orange powdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg 500mg 2g 10g
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Technical Note:

- See 26-1261 (page 111)

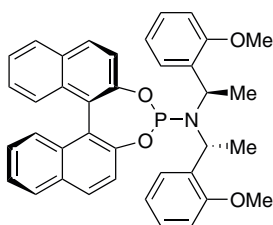
<b>15-7318</b> HAZ	<b>Bis(4-fluorophenyl) chlorophosphine, min. 98% (23039-97-6)</b> (C <sub>8</sub> H <sub>7</sub> F) <sub>2</sub> ClP; FW: 256.62; pale yellow liq. moisture sensitive	250mg 1g
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# PHOSPHORUS - Ligands and Compounds

15-0522

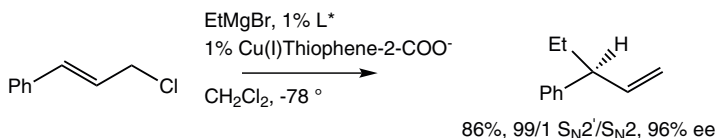
(11bR)-N,N-Bis[(R)-(-)-1-(2-methoxyphenyl)ethyl]dina-phtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-amine, min. 98% (736158-72-8)  
 $C_{39}H_{34}NO_4P$ ; FW: 599.65; white pwr.  
*moisture sensitive*



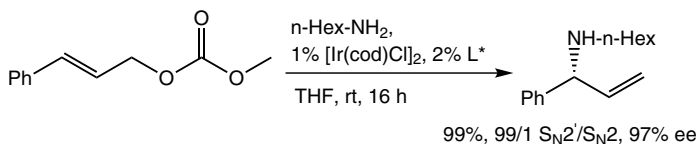
100mg  
500mg

## Technical Notes:

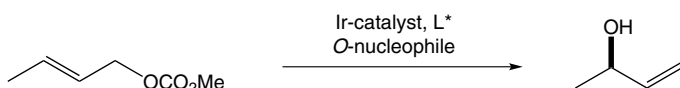
- Ligand for the copper catalyzed, highly regioselective substitution reactions of a wide variety of aromatic and aliphatic substituted allylic halides to form branched chiral products from diverse Grignard and dialkyl zinc reagents.
- Ligand for the iridium catalyzed, highly regioselective, substitution reactions of a wide variety of aromatic and aliphatic substituted allylic carboxylates to form branched chiral products from amines, stabilized carbanions, and aryl zinc reagents.
- Ligand for the iridium catalyzed, highly regioselective, substitution reactions of a wide variety of aromatic and aliphatic substituted allylic carboxylates to form branched chiral products from alcohol.
- Ligand for the iridium catalyzed, highly regioselective, substitution reactions of a wide variety of aromatic and aliphatic substituted allylic carboxylates to form branched chiral products from thiolate.
- Ligand for the copper catalyzed, highly regioselective substitution reactions of a wide variety of aromatic and aliphatic substituted allylic halides to form branched chiral products from diverse organolithium compounds.



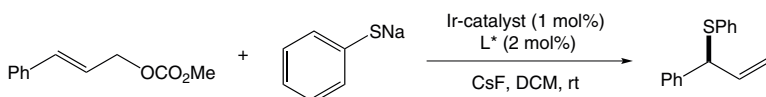
Tech. Note (1)  
Ref. (1-2)



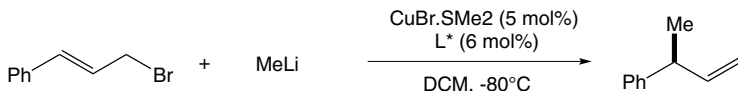
Tech. Note (2)  
Ref. (1,3,4)



Tech. Note (3)  
Ref. (5)



Tech. Note (4)  
Ref. (6)



Tech. Note (5)  
Ref. (7)

## References:

- Angew. Chem., Int. Ed.*, **2004**, 43, 2426.
- Eur. J. Org. Chem.* **2008**, 3765 (review article).
- Chem. Comm.*, **2007**, 675 (review article).
- Chem. Eur. J.*, **2009**, 15, 1205.
- J. Am. Chem. Soc.*, **2011**, 133, 2072.
- Org. Lett.*, **2010**, 12, 4454.
- Nature Chem.*, **2011**, 377.

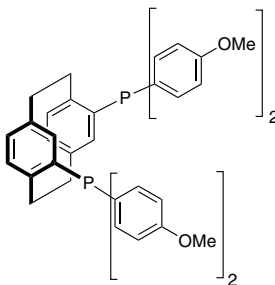
# PHOSPHORUS - Ligands and Compounds

<b>15-0523</b>	<b>(11bS)-N,N-Bis[(S)-(+)-1-(2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1'-1',2'-f][1,3,2]dioxaphosphepin-4-amine, min. 98%</b> (776316-48-4) C <sub>38</sub> H <sub>34</sub> NO <sub>4</sub> P; FW: 599.65; white pwdr. <i>moisture sensitive</i>	100mg 500mg
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Technical Note:

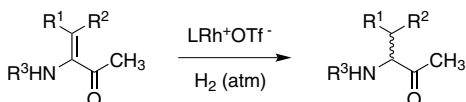
- See 15-0522 (page 112)

<b>15-0710</b>	<b>(R)-4,12-Bis(4-methoxyphenyl)-[2.2]-paracyclophane R-An-Phanephos (364732-86-5)</b> C <sub>44</sub> H <sub>42</sub> O <sub>4</sub> P; FW: 696.75; white pwdr. Note: Sold in collaboration with JM for research purposes only.	100mg 500mg
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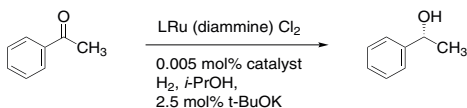


Technical Notes:

- Highly enantioselective catalyst for the hydrogenation of dehydroamino acids, methyl esters under mild conditions.
- Asymmetric hydrogenation of a wide variety of aromatic, heteroaromatic, and  $\alpha$ - $\beta$  unsaturated ketones.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

References:

- J. Am. Chem. Soc.*, **1997**, *119*, 6207.
- Org. Lett.*, **2000**, *2*, 4173.

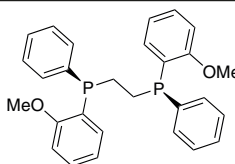
<b>15-0711</b>	<b>(S)-4,12-Bis(4-methoxyphenyl)-[2.2]-paracyclophane S-An-Phanephos</b> C <sub>44</sub> H <sub>42</sub> O <sub>4</sub> P; FW: 696.75; white pwdr. Note: Sold in collaboration with JM for research purposes only.	100mg 500mg
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Technical Note:

- See 15-0710 (page 113)

<b>15-0466</b>	<b>Bis(2-methoxyphenyl)phenylphosphine, min. 98%</b> (36802-41-2) (C <sub>8</sub> H <sub>4</sub> OCH <sub>3</sub> ) <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ); FW: 322.34; white xtl.; m.p. 163-164°	1g 5g 25g
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<b>15-0481</b>	<b>(R,R)-(-)-1,2-Bis[(2-methoxyphenyl)(phenyl)phosphino]ethane, 98%</b> <b>(-)-DIPAMP (55739-58-7)</b> (C <sub>8</sub> H <sub>4</sub> OCH <sub>3</sub> )(C <sub>6</sub> H <sub>5</sub> )PCH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> H <sub>4</sub> OCH <sub>3</sub> )(C <sub>6</sub> H <sub>5</sub> ); FW: 458.47; white xtl.; m.p. 102-103°	250mg 1g
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Technical Note:

- Rhodium DIPAMP catalysts have shown high activity and enantioselectivity in the asymmetric hydrogenation of enamides, enol acetates and olefins.

References:

- ACS Symposium Series*, **1993**, *517* (Selectivity in Catalysis), 58-74 (review).
- Acc. Chem. Res.*, **1983**, *16*, 106 (review).

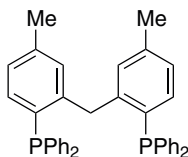
# PHOSPHORUS - Ligands and Compounds

<b>15-0482</b>	<b>(S,S)-(+)-1,2-Bis[(2-methoxyphenyl)(phenyl)phosphino]ethane, 98% (+)-DIPAMP (97858-62-3)</b> (C <sub>6</sub> H <sub>4</sub> OCH <sub>3</sub> )(C <sub>6</sub> H <sub>5</sub> )PCH <sub>2</sub> CH <sub>2</sub> P(C <sub>6</sub> H <sub>4</sub> OCH <sub>3</sub> )(C <sub>6</sub> H <sub>5</sub> ); FW: 458.47; white xtl.; m.p. 102-103°	250mg 1g
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Technical Note:

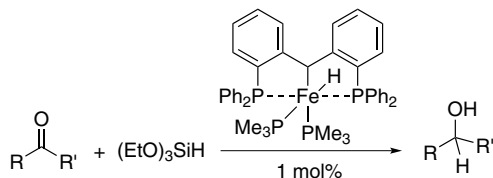
- See 15-0482 (page 114)

<b>15-0358</b>	<b>Bis[2-(4-methyldiphenylphosphino)phenyl]methane, 90%</b> <b>NEW</b> C <sub>39</sub> H <sub>34</sub> P <sub>2</sub> ; FW: 564.64; white powdr.	100mg 500mg 2g
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Technical Note:

- Alternative ligand for the iron catalyzed reduction of ketones



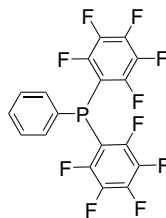
Tech. Note (1)  
Ref. (1)

References:

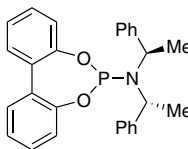
- Organometallics*, **2014**, *33*, 3535 (Note: This reference is for the non-methylated analog.)

<b>15-0115</b>	<b>Bis(1-naphthyl)chlorophosphine, min. 97% (36042-99-6)</b> C <sub>20</sub> H <sub>14</sub> ClP; FW: 320.75; white to pale yellow xtl. <i>moisture sensitive</i>	500mg 2g
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<b>15-0374</b>	<b>Bis(pentafluorophenyl)phenylphosphine, 97%</b> <b>NEW</b> (5074-71-5) C <sub>16</sub> H <sub>5</sub> F <sub>10</sub> P; FW: 442.20; white powdr.; m.p. 59-61°; b.p. 105°C/0.3mm; f.p. >110°C <i>air sensitive</i>	250mg 1g
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<b>15-0518</b>	<b>N,N-Bis[(1R)-(+)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine</b> (500103-26-4) C <sub>28</sub> H <sub>28</sub> NO <sub>2</sub> P; FW: 439.49; white powdr. <i>moisture sensitive</i>	100mg 500mg
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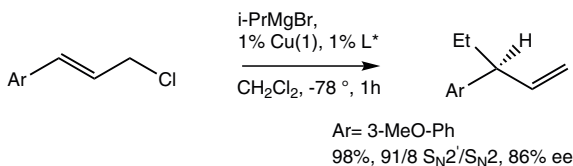


Technical Notes:

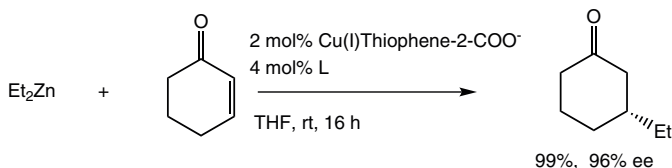
- Ligand for the copper catalyzed, highly regioselective substitution reactions of a wide variety of aromatic substituted allylic halides to form branched chiral products from diverse Grignard reagents.
- Ligand for the copper catalyzed, highly enantioselective conjugate addition of diethylzinc to enones and nitro olefins.
- Ligand for the nickel catalyzed, highly enantioselective hydrovinylation of alkenes.
- Ligand for the rhodium catalyzed, highly enantioselective hydroformylation of vinylarenes.
- Ligand for gold catalyzed asymmetric intramolecular hydroamination of allenes

# PHOSPHORUS - Ligands and Compounds

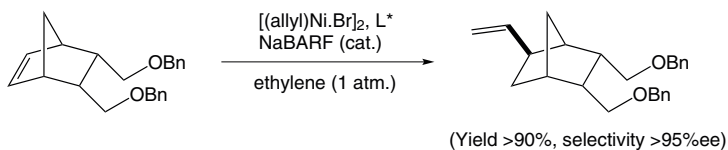
**15-0518** N,N-Bis[(1R)-(+)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine (500103-26-4)  
(continued)



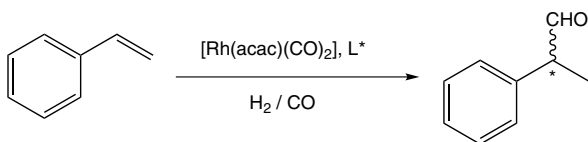
Tech. Note (1)  
Ref. (1,2)



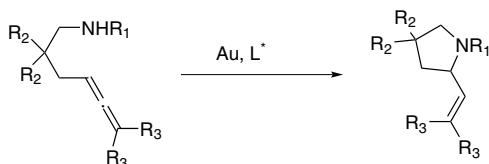
Tech. Note (2)  
Ref. (3,4)



Tech. Note (3)  
Ref. (5)



Tech. Note (4)  
Ref. (6)



Tech. Note (5)  
Ref. (7)

## References:


1. *Org. Lett.*, **2002**, 4, 4147
2. *Eur. J. Org. Chem.*, **2008**, 3765 (review article).
3. *J. Am. Chem. Soc.*, **2002**, 124, 5262.
4. *Synlett*, **2001**, 9, 1375.
5. *J. Org. Chem.*, **2010**, 75, 7636.
6. *Tetrahedron Asymmetry*, **2010**, 21, 2153.
7. *Organometallics*, **2013**, 32, 5589.

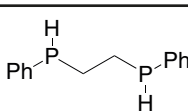
**15-0519** N,N-Bis[(1S)-(-)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine (376355-58-7)  
C<sub>28</sub>H<sub>26</sub>NO<sub>2</sub>P; FW: 439.49; white powdr.  
moisture sensitive

100mg  
500mg

## Technical Note:

1. See 15-0518 (page 114)

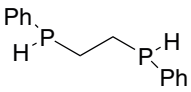

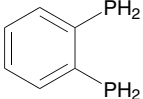

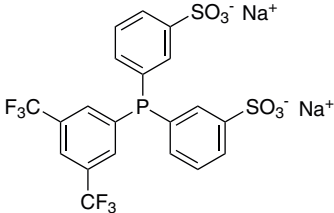
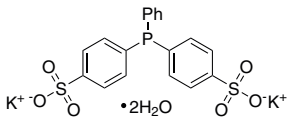
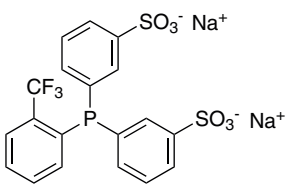
**15-0405**  
amp  
HAZ  
  
1,2-Bis(phenylphosphino)ethane, min. 90%  
(18899-64-4)  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>HPCH<sub>2</sub>CH<sub>2</sub>PH(C<sub>6</sub>H<sub>5</sub>); FW: 246.22;  
colorless to yellow liq.  
pyrophoric



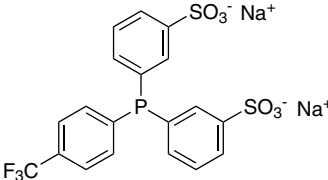
500mg  
2g

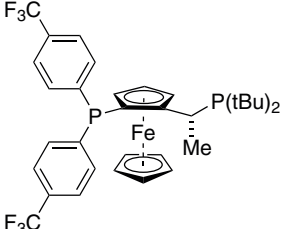


# PHOSPHORUS - Ligands and Compounds

15-0409 HAZ	<b>1,2-Bis(phenylphosphino)ethane, min. 95% (10wt% in hexanes)</b> (18899-64-4) $(C_6H_5)_2HPCH_2CH_2PH(C_6H_5)$ ; FW: 246.22; colorless liq. <i>air sensitive</i>		5g 20g
15-0456 amp HAZ	<b>1,3-Bis(phenylphosphino)propane, 90-95%</b> (28240-66-6) $C_6H_5P(H)CH_2CH_2CH_2(H)PC_6H_5$ ; FW: 260.26; colorless liq.; b.p. 160-165°/1 mm <i>air sensitive</i>		1g 5g
15-0461 amp HAZ 	<b>1,2-Bis(phosphino)benzene, 98+% (80510-04-9)</b> $C_6H_4(PH_2)_2$ ; FW: 142.08; colorless liq.; b.p. 53-55°/0.25mm; d. 1.101 <i>pyrophoric</i>		1g 5g
15-0462 HAZ	<b>1,2-Bis(phosphino)benzene, 98+% (10 wt% in hexanes)</b> (80510-04-9) $C_6H_4(PH_2)_2$ ; FW: 142.08; colorless liq. <i>air sensitive</i>		10g 50g
15-0459 amp HAZ 	<b>1,2-Bis(phosphino)ethane, 99%</b> (5518-62-7) $H_2PCH_2CH_2PH_2$ ; FW: 92.02; colorless liq.; b.p. 109-110° <i>pyrophoric</i>		250mg 1g
15-0570	<b>Bis(3-sulfonatophenyl)(3,5-di-trifluoromethylphenyl)phosphine, disodium salt monohydrate, min. 97% DANPHOS (water soluble)</b> (1289463-82-6) $C_{20}H_{13}F_6Na_2O_6PS_2 \cdot H_2O$ ; FW: 604.39 (622.41); white powdr. Note: Water soluble phosphine. Sold under license from UAB for research purposes only. PCT/EP2010/065531.		100mg 500mg
15-0638 <b>NEW</b>	<b>Bis(p-sulfonatophenyl)phenylphosphine dihydrate dipotassium salt, 97%</b> (308103-66-4) $C_{18}H_{13}K_2O_8PS_2$ ; FW: 498.60(534.63); white powdr.; m.p. 98-102° <i>air sensitive</i>		100mg 500mg
15-0463	<b>Bis(p-sulfonatophenyl)phenylphosphine dihydrate dipotassium salt, min. 97%</b> (151888-20-9) $C_6H_5P(C_6H_4SO_3K)_2 \cdot 2H_2O$ ; FW: 498.58 (534.62); white powdr.		500mg 2g 10g
Technical Note:			
1. A water-soluble phosphine ligand used in the formation of water-soluble catalysts.			
15-0577	<b>Bis(3-sulfonatophenyl)(2-trifluoromethylphenyl)phosphine, disodium dihydrate, min. 97% o-DANPHOS</b> (1289463-84-8) $C_{19}H_{12}F_3Na_2O_6PS_2 \cdot 2H_2O$ ; FW: 534.38 (570.41); white powdr. Note: Water soluble phosphine. Sold under license from UAB for research purposes only. PCT/EP2010/065531.		100mg 500mg

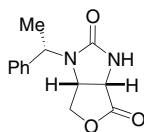
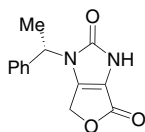
# PHOSPHORUS - Ligands and Compounds

<b>15-0575</b> <b>Bis(3-sulfonatophenyl)(4-trifluoromethylphenyl)phosphine disodium dihydrate, min. 97% p-DANPHOS (1289463-79-1)</b> $C_{19}H_{12}F_3Na_2O_6PS_2 \cdot 2H_2O$ ; FW: 534.38 (570.41); white powdr. Note: Water soluble phosphine. Sold under license from UAB for research purposes only. PCT/EP2010/065531.		100mg 500mg
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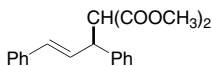
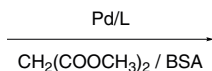
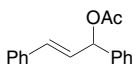
<b>26-0650</b> <b>(R)-(-)-1-((S)-2-[Bis(4-trifluoromethylphenyl) phosphino]ferrocenyl) ethyl-di-t-butylphosphine, min. 97% (246231-79-8)</b> $C_{34}H_{38}F_6FeP_2$ ; FW: 678.45; orange powdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.		100mg 500mg 2g 10g
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## Technical Notes:

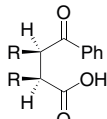
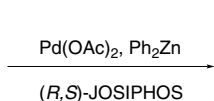
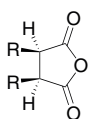
- Ferrocenylphosphine ligands of the type  $cpFecp(PR_2)(^*CH(CH_3)PR^1_2)$  are a class of asymmetric ligands developed at Solvias in Basel, Switzerland<sup>1</sup>. Ligands of this type are currently used industrially in the stereoselective synthesis of commercial products<sup>2,3</sup>. A unique feature of these bidentate ligands is the presence of a fixed phosphine moiety and a stereogenic, functionalized side chain, which can be easily modified to accommodate electronic and steric requirements. Based on a versatile synthetic procedure starting with optically active ferrocenes of the type  $cpFecp(PR_2)(^*CH(CH_3)X)$  [ $X = OAc$  or  $NR_2$ ], a variety of donor atoms can be introduced into the side chain.<sup>4</sup> These ferrocene based phosphine ligands have wide application in the stereoselective hydrogenation of substituted acetamidoacrylates, enol acetates,  $\beta$ -ketoesters and simple alkenes<sup>5-9</sup>.
- Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.
- Pd-catalyzed enantioselective alkylative desymmetrization of *meso*-succinic anhydrides.
- Asymmetric hydrogenation of ketones and phosphinylketimines.
- Michael addition of Grignard reagents to  $\alpha,\alpha$ -unsaturated esters and thioesters.
- Boration of  $\alpha,\alpha$ -unsaturated esters and nitriles.
- Reaction of aryl halides with ammonia.
- Cu-catalyzed reduction of activated C=C bonds with PMHS.
- Regio- and enantioselective hydroboration of vinyl arenes.
- Rh-catalyzed asymmetric ring-opening reactions of oxabicyclic alkenes.
- 1,2-Migrations in Pd-catalyzed Negishi couplings with JosiPhos ligands.
- Catalyst for the homodimerization of ketoketenes.
- Ligand for the Rh catalyzed synthesis of lactones.
- Ligand for the Cu-catalyzed synthesis of syn and anti  $\gamma$ -amino alcohol



Tech. Note (1)  
Ref. (3)



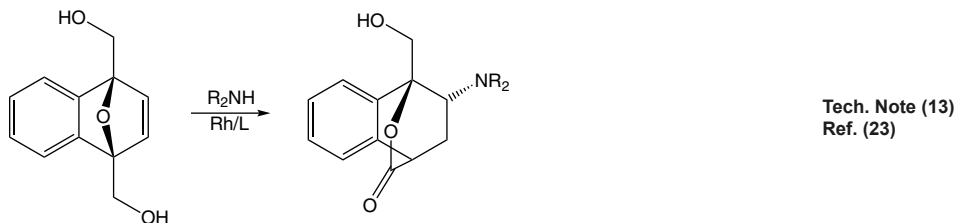
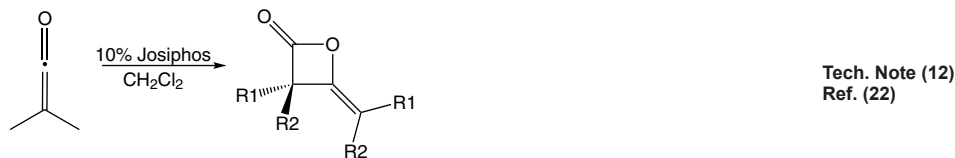
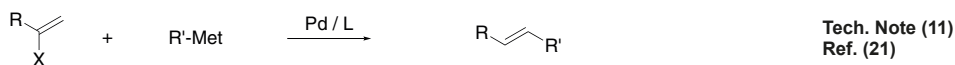
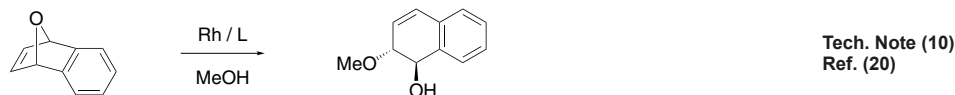
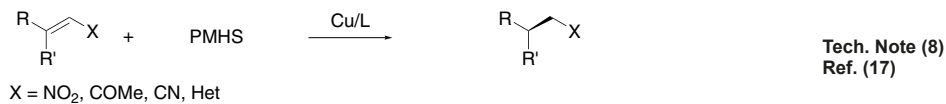
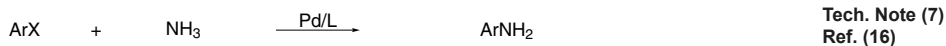
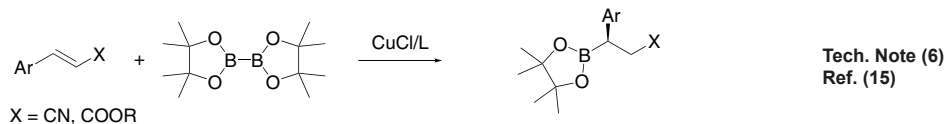
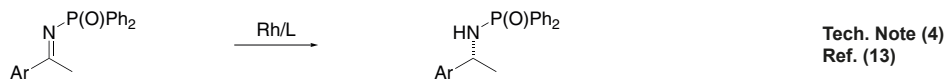
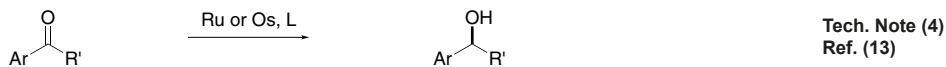
Tech. Note (1)  
Ref. (5)



Tech. Note (3)  
Ref. (12)

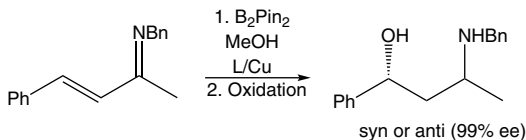
# PHOSPHORUS - Ligands and Compounds

26-0650 (continued) (R)-(-)-1-[(S)-2-[Bis(4-trifluoromethylphenyl) phosphino]ferrocenyl] ethyl-di-t-butylphosphine, min. 97% (246231-79-8)



# PHOSPHORUS - Ligands and Compounds

**26-0650** (R)-(-)-1-[(S)-2-[Bis(4-trifluoromethylphenyl) phosphino]ferrocenyl] ethyl-di-t-butylphosphine, min. 97% (246231-79-8)  
(continued)

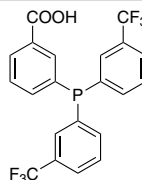


**Tech. Note (14)**  
**Ref. (25)**

## References:

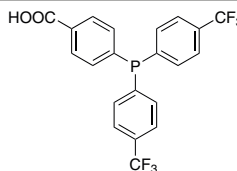
- Solvias owns the patent rights for Strem products 26-1000, 26-1001, 26-1200, 26-1201, 26-1230, 26-1101 and for the Ir and Rh complexes of the aforementioned products including the complexes 26-1210 and 26-1211.
- C&E News*, July 22, 1996, 38
- Angew. Chem. Int. Ed.*, 1996, 35, 1475
- J. Org. Chem.*, 1972, 37, 3052
- J. Am. Chem. Soc.*, 1994, 116, 4062
- Inorg. Chim. Acta.*, 1994, 222, 213
- Organometallics*, 1996, 15, 860
- Helv. Chim. Acta.*, 1995, 78, 883
- European Patents*; EP 624587 A2, 941117, EP, 612758, A1, 940831, EP, 564406, A1, 931006
- Comprehensive Asymmetric Catalysis*, 1999, Chapter, 6.1, pg, 199, 207
- Topics in Catalysis*, March 2002, 19, review
- J. Am. Chem. Soc.*, 2004, 126, 10248
- (a) *Angew. Chem. Int. Ed.*, 2007, 46, 7651, b, Adv, Synth, Catal, 2002, 343, 68
- Angew. Chem. Int. Ed.*, 2005, 44, 2752
- Angew. Chem. Int. Ed.*, 2007, 47, 145
- J. Am. Chem. Soc.*, 2006, 128, 10028
- (a) *Angew. Chem. Int. Ed.*, 2003, 42, 4793, b, *Angew. Chem. Int. Ed.*, 2006, 45, 2785
- Angew. Chem. Int. Ed.*, 2006, 45, 17674, review
- J. Am. Chem. Soc.*, 2004, 126, 9200
- Proc. Natl. Acad. Sci. U.S.A.*, 2004, 101, 5455
- J. Org. Chem.*, 2009, 74, 135
- J. Org. Chem.* 2011, 76, 7901
- Angew. Chem. Int. Ed.* 2011, 50, 7346
- Review: *Privileged Ligands and Catalysts*, 2011, 93
- Angew. Chem. Int. Ed.* 2011, 353, 376

**15-0265** **Bis(3-trifluoromethylphenyl)(3-carboxyphenyl) phosphine, min. 97% m-Miranphos (1808959-38-7)**  
C<sub>21</sub>H<sub>13</sub>F<sub>6</sub>O<sub>2</sub>P; FW: 442.29; white solid  
Note: Sold under license from UAB for research purposes only. Spanish Patent Application P201231702.



100mg  
500mg

**15-0260** **Bis(4-trifluoromethylphenyl)(4-carboxyphenyl)phosphine, min. 97% p-Miranphos (1808959-36-5)**  
C<sub>21</sub>H<sub>13</sub>F<sub>6</sub>O<sub>2</sub>P; FW: 442.29; white powder.  
Note: Sold under license from UAB for research purposes only. Spanish Patent Application P201231702.



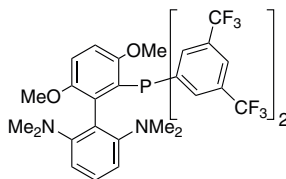
100mg  
500mg

# PHOSPHORUS - Ligands and Compounds

15-3015

NEW

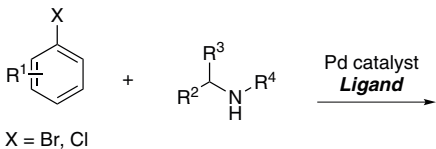
**2-[Bis(3,5-trifluoromethylphenyl)phosphino]-3,6-dimethoxy-2',6'-dimethylamino-1,1'-biphenyl, 98%** (1810068-30-4)  
 $C_{34}H_{29}F_{12}N_2O_2P$ ; FW: 756.56;  
 white to off-white powdr.  
 Note: Patents: US 6,395,916, US 6,307,087



100mg  
500mg  
2g

Technical Note:

- Ligand for the Palladium-catalyzed arylation of  $\alpha$ -Branched Secondary Amines



X = Br, Cl

References:

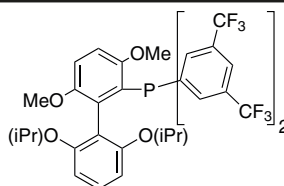
- Angew. Chem. Int. Ed.*, **2015**, *54*, 8259

Tech. Note (1)  
Ref. (1)

15-3020

NEW

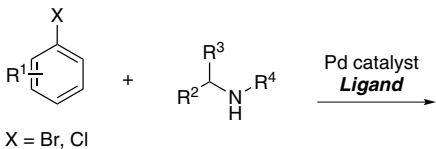
**2-[Bis(3,5-trifluoromethylphenyl)phosphino]-3,6-dimethoxy-2',6'-di-*i*-propoxy-1,1'-biphenyl, 98%** (1810068-31-5)  
 $C_{36}H_{31}F_{12}O_4P$ ; FW: 786.58;  
 white to off-white powdr.  
 Note: Patents: US 6,395,916, US 6,307,087



250mg  
1g  
5g

Technical Note:

- Ligand for the Palladium-catalyzed arylation of  $\alpha$ -Branched Secondary Amines



X = Br, Cl

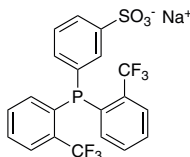
References:

- Angew. Chem. Int. Ed.*, **2015**, *54*, 8259

Tech. Note (1)  
Ref. (1)

15-0579

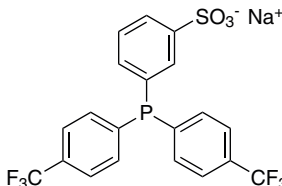
**Bis(2-trifluoromethylphenyl)(3-sulfonatophenyl)phosphine, sodium salt, min. 97%** ***o*-DAN2PHOS** (1289463-93-9)  
 $C_{20}H_{12}F_6NaO_3PS$ ; FW: 500.33; white powdr.  
 Note: Sold under license from UAB for research purposes only. PCT/EP2010/065531.



100mg  
500mg

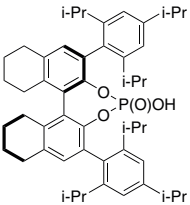
15-0582

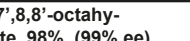
**Bis(4-trifluoromethylphenyl)(3-sulfonatophenyl)phosphine, sodium salt, min. 97%** ***p*-DAN2PHOS** (1289463-87-1)  
 $C_{20}H_{12}F_6NaO_3PS$ ; FW: 500.33;  
 white powdr.  
 Note: Sold under license from UAB for research purposes only. PCT/EP2010/065531.

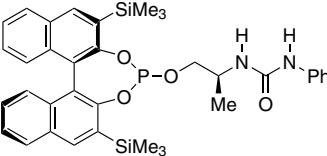


100mg  
500mg

# PHOSPHORUS - Ligands and Compounds

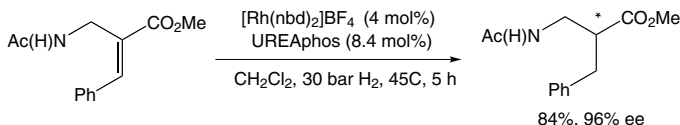
**15-1395** (R)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) (929294-27-9)  25mg  
**NEW** C<sub>50</sub>H<sub>65</sub>O<sub>4</sub>P; FW: 761; White to light-yellow powder.  
 Note: Sold in collaboration with Daicel for research purposes only.

**15-1394** (S)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) (878111-20-7)  25mg  
**NEW** C<sub>50</sub>H<sub>65</sub>O<sub>4</sub>P; FW: 761; White to light-yellow powder.  
 Note: Sold in collaboration with Daicel for research purposes only.

**15-2216** 1-(2S)-1-[(11bR)-2,6-Bis(trimethylsilyl)dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl)-3-phenylurea, min. 97% (1357562-70-9)  50mg  
 C<sub>36</sub>H<sub>41</sub>N<sub>2</sub>O<sub>4</sub>PSi<sub>2</sub>; FW: 652.87; white powder.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCaT for research purposes only.  
 WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component.

## Technical Note:

- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.

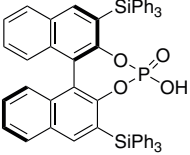


## References:

- J. Chem. Soc. Chem. Comm., 2007, 864.
- WO2004103559A2.

**93-1570** Bis(triphenylphosphine)iminium borohydride, min. 97% (65013-26-5) 2g  
 HAZ [(C<sub>6</sub>H<sub>5</sub>)<sub>3</sub>P]<sub>2</sub>NBH<sub>4</sub>; FW: 553.44; white powder.  
*moisture sensitive* 10g

**15-0455** Bis(triphenylphosphine)iminium chloride, 97% (21050-13-5) 5g  
 [(C<sub>6</sub>H<sub>5</sub>)<sub>3</sub>P]<sub>2</sub>NCI; FW: 574.04; white powder.; m.p. 260-265° 25g

**15-0340** (R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% ([(R)-TIPSY] (791616-55-2)  10mg  
**NEW** C<sub>56</sub>H<sub>41</sub>O<sub>4</sub>PSi<sub>2</sub>; FW: 865.07; white to light-yellow powder.; m.p. 329-335° 100mg  
 Note: Sold in collaboration with Daicel for research purposes only.

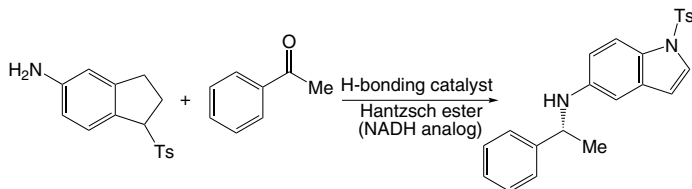
## Technical Notes:

- A chiral phosphoric acid catalyst providing a highly stereoselective method for the reductive amination of heterocyclic amines.
- Chiral phosphoric acid used for the enantioselective Biginelli and Biginelli-like reactions.

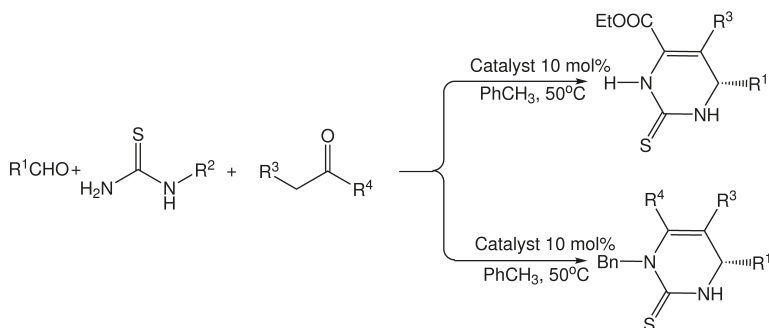
# PHOSPHORUS - Ligands and Compounds

**15-0340** (R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl- 2,2'-diyl hydrogen phosphate, min. 98% (continued) [(R)-TiPSY] (791616-55-2)

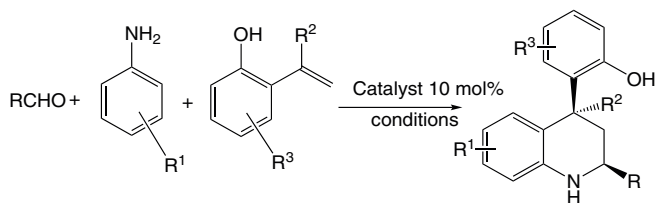
- Chiral phosphoric acid organocatalyst used in the asymmetric, three-component Povarov reaction involving 2-hydroxystyrenes. An efficient method to access structurally diverse *cis*-disubstituted tetrahydroquinolines in high stereoselectivities of up to >99:1 dr and 97% ee.
- A gold/chiral phosphoric acid catalyst used for the highly stereoselective, three-component reaction of salicylaldehydes, anilines, and alkynols to give aromatic spiroacetals in high yields and stereoselectivities.
- The first highly enantioselective catalytic protocol for the reductive coupling of ketones and hydrozones.
- Reagent-controlled regioselectivity enabled by dual activation.



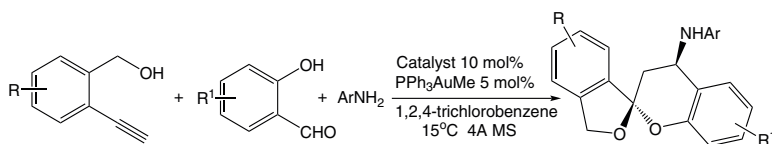
**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



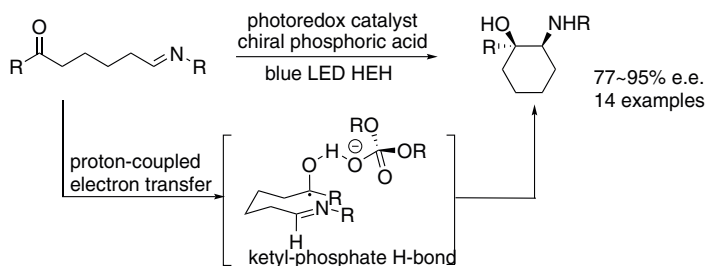
**Tech. Note (3)**  
**Ref. (3)**



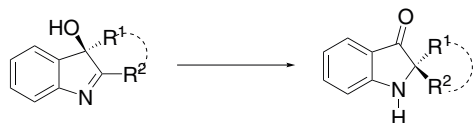
**Tech. Note (4)**  
**Ref. (4)**

# PHOSPHORUS - Ligands and Compounds

**15-0340** (R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98%  
(continued) [(R)-TiPSY] (791616-55-2)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)

## References:

1. *J. Am. Chem. Soc.* **2006**, *128*, 84
2. *J. Am. Chem. Soc.* **2009**, *131*, 15301
3. *J. Am. Chem. Soc.* **2012**, *134*, 6970
4. *Org. Lett.*, **2013**, *15*, 460
5. *J. Am. Chem. Soc.* **2013**, *135*, 17735
6. *Eur. J. Organic Chem.*, **2017**, *2017*, 3134.

**15-0341** (S)-(+)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(S)-TiPSY] (929097-92-7)

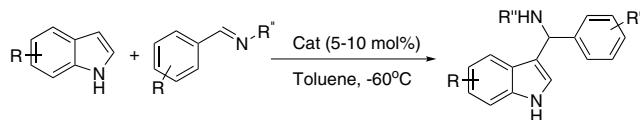
10mg  
100mg

NEW

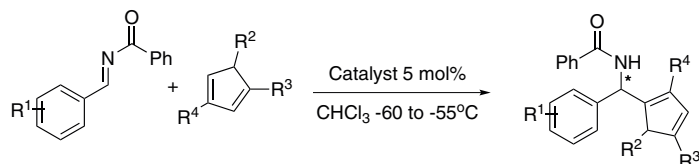
$C_{56}H_{41}O_4PSi_2$ ; FW: 865.07; white to light-yellow solid; m.p. 329-335°  
Note: Sold in collaboration with Daicel for research purposes only.

## Technical Notes:

1. Chiral phosphoric acid catalyst used for the highly enantioselective Friedel-Crafts reaction of indoles with imines.
2. Chiral phosphoric acid catalyst used for the highly enantioselective Friedel-Crafts reaction of pyrrole derivatives with *N*-acyl imines.
3. Chiral phosphoric acid catalyst used for the enantioselective transfer hydrogenation of hydroxylactams providing enantio-enriched tetrahydro- $\beta$ -carbolines (in dioxane) at room temperature (up to 94% yield, 90% ee).
4.  $[Rh_2(OAc)_4]$  chiral phosphonic acid catalyst used for the enantioselective symmetric, three-component reaction of diazo compounds with imines and water yielding  $\beta$ -amino- $\alpha$ -hydroxy acid derivatives.
5. Enantioselective desymmetrization of prochiral allenic diols via cooperative catalysis of  $Pd(OAc)_2$  and a chiral phosphoric acid.



Tech. Note (1)  
Ref. (1)

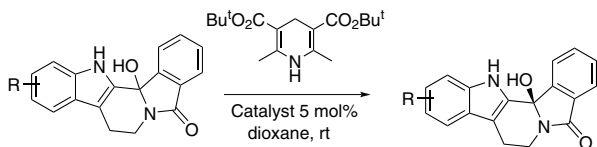


Tech. Note (2)  
Ref. (2)

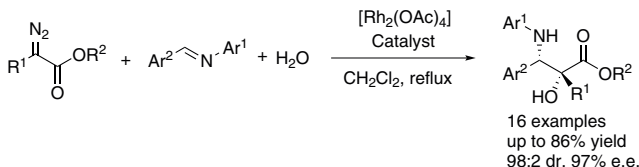


# PHOSPHORUS - Ligands and Compounds

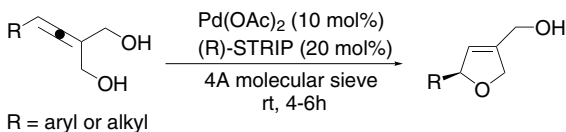
**15-0341** (S)-(+)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98%  
(continued) [(S)-TiPSY] (929097-92-7)



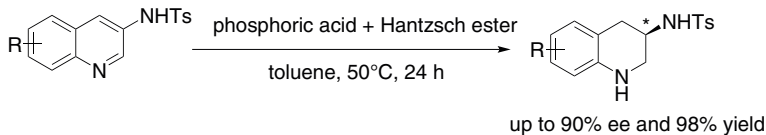
Tech. Note (3)  
Ref. (3)



Tech. Note (3)  
Ref. (3)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)

## References:

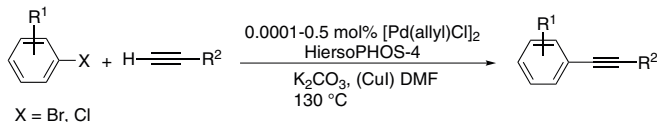
1. *J. Am. Chem. Soc.* **2007**, *129*, 1484
2. *Org. Lett.*, **2007**, *9*, 4065
3. *Org. Lett.*, **2013**, *15*, 2688
4. *ChemCatChem*, **2011**, *3*, 653
5. *Tetrahedron Asymmetry*, **2015**, *26*, 1150.
6. *New Journal of Chemistry*, **2016**, *40*, 9034.

**15-0125** **2-Bromophenyldiphenylphosphine, 98%** (62336-24-7) 1g  
C<sub>18</sub>H<sub>14</sub>BrP; FW: 341.18; white pwdr. 5g

**26-0324** **4-(t-Butyl)-1,2-bis(diphenylphosphino)-1'-di-i-propylphosphino ferrocene, 98% HiersoPHOS-4** 100mg  
(776315-37-8) 500mg  
C<sub>44</sub>H<sub>49</sub>FeP<sub>3</sub>; FW: 726.63; orange xtl.

## Technical Notes:

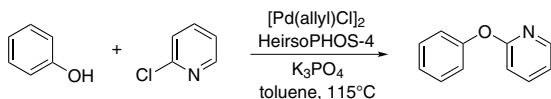
1. Ligand for the Sonogashira couplings of aryl halides at ultra-low catalyst loading
2. Ligand for the palladium catalysed C-O coupling of phenols with heteroaryl chlorides
3. Ligand for the Buchwald-Hartwig cross-coupling of aryl halides with arylamines



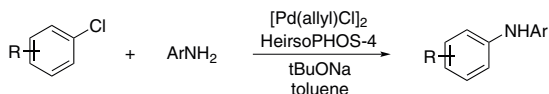
Tech. Note (1)  
Ref. (1,2)

# PHOSPHORUS - Ligands and Compounds

**26-0324**    **4-(t-Butyl)-1,2-bis(diphenylphosphino)-1'-(di-i-propylphosphino)ferrocene, 98%**  
**(continued)**    **HiersoPHOS-4 (776315-37-8)**



**Tech. Note (2)**  
**Ref. (3)**



**Tech. Note (3)**  
**Ref. (4,5)**

References:

1. *Org. Lett.*, **2004**, 6, 3473
2. *Organometallics*, **2010**, 29, 2815.
3. *Adv. Synth. Catal.*, **2011**, 353, 3403.
4. *Catal. Sci. Technol.*, **2014**, 4, 2072.
5. *Catal. Commun.*, **2014**, 51, 10.

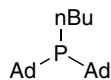
**15-0483**    **Butyldi-1-adamantylphosphine, min. 95%**

**[cataCXium® A] (321921-71-5)**

C<sub>4</sub>H<sub>9</sub>(C<sub>10</sub>H<sub>15</sub>)<sub>2</sub>P; FW: 358.54; white to yellow powdr.;  
m.p. 100°

*air sensitive*

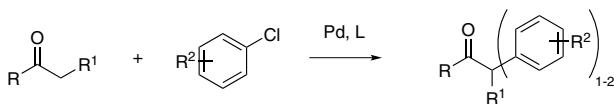
Note: Sold in collaboration with Solvias for research purposes only. Patent WO 0210178. Solvias cataCXium® Ligand Kit component.



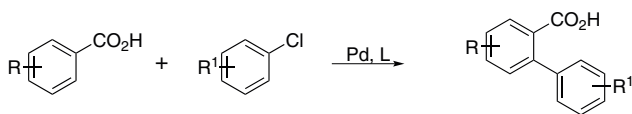
1g  
5g

Technical Notes:

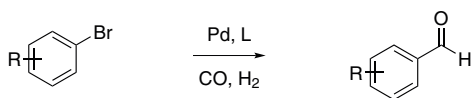
1. Ligand for the Pd-catalyzed Suzuki coupling reaction.
2. Ligand for the Pd-catalyzed formation of  $\alpha$ -aryl ketones.
3. Ligand for the Pd-catalyzed aminations
4. Ligand for the Pd-catalyzed Heck reaction.
5. Ligand used for arylation of benzoic acids.
6. Ligand for the formylation of aryl bromides.
7. Ni-catalyzed denitrogenative alkyne insertion reactions of triazoles.
8. Ligand for palladium-catalyzed aminocarbonylation of aryl halides
9. Palladium-catalyzed direct arylation of oxazole at C-5 with aryl bromides, chlorides, and triflates
10. Palladium-catalyzed carbonylative sonogashira coupling of aryl bromides.
11. Selective palladium-catalyzed C-2 or C-5 direct arylation of SEM-imidazole.
12. Ligand for palladium-catalyzed cascade process consisting of isocyanide insertion and benzylic C(sp<sup>3</sup>)-H activation.
13. Ligand for palladium-catalyzed aryl borylation.



**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (5)**  
**Ref. (5)**

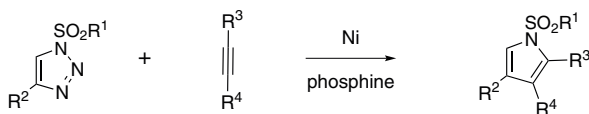


**Tech. Note (6)**  
**Ref. (6)**

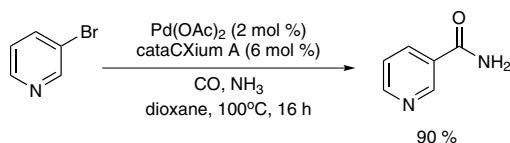
# PHOSPHORUS - Ligands and Compounds

15-0483 Butyldi-1-adamantylphosphine, min. 95% [cataCXium® A] (321921-71-5)

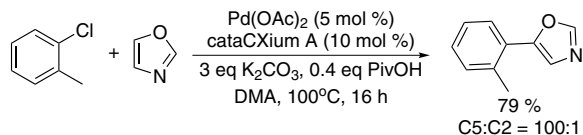
(continued)



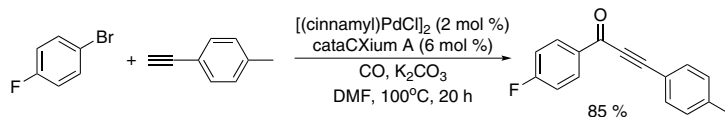
Tech. Note (7)  
Ref. (7)



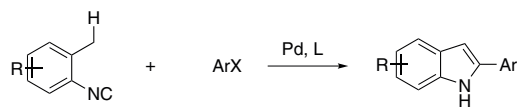
Tech. Note (8)  
Ref. (8)



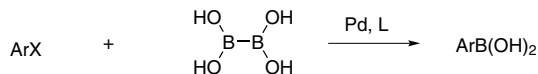
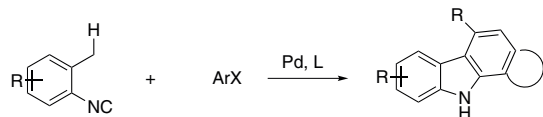
Tech. Note (9)  
Ref. (9)



Tech. Note (10)  
Ref. (10)



Tech. Note (12)  
Ref. (12)

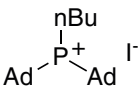
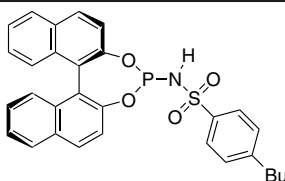


Tech. Note (13)  
Ref. (13)

## References:

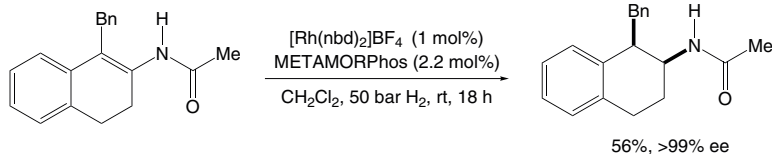
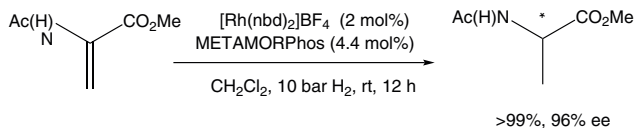
1. *Angew. Chem. Int. Ed.*, **2000**, 39, 4153.
2. *Adv. Synth. Catal.*, **2002**, 344, 209.
3. *J. Mol. Catal. A: Chemical*, **2002**, 182-183, 515.
4. *Synlett*, **2000**, 1589.
5. *J. Am. Chem. Soc.*, **2007**, 129, 9879.
6. *Angew. Chem., Int. Ed.*, **2006**, 45, 154.
7. *Chem. Commun.*, **2009**, 1470.
8. *Chem. Eur. J.*, **2010**, 16, 9750.
9. *Org. Lett.*, **2010**, 12, 3578.
10. *Chem. Eur. J.*, **2010**, 16, 12104.
11. *J. Org. Chem.*, **2010**, 75, 4911.
12. *Organic Letters*, **2012**, 14, 4270.
13. *J. Am. Chem. Soc.*, **2012**, 134, 11667.

# PHOSPHORUS - Ligands and Compounds

<b>15-0495</b>	<b>n-Butyl-di-(1-adamantyl)phosphonium iodide, min. 95%</b> [cataCXium® AH1] (714951-87-8) [(C <sub>4</sub> H <sub>9</sub> )(C <sub>10</sub> H <sub>15</sub> ) <sub>2</sub> PH] <sup>+</sup> I <sup>-</sup> ; FW: 486.45; white powdr. <i>light sensitive</i> Note: Sold in collaboration with Solvias for research purposes only. Patent US7148176. Solvias cataCXium® Ligand Kit component.		250mg 1g
<b>15-0500</b> amp HAZ	<b>t-Butyldichlorophosphine, 98% (25979-07-1)</b> (CH <sub>3</sub> ) <sub>3</sub> CPCl <sub>2</sub> ; FW: 159.00; white to pale yellow xtl.; m.p. 47-48°; b.p. 146-148° <i>air sensitive, moisture sensitive</i>		2g 10g
<b>15-0540</b>	<b>t-Butyldicyclohexylphosphine, min. 95% (93634-87-8)</b> [(CH <sub>3</sub> ) <sub>3</sub> C](C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> P; FW: 254.40; colorless liq.; d. 0.939 <i>air sensitive</i>		500mg 2g
<b>15-2218</b>	<b>4-Butyl-N-[(11bR)-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl]benzenesulfonamide triethylamine adduct, min. 97%</b> (1150592-91-8) C <sub>30</sub> H <sub>26</sub> NO <sub>3</sub> PS·(CH <sub>3</sub> CH <sub>2</sub> ) <sub>3</sub> N; FW: 527.57 (628.76); white powdr. <i>moisture sensitive, (store cold)</i> Note: Sold under license from InCatT for research purposes only. WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component.		50mg 250mg

## Technical Note:

- Chiral ligand for the rhodium-catalyzed asymmetric hydrogenation of  $\alpha$ - $\beta$  unsaturated substrates.

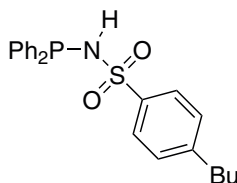


## References:

- J. Am. Chem. Soc.*, **2009**, *131*, 6683.
- Angew. Chem. Int. Ed.*, **2008**, *47*, 3180.
- Patent WO2009065856.

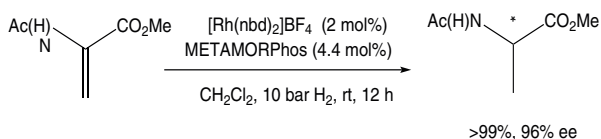
# PHOSPHORUS - Ligands and Compounds

**15-2220**     **4-Butyl-N-(diphenylphosphino) benzenesulfonamide, min. 97%**     50mg  
 (1025096-61-0)     250mg  
 C<sub>22</sub>H<sub>26</sub>NO<sub>2</sub>PS; FW: 397.47; white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component.

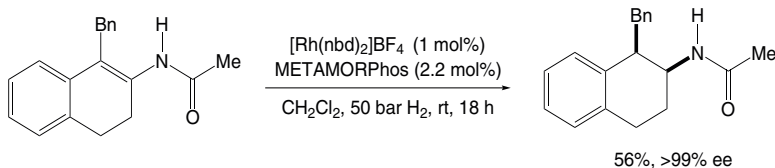


Technical Note:

- Chiral ligand for the rhodium-catalyzed asymmetric hydrogenation of  $\alpha$ - $\beta$  unsaturated substrates.



**Tech. Note (1)**  
**Ref. (1-3)**

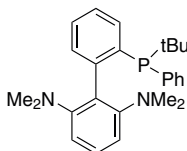


**Tech. Note (1)**  
**Ref. (1-3)**

References:

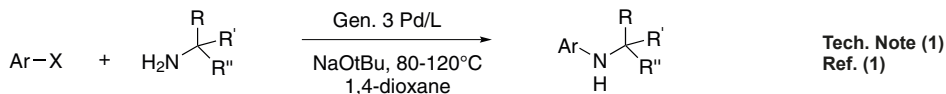
- J. Am. Chem. Soc.*, **2009**, *131*, 6683.
- Angew. Chem. Int. Ed.*, **2008**, *47*, 3180.
- Patent WO2009065856.

**15-3010**     **2-(t-Butylphenylphosphino)-2',6'-dimethyl-amino-1,1'-biphenyl, 98% (t-Bu)PhCPhos**     250mg  
NEW     (1660153-91-2)     1g  
 C<sub>26</sub>H<sub>33</sub>N<sub>2</sub>P; FW: 404.53;     5g  
 white to off-white powdr.     25g  
 Note: Patents: US 6,395,916, US 6,307,087



Technical Note:

- Ligand for the Palladium-catalyzed Buchwald-Hartwig cross-coupling of hindered primary amines and aryl halides



**Tech. Note (1)**  
**Ref. (1)**

References:

- J. Am. Chem. Soc.*, **2015**, *137*, 3085

**15-0966**     **t-Butylphosphine, min. 95% TBP (2501-94-2)**     1g  
 amp     (C<sub>4</sub>H<sub>9</sub>)PH<sub>2</sub>; FW: 90.10; colorless liq.; b.p. 54°; d. 0.7     5g  
 HAZ     *pyrophoric, STENCH*



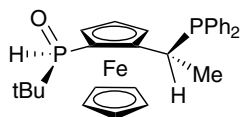
**15-0967**     **t-Butylphosphine, min. 95% TBP (10 wt% in hexanes) (2501-94-2)**     10g  
 HAZ     (C<sub>4</sub>H<sub>9</sub>)PH<sub>2</sub>; FW: 90.10; colorless liq.     50g  
*air sensitive*

# PHOSPHORUS - Ligands and Compounds

26-1270

(R,S(p), R(SPO)-1-t-Butylphosphinoyl)-2-[1-(diphenylphosphino)ethyl]ferrocene, min. 97%  
**JoSPOphos** (1221745-90-9)  
 $C_{28}H_{32}FeOP_2$ ; FW: 502.35; orange powdr.  
 (store cold)

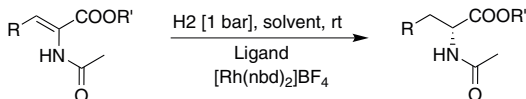
Note: Sold in collaboration with Solvias for research purposes only.



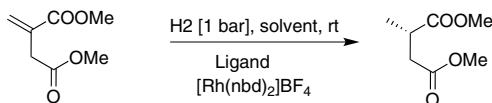
100mg  
 500mg  
 2g  
 10g

## Technical Notes:

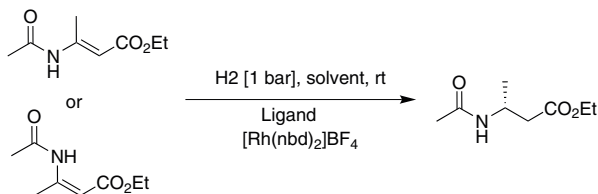
- Ligand for Rh-catalyzed hydrogenation of vinylboronic esters.
- Ligands used for the Ru-catalyzed asymmetric hydrogenation of  $\beta$ -ketoesters.
- Ligands used for the Rh-catalyzed asymmetric hydrogenation of  $\alpha$ -ketoesters.
- Ligand for the highly selective coupling of benzotriazoles with allenes.



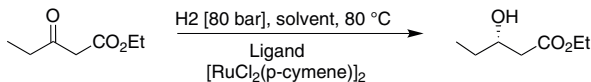
Tech. Note (1)  
 Ref. (1)



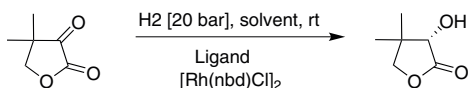
Tech. Note (1)  
 Ref. (1)



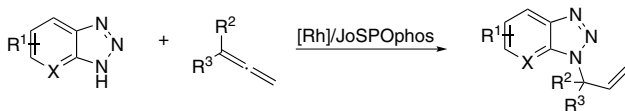
Tech. Note (1)  
 Ref. (1)



Tech. Note (2)  
 Ref. (1)



Tech. Note (3)  
 Ref. (1)



Tech. Note (4)  
 Ref. (1)

## References:

- Angew. Chem. Int. Ed., 2010, 49, 6873.
- Angew. Chem. Int. Ed., 2014, 53, 7268.

26-1271

(S, R(p), S(SPO)-1-t-Butylphosphinoyl)-2-[1-(diphenylphosphino)ethyl]ferrocene, min. 97%  
**JoSPOphos** (1221746-31-1)  
 $C_{28}H_{32}FeOP_2$ ; FW: 502.35; orange powdr.  
 (store cold)

Note: Sold in collaboration with Solvias for research purposes only.

100mg  
 500mg  
 2g  
 10g

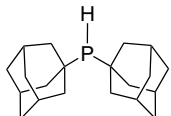
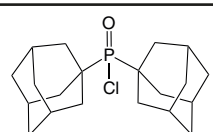
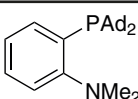
## Technical Note:

- See 26-1270 (page 129)

# PHOSPHORUS - Ligands and Compounds

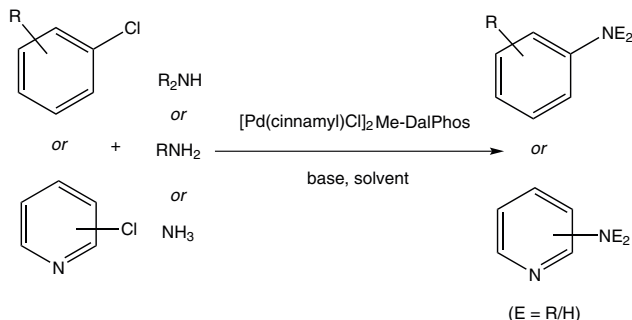
15-0690 <b>NEW</b> HAZ	<b>Chloro(<i>t</i>-butyl)phenylphosphine, 97%</b> (29949-69-7) C <sub>10</sub> H <sub>14</sub> ClP; FW: 200.65; colorless liq. <i>air sensitive, moisture sensitive</i>		1g 5g
15-0685	<b>(R)-(-)-4-Chlorodinaphthol[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, min. 97%</b> (155613-52-8) C <sub>20</sub> H <sub>12</sub> ClO <sub>2</sub> P; FW: 350.74; white powdr. <i>moisture sensitive</i>		1g 5g
15-0686	<b>(S)-(+)-4-Chlorodinaphthol[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, min. 97%</b> (137156-22-0) C <sub>20</sub> H <sub>12</sub> ClO <sub>2</sub> P; FW: 350.74; white powdr. <i>moisture sensitive</i>		1g 5g
15-0695	<b>2-Cyanoethyl N,N,N',N'-tetra(<i>i</i>-propyl)phosphorodiamidite, min. 98%</b> (102691-36-1) {[(CH <sub>3</sub> ) <sub>2</sub> CH] <sub>2</sub> N}POCH <sub>2</sub> CH <sub>2</sub> CN; FW: 301.41; colorless liq.; b.p. 100° (0.5mm); d. 0.949 <i>moisture sensitive, (store cold)</i>		1g 5g
15-0795	<b>(2-Cyanophenyl)diphenylphosphine, min. 98%</b> (34825-99-5) (NCC <sub>6</sub> H <sub>4</sub> )(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P; FW: 287.30; white to off-white powdr.; m.p. 148-150°		500mg 2g
15-1010 HAZ	<b>Cyclohexylidene-<i>t</i>-butylphosphine, 97%</b> (436865-11-1) [(CH <sub>3</sub> ) <sub>3</sub> C] <sub>2</sub> (C <sub>6</sub> H <sub>11</sub> )P; FW: 228.36; colorless liq. <i>air sensitive</i>		500mg 2g
15-1011 <b>NEW</b>	<b>Cyclohexylidene-<i>t</i>-butylphosphine, 98% (10wt% in hexanes)</b> (436865-11-1) C <sub>14</sub> H <sub>26</sub> P; FW: 228.36; colorless liq. <i>air sensitive</i>		5g 25g
15-0800 amp HAZ	<b>Cyclohexylidenechlorophosphine, 98%</b> (2844-89-5) C <sub>6</sub> H <sub>11</sub> PCl <sub>2</sub> ; FW: 185.03; colorless liq.; b.p. 100°/17mm <i>air sensitive, moisture sensitive</i>		1g 5g
15-0900	<b>Cyclohexyldiphenylphosphine, 98%</b> (6372-42-5) (C <sub>6</sub> H <sub>11</sub> )(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P; FW: 268.34; white xtl.; m.p. 58-62° <i>air sensitive</i>		1g 5g
15-0950 amp HAZ 	<b>Cyclohexylphosphine, min. 97%</b> (822-68-4) C <sub>6</sub> H <sub>11</sub> PH <sub>2</sub> ; FW: 116.14; colorless liq.; b.p. 145°; d. 0.8750 <i>pyrophoric</i>		10g 50g
15-0952 HAZ 	<b>Cyclohexylphosphine, min. 97% (Sure/Seal™ bottle)</b> (822-68-4) C <sub>6</sub> H <sub>11</sub> PH <sub>2</sub> ; FW: 116.14; colorless liq.; b.p. 145°; d. 0.8750 <i>pyrophoric</i>		50g
15-0953 HAZ	<b>Cyclohexylphosphine, min. 97% (10 wt% in hexanes)</b> (822-68-4) C <sub>6</sub> H <sub>11</sub> PH <sub>2</sub> ; FW: 116.14; colorless liq.; d. 0.684 <i>air sensitive</i>		100g
15-0958	<b><i>n</i>-Decylphosphonic acid, min. 97%</b> (6874-60-8) CH <sub>3</sub> (CH <sub>2</sub> ) <sub>9</sub> P(O)(OH) <sub>2</sub> ; FW: 222.26; white to off-white powdr.; m.p. 103-104° Note: Long-Chain <i>n</i> -Alkylphosphonic Acid Kit component.		1g 5g
15-1095 HAZ	<b>Di-1-adamantylchlorophosphine, min. 97%</b> (157282-19-4) (C <sub>10</sub> H <sub>16</sub> ) <sub>2</sub> ClP; FW: 336.88; white solid <i>moisture sensitive</i>		250mg 1g

# PHOSPHORUS - Ligands and Compounds

15-0954	<b>Di-1-adamantylphosphine, min. 97%</b> (131211-27-3) (C <sub>10</sub> H <sub>16</sub> ) <sub>2</sub> PH; FW: 302.43; white powdr. <i>air sensitive</i>		250mg 1g
15-0956	<b>Di-1-adamantylphosphine oxide, min. 90%</b> (131266-79-0) (C <sub>10</sub> H <sub>16</sub> ) <sub>2</sub> P(O)H; FW: 318.43; white powdr.		250mg 1g
15-0955	<b>Di-1-adamantylphosphinic chloride, 98%</b> (126683-99-6) (C <sub>10</sub> H <sub>16</sub> ) <sub>2</sub> POCl; FW: 352.88; white xtl.; m.p. 214° <i>moisture sensitive</i>		250mg 1g
15-1090	<b>2-(Di-1-adamantylphosphino) dimethylaminobenzene, 97% Me-DalPhos</b> (1219080-77-9) C <sub>28</sub> H <sub>40</sub> NP; FW: 421.60; white to yellow xtl. <i>air sensitive</i>		250mg 1g

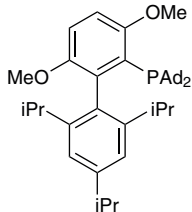
## Technical Note:

- Versatile ligand for the palladium-catalyzed amination of aryl and heteroaryl chlorides with primary aryl and alkylamines, cyclic and acyclic amines, lithium amide, N-H imines, hydrazones and ammonia.



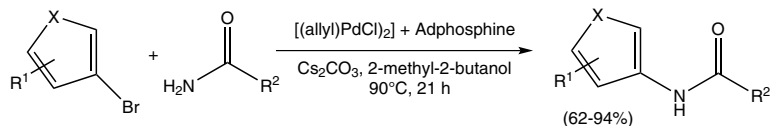
## References:

- Chem. Eur. J.*, **2010**, *16*, 1983.

15-1138	<b>2-(Di-1-adamantylphosphino)-3,6-dimethoxy-2',4',6'-tri-<i>i</i>-propyl-1,1'-biphenyl, min. 95% AdBrettPhos</b> (1160861-59-5) C <sub>43</sub> H <sub>61</sub> O <sub>2</sub> P; FW: 640.92; off-white to pale yellow powdr. Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component. Patents: US 6,395,916, US 6,307,087.		100mg 500mg 2g
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## Technical Note:

- Ligand used in the palladium-catalyzed amidation of five-membered heterocycles as electrophiles.



## References:

- J. Am. Chem. Soc.*, **2012**, *134*, 19922.

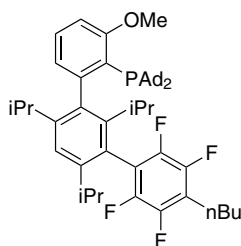


## PHOSPHORUS - Ligands and Compounds

15-2065

NEW

**2-(Diadamantylphosphino)-3-methoxy-2',4',6'-tri-*i*-propyl-3'-(2,3,5,6-tetrafluoro-4-butylphenyl)-1,1'-biphenyl AlPhos**  
(1805783-60-1)  
C<sub>52</sub>H<sub>67</sub>F<sub>4</sub>OP; FW: 815.06;  
white to yellow powder.  
*air sensitive*  
Note: Patents: US 6,395,916, US 6,307,087



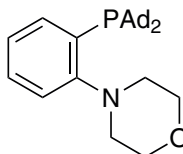
100mg  
500mg  
2g

Technical Note:

1. Visit [strem.com](http://strem.com) for the full technical note of item 46-0241as a reference.

15-1092

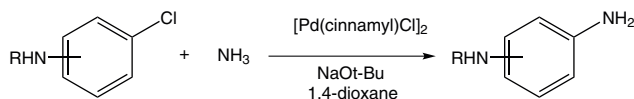
**N-[2-(di-1-adamantylphosphino)phenyl]morpholine, 98% Mor-DalPhos**  
(1237588-12-3)  
C<sub>30</sub>H<sub>42</sub>NOP; FW: 463.63; white to yellow xtl.  
*air sensitive*



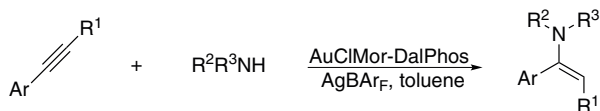
250mg  
1g  
5g

Technical Notes:

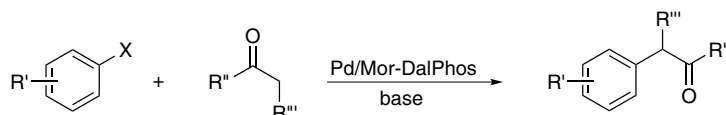
1. P-N-ligand for use in the Pd-catalyzed cross-coupling of ammonia and hydrazine. Ref. (2) with a diverse range of sterically hindered, unbiased aryl chlorides. Low catalyst loading and mild conditions. Ref (5) with diamines in a chemoselective arylation process. Ref (6) with solvent-free or aqueous conditions.
2. P-N-ligand for the gold-catalyzed stereoselective hydroamination of internal alkynes with dialkylamines to afford E-amines.
3. P-N-ligand for use in the Pd-catalyzed for mono- $\alpha$ -arylation of ketones employing aryl chlorides, bromides, iodides, mesylates (Ref. 7) and tosylates.



Tech. Note (1)  
Ref. (1,2,5,6)



Tech. Note (2)  
Ref. (3)



Tech. Note (3)  
Ref. (4,7)

References:

1. *Angew. Chem. Int. Ed.*, **2010**, 49, 4071.
2. *Angew. Chem. Int. Ed.*, **2010**, 49, 8686.
3. *J. Am. Chem. Soc.*, **2010**, 132, 18026.
4. *J. Am. Chem. Soc.*, **2011**, 133, 5194.
5. *J. Org. Chem.*, **2012**, 77, 1056.
6. *Eur. J. Org. Chem.*, **2012**, 3972.
7. *Angew. Chem. Int. Ed.*, **2013**, 52, 7242.

15-0961

**(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 95% (S,S)-DACH-Phenyl Trost Ligand**  
(169689-05-8)  
C<sub>44</sub>H<sub>40</sub>N<sub>2</sub>O<sub>2</sub>P<sub>2</sub>; FW: 690.76; white to off-white powder.; m.p. 134-136°

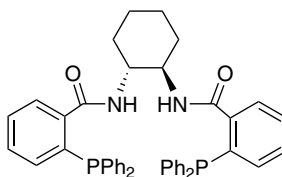
100mg  
500mg  
2g

Technical Note:

1. See 15-0960 (page 133)

# PHOSPHORUS - Ligands and Compounds

**15-0960** (1*R*,2*R*)-(+)-1,2-Diaminocyclohexane-*N,N'*-bis(2'-diphenylphosphinobenzoyl), 98%  
(*R,R*)-DACH-Phenyl Trost Ligand  
(138517-61-0)  
C<sub>44</sub>H<sub>40</sub>N<sub>2</sub>O<sub>2</sub>P<sub>2</sub>; FW: 690.76; white to off-white powdr.; m.p. 134-136°

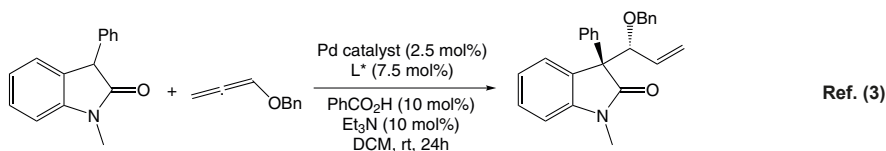
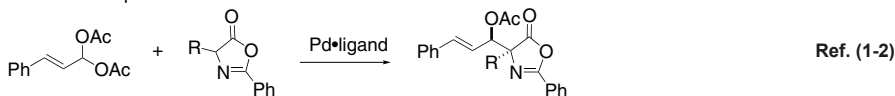


100mg  
500mg  
2g

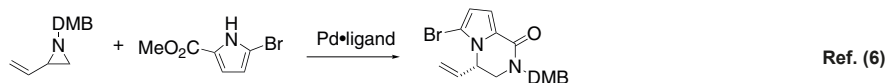
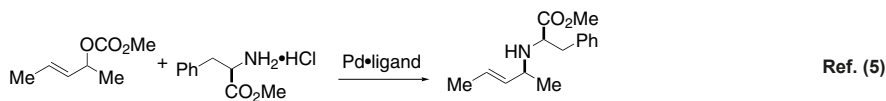
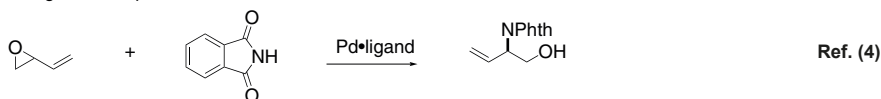
## Technical Note:

- The palladium complexes of the Trost ligands are effective in a variety of allylic substitution reactions involving carbon, nitrogen, oxygen, sulfur, and fluorides nucleophiles.

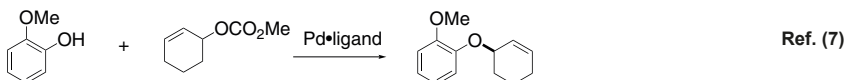
### Carbon nucleophile



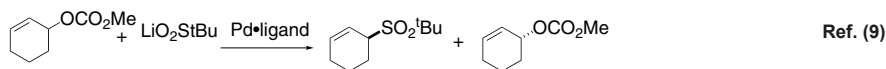
### Nitrogen nucleophile



### Oxygen nucleophile



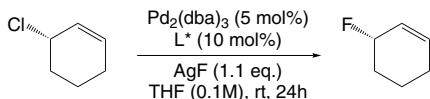
### Sulfur nucleophile



# PHOSPHORUS - Ligands and Compounds

**15-0960** (1R,2R)-(+)-1,2-Diaminocyclohexane- N,N'-bis(2'-diphenylphosphinobenzoyl), 98%  
(continued) (R,R)-DACH-Phenyl Trost Ligand (138517-61-0)

Fluoride nucleophile



Ref. (10)

References:

1. *Angew. Chem., Int. Ed.* **1997**, 36, 2635
2. *J. Am. Chem. Soc.* **1995**, 117, 7247
3. *J. Am. Chem. Soc.* **2011**, 133, 20611
4. *Angew. Chem., Int. Ed.* **1996**, 35, 99
5. *Org. Lett.*, **2007**, 9, 2357
6. *J. Am. Chem. Soc.*, **1998**, 120, 815
7. *J. Am. Chem. Soc.*, **2003**, 125, 6066
8. *Tetrahedron Lett.*, **2000**, 41, 3809
9. *J. Am. Chem. Soc.*, **2010**, 132, 17402

**15-0963** (1R,2R)-(+)-1,2-Diaminocyclohexane-N,N'-bis(2-diphenylphosphino-1-naphthoyl), min. 94% (R,R)-DACH-Naphthyl Trost Ligand  
(174810-09-4)

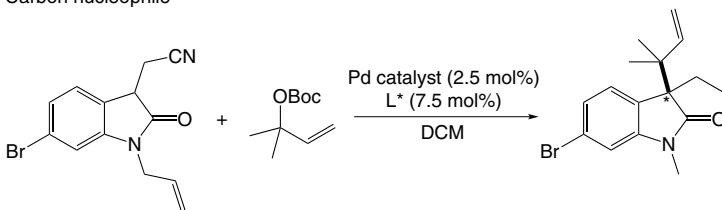
100mg  
500mg  
2g

C<sub>52</sub>H<sub>44</sub>N<sub>2</sub>O<sub>2</sub>P<sub>2</sub>; FW: 790.88; off-white powdr.

Technical Note:

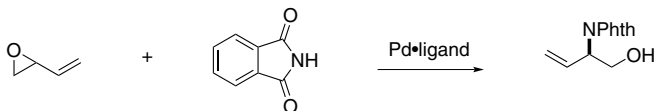
1. The palladium complexes of the Trost ligands are effective in a variety of allylic substitution reactions involving carbon, nitrogen, oxygen, and fluorides nucleophiles.

Carbon nucleophile

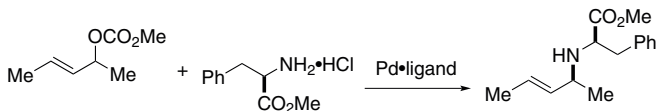


Ref. (1)

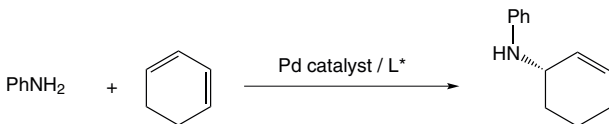
Nitrogen nucleophile



Ref. (2)



Ref. (3)

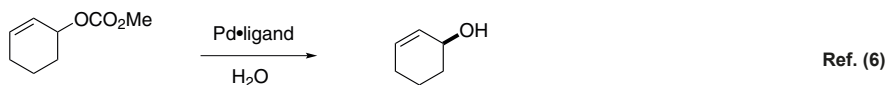
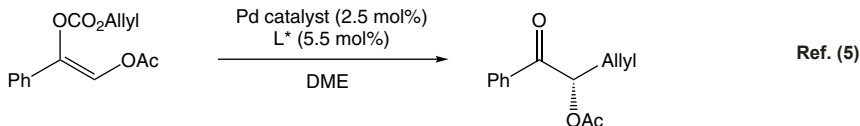


Ref. (4)

## PHOSPHORUS - Ligands and Compounds

15-0963 (1R,2R)-(+)-1,2-Diaminocyclohexane-N,N'-bis(2-diphenylphosphino-1-naphthoyl), min. (continued) 94% (R,R)-DACH-Naphthyl Trost Ligand (174810-09-4)

Oxygen nucleophile



Fluoride



References:

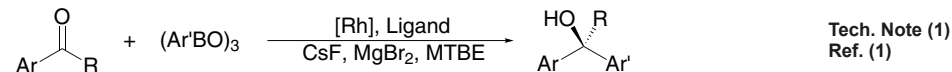
1. *J. Am. Chem. Soc.*, **2011**, 133, 7328.
2. *Angew. Chem., Int. Ed.*, **1996**, 35, 99.
3. *Tetrahedron Lett.*, **1998**, 39, 1713.
4. *J. Am. Chem. Soc.*, **2001**, 123, 4366.
5. *J. Am. Chem. Soc.*, **2008**, 130, 11852.
6. *J. Am. Chem. Soc.*, **2003**, 125, 6066.
7. *J. Am. Chem. Soc.*, **2011**, 133, 15902.

15-0964	(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N'-bis(2-diphenylphosphino-1-naphthoyl), min. 94% (S,S)-DACH-Naphthyl Trost Ligand (205495-66-5) C <sub>52</sub> H <sub>44</sub> N <sub>2</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 790.88; off-white pwr.	100mg 500mg 2g
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15-1970	(2R,2'R,3R,3'R)-4,4'-Di(anthracen-9-yl)-3,3'-di- <i>t</i> -butyl-2,2',3,3'-tetrahydro-2,2'-bibenzo[d][1,3]oxaphosphole, min 98% (>90% ee), [(2R,2'R,3R,3'R)-WingPhos] (1884680-45-8) C <sub>50</sub> H <sub>44</sub> O <sub>2</sub> P <sub>2</sub> ; FW: 738.83; light yello pwr. air sensitive, (store cold) Note: Sold in collaboration with Zejun for research purposes only. Patents ZL201310020371.1, CN 201610056390.	25mg 100mg 500mg
---------	---	------------------------

Technical Note:

1. Ligand for rhodium-catalyzed enantioselective addition of arylboroxines to simple aryl ketones.



References:

1. *Angew. Chem.Int Ed.*, **2016**, 55, 4527.

# PHOSPHORUS - Ligands and Compounds

15-1975

NEW

(2*S*,2'*S*,3*S*,3'*S*)-4,4'-Di(anthracen-9-yl)-3,3'-di-*t*-butyl-2,2',3,3'-tetrahydro-2,2'-bibenzo[d][1,3]oxaphosphole, min 98%, (>99% ee), [(2*S*,2'*S*,3*S*,3'*S*)-WingPhos] (1435940-19-4)

C<sub>50</sub>H<sub>44</sub>O<sub>2</sub>P<sub>2</sub>; FW: 738.83; light yellow powdr.

air sensitive, (store cold)

Note: Sold in collaboration with Zejun for research purposes only.

Patents ZL201310020371.1, CN 201610056390.

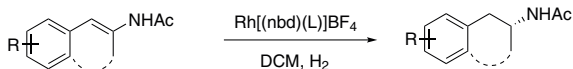
25mg

100mg

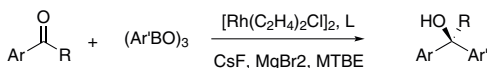
500mg

## Technical Notes:

- Ligand/Rhodium catalyst for asymmetric hydrogenation.
- Ligand/Rhodium catalyst for asymmetric arylboronic reagents addition to aryl ketones.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

## References:

- Angew. Chem.Int.Ed., 2013, 52, 4235.
- Angew. Chem.Int.Ed., 2016, 55, 4527.

15-1157

2-Di[3,5-bis(trifluoromethyl)phenylphosphino]-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% JackiePhos (1160861-60-8)

C<sub>39</sub>H<sub>37</sub>F<sub>12</sub>O<sub>2</sub>P<sub>2</sub>; FW: 796.66; white xtl.;

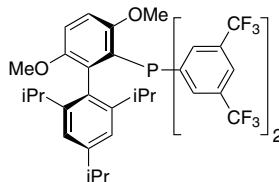
m.p. 185-190°

Note: Buchwald Biaryl Phosphine Ligand

Master Kit component.. Buchwald Biaryl

Phosphine Ligand Mini Kit 1 component..

Patents: US 6,395,916, US 6,307,087.



100mg

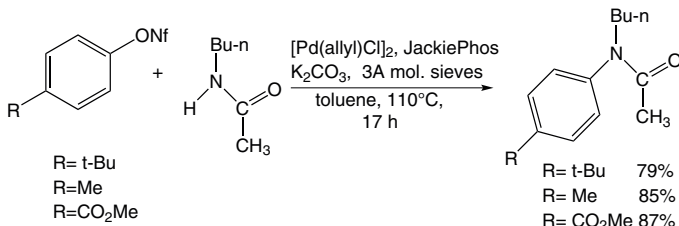
500mg

2g

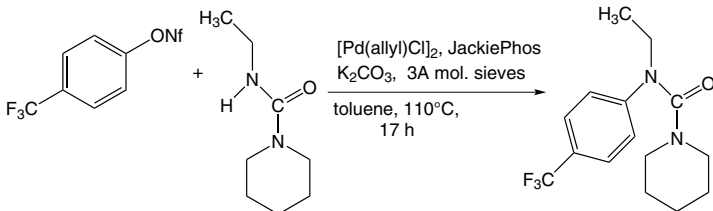
10g

## Technical Notes:

- Ligand used in the Pd-catalyzed coupling of aryl nonaflates and triflates with secondary amides.
- Ligand used in the Pd-catalyzed coupling of aryl nonaflates and triflates with secondary ureas, carbamates, and sulfonamides.
- Ligand used in the Pd-catalyzed coupling of aryl chlorides with secondary amides, carbamates, and sulfonamides.



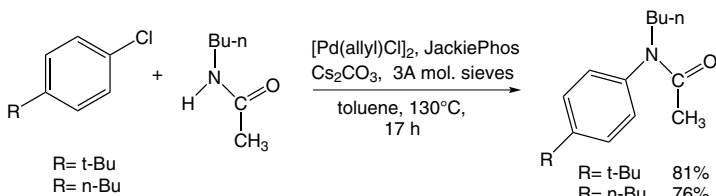
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

**15-1157** 2-Di[3,5-bis(trifluoromethyl)phenyl]phosphino]-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-bi-phenyl, min. 98% JackiePhos (1160861-60-8)



Tech. Note (3)  
Ref. (1)

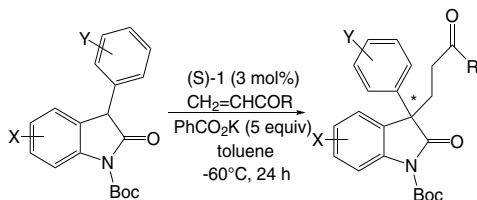
## References:

1. *J. Am. Chem. Soc.*, **2009**, *131*, 16720.

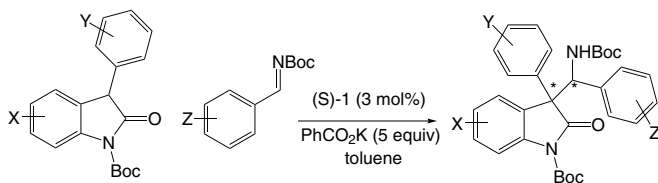
<b>15-0990</b>	<b>Dibromotriphenylphosphorane, 98%</b> (1034-39-5) (C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> PBr <sub>2</sub> ; FW: 422.10; light brown powdr. <i>air sensitive, moisture sensitive</i>	10g 50g
<b>15-1457</b>	<b>(11bR)-(+)-4,4-Dibutyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% R-MARUOKA CAT P-NB</b> [C <sub>46</sub> H <sub>38</sub> F <sub>12</sub> P] <sup>+</sup> Br <sup>-</sup> ; FW: 929.65; white xtl.; m.p. 262-263° Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component.	50mg 250mg

## Technical Note:

1. Chiral, phase-transfer catalyst for the asymmetric Michael and Mannich reactions of 3-aryloxindoles.



Tech. Note (1)  
Ref. (1)



Tech. Note (1)  
Ref. (1)

## References:

1. *Angew. Chem. Int. Ed.*, **2009**, *48*, 4559.

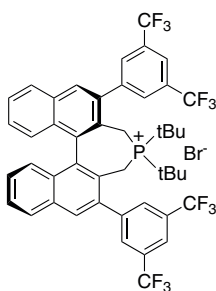
<b>15-1458</b>	<b>(11bS)-(-)-4,4-Dibutyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% S-Maruoka CAT P-NB</b> (1110711-01-7) [C <sub>46</sub> H <sub>30</sub> F <sub>12</sub> P] <sup>+</sup> Br <sup>-</sup> ; FW: 929.65; white xt.; m.p. 262-263° Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component.	50mg 250mg
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## Technical Note:

1. See 15-1457 (page 137)

# PHOSPHORUS - Ligands and Compounds

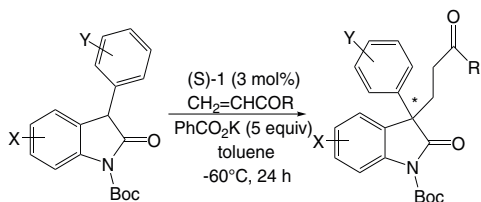
**15-1464** (11bR)-(+)-4,4-Di-*t*-butyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% R-MARUOKA CAT P-TB  
 [C<sub>46</sub>H<sub>38</sub>F<sub>12</sub>P]<sup>+</sup>Br<sup>-</sup>; FW: 929.65; white xtl.; m.p. 202-204°  
 Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component.



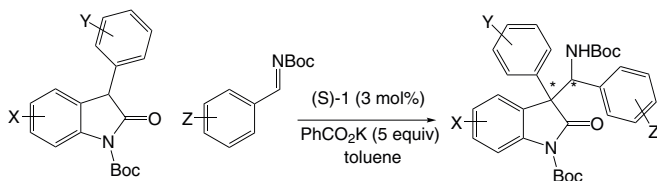
50mg  
250mg

Technical Note:

- Chiral, phase-transfer catalyst for the asymmetric Michael and Mannich reactions of 3-aryloxindoles.



Tech. Note (1)  
Ref. (1)



Tech. Note (1)  
Ref. (1)

References:

- Angew. Chem. Int. Ed., 2009, 48, 4559.

**15-1465** (11bS)-(-)-4,4-Di-*t*-butyl-2,6-bis[3,5-bis(trifluoromethyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99% S-MARUOKA CAT P-TB  
 [C<sub>46</sub>H<sub>38</sub>F<sub>12</sub>P]<sup>+</sup>Br<sup>-</sup>; FW: 929.65; white xtl.; m.p. 202-203°  
 Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component.

50mg  
250mg

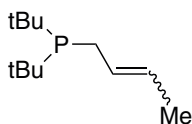
Technical Note:

- See 15-1464 (page 138)

**15-1725** Di-*t*-butyl(2-butenyl)phosphine (40% in xylene), 98% m-Crophos®  
 C<sub>12</sub>H<sub>25</sub>P; FW: 200.30; colorless liq.; b.p. 76-77° (4.0mm)  
*air sensitive*

NEW

HAZ



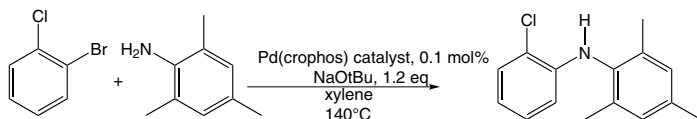
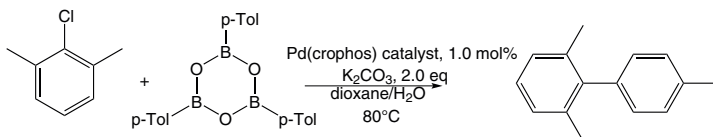
5g  
25g  
100g

Technical Note:

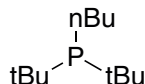
- Crophos® is a very reactive phosphine ligand used in catalysts that are especially effective for coupling reactions involving bulky reactants.

# PHOSPHORUS - Ligands and Compounds

**15-1725** Di-*t*-butyl(2-butenyl)phosphine (40% in xylene), 98% m-Crophos®  
(continued)



**15-1128** Di-*t*-butyl(2-butenyl)phosphine, min. 97%  
(29949-72-2)  
C<sub>12</sub>H<sub>27</sub>P; FW: 202.32; colorless liq.  
*air sensitive, pyrophoric*

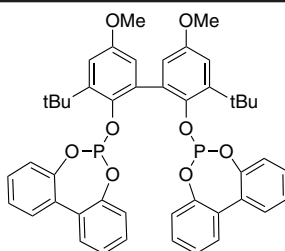


250mg  
1g  
5g

**15-1000** Di-*t*-butylchlorophosphine, min. 98% (13716-10-4)  
[(CH<sub>3</sub>)<sub>3</sub>C]<sub>2</sub>PCl; FW: 180.66; colorless to light yellow liq.; m.p. 2-3°;  
b.p. 69-70°/10 mm; f.p. 142°F; d. 0.951  
*air sensitive, moisture sensitive*

1g  
5g  
25g

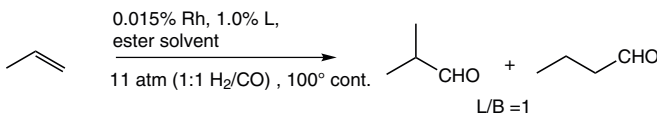
**15-0107** 6,6'-[(3,3'-Di-*t*-butyl-5,5'-dime-thoxy-1,1'-biphenyl-2,2'-diyl) bis(oxy)] bis(dibenzo[d,f][1,3,2] dioxaphosphepin) hemi ethyl acetate adduct, min. 95%  
**BIPHEPHOS** (121627-17-6)  
C<sub>46</sub>H<sub>44</sub>O<sub>8</sub>P<sub>2</sub>·0.5EtOAc;  
FW: 786.78 (830.84); white to off-white powdr.; m.p. 188-190°  
*air sensitive, moisture sensitive*



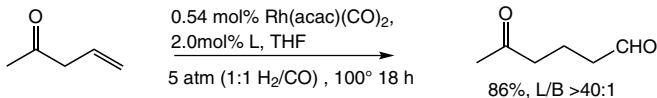
250mg  
1g  
5g

## Technical Notes:

1. With rhodium forms a highly active catalyst for the hydroformylation of  $\alpha$ -olefins.
2. The hydroformylation of functionalized  $\alpha$ -olefins is highly regioselective. The sterically demanding ligand increases *n*/*iso* ratio by reducing rhodium interaction with heteroatom functionality.
3. Ligand used in tandem reaction sequences where high *n*/*iso* ratio is desired in the hydroformylation step.



Tech. Note (1)  
Ref. (1)

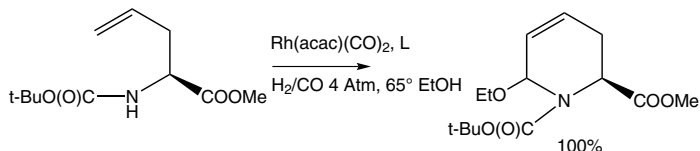


Tech. Note (2)  
Ref. (2-4)



# PHOSPHORUS - Ligands and Compounds

**15-0107** 6,6'-[(3,3'-Di-*t*-butyl-5,5'-dimethoxy-1,1'-biphenyl-2,2'-diyl)bis(oxy)] bis(dibenzo[d,f][1,3,2] dioxaphosphepin) hemi ethyl acetate adduct, min. 95% BIPHEPHOS (121627-17-6)



**Tech. Note (3)**  
**Ref. (5-7)**

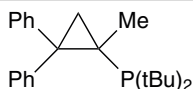
## References:

1. US Patent 4769498.
2. *J. Am. Chem. Soc.*, **1993**, *115*, 2066
3. *Organometallics*, **1995**, *14*, 3832
4. *J. Mol. Catal. A*, **2005**, *232*, 41
5. *J. Org. Chem.* **1995**, *60*, 7078
6. *J. Org. Chem.* **2007**, *72*, 1871
7. *Chem. Rev.* **1999**, *99*, 3329

**15-1005** Di-*t*-butyl(2,2-diphenyl-1-methyl-1-cyclopropyl)phosphine **cBRIDP** (742103-27-1)  
C<sub>24</sub>H<sub>33</sub>P; FW: 352.49; white to pale yellow solid

*air sensitive, (store cold)*

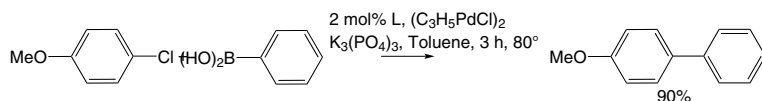
Note: Manufactured under license of Takasago patent US7129367B2.



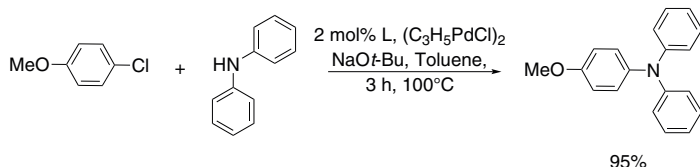
250mg  
1g  
5g

## Technical Notes:

1. Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
2. Ligand used in the palladium catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
3. Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.



**Tech. Note (1,2)**  
**Ref. (1,2)**



**Tech. Note (1,3)**  
**Ref. (1)**

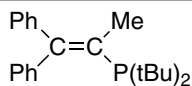
## References:

1. US Patent 7129367.
2. *Synlett.*, **2008**, *12*, 1809.

**15-1065** Di-*t*-butyl(2,2-diphenyl-1-methylvinyl)phosphine, min. 98% **vBRIDP** (384842-25-5)  
C<sub>23</sub>H<sub>31</sub>P; FW: 338.47; white to pale yellow xtl.

*air sensitive, (store cold)*

Note: Manufactured under license of Takasago patent US6455720.



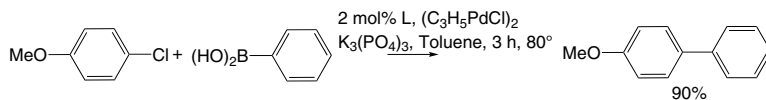
250mg  
1g  
5g

## Technical Notes:

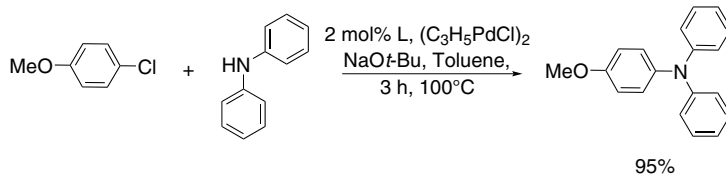
1. Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
2. Ligand used in the palladium catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
3. Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.

# PHOSPHORUS - Ligands and Compounds

**15-1065** Di-*t*-butyl(2,2-diphenyl-1-methylvinyl)phosphine, min. 98% vBRIDP (384842-25-5)  
(continued)



Tech. Note (1,2)  
Ref. (1,2)

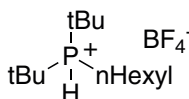


Tech. Note (1,2)  
Ref. (1)

References:

- US Patent 7129367.
- Synlett., 2008, 12, 1809.

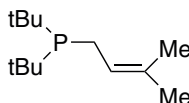
**15-7230** Di-*t*-butyl(*n*-hexyl)phosphonium tetrafluoroborate, 98%  
C<sub>14</sub>H<sub>32</sub>BF<sub>4</sub>P; FW: 318.18; white powdr.  
hygroscopic



500mg  
2g

**15-1729** Di-*t*-butyl(3-methyl-2-butenyl)phosphine (40% in xylene), 98% Crophos®  
C<sub>13</sub>H<sub>27</sub>P; FW: 214.33; colorless liq.  
air sensitive

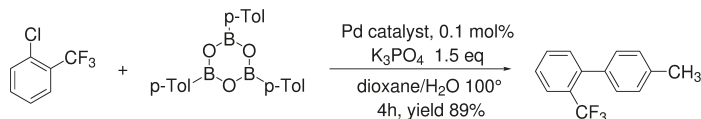
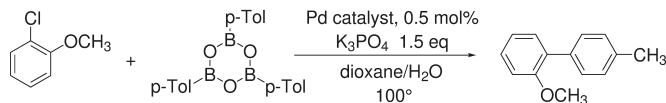
**NEW**  
HAZ



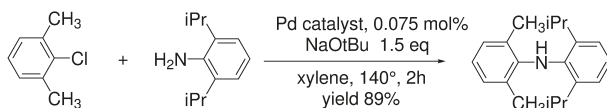
5g  
25g  
100g

Technical Note:

- m*-Crophos® is a very reactive phosphine ligand used in catalysts that are especially effective for coupling reactions involving bulky reactants.



Tech. Note (1,2)  
Ref. (1)

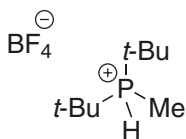


**15-1020** Di-*t*-butylmethylphosphine, 98+% (6002-40-0)  
[(CH<sub>3</sub>)<sub>3</sub>C]<sub>2</sub>(CH<sub>3</sub>)P; FW: 160.26; colorless liq.; d. 0.824  
air sensitive

1g  
5g

# PHOSPHORUS - Ligands and Compounds

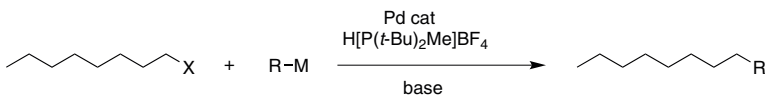
**15-1023** Di-*t*-butylmethylphosphonium tetrafluoroborate, 99% (870777-30-3)  
 (C<sub>4</sub>H<sub>9</sub>)<sub>2</sub>(CH<sub>3</sub>)PH<sup>+</sup>BF<sub>4</sub><sup>-</sup>; FW: 248.05; white powdr.  
 Note: Phosphine Ligand Kit component.



1g  
5g

## Technical Notes:

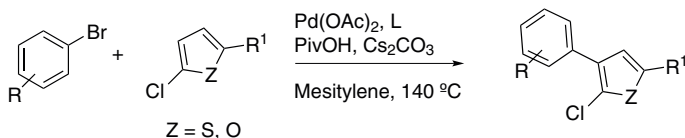
- Air and moisture-stable phosphonium salt used in palladium-catalyzed coupling reactions. The phosphonium salt is deprotonated in situ to yield the free phosphine ligand. Use of the phosphonium salt furnished nearly identical yields of product as reactions carried out using the phosphine.
- Ligand for the Pd-catalyzed heteroaromatic direct arylation.



**Tech. Note (1)**  
Ref. (1-5)

X = I, Br, OTs

R = aryl, M= B(OH)<sub>2</sub>, B<sub>pin</sub>  
 R = vinyl, M= SnBu<sub>3</sub>, Si(OMe)<sub>3</sub>



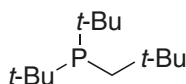
**Tech. Note (2)**  
Ref. (2-6)

Z = S, O

## References:

- J. Am. Chem. Soc.*, **2003**, *125*, 5616.
- J. Am. Chem. Soc.*, **2003**, *125*, 3718.
- Angew. Chem. Int. Ed.*, **2002**, *41*, 3910.
- J. Am. Chem. Soc.*, **2002**, *124*, 13662.
- Angew. Chem. Int. Ed.*, **2011**, *50*, 8660.
- J. Org. Chem.*, **2010**, *75*, 1047.

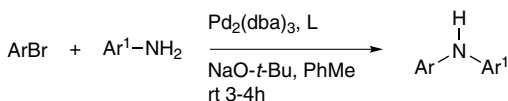
**15-1017** Di-*t*-butylneopentylphosphine, min. 95%  
 (DTBNpP) (60633-21-8)  
 (C<sub>4</sub>H<sub>9</sub>)<sub>2</sub>(C<sub>5</sub>H<sub>11</sub>)P; FW: 216.35; colorless to  
 yellow liq.  
 pyrophoric



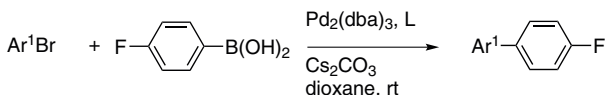
1g  
5g

## Technical Notes:

- The phosphine, used in combination with a palladium source, produces a highly effective catalyst for the Buchwald-Hartwig amination of aryl bromides at room temperature.
- Phosphine used in the palladium-catalyzed, Suzuki cross-coupling reaction.



**Tech. Note (1)**  
Ref. (1,3)



**Tech. Note (2)**  
Ref. (2,3)

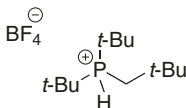
## References:

- J. Org. Chem.*, **2006**, *71*, 5117.
- Organometallics*, **2006**, *25*, 2978.
- J. Org. Chem.*, **2011**, *76*, 7918.

# PHOSPHORUS - Ligands and Compounds

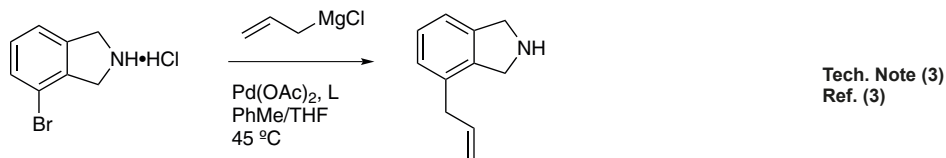
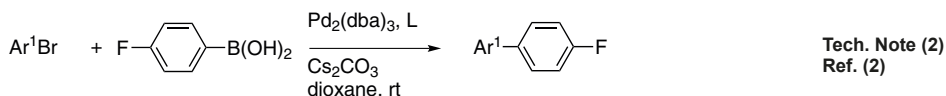
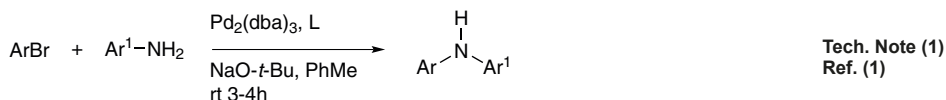
<b>15-1018</b> HAZ	<b>Di-<i>t</i>-butylneopentylphosphine, min. 95% (DTBNpP) (10 wt% in hexanes)</b> (60633-21-8) (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> (C <sub>5</sub> H <sub>11</sub> )P; FW: 216.35; colorless to pale yellow liq. <i>air sensitive</i>	10g 50g
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<b>15-1019</b>	<b>Di-<i>t</i>-butylneopentylphosphonium tetrafluoroborate, min. 95% (886059-84-3)</b> [(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> (C <sub>5</sub> H <sub>11</sub> )PH] <sup>+</sup> BF <sub>4</sub> <sup>-</sup> ; FW: 304.17; white solid	1g 5g
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## Technical Notes:

1. The phosphine, used in combination with a palladium source and base, produces a highly effective catalyst for the Buchwald-Hartwig amination of aryl bromides at room temperature.
2. Phosphine used in the palladium-catalyzed, Suzuki cross-coupling reaction.
3. Phosphine used in the palladium-catalyzed Kumada cross-coupling reaction.



## References:

1. *J. Org. Chem.*, **2006**, *71*, 5117.
2. *Organometallics*, **2006**, *25*, 2978.
3. *Org. Process Res. Dev.*, **2011**, *15*, 158.

<b>15-1093</b>	<b>Di-<i>t</i>-butylphenylphosphine, min. 98% (50wt% in toluene)</b> (32673-25-9) C <sub>14</sub> H <sub>23</sub> P; FW: 222.31; colorless liq. <i>air sensitive</i>	2g 10g
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<b>15-1028</b>	<b>Di-<i>t</i>-butylphenylphosphonium tetrafluoroborate, 97%</b> [[C(CH <sub>3</sub> ) <sub>3</sub> C] <sub>2</sub> (C <sub>6</sub> H <sub>5</sub> )PH] <sup>+</sup> BF <sub>4</sub> <sup>-</sup> ; FW: 310.12; white powd.	1g 5g
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## Technical Note:

1. Non-pyrophoric, air-stable derivative suitable as a replacement for the neat phosphine in a variety of stoichiometric and catalytic processes.

<b>15-1030</b> amp HAZ	<b>Di-<i>i</i>-butylphosphine, min. 97% (4006-38-6)</b> (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> PH; FW: 146.21; colorless liq.; f.p. -1°F <i>air sensitive, pyrophoric</i>	1g 5g 25g
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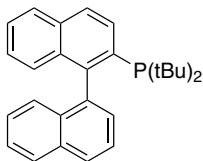
<b>15-1031</b> HAZ	<b>Di-<i>i</i>-butylphosphine, min. 97% (10 wt% in hexanes) (4006-38-6)</b> (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> PH; FW: 146.22; colorless liq. <i>air sensitive</i>	10g 50g 250g
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<b>15-1040</b> amp HAZ	<b>Di-<i>t</i>-butylphosphine, 98+% (819-19-2)</b> [(CH <sub>3</sub> ) <sub>3</sub> C] <sub>2</sub> PH; FW: 146.22; colorless liq.; m.p. -17°; b.p. 38-40°; f.p. -1°F; d. 0.790 <i>pyrophoric</i>	1g 5g 25g
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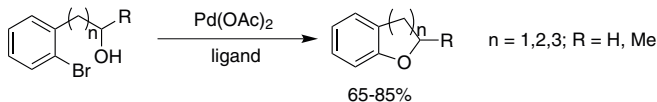
# PHOSPHORUS - Ligands and Compounds

15-1042	<b>Di-<i>t</i>-butylphosphine, 98+% (10 wt% in hexanes) (819-19-2)</b> HAZ [(CH <sub>3</sub> ) <sub>3</sub> C] <sub>2</sub> PH; FW: 146.22; colorless liq. <i>air sensitive</i>	50g 250g
15-1041	<b>Di-<i>t</i>-butylphosphine oxide, 98% (684-19-5)</b> (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> P(O)H; FW: 162.21; white xtl. <i>hygroscopic</i>	250mg 1g
15-1043	<b>racemic-2-Di-<i>t</i>-butylphosphino-1, 1'-binaphthyl, 98% TrixiePhos</b> (255836-67-0) C <sub>28</sub> H <sub>31</sub> P; FW: 398.53; white xtl.; m.p. 147-149° Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component.. Patents: US 6,395,916, US 6,307,087.	250mg 1g 5g

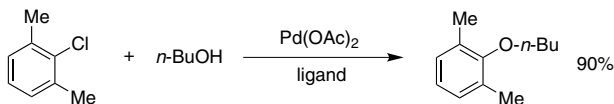


## Technical Notes:

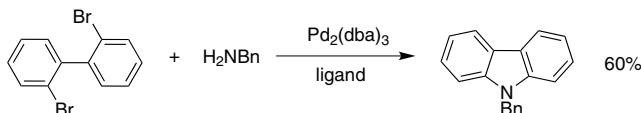
- Ligand for the Pd-catalyzed formation of oxygen heterocycles.
- Ligand for the intermolecular Pd-catalyzed synthesis of aryl ethers.
- Ligand for the intramolecular Pd-catalyzed synthesis of aryl ethers.
- Ligand for the synthesis of carbazoles by Pd-catalyzed double N-arylation reaction.
- Ligand for the Pd-catalyzed cyanation of (hetero)arylchlorides.
- Ligand for the Pd-catalyzed intramolecular synthesis of carbazoles via C-H functionalization.



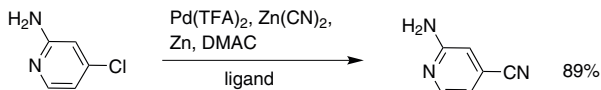
Tech. Note (1)  
Ref. (1)



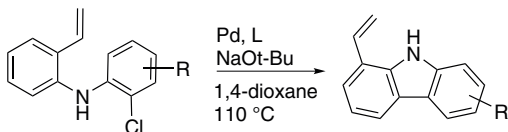
Tech. Note (2,3)  
Ref. (2,3)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)



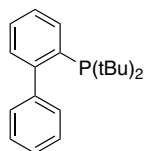
Tech. Note (6)  
Ref. (6)

## References:

- J. Am. Chem. Soc.*, **2000**, 122, 12907.
- J. Am. Chem. Soc.*, **2001**, 123, 10770.
- J. Am. Chem. Soc.*, **2001**, 123, 12202.
- Tetrahedron*, **2006**, 62, 6792.
- Org. Lett.*, **2007**, 9, 1711.
- J. Am. Chem. Soc.*, **2010**, 132, 14048.
- Chem. Sci.*, **2011**, 2, 27-50.

# PHOSPHORUS - Ligands and Compounds

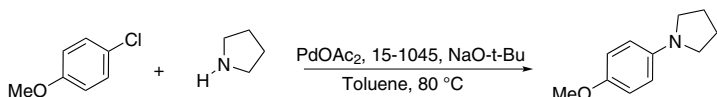
**15-1045** **2-(Di-*t*-butylphosphino))-1,1'-biphenyl, 99%**  
**JohnPhos** (224311-51-7)  
 C<sub>20</sub>H<sub>27</sub>P; FW: 298.41; white xtl.; m.p. 85°  
 Note: Phosphine Ligand Kit component. Note:  
 Buchwald Biaryl Phosphine Ligand Master Kit  
 component. Buchwald Biaryl Phosphine Ligand  
 Mini Kit 2 component. Patents: US 6,395,916, US  
 6,307,087.



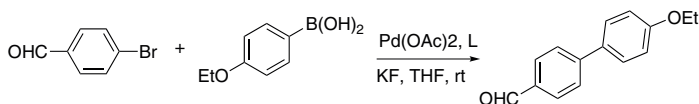
500mg  
 2g  
 10g  
 50g

## Technical Notes:

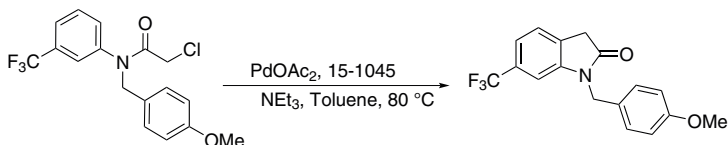
- Ligand used in the palladium-catalyzed synthesis of aromatic amines from aryl chlorides, bromides and triflates.
- Ligand employed in a very active and general catalyst for Suzuki coupling reactions using aryl chlorides, bromides and triflates.
- Ligand used in palladium-catalyzed synthesis of oxindoles from  $\alpha$ -chloroacetanilides.
- Effective ligand used in palladium-catalyzed arylation of thiazoles.
- Used in the formation of 2-benzylindolines via sequential palladium-catalyzed N-arylation/cyclization/C-arylation.
- Selective in the palladium-catalyzed arylation of silyl enol ethers formed from copper-catalyzed reduction of enones.
- Ligand used in the palladium-catalyzed vinylation of aryl bromides.
- Ligand used in the platinum-catalyzed synthesis of indolinones.
- Ligand used in the palladium-catalyzed diarylation of thiophenes.
- Ligand used in the amination of vinyl halides by carbazates.
- Ligand used in the regioselective synthesis of 2,4-disubstituted silyloles.
- Ligand used in the gold-catalyzed hydrophenoxylation of phenols with diphenylacetylene.
- Ligand used in the palladium-catalyzed tandem allenyl and aryl C-N bond formation.
- Ligand used in the copper-catalyzed electrophilic amination of arylsilanes with hydroxylamines.



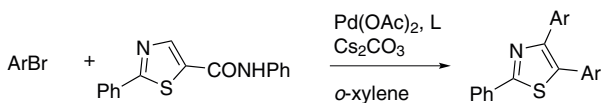
**Tech. Note (1)**  
**Ref. (2)**



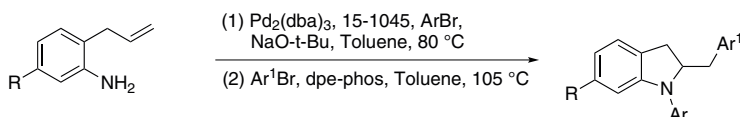
**Tech. Note (2)**  
**Ref. (3)**



**Tech. Note (3)**  
**Ref. (4-5)**



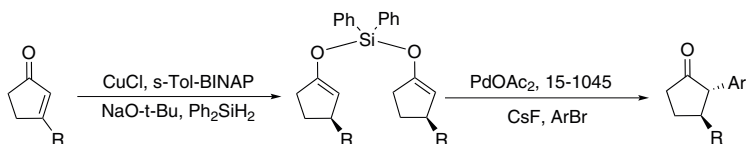
**Tech. Note (4)**  
**Ref. (6)**



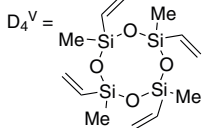
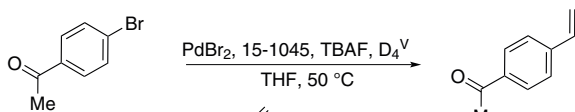
**Tech. Note (5)**  
**Ref. (7)**

# PHOSPHORUS - Ligands and Compounds

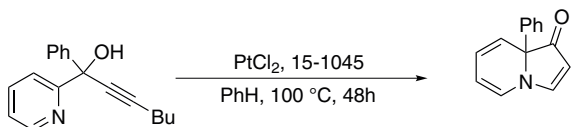
15-1045 2-(Di-*t*-butylphosphino))-1,1'-biphenyl, 99% JohnPhos (224311-51-7)  
(continued)



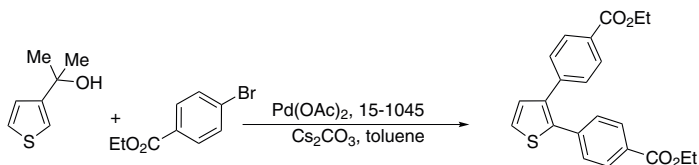
Tech. Note (6)  
Ref. (8)



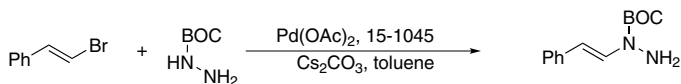
Tech. Note (7)  
Ref. (9)



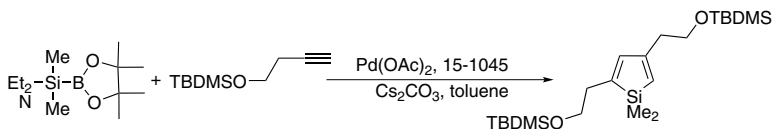
Tech. Note (8)  
Ref. (10)



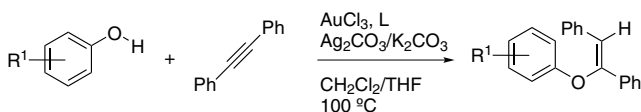
Tech. Note (9)  
Ref. (11)



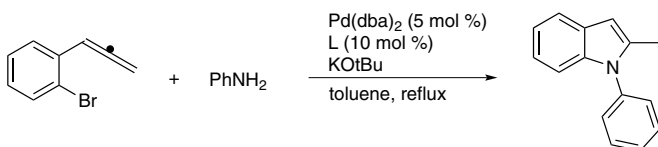
Tech. Note (10)  
Ref. (12)



Tech. Note (11)  
Ref. (13)



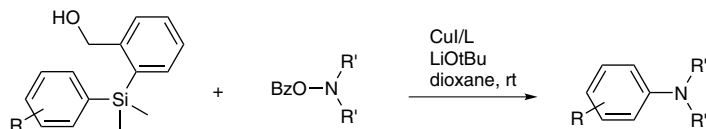
Tech. Note (12)  
Ref. (14)



Tech. Note (13)  
Ref. (16)

# PHOSPHORUS - Ligands and Compounds

**15-1045** 2-(Di-*t*-butylphosphino))-1,1'-biphenyl, 99% JohnPhos (224311-51-7)  
(continued)

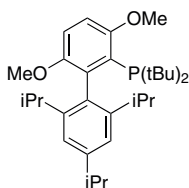


Tech. Note (14)  
Ref. (17)

References:

1. *Angew. Chem. Int. Ed.*, **1999**, 38, 2413.
2. *J. Org. Chem.*, **2000**, 65, 1158.
3. *J. Am. Chem. Soc.*, **1999**, 121, 9550.
4. *J. Am. Chem. Soc.*, **2003**, 125, 12084.
5. *Org. Process Res. Dev.*, **2012**, 16, 255
6. *Tetrahedron*, **2003**, 59, 5685.
7. *J. Am. Chem. Soc.*, **2004**, 126, 13906.
8. *Org. Lett.*, **2004**, 6, 4809.
9. *Org. Lett.*, **2006**, 7, 63.
10. *Org. Lett.*, **2007**, 9, 1169.
11. *J. Org. Chem.*, **2006**, 71, 8309.
12. *Org. Lett.*, **2007**, 9, 275.
13. *J. Am. Chem. Soc.*, **2008**, 130, 1526.
14. *J. Org. Chem.*, **2010**, 75, 2247.
15. *Chem. Sci.*, **2011**, 2, 27-50.
16. *Org. Lett.*, **2012**, 14, 4398.
17. *Org. Lett.*, **2013**, 15, 172.

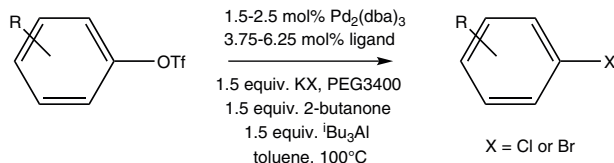
**15-1164** 2-(Di-*t*-butylphosphino)-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% **t-BuBrettPhos** (1160861-53-9)  
C<sub>31</sub>H<sub>49</sub>O<sub>2</sub>P; FW: 484.69; white xtl.  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component..  
Patents: US 6,395,916, US 6,307,087.



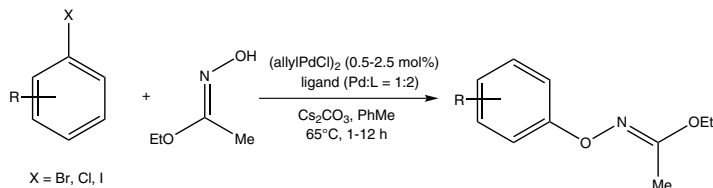
100mg  
500mg  
2g  
10g  
50g

Technical Notes:

1. Ligand used in the Pd-catalyzed conversion of aryl and vinyl triflates to bromides and chlorides.
2. Ligand used in the Pd-catalyzed O-arylation of ethyl acetoxyhydroximates.
3. Ligand used in the Pd-catalyzed conversion of aryl chlorides, triflates, and nonaflates to nitroaromatics.
4. Ligand used in the Pd-catalyzed cross-coupling of amides and aryl mesylates.



Tech. Note (1)  
Ref. (1)

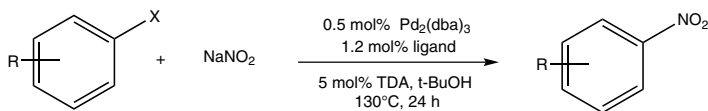


Tech. Note (2)  
Ref. (2)



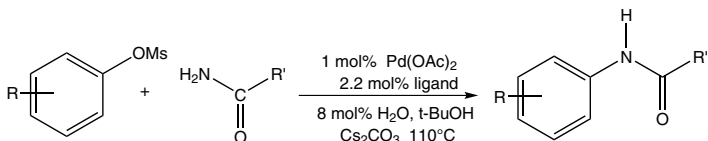
# PHOSPHORUS - Ligands and Compounds

**15-1164** 2-(Di-*t*-butylphosphino)-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98%  
(continued) **t-BuBrettPhos** (1160861-53-9)



X = Cl, triflate, nonaflates

Tech. Note (3)  
Ref. (3)

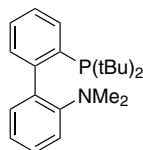


Tech. Note (4)  
Ref. (4)

## References:

1. *J. Am. Chem. Soc.*, **2010**, *132*, 14076.
2. *J. Am. Chem. Soc.*, **2010**, *132*, 9990.
3. *J. Am. Chem. Soc.*, **2009**, *131*, 12898.
4. *Org. Lett.*, **2010**, *12(10)*, 2350.

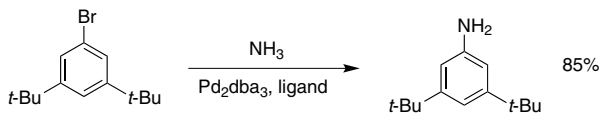
**15-1048** 2-Di-*t*-butylphosphino-2'-(*N,N*-dimethylamino)-1,1'-biphenyl, 98% **tBuDavePhos** (224311-49-3)  
(CH<sub>3</sub>)<sub>2</sub>NC<sub>6</sub>H<sub>4</sub>C<sub>6</sub>H<sub>4</sub>P(C<sub>4</sub>H<sub>9</sub>)<sub>2</sub>; FW: 341.47; white xtl.  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component.. Patents: US 6,395,916, US 6,307,087.



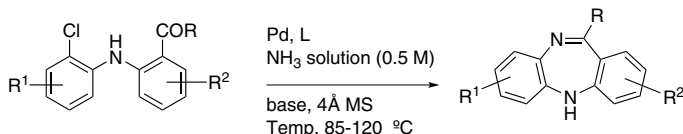
500mg  
2g  
10g

## Technical Notes:

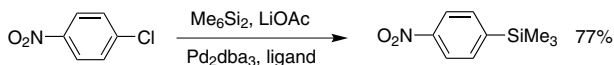
1. Useful ligand for Pd-catalyzed carbon-oxygen bond forming reactions.
2. Ligand used selective Pd-catalyzed arylation of ammonia. Application to the synthesis of dibenzodiazepines.
3. Ligand used for selective Pd-catalyzed silylation of aryl chlorides.
4. Ligand used for Pd(0)-catalyzed direct dehydrative coupling of terminal alkynes with allylic alcohols to access 1,4-enynes.



Tech. Note (2)  
Ref. (2)



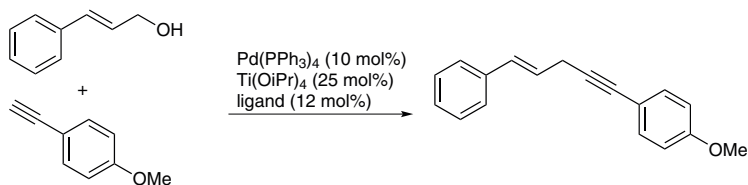
Tech. Note (2)  
Ref. (3)



Tech. Note (3)  
Ref. (4)

# PHOSPHORUS - Ligands and Compounds

**15-1048** 2-Di-t-butylphosphino-2'-(N,N-dimethylamino)-1,1'-biphenyl, 98% tBuDavePhos  
(continued) (224311-49-3)

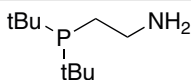


Tech. Note (4)  
Ref. (6)

## References:

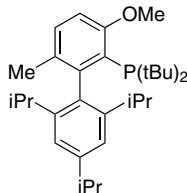
1. *J. Am. Chem. Soc.*, **2001**, *123*, 12202.
2. *J. Am. Chem. Soc.*, **2007**, *129*, 10354.
3. *J. Am. Chem. Soc.*, **2011**, *133*, 14228.
4. *Org. Lett.*, **2007**, *9*, 3785.
5. *Chem. Sci.*, **2011**, *2*, 27.
6. *J. Am. Chem. Soc.*, **2013**, *135*, 12536.

**15-7128** 2-(Di-t-butylphosphino)ethylamine, min.  
HAZ 97% (10 wt% in THF) (1053658-84-6)  
(tBu)<sub>2</sub>P(CH<sub>2</sub>)<sub>2</sub>NH<sub>2</sub>; FW: 189.28; pale yellow to colorless liq.  
*air sensitive, moisture sensitive*



5g  
25g

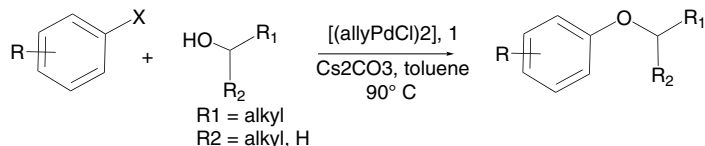
**15-1168** 2-(Di-t-butylphosphino)-3-methoxy-6-methyl-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min.  
98% RockPhos (1262046-34-3)  
C<sub>31</sub>H<sub>49</sub>OP; FW: 468.69; white xtl.; m.p. 129-130°  
Note: Patents: US 6,395,916, US 6,307,087.



100mg  
500mg  
2g

## Technical Note:

1. Ligand used in the palladium-catalyzed C-O bond forming reactions of secondary and primary alcohols with a range of arylhalides. Heterocyclic halides and, for the first time, electron-rich aryl halides can be coupled with secondary alcohols.

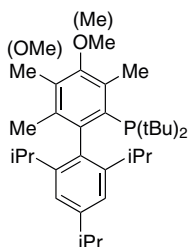


## References:

1. *Angew. Chem. Int. Ed.*, **2011**, *50*, 9943.

# PHOSPHORUS - Ligands and Compounds

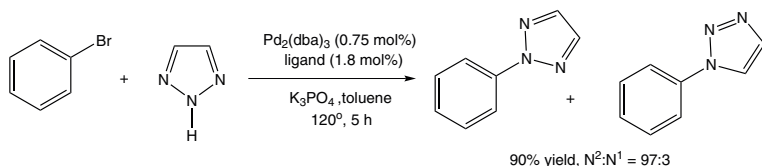
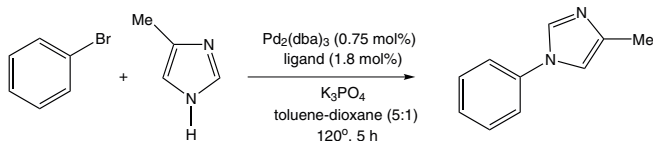
**15-1063** **2-Di-t-butylphosphino-4-methoxy-3,5,6-trimethyl-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% [~1:1 mixture with regioisomer, 2-Di-t-butylphosphino-5-methoxy-3,4,6-trimethyl-2',4',6'-tri-i-propylbiphenyl]** (1359986-21-2)  
 $C_{33}H_{53}OP$ ; FW: 496.75; white powdr.  
 Note: Patents: US 6,395,916, US 6,307,087



250mg  
1g  
5g

## Technical Note:

1. A surrogate ligand for Me4tBuXPhos in palladium-catalyzed C-N and C-O bond-forming reactions.

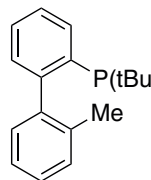


Tech. Note (1)  
Ref. (1)

## References:

1. *J. Org. Chem.*, **2012**, *77*, 2543.

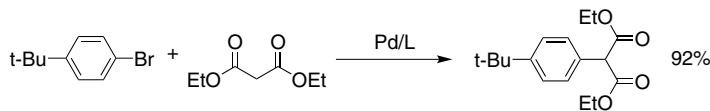
**15-1049** **2-Di-t-butylphosphino-2'-methyl-1,1'-biphenyl, 99% t-BuMePhos (255837-19-5)**  
 $C_{21}H_{29}P$ ; FW: 312.43; white xtl.  
 Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component.. Patents: US 6,395,916, US 6,307,087.



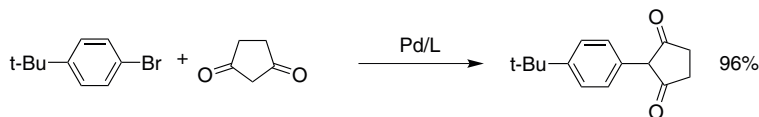
500mg  
2g  
10g  
50g

## Technical Notes:

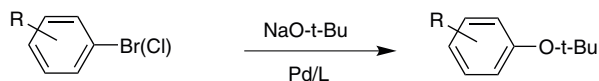
1. Ligand used in the Pd-catalyzed arylations of malonate esters and 1,3-diketones.
2. Ligand used in the Pd-catalyzed formation of t-butyl ethers from unactivated aryl halides.
3. Ligand used in the Pd-catalyzed  $\alpha$ -arylations of nitroalkanes.



Tech. Note (1)  
Ref. (1)



Tech. Note (1)  
Ref. (1)

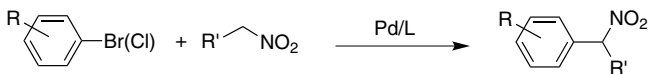


Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

**15-1049** 2-Di-t-butylphosphino-2'-methyl)-1,1'-biphenyl, 99% t-BuMePhos (255837-19-5)

(continued)

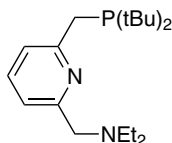


Tech. Note (3)  
Ref. (3)

References:

1. *J. Am. Chem. Soc.*, **2000**, 122, 1360.
2. *J. Org. Chem.*, **2001**, 66, 2498.
3. *J. Org. Chem.*, **2002**, 67, 106.
4. *Chem. Sci.*, **2011**, 2, 27-50.

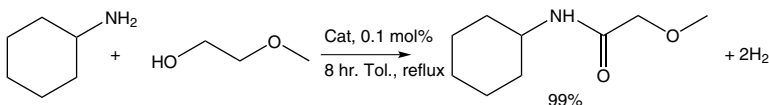
**15-0073** 2-(Di-t-butylphosphinomethyl)-6-(diethyl-aminomethyl)pyridine, 98% (863971-66-8)  
C<sub>19</sub>H<sub>35</sub>N<sub>2</sub>P; FW: 322.47; yellow liq.  
*air sensitive*



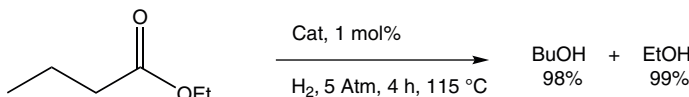
100mg  
500mg

Technical Notes:

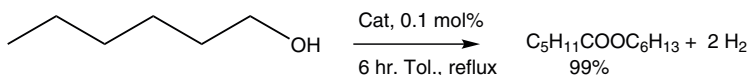
1. Ligand/Ruthenium catalyst for the direct synthesis of amides from alcohols and primary amines.
2. Ligand/ catalyst for the hydrogenation of esters in high yields under mild pressure and neutral conditions.
3. Ligand/Ruthenium catalyst for the dehydrogenative coupling of alcohols to form esters in high yields under neutral conditions
4. Ligand/Catalytic hydrogenation of dimethyl carbonate, methyl carbamates, and methyl formate, a route to methanol based on CO and CO<sub>2</sub>.



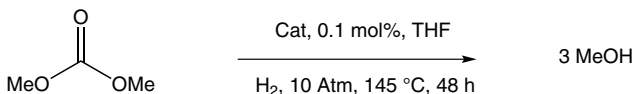
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3-4)

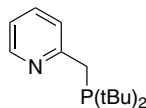


Tech. Note (4)  
Ref. (5)

References:

1. *Science*, **2007**, 317, 790.
2. *Angew. Chem. Int. Ed.*, **2006**, 45, 1113.
3. *J. Am. Chem. Soc.*, **2005**, 127, 12429.
4. *J. Am. Chem. Soc.*, **2005**, 127, 10840.
5. *Nature, Chem.*, **2011**, 3, 609.
6. *Chem. Soc.*, **2005**, 127, 10840.

**15-7350** 2-(Di-t-butylphosphinomethyl)pyridine, 99%  
(494199-72-3)  
C<sub>14</sub>H<sub>24</sub>NP; FW: 237.32; pale yellow liq.  
*air sensitive*



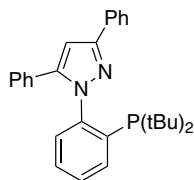
100mg  
500mg

# PHOSPHORUS - Ligands and Compounds

15-1720

NEW

**1-(2-Di-*t*-butylphosphinophenyl)-3,5-diphenyl-1H-pyrazole, 98%** (628333-86-8)  
 $C_{23}H_{33}N_2P$ ; FW: 203.30; white xtl.; m.p. 138-142°  
*air sensitive*

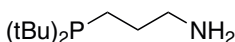


250mg  
1g

15-7130

HAZ

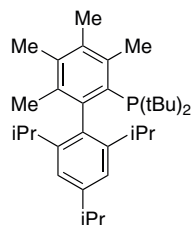
**3-(Di-*t*-butylphosphino)propylamine, min. 97% (10 wt% in THF)** (1196147-72-4)  
 $C_{11}H_{26}NP$ ; FW: 203.30; pale yellow to colorless liq.  
*air sensitive*



5g  
25g

15-1051

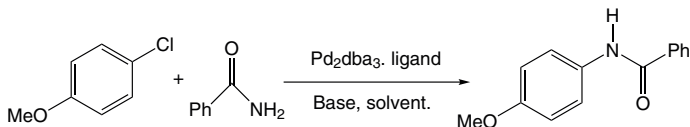
**2-Di-*t*-butylphosphino-3,4,5,6-tetramethyl-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% Me<sub>4</sub>-*t*-BuXPhos** (857356-94-6)  
 $C_{33}H_{53}P$ ; FW: 480.75; white microxtl.; m.p. 166-168°  
 Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component.. Patents: US 6,395,916, US 6,307,087.



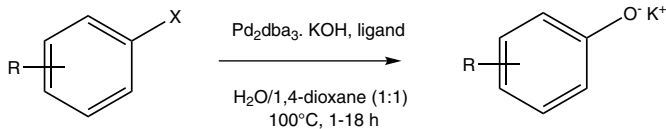
250mg  
1g  
5g  
25g

## Technical Notes:

- Ligand for the palladium-catalyzed amidation of aryl chlorides.
- Ligand for the palladium-catalyzed synthesis of phenols from aryl halides.
- Ligand for the palladium-catalyzed coupling of aryl halides and secondary alcohols.

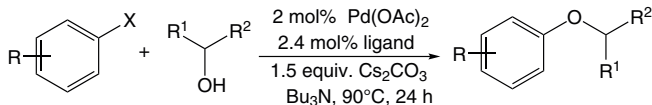


Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

X = Br, Cl



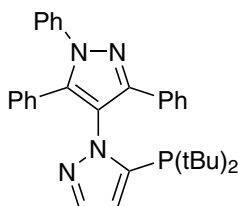
Tech. Note (3)  
Ref. (3)

## References:

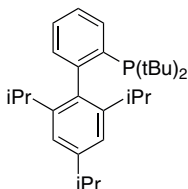
- J. Am. Chem. Soc.*, **2007**, *129*, 13001.
- J. Am. Chem. Soc.*, **2006**, *128*, 10894.
- J. Am. Chem. Soc.*, **2005**, *127*, 8146.

# PHOSPHORUS - Ligands and Compounds

**15-1037**    **5-(Di-*t*-butylphosphino)-1',3',5'-triph-enyl-1,4'-bi-1H-pyrazole, min. 95% *t*-Bu-BippyPhos (894086-00-1)**    250mg  
 C<sub>32</sub>H<sub>35</sub>N<sub>4</sub>P; FW: 506.62;    1g  
 white to pale yellow solid; m.p. 169-173°  
*air sensitive*

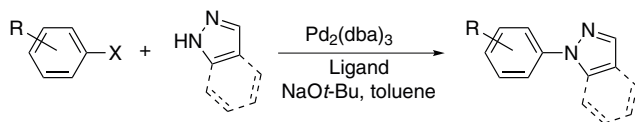


**15-1052**    **2-Di-*t*-butylphosphino-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% *t*-BuXPhos (564483-19-8)**    500mg  
 C<sub>29</sub>H<sub>45</sub>P; FW: 424.64; white xtl.;    2g  
 m.p. 147-149°    10g  
 Note: Buchwald Biaryl Phosphine Ligand    50g  
 Master Kit component.. Buchwald Biaryl    250g  
 Phosphine Ligand Mini Kit 1 component..  
 Patents: US 6,395,916, US 6,307,087.

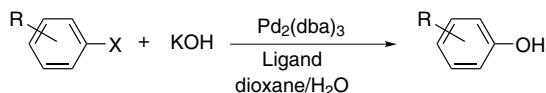


## Technical Notes:

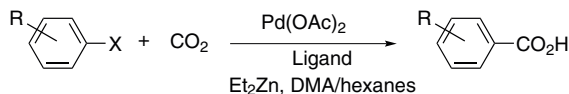
1. Effective ligand for the Pd-catalyzed arylation of pyrazoles, indazoles and amino heterocycles.
2. Ligand used in the Pd-catalyzed synthesis of phenols from aryl halides and KOH.
3. Ligand used in the Pd-catalyzed of benzoic acids from aryl halides and CO<sub>2</sub>.
4. Ligand used in the Pd-catalyzed trifluoromethylation of vinyl sulfonates.
5. Ligand used in the Pd-catalyzed arylation of nitroacetates.
6. Ligand used in the Pd-catalyzed Suzuki-Miyaura cross-coupling of allylboronates and aryl halides.
7. Ligand used in the Pd-catalyzed cyanation of (hetero)arylchlorides and bromides.
8. Ligand used in the Pd-catalyzed C-N cross coupling of sulfonamides and aryl halides.
9. Ligand used in the Pd-catalyzed arylation of cyanamides.



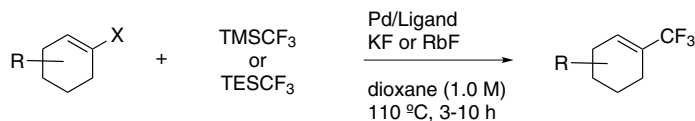
**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

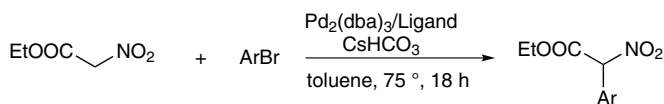


**Tech. Note (3)**  
**Ref. (3)**



**Tech. Note (4)**  
**Ref. (4)**

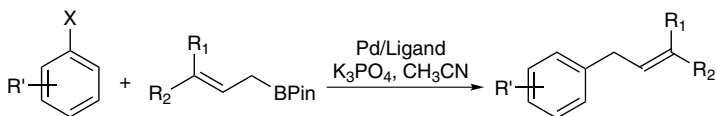
X = OTf or ONf



**Tech. Note (5)**  
**Ref. (5.6)**

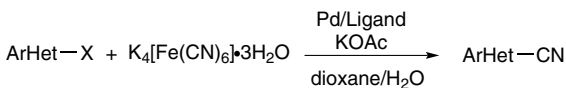
# PHOSPHORUS - Ligands and Compounds

**15-1052** 2-Di-*t*-butylphosphino-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% *t*-BuXPhos (564483-19-8)  
(continued)

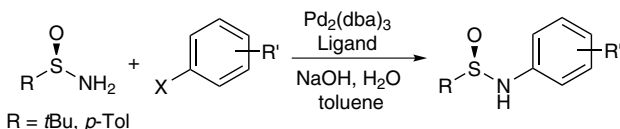


Tech. Note (6)  
Ref. (7)

X = Cl, Br, OTf

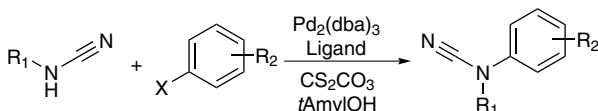


Tech. Note (7)  
Ref. (8)



R = *t*Bu, *p*-Tol

Tech. Note (8)  
Ref. (9)

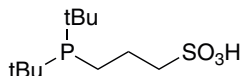


Tech. Note (9)  
Ref. (10)

## References:

1. *Angew. Chem., Int. Ed.*, **2006**, 45, 6523.
2. *J. Am. Chem. Soc.*, **2006**, 128, 10694.
3. *J. Am. Chem. Soc.*, **2009**, 131, 15974.
4. *Org. Lett.*, **2011**, 13, 6552.
5. *Chem. Sci.*, **2011**, 2, 27-50.
6. *Org. Lett.*, **2012**, 14, 760.
7. *J. Am. Chem. Soc.*, **2013**, 135, 10642.
8. *Angew. Chem., Int. Ed.*, **2013**, 52, 10035.
9. *J. Org. Chem.*, **2012**, 77, 4454.
10. *Org. Lett.*, **2012**, 14, 322.

<b>93-1518</b>	<b>Di-<i>n</i>-butylphosphite, 96%</b> (1809-19-4) (C <sub>4</sub> H <sub>9</sub> O) <sub>2</sub> P(O)H; FW: 194.21; colorless liq.; b.p. 118-119°/11 mm; f.p. 250°F; d. 0.995	50g 250g
<b>15-1054</b> HAZ 	<b>Di-<i>t</i>-butyl(<i>i</i>-propyl)phosphine, min. 98%</b> (25032-49-9) (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> (C <sub>3</sub> H <sub>7</sub> )P; FW: 118.29; colorless liq. <i>pyrophoric</i>	250mg 1g
<b>15-1067</b>	<b>Di-<i>t</i>-butyl(3-sulfonatopropyl)phosphine, min. 98%</b> (1055888-89-5) (C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> SO <sub>3</sub> H; FW: 268.35; white solid <i>moisture sensitive</i>	250mg 1g



# PHOSPHORUS - Ligands and Compounds

15-1053

NEW

(3*S*,3'*S*,4*S*,4'*S*,11*bS*,11'*bS*)-(+)-4,4'-Di-*t*-butyl-4,4',5,5'-tetrahydro-3,3'-bi-3*H*-dinaphtho[2,1-*c*:1',2'-*e*]phosphepin, 97% (S)-BINAPINE (610304-81-9)

C<sub>52</sub>H<sub>48</sub>P<sub>2</sub>; FW: 734.89;

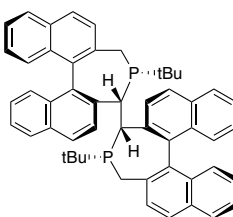
white to light yellow powdr.

air sensitive

Note: Sold in collaboration with Chiral

Quest for research purposes only. US

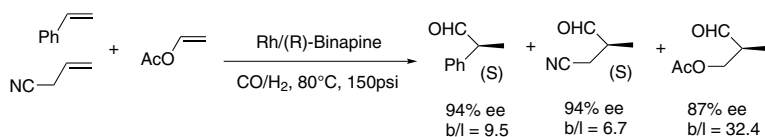
Patent No. 7105702, 7153809, 7169953.



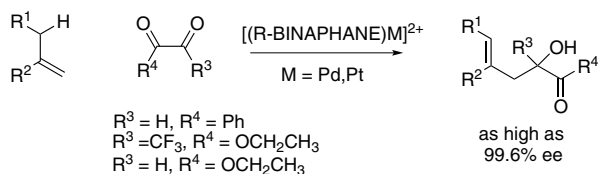
50mg  
250mg

## Technical Notes:

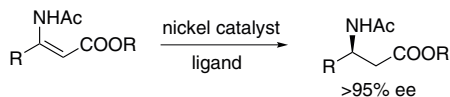
1. Rhodium complex used in asymmetric hydroformylation reactions.
2. Ligand-palladium complex used in enantioselective carbonyl-ene reactions.
3. Nickel-catalyzed asymmetric transfer hydrogenation of olefins for the synthesis of  $\alpha$ - and  $\beta$ - amino acids.
4. Nickel-catalyzed asymmetric transfer hydrogenation of hydrazones and other ketimines.
5. Nickel/ligand catalyst used in the enantioselective reductive amination of ketones with both arylamines and benzhydrazide,
6. Rh-Binapine and Pd-Binapine complexes form excellent catalysts for asymmetric (transfer) hydrogenation of aryl substituted olefins to form  $\beta$ -amino acids.



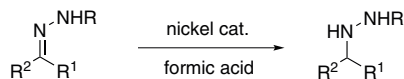
Tech. Note (1)  
Ref. (1)



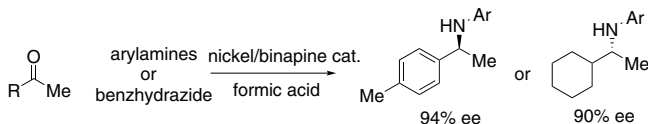
Tech. Note (2)  
Ref. (2)



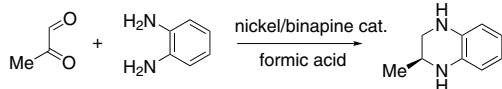
Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)



## References:

1. *Organometallics.*, **2006**, 25, 5003.
2. *Adv. Synth. Catal.*, **2010**, 352, 1356.
3. *Angew. Chem. Int. Ed.*, **2014**, 53, 12210.
4. *Angew. Chem. Int. Ed.*, **2015**, 54, 5112.
5. *Angew. Chem. Int. Ed.*, **2016**, 55, 12083.



# PHOSPHORUS - Ligands and Compounds

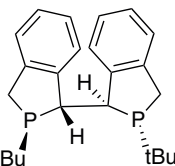
**15-1060** (1*R*,1'*R*,2*S*,2'*S*)-(+)-2,2'-Di-*t*-butyl-2,3,2',3'-tetrahydro-1,1'-bi-1*H*-isophosphindole, min. 98% (*R,R,S,S*)-DUANPHOS

(528814-26-8)

C<sub>24</sub>H<sub>32</sub>P<sub>2</sub>; FW: 382.46; white xtl.

air sensitive

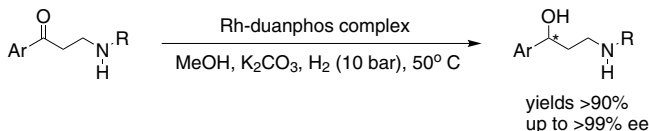
Note: Sold in collaboration with the Chiral Quest for research purposes only. Patent pending, PCT/US02/35788. Chiral Quest Catalyst and Ligand Toolbox Kit component.



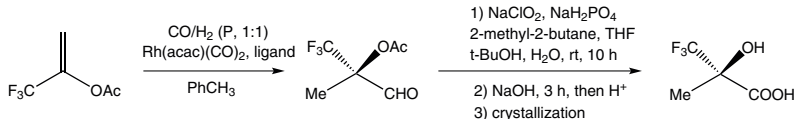
100mg  
500mg

## Technical Notes:

- As a highly electron-donating and conformationally rigid ligand, the rhodium complex of DuanPhos has exhibited remarkably high enantioselectivities and reactivities for the hydrogenation of a variety of functionalized olefins.
- Rhodium/DUANPHOS catalyst used in the synthesis of 2-trifluoromethyl lactic acid by asymmetric hydroformylation.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

## References:

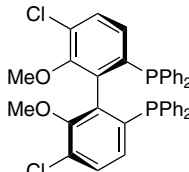
- Angew. Chem. Int. Ed.*, **2005**, *44*, 1687.
- J. Org. Chem.*, **2013**, *78*, 3429.

**15-1055** (*R*)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (*R*)-Cl-MeO-BIPHEP

(185913-97-7)

C<sub>38</sub>H<sub>30</sub>Cl<sub>2</sub>O<sub>2</sub>P<sub>2</sub>; FW: 651.50;  
yellow-white powder; m.p. 178°

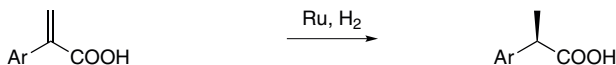
Note: Sold in collaboration with Lanxess for research purposes only. US Patents 5,710,339 and 5,801,261.



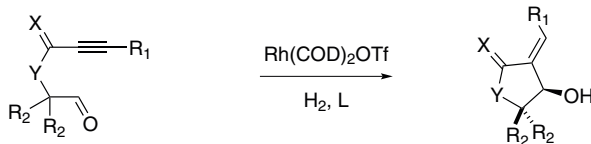
250mg  
1g

## Technical Notes:

- Ligand used in the ruthenium catalyzed, enantioselective hydrogenation of alkenes, carbonyls, and imines.
- Ligand used in the rhodium-catalyzed cyclization of acetylenic aldehydes.
- Ligand used in the iridium-catalyzed hydrogenative coupling of alkynes to aromatic and aliphatic N-arylsulfonyl aldimines.
- Asymmetric Cu-catalyzed propargylic substitution with amines,<sup>4a</sup> and enamines.<sup>4b</sup>
- Catalytic desymmetrizing intramolecular Heck reaction.
- Assembly of 1,3-polyols.
- Pd-catalyzed diastereo/enantioselective allylic alkylations of ketone enolates.
- Enantioselective vinylogous Reformatsky-type addition.
- Cu-catalyzed chemoselective preparation of 2-(pinacolato)boron- substituted allylcopper complexes and their *In situ* site-, diastereo-, and enantioselective additions to ketones.



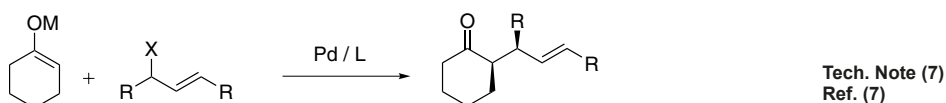
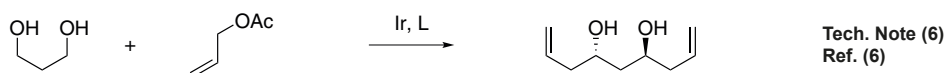
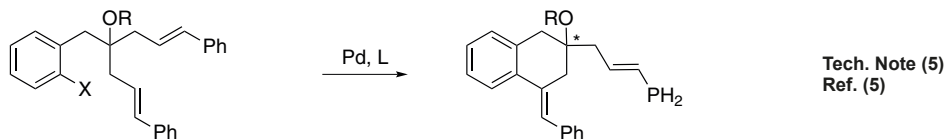
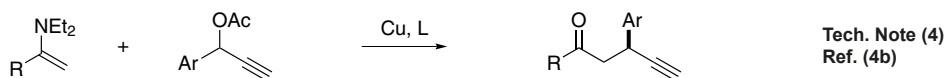
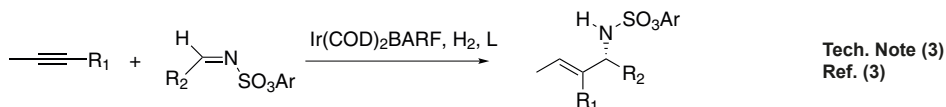
**Tech. Note (1)**  
**Ref. (1)**



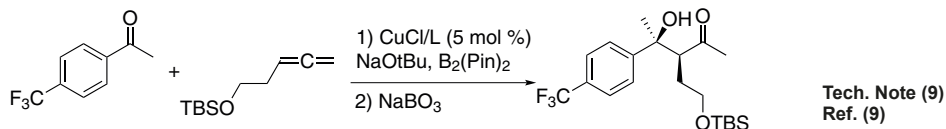
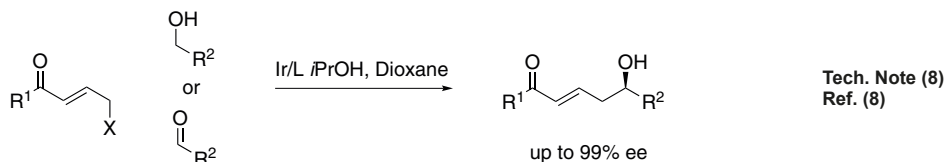
**Tech. Note (2)**  
**Ref. (2)**

# PHOSPHORUS - Ligands and Compounds

15-1055 (R)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95%  
 (continued) (R)-Cl-MeO-BIPHEP (185913-97-7)



X = OAc, OCO<sub>2</sub>Me



92 % yield  
> 98:2 d.r., 91:9 e.r.

## References:

1. Patents (Bayer) EP 0749973, DE 10027154.
2. *J. Am. Chem. Soc.*, **2006**, *128*, 10674.
3. *J. Am. Chem. Soc.*, **2007**, *129*, 12644.
4. (a) *Angew. Chem. Int. Ed.*, **2008**, *47*, 3781. (b) *Org. Lett.*, **2009**, *11*, 4612.
5. *Angew. Chem. Int. Ed.*, **2005**, *44*, 149.
6. *Angew. Chem. Int. Ed.*, **2009**, *48*, 5018.
7. *Adv. Synth. Catal.*, **2008**, *350*, 303.
8. *Angew. Chem. Int. Ed.*, **2011**, *50*, 3493.
9. *Angew. Chem. Int. Ed.*, **2013**, *52*, 5046.

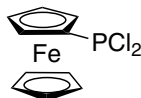
# PHOSPHORUS - Ligands and Compounds

**15-1056** (S)-(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95% (S)-Cl-MeO-BIPHEP (185913-98-8) 250mg  
 $C_{38}H_{30}Cl_2O_2P_2$ ; FW: 651.50; yellow-white powdr.; m.p. 178° 1g  
 Note: Sold in collaboration with Lanxess for research purposes only. US Patents 5,710,339 and 5,801,261.

Technical Note:

- See 15-1055 (page 156)

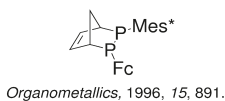
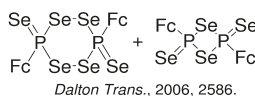
**26-0985** Dichlorophosphinofercene, 98% (1291-31-2) 1g  
 HAZ  $C_{10}H_9Cl_2FeP$ ; FW: 286.90; red-brown viscous liq. (solid when cold) 5g  
*moisture sensitive*



Technical Note:

- Ferrocene organophosphorus building block.

*Organometallics*, 1992, 11, 2930.

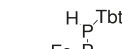


1. Mes\*PHSiMe<sub>3</sub>



MeLi

Na<sub>2</sub>Se, Se

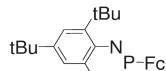


*Organometallics*, 2005, 24, 3074.

Mes\*NHSiMe<sub>3</sub>



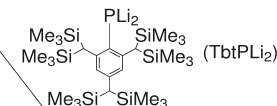
2 TbtP(H)Li



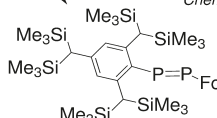
*J. Organomet. Chem.*, 1997, 529, 127.

Tricobalt clusters

*J. Coord. Chem.*, 2000, 51, 33.  
*J. Organomet. Chem.*, 1997, 543, 241.



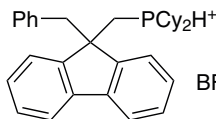
*Chem. Eur. J.*, 2004, 10, 6146.



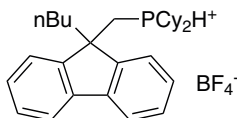
References:

- See above.

**15-1072** Dicyclohexyl(9-benzylfluoren-9-yl) phosphonium tetrafluoroborate, min. 97% [cataCXium® FBn] (937378-18-2) 500mg  
 $C_{32}H_{38}BF_4P$ ; FW: 540.42; white powdr. 2g  
*air sensitive*  
 Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component.



**15-1074** Dicyclohexyl(9-butylfluoren-9-yl) phosphonium tetrafluoroborate, min. 95% [cataCXium® FBu] (1007311-98-9) 500mg  
 $C_{28}H_{40}BF_4P$ ; FW: 506.41; white powdr. 2g  
 Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component.



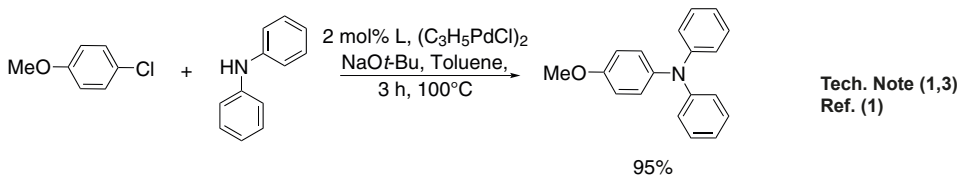
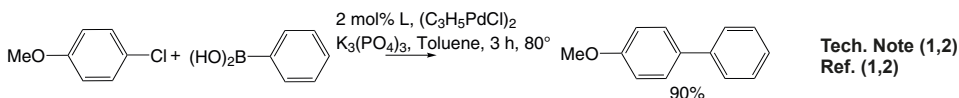
## PHOSPHORUS - Ligands and Compounds

<b>15-1050</b>	<b>Dicyclohexylchlorophosphine, min. 98%</b> (16523-54-9) (C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> PCl; FW: 232.74; colorless to pale yellow, cloudy liq.; b.p. 96-99°/0.1 mm; d. 1.054 <i>air sensitive, moisture sensitive</i>		1g 5g
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<b>15-1007</b>	<b>Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine Cy-cBRIDP</b> (1023330-38-2) C <sub>28</sub> H <sub>37</sub> P; FW: 404.57; white to pale yellow solid <i>air sensitive, (store cold)</i> Note: Manufactured under license of Takasago patent US7129367B2.		250mg 1g 5g
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### Technical Notes:

- Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
- Ligand used in the palladium catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
- Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.



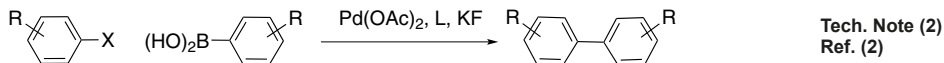
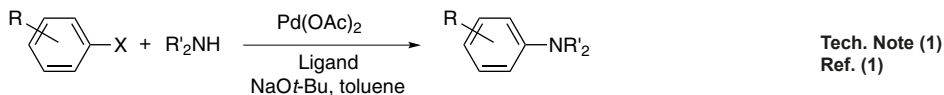
### References:

- US Patent 7129367.
- Synlett., 2008, 12, 1809.

<b>15-1062</b>	<b>Dicyclohexyl(2,2-diphenyl-1-methylvinyl) phosphine Cy-vBRIDP</b> (384842-24-4) C <sub>25</sub> H <sub>35</sub> P; FW: 366.52; white to pale yellow solid <i>air sensitive, (store cold)</i> Note: Manufactured under license of Takasago patent US6455720.		250mg 1g 5g
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### Technical Notes:

- Ligand used in the Pd-catalyzed amination of aryl halides.
- Ligand used for Suzuki-Miyaura coupling.

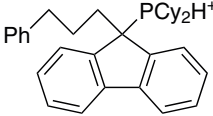

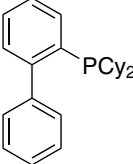


### References:

- Adv. Synth. Catal., 2007, 349, 2089.
- Synlett., 2007, 20, 3206.

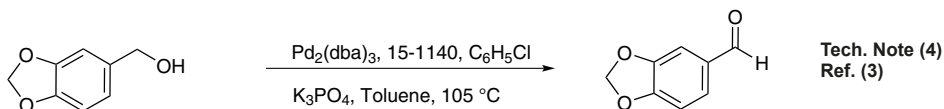
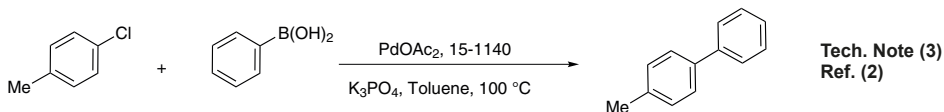
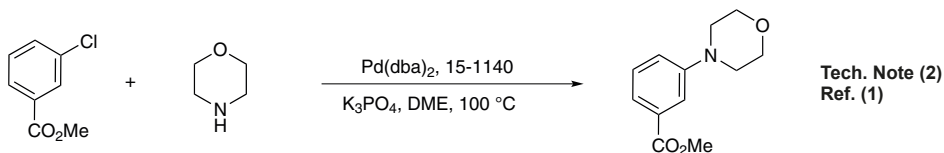
<b>15-1100</b>	<b>Dicyclohexylphenylphosphine, min. 95%</b> (6476-37-5) (C <sub>6</sub> H <sub>11</sub> ) <sub>2</sub> (C <sub>6</sub> H <sub>5</sub> )P; FW: 274.38; white solid <i>air sensitive</i>		1g 5g
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# PHOSPHORUS - Ligands and Compounds

15-1076	<p><b>Dicyclohexyl[9-(3-phenylpropyl)fluoren-9-yl]phosphonium tetrafluoroborate, min. 95% [cataCXium® FPrPh] (1007311-95-6)</b>  <math>C_{34}H_{42}BF_4P</math>; FW: 568.48; white powdr.  <i>air sensitive</i>                      Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component.</p>		500mg 2g
<p>15-1120 amp HAZ </p>	<p><b>Dicyclohexylphosphine, 98% (829-84-5)</b>  <math>(C_6H_{11})_2PH</math>; FW: 198.29; light yellow liq.; b.p. 129°/8 mm; d. 0.98  <i>pyrophoric</i></p>	2g 10g 50g	
<p>15-1122 HAZ</p>	<p><b>Dicyclohexylphosphine, 98% (10 wt% in hexanes) (829-84-5)</b>  <math>(C_6H_{11})_2PH</math>; FW: 198.29; colorless liq.  <i>air sensitive</i></p>	20g 100g	
15-1140	<p><b>2-(Dicyclohexylphosphino))-1,1'-biphenyl, 98% CyJohnPhos (247940-06-3)</b>  <math>C_{26}H_{31}P</math>; FW: 350.49; white xtl.; m.p. 103°                      Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component.. Patents: US 6,395,916, US 6,307,087.</p>		1g 5g 25g 100g

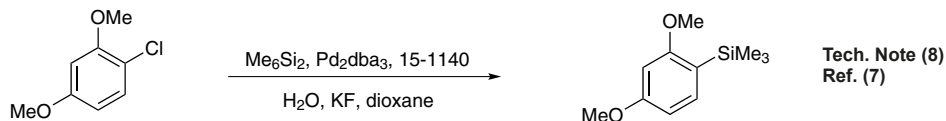
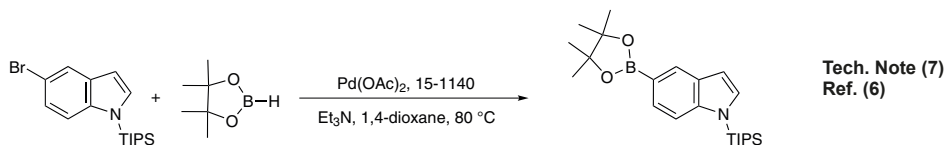
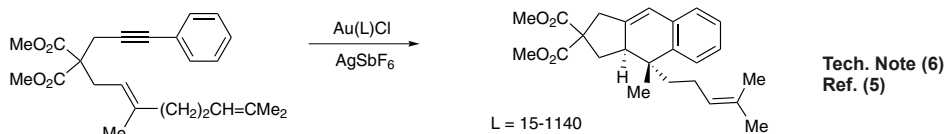
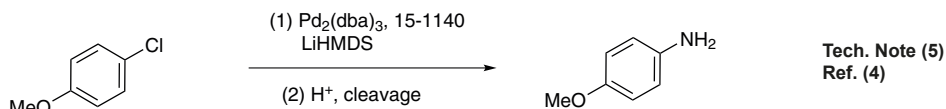
## Technical Notes:

- See 15-1045.
- Ligand used in the palladium-catalyzed synthesis of aromatic amines from aryl chlorides, bromides and triflates.
- Ligand employed in Suzuki coupling reactions involving aryl chlorides, bromides and triflates.
- Useful ligand for the Pd-catalyzed oxidation of alcohols in the presence of chlorobenzenes.
- Useful ligand for the Pd-catalyzed amination with ammonia equivalents
- Ligand for the gold(I)-catalyzed intramolecular [4+2] cycloadditions involving 1,3-enynes and arylalkynes with alkenes
- Ligand used in the palladium-catalyzed borylation of aryl bromides.
- Ligand used in the palladium-catalyzed silylation of aryl chlorides.



# PHOSPHORUS - Ligands and Compounds

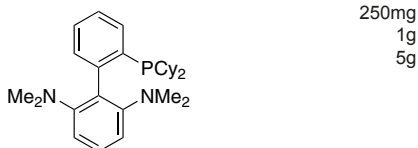
**15-1140** 2-(Dicyclohexylphosphino)-1,1'-biphenyl, 98% CyJohnPhos (247940-06-3)  
(continued)



## References:

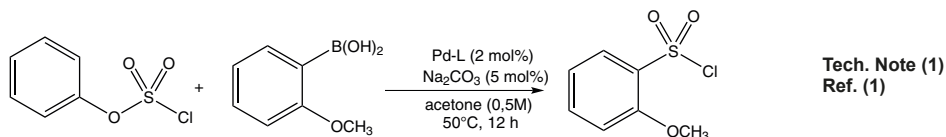
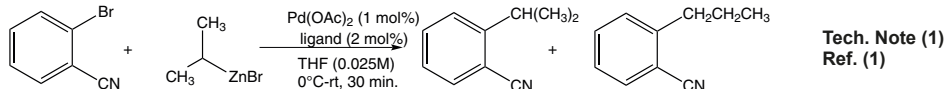
1. *J. Org. Chem.*, **2000**, 65, 1158.
2. *J. Am. Chem. Soc.*, **1999**, 121, 9550.
3. *Org. Lett.*, **2003**, 5, 2485.
4. *Org. Lett.*, **2001**, 3, 3417.
5. *J. Am. Chem. Soc.*, **2005**, 127, 6178.
6. *Helv. Chim. Acta.*, **2006**, 89, 936.
7. *Org. Lett.*, **2007**, 9, 3785.
8. *Chem. Sci.*, **2011**, 2, 27.

**15-1147** 2-Dicyclohexylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl, min. 98% CPhos  
(1160556-64-8)  
C<sub>28</sub>H<sub>41</sub>N<sub>2</sub>P; FW: 436.61; yellow-orange xtl.;  
m.p. 111-113°  
Note: Patents: US 6,395,916, US 6,307,087



## Technical Note:

1. Preparation of aryl sulfonamides via palladium-catalyzed chlorosulfonylation of arylboronic acids.

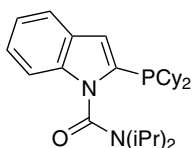


## References:

1. *J. Am. Chem. Soc.*, **2013**, 135, 10638.
2. *J. Am. Chem. Soc.*, **2009**, 131, 7532.

# PHOSPHORUS - Ligands and Compounds

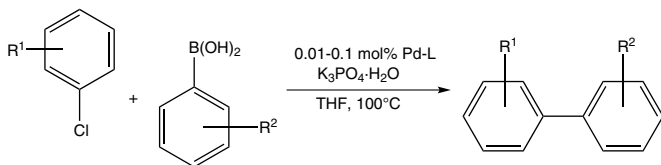
**15-1086** **2-(Dicyclohexylphosphino)-N,N-bis(1-methylethyl)-1H-indole-1-carboxamide, min. 98% Amidole-Phos (1067175-36-3)**  
 $C_{27}H_{41}N_2OP$ ; FW: 440.60; white to off-white powder.; m.p. 192.1-193.8°



100mg  
500mg

Technical Note:

1. Suzuki-Miyaura Coupling of Aryl Chlorides (low catalyst loading).



$R^1 = \text{Me, MeO, NH}_2, \text{CO}_2\text{Me, COMe, pyr}$ ;  $R^2 = \text{Me, Np, Bu}$

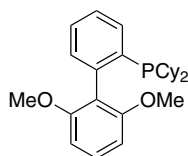
up to 99% yield

Tech. Note (1)  
Ref. (1)

References:

1. *J. Org. Chem.* **2008**, *73*, 7803.

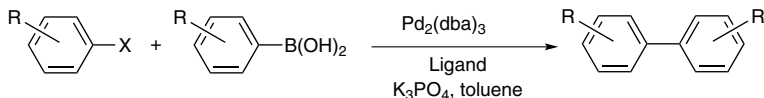
**15-1143** **2-Dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl, min. 98% SPhos (657408-07-6)**  
 $C_{26}H_{35}O_2P$ ; FW: 410.53; white xtl.; m.p. 164-166°  
 Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component.  
 Patents: US 6,395,916, US 6,307,087.



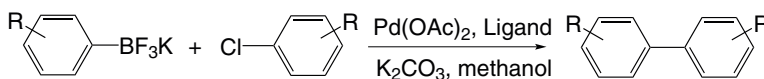
500mg  
2g  
10g  
50g

Technical Notes:

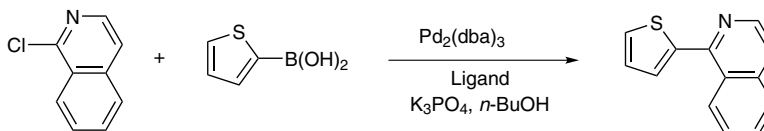
1. Ligand/palladium catalyst for general Suzuki-Miyaura cross-coupling reactions.
2. Ligand/palladium catalyst for the Suzuki-Miyaura coupling of aryltrifluoroborates with aryl chlorides.
3. Ligand/palladium catalyst for the Suzuki-Miyaura reaction of heteroaryl halides and heteroaryl boronic acids and esters.
4. Ligand/palladium catalyst for the Kumada-Corriu cross-coupling reaction.
5. Ligand/palladium catalyst for the borylation of aryl halides with pinacol borane.
6. Suzuki couplings involving amino acids. Synthesis of biaryl derivatives of 4-hydroxyphenyl glycine, tyrosine and tryptophan.
7. Synthesis of substituted adamantylzinc reagents using Mg-insertion in the presence of zinc chloride.
8. Highly efficient catalyst for the palladium-catalyzed Suzuki-Miyaura reaction of heteroaryl halides and heteroaryl boronic acids and esters.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

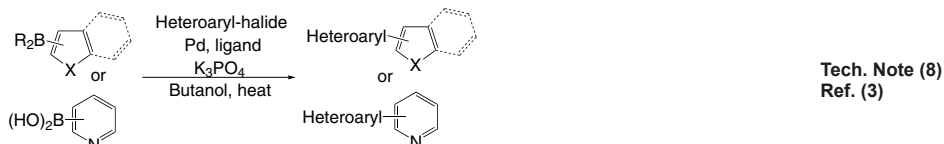
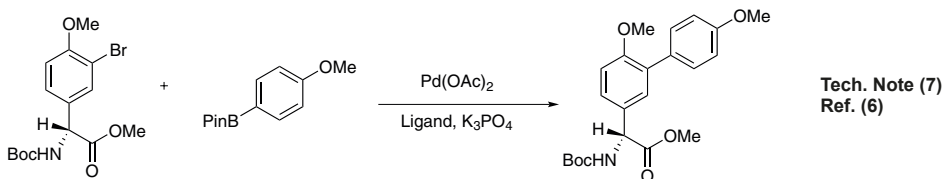
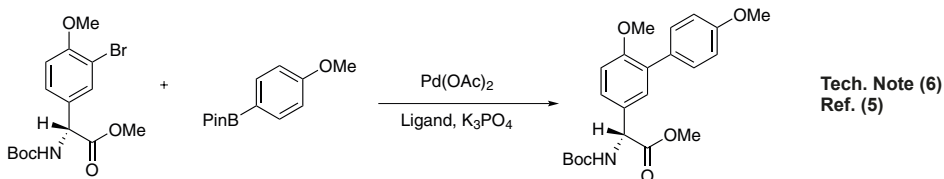
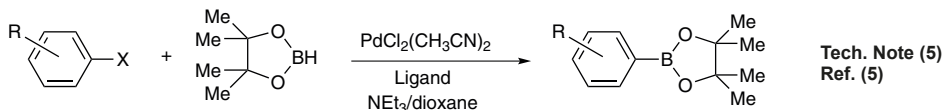
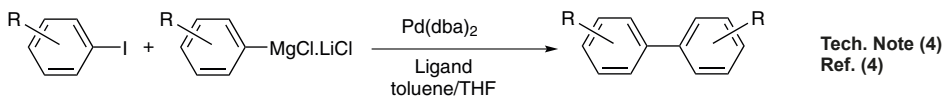


Tech. Note (3)  
Ref. (3)

# PHOSPHORUS - Ligands and Compounds

**15-1143** 2-Dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl, min. 98% SPhos (657408-07-6)

(continued)



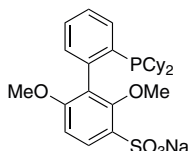
## References:

1. *Angew. Chem., Int. Ed.*, **2004**, *43*, 1871.
2. *Org. Lett.*, **2004**, *6*, 2649.
3. *J. Am. Chem. Soc.*, **2007**, *129*, 3358.
4. *J. Am. Chem. Soc.*, **2008**, *129*, 3844.
5. *J. Org. Chem.*, **2008**, *73*, 5589.
6. *Org. Lett.*, **2014**, *16*, 2418.

**15-1142** 2'-Dicyclohexylphosphino-2,6-dimethoxy-3-sulfonato-1,1'-biphenyl hydrate sodium salt (water soluble SPhos), min. 98% (1049726-96-6)

C<sub>26</sub>H<sub>34</sub>NaO<sub>5</sub>PS·XH<sub>2</sub>O; FW: 512.58; light yellow solid

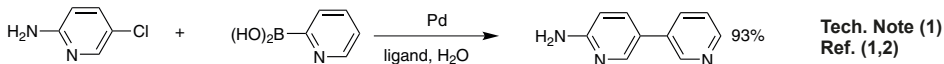
Note: Water soluble version of 15-1143 S-Phos. Buchwald Biaryl Ligand Master Kit component. Patents: US 6,395,916 and US 6,307,087.



500mg  
2g  
10g

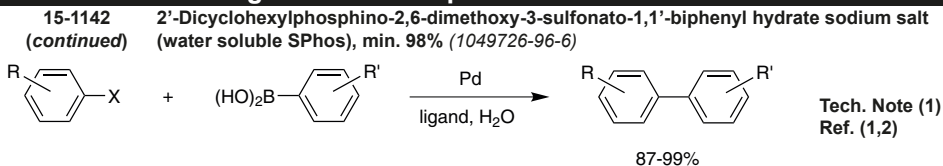
## Technical Note:

1. First general ligand for the Pd-catalyzed Suzuki-Miyaura coupling reaction of aryl chlorides and for the coupling of challenging substrate combinations in water.





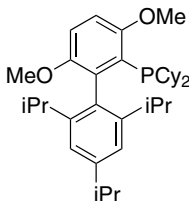
# PHOSPHORUS - Ligands and Compounds



## References:

1. *Angew. Chem. Int. Ed.*, **2005**, *44*, 6173.
2. *Acc. Chem. Res.* **2008**, *41*, 1461.

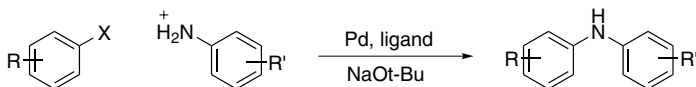
**15-1152** 2-(Dicyclohexylphosphino)-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% BrettPhos (1070663-78-3)  
C<sub>35</sub>H<sub>53</sub>O<sub>2</sub>P; FW: 536.77; white xtl.; m.p. 191-193°  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component..  
Patents: US 6,395,916, US 6,307,087.



250mg  
1g  
5g  
25g  
100g

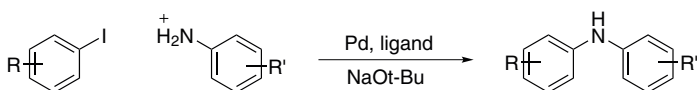
## Technical Notes:

1. Versatile Ligand for the Pd-catalyzed coupling of primary arylamines and alkylamines. (a) See also 46-0367, 46-0267. (b) See references 7,8.
2. Ligand for palladium-catalyzed cross-coupling reactions using aryl mesylates with electron-deficient anilines.
3. Ligand for palladium-catalyzed cross-coupling of primary arylamines at low catalyst loading.
4. Ligand for palladium-catalyzed cross-coupling of aryl iodides and primary amines.
5. Ligand for the Suzuki-Miyaura coupling of tosylates and mesylates.
6. Ligand for the palladium-catalyzed trifluoromethylation of aryl chlorides.
7. Ligand for the palladium-catalyzed formation of aryl-SCF<sub>3</sub> compounds from aryl bromides.
8. Ligand for the nickel-catalyzed cross-coupling of styrenyl epoxides with boronic acids.
9. Ligand for the palladium-catalyzed intramolecular CH difluoroalkylation.

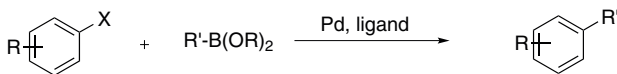


Tech. Note (2,3)  
Ref. (1)

X = Cl, OMs

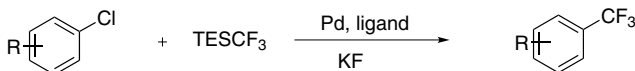


Tech. Note (4)  
Ref. (2)

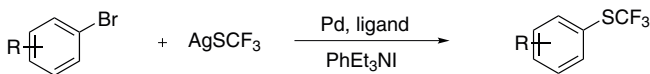


X = OMs, OTs  
R' = Ar, HetAr, Vinyl

Tech. Note (5)  
Ref. (3)



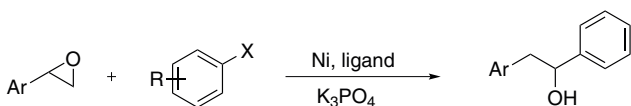
Tech. Note (6)  
Ref. (4)



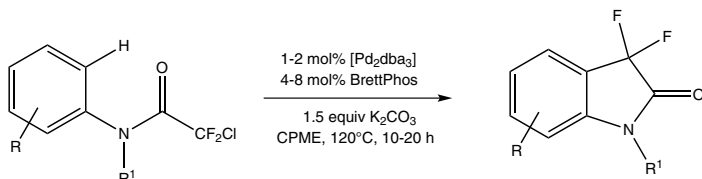
Tech. Note (7)  
Ref. (5)

# PHOSPHORUS - Ligands and Compounds

**15-1152** 2-(Dicyclohexylphosphino)-3,6-dimethoxy-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98%  
(continued) BrettPhos (1070663-78-3)



Tech. Note (8)  
Ref. (6)

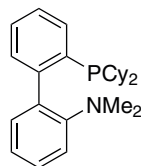


Tech. Note (9)  
Ref. (9)

## References:

1. *J. Am. Chem. Soc.*, **2008**, *130*, 13552.
2. *J. Am. Chem. Soc.*, **2009**, *131*, 5766.
3. *Org. Lett.*, **2009**, *11*, 3954.
4. *Science*, **2010**, *328*, 1679.
5. *Angew. Chem, Int. Edit.*, **2011**, *50*, 7312.
6. *Angew. Chem, Int. Edit.*, **2011**, *50*, 6056.
7. *Chem. Sci.*, **2011**, *2*, 27.
8. *Chem. Sci.*, **2011**, *2*, 57.
9. *Angew. Chem, Int. Edit.*, **2014**, *53*, 1.

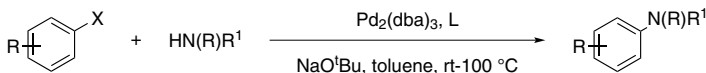
**15-1145** 2-(Dicyclohexylphosphino)-2'-(*N,N*-dimethylamino)-1,1'-biphenyl, 98% DavePhos  
(213697-53-1)  
C<sub>26</sub>H<sub>36</sub>NP; FW: 393.55; white xtl.; m.p. 115-119°  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component. Patents: US 6,395,916, US 6,307,087.



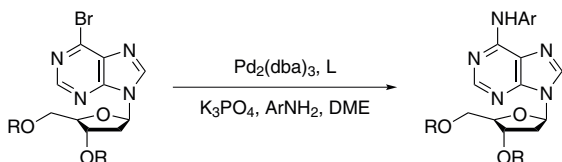
500mg  
2g  
10g  
50g

## Technical Notes:

1. Ligand used in the Pd-catalyzed Suzuki coupling and amination of unactivated aryl chlorides. The reactions generally occur at room temperature and give high yields of product.
2. Ligand used in Pd-catalyzed C-N bond formation. A general synthesis of N6-aryl-2'-deoxyadenosine analogues.
3. Ligand used in Pd-catalyzed N-arylation of indoles.
4. Ligand used in Pd-catalyzed synthesis of aryl-tert-butyl ethers.
5. Effective ligand in the Pd-catalyzed arylation of ester enolates.
6. Ligand employed in arylation of ketone enolates using ortho-halo nitrobenzenes.
7. Ligand employed in the amination of aryl nonaflates using Pd catalysts.
8. Ligand used for cascade alkenyl amination/Heck reaction for the synthesis of indoles
9. Ligand used in Pd-catalyzed Kumada-Corriu cross coupling at low temperatures
10. Ligand used in Rh-catalyzed intramolecular hydroamination of unactivated terminal and internal alkenes with primary and secondary amines.
11. Ligand used in Au-catalyzed cycloisomerization of allenes.



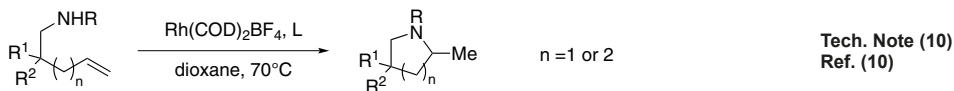
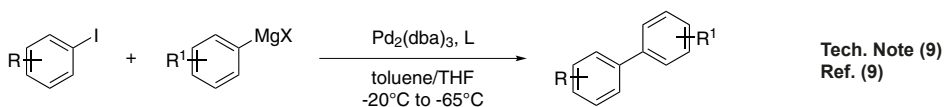
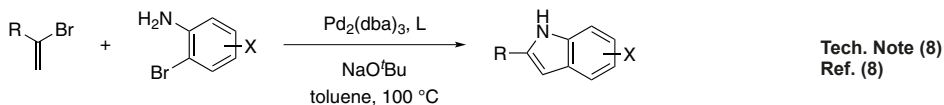
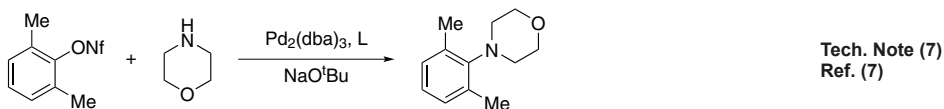
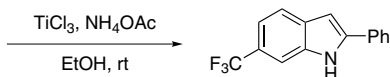
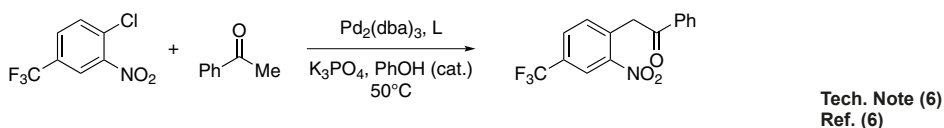
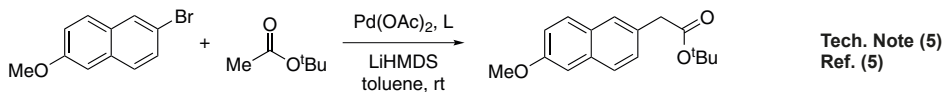
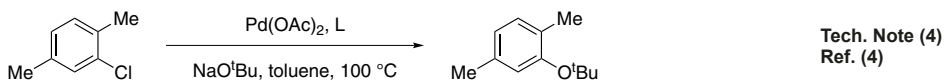
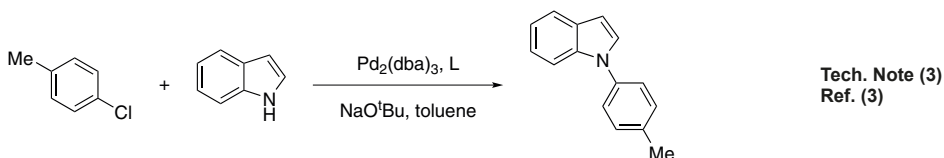
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

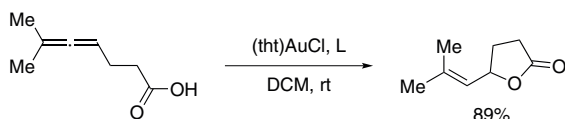
# PHOSPHORUS - Ligands and Compounds

15-1145 2-(Dicyclohexylphosphino)-2'-(N,N-dimethylamino)-1,1'-biphenyl, 98% DavePhos  
(continued) (213697-53-1)



# PHOSPHORUS - Ligands and Compounds

**15-1145** 2-(Dicyclohexylphosphino)-2'-(N,N-dimethylamino)-1,1'-biphenyl, 98% DavePhos  
(continued) (213697-53-1)



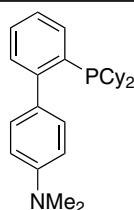
Tech. Note (11)  
Ref. (11)

## References:

1. *J. Am. Chem. Soc.*, **1998**, *120*, 9722
2. *J. Am. Chem. Soc.*, **1999**, *121*, 6090.
3. *Org. Lett.*, **2000**, *2*, 1403.
4. *J. Org. Chem.*, **2001**, *66*, 2498.
5. *J. Am. Chem. Soc.*, **2001**, *123*, 7996.
6. *J. Am. Chem. Soc.*, **2002**, *124*, 15168.
7. *J. Org. Chem.*, **2003**, *68*, 9563.
8. *Chem. Eur. J.*, **2005**, *11*, 2276
9. *J. Am. Chem. Soc.*, **2007**, *129*, 3844.
10. *J. Am. Chem. Soc.*, **2008**, *130*, 1570.
11. *Adv. Synth. Catal.*, **2009**, *351*, 576.
12. *Chem. Sci.*, **2011**, *2*, 27.

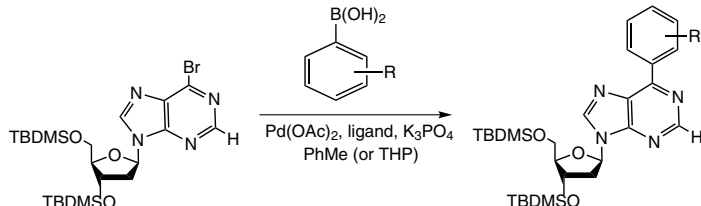
**15-1154** 2-Dicyclohexylphosphino-4'-(N,N-dimethylamino)-1,1'-biphenyl, 98% (1185899-00-6)  
**NEW** C<sub>26</sub>H<sub>36</sub>NP; FW: 393.55; white xtl.  
Note: Patents: US 6,395,916, US 6,307,087.

250mg  
1g  
5g



## Technical Note:

1. Ligand used in the palladium-catalyzed C-C bond formation in a substituted deoxyguanosine.

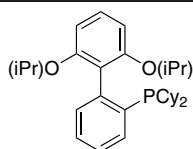


Tech. Note (1)  
Ref. (1)

## References:

1. *J. Am. Chem. Soc.*, **2009**, *131*, 12240.

**15-1146** 2-Dicyclohexylphosphino-2',6'-di-*i*-propoxy-1,1'-biphenyl, min. 98% RuPhos (787618-22-8)  
C<sub>30</sub>H<sub>43</sub>O<sub>2</sub>P; FW: 466.64; white powder; m.p. 123-124°  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component. Patents: US 6,395,916, US 6,307,087.



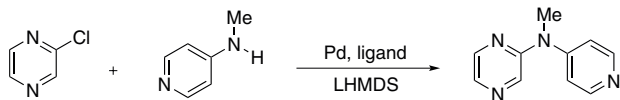
1g  
5g  
25g  
100g

## Technical Notes:

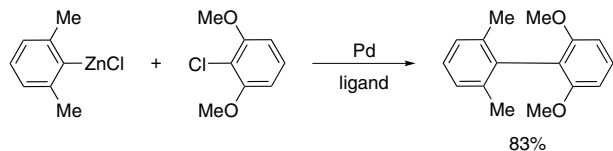
1. Versatile Ligand for the Pd-catalyzed coupling of secondary arylamines and alkylamines.  
(a) See also 46-0266, 46-0366. (b) See reference 7, 8.
2. Ligand used for the Pd-catalyzed Negishi cross-coupling reaction of (hetero)arylchlorides.
3. Ligand used for the Pd-catalyzed synthesis of N-aryl benzimidazoles
4. Ligand used for the Pd-catalyzed synthesis of heteroarenes.
5. Versatile ligand used for the Pd-catalyzed C-N coupling reaction of secondary aryl- and alkyl-amines at low temperature with the Pd precatalyst.
6. Ligand used for the Pd-catalyzed Suzuki-Miyaura coupling of aryl chloride and NHC-boranes.
7. Ligand for the palladium-catalyzed trifluoromethylation of hindered aryl chlorides.
8. Ligand used for the palladium-catalyzed coupling of alkyl boronates.

# PHOSPHORUS - Ligands and Compounds

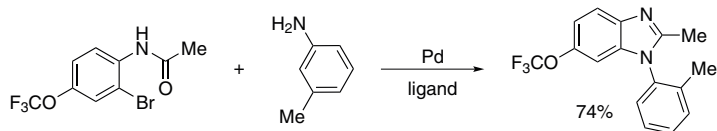
15-1146 2-Dicyclohexylphosphino-2',6'-di-*i*-propoxy-1,1'-biphenyl, min. 98% RuPhos  
(continued) (787618-22-8)



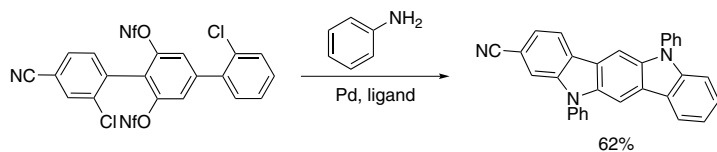
Tech. Note (1)  
Ref. (6,7)



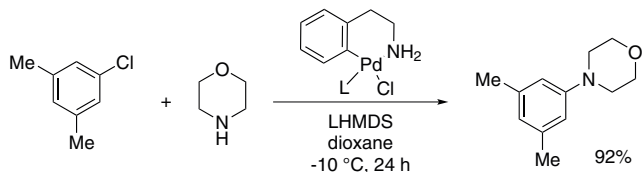
Tech. Note (2)  
Ref. (1)



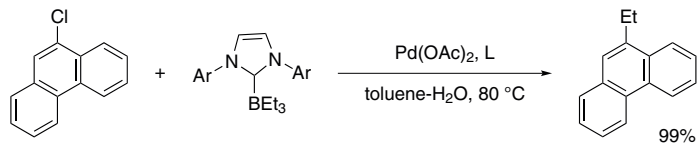
Tech. Note (3)  
Ref. (2)



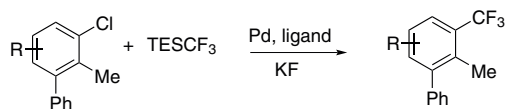
Tech. Note (4)  
Ref. (3)



Tech. Note (5)  
Ref. (4)



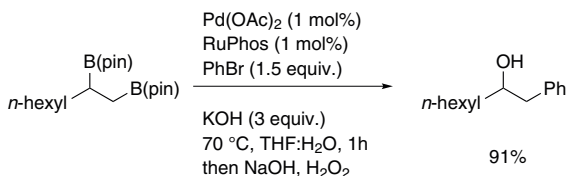
Tech. Note (6)  
Ref. (5)



Tech. Note (7)  
Ref. (6)

# PHOSPHORUS - Ligands and Compounds

**15-1146** 2-Dicyclohexylphosphino-2',6'-di-i-propoxy- 1,1'-biphenyl, min. 98% RuPhos  
(continued) (787618-22-8)

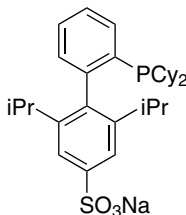


Tech. Note (8)  
Ref. (9)

## References:

1. *J. Am. Chem. Soc.*, **2004**, 126, 13028.
2. *Angew. Chem. Int. Ed.*, **2007**, 46, 7509.
3. *J. Org. Chem.*, **2007**, 72, 5119.
4. *J. Am. Chem. Soc.*, **2008**, 130, 6686.
5. *Org. Lett.*, **2009**, 11, 4914.
6. *Science*, **2010**, 328, 1679.
7. *Chem. Sci.*, **2011**, 2, 27.
8. *Chem. Sci.*, **2011**, 2, 57.
9. *Nature*, **2014**, 505, 386.

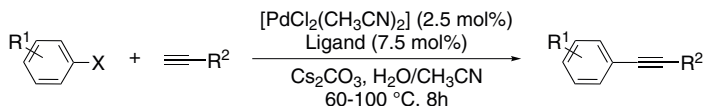
**15-1135** 2'-Dicyclohexylphosphino-2,6-di-i-propyl-4-sulfonato-1,1'-biphenyl hydrate sodium salt (XPhos-SO<sub>3</sub>Na) (870245-84-4)  
C<sub>30</sub>H<sub>42</sub>NaO<sub>3</sub>PS·XH<sub>2</sub>O; FW: 536.68; beige solid  
Note: Water soluble phosphine. Buchwald Biaryl Phosphine Ligand Master Kit component. Patents: US 6,395,916, US 6,307,087.



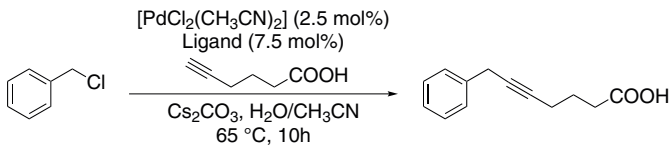
100mg  
500mg  
2g

## Technical Notes:

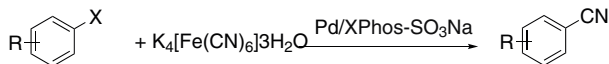
1. Water soluble catalyst for Sonogashira coupling reactions
2. Water soluble catalyst for coupling of benzyl chloride and terminal alkynes.
3. Water soluble ligand for cyanation of aryl chlorides and aryl sulfonates with potassium ferrocyanide.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



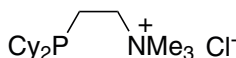
Tech. Note (3)  
Ref. (3)

## References:

1. *Angew. Chem. Int. Ed.*, **2005**, 44, 6173.
2. *Synlett.*, **2006**, 18, 2941.
3. *Catal. Lett.*, **2010**, 139, 56.

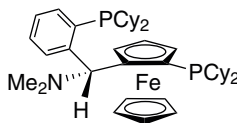
# PHOSPHORUS - Ligands and Compounds

**15-1144** [2-(Dicyclohexylphosphino)ethyl] trimethylammonium chloride, min. 95% (181864-78-8)  
 $(C_6H_{11})_2PCH_2CH_2N(CH_3)_3^+Cl^-$ ; FW: 319.89; white powd. hygroscopic



1g  
5g

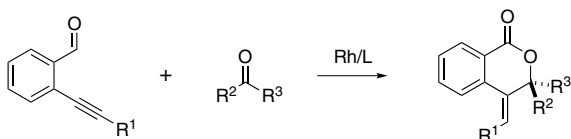
**26-0956** (R)-(+)-[(R)-2-Dicyclohexylphosphinoferrocenyl](N,N-dimethylamino)(2-dicyclohexylphosphinophenyl)methane, min. 97% (1156547-61-3)  
 $C_{43}H_{83}FeNP_2$ ; FW: 711.76; orange powd. (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.



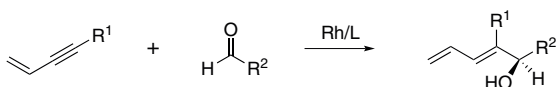
100mg  
500mg  
2g  
10g

## Technical Notes:

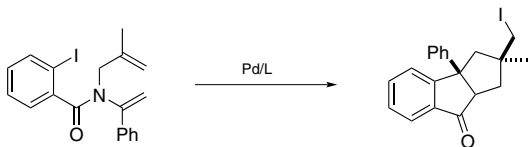
1. Ligand for Rh and Ru-catalyzed hydrogenation of alkenes and ketones.
2. Rh-catalyzed intermolecular [4+2].
3. Enantioselective reductive coupling of 1,3-enynes to heterocyclic aromatic aldehydes and ketones.
4. Pd-catalyzed enantioselective carbohalogenation.



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)

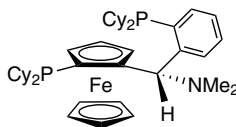


Tech. Note (4)  
Ref. (4)

## References:

1. (a) *Adv. Synth. Catal.*, **2003**, 345, 160, (b) *Org. Lett.*, **2006**, 8, 2413
2. *Angew. Chem.*, **2008**, 120, 5904
3. *J. Am. Chem. Soc.*, **2006**, 128, 16448
4. *J. Am. Chem. Soc.*, **2011**, 133, 14916

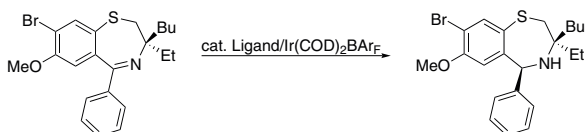
**26-0955** (S)-(-)-[(S)-2-Dicyclohexylphosphinoferrocenyl](N,N-dimethylamino)(2-dicyclohexylphosphinophenyl)methane, min. 97% (914089-00-2)  
 $C_{43}H_{83}FeNP_2$ ; FW: 711.76; orange powd. (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.



100mg  
500mg  
2g  
10g

## Technical Note:

1. Ligand for the iridium-catalyzed asymmetric cis hydrogenation bromobenzodiazepine.



Tech. Note (2)  
Ref. (2)

## References:

1. *J. Org. Chem.*, **2013**, 78, 12726.

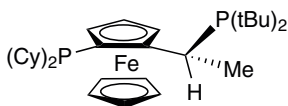
# PHOSPHORUS - Ligands and Compounds

26-0975

(R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl] ethylidene-*t*-butylphosphine, min. 97% (158923-11-6)

C<sub>32</sub>H<sub>52</sub>FeP<sub>2</sub>; FW: 554.56; orange powdr.

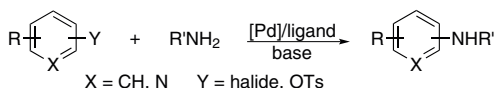
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.



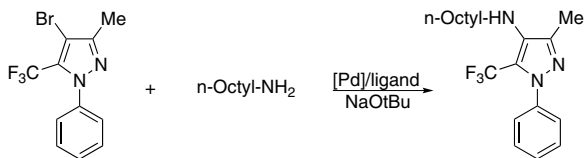
100mg  
500mg  
2g  
10g

## Technical Notes:

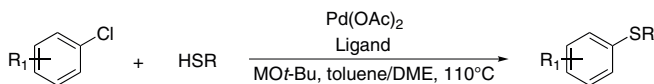
1. Ligand for Palladium-catalyzed C-N cross-coupling.
2. Ligand for Palladium-catalyzed C-S cross-coupling.
3. Ligand for Palladium-catalyzed Kumada couplings of aryl and vinyl tosylates.
4. Ligand for Rhodium-catalyzed hydroacylation of cyclopropenes, an enantioselective desymmetrization method.
5. Ligand for Palladium-catalyzed C-O cross-coupling.
6. Ligand for Rhodium-catalyzed coupling of imidazole derivatives with terminal allenes.
7. Ligand for Ruthenium-catalyzed C-C coupling of alkynes and alcohols to form branched products of carbonyl allylation.



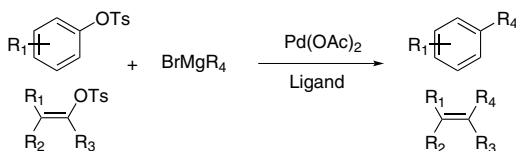
Tech. Note (1)  
Ref. (1,2,3,4,5)



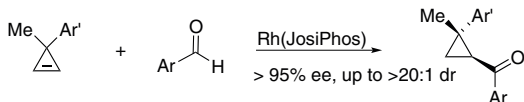
Tech. Note (1)  
Ref. (6)



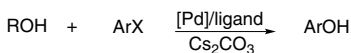
Tech. Note (2)  
Ref. (7)



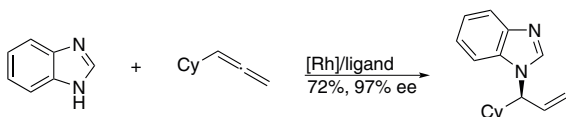
Tech. Note (3)  
Ref. (8)



Tech. Note (4)  
Ref. (9)



Tech. Note (5)  
Ref. (10,11)

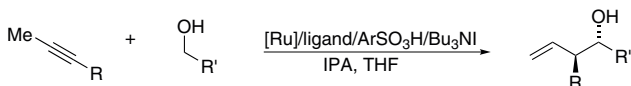


Tech. Note (6)  
Ref. (12)



# PHOSPHORUS - Ligands and Compounds

**26-0975** (R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldi-*t*-butylphosphine, min. 97%  
(continued) (158923-11-6)



Tech. Note (7)  
Ref. (13)

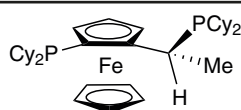
## References:

1. *Angew. Chem. Int. Ed.*, **2005**, *44*, 1371. (X=N; Y=Cl)
2. *J. Am. Chem. Soc.*, **2008**, *130*, 13848. (X=CH,N; Y=OTs)
3. *J. Am. Chem. Soc.*, **2009**, *131*, 11049. (X=CH,N; Y=I,Br,Cl,OTs; R'=H [ammonia])
4. *Tetrahedron Lett.*, **2014**, *55*, 6743. (X=N; Y=Cl)
5. *Org. Lett.*, **2014**, *16*, 4388. (X=CH; Y=Cl,Br; R'=ammonium salt)
6. *Org. Biomol. Chem.*, **2016**, *14*, 2352.
7. *J. Am. Chem. Soc.*, **2006**, *128*, 2180.
8. *J. Org. Chem.*, **2005**, *70*, 9364.
9. *J. Am. Chem. Soc.*, **2010**, *132*, 16354.
10. *Angew. Chem. Int. Ed.*, **2012**, *51*, 9071.
11. *Tetrahedron Lett.*, **2015**, *56*, 2329.
12. *Angew. Chem. Int. Ed.*, **2014**, *53*, 2162.
13. *J. Am. Chem. Soc.*, **2015**, *137*, 3161.

**26-1000** (R)-(-)-1-[(S)-2-(Di-cyclohexylphosphino) ferrocenyl] ethyldicyclohexylphosphine, min. 97%  
(167416-28-6)

C<sub>36</sub>H<sub>56</sub>FeP<sub>2</sub>; FW: 606.64; orange powdr.

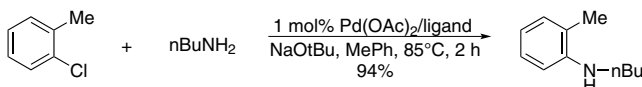
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.



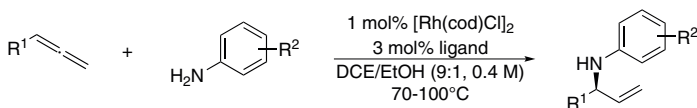
100mg  
500mg  
2g  
10g

## Technical Notes:

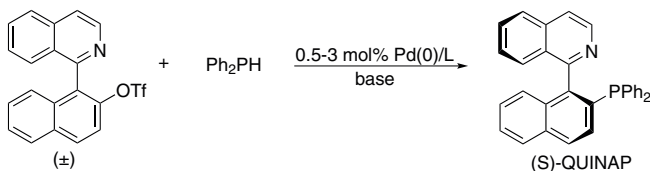
1. Ligand for Pd-catalyzed C-N cross-coupling.
2. Ligand for Rh-catalyzed C-N cross-coupling.
3. Ligand for Pd-catalyzed asymmetric synthesis of (S)-QUINAP via dynamic kinetic resolution.
4. Ligand for Ni-catalyzed monoarylation of ammonia.



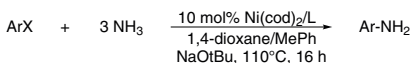
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2,4)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (5)

## References:

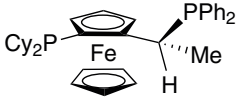
1. *J. Am. Chem. Soc.*, **1998**, *120*, 7369.
2. *Angew. Chem. Int. Ed.*, **2012**, *51*, 10876.
3. *J. Am. Chem. Soc.*, **2013**, *135*, 16829.
4. *Angew. Chem. Int. Ed.*, **2014**, *53*, 2162.
5. *Angew. Chem. Int. Ed.*, **2015**, *54*, 3773.

## PHOSPHORUS - Ligands and Compounds

<b>26-1001</b>	<b>(S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl</b> dicyclohexylphosphine, min. <b>97%</b> (246231-77-6) C <sub>36</sub> H <sub>56</sub> FeP <sub>2</sub> ; FW: 606.64; orange pwdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg
		500mg
		2g
		10g

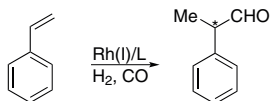
Technical Note:

1. See 26-1000 (page 172)

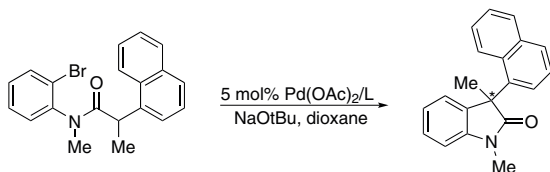
<b>26-1230</b>	<b>(R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl</b> diphenylphosphine, min. <b>97%</b> (158923-09-2) C <sub>36</sub> H <sub>44</sub> FeP <sub>2</sub> ; FW: 594.59; orange pwdr. Note: Sold in collaboration with Solvias for research purposes only.		100mg
		500mg	
		2g	
		10g	

Technical Notes:

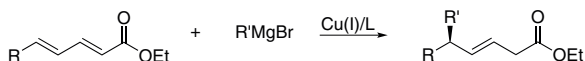
1. Ligand for the asymmetric hydroformylation reactions.
2. Ligand for asymmetric intramolecular amide arylation.
3. Ligand for enantioselective 1,6-conjugate addition of Grignard reagents to linear dienolates.
4. Ligand for enantioselective synthesis of vicinal dialkyl arrays
5. Ligand for asymmetric conjugate addition of Grignard reagents to chromones



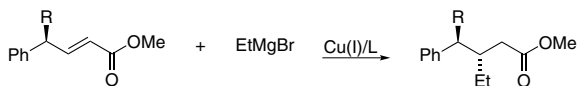
Tech. Note (2)  
Ref. (1)



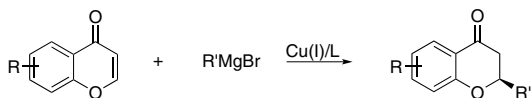
Tech. Note (3)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)

References:

1. *J. Organomet. Chem.*, **2000**, 601, 138
2. *J. Org. Chem.*, **2001**, 66, 3402
3. *Angew. Chem. Int. Ed.*, **2008**, 47, 398.
4. *J. Org. Chem.*, **2008**, 73, 6994.
5. *Chem. Commun.*, **2013**, 49, 5933.

<b>26-1101</b>	<b>(S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethyl</b> diphenylphosphine, min. <b>97%</b> (162291-01-2) C <sub>36</sub> H <sub>44</sub> FeP <sub>2</sub> ; FW: 594.59; orange pwdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg
		500mg
		2g
		10g

Technical Note:

1. See 26-1230 (page 173)

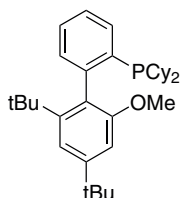
# PHOSPHORUS - Ligands and Compounds

15-1105

NEW

**2-Dicyclohexylphosphino-2'-methoxy-4',6'-di-*t*-butyl-1,1'-biphenyl, min. 98% VPhos (1848244-75-6)**

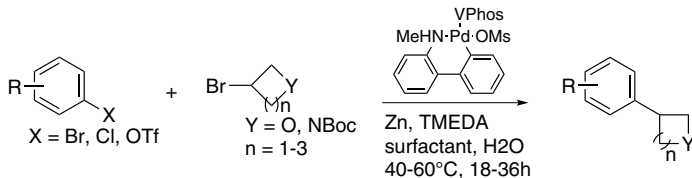
C<sub>33</sub>H<sub>49</sub>OP; FW: 492.72; white to off-white solid  
Note: Patents: US 6,395,916, US 6,307,087



250mg  
1g  
5g

Technical Note:

- Ligand for the palladium catalyzed aqueous Lipshutz-Negishi cross-coupling of alkyl halides with aryl electrophiles.



Tech. Note (1)  
Ref. (1)

References:

- Angew. Chem. Int. Ed.*, **2016**, 55, 1849

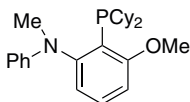
15-6528

NEW

**[2-Dicyclohexylphosphino-3-methoxy-N-methyl-N-phenylbenzenamine, 98% Zheda-Phos (1398565-95-1)**

C<sub>26</sub>H<sub>36</sub>NOP; FW: 409.54; white powdr.;  
m.p. 169-170°

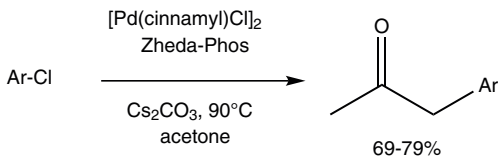
Note: Sold under license from ZJU  
for research purposes only. Patent  
CN201210146220.6, PCT/CN2012/078129.



250mg  
1g

Technical Note:

- Ligand/Pd catalyst used in the general  $\alpha$ -monoarylation of acetone with aryl chlorides.



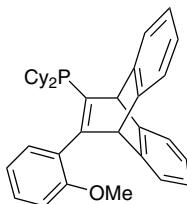
Tech. Note (1)  
Ref. (1)

References:

- Adv. Synth. Catal.*, **2013**, 355, 1255.

15-1082

**11-Dicyclohexylphosphino-12-(2-methoxy-phenyl)-9,10-ethenoanthracene dichloromethane adduct, min. 98% o-MeO-KITPHOS (1166994-78-0)**  
C<sub>35</sub>H<sub>39</sub>OP; FW: 506.66; white powdr.  
Note: Sold under license from NCL for  
research purposes only. Patent Pending.



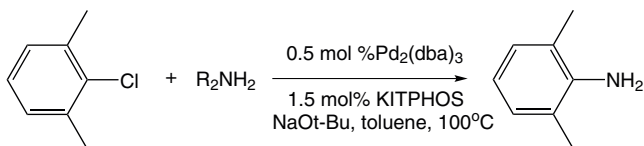
100mg  
500mg

Technical Notes:

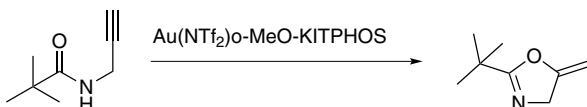
- Useful ligand for the Palladium-catalyzed amination reaction.
- Useful ligand for Gold(I)-triflimide catalyzed intramolecular cyclizations.

# PHOSPHORUS - Ligands and Compounds

**15-1082** 11-Dicyclohexylphosphino-12-(2-methoxyphenyl)-9,10-ethenoanthracene dichloromethane adduct, min. 98% **o-MeO-KITPHOS** (1166994-78-0)



Tech. Note (1)  
Ref. (1)

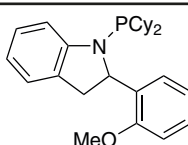


Tech. Note (2)  
Ref. (2)

References:

1. *Adv. Synth. Catal.*, **2008**, 350, 1808.
2. *Adv. Synth. Catal.*, **2009**, 351, 576.

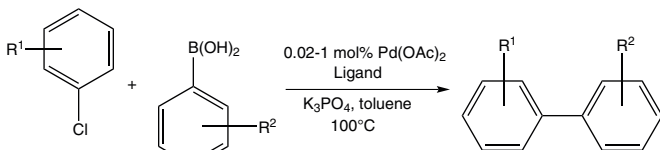
**15-1087** 1-(Dicyclohexylphosphino)-2-(2-methoxyphenyl)-1H-indole, min. 98% **NPCy o-Andole-Phos** (947402-60-0)  
C<sub>27</sub>H<sub>34</sub>NOP; FW: 419.54; white to off-white powder.; m.p. 131.1-132.5°



100mg  
500mg

Technical Note:

1. Suzuki-Miyaura Coupling of Aryl and Hetero-aryl Chlorides.



Tech. Note (1)  
Ref. (1)

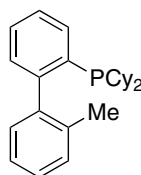
R<sup>1</sup> = Me, MeO, NH<sub>2</sub>, CO<sub>2</sub>Me, COMe, pyr; R<sup>2</sup> = Me, Np, Bu

up to 99% yield

References:

1. *Org. Lett.* **2007**, 9, 2795.
2. *J. Org. Chem.*, **2012**, 77, 3543.

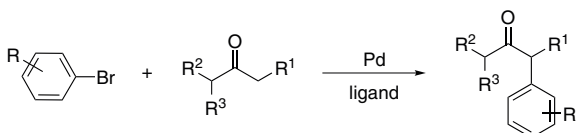
**15-1148** 2-Dicyclohexylphosphino-2'-methyl)-1,1'-biphenyl, min. 98% **MePhos** (251320-86-2)  
C<sub>25</sub>H<sub>33</sub>P; FW: 364.51; white xtl.; m.p. 107-110°  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component. Patents: US 6,395,916, US 6,307,087.



500mg  
2g  
10g  
50g

Technical Notes:

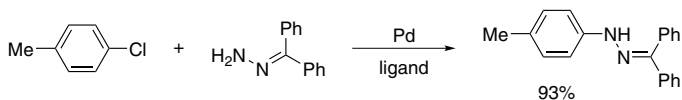
1. Ligand used for the Pd-catalyzed formation of  $\alpha$ -arylketones
2. Ligand used for the Pd-catalyzed amination reaction (see 15-1045).<sup>[5]</sup>
3. Ligand used for the Pd-catalyzed hydrazone arylation
4. Ligand used for the Pd-catalyzed synthesis of 5,5-disubstituted butenolides.
5. Ligand used for the Pd-catalyzed direct arylation of polyfluorinated arenes at room temperature.



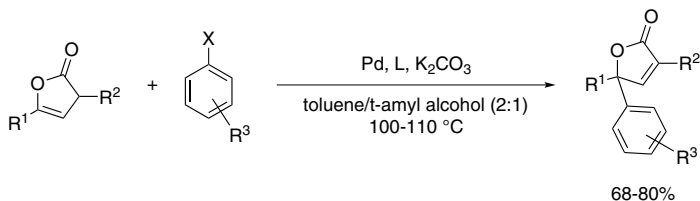
Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

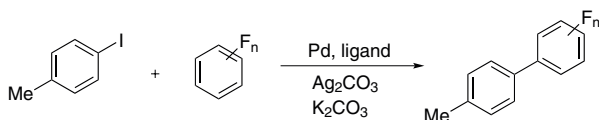
15-1148 2-Dicyclohexylphosphino-2'-methyl-)-1,1'-biphenyl, min. 98% MePhos (251320-86-2)  
(continued)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)

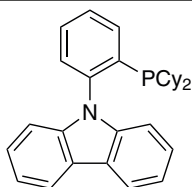


Tech. Note (4)  
Ref. (4)

## References:

1. *J. Am. Chem. Soc.*, **2000**, 122, 1360.
2. *Adv. Synth. Catal.*, **2007**, 347, 773.
3. *Org. Lett.*, **2009**, 11, 2663.
4. *Org. Lett.*, **2010**, 12, 2116.
5. *Chem. Sci.*, **2011**, 2, 27.

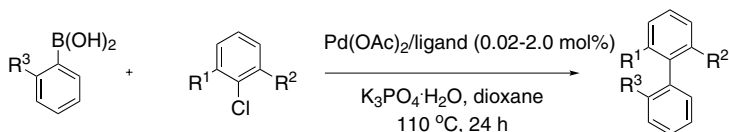
15-0445 9-[2-(Dicyclohexylphosphino)phenyl]-9H-carbazole, min. 98%  
PhenCar-Phos (1308652-64-3)  
 $\text{C}_{30}\text{H}_{34}\text{NP}$ ; FW: 439.57; white powdr.  
*air sensitive*  
Note: PhenCar-Phos Ligand Kit component.



250mg  
1g

## Technical Note:

1. Carbazolyl-derived phosphine ligand used in the highly efficient, catalytic coupling of sterically hindered aryls.



Tech. Note (1)  
Ref. (1)

## References:

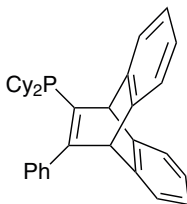
1. *Chem. Commun.*, **2011**, 47, 5079.

# PHOSPHORUS - Ligands and Compounds

15-1084

**11-Dicyclohexylphosphino-12-phenyl-9,10-ethenoanthracene dichloromethane adduct, min. 98% KITPHOS**  
(1166994-77-9)

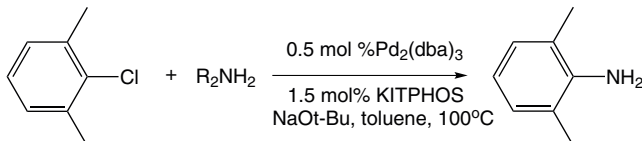
C<sub>34</sub>H<sub>37</sub>P; FW: 476.63; white powdr.  
Note: Sold under license from NCL for research purposes only. Patent Pending.



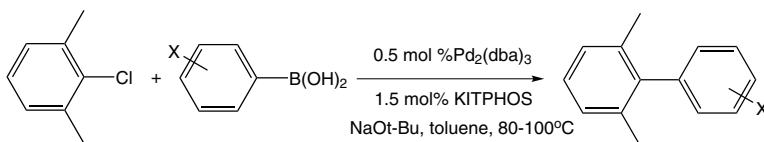
100mg  
500mg

## Technical Notes:

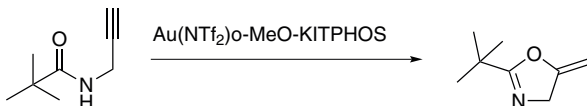
- Useful ligand for the palladium-catalyzed amination reaction.
- Useful ligand for the palladium-catalyzed Suzuki cross-coupling reaction.
- Useful ligand for Gold(I)-triflimide catalyzed intramolecular cyclizations.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (1,2)**



**Tech. Note (3)**  
**Ref. (3)**

## References:

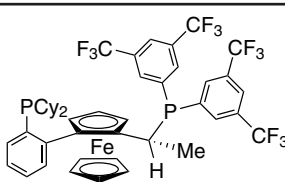
- Adv. Synth. Catal.*, **2008**, *350*, 1801.
- Adv. Synth. Catal.*, **2010**, *352*, 201.
- Adv. Synth. Catal.*, **2009**, *351*, 576.

26-1120

**(R)-(+)-1-[(R)-2-(2'-Dicyclohexylphosphinophenyl)ferrocenyl] ethylbis(3,5-trifluoromethylphenyl)phosphine, min. 97%**  
(821009-34-1)

C<sub>46</sub>H<sub>44</sub>F<sub>12</sub>FeP<sub>2</sub>; FW: 942.62; orange powdr.  
(store cold)

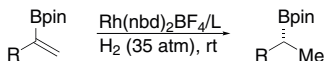
Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component.



100mg  
500mg  
2g  
10g

## Technical Note:

- Ligand for Rh-catalyzed hydrogenation of vinylboronic esters.



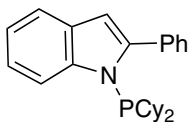
**Tech. Note (1)**  
**Ref. (1)**

## References:

- Org. Lett.*, **2006**, *8*, 2413

# PHOSPHORUS - Ligands and Compounds

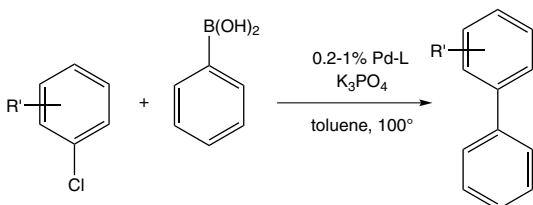
**15-1089** **1-(Dicyclohexylphosphino)-2-phenyl-1H-indole, min. 98%**  
**NPCy Phendole-Phos (947402-57-5)**  
 $C_{26}H_{32}NP$ ; FW: 389.51;  
 white to off-white powdr.



100mg  
 500mg

Technical Note:

- Suzuki-Miyaura Coupling of Aryl and Hetero-aryl Chlorides.

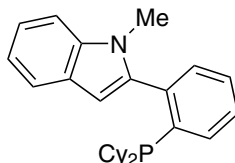


**Tech. Note (1)**  
**Ref. (1)**

References:

- Org. Lett.*, **2007**, *9*, 2795.

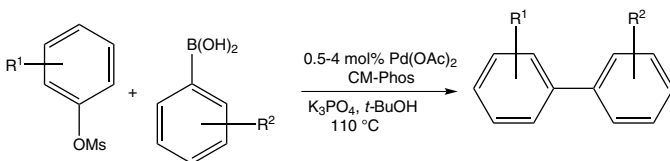
**15-1088** **2-[2-(Dicyclohexylphosphino)phenyl]-1-methyl-1H-indole, min. 98%**  
**CM-Phos (1067883-58-2)**  
 $C_{27}H_{34}NP$ ; FW: 403.54;  
 white to off-white powdr.;  
 m.p. 171.9-174.9°



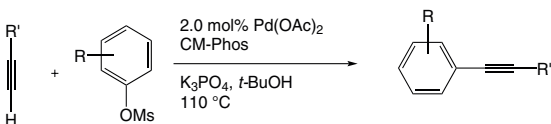
100mg  
 500mg

Technical Notes:

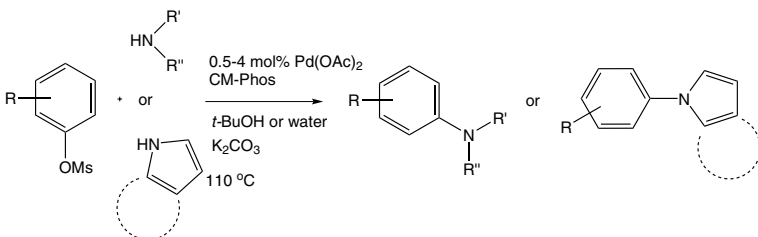
- Suzuki-Miyaura Coupling of Aryl Mesylates and alkenyl triflate and mesylate bearing alkyl, methoxy, aldehyde, keto, nitrile, ester, and heteroaryl substitution.
- Sonogashira Coupling of Aryl Mesylates, R' = alkyl, aryl; R = C(O)R, COOMe, CHO, CN.
- Buchwald-Hartwig Amination of Aryl Mesylates, R = cyano, chloro, methoxy, keto, ester and etc.
- Additional catalyzed reactions include Cyanation of functional Aryl Mesylates and Chlorides (Ref. 4,5); Hiyama Coupling of Aryl Mesylates (Ref. 6); Direct Arylation of Heterocycles with Aryl Mesylates (Ref. 7); Borylation of Aryl Mesylates (Ref. 8).



**Tech. Note (1)**  
**Ref. (1)**



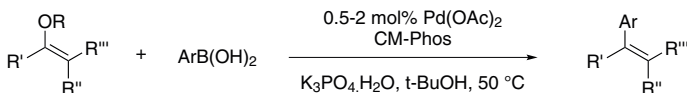
**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (3)**  
**Ref. (3)**

# PHOSPHORUS - Ligands and Compounds

**15-1088** 2-[2-(Dicyclohexylphosphino)phenyl]-1-methyl-1H-indole, min. 98% CM-Phos  
(continued) (1067883-58-2)



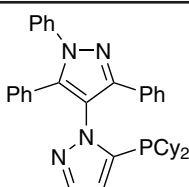
Tech. Note (1)  
Ref. (9)

OR= OTs, OMs

References:

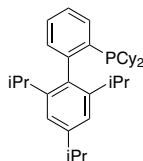
1. *Angew. Chem. Int. Ed.*, **2008**, *47*, 8059.
2. *Chem. Eur. J.*, **2010**, *16*, 9982.
3. *Angew. Chem. Int. Ed.*, **2008**, *47*, 6402.
4. *Angew. Chem. Int. Ed.*, **2010**, *49*, 8918.
5. *Org. Lett.*, **2011**, *13*, 648.
6. *Org. Lett.*, **2009**, *11*, 317.
7. *Chem. Eur. J.*, **2011**, *17*, 761.
8. *Chem. Eur. J.*, **2011**, *17*, 6913.
9. *Chem. Commun.*, **2011**, *47*, 8328.

**15-1039** 5-(Dicyclohexylphosphino)-2',3',5'-triphenyl-[1,4']-bi-1H-pyrazole, min. 95%  
**Cy-BippyPhos** (1021176-69-1)  
C<sub>36</sub>H<sub>39</sub>N<sub>4</sub>P; FW: 558.70; white powdr.  
*air sensitive*



250mg  
1g

**15-1149** 2-(Dicyclohexylphosphino)-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% XPhos (564483-18-7)  
C<sub>33</sub>H<sub>49</sub>P; FW: 476.72; white powdr.; m.p. 185°  
Note: Buchwald Biaryl Phosphine Ligand Master Kit component. Buchwald Biaryl Phosphine Ligand Mini Kit 1 component. Patents: US 6,395,916, US 6,307,087.



500mg  
2g  
10g  
100g  
500g

Technical Notes:

1. See also 46-0268.
2. Exceptional ligands for Pd-catalyzed amination and amidation of aryl sulfonates. [16]
3. Ligand used for the Pd-catalyzed Suzuki-Miyaura coupling reaction and carbonyl enolate coupling [9].
4. Ligand used for the chemoselective amination of aryl chlorides.
5. Ligand used for the Pd-catalyzed borylation of aryl chlorides. (For the formation of trifluoroborates, see also Ref. 11)
6. Ligand used for the Pd-catalyzed amination of vinyl halides and triflates.
7. Ligand used for the Pd-catalyzed three-component synthesis of indoles.
8. Ligand used for the Pt-catalyzed regioselective hydrosilylation of functionalized terminal arylalkynes.
9. Ligand used for the Pd-catalyzed synthesis of carbazoles.
10. Ligand used for the Pd-catalyzed Suzuki-Miyaura coupling of aryl chloride and NHC-boranes.
11. Ligand used for the direct arylation of picoline N-oxide.
12. Ligand used for the Negishi coupling of 2-heterocyclic organozinc reagents.
13. Catalyst for a phosphine-catalyzed Heine reaction.
14. Ligand used for the palladium-catalyzed oxidative coupling of indoles and heteroarenes.
15. Ligand used for the silver-catalyzed hydrogenation of aldehydes.
16. Ligand used for the palladium-catalyzed cyanation of heterocyclic halides.



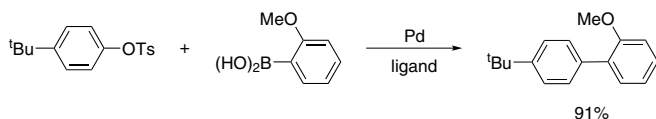
R,R' = *n*-Butyl: 88%  
R = C(O)Me, R' = H: 88%

Tech. Note (2)  
Ref. (1)

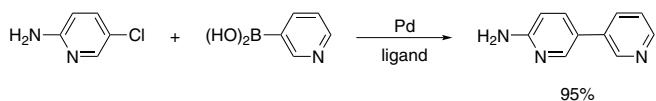


# PHOSPHORUS - Ligands and Compounds

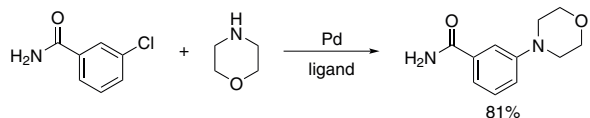
15-1149 2-(Dicyclohexylphosphino)-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% XPhos  
(continued) (564483-18-7)



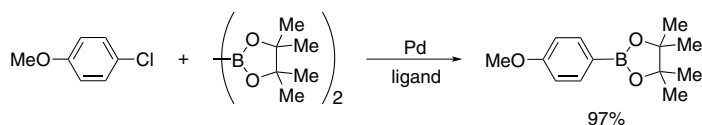
Tech. Note (3)  
Ref. (2)



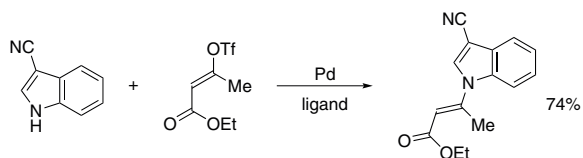
Tech. Note (3)  
Ref. (3,4)



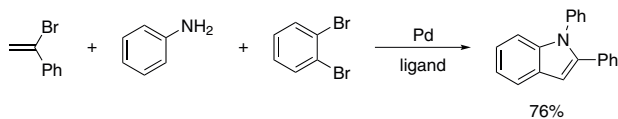
Tech. Note (4)  
Ref. (3)



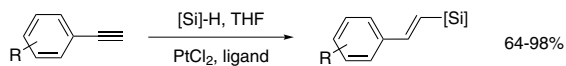
Tech. Note (5)  
Ref. (5)



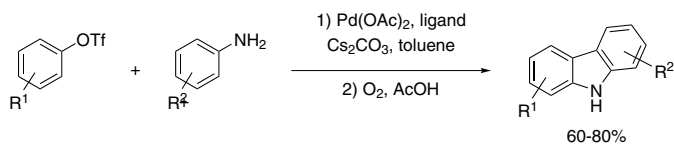
Tech. Note (6)  
Ref. (6)



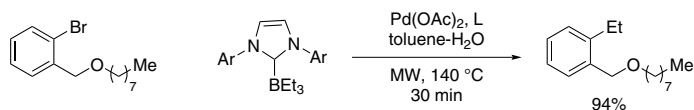
Tech. Note (7)  
Ref. (7)



Tech. Note (8)  
Ref. (8)



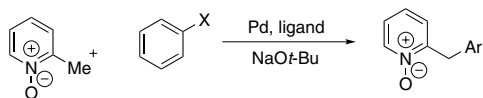
Tech. Note (9)  
Ref. (10)



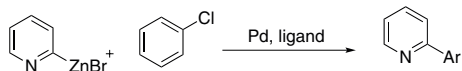
Tech. Note (10)  
Ref. (10)

# PHOSPHORUS - Ligands and Compounds

15-1149 2-(Dicyclohexylphosphino)-2',4',6'-tri-*i*-propyl-1,1'-biphenyl, min. 98% XPhos  
(continued) (564483-18-7)



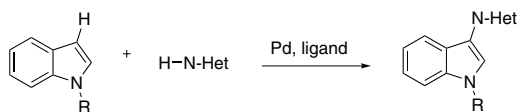
Tech. Note (11)  
Ref. (12)



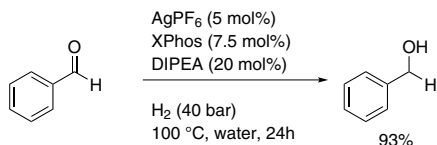
Tech. Note (12)  
Ref. (13)



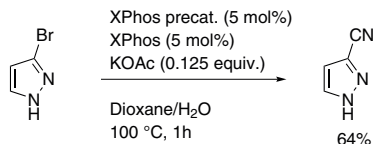
Tech. Note (13)  
Ref. (14)



Tech. Note (14)  
Ref. (15)



Tech. Note (15)  
Ref. (16)

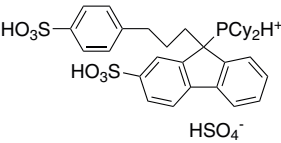
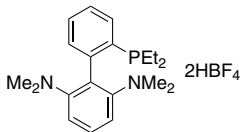


Tech. Note (16)  
Ref. (17)

## References:

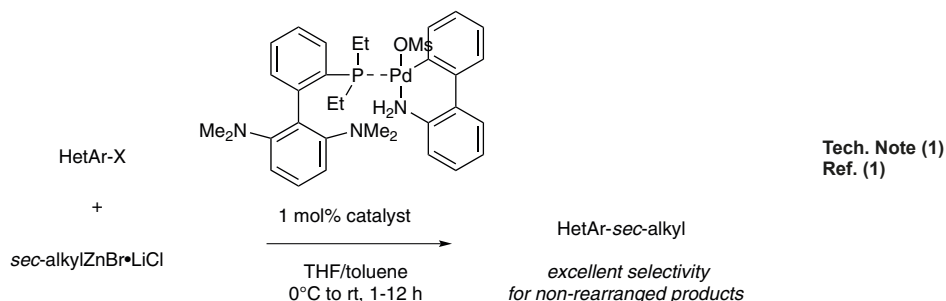
1. *J. Am. Chem. Soc.*, **2003**, 125, 6653.
2. *J. Am. Chem. Soc.*, **2003**, 125, 11818.
3. *Angew. Chem. Int. Ed.*, **2006**, 45, 6523.
4. *J. Am. Chem. Soc.*, **2007**, 129, 3358.
5. *Angew. Chem. Int. Ed.*, **2007**, 46, 5359.
6. *J. Org. Chem.*, **2005**, 70, 8638.
7. *Angew. Chem. Int. Ed.*, **2007**, 46, 1529.
8. *Tetrahedron Lett.*, **2008**, 49, 2429.
9. *Acc. Chem. Res.* **2008**, 41, 1461.
10. *J. Org. Chem.*, **2009**, 74, 4720.
11. *Org. Lett.*, **2009**, 11, 4914.
12. *J. Am. Chem. Soc.*, **2010**, 132, 17701.
13. *J. Org. Chem.*, **2010**, 75, 8330.
14. *Org. Lett.*, **2011**, 13, 5444.
15. *Angew. Chem., Int. Ed.*, **2011**, 50, 5365.
16. *Chem. Sci.*, **2011**, 2, 27.
17. *Angew. Chem., Int. Ed.*, **2013**, 52, 11871.
18. *Angew. Chem., Int. Ed.*, **2013**, 52, 10035.

# PHOSPHORUS - Ligands and Compounds

15-1078	<p><b>Dicyclohexyl-[9-[3-(4-sulfonylphenyl)propyl]-2-sulfonylfluoren-9-yl] phosphonium hydrogen sulfate, min. 95% [cataCXium® FSulf]</b></p> <p><math>C_{34}H_{43}O_{10}PS_3</math>; FW: 738.87</p> <p>Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component.</p>		500mg 2g
15-1130	<p><b>Dicyclopentylphosphine, 97+% (39864-68-1)</b></p> <p><math>(C_5H_9)_2PH</math>; FW: 170.23; colorless liq.; d. 0.933</p> <p><i>air sensitive, pyrophoric</i></p>		1g 5g
15-1131	<p><b>Dicyclopentylphosphine, 97+% (10 wt% in hexanes) (39864-68-1)</b></p> <p><math>(C_5H_9)_2PH</math>; FW: 170.23; colorless liq.</p> <p><i>air sensitive</i></p>		10g 50g
15-1150	<p><b>Diethylchlorophosphine, min. 95% (686-69-1)</b></p> <p><math>(C_2H_5)_2PCl</math>; FW: 124.55; colorless to light yellow liq.; b.p. 131-132°; f.p. 66°F; d. 1.023</p> <p><i>air sensitive, moisture sensitive, (store cold)</i></p>		1g 5g
93-1520	<p><b>Di-(2-ethylhexyl)phosphoric acid (contains some mono) (298-07-7)</b></p> <p><math>[C_4H_9CH_2(C_2H_5)CH_2O]_2P(O)(OH)</math>; FW: 322.42; colorless liq.; d. 0.974</p>		100g 500g
15-1210	<p><b>Diethylphosphine, 99% (627-49-6)</b></p> <p><math>(C_2H_5)_2PH</math>; FW: 90.11; colorless liq.; b.p. 85°; d. 0.7862</p> <p><i>pyrophoric, STENCH</i></p>		1g 5g
15-1211	<p><b>Diethylphosphine, 99% (10 wt% in hexanes) (627-49-6)</b></p> <p><math>(C_2H_5)_2PH</math>; FW: 90.11; colorless liq.; d. 0.66</p> <p><i>air sensitive</i></p>		10g 50g
15-1151	<p><b>2-Diethylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl di(hydrogen tetrafluoroborate) salt, min. 98% EtCPhos</b></p> <p><math>C_{20}H_{29}N_2P \cdot 2(HBF_4)</math>; FW: 504.01; white powdr.</p> <p>Note: Patents: US 6,395,916, US 6,307,087.</p>		100mg 500mg

## Technical Note:

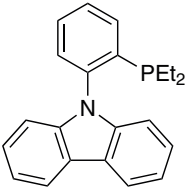
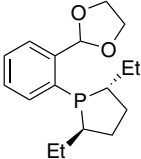
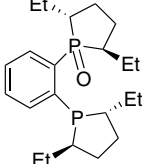
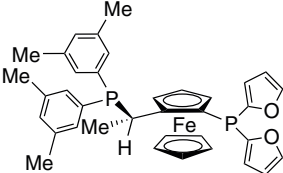
- Ligand used in palladium-catalyzed cross-coupling of secondary alkylzinc reagents with heteroaryl halides



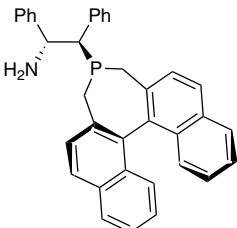
## References:

- Org. Lett.*, **2014**, *16*, 4638 (Note this reference is for is for 46-0348, EtCPhos Palladacycle Gen. 3.)

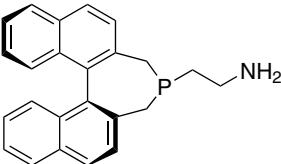
# PHOSPHORUS - Ligands and Compounds

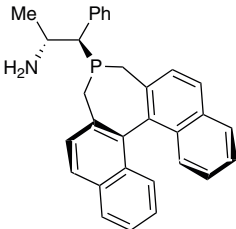
15-0496	<b>9-[2-(Diethylphosphino)phenyl]-9H-carbazole, min. 97% Et PhenCar-Phos</b> (1308652-66-5) $C_{22}H_{22}NP$ ; FW: 331.39; white powdr. <i>air sensitive</i> Note: PhenCar-Phos Ligand Kit component.		100mg 500mg
93-1521	<b>Diethylphosphite, min. 95% (762-04-9)</b> $(C_2H_5O)_2P(O)H$ ; FW: 138.11; colorless liq.; b.p. 50-51°/2 mm; f.p. 195°F; d. 1.072		100g 500g
15-7332	<b>2-{2-[(2R,5R)-2,5-Diethyl-1-phospholano]phenyl}1,3-dioxolane, min. 97%</b> $C_{17}H_{25}O_2P$ ; FW: 292.35; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.		100mg 500mg
15-7333	<b>2-{2-[(2S,5S)-2,5-Diethyl-1-phospholano]phenyl}1,3-dioxolane, min. 97%</b> (1217655-83-8) $C_{17}H_{25}O_2P$ ; FW: 292.35; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.		100mg 500mg
15-7354	<b>[1-(2R,5R)-2,5-Diethylphospholanyl]-[2-(2R,5R)-2,5-diethylphospholanyl-1-oxide]benzene, min. 97%</b> (924294-55-3) $C_{22}H_{36}OP_2$ ; FW: 378.47; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.		100mg 500mg
15-7355	<b>[1-(2S,5S)-2,5-Diethylphospholanyl]-[2-(2S,5S)-2,5-diethylphospholanyl-1-oxide]benzene, min. 97%</b> $C_{22}H_{36}OP_2$ ; FW: 378.47; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.		100mg 500mg
93-1571 HAZ	<b>Difluorophosphoric acid hemihydrate, tech. gr. (13779-41-4)</b> $HPO_2F_2 \cdot 0.5H_2O$ ; FW: 101.98 (110.99); yellow fuming liq.; m.p. -96.5°; b.p. 115.9°; d. 1.583 (25°)		250g 1kg
26-1170	<b>(S)-(+)-1-[(R)-2-(Di-2-furylphosphino)ferrocenyl]ethyl-di-3,5-xilylphosphine, min. 97%</b> (649559-66-0) $C_{36}H_{36}FeO_2P_2$ ; FW: 618.46; orange powdr. Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.		100mg 500mg 2g 10g

# PHOSPHORUS - Ligands and Compounds

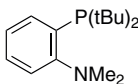
15-7137	(1R,2R)-2-[(4S,11bR)-3,5-Dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1,2-diphenylethanamine, min. 97% (1469882-57-2) C <sub>36</sub> H <sub>30</sub> NP; FW: 507.60; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO 2008148202.		100mg 500mg
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15-7136	(1S,2S)-2-[(4R,11bS)-3,5-Dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1,2-diphenylethanamine, min. 97% (1092064-02-2) C <sub>36</sub> H <sub>30</sub> NP; FW: 507.60; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO 2008148202.		100mg 500mg
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15-7134	2-[(11bS)-3,5-Dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethyl]amine, min. 97% (1053659-64-5) C <sub>24</sub> H <sub>22</sub> NP; FW: 355.41; pale yellow solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO2008148202.		100mg 500mg
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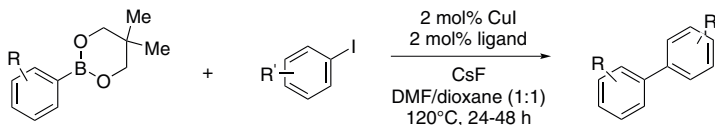
15-7141	(1R,2R)-2-[(4S,11bR)-3,5-Dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1-phenylpropan-2-amine, min. 97% C <sub>31</sub> H <sub>28</sub> NP; FW: 445.53; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO 2008148202.		100mg 500mg
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15-7140	(1S,2S)-2-[(4R,11bS)-3,5-Dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1-phenylpropan-2-amine, min. 97% (1092064-04-4) C <sub>31</sub> H <sub>28</sub> NP; FW: 445.53; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO 2008148202.		100mg 500mg
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15-1260	[2-(N,N-Dimethylamino)phenyl]di-t-butylphosphine, min. 95% (415941-58-1) C <sub>16</sub> H <sub>28</sub> NP; FW: 265.37; white to light-brown xtl.; m.p. 50-53° Note: Ligand used in the copper-catalyzed coupling of arylboronate esters with aryl and heteroaryl halides.		1g 5g
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## Technical Notes:

- Ligand for the Copper-Catalyzed Suzuki-Miyaura Coupling of Arylboronate Esters and Aryl Iodides
- Ligand for the Copper-Catalyzed Coupling of Triaryl- and Trialkylindium reagents with Aryl Iodides and Bromides

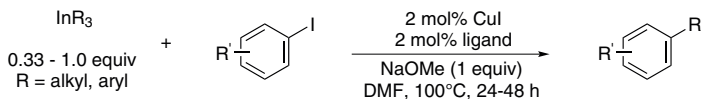


Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds

**15-1260** [2-(N,N-Dimethylamino)phenyl]di-t-butylphosphine, min. 95% (415941-58-1)

(continued)



Tech. Note (2)  
Ref. (2)

References:

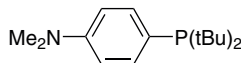
1. *Org. Lett.*, **2014**, 16, 1264
2. *Angew. Chem. Int. Ed.*, **2014**, 53, 11620

**15-1248** [4-(N,N-Dimethylamino)phenyl]

di-t-butylphosphine, min. 95% amphos

(932710-63-9)

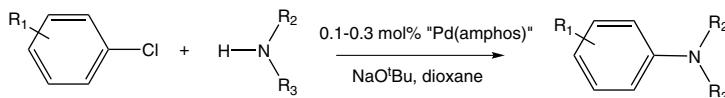
$\text{C}_{16}\text{H}_{28}\text{NP}$ ; FW: 265.37; white to light-brown xtl.; m.p. 57-61°



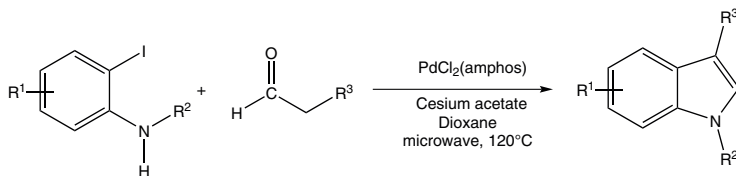
1g  
5g  
25g

Technical Notes:

1. Ligand used in a highly-active palladium precatalyst for the efficient amination of aryl chloride.
2. Ligand used in the palladium-catalyzed annulations under microwave enhanced conditions.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

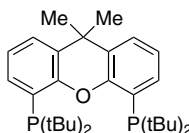
References:

1. *Organometallics*, **2011**, 30, 4432.
2. *Tetrahedron Letters*, **2013**, 54, 5126.

**15-1241** 9,9-Dimethyl-4,5-bis(di-t-butylphosphino)xanthene, min. 97% t-Bu-XANTPHOS

(856405-77-1)

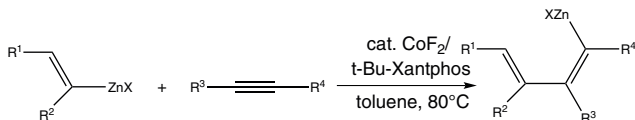
$\text{C}_{31}\text{H}_{48}\text{OP}_2$ ; FW: 498.66; white to light yellow powdr.



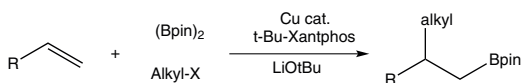
500mg  
2g

Technical Notes:

1. Ligand used in the cobalt-catalyzed alkenylzincation of unfunctionalized alkynes.
2. Ligand used in the cobalt-catalyzed alkylation of alkenes
3. Ligand used in the palladium-catalyzed N-alkylation of amines using primary and secondary alcohols
4. Ligand used in the palladium-catalyzed methylation of alkynyl C(sp)-H bonds with dimethyl sulfonium ylides



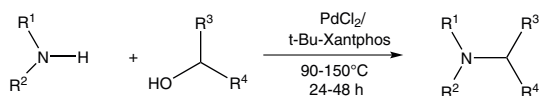
Tech. Note (1)  
Ref. (1)



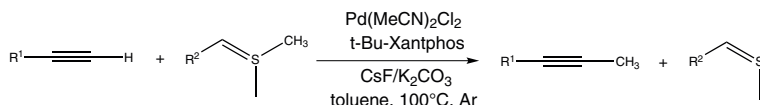
Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

**15-1241** **9,9-Dimethyl-4,5-bis(di-t-butylphosphino)xanthene, min. 97% t-Bu-XANTPHOS**  
(continued) (856405-77-1)



**Tech. Note (3)**  
**Ref. (3)**

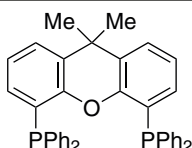


**Tech. Note (4)**  
**Ref. (4)**

## References:

1. *Angew. Chem. Int. Ed.*, **2016**, *55*, 336
2. *Angew. Chem. Int. Ed.*, **2015**, *54*, 12961.
3. *ACS Catalysis*, **2013**, *3*, 2536.
4. *J. Org. Chem.*, **2013**, *78*, 10421.

**15-1242** **9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS**  
(161265-03-8)  
C<sub>39</sub>H<sub>32</sub>OP<sub>2</sub>; FW: 578.63; light-yellow xtl.;  
m.p. 221-222°



1g  
5g  
25g  
100g

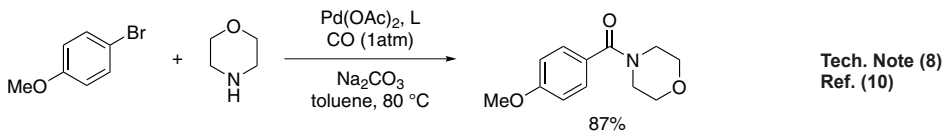
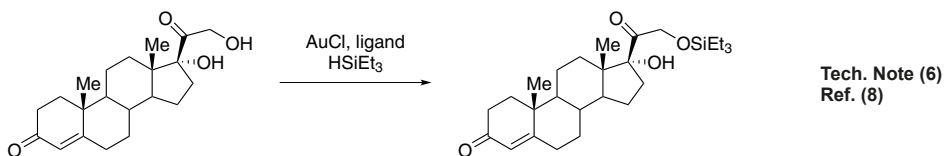
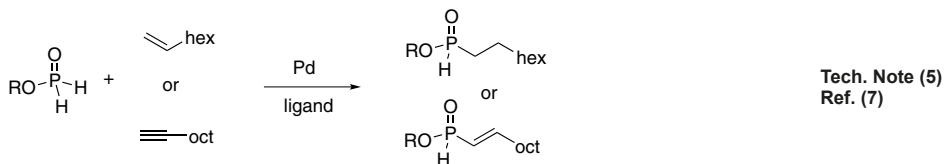
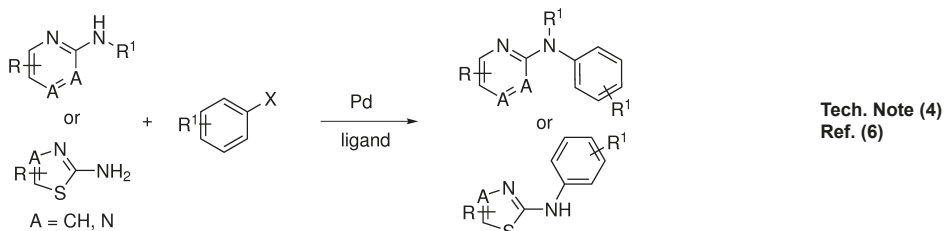
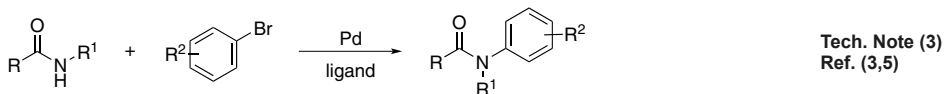
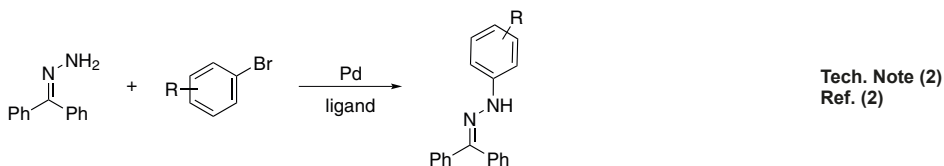
## Technical Notes:

1. Ligand used for the hydroformylation of alkenes.
2. Ligand used in the intermolecular coupling of amides and hydrazones with aryl halides.
3. Ligand used in the intermolecular coupling of amides with aryl halides or triflates.
4. Ligand used in the coupling of heteroaryl amines and aryl halides.
5. Ligand used in the hydrophosphinylation of alkenes and alkynes.
6. Ligand used for the Au(I)-catalyzed dehydrogenative silylation of alcohols.
7. Ligand used for the sulfonylation of aryl iodides.
8. Ligand used for the Pd-catalyzed carbonylation reaction of aryl bromides and amines.
9. Ligand used for the Ni-catalyzed alkyne cyanation of alkynes.
10. Ligand used for the Pd-catalyzed N-arylation of 3-amino-1H-pyrazole.
11. Ligand used for the Rh-catalyzed dehydrogenative borylation of cyclic alkenes.
12. Ligand used for the Pd-catalyzed intermolecular coupling of H-Phosphonate diesters with benzyl halides.
13. Ligand used for the Pd-catalyzed one pot synthesis of 4-aryl-1H-1,2,3-triazoles.
14. Ligand used for the Pd-catalyzed intermolecular addition of formamides to alkynes.
15. Ligand used for the Pd-catalyzed decarboxylative couplings of 2-(2-azaaryl)acetates with aryl halides and triflates.
16. Ligand used for the Pd-catalyzed benzylic arylation of 2-methyl azaarenes
17. Ligand used for the Pd-catalyzed  $\alpha$ -arylation of heteroaromatic ketones.
18. Ligand used for the Pd-catalyzed direct alkylation of both azoles and azolines.
19. Ligand used for the Cu-catalyzed intermolecular coupling of alkynes with aryl iodides.
20. Ligand used for the Pd-catalyzed ene-type reaction of aldehydes with 1,3-diene.
21. Ligand used for the Pd-catalyzed ene-type reaction of aldehydes with 1,3-diene.
22. Ligand used for the Pd/Cu-catalyzed direct arylation of heteroarenes.
23. Ligand used for the Pd-catalyzed reaction of propargyl-substituted malonate esters with aryl halides.
24. Ligand used for the Pd-catalyzed decarboxylative coupling of tertiary cyanoacetate salts with aryl halides and triflates.
25. Ligand used for the Pd-catalyzed hydroesterification of alkynes.
26. Ligand used for the Cu-catalyzed arylation of arylboronic acids with aldehydes.
27. Ligand used for the Ru-catalyzed oxidative synthesis of heterocycles from alcohols.
28. Ligand used for the Rh-catalyzed borylation of nitriles.
29. Ligand used in the Pd-catalyzed  $\alpha$ -arylation of benzylic phosphine oxides.
30. Ligand used in the Pd-Catalyzed Oxidative Coupling of Enamides and Alkynes.
31. Ligand used in the Pd-catalyzed difunctionalization of enol ethers to amino acetals with aminals and alcohols.
32. Ligand used in the Pd-catalyzed alkoxy carbonylation of  $\alpha$ -chloro ketones.

# PHOSPHORUS - Ligands and Compounds

15-1242 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS

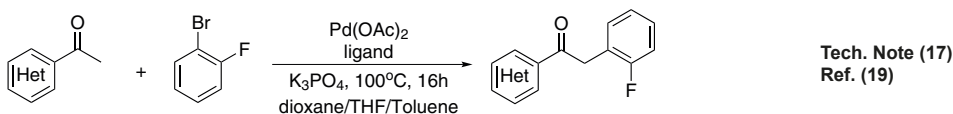
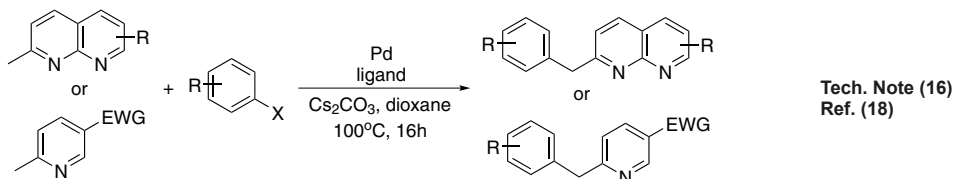
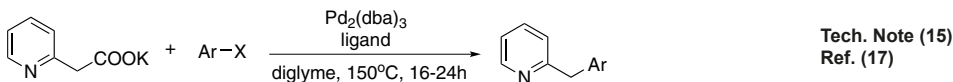
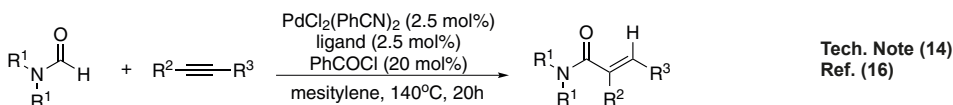
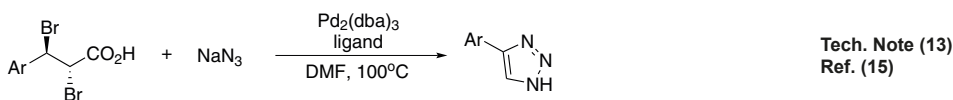
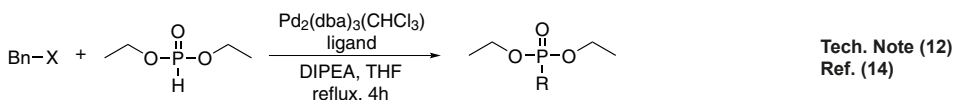
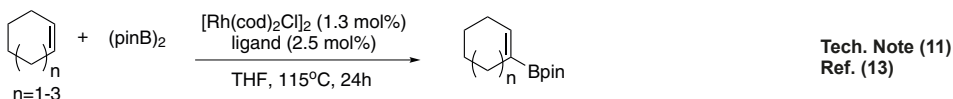
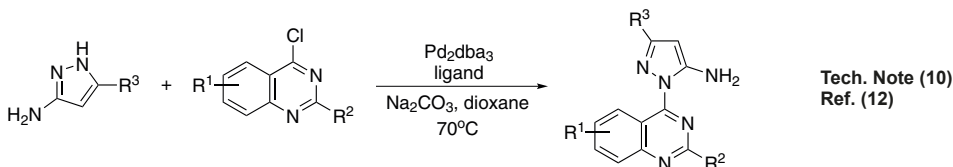
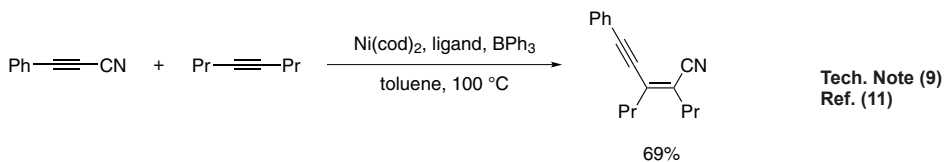
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# PHOSPHORUS - Ligands and Compounds

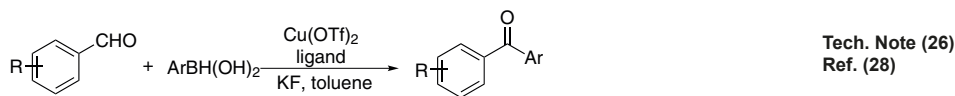
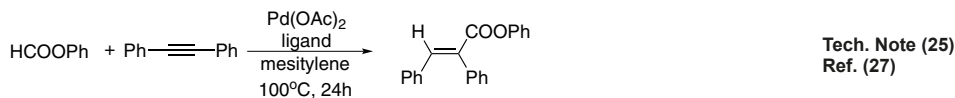
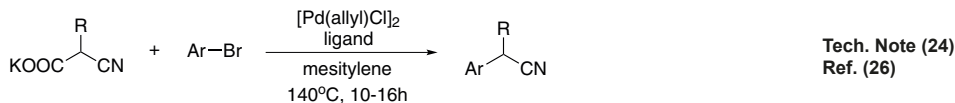
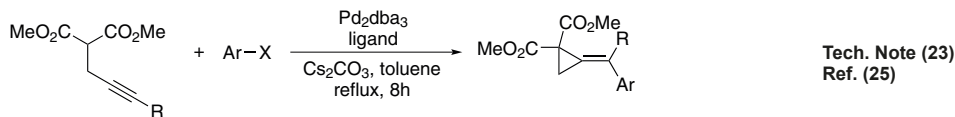
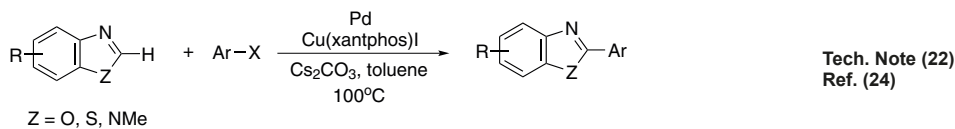
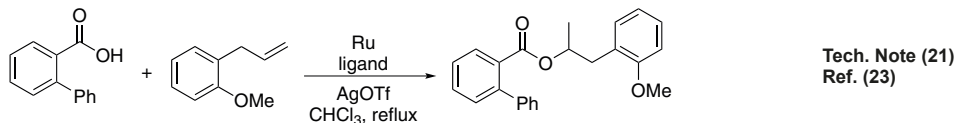
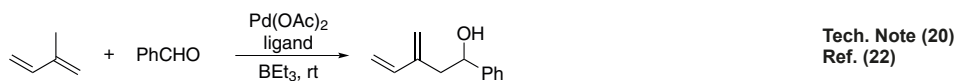
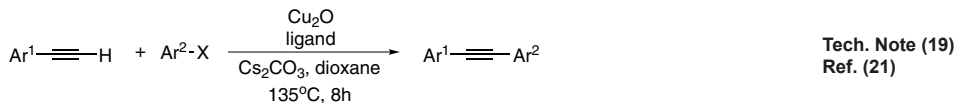
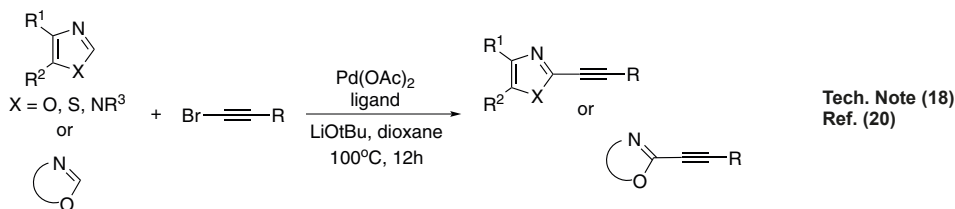
15-1242 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS  
(continued)



# PHOSPHORUS - Ligands and Compounds

15-1242 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS

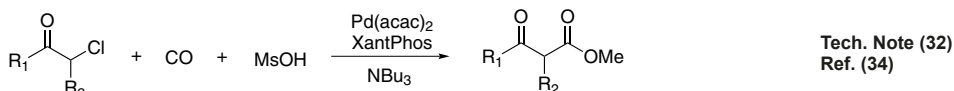
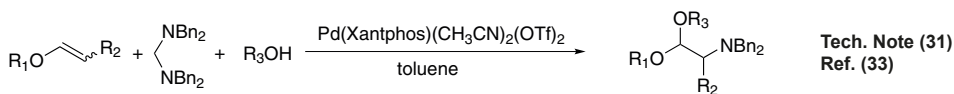
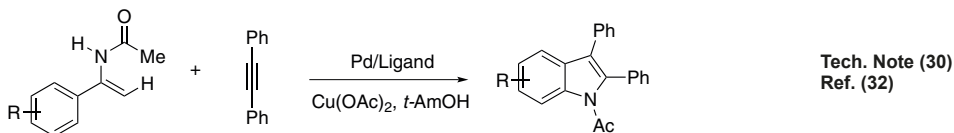
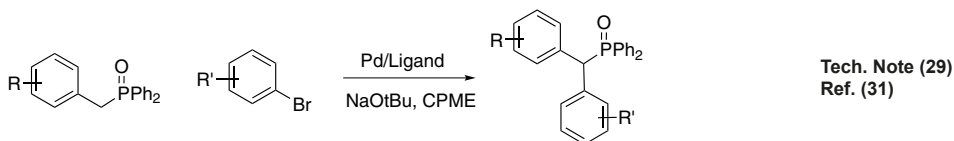
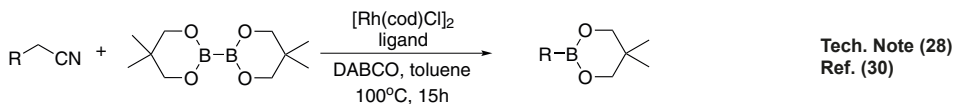
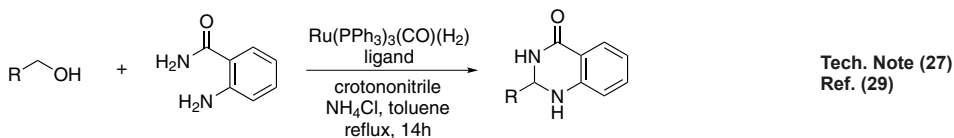
(continued)



# PHOSPHORUS - Ligands and Compounds

15-1242 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS

(continued)



## References:



1. Organometallics, 1995, 14, 3081.
2. J. Am. Chem. Soc., 1999, 121, 10251.
3. Org. Lett., 2000, 2, 1101.
4. Acc. Chem. Res., 2001, 34, 895 (review).
5. J. Am. Chem. Soc., 2002, 124, 6043.
6. Org. Lett., 2002, 4, 3481.
7. J. Am. Chem. Soc., 2002, 124, 9386.
8. Org. Lett., 2005, 7, 3001.
9. Org. Lett., 2006, 8, 5951.
10. J. Org. Chem., 2008, 73, 7102.
11. Tetrahedron, 2009, 65, 5037.
12. Org. Lett., 2010, 12, 552.
13. Chem. Commun., 2010, 46, 907.
14. New J. Chem., 2010, 34, 967.
15. Synthesis, 2010, 2, 283.
16. J. Am. Chem. Soc., 2010, 132, 2094.
17. J. Am. Chem. Soc., 2010, 132, 14391.
18. Org. Lett., 2010, 12, 5359.
19. Org. Lett., 2010, 12, 1032.
20. Org. Lett., 2010, 12, 1868.
21. Eur. J. Org. Chem., 2010, 4368.
22. J. Am. Chem. Soc., 2010, 132, 16346.

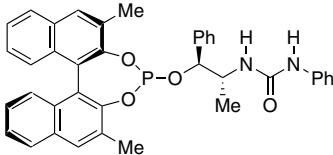
# PHOSPHORUS - Ligands and Compounds

**15-1242** 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS

(continued)

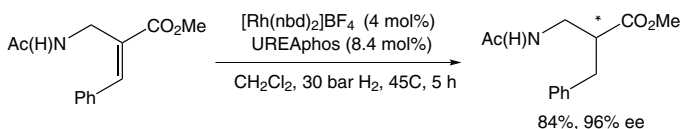
23. Tetrahedron Letters, 2010, 51, 2806.
24. J. Am. Chem. Soc., 2010, 132, 3674.
25. J. Am. Chem. Soc., 2011, 133, 9682.
26. Angew. Chem. Int. Ed., 2011, 50, 4470.
27. Adv. Synth. Catal., 2011, 353, 475.
28. Synlett, 2011, 11, 1626.
29. Org. Biomol. Chem., 2012, 10, 240.
30. J. Am. Chem. Soc., 2012, 134, 115.
31. Org. Lett., 2014, 16, 130.
32. Org. Lett., 2014, 16, 608.
33. J. Am. Chem. Soc., 2013, 135, 18327.
34. Adv. Synth. Catal., 2012, 354, 3105

<b>15-1250</b>	<b>Dimethylchlorophosphine, min. 97% (811-62-1)</b>	1g
amp	(CH <sub>3</sub> ) <sub>2</sub> PCl; FW: 96.50; colorless to pale yellow liq. (may contain some solids);	5g
HAZ	b.p. 76-77°; f.p. -1°F; d. 1.22	
	<i>moisture sensitive, pyrophoric</i>	
		

<b>15-2206</b>	<b>1-((1S,2R)-1-[(11bR)-2,6-Dimethylidnaptho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]-1-phenylpropan-2-yl)-3-phenylurea, min. 97% (1858223-86-5)</b>	50mg 250mg
		
	C <sub>38</sub> H <sub>33</sub> N <sub>2</sub> O <sub>4</sub> P; FW: 612.65; white powdr.	
	<i>moisture sensitive, (store cold)</i>	
	Note: Sold under license from InCaT for research purposes only. WO2004/103559. UREAphos and METAMORPhos Ligand Kit component.	

## Technical Note:

1. The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



## References:

1. J. Chem. Soc. Chem. Comm., 2007, 864.
2. WO2004103559A2.

# PHOSPHORUS - Ligands and Compounds

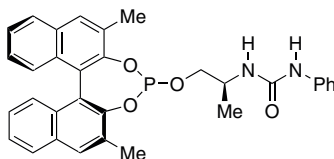
**15-2204** 1-((2S)-1-[(11bS)-2,6-Dimethyldinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl)-3-phenylurea, min. 97% (1357562-63-0)

C<sub>32</sub>H<sub>29</sub>N<sub>2</sub>O<sub>4</sub>P; FW: 536.56; white powdr.

moisture sensitive, (store cold)

Note: Sold under license from InCaT for research purposes only. WO2004/103559.

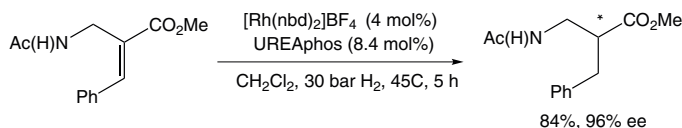
UREAPhos and METAMORPhos Ligand Kit component.



50mg  
250mg

## Technical Note:

- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



## References:

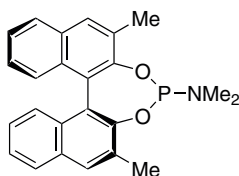
- J. Chem. Soc. Chem. Comm., 2007, 864.
- WO2004103559A2,

**15-1255** (S)-(+)-(2,6-Dimethyl-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 98% (185449-86-9)

C<sub>24</sub>H<sub>22</sub>NO<sub>2</sub>P; FW: 387.41; off-white powdr.; m.p. 228-229°

moisture sensitive

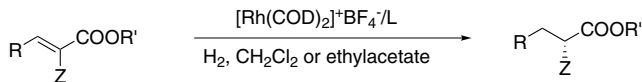
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



100mg  
500mg

## Technical Notes:

- Ligand used in the enantioselective, rhodium-catalyzed hydrogenation of substituted olefins, such as N-acetyldihydroamino acids, enamides, and unsaturated acids.
- Ligand used in the enantioselective, iridium-catalyzed allylic substitution of allyl acetates containing only a single substituent in the 1 or 3 position
- Ligand use in the rhodium-catalyzed, amide directed, asymmetric hydroboration reaction
- Ligand used in asymmetric conjugate addition of aryl boronic acids to dihydronaphthalenes.
- Ligand used in the rhodium-catalyzed asymmetric intramolecular 1,4 addition.



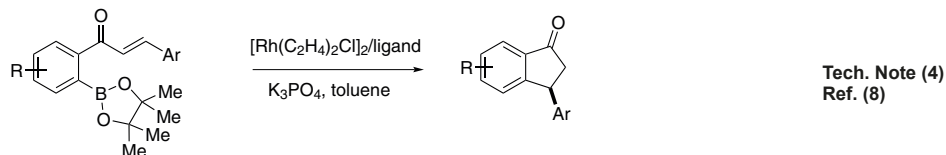
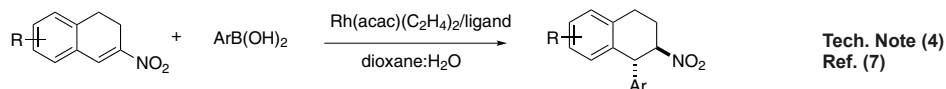
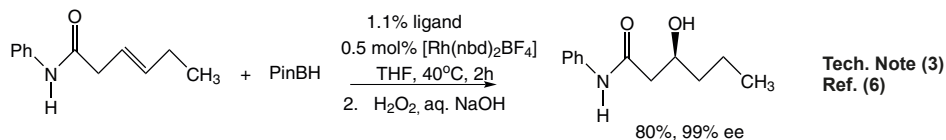
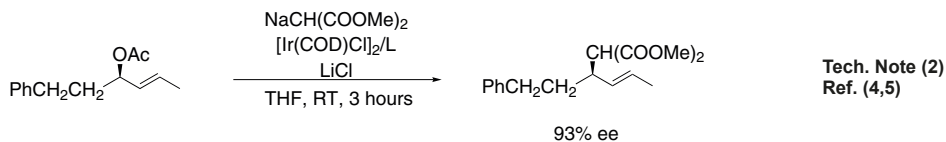
R = H, Ph    R' = H, CH<sub>3</sub>    Z = NHCOCH<sub>3</sub>, CH<sub>2</sub>COOH

>97% ee

Tech. Note (1)  
Ref. (1-3)

# PHOSPHORUS - Ligands and Compounds

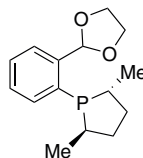
**15-1255** (S)-(+)-(2,6-Dimethyl-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dime-  
(continued) thylamine, min. 98% (185449-86-9)



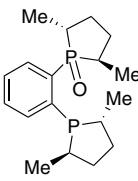
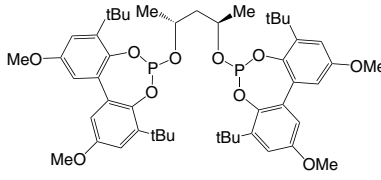
## References:

1. *J. Am. Chem. Soc.*, **2000**, 122, 11539.
2. *Adv. Synth. Catal.*, **2003**, 345, 308.
3. *Adv. Synth. Catal.*, **2002**, 344, 1003.
4. *Chem. Comm*, **1999**, 741.
5. *Eur. J. Inorg. Chem.*, **2002**, 2569
6. *J. Am. Chem. Soc.*, **2008**, 130, 3734.
7. *Ad. Synth. Catal*, **2012**, 354, 2433.
8. *J. Org. Chem.*, **2013**, 78, 2736.

<b>15-1280</b>	<b>Dimethyldiphenylphosphonium iodide, 98%</b> (1017-88-5) (CH <sub>3</sub> ) <sub>2</sub> (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P <sup>+</sup> I <sup>-</sup> ; FW: 342.16; white xtl. <i>hygroscopic</i>	5g 25g
<b>93-1523</b>	<b>Dimethylmethylphosphonate, 97%</b> (756-79-6) (CH <sub>3</sub> O) <sub>2</sub> P(O)(CH <sub>3</sub> ); FW: 124.08; colorless liq.; b.p. 92-97°/50 mm; f.p. 156°F; d. 1.160	100g 500g 2kg
<b>15-1400</b> amp HAZ	<b>Dimethylphenylphosphine, 99%</b> (672-66-2) (CH <sub>3</sub> ) <sub>2</sub> (C <sub>6</sub> H <sub>5</sub> )P; FW: 138.15; colorless liq.; b.p. 75-79°/12 mm; f.p. 122°F; d. 0.967 <i>air sensitive</i>	2g 10g
<b>15-1425</b>	<b>Dimethylphosphine oxide, min. 97%</b> (7211-39-4) C <sub>2</sub> H <sub>5</sub> OP; FW: 78.05; white solid <i>air sensitive</i>	500mg 2g
<b>15-7335</b>	<b>2-{2-[(2R,5R)-2,5-Dimethyl-1-phospholano]phenyl}1,3-dioxolane, min. 97%</b> (1044256-04-3) C <sub>16</sub> H <sub>21</sub> O <sub>3</sub> P; FW: 264.30; pale yellow to colorless liq. <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only.	100mg 500mg

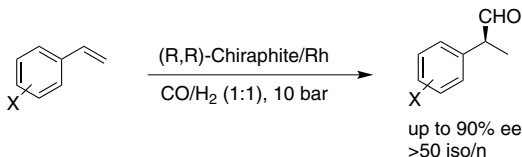


## PHOSPHORUS - Ligands and Compounds

15-7336	<p><b>2-{2-[(2S,5S)-2,5-Dimethyl-1-phospholano]phenyl}1,3-dioxolane</b>, min. 97% (695816-47-8)  <math>C_{15}H_{21}O_3P</math>; FW: 264.30; pale yellow to colorless liq.  <i>air sensitive</i>                      Note: Sold under license from Kanata for research purposes only.</p>	100mg 500mg	
15-7360	<p><b>[1-(2R,5R)-2,5-Dimethylphospholanyl]-[2-(2R,5R)-2,5-dimethylphospholanyl-1-oxide]benzene</b>, min. 97% (638132-66-8)  <math>C_{18}H_{28}OP_2</math>; FW: 322.36; white solid  <i>air sensitive</i>                      Note: Sold under license from Kanata for research purposes only.</p>		100mg 500mg
15-7361	<p><b>[1-(2S,5S)-2,5-Dimethylphospholanyl]-[2-(2S,5S)-2,5-dimethylphospholanyl-1-oxide]benzene</b>, min. 97% (1380079-15-1)  <math>C_{18}H_{28}OP_2</math>; FW: 322.36; white solid  <i>air sensitive</i>                      Note: Sold under license from Kanata for research purposes only.</p>	100mg 500mg	
15-1455	<p><b>(+)-6,6'-{[(1R,3R)-1,3-Dimethyl-1,3-propanediyl]bis(oxy)}bis[4,8-bis(t-butyl)-2,10-dimethoxy-benzo[d,f][1,3,2]dioxaphosphepin]</b>, min. 95% (R,R)-Chiraphite (149646-83-3)  <math>C_{48}H_{88}O_{10}P_2</math>; FW: 876.99; off-white powdr.  <i>air sensitive, moisture sensitive</i>                      Note: Sold in collaboration with Chirotech for research purposes only. US Patent No. 5,491,266.</p>		100mg 500mg

### Technical Note:

- Useful catalyst for the asymmetric hydroformylation of olefins under mild conditions. High enantio- and regioselectivities have been demonstrated for several prochiral vinylarenes, and a wide variety of functional groups can be tolerated.



### References:

- J. Org. Chem.*, **2004**, 69, 4031.
- Organometallics*, **1997**, 16, 2929.
- J. Chem. Soc., Dalton Trans.*, **1995**, 409.
- J. Am. Chem. Soc.*, **2005**, 127, 5040.

15-1456	<p><b>(-)-6,6'-{[(1S,3S)-1,3-Dimethyl-1,3-propanediyl]bis(oxy)}bis[4,8-bis(t-butyl)-2,10-dimethoxy-benzo[d,f][1,3,2]dioxaphosphepin]</b>, min. 95% (S,S)-Chiraphite (852042-07-0)  <math>C_{48}H_{88}O_{10}P_2</math>; FW: 876.99; off-white powdr.  <i>air sensitive, moisture sensitive</i>                      Note: Sold in collaboration with Chirotech for research purposes only. US Patent 5,491,266.</p>	100mg 500mg
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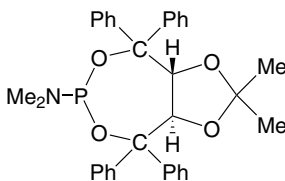
### Technical Note:

- See 15-1455 (page 194)

# PHOSPHORUS - Ligands and Compounds

**15-1505** (3aR,8aR)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3]dioxolo[4,5-e][1,3,2]dioxaphosphin-6-yl)dimethylamine, min. 98% (213843-90-4)  
 $C_{33}H_{34}NO_4P$ ; FW: 539.60;  
 white powdr.; m.p. 218-221°  
*moisture sensitive*

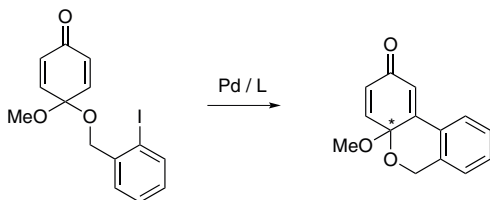
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



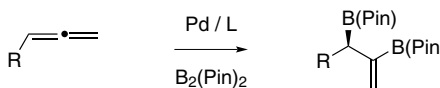
100mg  
500mg

## Technical Notes:

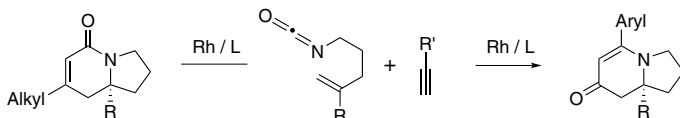
1. Monodentate ligand for the enantioselective intramolecular reaction of prochiral cyclohexadienones.
2. Ligand use in the palladium-catalyzed, enantioselective diboration of allenes.
3. Enantioselective Rh-catalyzed [2+2+2] cycloaddition of alkynes and isocyanates.
4. Palladium-catalyzed enantioselective C-H arylation.
5. Palladium-catalyzed dynamic kinetic cross-coupling.
6. Palladium-catalyzed enantioselective C-H arylation.



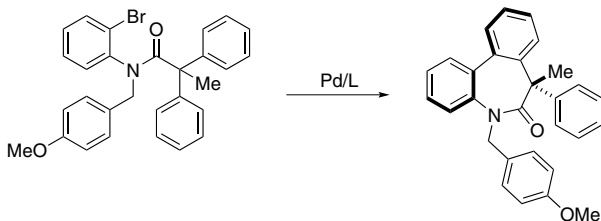
Tech. Note (1)  
Ref. (1)



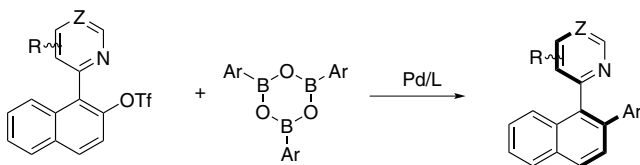
Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

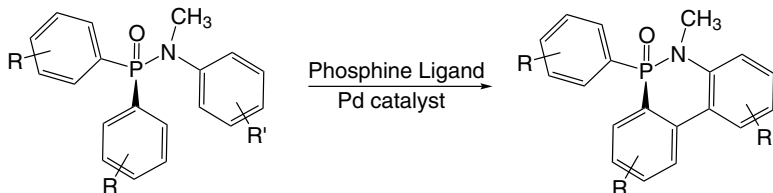


Tech. Note (5)  
Ref. (5)



# PHOSPHORUS - Ligands and Compounds

**15-1505** (3aR,8aR)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3]dioxolo[4,5-e][1,3,2]dioxaphosphin-6-yl)dimethylamine, min. 98% (213843-90-4)  
(continued)



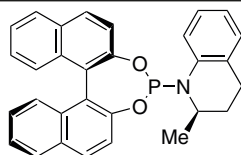
Tech. Note (6)  
Ref. (6)

## References:

1. *J. Am. Chem. Soc.*, **2002**, 124, 184.
2. *J. Am. Chem. Soc.*, **2004**, 126, 16328.
3. *Org. Lett.*, **2008**, 10, 1231.
4. *Angew. Chem. Int. Ed.*, **2013**, 52, 7865.
5. *J. Am. Chem. Soc.*, **2013**, 135, 15730.
6. *Angew. Chem. Int. Ed.*, **2015**, 54, 6265.

**15-7203** (2R)-1-(11bR)-(Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline, 98% (1186392-43-7)

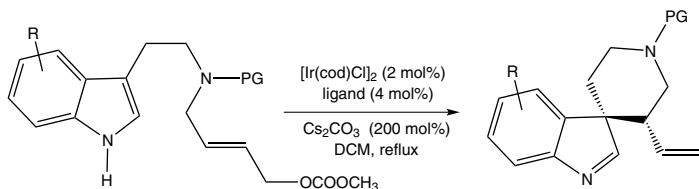
C<sub>30</sub>H<sub>24</sub>NO<sub>2</sub>P; FW: 461.49; yellow pwr.  
moisture sensitive  
Note: Sold in collaboration with SIOC  
for research purposes only. Patent  
ZL200910048438.6.



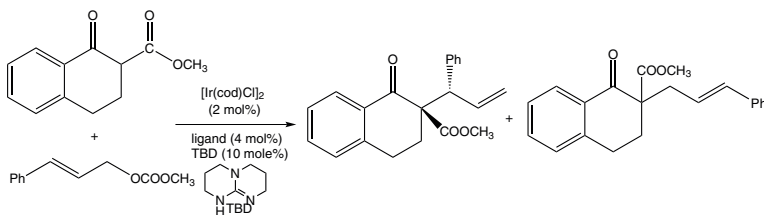
250mg  
1g

## Technical Notes:

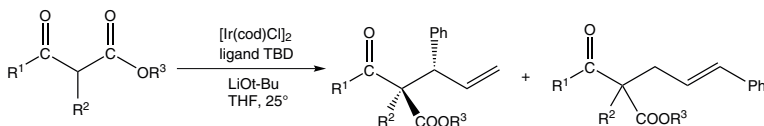
1. Chiral ligand used in the iridium-catalyzed formation of a chiral five-membered ring spiroindolenine.
2. Chiral ligand used in an iridium-catalyzed, enantioselective, allylic alkylation reaction.
3. Chiral ligand used in the iridium-catalyzed, enantioselective functional group substitution at the  $\alpha$ -position of  $\beta$ -ketoesters.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



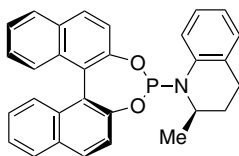
Tech. Note (3)  
Ref. (3)

## References:

1. *J. Am. Chem. Soc.*, **2010**, 132, 11419.
2. *J. Am. Chem. Soc.*, **2013**, 135, 10626.
3. *J. Am. Chem. Soc.*, **2013**, 135, 17298.

## PHOSPHORUS - Ligands and Compounds

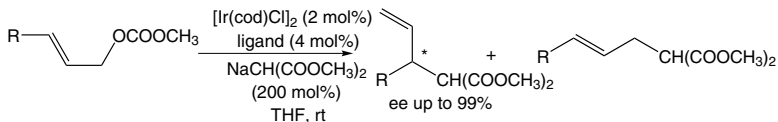
**15-7204** (2R)-1-(11bS)-(Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline, 98% (1186392-32-4)  
 $C_{30}H_{24}NO_2P$ ; FW: 461.49; white to off-white powdr.  
*moisture sensitive*  
 Note: Sold in collaboration with SIOC for research purposes only. Patent ZL200910048438.6.



250mg  
1g

### Technical Notes:

- Chiral ligand used in the iridium-catalyzed, allylic alkylation reaction.
- See 15-7203.

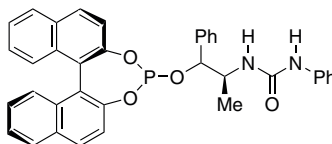


**Tech. Note (1)**  
**Ref. (1)**

### References:

- J. Am. Chem. Soc.*, **2012**, *134*, 4812.

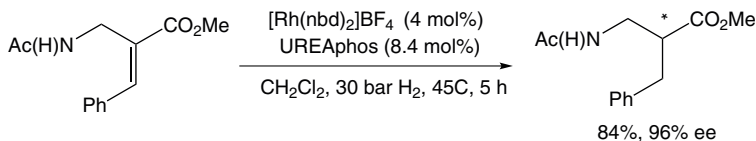
**15-2202** 1-((1R,2S)-1-((11bR)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy)-1-phenylpropan-2-yl)-3-phenylurea, min. 97% (1198080-55-5)  
 $C_{36}H_{29}N_2O_4P$ ; FW: 584.60; white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559.  
 UREAphos and METAMORPhos Ligand Kit component.



50mg  
250mg

### Technical Note:

- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



### References:

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

# PHOSPHORUS - Ligands and Compounds

15-2200

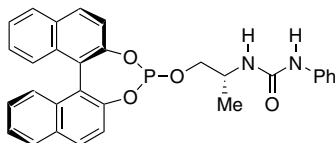
1-[(2R)-1-[(11bR)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl]-3-phenylurea, min. 97% UREAPhos (1198080-53-3)

$C_{30}H_{25}N_2O_4P$ ; FW: 508.50; white powdr.

moisture sensitive, (store cold)

Note: Sold under license from InCatT for research purposes only. WO2009/065856.

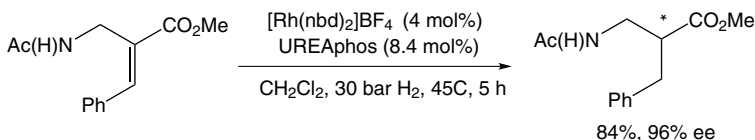
UREAPhos and METAMORPhos Ligand Kit component.



50mg  
250mg

Technical Note:

- The UREAPhos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



References:

- J. Chem. Soc. Chem. Comm., 2007, 864.
- WO2004103559A2

15-2201

1-[(2S)-1-[(11bR)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl]-3-phenylurea, min. 97% (1357562-63-0)

$C_{30}H_{25}N_2O_4P$ ; FW: 508.50; white powdr.

moisture sensitive, (store cold)

Note: Sold under license from InCatT for research purposes only.

WO2004/103559, WO2009/065853. UREAPhos and METAMORPhos Ligand Kit component.

50mg  
250mg

Technical Note:

- See 15-2200 (page 198)

15-2228

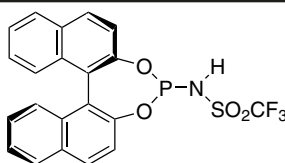
N-[(11bS)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl]-1,1,1-trifluoromethanesulfonamide triethylamine adduct, min. 97% METAMORPhos (1493790-73-0)

$C_{21}H_{13}F_3NO_4PS \cdot (C_2H_5)_3N$ ; FW: 564.56; white powdr.

moisture sensitive, (store cold)

Note: Sold under license from InCatT for research purposes only.

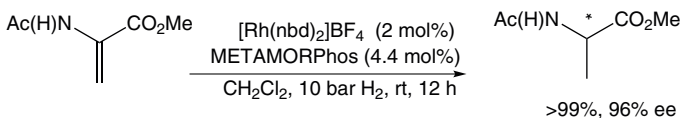
WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component.



50mg  
250mg

Technical Note:

- Chiral ligand for the rhodium-catalyzed asymmetric hydrogenation of  $\alpha$ - $\beta$  unsaturated substrates.

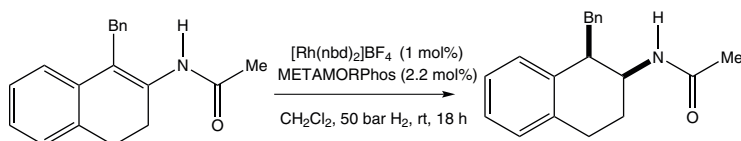


Tech. Note (1)  
Ref. (1-3)

>99%, 96% ee

# PHOSPHORUS - Ligands and Compounds

**15-2228** N-[[**(11bS)**-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphospepin-4-yl]-1,1,1-trifluoromethanesulfonylamide triethylamine adduct, min. 97% **METAMORPhos** (1493790-73-0)



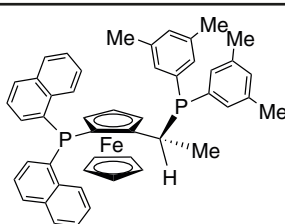
56%, >99% ee

**Tech. Note (1)**  
**Ref. (1-3)**

## References:

1. *J. Am. Chem. Soc.*, **2009**, *131*, 6683.
2. *Angew. Chem. Int. Ed.*, **2008**, *47*, 3180.
3. Patent WO2009065856.

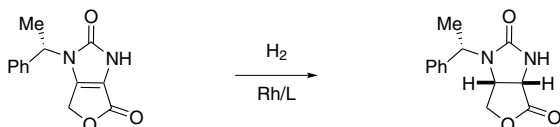
**26-1175** **(R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino)ferrocenyl]ethyl-di-3,5-xylylphosphine**, min. 97% (851308-40-2)  
C<sub>48</sub>H<sub>44</sub>FeP<sub>2</sub>; FW: 738.68; orange powder.  
Note: Sold in collaboration with Solvias for research purposes only.



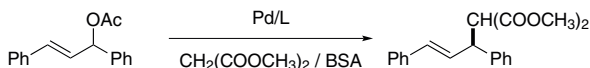
100mg  
500mg  
2g  
10g

## Technical Notes:

1. Ferrocenylphosphine ligands of the type cpFecp(PR<sub>2</sub>)(\*CH(CH<sub>3</sub>)PR'<sub>2</sub>) are a class of asymmetric ligands developed at Solvias in Basel, Switzerland<sup>1</sup>. Ligands of this type are currently used industrially in the stereoselective synthesis of commercial products<sup>2,3</sup>. A unique feature of these bidentate ligands is the presence of a fixed phosphine moiety and a stereogenic, functionalized side chain, which can be easily modified to accommodate electronic and steric requirements. Based on a versatile synthetic procedure starting with optically active ferrocenes of the type cpFecp(PR<sub>2</sub>)(\*CH(CH<sub>3</sub>)X) [X = OAc or NR<sub>2</sub>], a variety of donor atoms can be introduced into the side chain<sup>4</sup>. These ferrocene based phosphine ligands have wide application in the stereoselective hydrogenation of substituted acetamidoacrylates, enol acetates, β-ketoesters and simple alkenes<sup>5-9</sup>.
2. Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.
3. Pd-catalyzed enantioselective alkylative desymmetrization of meso-succinic anhydrides.
4. Asymmetric hydrogenation of ketones and phosphinylketimines.
5. Michael addition of Grignard reagents to α,β-unsaturated esters and thioesters
6. Boration of α,β-unsaturated esters and nitriles
7. Reaction of aryl halides with ammonia.
8. Cu-catalyzed reduction of activated C=C bonds with PMHS.
9. Regio- and enantioselective hydroboration of vinyl arenes.
10. Rh-catalyzed asymmetric ring-opening reactions of oxabicyclic alkenes.
11. 1,2-Migrations in Pd-catalyzed Negishi couplings with JosiPhos ligands.
12. Catalyst for the homodimerization of ketoketenes.
13. Ligand for the Rh catalyzed synthesis of lactones.
14. Ligand for the Cu-catalyzed synthesis of syn and anti γ-amino alcohols.



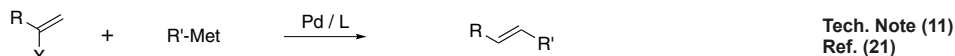
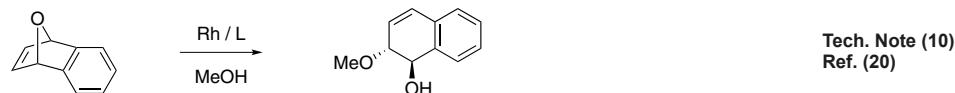
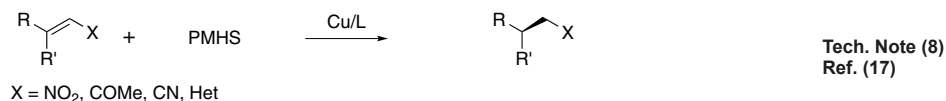
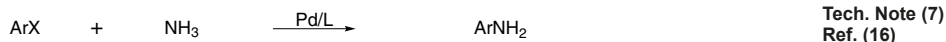
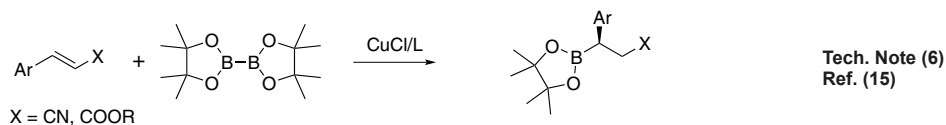
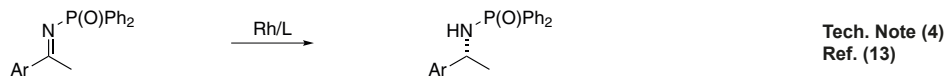
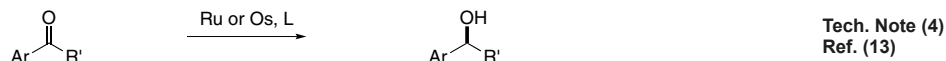
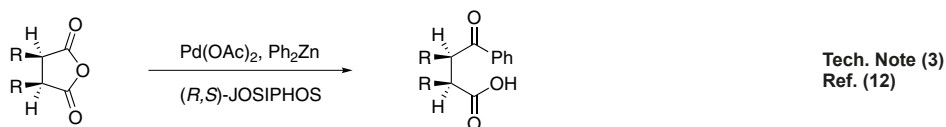
**Tech. Note (1)**  
**Ref. (3)**



**Tech. Note (1)**  
**Ref. (5)**

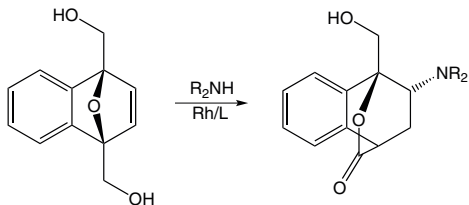
# PHOSPHORUS - Ligands and Compounds

26-1175 (continued) (R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino) ferrocenyl]ethylidene-3,5-xylylphosphine, min. 97% (851308-40-2)

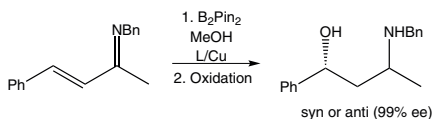


# PHOSPHORUS - Ligands and Compounds

**26-1175** (R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino) ferroceny]ethylidene-3,5-xylylphosphine, min. 97%  
(continued) (851308-40-2)




Tech. Note (13)  
Ref. (23)

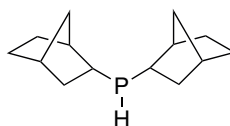


Tech. Note (14)  
Ref. (25)

## References:

1. *Solvias owns the patent rights for Strem products 26, 1000, 26, 1001, 26, 1200, 26, 1201, 26, 1230, 26-1101, and for the Ir and Rh complexes of the aforementioned products, including the complexes of 26-1210 and 26-1211.*
2. *C&E News, July 22, 1996, 38*
3. *Angew. Chem. Int. Ed., 1996, 35, 1475*
4. *J. Org. Chem., 1972, 37, 3052*
5. *J. Am. Chem. Soc., 1994, 116, 4062*
6. *Inorg. Chim. Acta., 1994, 222, 213*
7. *Organometallics, 1996, 15, 860*
8. *Helv. Chim. Acta., 1995, 78, 883*
9. *European Patents; EP 624587 A2, 941117, EP, 612758, A1, 940831, EP, 564406, A1, 931006*
10. *Comprehensive Asymmetric Catalysis, 1999, Chapter, 6.1, pg, 199, 207*
11. *Topics in Catalysis, March 2002, 19, review*
12. *J. Am. Chem. Soc., 2004, 126, 10248*
13. (a) *Angew. Chem. Int. Ed., 2007, 46, 7651.* (b) *Adv. Synth. Catal, 2002, 343, 68.* (c) *J. Am. Chem. Soc., 2009, 131, 10386.*
14. *Angew. Chem. Int. Ed., 2005, 44, 2752*
15. *Angew. Chem. Int. Ed., 2007, 47, 145*
16. *J. Am. Chem. Soc., 2006, 128, 10028*
17. (a) *Angew. Chem. Int. Ed., 2003, 42, 4793.* (b) *Angew. Chem, Int, Ed, 2006, 45, 2785.* (c) *J. Am. Chem. Soc., 2009, 131, 10386.*
18. *Angew. Chem. Int. Ed., 2006, 45, 17674, review*
19. *J. Am. Chem. Soc., 2004, 126, 9200*
20. *Proc. Natl. Acad. Sci. U.S.A., 2004, 101, 5455*
21. *J. Org. Chem., 2009, 74, 135*
22. *J. Org. Chem. 2011, 76, 7901*
23. *Angew. Chem. Int. Ed. 2011, 50, 7346*
24. *Review: Privileged Ligands and Catalysts, 2011, 93*
25. *Angew. Chem. Int. Ed. 2011, 353, 376*

**15-1460**  
HAZ  
  
**Di-2-norbornylphosphine, min. 98% (mixture of endo and exo isomers)**  
(148432-44-4)  
(C<sub>7</sub>H<sub>11</sub>)<sub>2</sub>PH; FW: 222.31; colorless liq.;  
d. 0.88  
pyrophoric



1g  
5g

**15-1461**  
HAZ  
**Di-2-norbornylphosphine, min. 98% (mixture of endo and exo isomers)**  
**(10 wt% in hexanes)** (148432-44-4)  
(C<sub>7</sub>H<sub>11</sub>)<sub>2</sub>PH; FW: 222.31; colorless liq.  
air sensitive

10g  
50g

# PHOSPHORUS - Ligands and Compounds

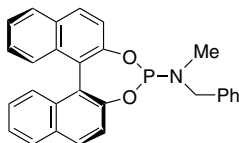
15-1510

(S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl(methyl)amine, 99% (490023-37-5)

C<sub>28</sub>H<sub>22</sub>NO<sub>2</sub>P; FW: 435.45; white powdr.; m.p. 155°

moisture sensitive

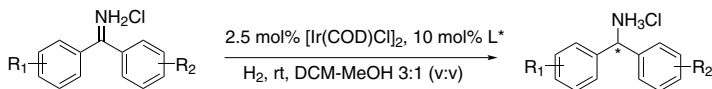
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



100mg  
500mg

## Technical Notes:

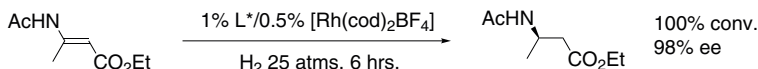
- The ligand has been used in Ir-catalyzed asymmetric hydrogenation of substituted benzophenone N-H imines
- The ligand has been used in the rhodium-catalyzed enantioselective hydrogenation of (E)-N-acylated dehydro-β-aminoacid esters (For (Z) isomer, use 15-1525).



R<sup>1</sup>, R<sup>2</sup> = Me, OMe, CF<sub>3</sub>, F, Cl, Br

80 - 96 % yield  
76 - 98 % ee

Tech. Note (1)  
Ref. (1)



100% conv.  
98% ee

Tech. Note (2)  
Ref. (2)

## References:

- J. Am. Chem. Soc., 2010, 132, 2124
- J. Am. Chem. Soc., 2002, 124, 14552

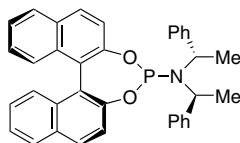
15-1521

(S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) bis[(1S)-1-phenylethyl]amine, min. 95% (380230-02-4)

C<sub>36</sub>H<sub>30</sub>NO<sub>2</sub>P; FW: 539.60; off-white powdr.; m.p. 88-89°

moisture sensitive

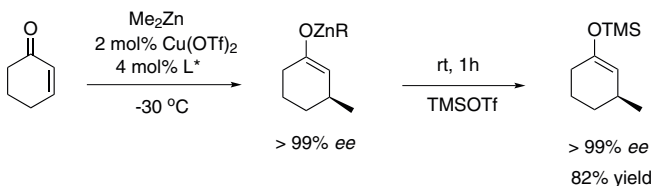
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component..



100mg  
500mg

## Technical Notes:

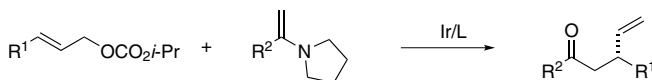
- A ligand for asymmetric conjugate addition of dialkyl zinc reagents to activated olefins.
- Iridium-catalyzed regioselective and enantioselective allylation of enamines.
- Iridium-catalyzed asymmetric allylation of KSAC.



> 99% ee

> 99% ee  
82% yield

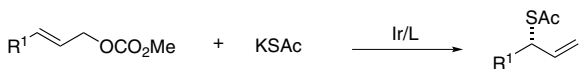
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

**15-1521** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1S)-1-phenylethyl]amine, min. 95% (380230-02-4)

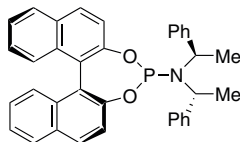


Tech. Note (3)  
Ref. (3)

References:

1. *Org. Lett.*, **2002**, 4, 3835.
2. *J. Am. Chem. Soc.*, **2007**, 129, 7720.
3. *Eur. J. Org. Chem.*, **2013**, 2708.

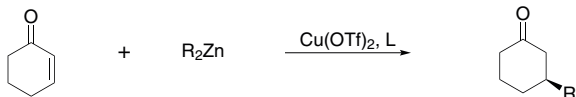
**15-1520** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-phenylethyl]amine, dichloromethane adduct, min. 95% (415918-91-1)  
C<sub>35</sub>H<sub>30</sub>NO<sub>2</sub>P; FW: 539.60; white powdr.; m.p. 102-103°  
*moisture sensitive*  
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



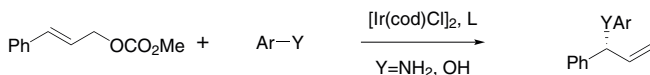
100mg  
500mg

Technical Notes:

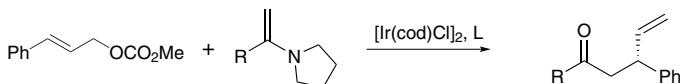
1. A ligand for asymmetric conjugate addition of dialkyl zinc reagents to activated olefins.
2. Ligand used in the iridium-catalyzed, enantioselective addition of nucleophiles to achiral allylic esters.
3. Asymmetric hydrogenation.
4. Ir-catalyzed regio- and enantioselective Friedel-Crafts allylic alkylation of indoles.
5. Asymmetric hydrovinylation.
6. Used in 1,3-dipolar cycloaddition reactions of azomethine ylides and alkenes,<sup>9a</sup> and Rh-catalyzed [5+2] cycloaddition of alkyne-vinyl-cyclopropanes.<sup>9b</sup>
7. Palladium-catalyzed enantioselective de-epimerization in catalytic asymmetric allylic alkylation.
8. Palladium-catalyzed enantioselective diamination of alkyl dienes.



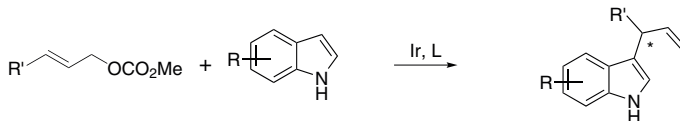
Tech. Note (1)  
Ref. (1)



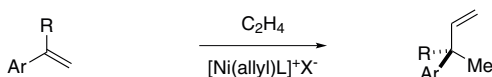
Tech. Note (2)  
Ref. (2-4)



Tech. Note (2)  
Ref. (5)



Tech. Note (4)  
Ref. (7)

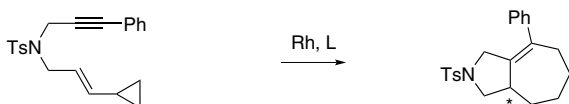


Tech. Note (5)  
Ref. (8)

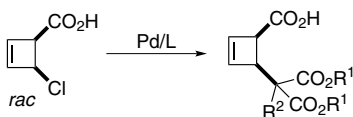


# PHOSPHORUS - Ligands and Compounds

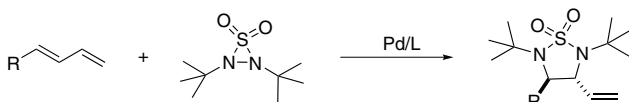
**15-1520** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-phenyl-ethyl]amine, dichloromethane adduct, min. 95% (415918-91-1)



Tech. Note (6)  
Ref. (9b)



Tech. Note (7)  
Ref. (10)



Tech. Note (8)  
Ref. (11)

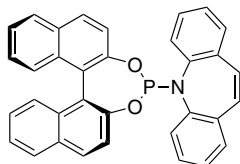
## References:

1. *Angew. Chem. Int. Ed.*, **1997**, 36, 2620.
2. *J. Am. Chem. Soc.*, **2002**, 124, 15164.
3. *J. Am. Chem. Soc.*, **2003**, 125, 3426.
4. *Org. Lett.*, **2005**, 7, 1093.
5. *J. Am. Chem. Soc.*, **2007**, 129, 7720.
6. *Acc. Chem. Res.*, **2007**, 40, 1267.
7. *Org. Lett.*, **2008**, 10, 1815.
8. *Synthesis.*, **2009**, 2089.
9. (a) *Angew. Chem. Int. Ed.*, **2008**, 47, 6055. (b) *Chem. Eur. J.*, **2009**, 15, 8692.
10. *Angew. Chem. Int. Ed.*, **2012**, 51, 7314.
11. *Org. Lett.*, **2013**, 15, 796.

**15-1227**

**NEW**

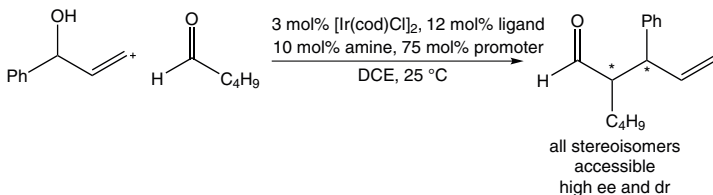
(S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)-5H-dibenz[b,f]azepine, min. 97% (942939-38-0)  
C<sub>34</sub>H<sub>22</sub>NO<sub>2</sub>P; FW: 507.52; yellow solid  
air sensitive, moisture sensitive



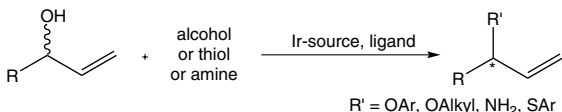
100mg  
500mg

## Technical Notes:

1. The ligand is used in the stereodivergent  $\alpha$ -allylation of linear aldehydes with dual iridium and amine catalysis.
2. The ligand is used in the direct, enantioselective iridium-catalyzed amination and (thio-) etherification of racemic allylic alcohols.
3. The ligand is used in an asymmetric, rhodium-catalyzed, intramolecular hydroacylation reaction.



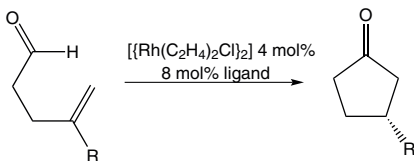
Tech. Note (1)  
Ref. (1,2)



Tech. Note (2)  
Ref. (3,4,5)

# PHOSPHORUS - Ligands and Compounds

**15-1227** (S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)-5H-dibenz[b,f]azepine, min. 97% (942939-38-0)



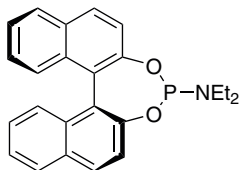
Tech. Note (3)  
Ref. (6)

## References:

1. *J. Am. Chem. Soc.*, **2014**, *136*, 3020.
2. *Science*, **2013**, *340*, 1065.
3. *Angew. Chem. Int. Ed.*, **2012**, *51*, 3470.
4. *Angew. Chem. Int. Ed.*, **2012**, *51*, 8652.
5. *Angew. Chem. Int. Ed.*, **2011**, *50*, 5568.
6. *Angew. Chem. Int. Ed.*, **2011**, *50*, 10670.

**15-1231** (S)-(+)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) diethylamine, min. 97% (252288-04-3)  
 $\text{C}_{24}\text{H}_{22}\text{NO}_2\text{P}$ ; FW: 387.41; white powd. moisture sensitive

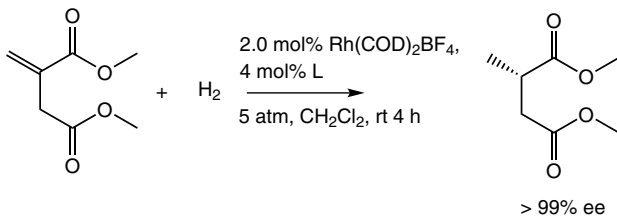
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



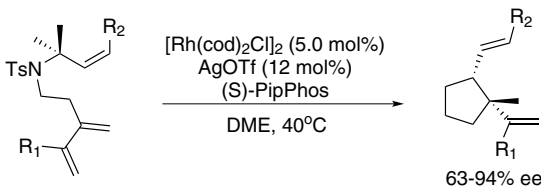
250mg  
1g

## Technical Notes:

1. See 15-1232.
2. Ligand used in the enantioselective rhodium catalyzed low pressure high activity hydrogenation of  $\alpha$ -dehydroaminoesters, enamides, and dimethylitaconate.
3. Ligand used in enantioselective rhodium-catalyzed allylic C-H activation for addition to conjugated dienes.



Tech. Note (2)  
Ref. (1)



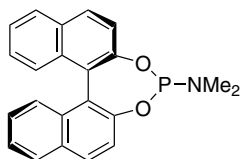
Tech. Note (3)  
Ref. (2)

## References:

1. *J. Org. Chem.*, **2005**, *70*, 943.
2. *Angew. Chem. Int. Ed.*, **2011**, *50*, 2144.

# PHOSPHORUS - Ligands and Compounds

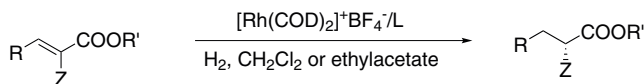
**15-1232** (R)-(-)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dime-thylamine, min. 97% (R)-MONOPHOS (157488-65-8)  
 $C_{22}H_{18}NO_2P$ ; FW: 359.36; white xtl.; m.p. 190°  
*air sensitive*  
 Note: Sold in collaboration with DSM for research purposes only. Patent no. WO02 04466. DSM's MonoPhos™ Ligand Kit component.



250mg  
1g

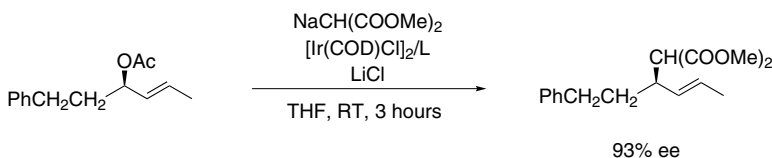
## Technical Notes:

- Ligand used in the enantioselective, rhodium-catalyzed hydrogenation of substituted olefins, such as N-acetyldihydroamino acids, enamides, and unsaturated acids.
- Ligand used in the enantioselective, iridium-catalyzed allylic substitution of allyl acetates containing only a single substituent in the 1 or 3 position.
- Ligand use in the rhodium-catalyzed, amide directed, asymmetric hydroboration reaction.
- Ligand used in asymmetric conjugate addition of aryl boronic acids to dihydronaphthalenes.
- Ligand used in the rhodium-catalyzed asymmetric intramolecular 1,4 addition.



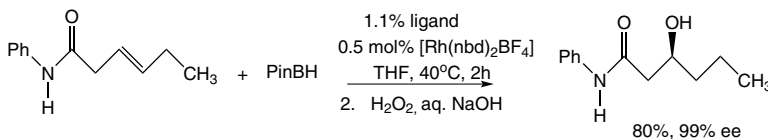
**Tech. Note (1)**  
**Ref. (1-3)**

R = H, Ph R' = H, CH<sub>3</sub> Z = NHCOCH<sub>3</sub>, CH<sub>2</sub>COOH >97% ee



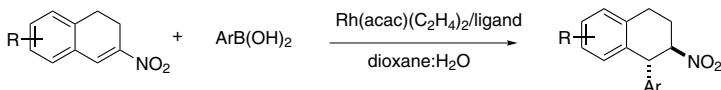
**Tech. Note (2)**  
**Ref. (4,5)**

93% ee

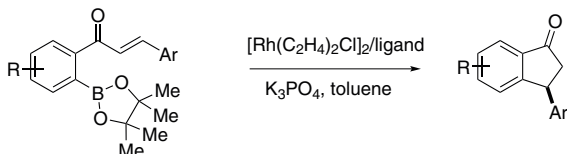


**Tech. Note (3)**  
**Ref. (6)**

80%, 99% ee



**Tech. Note (4)**  
**Ref. (7)**



**Tech. Note (4)**  
**Ref. (8)**

## References:

- J. Am. Chem. Soc.*, **2000**, 122, 11539.
- Adv. Synth. Catal.*, **2003**, 345, 308.
- Adv. Synth. Catal.*, **2002**, 344, 1003.
- Chem. Comm*, **1999**, 741.
- Eur. J. Inorg. Chem.*, **2002**, 2569.
- J. Am. Chem. Soc.*, **2008**, 130, 3734.
- Ad. Synth. Catal*, **2012**, 354, 2433.
- J. Org. Chem.*, **2013**, 78, 2736.

# PHOSPHORUS - Ligands and Compounds

**15-1233** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (S)-MONOPHOS (185449-80-3)  
 $C_{22}H_{18}NO_3P$ ; FW: 359.36; white xtl.; m.p. 190°  
*moisture sensitive*  
 Note: Sold in collaboration with DSM for research purposes only. Patent no. WO02 04466. DSM's MonoPhos™ Ligand Kit component.

250mg  
1g

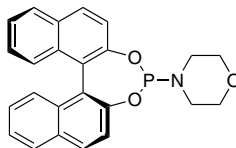
## Technical Notes:

1. See 15-1232.
2. Asymmetric hydrogenation of ketones and  $\beta$ -keto esters.
3. Light-induced, enantioselective hydrogenation.

## References:

1. *Org. Lett.*, **2004**, 6, 4105.
2. *Angew. Chem. Int. Ed.*, **2004**, 43, 5066.
3. *J. Org. Chem.*, **2005**, 70, 943.
4. *Organometallics*, **2011**, 30, 3880.

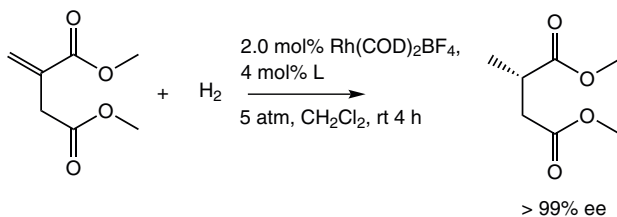
**15-1235** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)morpholine, min. 97% (S)-MorfPhos (185449-81-4)  
 $C_{24}H_{20}NO_3P$ ; FW: 401.39; white powdr.  
*moisture sensitive*  
 Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



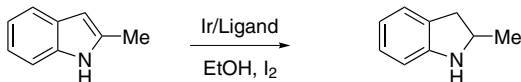
100mg  
500mg

## Technical Notes:

1. See 15-1232.
2. Ligand used in the enantioselective rhodium catalyzed low pressure high activity hydrogenation of  $\alpha$ -dehydroaminoesters, enamides, and dimethylitaconate. See 15-1234.
3. Ligand used in iridium-catalyzed asymmetric hydrogenation of 2-methylindole



Tech. Note (2)  
Ref. (1)

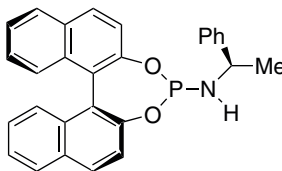


Tech. Note (3)  
Ref. (2)

## References:

1. *J. Org. Chem.*, **2005**, 70, 943.
2. *Tetrahedron Lett.*, **2014**, 55, 3613.

**15-1525** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)[(1R)-1-phenylethyl]amine, min. 95% (422509-53-3)  
 $C_{28}H_{22}NO_3P$ ; FW: 435.45; white powdr.; m.p. 212-213°  
*moisture sensitive*  
 Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



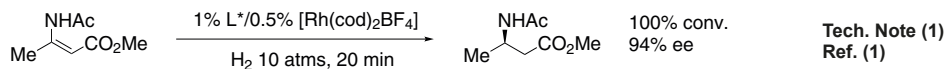
100mg  
500mg

## Technical Note:

1. The ligand for the rhodium-catalyzed enantioselective hydrogenation of (E)-N-acylated dehydro- $\beta$ -aminoacid esters

# PHOSPHORUS - Ligands and Compounds

**15-1525** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)[(1R)-1-phenylethyl]amine, min. 95% (422509-53-3)

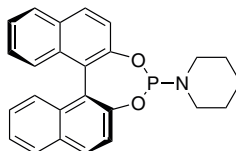


References:

1. *J. Am. Chem. Soc.*, **2002**, *124*, 14552

**15-1234** (S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) piperidine, min. 97% (S)-PipPhos (284472-79-3)

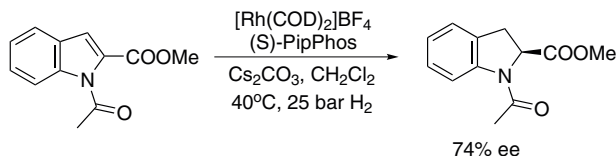
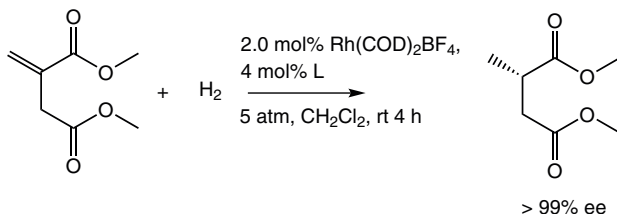
C<sub>25</sub>H<sub>22</sub>NO<sub>2</sub>P; FW: 399.42; white powd. moisture sensitive  
Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.



100mg  
500mg  
2g

Technical Notes:

1. See 15-1232.
2. Ligand used in the enantioselective rhodium catalyzed low pressure high activity hydrogenation of α-dehydroaminoesters, enamides, and dimethylitaconate.
3. Ligand used in asymmetric hydrogenation of 2-substituted N-protected indoles using Rhodium-based catalysts.



References:

1. *J. Org. Chem.*, **2005**, *70*, 943.
2. *Tetrahedron*, **2010**, *21*, 7.
3. *Organometallics*, **2011**, *30*, 1942.
4. *Adv. Synth. Catal.*, **2011**, 353.

**15-1551** Diphenylchlorophosphine, min. 95% (1079-66-9)

HAZ (C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>PCl; FW: 220.64; yellow liq.; b.p. 100-102°/1mm; f.p. >230°F;  
d. 1.19  
air sensitive, moisture sensitive

50g  
250g  
1kg

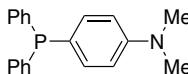
**15-1549** Diphenylchlorophosphine, 98% (1079-66-9)

HAZ C<sub>12</sub>H<sub>10</sub>ClP; FW: 220.64; yellow liq.; b.p. 100-102°/1 mmm; f.p. >230°F;  
d. 1.19  
moisture sensitive

25g  
100g  
500g


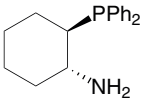
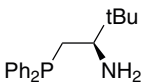
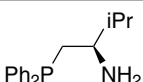
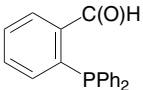
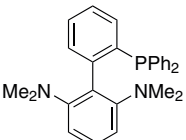
**15-1380** Diphenyl[4-(N,N-dimethylamino)phenyl] phosphine, min. 95% (739-58-2)

**NEW** C<sub>20</sub>H<sub>20</sub>NP; FW: 305.35; white solid;  
m.p. 151-154°  
air sensitive



1g  
5g

## PHOSPHORUS - Ligands and Compounds

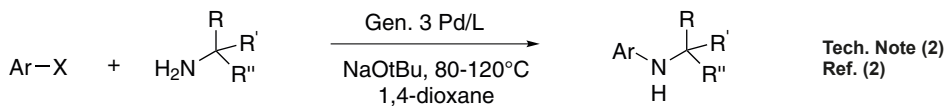
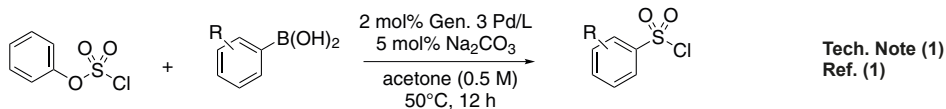
15-1700 amp HAZ 	<b>Diphenylphosphine, 99%</b> (829-85-6) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PH; FW: 186.20; colorless liq.; b.p. 116-119°/2.6 mm; d. 1.07 <i>pyrophoric</i>	10g 50g 250g	
15-1702 HAZ	<b>Diphenylphosphine, 99% (10 wt% in hexanes)</b> (829-85-6) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PH; FW: 186.20; colorless liq.; d. 0.68 <i>air sensitive</i>	100g 500g	
15-1740 HAZ	<b>Diphenylphosphinic chloride, 98%</b> (1499-21-4) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P(O)Cl; FW: 236.64; colorless to pale yellow liq.; b.p. 138-139°/0.15 mm; f.p. 79°F; d. 1.240 <i>moisture sensitive</i>	5g 25g 100g	
15-7153	<b>(1R,2R)-2-(Diphenylphosphino)-1-aminocyclohexane, min. 97%</b> (452304-59-5) C <sub>18</sub> H <sub>22</sub> NP; FW: 283.35; white solid <i>air sensitive</i>	100mg 500mg	
15-7154	<b>(1S,2S)-2-(Diphenylphosphino)-1-aminocyclohexane, min. 97%</b> (452304-63-1) C <sub>18</sub> H <sub>22</sub> NP; FW: 283.35; white solid; m.p. 51-56° <i>air sensitive</i>	100mg 500mg	
15-7253 HAZ	<b>(R)-1-(Diphenylphosphino)-2-amino-3,3-dimethylbutane, min. 97% (10wt% in hexanes)</b> (1366384-12-4) C <sub>18</sub> H <sub>24</sub> NP; FW: 285.36; colorless liq. <i>air sensitive</i>	1g 5g	
15-7255 HAZ	<b>(S)-1-(Diphenylphosphino)-2-amino-3,3-dimethylbutane, min. 97% (10wt% in hexanes)</b> (286454-86-2) C <sub>18</sub> H <sub>24</sub> NP; FW: 285.36; colorless liq. <i>air sensitive</i>	1g 5g	
15-7146	<b>(R)-1-(Diphenylphosphino)-2-amino-3-methylbutane, min. 97%</b> (1400149-69-0) C <sub>17</sub> H <sub>22</sub> NP; FW: 271.34; colorless oil <i>air sensitive</i>	100mg 500mg	
15-7147	<b>(S)-1-(Diphenylphosphino)-2-amino-3-methylbutane, min. 97%</b> (146476-37-1) C <sub>17</sub> H <sub>22</sub> NP; FW: 271.34; colorless oil <i>air sensitive</i>	100mg 500mg	
15-0120	<b>2-(Diphenylphosphino)benzaldehyde, min. 97%</b> (50777-76-9) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> COH); FW: 290.30; white to yellow powdr.; m.p. 112-115°	250mg 1g	
15-0133	<b>2-(Diphenylphosphino)benzoic acid, min. 97%</b> (17261-28-8) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> COOH); FW: 306.30; white to yellow solid; m.p. 174-181°	1g 5g	
15-1125 <b>NEW</b>	<b>2-Diphenylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl, min. 98% PhCPhos</b> (1447963-71-4) C <sub>28</sub> H <sub>28</sub> N <sub>2</sub> P; FW: 424.52; tan solid Note: Patents: US 6,395,916, US 6,307,087	100mg 500mg	

### Technical Notes:

- Ligand for the Palladium catalyzed chlorosulfonylation of aryl boronic acids
- Ligand for the Palladium-catalyzed Buchwald-Hartwig cross-coupling of hindered primary amines and aryl halides

# PHOSPHORUS - Ligands and Compounds

**15-1125** 2-Diphenylphosphino-2',6'-bis(dimethylamino)-1,1'-biphenyl, min. 98% PhCPhos  
(continued) (1447963-71-4)



References:

1. *J. Am. Chem. Soc.*, **2013**, *135*, 10638
2. *J. Am. Chem. Soc.*, **2015**, *137*, 3085

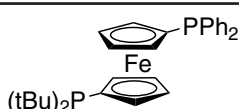
**26-1240**

**NEW**

**1-Diphenylphosphino-1'-(di-*t*-butylphosphino)ferrocene, 97%**

(95408-38-1)

C<sub>30</sub>H<sub>36</sub>FeP<sub>2</sub>; FW: 514.40; yellow to orange powdr.; m.p. 75-79°  
*air sensitive*



250mg  
1g

**15-7110**

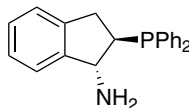
HAZ

**(1*R*,2*R*)-2-(Diphenylphosphino)-2,3-dihydro-1*H*-inden-1-amine, min. 97%**

(10wt% in THF) (1091606-70-0)

C<sub>21</sub>H<sub>20</sub>NP; FW: 317.36; colorless to pale yellow liq.  
*air sensitive*

Note: Sold under license from Kanata for research purposes only. WO2008148202.



1g  
5g

**15-7111**

HAZ

**(1*S*,2*S*)-2-(Diphenylphosphino)-2,3-dihydro-1*H*-inden-1-amine, min. 97% (10wt% in THF) (1091606-69-7)**

C<sub>21</sub>H<sub>20</sub>NP; FW: 317.36; colorless to pale yellow liq.  
*air sensitive*

Note: Sold under license from Kanata for research purposes only. WO2008148202.

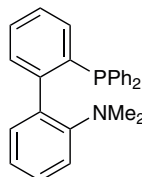
1g  
5g

**15-1745**

**2-Diphenylphosphino-2'-(*N,N*-dimethylamino))-1,1'-biphenyl, 98% PhDavePhos (240417-00-9)**

C<sub>26</sub>H<sub>24</sub>NP; FW: 381.46; white powdr.

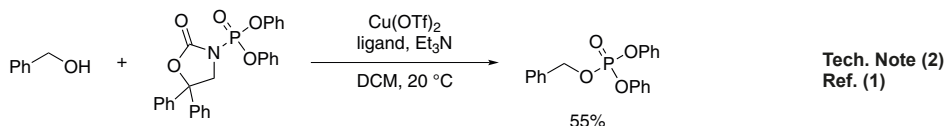
Note: Buchwald Biaryl Phosphine Ligand Master Kit component.. Buchwald Biaryl Phosphine Ligand Mini Kit 2 component.. Patents: US 6,395,916, US 6,307,087.



500mg  
2g  
10g

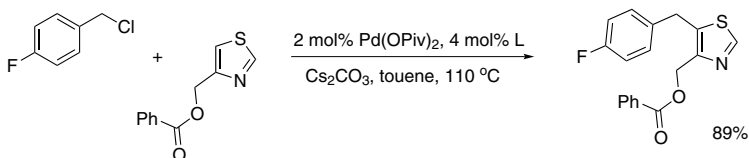
Technical Notes:

1. Useful ligand for sterically hindered substrates in the Pd-catalyzed amination reactions of aryl bromides.
2. Ligand used for the Cu-catalyzed phosphorylation of alcohols
3. Ligand for Pd-catalyzed C-H benzylation
4. Ligand for palladium-catalyzed [4 + 2] benzannulation reaction.

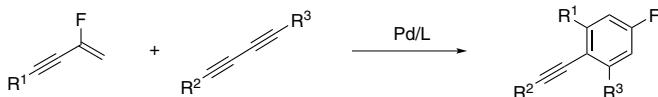


# PHOSPHORUS - Ligands and Compounds

**15-1745** 2-Diphenylphosphino-2'-(N,N-dimethylamino))-1,1'-biphenyl, 98% PhDavePhos  
(continued) (240417-00-9)



Tech. Note (3)  
Ref. (2)

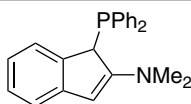


Tech. Note (4)  
Ref. (3)

## References:

1. *Org. Lett.*, **2005**, 7, 3271.
2. *Org. Lett.*, **2009**, 11, 4160.
3. *Org. Lett.*, **2013**, 15, 2562.
4. *Chem. Sci.*, **2011**, 2, 27.

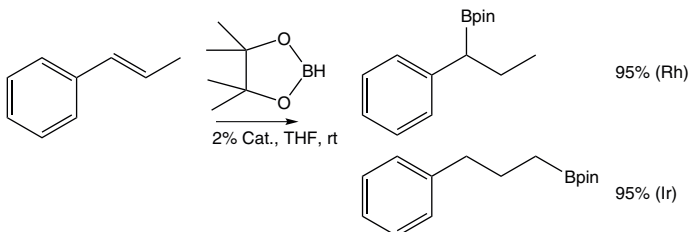
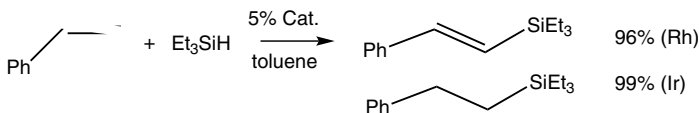
**15-1748** 1-Diphenylphosphino-2-(N,N-dimethylamino)-1H-indene, 99% (contains vinylic isomer) (628323-64-8)  
C<sub>23</sub>H<sub>22</sub>NP; FW: 343.40; off-white xtl.  
(store cold)



250mg  
1g

## Technical Note:

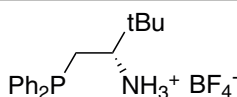
1. Zwitterionic hydrogenation, hydrosilylation and hydroboration catalyst soluble in non-polar solvents.



## References:

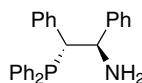
1. *Organometallics*, **2007**, 26, 594.
2. *Organometallics*, **2006**, 25, 5965.

**15-7194** (S)-1-(Diphenylphosphino)-3,3-dimethylbutan-2-aminium tetrafluoroborate, min. 97%  
C<sub>18</sub>H<sub>25</sub>BF<sub>4</sub>NP; FW: 373.18; white solid  
*air sensitive*  
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.



100mg  
500mg

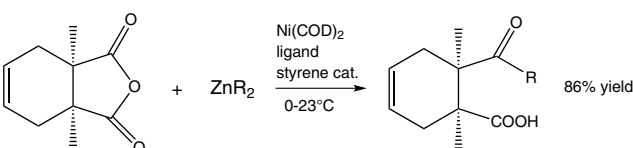
**15-7102** (1R,2R)-2-(Diphenylphosphino)-1,2-diphenylethylamine, min. 97% (1091606-68-6)  
C<sub>26</sub>H<sub>24</sub>NP; FW: 318.45; white solid  
*air sensitive*  
Note: Sold under license from Kanata for research purposes only. WO2008148202.



100mg  
500mg

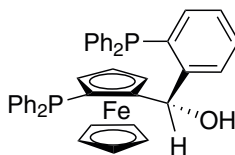


# PHOSPHORUS - Ligands and Compounds

15-7103	(1S,2S)-2-(Diphenylphosphino)-1,2-diphenylethylamine, min. 97% (1091606-67-5) C <sub>26</sub> H <sub>24</sub> NP; FW: 318.45; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. WO2008148202.	100mg 500mg
15-7156	(1R,2R)-2-(Diphenylphosphino)-1,2-diphenylethylammonium tetrafluoroborate, min. 97% C <sub>26</sub> H <sub>25</sub> BF <sub>4</sub> NP; FW: 469.26; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.	100mg 500mg
15-7174	2-(Diphenylphosphino)ethanammonium tetrafluoroborate, min. 97% (1222630-32-1) C <sub>14</sub> H <sub>17</sub> BF <sub>4</sub> NP; FW: 317.06; white to beige solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.	500mg 2g
15-1762	2-(Diphenylphosphino)ethylamine, min. 95% (4848-43-5) (C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub> ; FW: 229.26; colorless to yellow liq. <i>air sensitive</i>	1g 5g
<p>Technical Note:</p> <p>1. Ligand used in the preparation of a highly efficient ruthenium catalyst for the chemoselective hydrogenolysis of epoxides.</p>		
<p>References:</p> <p>1. <i>Organometallics</i>, <b>2003</b>, 22, 4190.</p>		
15-1765	2-[2-(Diphenylphosphino)ethyl]pyridine, min. 97% (10150-27-3) C <sub>16</sub> H <sub>18</sub> NP; FW: 291.33; white powdr. <i>air sensitive</i>	100mg 500mg
<p>Technical Note:</p> <p>1. Catalyst used for the room temperature cross-coupling of organozinc reagents with carboxylic fluorides, chlorides, anhydrides and thioesters.</p>		
		
<p>References:</p> <p>1. <i>Org. Lett.</i>, <b>2006</b>, 8, 4307. 2. <i>J. Am. Chem. Soc.</i>, <b>2004</b>, 126, 15964.</p>		
26-1153	(S)-(-)-[(S)-2-Diphenylphosphinoferrrocenyl][2-bis(3,5-dimethyl-4-methoxyphenyl)phosphinophenyl]methanol, min. 97% (851308-47-9) C <sub>47</sub> H <sub>47</sub> FeO <sub>2</sub> P <sub>2</sub> ; FW: 777.68; orange foam Note: Air-stable. Sold in collaboration with Solvias for research purposes only.	100mg

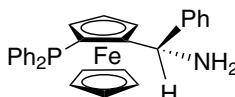
# PHOSPHORUS - Ligands and Compounds

**26-1160** (S)-(-)-[(S)-2-Diphenylphosphinoferrocenyl][2-diphenylphosphinophenyl]methanol, min. 97% (851308-43-5)  
 $C_{41}H_{34}FeOP_2$ ; FW: 660.50; yellow powd.  
 Note: Air-stable. Sold in collaboration with Solvias for research purposes only.



100mg  
500mg

**26-1151** (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]benzylamine, min. 98% (498580-48-6)  
 $C_{28}H_{26}FeNP$ ; FW: 475.34; yellow to orange powd.



100mg  
500mg

Technical Note:

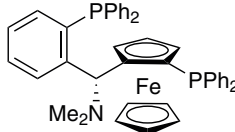
1. Precursor ligand for the preparation of catalysts used in palladium-catalyzed asymmetric allylic alkylations.

**26-1152** (S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]benzylamine, min. 98%  
 $C_{29}H_{26}FeNP$ ; FW: 475.34; yellow to orange powd.

Technical Note:

1. See 26-1151 (page 213)

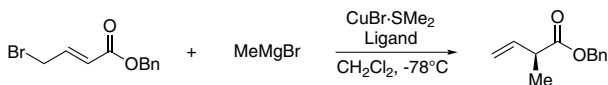
**26-1156** (R)-(+)-[(R)-2-Diphenylphosphinoferrocenyl](N,N-dimethylamino)(2-diphenylphosphinophenyl)methane, min. 97% (1003012-96-1)  
 $C_{43}H_{39}FeNP_2$ ; FW: 687.57; orange powd. (store cold)  
 Note: Sold in collaboration with Solvias for research purposes only.



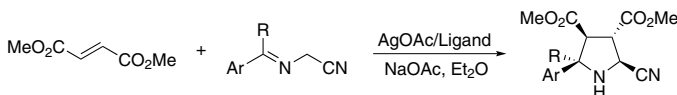
100mg  
500mg  
2g  
10g

Technical Notes:

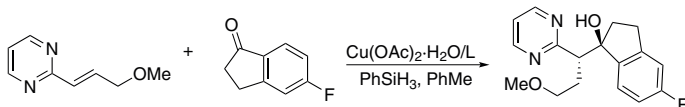
1. Ligand for copper-catalyzed asymmetric allylic alkylation of halocrotonates.
2. Ligand for silver-catalyzed asymmetric 1,3-dipolar cycloadditions of  $\alpha$ -iminonitriles.
3. Ligand for copper-catalyzed enantioselective reductive couplings of alkenylazaarenes with ketones.
4. Ligand for copper-catalyzed chiral Mannich-type reactions of  $\gamma$ -butenolides and N-thiophosphinoyl ketimines.
5. Ligand for palladium-catalyzed asymmetric borylation.
6. Ligand for copper-catalyzed enantiodivergent hydroboration of bicyclic alkenes.



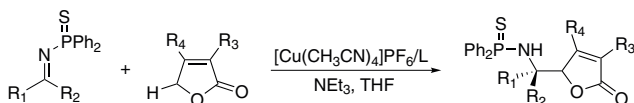
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



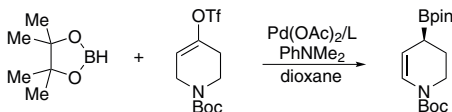
Tech. Note (3)  
Ref. (3)



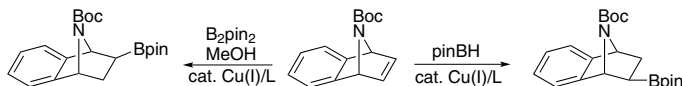
Tech. Note (4)  
Ref. (4)

# PHOSPHORUS - Ligands and Compounds

**26-1156** (R)-(+)-[(R)-2-Diphenylphosphinoferrocenyl](N,N-dimethylamino)(2-diphenylphosphino-phenyl)methane, min. 97% (1003012-96-1)



Tech. Note (5)  
Ref. (5)



Tech. Note (6)  
Ref. (6)

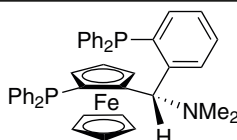
## References:

1. *Adv. Synth. Catal.*, **2010**, 352, 999.
2. *Chem. Commun.*, **2011**, 47, 6784.
3. *J. Am. Chem. Soc.*, **2012**, 134, 8428.
4. *Angew. Chem. Int. Ed.*, **2013**, 52, 7310.
5. *Angew. Chem. Int. Ed.*, **2013**, 52, 8069.
6. *Org. Lett.*, **2015**, 17, 764.

**26-1155** (S)-(-)-[(S)-2-Diphenylphosphinoferrocenyl] (N,N-dimethylamino) (2-diphenylphosphinophenyl) methane, min. 97% TANIAPHOS (850444-36-9)

C<sub>43</sub>H<sub>39</sub>FeNP<sub>2</sub>; FW: 687.57; orange powdr. (store cold)

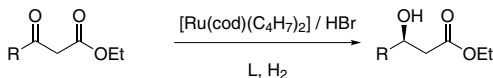
Note: Sold in collaboration with Solvias for research purposes only.



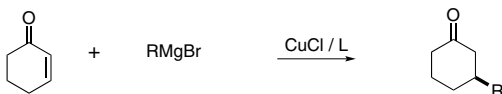
100mg  
500mg  
2g  
10g

## Technical Notes:

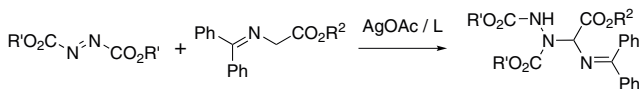
1. Ligand for the Ru-catalyzed hydrogenation of  $\beta$ -ketoesters, enamides and itaconates.
2. Ligand for Cu-catalyzed asymmetric conjugate addition of Grignard reagents to cyclic enones.
3. AgOAc-catalyzed asymmetric amination of glycine Schiff bases with azodicarboxylates.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

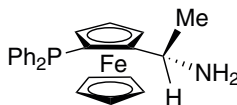


Tech. Note (3)  
Ref. (4)

## References:

1. *Angew. Chem. Int. Ed.*, **1999**, 38, 3212
2. *Proc. Nat. Acad. Sci.*, **2004**, 10, 5834
3. *Tetrahedron Asymm.*, **2004**, 15, 2299
4. *Tetrahedron Lett.*, **2009**, 50, 6866

**26-1425** (R)-1-((S)-2-Diphenylphosphinoferrocenylethylamine, min. 97% (607389-84-4)  
C<sub>24</sub>H<sub>24</sub>FeNP; FW: 413.27; yellow solid air sensitive



100mg  
500mg

**26-1426** (S)-1-((R)-2-Diphenylphosphinoferrocenylethylamine, min. 97%  
C<sub>24</sub>H<sub>24</sub>FeNP; FW: 413.27; yellow solid air sensitive

100mg  
500mg

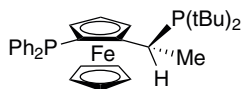
# PHOSPHORUS - Ligands and Compounds

26-1200

(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyldi-*t*-butylphosphine, min. 97% (155830-69-6)

C<sub>32</sub>H<sub>40</sub>FeP<sub>2</sub>; FW: 542.46; orange pwdr.

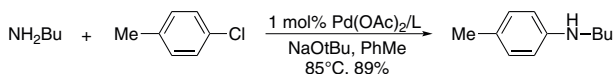
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.



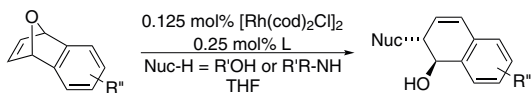
100mg  
500mg  
2g  
10g

## Technical Notes:

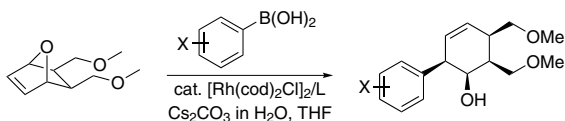
- Ligand for Palladium-catalyzed amination of aryl halides.
- Ligand for Rhodium-catalyzed asymmetric alcoholysis and aminolysis of oxabenzonorbornadiene.
- Ligand for Rhodium-catalyzed asymmetric ring opening of oxabicyclic alkenes with organoboronic acids.
- Ligand for Copper-catalyzed asymmetric 1,4-hydrosilylations of  $\alpha,\beta$ -unsaturated esters.
- Ligand for Ruthenium-catalyzed asymmetric hydrogenation of N-sulfonated- $\alpha$ -dehydroamino acids.
- Ligand for Rhodium-catalyzed asymmetric hydrogenation of enamines.
- Ligand for Palladium-catalyzed Kumada coupling of aryl and vinyl tosylates.
- Ligand for Palladium-catalyzed enantioselective synthesis of aryl sulfoxides.
- Ligand for Rhodium-catalyzed enantioselective insertion of a carbenoid carbon into a C-C bond.



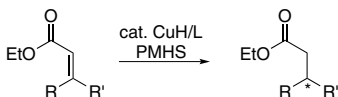
Tech. Note (1)  
Ref. (1,13)



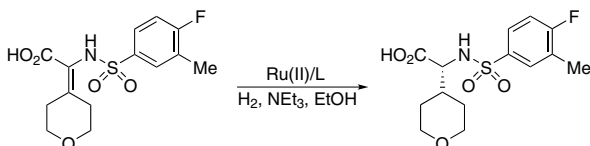
Tech. Note (2)  
Ref. (2,3,5,14,16)



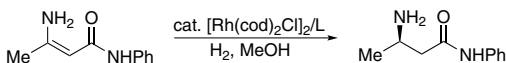
Tech. Note (3)  
Ref. (4,17)



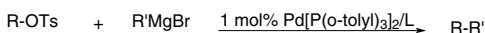
Tech. Note (4)  
Ref. (6,10)



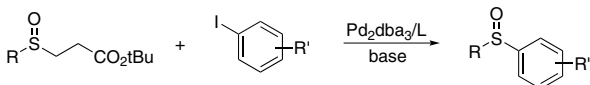
Tech. Note (5)  
Ref. (7)



Tech. Note (6)  
Ref. (8,11,15)



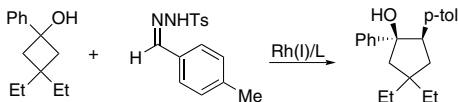
Tech. Note (7)  
Ref. (9)



Tech. Note (8)  
Ref. (12)

# PHOSPHORUS - Ligands and Compounds

**26-1200** (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97%  
(continued) (155830-69-6)



Tech. Note (9)  
Ref. (18)

## References:

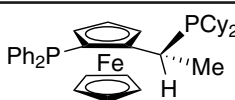
1. *J. Am. Chem. Soc.*, **1998**, *120*, 7369.
2. *J. Am. Chem. Soc.*, **2000**, *122*, 5650.
3. *Org. Lett.*, **2000**, *2*, 1677.
4. *Org. Lett.*, **2002**, *4*, 1311.
5. *J. Am. Chem. Soc.*, **2003**, *125*, 14884.
6. *J. Am. Chem. Soc.*, **2004**, *126*, 8352.
7. *Org. Lett.*, **2005**, *7*, 3405.
8. *Org. Lett.*, **2005**, *7*, 4935.
9. *J. Org. Chem.*, **2005**, *70*, 9364.
10. *Org. Lett.*, **2006**, *8*, 1963.
11. *Org. Process Res. Dev.*, **2006**, *10*, 723.
12. *Org. Lett.*, **2007**, *9*, 5493.
13. *J. Am. Chem. Soc.*, **2008**, *130*, 6586.
14. *J. Am. Chem. Soc.*, **2009**, *131*, 444.
15. *J. Am. Chem. Soc.*, **2009**, *131*, 8798.
16. *Org. Lett.*, **2010**, *12*, 5418.
17. *Org. Lett.*, **2013**, *15*, 3424.
18. *J. Am. Chem. Soc.*, **2014**, *136*, 7217.

<b>26-1201</b>	(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyl-di-t-butylphosphine, min. 97% (277306-29-3) C <sub>32</sub> H <sub>40</sub> FeP <sub>2</sub> ; FW: 542.46; orange pwdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg 500mg 2g 10g
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## Technical Note:

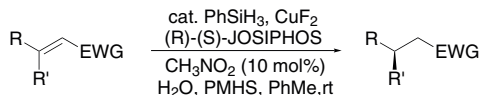
1. See 26-1200 (page 215)

<b>26-1210</b>	(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyl-dicyclohexylphosphine ethanol adduct, min. 97% (R)-(-)-JOSIPHOS (155806-35-2) C <sub>36</sub> H <sub>44</sub> FeP <sub>2</sub> ·CH <sub>3</sub> CH <sub>2</sub> OH; FW: 594.59 (640.66); orange pwdr. (store cold) Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.	100mg 500mg 2g 10g
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## Technical Notes:

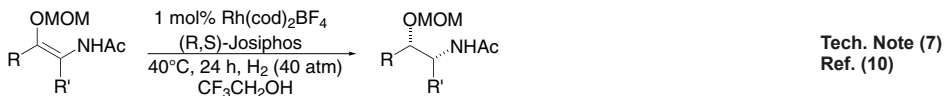
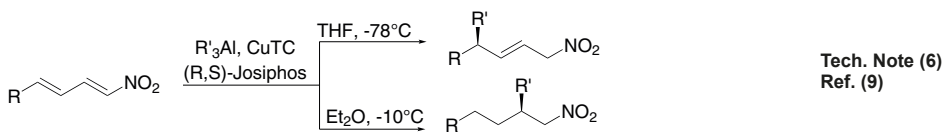
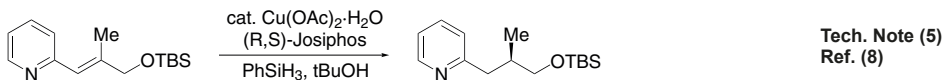
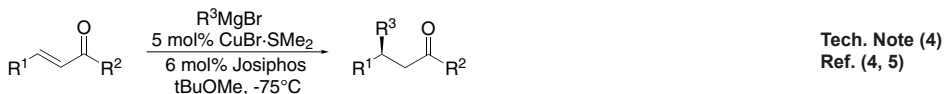
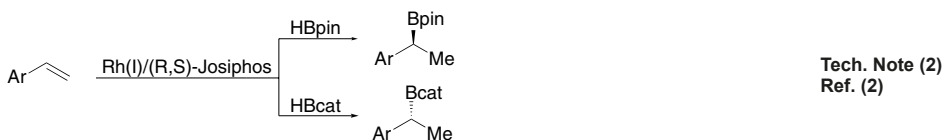
1. Ligand for Copper-catalyzed enantioselective reduction of alkenes bearing electron-withdrawing groups.
2. Ligand for Rhodium-catalyzed regio- and enantiocontrol in the hydroboration of vinyl arenes with pinacol borane.
3. Ligand for Palladium-catalyzed enantioselective desymmetrization of meso-succinic anhydride.
4. Ligand for Copper-catalyzed enantioselective conjugate addition of Grignard reagents to acyclic enones.
5. Ligand for Copper-catalyzed enantioselective reduction of 2-alkenylheteroarenes.
6. Ligand for Copper-catalyzed conjugate addition of trialkylaluminum reagents to extended nitro-Michael acceptors.
7. Ligand for Rhodium-catalyzed enantioselective hydrogenation of o-alkoxy tetrasubstituted enamides.



Tech. Note (1)  
Ref. (1, 6, 7)

## PHOSPHORUS - Ligands and Compounds

26-1210 (R)-(-)-1-[(S)-2-(Diphenylphosphino) ferrocenyl]ethylidicyclohexylphosphine ethanol  
(continued) adduct, min. 97% (R)-(-)-S-JOSIPHOS (155806-35-2)



### References:

1. *Org. Lett.*, **2004**, 6, 4575.
2. *J. Am. Chem. Soc.*, **2004**, 126, 9200.
3. *J. Am. Chem. Soc.*, **2004**, 126, 10248.
4. *J. Am. Chem. Soc.*, **2004**, 126, 12784.
5. *J. Am. Chem. Soc.*, **2005**, 127, 9966.
6. *Org. Process Res. Dev.*, **2007**, 11, 633.
7. *Org. Lett.*, **2007**, 9, 2749.
8. *J. Am. Chem. Soc.*, **2009**, 131, 10386.
9. *Org. Lett.*, **2010**, 12, 2770.

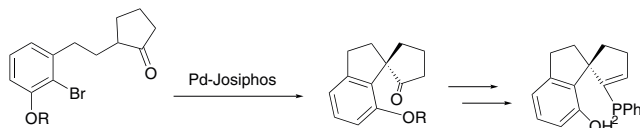
# PHOSPHORUS - Ligands and Compounds

<b>26-1211</b>	<b>(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethylcyclohexylphosphine ethanol adduct, min. 97% (S)-(R)-JOSIPHOS</b>	100mg
	(162291-02-3)	500mg
	C <sub>36</sub> H <sub>44</sub> FeP <sub>2</sub> ·CH <sub>3</sub> CH <sub>2</sub> OH; FW: 594.59 (640.66); orange powd.	2g
	(store cold)	10g

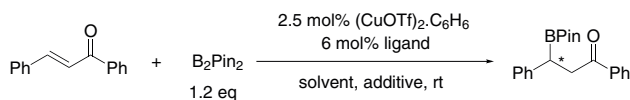
Note: Sold in collaboration with Solvias for research purposes only.

## Technical Notes:

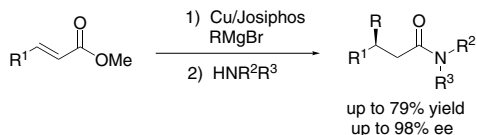
- Ferrocenylphosphine ligands of the type cpFecp(PR<sub>2</sub>)(\*CH(CH<sub>3</sub>)PR'<sub>2</sub>) are a class of asymmetric ligands developed at Solvias in Basel, Switzerland.<sup>1</sup> Ligands of this type are currently used industrially in the stereoselective synthesis of commercial products.<sup>2,3</sup> A unique feature of these bidentate ligands is the presence of a fixed phosphine moiety and a stereogenic, functionalized side chain, which can be easily modified to accommodate electronic and steric requirements. Based on a versatile synthetic procedure starting with optically active ferrocenes of the type cpFecp(PR<sub>2</sub>)(\*CH(CH<sub>3</sub>)X) [X = OAc or NR<sub>2</sub>], a variety of donor atoms can be introduced into the side chain<sup>4</sup>. These ferrocene based phosphine ligands have wide application in the stereoselective hydrogenation of substituted acetamidoacrylates, enol acetates, β-ketoesters and simple alkenes.<sup>5-9</sup>
- Pd-catalyzed, enantioselective, intramolecular α-substituted cyclic ketones: facile synthesis of functionalized chiral spirobicycles.
- Asymmetric boron conjugate addition of α,β-unsaturated carbonyl compounds catalyzed by CuOTf/Josiphos under non-alkaline conditions.
- Chiral amides via copper-catalyzed enantioselective conjugate addition.
- Ruthenium-catalyzed enantioselective synthesis of β-amino alcohols from 1,2-diols by "borrowing hydrogen".
- Cobalt-catalyzed asymmetric addition of silylacetylenes to 1,1-disubstituted allenes.



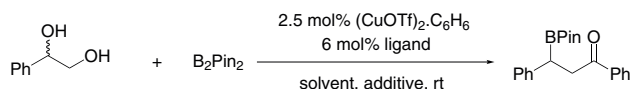
**Tech. Note (1)**  
**Ref. (2)**



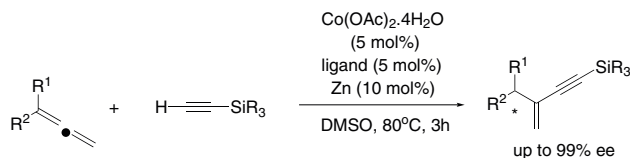
**Tech. Note (2)**  
**Ref. (3)**



**Tech. Note (3)**  
**Ref. (4)**



**Tech. Note (4)**  
**Ref. (5)**



**Tech. Note (5)**  
**Ref. (6)**

## References:

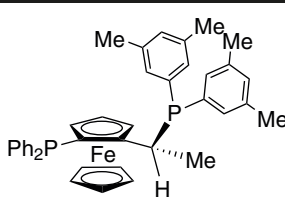
- Solvias owns the patent rights for Strem products 26-1000, 26-1001, 26-1200, 26-1201, 26-1230, 26-1101, and for the Ir and Rh complexes of the aforementioned products, including the complexes of 26-1210 and 26-1211.
- Org. Biomol. Chem* **2015**, 13,4837.
- Org. Chem. Front.*, **2015**, 2, 42.
- Org. Biomol. Chem.*, **2014**, 12, 36.
- Eur. J. Org. Chem.*, **2013**, 27, 6146.
- J. Org. Chem.*, **2013**, 78, 8986.

# PHOSPHORUS - Ligands and Compounds

**26-1255** (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethylidene-3,5-xyllyphosphine, min. 97%  
(184095-69-0)

C<sub>40</sub>H<sub>40</sub>FeP<sub>2</sub>; FW: 638.56; orange powdr.

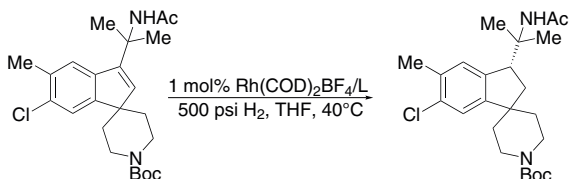
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.



100mg  
500mg  
2g  
10g

Technical Note:

- Ligand for Rhodium-catalyzed asymmetric hydrogenation in the synthesis of tertiary carbinamide.



Tech. Note (1)  
Ref. (1)

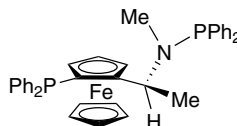
References:

- J. Org. Chem.*, **2008**, *73*, 1639.

**26-2515** (R)-1-[(S)-2-Diphenylphosphinoferrocenyl](N-methyl)(N-diphenylphosphino)ethylamine (R)-Me-Bophoz  
(406680-94-2)

C<sub>37</sub>H<sub>35</sub>FeNP<sub>2</sub>; FW: 611.50; yellow solid

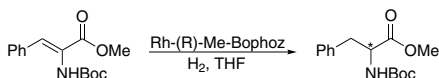
Note: Sold in collaboration with JM for research purposes only.



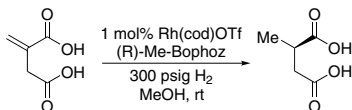
100mg  
500mg

Technical Notes:

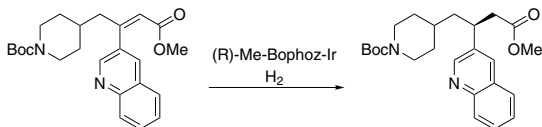
- Ligand for Rhodium-catalyzed asymmetric hydrogenation of dehydro- $\alpha$ -amino acid derivatives.
- Ligand for Rhodium-catalyzed asymmetric hydrogenation of itaconate derivatives.
- Ligand for Iridium-catalyzed asymmetric hydrogenation in the synthesis of an  $\alpha,\beta$  integrin antagonist intermediate.
- Ligand for Rhodium-catalyzed asymmetric hydrogenation of  $\beta$ -amino-vinylphosphonates to  $\beta$ -aminophosphonates



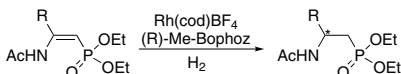
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

References:

- Org. Lett.*, **2002**, *4*, 2421.
- J. Org. Chem.*, **2005**, *70*, 1872.
- Tetrahedron: Asymmetry*, **2008**, 938.
- Tetrahedron: Asymmetry*, **2008**, 1189.

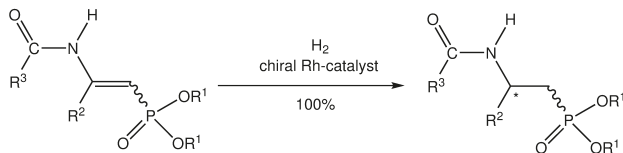


# PHOSPHORUS - Ligands and Compounds

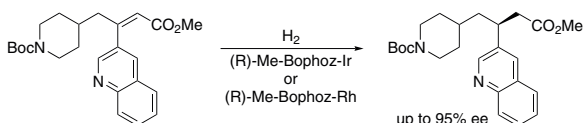
**26-2516** (S)-1-[(R)-2-Diphenylphosphinoferrocenyl](N-methyl)(N-diphenylphosphino)ethylamine (S)-Me-Bophoz (406681-09-2) 100mg  
 C<sub>37</sub>H<sub>35</sub>FeNP<sub>2</sub>; FW: 611.50; yellow solid 500mg  
 Note: Sold in collaboration with JM for research purposes only.

## Technical Notes:

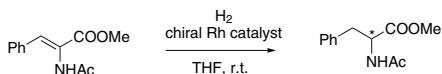
- Ligand used in the rhodium-catalyzed, asymmetric hydrogenation of β-amido-vinylphosphonates.
- Ligand used in the rhodium or iridium-catalyzed asymmetric hydrogenation of α,β-unsaturated esters.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**

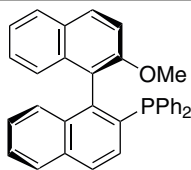


**Tech. Note (3)**  
**Ref. (3)**

## References:

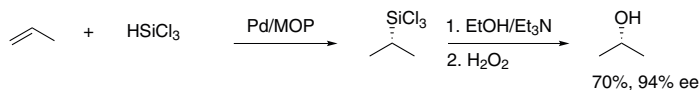
- Tetrahedron Asymm.*, **2008**, *19*, 1189.
- Tetrahedron Asymm.*, **2008**, *19*, 938.
- J. Org. Chem.* **2005**, *70*, 1872.

**15-1775** (R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP (145964-33-6) 100mg  
 C<sub>33</sub>H<sub>25</sub>OP; FW: 468.53; white powdr.; 500mg  
 m.p. 177-179°  
*air sensitive*  
 Note: Sold in collaboration with Takasago for research purposes only. Patents US 5231202, EP 0503884, JP 05-017491.

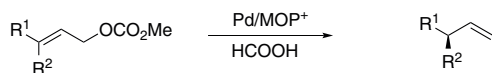


## Technical Notes:

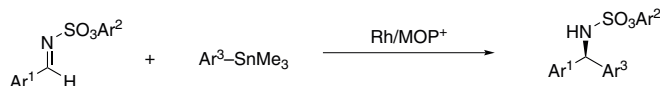
- Efficient catalyst for the enantioselective hydrosilylation of 1-alkenes to optically active 2-alcohols.
- Ligand for palladium-catalyzed asymmetric reduction of allylic esters.
- Ligand for the rhodium-catalyzed asymmetric arylation of imines with organostannanes.
- Ligand for the rhodium-catalyzed asymmetric addition of aryl- and alkenylboronic acids to Isatins.
- Ligand for desymmetrization of malonamides via an enantioselective intramolecular Buchwald-Hartwig reaction.



**Tech. Note (1)**  
**Ref. (1,2)**



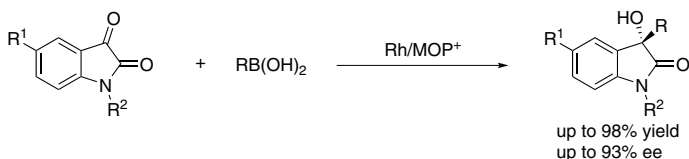
**Tech. Note (2)**  
**Ref. (3)**



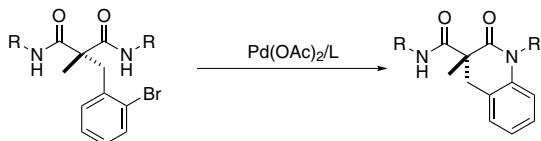
**Tech. Note (3)**  
**Ref. (4)**

# PHOSPHORUS - Ligands and Compounds

**15-1775** (R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP (145964-33-6)  
(continued)



Tech. Note (4)  
Ref. (5)



Tech. Note (5)  
Ref. (6)

## References:

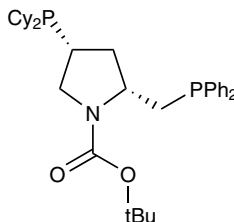
1. *J. Am. Chem. Soc.*, **1991**, *113*, 9887.
2. *Acc. Chem. Res.*, **2000**, *33*, 354. (review)
3. *J. Am. Chem. Soc.*, **1994**, *116*, 775.
4. *J. Am. Chem. Soc.*, **2000**, *122*, 976.
5. *Angew. Chem. Int. Ed.*, **2006**, *45*, 3353.
6. *Tetrahedron Lett.*, **2009**, *50*, 4170

<b>15-1776</b>	(S)-(-)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (S)-MOP (134484-36-9) C <sub>33</sub> H <sub>25</sub> OP; FW: 468.53; white powdr.; m.p. 175-179° <i>air sensitive</i> Note: Sold in collaboration with Takasago for research purposes only. Patents US 5231202, EP 0503884, JP 05-017491.	100mg 500mg
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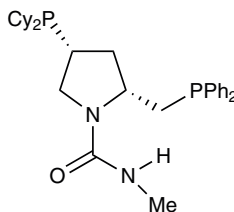
## Technical Note:

1. See 15-1775 (page 220)

<b>15-7220</b>	(2R,4R)-(+)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-(t-butoxycarbonyl)pyrrolidine, min. 97% (R,R-BCPM) (114751-47-2) C <sub>34</sub> H <sub>49</sub> NO <sub>2</sub> P <sub>2</sub> ; FW: 565.71; white powdr. <i>air sensitive</i>	50mg 250mg
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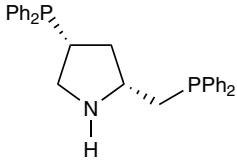
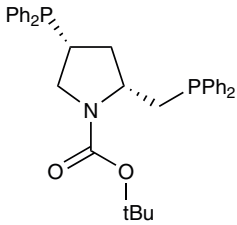
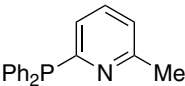
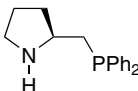
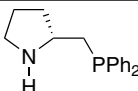
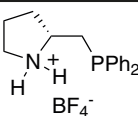
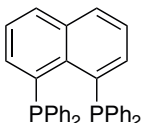


<b>15-7224</b>	(2R,4R)-(+)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-methyl-1-pyrrolidinecarboxamide, min. 95% (R,R-MCCPM) (122709-72-2) C <sub>31</sub> H <sub>44</sub> N <sub>2</sub> OP <sub>2</sub> ; FW: 522.64; white powdr. <i>air sensitive</i>	50mg 250mg
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<b>15-7225</b>	(2S,4S)-(-)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-methyl-1-pyrrolidinecarboxamide, min. 97% (S,S-MCCPM) (112521-97-8) C <sub>31</sub> H <sub>44</sub> N <sub>2</sub> OP <sub>2</sub> ; FW: 522.64; white powdr. <i>air sensitive</i>	50mg 250mg
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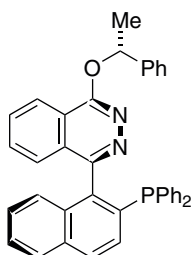
# PHOSPHORUS - Ligands and Compounds

15-7210	(2R,4R)-(+)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)pyrrolidine, min. 97% (R,R-PPM) (77450-05-6) C <sub>29</sub> H <sub>29</sub> NP <sub>2</sub> ; FW: 453.50; white powdr. <i>air sensitive</i>		100mg 500mg
15-7211	(2S,4S)-(-)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)pyrrolidine, min. 97% (S,S-PPM) (61478-29-3) C <sub>29</sub> H <sub>29</sub> NP <sub>2</sub> ; FW: 453.50; white powdr. <i>air sensitive</i>		100mg 500mg
15-7216	(2R,4R)-(+)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)-N-(t-butoxycarbonyl)pyrrolidine, min. 97% (R,R-BPPM) (72598-03-9) C <sub>34</sub> H <sub>37</sub> NO <sub>2</sub> P <sub>2</sub> ; FW: 553.61; white powdr. <i>air sensitive</i>		100mg 500mg
15-7217	(2S,4S)-(-)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)-N-(t-butoxycarbonyl)pyrrolidine, min. 97% (S,S-BPPM) (61478-28-2) C <sub>34</sub> H <sub>39</sub> NO <sub>2</sub> P <sub>2</sub> ; FW: 565.71; white powdr. <i>air sensitive</i>		100mg 500mg
15-1804	2-Diphenylphosphino-6-methylpyridine, 98% (132682-77-0) C <sub>16</sub> H <sub>16</sub> NP; FW: 277.30; white to off-white xtl.; m.p. 81-83°		500mg 2g
15-7116	(S)-2-[(Diphenylphosphino)methyl]pyrrolidine, min. 97% (60261-46-3) C <sub>17</sub> H <sub>20</sub> NP; FW: 269.32; colorless to pale yellow liq. <i>air sensitive</i>		250mg 1g
15-7115 HAZ	(R)-2-[(Diphenylphosphino)methyl]pyrrolidine, min. 97% (10 wt% in tetrahydrofuran) (428514-91-4) C <sub>17</sub> H <sub>20</sub> NP; FW: 269.32; colorless liq. <i>air sensitive</i>		2g 10g
15-7165	(R)-2-[(Diphenylphosphino)methyl]pyrrolidinium tetrafluoroborate, min. 97% C <sub>17</sub> H <sub>21</sub> BF <sub>4</sub> NP; FW: 357.13; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.		100mg 500mg
15-7166	(S)-2-[(Diphenylphosphino)methyl]pyrrolidinium tetrafluoroborate, min. 97% (1222630-36-5) C <sub>17</sub> H <sub>21</sub> BF <sub>4</sub> NP; FW: 357.13; white solid <i>air sensitive</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.		100mg 500mg
15-7123	1,8-(Diphenylphosphino)naphthalene, 99% (153725-04-3) C <sub>34</sub> H <sub>26</sub> P <sub>2</sub> ; FW: 496.52; yellow xtl. <i>air sensitive</i>		250mg 1g

# PHOSPHORUS - Ligands and Compounds

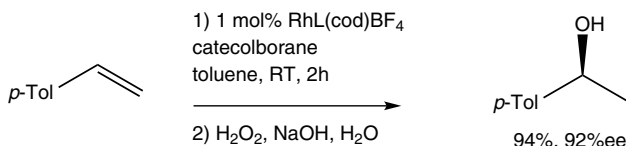
**15-1782** (R)-(+)-4-[2-(Diphenylphosphino)-1-naphthaleny]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,R)-O-PINAP (828927-95-3)  
 $C_{38}H_{29}N_2OP$ ; FW: 560.62; colorless xtl.; m.p. 64-65°  
*air sensitive*  
 Note: PINAP Ligand Kit component.

250mg  
1g

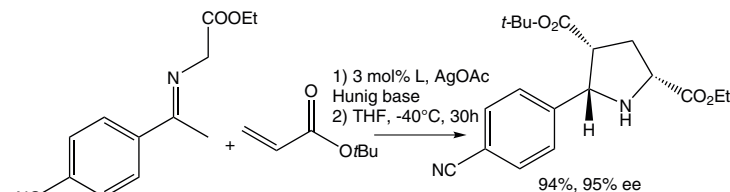


## Technical Notes:

1. The PINAP family of P,N ligands is a synthetically more accessible but a similarly performing analog of the QUINAP (15-1777, 15-1778) ligand in enantioselective hydroboration, alkyne addition, and azomethine cycloaddition reactions. (Ref. 1)
2. With rhodium, enantioselective hydroboration of alkenes as a route to chiral alcohols.
3. With silver, catalytic, enantioselective, azomethine cycloaddition with acrylates.



**Tech. Note (2)**  
**Ref. (1)**



**Tech. Note (3)**  
**Ref. (1)**

## References:

1. *Angew. Chem. Int. Ed.*, **2004**, 43, 5971.

**15-1783** (S)-(-)-4-[2-(Diphenylphosphino)-1-naphthaleny]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,S)-O-PINAP (828927-94-2)  
 $C_{38}H_{29}N_2OP$ ; FW: 560.62; colorless xtl.; m.p. 178-181°  
*air sensitive*  
 Note: PINAP Ligand Kit component.

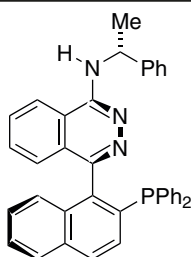
250mg  
1g

## Technical Note:

1. See 15-1782 (page 223)

**15-1784** (R)-(+)-4-[2-(Diphenylphosphino)-1-naphthaleny]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97% (R,R)-N-PINAP (828927-97-5)  
 $C_{38}H_{30}N_2P$ ; FW: 559.64; colorless xtl.; m.p. 185-188°  
*air sensitive*  
 Note: PINAP Ligand Kit component.

100mg  
500mg

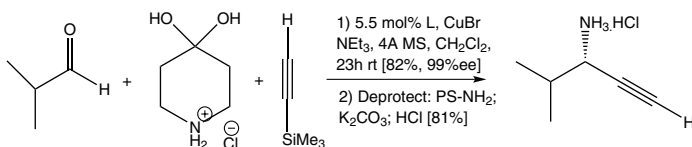


## Technical Notes:

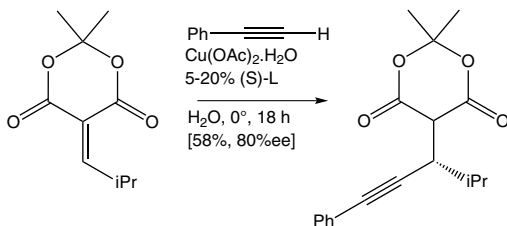
1. The PINAP family of P,N ligands is a synthetically more accessible but a similarly performing analog of the QUINAP (15-1777, 15-1778) ligand in enantioselective hydroboration, alkyne addition, and azomethine cycloaddition reactions. (Ref. 1)
2. With copper, enantioselective addition of alkynes to aldehydes to synthesize propargylamines.
3. With copper, catalytic, enantioselective, conjugate alkyne addition in aqueous media.

# PHOSPHORUS - Ligands and Compounds

**15-1784** (R)(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazin-  
(continued) amine, min. 97% (R,R)-N-PINAP (828927-97-5)



Tech. Note (2)  
Ref. (1,2)



Tech. Note (3)  
Ref. (3)

## References:

1. *Angew. Chem. Int. Ed.*, **2004**, 43, 5971.
2. *Org. Lett.*, **2006**, 8, 2437.
3. *J. Am. Chem. Soc.*, **2005**, 127, 9682.

**15-1787** (R)(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(S)-1-phenylethyl]-1-phthalazinamine, min. 97% (S,R)-N-PINAP (1173836-08-2) 250mg  
C<sub>33</sub>H<sub>30</sub>N<sub>2</sub>P; FW: 559.64; colorless xtl.; m.p. >210° 1g  
*air sensitive*  
Note: PINAP Ligand Kit component.

## Technical Note:

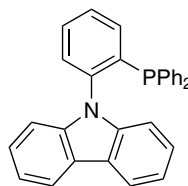
1. See 15-1784 (page 223)

**15-1786** (S)(-)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97% (R,S)-N-PINAP (828927-96-4) 250mg  
C<sub>33</sub>H<sub>30</sub>N<sub>2</sub>P; FW: 559.64; colorless xtl.; m.p. >210° 1g  
*air sensitive*  
Note: PINAP Ligand Kit component.

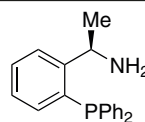
## Technical Note:

1. See 15-1784 (page 223)

**15-0498** 9-[2-(Diphenylphosphino)phenyl]-9H-carbazole, min. 97% Ph PhenCar-Phos (1308652-67-6) 250mg  
C<sub>30</sub>H<sub>22</sub>NP; FW: 427.48; white pwdr. 1g  
*air sensitive*  
Note: PhenCar-Phos Ligand Kit component.

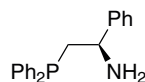


**15-7118** (R)-1-[2-(Diphenylphosphino)phenyl]ethylamine, min. 97% (192057-60-6) 250mg  
C<sub>20</sub>H<sub>20</sub>NP; FW: 305.35; white solid 1g  
*air sensitive*



**15-7119** (S)-1-[2-(Diphenylphosphino)phenyl]ethylamine, min. 97% (913196-43-7) 250mg  
C<sub>20</sub>H<sub>20</sub>NP; FW: 305.35; white solid 1g  
*air sensitive*

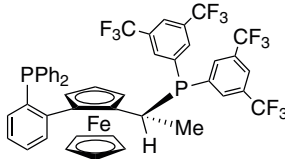
**15-7121** (R)-2-(Diphenylphosphino)-1-phenylethylamine, min. 97% (141096-35-7) 250mg  
C<sub>20</sub>H<sub>20</sub>NP; FW: 381.45; white solid 1g  
*air sensitive*



# PHOSPHORUS - Ligands and Compounds

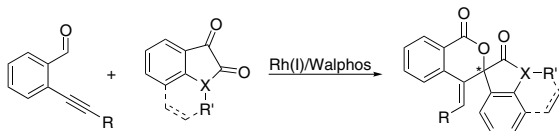
**15-7122** (S)-2-(Diphenylphosphino)-1-phenylethylamine, min. 97% 250mg  
(1103533-85-2) 1g  
C<sub>20</sub>H<sub>20</sub>NP; FW: 381.45; white solid  
*air sensitive*

**26-1300** (R)-(-)-1-[(R)-2-(2'-Di-phenylphosphinophenyl)ferrocenyl]ethylbis(di-3,5-trifluoromethylphenyl)phosphine, min. 97% (565184-33-0) 100mg  
C<sub>46</sub>H<sub>32</sub>F<sub>12</sub>FeP<sub>2</sub>; FW: 930.52; 500mg  
orange powdr. 2g  
Note: Sold in collaboration with 10g  
Solvias for research purposes  
only. Solvias Walphos Ligand Kit  
component.

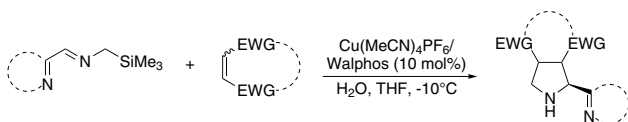


## Technical Notes:

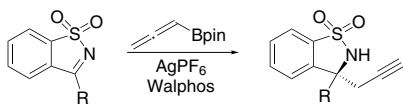
- Ligand for Rhodium-catalyzed enantioselective synthesis of spirocyclic benzopyranones by intermolecular[4+2]annulation.
- Ligand for Copper-catalyzed enantioselective synthesis of  $\alpha$ -heteroarylpyrrolidines by 1,3-cycloaddition of  $\alpha$ -silylimines.
- Ligand for Silver-catalyzed enantioselective propargylation reactions of N-sulfonylketimines.
- Ligand for Rhodium-catalyzed enantioselective addition of arylboronic acids to cyclic ketimines.



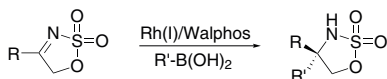
**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (3)**  
**Ref. (3)**

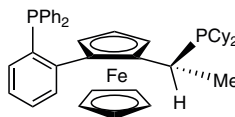


**Tech. Note (4)**  
**Ref. (4)**

## References:

- Angew. Chem., Int. Ed.* **2008**, *47*, 5820.
- Org. Lett.*, **2014**, *16*, 2228.
- Org. Lett.*, **2015**, *17*, 5540.
- Org. Lett.*, **2015**, *17*, 5520.

**26-1310** (R)-(-)-1-[(R)-2-(2'-Di-phenylphosphino-phenyl)ferrocenyl]ethylidicyclohexylphosphine, min. 97% (565184-29-4) 100mg  
C<sub>42</sub>H<sub>48</sub>FeP<sub>2</sub>; FW: 670.62; orange powdr. 500mg  
Note: Sold in collaboration with Solvias 2g  
for research purposes only. Solvias 10g  
Walphos Ligand Kit component.

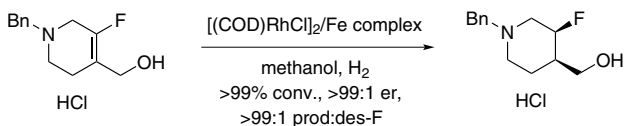


## Technical Notes:

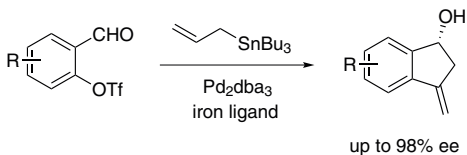
- Enantioselective synthesis of chiral fluoropiperidine via asymmetric hydrogenation of a vinyl fluoride.
- Palladium/ClickFerrophos – Catalyzed asymmetric domino allylstannylation-Heck reaction of o-formylaryl triflate.
- Catalytic asymmetric alkylation of acylsilanes.

# PHOSPHORUS - Ligands and Compounds

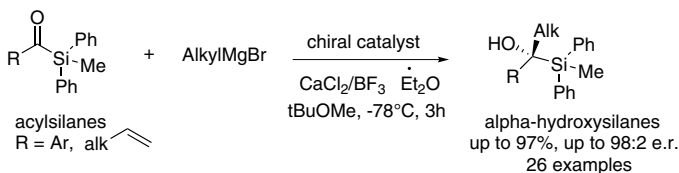
**26-1310** (R)-(-)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylidicyclohexylphosphine, min. 97% (565184-29-4)



Tech. Note (2)  
Ref. (2)



Tech. Note (2)  
Ref. (2)

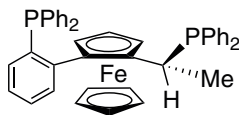


Tech. Note (3)  
Ref. (3)

## References:

1. *Tetrahedron*, **2009**, 65, 8987
2. *J. Org. Chem.*, **2014**, 79, 7905.
3. *Angew. Chem. Int. Ed.*, **2015**, 54, 3038.

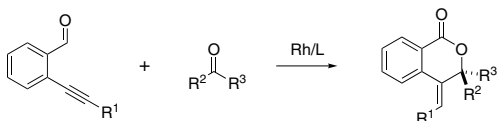
**26-1315** (R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylidiphenylphosphine, min. 97% (565184-32-9)  
C<sub>42</sub>H<sub>36</sub>FeP<sub>2</sub>; FW: 658.53; orange powdr.  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component.



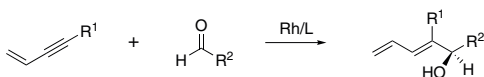
100mg  
500mg  
2g  
10g

## Technical Notes:

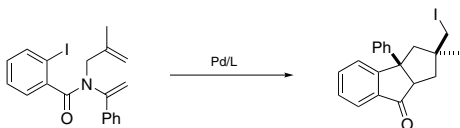
1. Ligand for Rh and Ru-catalyzed hydrogenation of alkenes and ketones.
2. Rh-catalyzed intermolecular [4+2].
3. Enantioselective reductive coupling of 1,3-enynes to heterocyclic aromatic aldehydes and ketones.
4. Pd-catalyzed enantioselective carbohalogenation.



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

## References:

1. (a) *Adv. Synth. Catal.*, **2003**, 345, 160, b, *Org. Lett.*, 2006, 8, 2413
2. *Angew. Chem.*, **2008**, 120, 5904
3. *J. Am. Chem. Soc.*, **2006**, 128, 16448
4. *J. Am. Chem. Soc.*, **2011**, 133, 14916

# PHOSPHORUS - Ligands and Compounds

26-1320

(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylidene(3,5-xylyl)phosphine, min. 97%

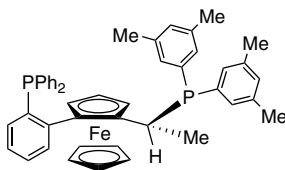
(894771-25-6)

C<sub>46</sub>H<sub>44</sub>FeP<sub>2</sub>; FW: 714.63;

orange powder.

(store cold)

Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component.



100mg

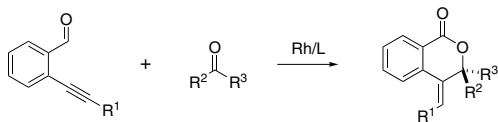
500mg

2g

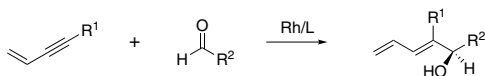
10g

## Technical Notes:

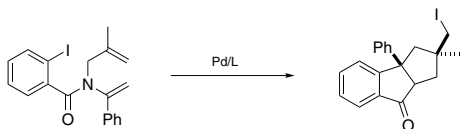
- Ligand for Rh and Ru-catalyzed hydrogenation of alkenes and ketones.
- Rh-catalyzed intermolecular [4+2].
- Enantioselective reductive coupling of 1,3-enynes to heterocyclic aromatic aldehydes and ketones.
- Pd-catalyzed enantioselective carbonylation.



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

## References:

- (a) *Adv. Synth. Catal.*, **2003**, *345*, 160, (b) *Org. Lett.*, **2006**, *8*, 2413
- Angew. Chem.*, **2008**, *120*, 5904
- J. Am. Chem. Soc.*, **2006**, *128*, 16448
- J. Am. Chem. Soc.*, **2011**, *133*, 14916

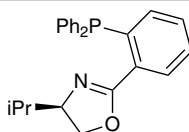
15-1821

(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (R)-iPr-PHOX (164858-78-0)

C<sub>24</sub>H<sub>24</sub>NOP; FW: 373.44; white powder;

m.p. 77-80°

air sensitive



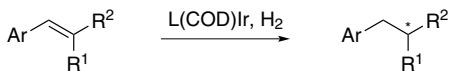
50mg

250mg

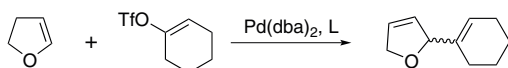
1g

## Technical Notes:

- Chiral ligand used in the asymmetric reduction of highly substituted olefins.
- Chiral ligand used in the enantioselective Heck reaction. The success of the reaction is due to the fact that the catalytic system does not promote double bond isomerization.
- Chiral ligand used in the enantioselective palladium-catalyzed allylic substitution of sodium benzotriazole.
- Decarboxylative allylic alkylation.



Tech. Note (1)  
Ref. (1,3)

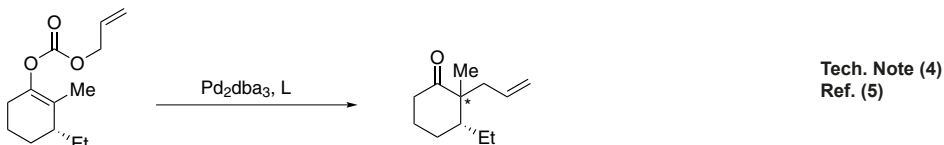
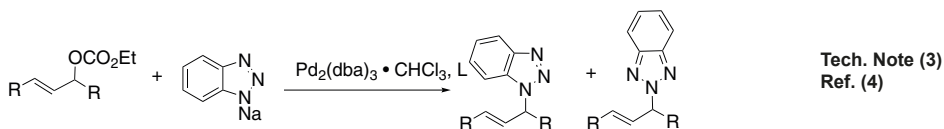


Tech. Note (2)  
Ref. (2,3)



# PHOSPHORUS - Ligands and Compounds

**15-1821** (R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98%  
(continued) (R)-iPr-PHOX (164858-78-0)



## References:

1. *Angew. Chem. Int. Ed.*, **1998**, 37, 2897
2. *Angew. Chem. Int. Ed.*, **1996**, 35, 200
3. *Acc. Chem. Res.*, **2000**, 33, 336
4. *Eur. J. Org. Chem.*, **2011**, 31, 6288
5. *Org. Lett.*, **2014**, 16, 118

**15-1822** (S)-(-)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% (S)-iPr-PHOX (148461-14-7) 50mg  
C<sub>24</sub>H<sub>24</sub>NOP; FW: 373.44; white powdr.; m.p. 77-80° 250mg  
*air sensitive* 1g

## Technical Note:

1. See 15-1821 (page 227)

**15-3152** 4-Diphenylphosphino-phenyl{2-methyl-3-[polyisobutyl(21)]propyl}ether (50% in heptane/polyisobutylene) 1g  
amp 5g  
HAZ

H[CH<sub>2</sub>C(Me)<sub>2</sub>]<sub>21</sub>CH<sub>2</sub>C(Me)HCH<sub>2</sub>OC<sub>6</sub>H<sub>4</sub>P(Ph)<sub>2</sub>; FW: 1513; colorless liq.

**15-7159** (1R,2R)-1-(Diphenylphosphino)-1-phenylpropan-2-ammonium tetrafluoroborate, min. 97% 100mg  
C<sub>21</sub>H<sub>23</sub>BF<sub>4</sub>NP; FW: 407.19; white solid 500mg  
*air sensitive*  
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

Ph<sub>2</sub>P-CH(Ph)-CH(Me)-NH<sub>3</sub><sup>+</sup> BF<sub>4</sub><sup>-</sup>

**15-1767** 3-(Diphenylphosphino)propylamine, min. 97% (16605-03-1) 500mg  
(C<sub>8</sub>H<sub>9</sub>)<sub>2</sub>P(CH<sub>2</sub>)<sub>3</sub>NH<sub>2</sub>; FW: 243.28; colorless to pale yellow liq. 2g  
*air sensitive*

Ph<sub>2</sub>P-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-NH<sub>2</sub>

**15-1769** 3-(Diphenylphosphino)propylammonium tetrafluoroborate 500mg  
(C<sub>8</sub>H<sub>9</sub>)<sub>2</sub>PCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>3</sub><sup>+</sup>(BF<sub>4</sub>)<sup>-</sup>; FW: 331.10; white solid 2g  
*air sensitive, hygroscopic*  
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

Ph<sub>2</sub>P-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-NH<sub>3</sub><sup>+</sup> BF<sub>4</sub><sup>-</sup>

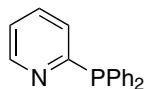
# PHOSPHORUS - Ligands and Compounds

15-1780

**2-Diphenylphosphinopyridine, min. 97%**

(37943-90-1)

C<sub>17</sub>H<sub>14</sub>NP; FW: 263.27; white to off-white solid

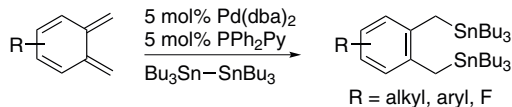


5g  
25g

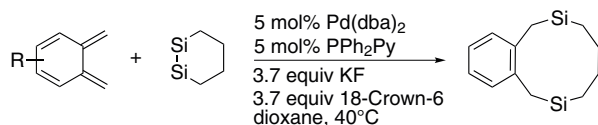
NEW

## Technical Notes:

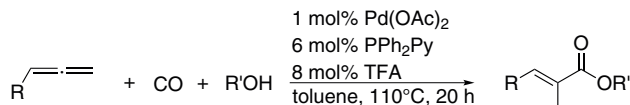
- Ligand for the palladium-catalyzed distannylation of ortho-quinodimethanes
- Ligand for the palladium-catalyzed disilylation of o-quinodimethanes to synthesize 9- and 10-membered disilacarbycles
- Ligand for the palladium-catalyzed alkoxyacylation of allenes



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)

## References:

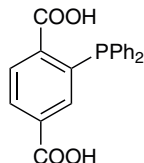
- Org. Lett.*, **2006**, 8, 4157
- Org. Lett.*, **2008**, 10, 4319
- J. Am. Chem. Soc.*, **2015**, 137, 8556

15-7170

**2-(Diphenylphosphino)terephthalic acid, 98%**  
(1537175-69-1)

C<sub>20</sub>H<sub>18</sub>O<sub>4</sub>P; FW: 350.30; white powd.

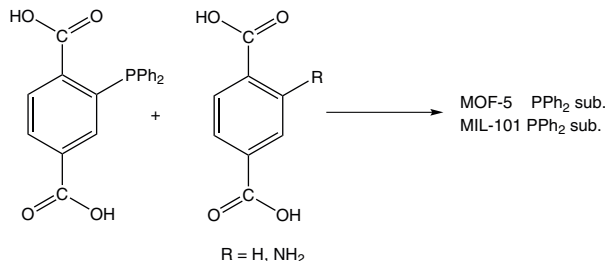
Note: Ligand for MOF synthesis. Developed at the Paul Scherrer Institute, Switzerland PCT/EP2013/051405.



50mg  
250mg

## Technical Note:

- Starting material for the construction of diphenylphosphino-substituted MOFs.



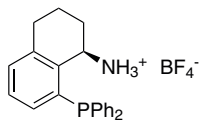
Tech. Note (1)  
Ref. (1)

## References:

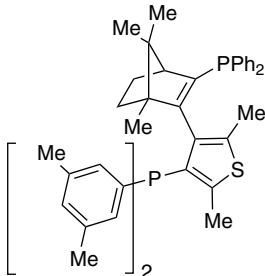
- Ind. Eng. Chem. Res.*, **2014**, 53, 9120.

# PHOSPHORUS - Ligands and Compounds

**15-7189** **(R)-8-(Diphenylphosphino)-1,2,3,4-tetrahydronaphthalenaminate tetrafluoroborate, min. 97%** 100mg  
500mg  
C<sub>22</sub>H<sub>23</sub>BF<sub>4</sub>NP; FW: 419.20; white solid  
*air sensitive*  
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.



**15-0164** **(+)-[4-[(1R,4S)-3-(Diphenylphosphino)-1,7,7-trimethylbicyclo[2.2.1]hept-2-en-2-yl]-2,5-dimethyl-3-thien-3-yl]bis(3,5-dimethylphenyl)phosphine, min. 95% [catASium® T3] (868851-50-7)** 100mg  
C<sub>44</sub>H<sub>48</sub>P<sub>2</sub>S; FW: 670.87; white powder.  
*air sensitive, light sensitive*  
Note: Sold in collaboration with Solvias for research purposes only. Patent WO2005/108407.



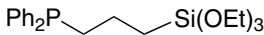
**15-1827** **Diphenyl(m-sulfonatophenyl)phosphine dihydrate sodium salt, min. 90%** 250mg  
(63995-75-5) 1g  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>P(C<sub>6</sub>H<sub>4</sub>SO<sub>3</sub>Na)·2H<sub>2</sub>O; FW: 364.33 (400.36); white powder. 5g

Technical Note:

1. A water-soluble phosphine ligand used in the formation of water-soluble catalysts.

**15-1825** **Diphenyl(p-sulfonatophenyl)phosphine monohydrate dimethylsulfide adduct, potassium salt** 1g  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>P(C<sub>6</sub>H<sub>4</sub>SO<sub>3</sub>K)·H<sub>2</sub>O·CH<sub>3</sub>SOCH<sub>3</sub>; FW: 380.44 (476.59); white powder. 5g  
Note: Water soluble phosphine.

**15-1823** **Diphenyl[3-(triethoxysilyl)propyl]phosphine, 98% (52090-23-0)** 250mg  
(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>P(CH<sub>2</sub>)<sub>3</sub>Si(OCH<sub>2</sub>CH<sub>3</sub>)<sub>3</sub>; 1g  
FW: 390.53; colorless, oily liquid.  
*air sensitive, moisture sensitive*

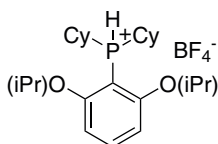


Technical Note:

1. Useful ligand for the preparation of silica-immobilized metal catalysts.

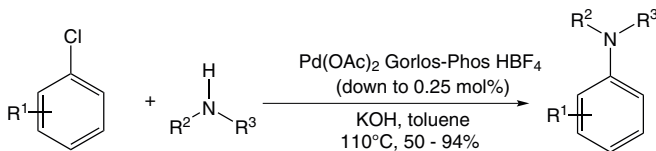
**15-6525** **[2,6-Di-i-propoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% GorlosPhosHBF<sub>4</sub> (1268824-70-9)** 500mg  
C<sub>24</sub>H<sub>40</sub>BF<sub>4</sub>O<sub>2</sub>P; FW: 478.35; white solid; m.p. 221.6-223.2° 2g  
Note: Sold under license from ZJU for research purposes only. Patents ZL200910154029.4, PCT/CN2009/001527.

NEW



Technical Notes:

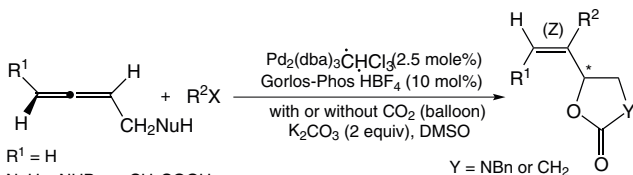
1. A new ligand for the palladium-catalyzed amination reactions of aryl chlorides with potassium hydroxide as the base.
2. A new ligand for the palladium-catalyzed exo-mode cyclization of allenes with a nucleophilic functionality.



Tech. Note (1)  
Ref. (1)

# PHOSPHORUS - Ligands and Compounds


**15-6525** [2,6-Di-*i*-propoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98%  
(continued) GorlosPhosHBF<sub>4</sub> (1268824-70-9)

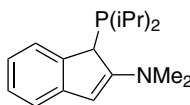


Tech. Note (2)  
Ref. (2)

## References:

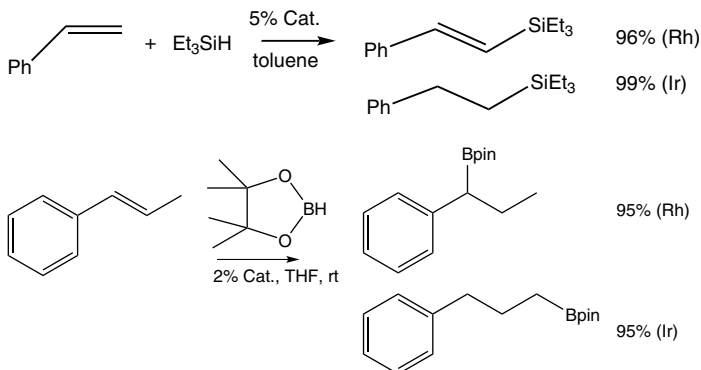
1. *Adv. Synth. Catal.*, **2011**, 353, 100.
2. *Org. Biomol. Chem.*, **2013**, 11, 5370.

<b>15-1800</b>	<b>Di-<i>i</i>-propylchlorophosphine, min. 97% (40244-90-4)</b>	1g
amp	(C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PCl; FW: 152.60; colorless liq.; f.p. 39°F; d. 0.959	5g
HAZ	<i>air sensitive, moisture sensitive</i>	
<b>15-1795</b>	<b>Di-<i>i</i>-propylphosphine, 98% (20491-53-6)</b>	1g
HAZ	(C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PH; FW: 118.16; colorless liq.	5g
	<i>air sensitive, pyrophoric</i>	
<b>15-1796</b>	<b>Di-<i>i</i>-propylphosphine, 98% (10 wt% in hexanes) (20491-53-6)</b>	10g
HAZ	(C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PH; FW: 118.16; colorless liq.	50g
	<i>air sensitive</i>	
<b>15-1802</b>	<b>1-Di-<i>i</i>-propylphosphino-2-(<i>N,N</i>-dimethylamino)-1<i>H</i>-indene, 99% (540492-51-1)</b>	250mg
	C <sub>17</sub> H <sub>26</sub> NP; FW: 275.37; off-white xtl.	1g
	<i>air sensitive</i>	
	Note: Sold under license from Dalhousie for research purposes only. Provisional US patents 60/778,368 and 60/778,358.	



## Technical Note:

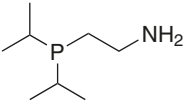
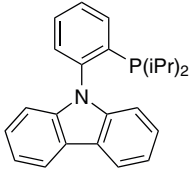
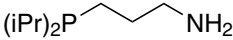
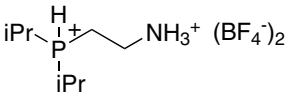
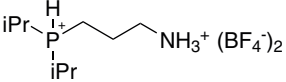
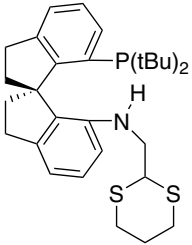
1. Zwitterionic hydrogenation, hydrosilylation and hydroboration catalyst soluble in non-polar solvents.



## References:

1. *Organometallics*, **2007**, 26, 594.
2. *Organometallics*, **2006**, 25, 5965.

# PHOSPHORUS - Ligands and Compounds

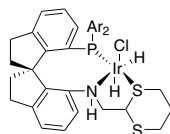
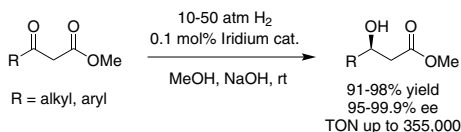
15-1812 HAZ	<b>2-(Di-i-propylphosphino)ethylamine, min. 97% (10 wt% in THF) (1053657-14-9)</b> (C <sub>7</sub> H <sub>17</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub> ; FW: 161.23; pale yellow to colorless liq. <i>air sensitive, moisture sensitive</i>		5g 25g
15-0493	<b>9-[2-(Di-i-propylphosphino)phenyl]- 9H-carbazole, min. 97% i-Pr PhenCar-Phos (1308652-65-4)</b> C <sub>24</sub> H <sub>26</sub> NP; FW: 359.44; white powdr.; m.p. 145-149° <i>air sensitive</i> Note: PhenCar-Phos Ligand Kit component.		250mg 1g
15-1831 HAZ	<b>3-(Di-i-propylphosphino)propylamine, min. 97% (10 wt% in THF) (1196147-69-9)</b> (C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub> ; FW: 175.25; colorless to pale yellow liq. <i>air sensitive</i>		5g 25g
93-1527	<b>Di-i-propylphosphite, min. 98% (1809-20-7)</b> (C <sub>3</sub> H <sub>7</sub> O) <sub>2</sub> P(O)H; FW: 166.16; colorless liq.; b.p. 70-71°/9 mm; f.p. 156°F; d. 0.997 <i>moisture sensitive</i>		50g 250g
15-1813	<b>2-(Di-i-propylphosphonium)ethylammonium bis(tetrafluoroborate), min. 97% (1222630-50-3)</b> (C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PH <sup>+</sup> CH <sub>2</sub> CH <sub>2</sub> NH <sub>3</sub> <sup>+</sup> (BF <sub>4</sub> ) <sub>2</sub> ; FW: 336.85; white to beige solid <i>air sensitive, hygroscopic</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.		500mg 2g
15-1832	<b>3-(Di-i-propylphosphonium)propylammonium bis(tetrafluoroborate)</b> (C <sub>3</sub> H <sub>7</sub> ) <sub>2</sub> PH <sup>+</sup> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> NH <sub>3</sub> <sup>+</sup> (BF <sub>4</sub> ) <sub>2</sub> ; FW: 350.88; white solid <i>air sensitive, hygroscopic</i> Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.		500mg 2g
15-1638 <b>NEW</b>	<b>(R)-(+)-7-[N-(1,3-Dithian-2-yl)methylamino]-7'-[bis(3,5-di-t-butylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (&gt;99% ee) [(R)-DTB-SpiroSAP] (1809609-53-7)</b> C <sub>50</sub> H <sub>66</sub> NPS <sub>2</sub> ; FW: 776.17; white to off-white solid; m.p. 95-97° <i>air sensitive</i>		25mg 100mg

## Technical Note:

- Chiral P-N-S Spiro Ligand used in the Iridium-catalyzed asymmetric Hydrogenation of Ketoesters

# PHOSPHORUS - Ligands and Compounds

**15-1638** (R)-(-)-7-[N-(1,3-Dithian-2-yl)methylamino]-7'-[bis(3,5-di-*t*-butylphenyl)phosphino]-  
(continued) 2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (>99% ee) [(R)-DTB-SpiroSAP] (1809609-53-7)



Iridium catalyst (77-2150)

Tech. Note (1)  
Ref. (1)

## References:

1. *Angew. Chem. Int. Ed.* **2015**, *54*, 8791

**15-1639** (S)-(-)-7-[N-(1,3-Dithian-2-yl)methylamino]-7'-[bis(3,5-di-*t*-butylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (>99% ee) [(S)-DTB-SpiroSAP] C<sub>50</sub>H<sub>66</sub>NPS<sub>2</sub>; FW: 776.17; white to off-white solid; m.p. 95-97° *air sensitive* 25mg  
100mg

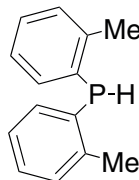
NEW

## Technical Note:

1. See 15-1638 (page 232)

**15-1815** Di-*o*-tolylchlorophosphine, min. 98% (36042-94-1) 1g  
HAZ (CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>PCl; FW: 248.69; white to yellow hazy viscous liq. 5g  
*air sensitive, moisture sensitive*

**15-0435** Di-*o*-tolylphosphine, min. 97% (29949-64-2) 1g  
(CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>PH; FW: 214.24; colorless solid; 5g  
m.p. 42-46°  
*air sensitive*

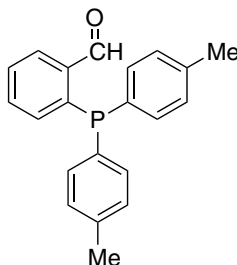


**15-1820** Di-*p*-tolylphosphine, 99% (1017-60-3) 2g  
amp (CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>PH; FW: 214.25; colorless liq. 10g  
HAZ  
*pyrophoric*



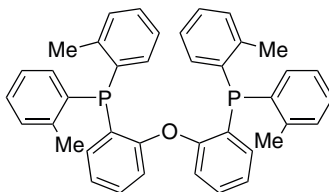
**15-1819** Di-*p*-tolylphosphine, 99% (10 wt% in hexanes) (1017-60-3) 20g  
HAZ (CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>PH; FW: 214.25; colorless liq. 100g  
*air sensitive*

**15-7344** 2-(Di-*p*-tolylphosphino)benzaldehyde, min. 97% (1202865-03-9) 500mg  
C<sub>21</sub>H<sub>19</sub>OP; FW: 318.12; yellow solid 2g

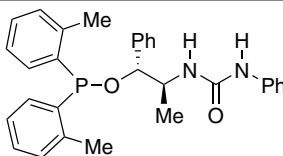


# PHOSPHORUS - Ligands and Compounds

**15-7365**     **2,2'-(Di-o-tolylphosphino) diphenylether, min. 97%**     250mg  
**DTP-DPEphos (205497-64-9)**     1g  
 $C_{40}H_{36}OP_2$ ; FW: 594.66; white powdr.



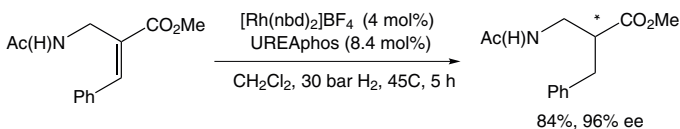
**15-2214**     **1-[(1R,2S)-1-(Di-o-tolylphosphinooxy)-1-phenylpropan-2-yl]-3-phenylurea, min. 97%**     50mg  
*(1391410-56-2)*     250mg  
 $C_{30}H_{31}N_2O_2P$ ; FW: 482.55; white powdr.



*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAphos and METAMORPhos Ligand Kit component.

### Technical Note:

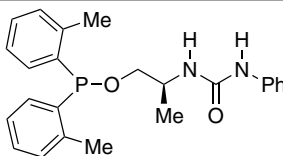
- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



### References:

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

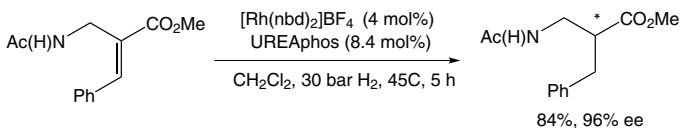
**15-2212**     **1-[(2S)-1-(Di-o-tolylphosphinooxy)propan-2-yl]-3-phenylurea, min. 97%**     50mg  
 97%     250mg



$C_{24}H_{27}N_2O_2P$ ; FW: 406.46; white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAphos and METAMORPhos Ligand Kit component.

### Technical Note:

- The UREAphos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.

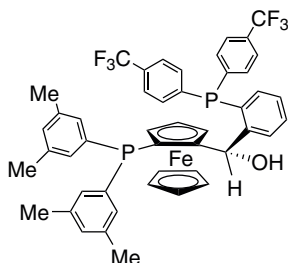


### References:

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

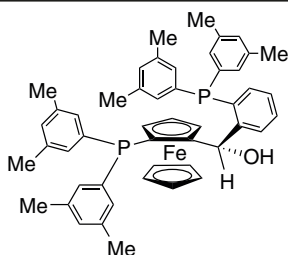
# PHOSPHORUS - Ligands and Compounds

**26-1560** (S)-(-)-[(S)-2-Di(3,5-xylyl)phosphinoferrrocenyl][2-di(4-trifluoromethylphenyl)phosphinophenyl]methanol, min. 97% (851308-48-0)  
 $C_{47}H_{40}F_6FeOP_2$ ; FW: 852.60;  
 yellow powd.  
 Note: Air-stable. Sold in collaboration with Solvias for research purposes only.  
 \*\*Limited quantities available\*\*



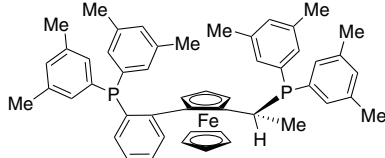
100mg

**26-1565** (S)-(-)-[(S)-2-Di(3,5-xylyl)phosphinoferrrocenyl][2-di(3,5-xylyl)phosphinophenyl]methanol, min. 97% (851308-45-7)  
 $C_{49}H_{50}FeOP_2$ ; FW: 772.71; orange foam  
 Note: Air-stable. Sold in collaboration with Solvias for research purposes only.



100mg  
500mg

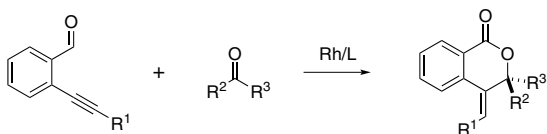
**26-1555** (R)-(+)-1-[(R)-2-(2'-Di-3,5-xylylphosphinophenyl)ferrocenyl]ethyl-di-3,5-xylylphosphine, min. 97% (894771-28-9)  
 $C_{50}H_{52}FeP_2$ ; FW: 770.74; orange-red solid  
 Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component.



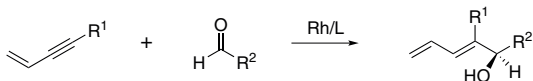
100mg  
500mg  
2g  
10g

## Technical Notes:

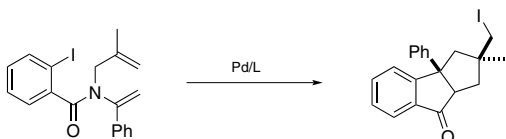
1. Ligand for Rh and Ru-catalyzed hydrogenation of alkenes and ketones.
2. Rh-catalyzed intermolecular [4+2].
3. Enantioselective reductive coupling of 1,3-enynes to heterocyclic aromatic aldehydes and ketones.
4. Pd-catalyzed enantioselective carbohalogenation.



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)




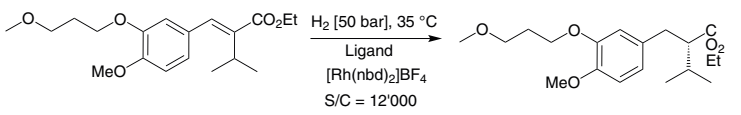
Tech. Note (4)  
Ref. (4)

## References:

1. (a) *Adv. Synth. Catal.*, **2003**, 345, 160, (b) *Org. Lett.*, **2006**, 8, 2413
2. *Angew. Chem.*, **2008**, 120, 5904
3. *J. Am. Chem. Soc.*, **2006**, 128, 16448
4. *J. Am. Chem. Soc.*, **2011**, 133, 14916

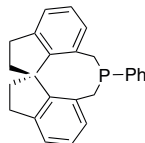


# PHOSPHORUS - Ligands and Compounds

<b>15-1835</b>	<b>n-Dodecylphosphonic acid, min. 97% DDPA (5137-70-2)</b> $\text{CH}_3(\text{CH}_2)_{11}\text{P}(\text{O})(\text{OH})_2$ ; FW: 250.31; white to off-white powdr.; m.p. 96-98° Note: Long-Chain n-Alkylphosphonic Acid Kit component.	1g 5g
<b>15-0011</b>	<b>Ethyl/butyl phosphonic acid Silica (PhosphonicS POH1)</b> white solid; SA: 380 m <sup>2</sup> /g Note: Sold in collaboration with PhosphonicS Ltd. for research purposes only.	10g 50g
Particle size range: 60-200 microns Average pore size: 60Å Functional group loading : 0.8 to 1.0 mmol/g		
<b>Technical Note:</b> 1. Applications include esterification, trans-esterification, hydrolysis, rearrangements, dehydration, protection and de-protection, cyclizations, etherifications. At the end of the reaction the solid silica catalyst can simply be filtered from the reaction mixture and reused.		
<b>References:</b> 1. <i>Org. Process Res. Dev.</i> , <b>2007</b> , <i>11</i> , 406.		
<b>15-2100</b> amp HAZ 	<b>Ethyl dichlorophosphine, 98% (1498-40-4)</b> $\text{C}_2\text{H}_5\text{PCl}_2$ ; FW: 130.94; colorless liq.; b.p. 113-116°; f.p. 91°F; d. 1.26 <i>air sensitive, moisture sensitive, pyrophoric</i>	5g 25g
<b>15-2150</b> HAZ	<b>Ethyl diphenylphosphine, 99% (607-01-2)</b> $(\text{C}_2\text{H}_5)(\text{C}_6\text{H}_5)_2\text{P}$ ; FW: 214.25; colorless liq.; b.p. 130-132°/1 mm; f.p. >230°F; d. 1.04 <i>air sensitive</i>	5g 25g
<b>15-2301</b>	<b>Ethyltriphenylphosphonium bromide, 99% (1530-32-1)</b> $\text{C}_2\text{H}_5(\text{C}_6\text{H}_5)_3\text{PBr}$ ; FW: 371.26; white to off-white powdr.; m.p. 206-208°	25g 100g
<b>26-1266</b>	<b>1-(((R)-Ferrocenyl-2-(S)-ethyl-1-dimethylamino)phenyl)-(R)-phosphino)-1'-dicyclohexylphosphinoferrocene, min. 97% Chenphos (952586-19-5)</b> $\text{C}_{42}\text{H}_{53}\text{Fe}_2\text{NP}_2$ ; FW: 745.51; orange powdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg 500mg 2g 10g
<b>Technical Note:</b> 1. Ligand used for the Rh-catalyzed asymmetric hydrogenation of $\alpha$ -substituted acrylic acids.		
		<b>Tech. Note (1)</b> <b>Ref. (1)</b>
<b>References:</b> 1. Patent number US 8,106,227, B2.		
<b>26-1265</b>	<b>1-(((S)-Ferrocenyl-2-(R)-ethyl-1-dimethylamino)phenyl)-(S)-phosphino)-1'-dicyclohexylphosphinoferrocene, min. 97% Chenphos (1036373-39-3)</b> $\text{C}_{42}\text{H}_{53}\text{Fe}_2\text{NP}_2$ ; FW: 745.51; orange powdr. Note: Sold in collaboration with Solvias for research purposes only.	100mg 500mg 2g 10g
<b>Technical Note:</b> 1. See 26-1266 (page 236)		
<b>93-1529</b> HAZ	<b>Fluorophosphoric acid, 60-70% (13537-32-1)</b> $(\text{HO})_2\text{P}(\text{O})\text{F}$ ; FW: 100.00; yellow liq. <i>moisture sensitive</i>	50g 250g

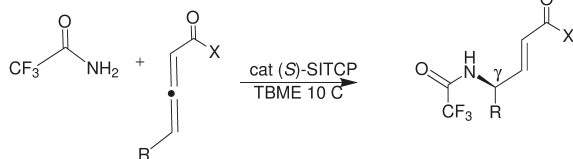
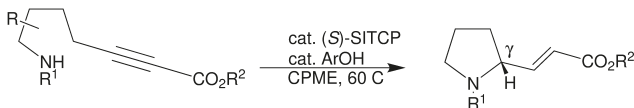
# PHOSPHORUS - Ligands and Compounds

<b>15-2400</b>	<b>n-Hexadecylphosphonic acid, min. 97% HDPA (4721-17-9)</b> CH <sub>3</sub> (CH <sub>2</sub> ) <sub>15</sub> P(O)(OH) <sub>2</sub> ; FW: 306.42; white to off-white powder; m.p. 96-99° Note: Long-Chain n-Alkylphosphonic Acid Kit component.	1g 5g
<b>93-1581</b>	<b>Hexadecyltri-n-butylphosphonium bromide, 98+% (14937-45-2)</b> (C <sub>16</sub> H <sub>33</sub> )(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> PBr; FW: 507.65; white xtl.; m.p. 54-56°	10g 50g
<b>93-1531</b> HAZ	<b>Hexafluorophosphoric acid, 60-70% in water (16940-81-1)</b> HPF <sub>6</sub> ; FW: 145.97; colorless to pale yellow liq.	250g 1kg
<b>15-5184</b>	<b>(11aR)-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1-cd:1',7'-ef]phosphocin, min. 97% (R)-SITCP (856407-37-9)</b> C <sub>25</sub> H <sub>23</sub> P; FW: 354.42; white solid; m.p. 148-149° <i>air sensitive</i>	25mg 100mg

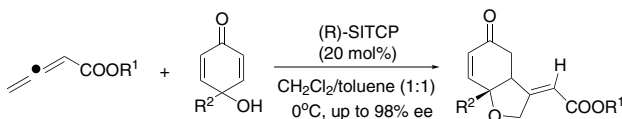


## Technical Notes:

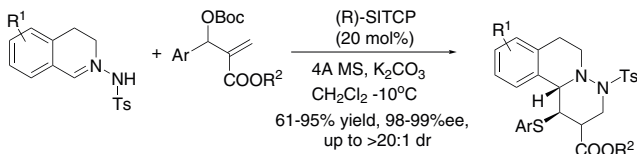
- Chiral catalyst for the intra and intermolecular  $\gamma$ -addition of nitrogen nucleophiles to  $\gamma$ -substituted alkynoates or allenates
- Phosphine-catalyzed  $\beta$ , $\gamma$ -umpolung domino reaction of allenic esters: facile synthesis of tetrahydrobenzofuranones bearing a chiral tetrasubstituted stereogenic carbon center.
- Phosphine-catalyzed highly enantioselective [3+3]cycloaddition of Morita-Baylis-Hillman carbonates with C,N-cyclic azomethine imines.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2)**



**Tech. Note (3)**  
**Ref. (3)**

## References:

- Angew. Chem. Int. Ed.*, **2013**, 52, 2525.
- Angew. Chem. Int. Ed.*, **2015**, 54, 1511.
- J. Am. Chem. Soc.*, **2015**, 137, 4316.

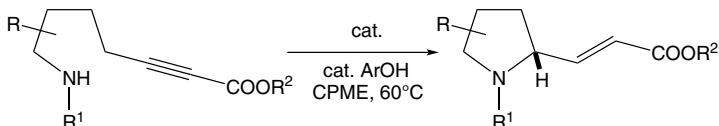
# PHOSPHORUS - Ligands and Compounds

**15-5185** (11aS)-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1-cd:1',7'-ef]phosphocin, min. 97% (S)-SITCP (885701-78-0)  
 $C_{25}H_{23}P$ ; FW: 354.42; white solid; m.p. 148-149°  
*air sensitive*

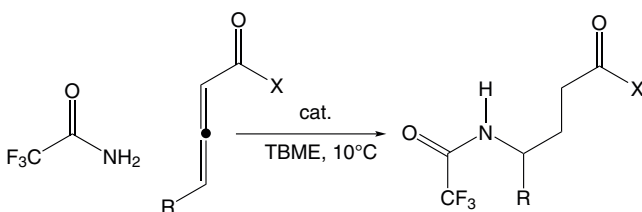
25mg  
100mg

## Technical Notes:

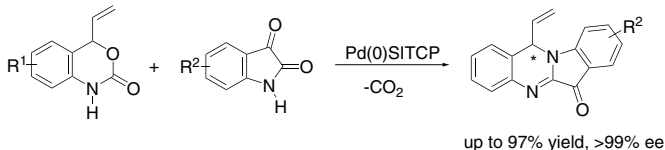
1. Phosphine-catalyzed intra- and intermolecular gamma-addition of nitrogen nucleophiles to allenates and alkynoates.
2. Catalytic asymmetric construction of the tryptanthrin skeleton via enantioselective decarboxylative [4+2] cyclization.
3. Catalytic, enantioselective carbon-oxygen bond formation – phosphorus-catalyzed synthesis of benzylic esters via oxidation of benzylic C-H bonds.
4. Use of a new spirophosphine to achieve catalytic, enantioselective [4+1] annulations of amines with allenes to generate dihydropyrroles.



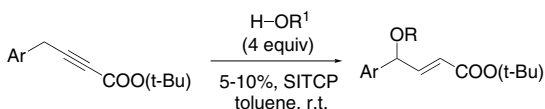
Tech. Note (1)  
Ref. (1)



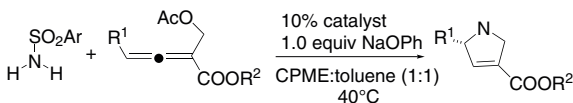
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

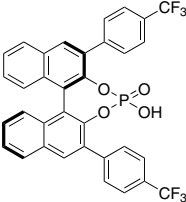
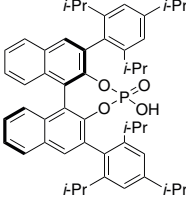
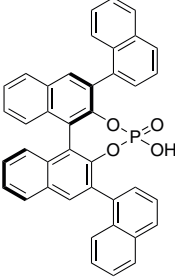
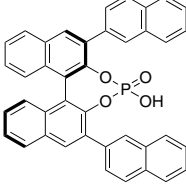
## References:

1. *Angew. Chem. Int. Ed.*, **2013**, *52*, 2525.
2. *Org. Lett.*, **2017**, *19*, 3219.
3. *J. Am. Chem. Soc.*, **2016**, *138*, 12069.
4. *J. Am. Chem. Soc.*, **2015**, *137*, 3803.

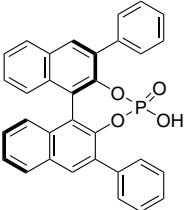
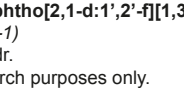
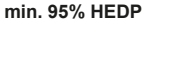
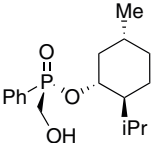
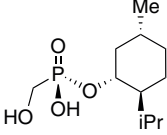
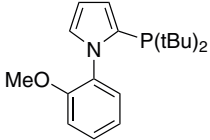
**15-2410** n-Hexylphosphonic acid, min. 97% HPA (4721-24-8)  
 $CH_3(CH_2)_5P(O)(OH)_2$ ; FW: 166.16; white to off-white powdr.;  
m.p. 105-106°  
Note: Long-Chain n-Alkylphosphonic Acid Kit component.

1g  
5g

# PHOSPHORUS - Ligands and Compounds

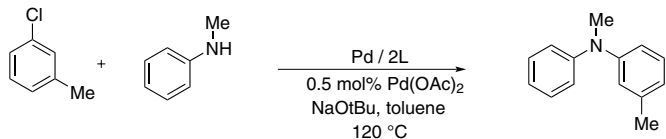
15-1392 <b>NEW</b>	<p><b>(11bR)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee)</b> (791616-59-6)</p> <p><math>C_{34}H_{19}F_6O_4P</math>; FW: 636.5; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1393 <b>NEW</b>	<p><b>(11bS)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee)</b> (1264573-23-0)</p> <p><math>C_{34}H_{19}F_6O_4P</math>; FW: 636.5; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1381	<p><b>(11bR)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (791616-63-2)</p> <p><math>C_{50}H_{57}O_4P</math>; FW: 753.0; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1382 <b>NEW</b>	<p><b>(11bS)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (874948-63-7)</p> <p><math>C_{50}H_{57}O_4P</math>; FW: 753; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1388 <b>NEW</b>	<p><b>(11bR)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (864943-23-7)</p> <p><math>C_{40}H_{25}O_4P</math>; FW: 600.6; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1389 <b>NEW</b>	<p><b>(11bS)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (929097-93-8)</p> <p><math>C_{40}H_{25}O_4P</math>; FW: 600.6; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		25mg 100mg
15-1390 <b>NEW</b>	<p><b>(11bR)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (791616-56-3)</p> <p><math>C_{40}H_{25}O_4P</math>; FW: 600.6; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		100mg
15-1391 <b>NEW</b>	<p><b>(11bS)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)</b> (874948-60-4)</p> <p><math>C_{40}H_{25}O_4P</math>; FW: 600.6; White to light-yellow powder.</p> <p>Note: Sold in collaboration with Daicel for research purposes only.</p>		25mg 100mg

# PHOSPHORUS - Ligands and Compounds

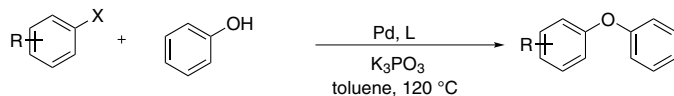
15-1386 <b>NEW</b>	<b>(11bR)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin, 98%, (99% ee)</b> (695162-86-8) $C_{32}H_{21}O_4P$ ; FW: 500.5; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-1387 <b>NEW</b>	<b>(11bS)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin, 98%, (99% ee)</b> (874948-59-1) $C_{32}H_{21}O_4P$ ; FW: 500.5; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-2900	<b>1-Hydroxyethylidene-1,1-diphosphonic acid, min. 95% HEDP</b> (2809-21-4) $C(OH)(CH_3)(PO_3H_2)_2$ ; FW: 206.03; white powdr.		5g 25g
15-2928	<b>(Sp)-Hydroxymethylphenylphosphinic acid [(-)-(1R,2S,2R)-2-i-propyl-5-methylcyclohexanol]ester, 99%</b> (1508260-88-5) $C_{17}H_{27}O_3P$ ; FW: 310.37; white powdr. <i>hygroscopic</i> Note: Patent pending 13/912,392		100mg 500mg
15-2915	<b>(Rp)-Hydroxymethylphosphinic acid [(-)-(1R,2S,2R)-2-i-propyl-5-methylcyclohexanol]ester, 99%</b> (1823532-14-4) $C_{17}H_{23}O_3P$ ; FW: 234.27; white solid <i>hygroscopic, (store cold)</i> Note: Patent pending.		100mg 500mg
15-2975	<b>N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMeTB]</b> (1053658-91-5) $C_{18}H_{28}NOP$ ; FW: 317.41; white to yellowish powdr. <i>air sensitive</i> Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.		500mg 2g

## Technical Notes:

- Useful ligand for the Pd-catalyzed amination reaction.
- Ligand used for the Pd-catalyzed arylation of phenols.
- Useful ligand for the Suzuki-Miyaura coupling.
- Ligand used for the Sonagashira reaction of aryl bromides.



Tech. Note (1)  
Ref. (1)

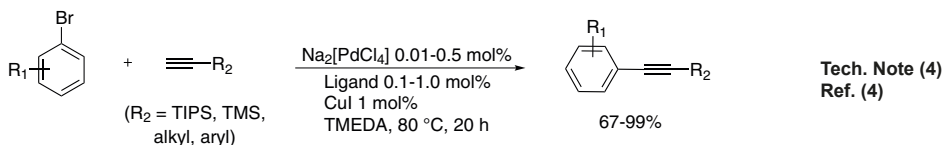
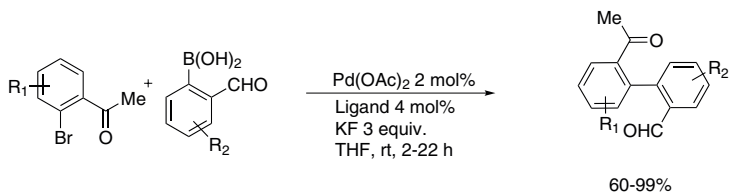


Tech. Note (2)  
Ref. (2)

51-99%

# PHOSPHORUS - Ligands and Compounds

**15-2975** N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMeB]  
(continued) (1053658-91-5)



## References:

1. *Chem. Eur. J.*, **2004**, *10*, 2983
2. *J. Org. Chem.*, **2009**, *74*, 3948.
3. *Chem. Sus. Chem.*, **2008**, *1*, 91.
4. *Chem. Sus. Chem.*, **2008**, *1*, 91.

**15-2980** 1-(2-Methoxyphenyl)-2-(dicyclohexylphosphino)pyrrole, min. 95%

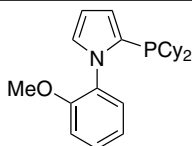
[cataCXium® POMeCy] (672937-63-2)

C<sub>23</sub>H<sub>32</sub>NOP; FW: 369.48;

white to yellow powdr.; m.p. 96-97°

*air sensitive*

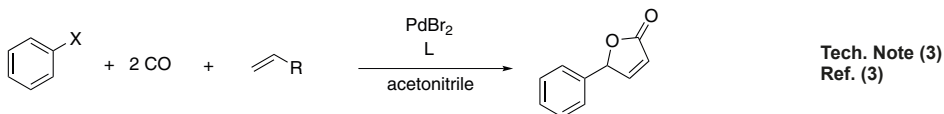
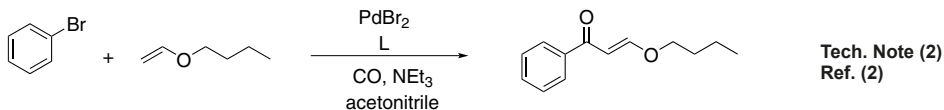
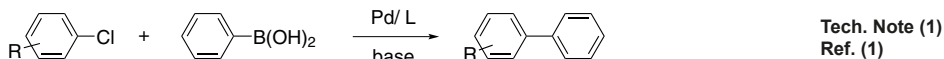
Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.



500mg  
2g

## Technical Notes:

1. Highly efficient ligand for the palladium-catalyzed Suzuki reaction using aryl chlorides.
2. Carbonylative Heck reaction of aryl bromides with vinyl ethers.
3. Double carbonylation of aryl halides to synthesize 5-arylfuranones.

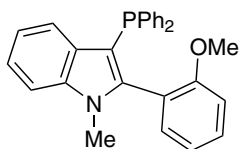


## References:

1. *Chem. Commun.*, **2004**, 38.
2. *Chem. Eur. J.*, **2012**, *18*, 4827
3. *Chem. Eur. J.*, **2013**, *19*, 12959

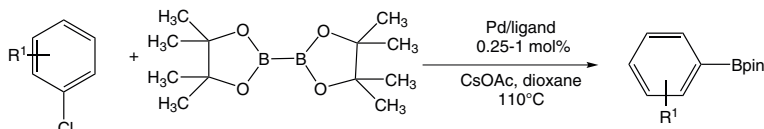
# PHOSPHORUS - Ligands and Compounds

**15-1091**    **2-(2-Methoxyphenyl)-1-methyl-3-di-phenylphosphino)-1H-indole, min. 98% PPh<sub>2</sub>-Andole-Phos (1242759-01-8)**    500mg  
 C<sub>26</sub>H<sub>24</sub>NOP; FW: 421.47; white to off-white powdr.    2g



Technical Note:

- Palladium-Indolylphosphine catalyzed borylation of nonactivated aryl chlorides.

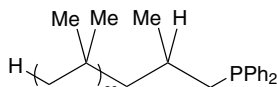


**Tech. Note (1)**  
**Ref. (1)**

References:

- J. Org. Chem.*, **2012**, *77*, 3543.

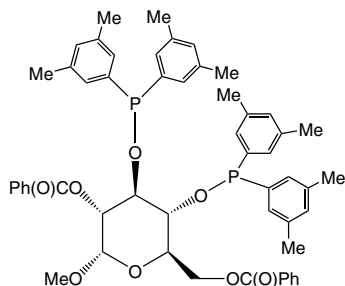
**15-3155**    **{2-Methyl-3-[polyisobutyl(20)]propyl} diphenylphosphine (50% in heptane/polyisobutylene)**    1g  
 amp    H[CH<sub>2</sub>C(Me)<sub>2</sub>]<sub>20</sub>CH<sub>2</sub>C(Me)HCH<sub>2</sub>P(Ph)<sub>2</sub>;    5g  
 HAZ    FW: 1364; colorless liq.



**15-3220**    **Methyldichlorophosphine, 97% (676-83-5)**    5g  
 amp    CH<sub>3</sub>PCl<sub>2</sub>; FW: 116.92; colorless to pale yellow liq.; b.p. 81°; d. 1.31    25g  
 HAZ    *air sensitive, moisture sensitive*  
 Note: May be slightly turbid. For sale in USA. For other countries contact Strem.

**15-3250**    **Methyldiphenylphosphine, 99% (1486-28-8)**    5g  
 CH<sub>3</sub>(C<sub>6</sub>H<sub>5</sub>)<sub>2</sub>P; FW: 200.22; colorless liq.; b.p. 118-120°/2.2 mm;    25g  
 f.p. >230°F; d. 1.065    100g  
*air sensitive*

**15-3300**    **Methyl α-D-glucopyranoside-2,6-dibenzoate-3,4-di(bis(3,5-dimethylphenyl)phosphinite), min. 95% CARBOPHO (158214-06-3)**    100mg  
 C<sub>53</sub>H<sub>56</sub>O<sub>8</sub>P<sub>2</sub>; FW: 882.98; white powdr.;    500mg  
 m.p. 162-164°  
*air sensitive*



Technical Note:

- Sugar-based phosphinite ligand used in the asymmetric reduction of prochiral acetamidoacrylates

References:

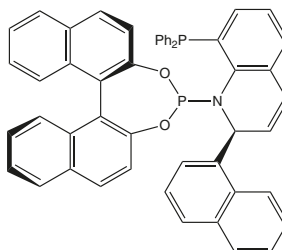
- J. Am. Chem. Soc.*, **1994**, *116*, 4101.
- J. Org. Chem.*, **1997**, *62*, 6012.

**15-3400**    **Methyltriphenylphosphonium bromide, 98+% (1779-49-3)**    50g  
 CH<sub>3</sub>(C<sub>6</sub>H<sub>5</sub>)<sub>3</sub>PBr; FW: 357.23; white xtl.; m.p. 234-235°    250g

**93-4249**    **12-Molybdophosphoric acid hydrate (ACS) (51429-74-4)**    10g  
 H<sub>3</sub>PO<sub>4</sub>·12MoO<sub>3</sub>·xH<sub>2</sub>O; FW: 1825.25; yellow xtl.    50g

# PHOSPHORUS - Ligands and Compounds

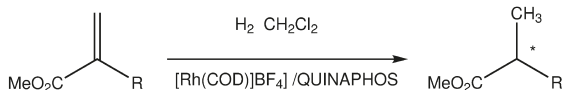
**15-1530** (S)-2-(1-Naphthyl)-8-diphenylphosphino-1-[(R)-3,5-dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl]-1,2-dihydroquinoline toluene adduct, min. 97% (Ra,Sc)-(1-Nph)-Quinaphos (1242168-77-9)  
 $C_{51}H_{35}NO_2P_2$ ; 1/2C<sub>7</sub>H<sub>8</sub>;  
 FW: 755.78 (801.85); white powdr.  
*moisture sensitive*  
 Note: \*\*Limited quantities available\*\*



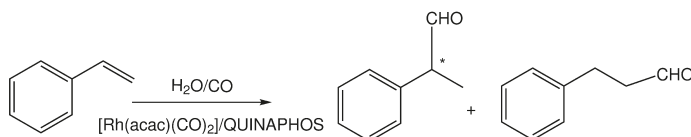
50mg  
250mg

## Technical Notes:

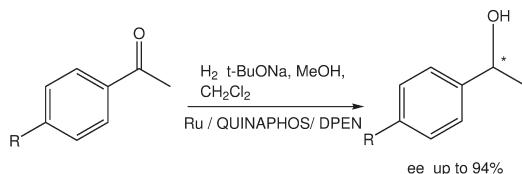
- Ligand used for the highly active and enantioselective hydrogenation of functionalized olefins.
- Useful ligand for the rhodium-catalyzed, asymmetric hydroformylation of styrenes.
- Useful ligand for the ruthenium-catalyzed, enantioselective hydrogenation of aromatic ketones..



**Tech. Note (1)**  
**Ref. (1,3)**



**Tech. Note (2)**  
**Ref. (1)**



**Tech. Note (3)**  
**Ref. (2)**

## References:

- Angew. Chem. Int. Ed., 2000, 39, 1428.
- Chem. Commun., 2005, 3460.
- Chem. Eur. J., 2010, 16, 7517.

**15-3490** (S)-(+)-Neomenthylidiphenylphosphine, 98% (S)-NMDPP (43077-29-8)  
 $C_{10}H_{19}P(C_6H_5)_2$ ; FW: 324.25; white xtl.; m.p. 90-92°  
*air sensitive*

500mg  
2g

**93-0739** HAZ Nitronium hexafluorophosphate, min. 97% (19200-21-6)  
 $NO_2PF_6$ ; FW: 190.97; white xtl.  
*moisture sensitive*

10g

**93-0736** HAZ Nitrosonium hexafluorophosphate, min. 97% (16921-91-8)  
 $NOF_6$ ; FW: 174.96; white xtl.  
*moisture sensitive*

10g

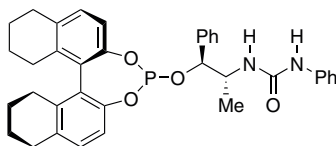
**15-3510** n-Octadecylphosphonic acid, min. 97% ODP A (4724-47-4)  
 $CH_3(CH_2)_{17}P(O)(OH)_2$ ; FW: 334.47; white to off-white powdr.;  
 m.p. 100-101°  
 Note: Long-Chain n-Alkylphosphonic Acid Kit component.

1g  
5g  
25g



# PHOSPHORUS - Ligands and Compounds

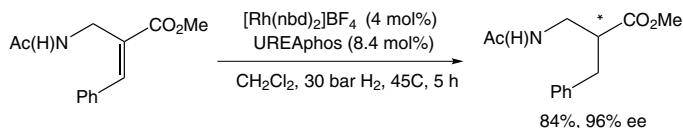
**15-2224** 1-[(1S,2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodronaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]-1-phenylpropan-2-yl]-3-phenylurea, **min. 97%** (1858224-21-1)  
 $C_{36}H_{37}N_2O_4P$ ; FW: 592.86;  
 white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559.  
 UREAPhos and METAMORPhos Ligand Kit component.



50mg  
250mg

## Technical Note:

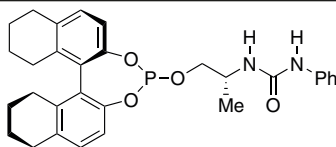
- The UREAPhos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



## References:

- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

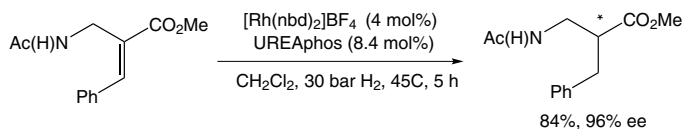
**15-2222** 1-[(2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodronaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl]-3-phenylurea, **min. 97%** (1858223-90-1)  
 $C_{30}H_{33}N_2O_4P$ ; FW: 516.57;  
 white powdr.  
*moisture sensitive, (store cold)*  
 Note: Sold under license from InCatT for research purposes only. WO2004/103559.  
 UREAPhos and METAMORPhos Ligand Kit component.



50mg

## Technical Note:

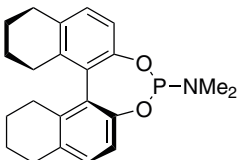
- The UREAPhos ligands are a new class of ligands containing a urea group, which due to its self-complementary hydrogen bond character, enables the formation of bidentate ligands in a supramolecular fashion. This interesting feature makes this ligand class highly suitable for combinatorial approaches and high throughput experimentation.



## References:

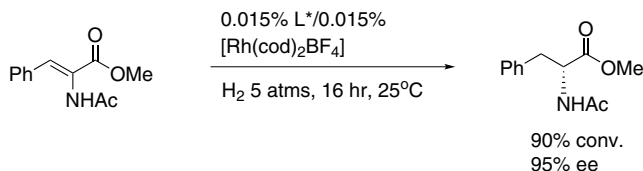
- J. Chem. Soc. Chem. Comm.*, **2007**, 864.
- WO2004103559A2.

# PHOSPHORUS - Ligands and Compounds

<p><b>15-3495</b></p>	<p><b>(S)-(+)-(8,9,10,11,12,13,14,15-Octahydro-3,5-dioxo-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, 99%</b> (389130-06-7) C<sub>22</sub>H<sub>26</sub>NO<sub>2</sub>P; FW: 367.42; white powdr.; m.p. 112-113° <i>moisture sensitive, (store cold)</i> Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component.</p>		<p>100mg 500mg</p>
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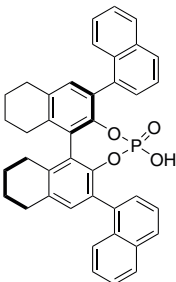
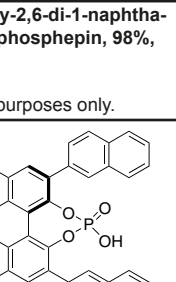
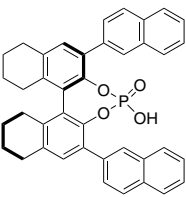
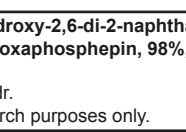
## Technical Note:

1. A ligand for enantioselective hydrogenation of prochiral functional olefins.

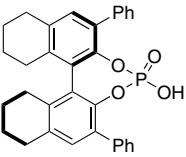
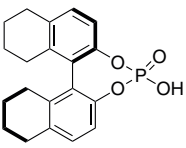
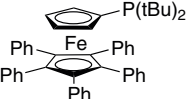


## References:

1. *Adv. Synth. Catal.*, **2003**, 345, 308.

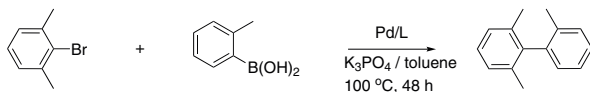
<p><b>15-1383</b> <b>NEW</b></p>	<p><b>(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphospepin, 98%, (99% ee)</b> (1242066-20-1) C<sub>40</sub>H<sub>33</sub>O<sub>4</sub>P; FW: 608.7; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.</p>		<p>25mg 100mg</p>
<p><b>15-1384</b> <b>NEW</b></p>	<p><b>(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphospepin, 98%, (99% ee)</b> C<sub>40</sub>H<sub>33</sub>O<sub>4</sub>P; FW: 608.7; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.</p>		<p>25mg 100mg</p>
<p><b>15-1378</b> <b>NEW</b></p>	<p><b>(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphospepin, 98%, (99% ee)</b> (922711-75-9) C<sub>40</sub>H<sub>33</sub>O<sub>4</sub>P; FW: 608.7; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.</p>		<p>25mg 100mg</p>
<p><b>15-1379</b> <b>NEW</b></p>	<p><b>(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphospepin, 98%, (99% ee)</b> C<sub>40</sub>H<sub>33</sub>O<sub>4</sub>P; FW: 608.7; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.</p>		<p>25mg 100mg</p>

# PHOSPHORUS - Ligands and Compounds

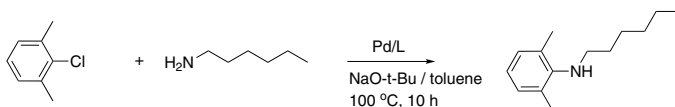
15-1396 <b>NEW</b>	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-65-4) C <sub>32</sub> H <sub>29</sub> O <sub>3</sub> P; FW: 508.5; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-1397 <b>NEW</b>	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (945852-48-2) C <sub>32</sub> H <sub>29</sub> O <sub>3</sub> P; FW: 508.5; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-1370 <b>NEW</b>	(11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (297752-25-1) C <sub>26</sub> H <sub>21</sub> O <sub>3</sub> P; FW: 356.4; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-1371 <b>NEW</b>	(11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (1193697-61-8) C <sub>26</sub> H <sub>21</sub> O <sub>3</sub> P; FW: 356.4; White to light-yellow powdr. Note: Sold in collaboration with Daicel for research purposes only.		100mg
15-3520	n-Octylphosphonic acid, min. 97% OPA (4724-48-5) CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> P(O)(OH) <sub>2</sub> ; FW: 194.21; white to off-white powdr.; m.p. 102-103° Note: Long-Chain n-Alkylphosphonic Acid Kit component.		1g 5g
26-3575	1,2,3,4,5-Pentaphenyl-1'-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS (312959-24-3) C <sub>48</sub> H <sub>47</sub> FeP; FW: 710.71; pink powdr. Note: Sold in collaboration with Johnson Matthey for research purposes only. Patent Application No WO 02/11883.		100mg 500mg 2g 10g

## Technical Notes:

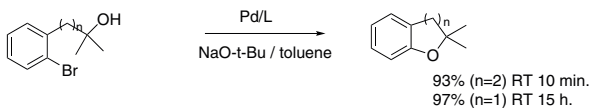
- Ligand used in the preparation of active Pd catalysts for C-C, C-N and C-O bond formation.
- Ligand used in Pd-catalyzed  $\alpha$ -arylation of azlactones.
- Pd-catalyzed  $\alpha$ -arylation of esters, amides and aldehydes.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

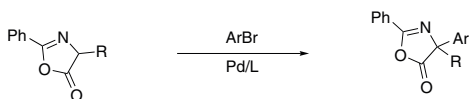


Tech. Note (3)  
Ref. (3)

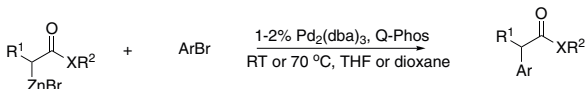
93% (n=2) RT 10 min.  
97% (n=1) RT 15 h.

# PHOSPHORUS - Ligands and Compounds

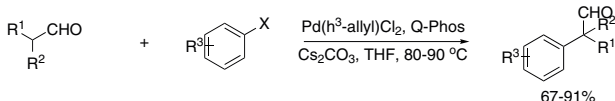
26-3575 1,2,3,4,5-Pentaphenyl-1'-(di-*t*-butylphosphino)ferrocene, 95% CTC-Q-PHOS (312959-24-3)  
(continued)



Tech. Note (4)  
Ref. (4)



Tech. Note (3)  
Ref. (3)

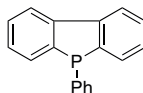


Tech. Note (4)  
Ref. (4)

## References:

1. *J. Org. Chem.*, **2002**, 67, 5553
2. *Org. Lett.*, **2003**, 5, 1915
3. *J. Am. Chem. Soc.*, **2003**, 125, 11176
4. *Angew. Chem. Int. Ed.*, **2008**, 47, 2127

**15-3525** 5-Phenyl-5H-benzo[b]phosphindole, 99%  
(1088-00-2)  
C<sub>18</sub>H<sub>13</sub>P; FW: 260.27; off-white to beige solid

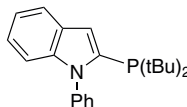


100mg  
500mg

**15-3550** N-Phenyl-2-(di-*t*-butylphosphino)indol, min. 98% [cataCXium® PIntB]  
(740815-37-6)

C<sub>22</sub>H<sub>28</sub>NP; FW: 337.44;  
white to yellow powdr.  
*air sensitive*

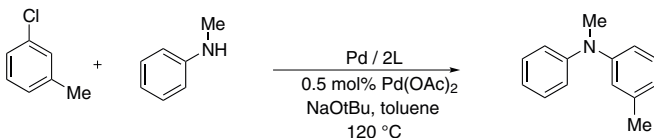
Note: Sold in collaboration with  
Solvias for research purposes only.  
Patent Application pending. Solvias  
cataCXium® Ligand Kit component.



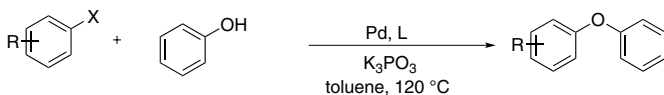
500mg  
2g

## Technical Notes:

1. Useful ligand for the Pd-catalyzed amination reaction.
2. Ligand used for the Pd-catalyzed arylation of phenols.
3. Useful ligand for the Suzuki-Miyaura coupling.
4. Ligand used for the Sonogashira reaction of aryl bromides.



Tech. Note (1)  
Ref. (1)

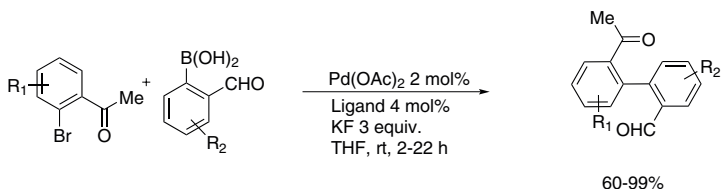


Tech. Note (2)  
Ref. (2)

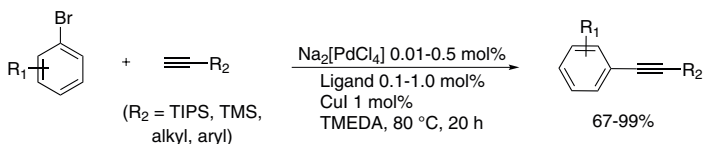
51-99%

# PHOSPHORUS - Ligands and Compounds

**15-3550** N-Phenyl-2-(di-t-butylphosphino)indol, min. 98% [cataCXium® PlntB] (740815-37-6)  
(continued)



Tech. Note (3)  
Ref. (3)

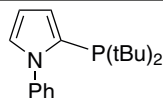


Tech. Note (4)  
Ref. (4)

## References:

1. *Chem. Eur J.* **2004**, *10*, 2983.
2. *Tetrahedron Lett.*, **2005**, *46*, 3237.
3. *J. Org. Chem.*, **2009**, *74*, 3948.
4. *Chem. Sus. Chem.*, **2008**, *1*, 91.

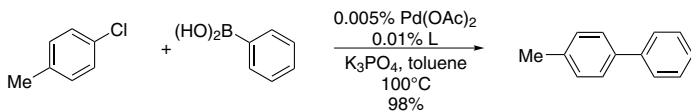
**15-3600** N-Phenyl-2-(di-t-butylphosphino)pyrrole, 95+% [cataCXium® PtB] (672937-61-0)  
 $\text{C}_{18}\text{H}_{26}\text{NP}$ ; FW: 287.38; white to yellow powder;  
 m.p. 51°  
 air sensitive  
 Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.



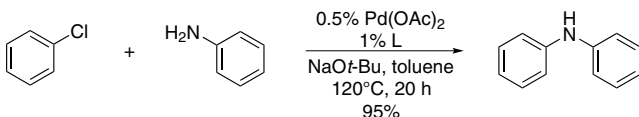
500mg  
2g

## Technical Notes:

1. Ligand for Suzuki reaction of aryl chlorides.
2. Ligand for Pd-catalyzed amination of aryl and heteroaryl chlorides.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

## References:

1. *Chem. Commun.*, **2004**, 38-39.
2. *Chem.-Eur. J.*, **2004**, *10*, 2983.

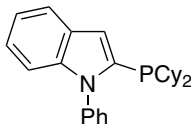
**15-4150** Phenyl dichlorophosphine, 97% (644-97-3) 50g  
 HAZ  $\text{C}_6\text{H}_5\text{PCl}_2$ ; FW: 178.99; yellow liq.; m.p. -51°; b.p. 225°; f.p. >230°F; 250g  
 d. 1.319 (20°) 1kg  
 air sensitive, moisture sensitive

**15-4155** Phenyl dichlorophosphine, 99% (644-97-3) 50g  
 HAZ  $\text{C}_6\text{H}_5\text{PCl}_2$ ; FW: 178.99; colorless to light yellow liq.; m.p. -51°; b.p. 225°; 250g  
 f.p. >230°F; d. 1.319 (20°)  
 air sensitive, moisture sensitive

## PHOSPHORUS - Ligands and Compounds

**15-4158** **Phenyldichlorophosphine oxide, min. 94% (824-72-6)** 50g  
 HAZ  $C_6H_5P(O)Cl_2$ ; FW: 194.99; colorless to light yellow liq.; m.p. 3°; b.p. 258°; 250g  
 f.p. 400°F; d. 1.394 (25°)  
*air sensitive, moisture sensitive*

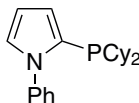
**15-3605** **N-Phenyl-2-(dicyclohexylphosphino) indol, min. 95% [cataCXium® PlnCy] (740815-36-5)** 500mg  
 $C_{26}H_{32}NP$ ; FW: 389.51; white to yellow 2g  
 powd.  
*air sensitive*  
 Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.



### Technical Note:

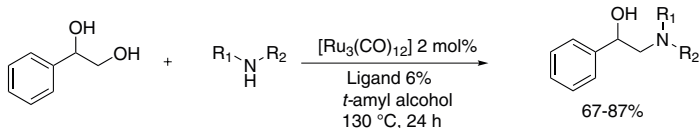
- See 15-3550.

**15-3610** **N-Phenyl-2-(dicyclohexylphosphino) pyrrole, 90% [cataCXium® PCy]** 500mg  
 $C_{22}H_{30}NP$ ; FW: 339.45; white to yellow powd.; 2g  
 m.p. 92°  
*air sensitive*  
 Note: Contains ca. 10% of the regioisomer, N-(2-(dicyclohexylphosphino-phenyl)pyrrole). Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.

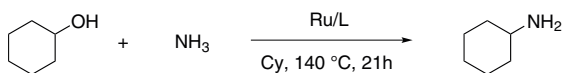


### Technical Notes:

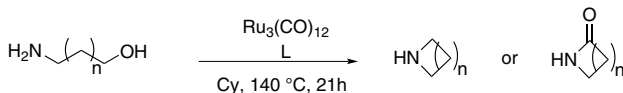
- Useful ligand for the Ru-catalyzed amination of diols.
- Direct amination of secondary alcohols with ammonia.
- Amino-alcohol cyclization to lactams or cyclic amines.



**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (2)**  
**Ref. (2,3)**





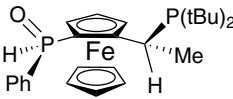
**Tech. Note (3)**  
**Ref. (4)**

### References:

- Chem. Sus. Chem.*, **2009**, 2, 551.
- Angew. Chem. Int. Ed.*, **2010**, 49, 8130.
- Angew. Chem. Int. Ed.*, **2010**, 49, 8126.
- Catal. Sci. Technol.*, **2014**, 4, 47.

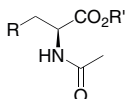
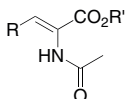
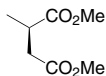
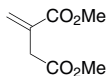
**15-4250** **Phenyldimethoxyphosphine, 98% (2946-61-4)** 1g  
 $(C_6H_5)(CH_3O)_2P$ ; FW: 170.15; colorless liq.; b.p. 77-79°/7 mm; 5g  
 f.p. >230°F; d. 1.072  
*air sensitive, moisture sensitive*

# PHOSPHORUS - Ligands and Compounds

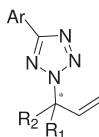
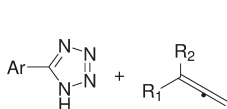
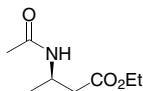
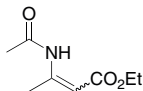
15-4400	<b>Phenylphosphine, 99%</b> (638-21-1) amp HAZ 	$C_6H_5PH_2$ ; FW: 110.10; colorless liq.; b.p. 160°; f.p. 165°F; d. 1.001 <i>pyrophoric, STENCH</i>	2g 10g
15-4402	<b>Phenylphosphine, 99% (Sure/Seal™ bottle)</b> (638-21-1) HAZ 	$C_6H_5PH_2$ ; FW: 110.10; colorless liq.; b.p. 160°; f.p. 165°F; d. 1.001 <i>pyrophoric, STENCH</i>	25g
15-4403	<b>Phenylphosphine, 99% (10 wt% in hexanes)</b> (638-21-1) HAZ	$C_6H_5PH_2$ ; FW: 110.10; colorless liq. <i>air sensitive, STENCH</i>	20g 100g
93-1536	<b>Phenylphosphinic acid, 99%</b> (1779-48-2) HAZ	$C_6H_5P(O)(OH)H$ ; FW: 142.09; white xtl.; m.p. 83-85°	100g 500g
26-1268	<b>(R,S(p), R(SPO)-1-Phenylphosphino)-2-[1-(di-<i>t</i>-butylphosphino)ethyl]ferrocene, min. 97% JoSPOphos</b> (1221746-66-2) $C_{26}H_{36}FeOP_2$ ; FW: 482.36; orange powd. (store cold) Note: Sold in collaboration with Solvias for research purposes only.		100mg 500mg 2g 10g

## Technical Notes:

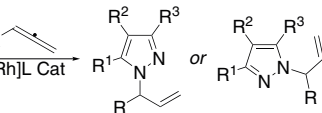
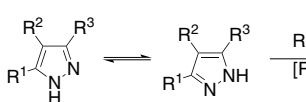
- Ligands used for the rhodium-catalyzed asymmetric hydrogenation of functionalized alkenes,  $\alpha$ - and  $\beta$ -ketoesters.
- Ligand for rhodium-catalyzed enantioselective formation of tertiary and quaternary allylic C–N bonds via allylation of tetrazoles.
- Ligand for rhodium-catalyzed highly regio- and enantioselective addition of pyrazoles to terminal allenes.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3,4)

## References:

- Angew. Chem. Int. Ed.*, **2010**, 49, 6873.
- Chem. Commun.*, **2015**, 51, 10861.
- Angew. Chem. Int. Ed.*, **2015**, 54, 7149.
- Chem. Eur. J.*, **2016**, 22, 6547.

## PHOSPHORUS - Ligands and Compounds

26-1269	<b>(S, R(p), S(SPO)-1-Phenylphosphinoyl)-2-[1-(di-<i>t</i>-butylphosphino)ethyl]ferrocene, min. 97% JoSPOphos (1221746-56-0)</b>	100mg
		500mg
	$C_{26}H_{36}FeOP_2$ ; FW: 482.36; orange powdr. (store cold)	2g
	Note: Sold in collaboration with Solvias for research purposes only.	10g

Technical Note:

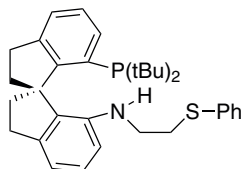
- See 26-1268 (page 250)

93-1537	<b>Phenylphosphonic acid, 98% (1571-33-1)</b>	50g
		250g
	HAZ $(C_6H_5)_2P(O)(OH)_2$ ; FW: 158.09; white xtl.; m.p. 163-166°	1kg

15-1605	<b>(R)-(+)-7-[N-(2-Phenylthio)ethyl-amino]-7'-[bis(3,5-di-<i>t</i>-butylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (&gt;99% ee) [(R)-DTB-SpiroSAP-Ph] (1809609-38-8)</b>	25mg
		100mg

NEW

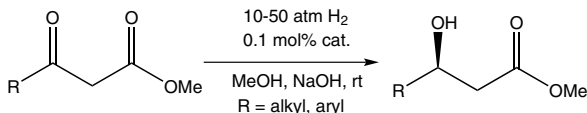
$C_{55}H_{66}NPS$ ; FW: 780.14; off-white solid; m.p. 58-60°  
*air sensitive*



This technical note is for the iridium complex 77-2510. This is an analogous ligand included in the reference below.

Technical Note:

- Catalyst used for the asymmetric hydrogenation of  $\beta$ -alkyl-  $\beta$ -ketoesters.



Tech. Note (1)  
Ref. (1)

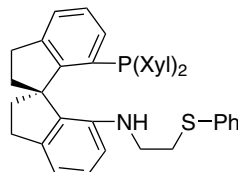
References:

- Angew. Chem. Int. Ed.*, 2015, 54, 8791

15-1645	<b>(R)-(+)-7-[N-(2-Phenylthio)ethyl-amino]-7'-[bis(3,5-dimethylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (&gt;99% ee) [(R)-Xyl-SpiroSAP-Ph] (1809609-39-9)</b>	25mg
		100mg

NEW

$C_{41}H_{42}NPS$ ; FW: 611.82; off-white solid; m.p. 58-60°  
*air sensitive*



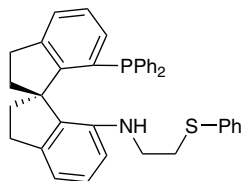
Technical Note:

- See 15-1605 (page 251)

15-1643	<b>(R)-(+)-7-[N-(2-Phenylthio)ethyl-amino]-7'-[diphenylphosphino]-2,2',3,3'-tetrahydro-1,1'-spirobindane, 97+% (&gt;99% ee) [(R)-Ph-SpiroSAP-Ph] (1809609-40-2)</b>	25mg
		100mg

NEW

$C_{37}H_{34}NPS$ ; FW: 555.71; off-white solid; m.p. 55-58°  
*air sensitive*

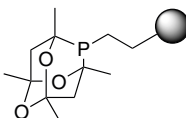


Technical Note:

- See 15-1605 (page 251)

15-4510	<b>Phosphaadamantane ethyl Silica (free phosphine ligand) (PhosphonicS PAR)</b>	500mg
		white solid

Note: Sold in collaboration with PhosphonicS Ltd. for research purposes only.



Particle size range: 60-200 microns

Functional group loading : 0.4 to 0.8 mmol/g

Technical Note:

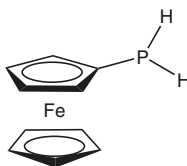
- Supported, free phosphine used in the preparation of immobilized phosphine metal complexes.



# PHOSPHORUS - Ligands and Compounds

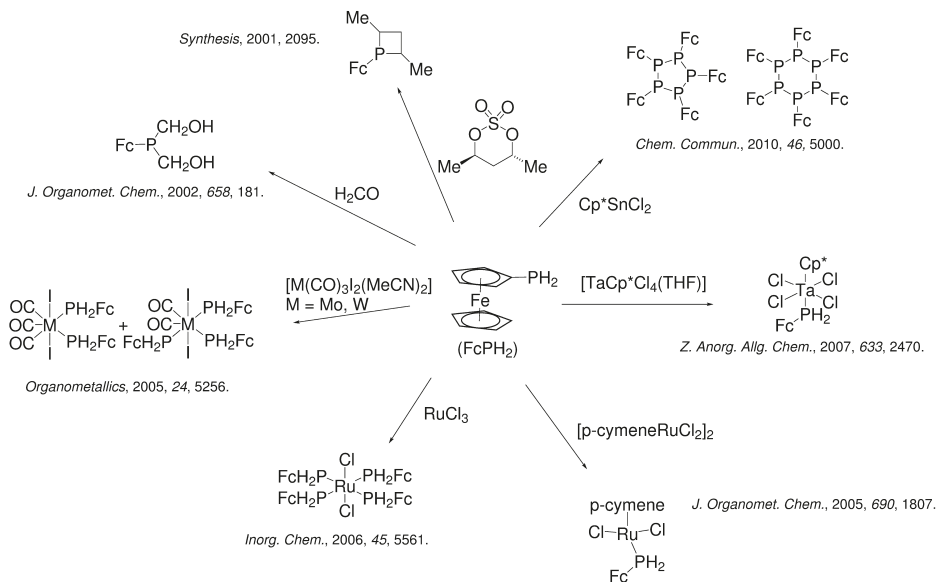
**26-3620 Phosphinoferrrocene, 98% (83528-85-2)**  
 $C_{10}H_{11}FeP$ ; FW: 218.01; red-brown solid  
*air sensitive*

1g  
5g





## Technical Note:

1. Ferrocene organophosphorus building block.





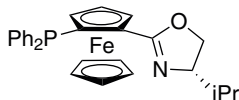
## References:

1. See above.

<b>15-4530</b> HAZ	<b>Phosphonitrilic chloride trimer, 98.5% (940-71-6)</b> (PNCl <sub>2</sub> ) <sub>3</sub> ; FW: 347.66; white xtl.; m.p. 128.8°; b.p. 127°/12 mm; d. 1.98 <i>moisture sensitive</i>	10g 50g
<b>93-1541</b> HAZ	<b>Phosphoric acid (ACS), 85% (7664-38-2)</b> H <sub>3</sub> PO <sub>4</sub> ; FW: 98.00; colorless liq.; d. 1.685	1kg
<b>93-1550</b> HAZ	<b>Phosphorus(III) bromide, 97+% (7789-60-8)</b> PBr <sub>3</sub> ; FW: 270.70; colorless to pale yellow liq.; m.p. -40°; b.p. 172.9°; d. 2.852 (15°) <i>air sensitive, moisture sensitive</i>	100g 500g
<b>93-1587</b> HAZ 	<b>Phosphorus(III) chloride, 98+% (7719-12-2)</b> PCl <sub>3</sub> ; FW: 137.33; colorless liq.; m.p. -111.8°; b.p. 76°; d. 1.574 <i>moisture sensitive</i>	250g
<b>93-1588</b> amp HAZ 	<b>Phosphorus(III) chloride (99.998%-P) PURATREM (7719-12-2)</b> PCl <sub>3</sub> ; FW: 137.33; m.p. -111.8°; b.p. 76°; d. 1.574 <i>moisture sensitive</i>	10g 50g

## PHOSPHORUS - Ligands and Compounds

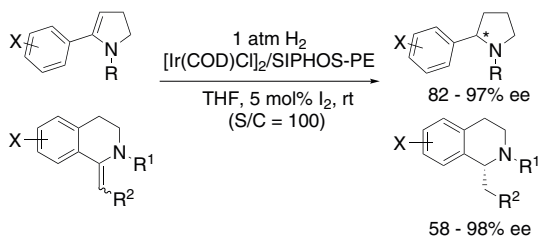
93-1545 HAZ	<b>Phosphorus(V) chloride, 98% (10026-13-8)</b> PCl <sub>5</sub> ; FW: 208.24; white to pale yellow xtl.; m.p. 166.8° subl. <i>moisture sensitive</i>	250g 1kg
93-1548 HAZ	<b>Phosphorus(V) oxide, 98+% (ACS) (1314-56-3)</b> P <sub>2</sub> O <sub>5</sub> ; FW: 141.95; white powdr.; m.p. 580-585°; b.p. 300° subl.; d. 2.39 <i>hygroscopic</i>	500g 4 x 500g
93-1592 HAZ	<b>Phosphorus(V) oxide (99.99%-P) PURATREM (1314-56-3)</b> P <sub>2</sub> O <sub>5</sub> ; FW: 141.95; white powdr.; m.p. 580-585°; b.p. 300° subl.; d. 2.39 <i>hygroscopic</i>	50g 250g
93-1586 amp HAZ	<b>Phosphorus oxybromide, 99% (7789-59-5)</b> POBr <sub>3</sub> ; FW: 286.73; colorless to light yellow xtl.; m.p. 56°; b.p. 193°; d. 2.822 <i>moisture sensitive</i>	5g 25g 100g
93-1543 HAZ 	<b>Phosphorus oxychloride, 98+% (10025-87-3)</b> POCl <sub>3</sub> ; FW: 153.35; colorless liq.; m.p. 2°; b.p. 105.3°; d. 1.675 <i>moisture sensitive</i>	250g 1kg
97-8875 amp HAZ 	<b>Phosphorus oxychloride, elec. gr. (99.999%-P) PURATREM (10025-87-3)</b> POCl <sub>3</sub> ; FW: 153.35; colorless liq.; m.p. 2°; b.p. 105.3°; d. 1.675 <i>moisture sensitive</i>	25g 100g
93-1552 HAZ	<b>Polyphosphoric acid (83% P<sub>2</sub>O<sub>5</sub>) (8017-16-1)</b> H <sub>3</sub> PO <sub>4</sub> ·P <sub>2</sub> O <sub>5</sub> ; FW: 239.95; viscous liq. <i>hygroscopic</i>	250g 1kg
19-2610	<b>Potassium di-t-butylphosphate, min. 91% (contains &lt;5% water) (33494-80-3)</b> K[OP(O)(OC <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ]; FW: 248.30; white powdr.	500mg 2g
15-4581 amp HAZ	<b>n-Propyldichlorophosphine, min. 98% (15573-31-6)</b> n-C <sub>3</sub> H <sub>7</sub> PCl <sub>2</sub> ; FW: 144.97; colorless liq.; b.p. 133°; d. 1.118 <i>air sensitive, moisture sensitive</i>	2g 10g
26-4011	<b>(R,R)-[2-(4'-i-Propyloxazolin-2'-yl)ferrocenyl]diphenylphosphine, min. 97% (541540-70-9)</b> C <sub>28</sub> H <sub>28</sub> FeNOP; FW: 481.35; orange solid <i>air sensitive</i>	100mg 500mg
26-4010	<b>(S,S)-[2-(4'-i-Propyloxazolin-2'-yl)ferrocenyl]diphenylphosphine, min. 97% (163169-29-7)</b> C <sub>28</sub> H <sub>28</sub> FeNOP; FW: 481.35; orange solid <i>air sensitive</i>	100mg 500mg
93-1579 HAZ	<b>Tetra-n-butylphosphonium bromide, 98% (3115-68-2)</b> (C <sub>4</sub> H <sub>9</sub> ) <sub>4</sub> P <sup>+</sup> Br <sup>-</sup> ; FW: 339.35; white xtl.; m.p. 100-103° <i>hygroscopic</i>	25g 100g
15-1318 HAZ	<b>Tetrabutylphosphonium chloride (80-82 wt% solution in water) (2304-30-5)</b> C <sub>16</sub> H <sub>36</sub> ClP; FW: 294.88; colorless to pale-yellow liq.	5g 25g
15-5145	<b>n-Tetradecylphosphonic acid, min. 97% TDPA (4671-75-4)</b> CH <sub>3</sub> (CH <sub>2</sub> ) <sub>13</sub> P(O)(OH) <sub>2</sub> ; FW: 278.37; white to off-white powdr.; m.p. 96-98° Note: Long-Chain n-Alkylphosphonic Acid Kit component.	1g 5g 25g



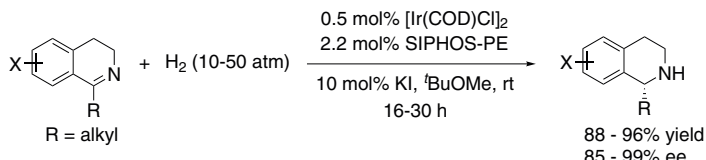


# PHOSPHORUS - Ligands and Compounds

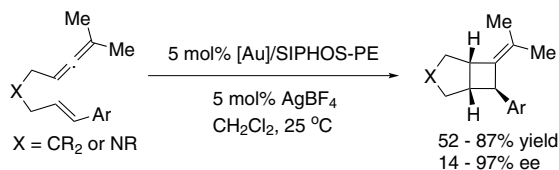
15-5162 (11aR)-(+)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (R)-SIPHOS-PE (500997-69-3)



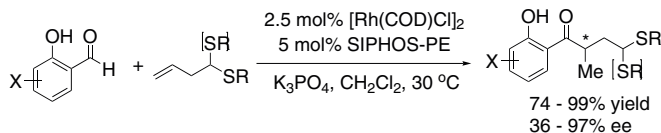
Tech. Note (6)  
Ref. (7,8)



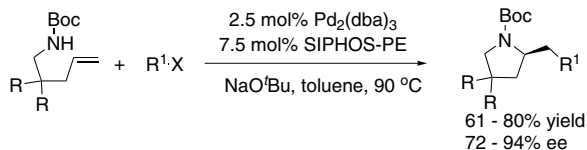
Tech. Note (7)  
Ref. (9)



Tech. Note (8)  
Ref. (10)



Tech. Note (9)  
Ref. (11)



Tech. Note (10)  
Ref. (12,13)

## References:

1. *Tetrahedron: Asymmetry* **2003**, 14, 3867.
2. *J. Org. Chem.* **2003**, 68, 1582.
3. *Tetrahedron: Asymmetry* **2004**, 15, 2231
4. *J. Org. Chem.* **2005**, 70, 3734.
5. *J. Am. Chem. Soc.* **2006**, 128, 2780.
6. *Sci. China Chem.* **2010**, 53, 1899.
7. *J. Am. Chem. Soc.* **2009**, 131, 1366.
8. *Adv. Synth. Catal.* **2010**, 351, 3243.
9. *ACS Catal.* **2012**, 2, 561.
10. *J. Am. Chem. Soc.* **2011**, 133, 5500.
11. *J. Am. Chem. Soc.* **2010**, 132, 16330.
12. *J. Am. Chem. Soc.* **2010**, 132, 12157.
13. *Org. Lett.* **2011**, 13, 2932.

# PHOSPHORUS - Ligands and Compounds

**15-5163** (11aS)-(-)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% 100mg  
(S)-SIPHOS-PE (500997-70-6) 500mg

C<sub>33</sub>H<sub>32</sub>NO<sub>2</sub>P; FW: 505.59; white solid; m.p. 99-101°  
*moisture sensitive*

Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component.

Technical Note:

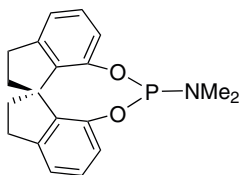
1. See 15-5162 (page 254)

**15-5150** (11aR)-(+)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-dimethylamine, min. 98% 100mg  
(R)-SIPHOS (443965-14-8) 500mg

C<sub>18</sub>H<sub>20</sub>NO<sub>2</sub>P; FW: 325.34; white solid;  
m.p. 95-96°

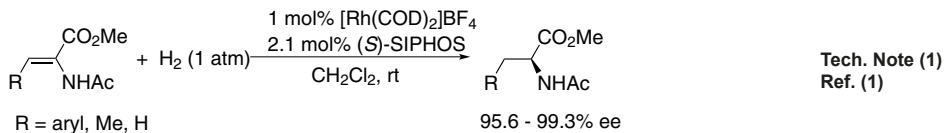
*moisture sensitive*

Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component.

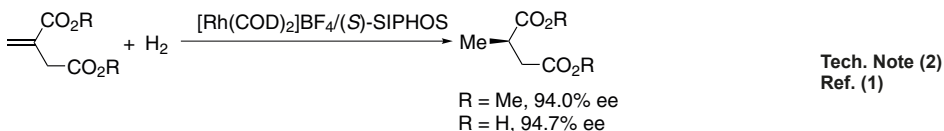


Technical Notes:

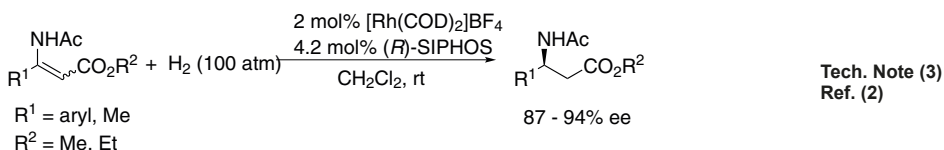
1. Chiral ligands for the rhodium-catalyzed asymmetric hydrogenation of  $\alpha$ -dehydroamino esters.
2. Chiral ligands for the rhodium-catalyzed asymmetric hydrogenation of itaconic acid derivatives.
3. Chiral ligands for rhodium-catalyzed asymmetric hydrogenation of  $\beta$ -dehydroaminoesters.
4. Chiral ligands for rhodium-catalyzed asymmetric hydrogenation of enamides.
5. Chiral ligands for rhodium-catalyzed asymmetric Pauson-Khand reaction.
6. Chiral ligands for palladium-catalyzed asymmetric umpolung allylation of aldehydes.



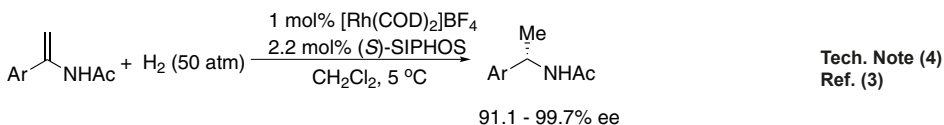
Tech. Note (1)  
Ref. (1)



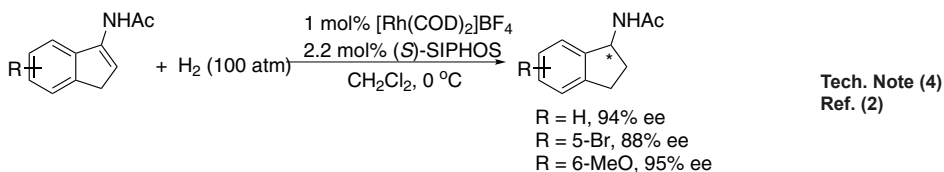
Tech. Note (2)  
Ref. (1)



Tech. Note (3)  
Ref. (2)



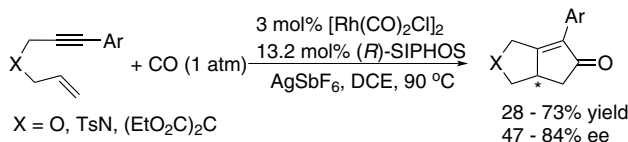
Tech. Note (4)  
Ref. (3)



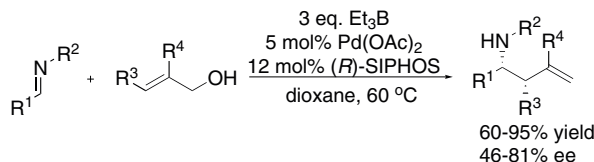
Tech. Note (4)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

**15-5150** (11aR)-(+)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-dimethylamine, min. 98% (R)-SIPHOS (443965-14-8)



Tech. Note (5)  
Ref. (4)



Tech. Note (6)  
Ref. (5)

## References:

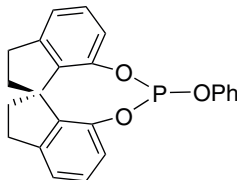
1. *Chem. Commun.* **2002**, 480.
2. *J. Org. Chem.* **2004**, 69, 4648.
3. *Angew. Chem., Int. Ed.* **2002**, 41, 2348.
4. *Adv. Synth. Catal.* **2005**, 347, 759.
5. *Tetrahedron: Asymm.* **2010**, 21, 1216.

**15-5151** (11aS)-(-)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-dimethylamine, min. 98% (S)-SIPHOS (443965-10-4) 100mg  
500mg  
C<sub>19</sub>H<sub>20</sub>NO<sub>2</sub>P; FW: 325.34; white solid; m.p. 95-96°  
*moisture sensitive*  
Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component.

## Technical Note:

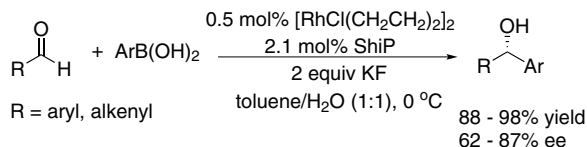
1. See 15-5150 (page 256)

**15-5156** (11aR)-(+)-10,11,12,13-Tetrahydroindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (R)-ShiP (656233-53-3) 100mg  
500mg  
C<sub>23</sub>H<sub>19</sub>O<sub>3</sub>P; FW: 374.37; white solid;  
m.p. 104-106°  
*moisture sensitive*  
Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component.

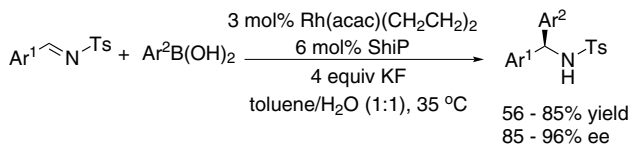


## Technical Notes:

1. Chiral ligands for rhodium-catalyzed arylation of aldehydes with arylboronic acids.
2. Chiral ligands for rhodium-catalyzed arylation of imines with arylboronic acids.
3. Chiral ligands for rhodium-catalyzed arylation of α-ketoesters with arylboronic acids.
4. Chiral ligands for palladium-catalyzed asymmetric umpolung allylation of aldehydes.
5. Chiral ligands for rhodium-catalyzed asymmetric hydrogenation of (Z)-β-arylenamides.



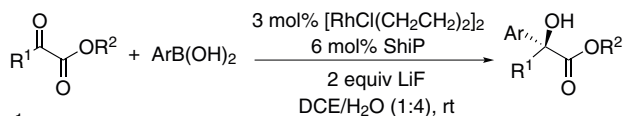
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

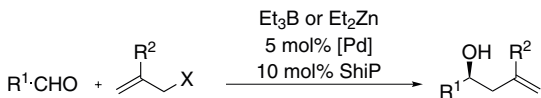
**15-5156** (11aR)-(+)-10,11,12,13-Tetrahydrodiinden[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (R)-ShiP (656233-53-3)



R<sup>1</sup> = aryl, alkenyl  
R<sup>2</sup> = Et, *i*-Pr, *t*-Bu, Ph, Bn

51 - 96% yield  
70 - 93% ee

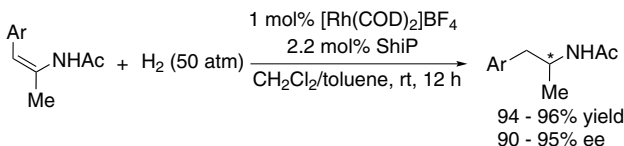
Tech. Note (3)  
Ref. (3)



R<sup>1</sup> = aryl, alkyl  
R<sup>2</sup> = aryl, methyl  
X = OH, OAc, OPh, Cl, Br, ect.

52-97% yield  
83-97% ee

Tech. Note (4)  
Ref. (4)



Tech. Note (5)  
Ref. (5)

## References:

1. *Org. Lett.* **2006**, 8, 1479.
2. *Org. Lett.* **2006**, 8, 2567.
3. *Angew. Chem. Int. Ed.* **2008**, 47, 4351.
4. *Chem. Sci.* **2011**, 2, 1135.
5. *Tetrahedron* **2012**, 68, 7685.

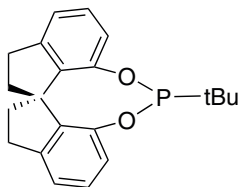
**15-5157** (11aS)-(-)-10,11,12,13-Tetrahydrodiinden[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (S)-ShiP (885701-71-3)  
C<sub>23</sub>H<sub>19</sub>O<sub>3</sub>P; FW: 374.37; white solid; m.p. 102-103°  
*moisture sensitive*  
Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component.

100mg  
500mg

## Technical Note:

1. See 15-5156 (page 257)

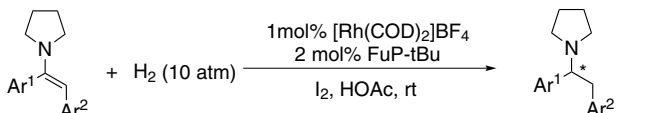
**15-5130** (11aR)-(+)-10,11,12,13-Tetrahydro-5-(1,1-dimethylethyl)diinden[7,1-de,1',7'-fg][1.3.2] dioxaphosphocin, 97% (R)-FuP-tBu  
C<sub>21</sub>H<sub>23</sub>O<sub>2</sub>P; FW: 338.38; white solid  
*moisture sensitive*



25mg  
100mg

## Technical Note:

1. Chiral ligand for the rhodium-catalyzed, asymmetric hydrogenation of enamines.



Tech. Note (1)  
Ref. (1)

100 conv.  
73 - 99.9% ee

## References:

1. *J. Am. Chem. Soc.*, **2006**, 128, 11774.

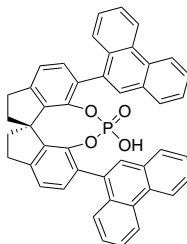
# PHOSPHORUS - Ligands and Compounds

**15-5131** (11aS)-(-)-10,11,12,13-Tetrahydro-5-(1,1-dimethylethyl)diinden[7,1-de:1',7'-fg][1.3.2] dioxaphosphocin, 97% (S)-FuP-tBu  
(912457-08-0)  
C<sub>21</sub>H<sub>23</sub>O<sub>2</sub>P; FW: 338.38; white solid  
*moisture sensitive* 25mg  
100mg

Technical Note:

1. See 15-5130 (page 258)

**15-1363** (11aR)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diinden[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% (1372719-93-1)  
**NEW** C<sub>45</sub>H<sub>31</sub>O<sub>3</sub>P; FW: 666.70; white to light-yellow powdr.  
Note: Sold in collaboration with Daicel for research purposes only. 25mg  
100mg

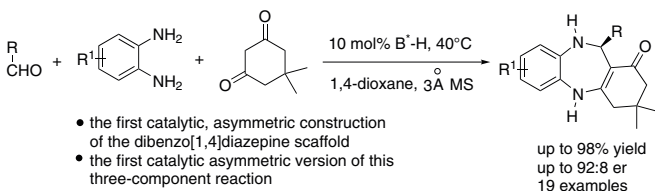


Technical Notes:

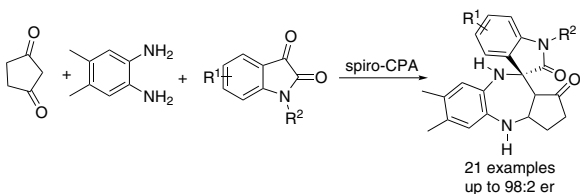
1. Catalytic asymmetric homo-1,3-dipolar cycloadditions of azomethine ylides: diastereo and enantioselective synthesis of imidazolidines.
2. Enantioselective construction of the biologically significant dibenzo[1,4]diazepine scaffold via organocatalytic asymmetric three-component reactions.
3. Enantioselective construction of the biologically important cyclopenta[1,4]diazepine framework enabled by asymmetric catalysis by chiral spiro-phosphoric acid.
4. Triply hydrogen-bond-directed enantioselective assembly of pyrrolobenzo-1,4-diazine skeletons with quaternary stereocenters.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)

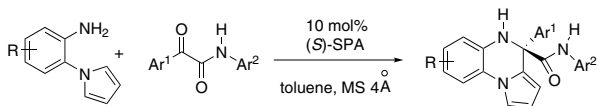


Tech. Note (3)  
Ref. (3)



# PHOSPHORUS - Ligands and Compounds

**15-1363** (11aR)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% (1372719-93-1)



13 examples, 85-94% yield,  
up to 99% ee

Tech. Note (4)  
Ref. (4)

## References:

1. *Tetrahedron Asymmetry*, **2014**, 25, 617.
2. *Adv. Synth. Catal.*, **2009**, 356, 2009.
3. *Eur. J. Org. Chem.*, **2015**, 2015, 7926.
4. *Chem-Eur. J.*, **2015**, 21, 9039.

**15-1364** (11aS)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-di-9-phenanthrenyl-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, min. 98% (1585988-92-6)

NEW

C<sub>46</sub>H<sub>31</sub>O<sub>4</sub>P; FW: 666.70; white to light-yellow powdr.

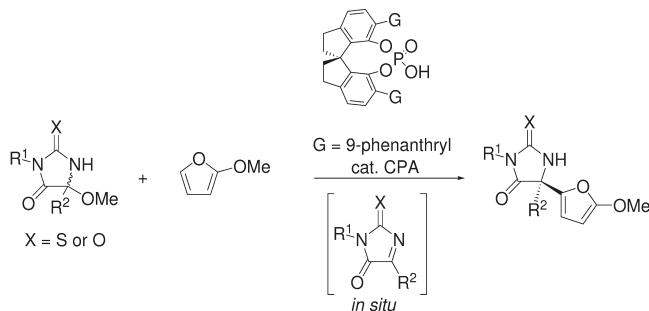
Note: Sold in collaboration with Daicel for research purposes only.

25mg

100mg

## Technical Note:

1. Chiral Bronsted, acid-catalyzed, enantioselective Friedel-Crafts reaction of 2-methoxyfuran with aliphatic ketimines generated in situ.



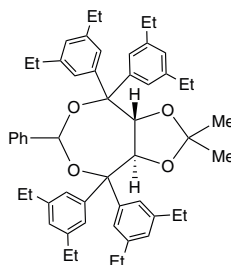
Tech. Note (1)  
Ref. (1)

## References:

1. *Chem. Sci.*, **2016**, 7, 1057.

**15-1517** (3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-diethylphenyl) tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo [4,5-e] dioxaphosphepin (1187446-93-0)

C<sub>63</sub>H<sub>65</sub>O<sub>4</sub>P; FW: 797.06; off-white powdr.

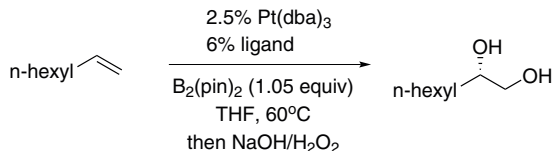


100mg

500mg

## Technical Note:

1. Chiral ligand used in the platinum-catalyzed, enantioselective diboration of terminal alkenes.



Tech. Note (1)  
Ref. (1)

## References:

1. *J. Am. Chem. Soc.* **2009**, 131, 13210.

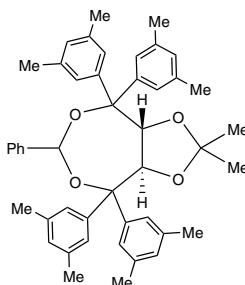
# PHOSPHORUS - Ligands and Compounds

15-1518	(3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-diethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin C <sub>53</sub> H <sub>65</sub> O <sub>4</sub> P; FW: 797.06; off-white powdr.	100mg 500mg
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Technical Note:

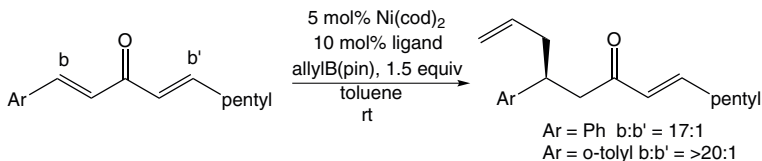
- See 15-1518 (page 261)

15-1511	(3aR,8aR)-(-)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin (1019840-96-0) C <sub>48</sub> H <sub>49</sub> O <sub>4</sub> P; FW: 684.84; off-white solid	100mg 500mg
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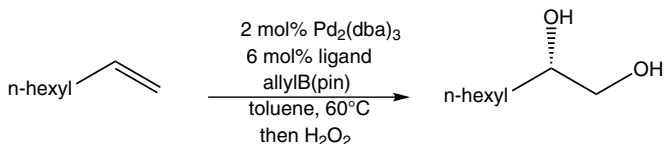


Technical Notes:

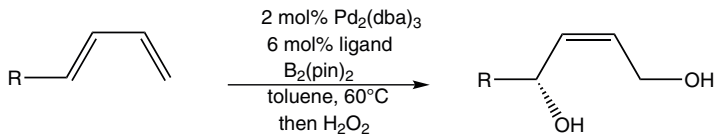
- Chiral ligand used in the nickel-catalyzed, enantioselective, conjugate allylation of activated enones.
- Chiral ligand used in the palladium-catalyzed, enantioselective diboration of terminal alkenes.
- Chiral ligand used in the palladium-catalyzed, asymmetric, 1,4-dihydroxylation of 1,3-dienes via catalytic enantioselective diboration.
- Chiral ligand used in the palladium-catalyzed diboration of N-silylated imines.



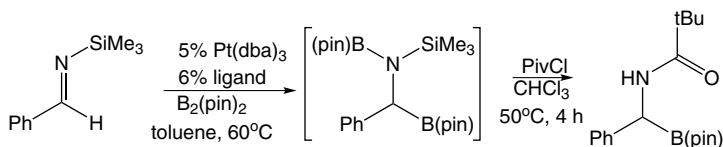
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



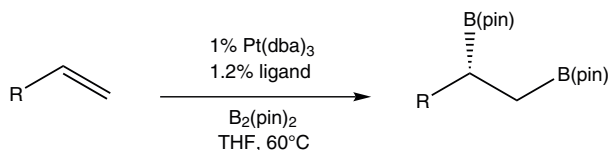
Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

# PHOSPHORUS - Ligands and Compounds

**15-1511** (3aR,8aR)-(-)-4,4,8,8-Tetrakis (3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin (1019840-96-0)



Tech. Note (2)  
Ref. (5)

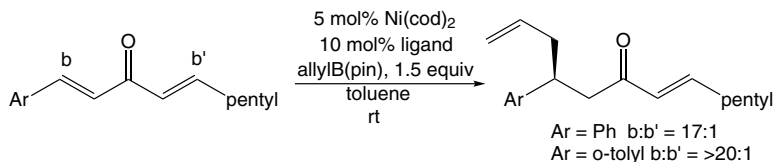
## References:

1. *J. Am. Chem. Soc.*, **2008**, *130*, 4978.
2. *J. Am. Chem. Soc.*, **2009**, *131*, 13210.
3. *J. Am. Chem. Soc.*, **2009**, *131*, 9134.
4. *J. Am. Chem. Soc.*, **2013**, *135*, 9252.
5. *Nature*, **2014**, *505*, 386.

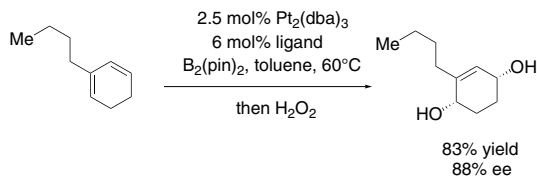
**15-1512** (3aS,8aS)-(+)-4,4,8,8-Tetrakis(3,5-dimethylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-e]dioxaphosphepin (1169835-86-2) 100mg  
500mg  
C<sub>45</sub>H<sub>49</sub>O<sub>4</sub>P; FW: 684.84; off-white solid

## Technical Notes:

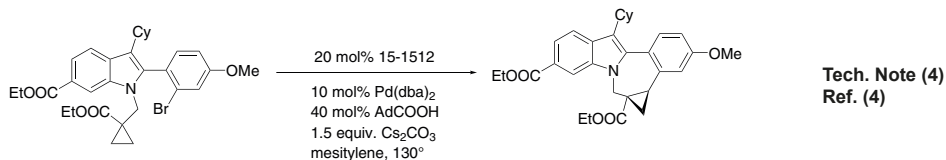
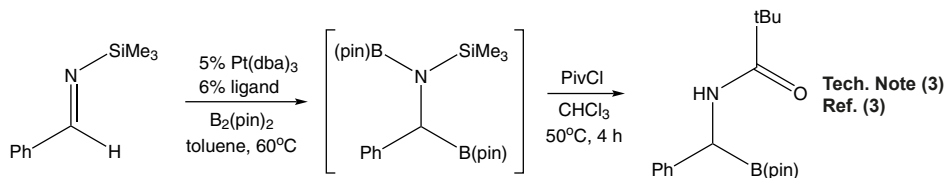
1. Chiral ligand used in the nickel-catalyzed, enantioselective, conjugate allylation of activated enones.
2. Chiral ligand used in the platinum-catalyzed, asymmetric, 1,4-dihydroxylation of 1,3-dienes via catalytic enantioselective diboration.
3. Chiral ligand used in the platinum-catalyzed, asymmetric addition of B<sub>2</sub>(pin)<sub>2</sub> to N-silyl imines for the synthesis of α-amino boronates.
4. Asymmetric 1,4-dihydroxylation of 1,3-dienes by catalytic enantioselective diboration.



Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



## References:

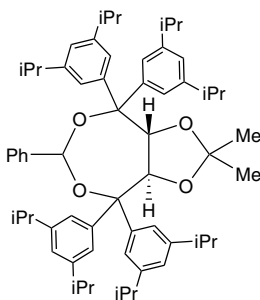
1. *J. Am. Chem. Soc.*, **2008**, *130*, 4978.
2. *J. Am. Chem. Soc.*, **2009**, *131*, 9134.
3. *J. Am. Chem. Soc.*, **2013**, *135*, 9252.
4. *Chem. Sci.*, **2015**, *6*, 5164.

# PHOSPHORUS - Ligands and Compounds

15-1513

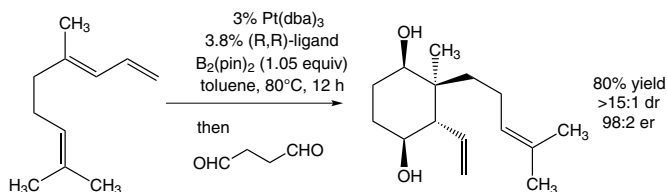
(3*aR*,8*aR*)-(-)-4,4,8,8-Tetrakis  
(3,5-di-*i*-propylphenyl)tetrahy-  
dro-2,2-dimethyl-6-phenyl-1,3-di-  
oxolo[4,5-*e*]dioxaphospepin  
(1361146-90-8)  
C<sub>61</sub>H<sub>81</sub>O<sub>4</sub>P; FW: 909.27; off-white  
powd.

100mg  
500mg

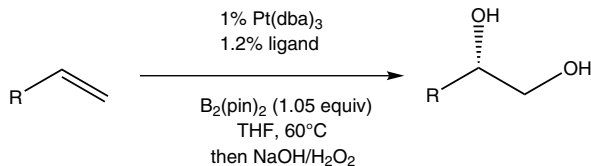


## Technical Notes:

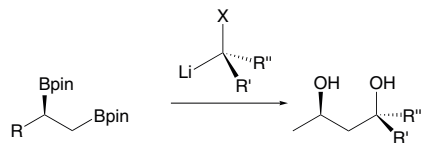
1. Chiral ligand used in a platinum-catalyzed, enantioselective, terpene construction.
2. Chiral ligand used in a platinum-catalyzed, diboration of aliphatic 1-alkenes.
3. Regio- and stereoselective homologation of 1,2-bis(boronic esters): stereocontrolled synthesis of 1,3-diols.
4. Synthesis of  $\beta$ -lactams by palladium(0)-catalyzed C(sp<sup>3</sup>)-H carbamoylation.



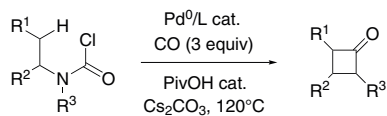
Tech. Note (1)  
Ref. (1)



Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (4)

## References:

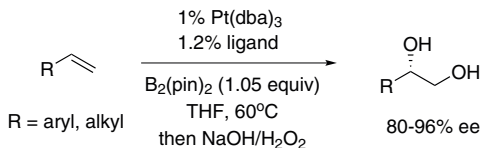
1. *J. Am. Chem. Soc.*, **2013**, 135, 2501.
2. *J. Am. Chem. Soc.*, **2013**, 135, 11222.
3. *Angew. Chem. Int. Ed.*, **2016**, 55, 14663.
4. *Angew. Chem. Int. Ed.*, **2017**, 56, 7218.

# PHOSPHORUS - Ligands and Compounds

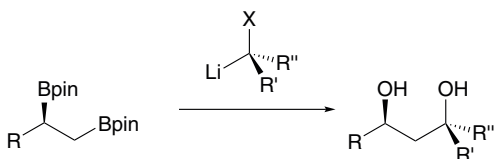
**15-1514** (3a*S*,8a*S*)-(+)-4,4,8,8-Tetrakis(3,5-di-*i*-propylphenyl)tetrahydro-2,2-dimethyl-6-phenyl-1,3-dioxolo[4,5-*e*]dioxaphosphepin (1422371-27-4)  
 $C_{61}H_{81}O_4P$ ; FW: 909.27; off-white powdr. 100mg  
 500mg

**Technical Notes:**

- Chiral ligand for the platinum-catalyzed enantioselective diboration of monosubstituted alkenes.
- Regio- and stereoselective homologation of 1,2-bis(boronic esters): stereocontrolled synthesis of 1,3-diols.



**Tech. Note (1)**  
**Ref. (1)**



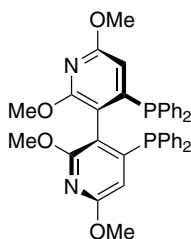
**Tech. Note (2)**  
**Ref. (2)**

**References:**

- J. Am. Chem. Soc.* **2013**, *135*, 11222.
- Angew. Chem.Int. Ed.*, **2016**, *55*, 14663.

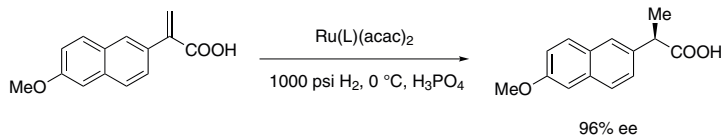
**15-5201** (S)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(diphenylphosphino)-3,3'-bipyridine, min. 95% CTH-(S)-P-Phos (362524-23-0)  
 $C_{38}H_{34}N_4O_4P_2$ ; FW: 644.64; white to pale yellow powdr.  
 Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No US Patent 5 886 182, 1999 and patents arising therefrom. 100mg  
 500mg

**15-5200** (R)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(diphenylphosphino)-3,3'-bipyridine, min. 97% CTH-(R)-P-Phos (221012-82-4)  
 $C_{38}H_{34}N_4O_4P_2$ ; FW: 644.64; white to pale yellow powdr.  
 Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No US Patent 5 886 182, 1999 and patents arising therefrom. 100mg  
 500mg

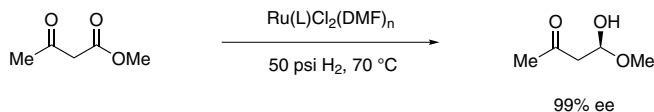


**Technical Notes:**

- New class of highly effective chiral dipyridylphosphine ligands used in the asymmetric hydrogenation of 2-arylacrylic acids,  $\beta$ -ketoesters, aryl ketones, and  $\alpha$ -dehydroamino acids.
- Ligand used in the Pd-catalyzed asymmetric bis-alkoxycarbonylation of styrene.



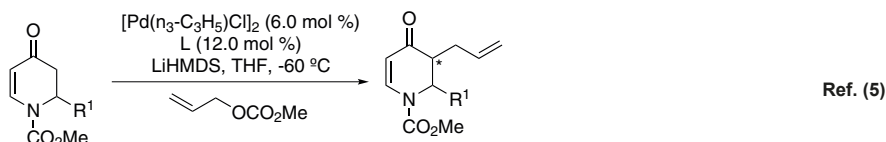
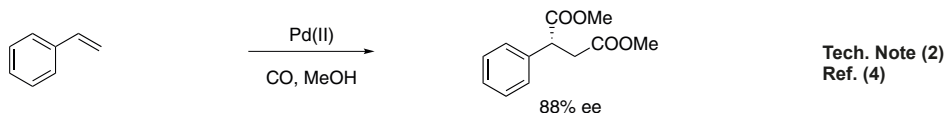
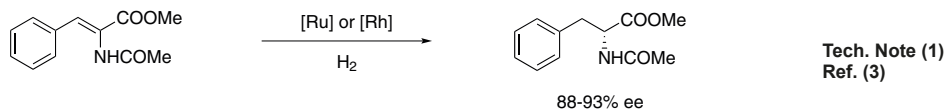
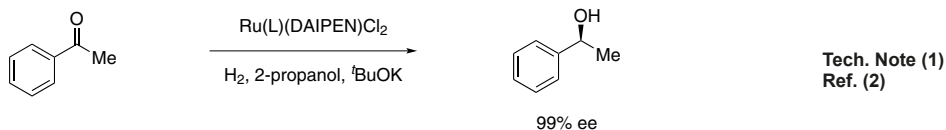
**Tech. Note (1)**  
**Ref. (1)**



**Tech. Note (1)**  
**Ref. (1)**

# PHOSPHORUS - Ligands and Compounds

**15-5200** (continued) **(R)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(diphenylphosphino)-3,3'-bipyridine, min. 97%**  
**CTH-(R)-P-Phos (221012-82-4)**



## References:

1. *J. Am. Chem. Soc.*, **2000**, *122*, 11513.
2. *J. Org. Chem.*, **2002**, *67*, 7908.
3. *Tetrahedron: Asymmetry*, **2003**, *14*, 987.
4. *J. Mol. Catal. A: Chem.*, **2003**, *196*, 171.
5. *Org. Lett.*, **2014**, *16*, 1944.

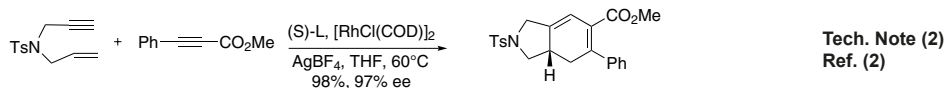
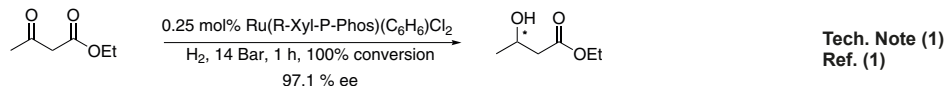
**15-5211** **(S)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine, min. 95%** **CTH-(S)-Xylyl-P-Phos (443347-10-2)** 100mg  
500mg

$C_{46}H_{50}N_2O_4P_2$ ; FW: 756.85; white to pale yellow powder.

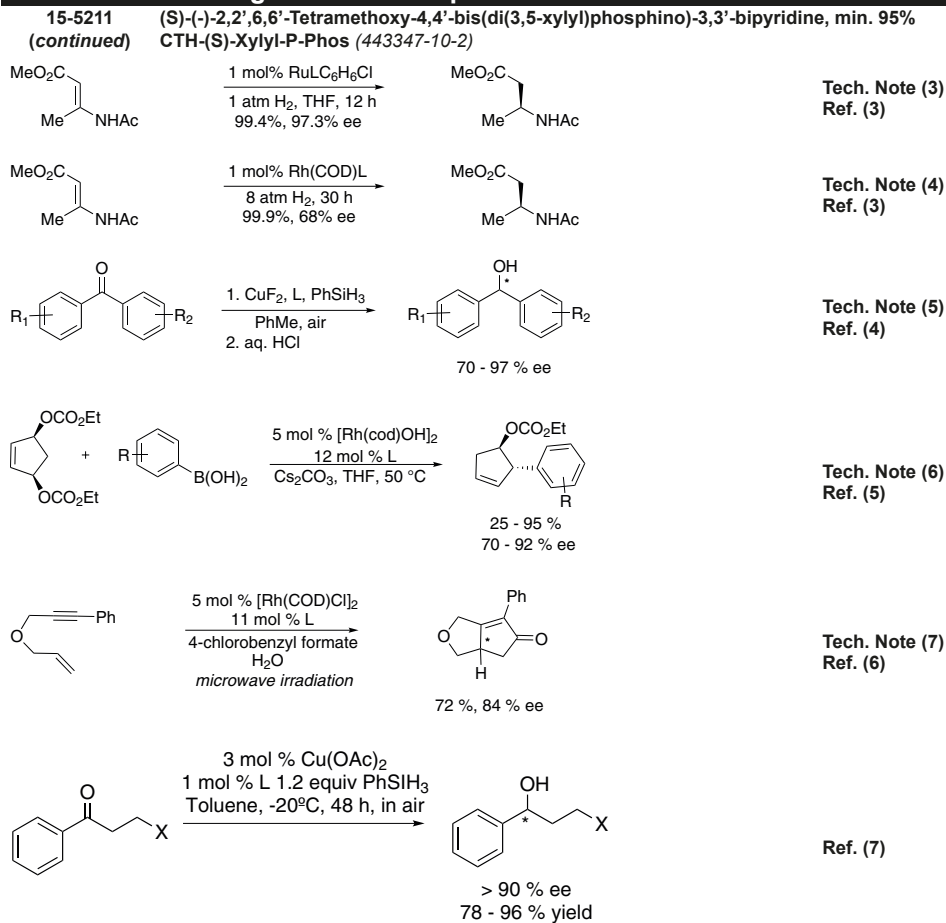
Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No US Patent 5 886 182, 1999 and patents arising therefrom.

## Technical Notes:

1. Chiral ligand for the asymmetric hydrogenation of  $\beta$ -keto esters.
2. Chiral ligand for enantioselective rhodium-catalyzed [2+2+2] carbocyclization reactions.
3. Chiral ligand for ruthenium catalyzed hydrogenation of (E)- $\beta$ -(acylamino)acrylates to  $\beta$ -amino acids.
4. The Rhodium complex gives higher enantioselectivity for hydrogenation of (Z)- $\beta$ -(acylamino)acrylates to  $\beta$ -amino acids.
5. Chiral ligand for copper-catalyzed asymmetric hydrosilylation of ketones
6. Chiral ligand for asymmetric allylic substitution reactions using boronic acids as nucleophiles.
7. Gives useful selectivity in asymmetric Pauson-Khand-type cyclizations.



# PHOSPHORUS - Ligands and Compounds

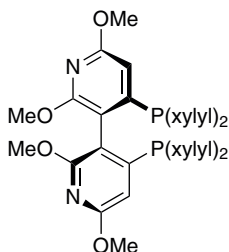


## References:

1. *Tetrahedron Lett.*, **2002**, 43, 1539.
2. *J. Am. Chem. Soc.*, **2005**, 127, 12466.
3. *J. Org. Chem.*, **2003**, 68, 2490.
4. *Proc. Nat. Acad. Sci.*, **2005**, 102, 3570
5. *Org. Lett.*, **2006**, 8, 4569
6. *Synlett.*, **2008**, 10, 1553.
7. *Chem. Eur. J.*, **2011**, 17, 14234.

# PHOSPHORUS - Ligands and Compounds

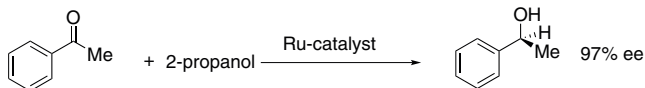
**15-5210** (R)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine, min. 97% CTH-(R)-Xylyl-P-PHOS (442905-33-1)  
 $C_{46}H_{50}N_2O_4P_2$ ; FW: 756.85; white to pale yellow powdr.  
 Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No US Patent 5 886 182, 1999 and patents arising therefrom.



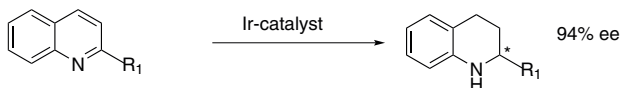
100mg  
500mg

## Technical Notes:

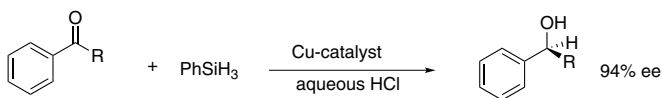
1. Chiral ligand for ruthenium catalyzed asymmetric hydrogenation of aromatic ketones.
2. Chiral ligand for iridium catalyzed asymmetric hydrogenation of quinolines.
3. Chiral ligand for copper catalyzed asymmetric hydrosilylation of ketones
4. Synthesis of new chiral 2-functionized-1,2,3,4-tetrahydroquinoline derivatives via asymmetric hydrogenation of substituted quinolines.
5. Rhodium-biphosphine-catalyzed asymmetric, intermolecular hydroheteroarylation of  $\alpha$ -substituted acrylate derivatives.



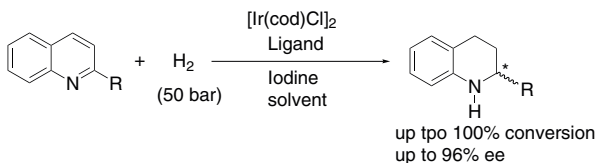
Tech. Note (1)  
Ref. (1)



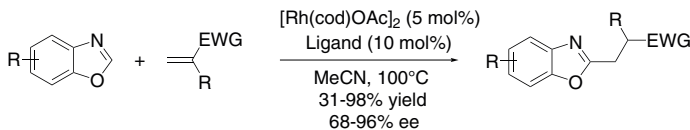
Tech. Note (2)  
Ref. (2)



Tech. Note (3)  
Ref. (3)



Tech. Note (4)  
Ref. (3)

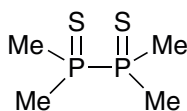


Tech. Note (5)  
Ref. (5)

## References:

1. *J. Organomet. Chem.*, **2006**, 691, 2332.
2. *Tetrahedron Asym.*, **2007**, 18, 2625.
3. *Chem. Eur. J.*, **2009**, 15, 5888
4. *Tetrahedron*, **2013**, 69, 9322.
5. *J. Am. Chem. Soc.*, **2015**, 137, 508.

**15-5350** Tetramethylbiphosphine disulfide, 99% (3676-97-9)  
 $(CH_3)_2P(S)P(S)(CH_3)_2$ ; FW: 186.21; white xtl.; m.p. 224-228°



5g  
25g

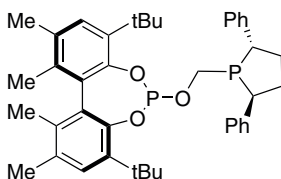


# PHOSPHORUS - Ligands and Compounds

15-0557

NEW

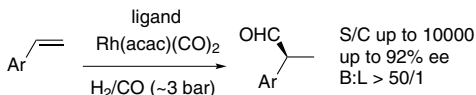
(11*aS*)-1,2,10,11-Tetramethyl-4,8-bis(*t*-butyl)-6-[[[(2*S*,5*S*)-(2,5-diphenyl-1-phospholanyl)methoxy]-dibenzo[*d,f*][1,3,2]dioxaphosphepin] *S*<sub>ax</sub>*S*<sub>ax</sub>*S*-BOBPPOS (1373349-83-7)  
C<sub>41</sub>H<sub>50</sub>O<sub>3</sub>P<sub>2</sub>; FW: 652.78;  
white microxtl. powdr.  
*moisture sensitive*



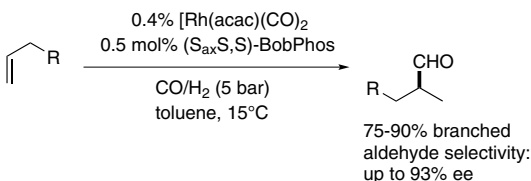
100mg  
500mg

## Technical Notes:

- Rhodium/phospholane catalysts for the unusually high regioselectivity in the enantioselective hydroformylation of vinyl arenes.
- An asymmetric hydroformylation catalyst that delivers branched aldehydes from alkyl alkenes



Tech. Note (1)  
Ref. (1)



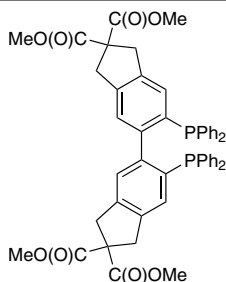
Tech. Note (2)  
Ref. (2)

## References:

- Chem Commun.*, **2014**, 50, 1475.
- Angew. Chem. Int. Ed.*, **2012**, 51, 2477.

15-0506

**Tetramethyl 6,6'-bis(diphenylphosphino)-1,1',3,3'-tetrahydro[5,5']biindenyl-2,2',2,2'-tetracarboxylate, 99%** (959864-39-2)  
C<sub>48</sub>H<sub>44</sub>O<sub>8</sub>P<sub>2</sub>; FW: 810.81;  
white to pale yellow powdr.  
Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.



100mg  
500mg

## Technical Note:

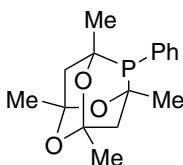
- Ligand used in the platinum-catalyzed asymmetric carbonyl-ene reaction.

## References:

- Org. Lett.*, **2007**, 9, 4925.

15-5355

**1,3,5,7-Tetramethyl-8-phenyl-2,4,6-tri-oxa-8-phosphaadamantane, 99%**  
**MeCgPPh** (97739-46-3)  
C<sub>16</sub>H<sub>21</sub>O<sub>3</sub>P; FW: 292.31; white powdr.;  
m.p. 107-109°  
*air sensitive, moisture sensitive*



500mg  
2g

## Technical Note:

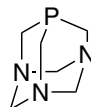
- A bulky, robust, and electron-poor ligand that gives efficient rhodium hydroformylation and palladium cross-coupling catalysts.

## References:

- Dalton Transactions*, **2005**, 6, 1079.
- Synthesis.*, **2007**, 23, 3722.
- Tetrahedron Lett.*, **2004**, 45, 8319.
- J. Org. Chem.*, **2004**, 69, 7635.

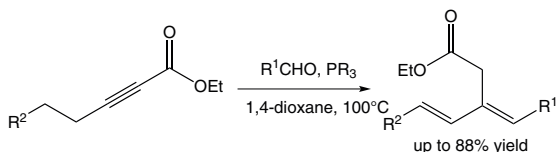
## PHOSPHORUS - Ligands and Compounds

15-5360	<b>Tetramethylphosphonium bromide, 98% (4519-28-2)</b> (CH <sub>3</sub> ) <sub>4</sub> P <sup>+</sup> Br <sup>-</sup> ; FW: 171.02; colorless xtl. <i>hygroscopic</i>	1g 5g
15-1322	<b>Tetraoctylphosphonium bromide, min. 95% (23906-97-0)</b> C <sub>32</sub> H <sub>68</sub> BrP; FW: 563.76; white to yellow, waxy solid <i>hygroscopic</i>	5g 25g
15-5450	<b>Tetraphenylphosphonium bromide, 99% (2751-90-8)</b> (C <sub>6</sub> H <sub>5</sub> ) <sub>4</sub> P <sup>+</sup> Br <sup>-</sup> ; FW: 419.30; white xtl.; m.p. 294-296° <i>hygroscopic</i>	5g 25g 100g
93-1591	<b>Thiophosphoryl chloride, 98% (3982-91-0)</b> HAZ PSCl <sub>3</sub> ; FW: 169.40; colorless liq.; m.p. -35°; b.p. 125°; d. 1.668 <i>moisture sensitive</i>	100g 500g
15-5600	<b>p-Tolyldiphenylphosphine, min. 96% (1031-93-2)</b> (p-CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> )(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P; FW: 276.32; white xtl.; m.p. 64-66°	25g 100g
15-5700	<b>Triallylphosphine, min. 97% (16523-89-0)</b> amp HAZ (CH <sub>2</sub> =CHCH <sub>2</sub> ) <sub>3</sub> P; FW: 154.19; colorless to pale yellow liq.; b.p. 69°/13 mm; d. 0.861 <i>air sensitive</i>	1g 5g
93-1556	<b>Tri-n-amyolphosphate, min. 97% (2528-38-3)</b> (C <sub>8</sub> H <sub>17</sub> O) <sub>3</sub> P(O); FW: 308.40; colorless liq.	25g 100g
15-5710	<b>1,3,5-Triaza-7-phosphaadamantane, min. 97% PTA</b> (53597-69-6) C <sub>6</sub> H <sub>12</sub> N <sub>3</sub> P; FW: 157.15; white xtl.	1g 5g

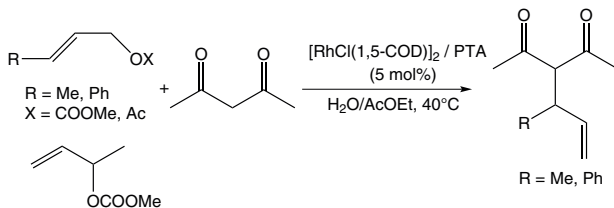


### Technical Notes:

1. Air-stable, water-soluble version of trimethylphosphine.
2. Reagent used in the  $\beta$ -olefination of 2-alkynoates leading to trisubstituted 1,3-dienes.
3. Ligand/rhodium catalyst used in the branch selective allylation of acetylacetone.
4. Ligand/oxorhenium complex used as a catalyst for the Baeyer-Villiger oxidation of ketones.



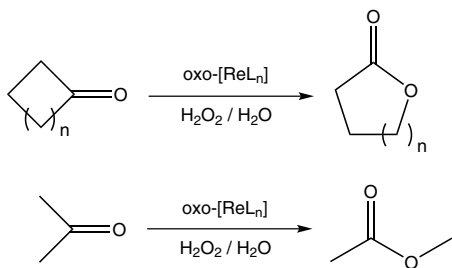
Tech. Note (2)  
Ref. (1)



Tech. Note (3)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

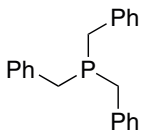









15-5710 1,3,5-Triaza-7-phosphaadamantane, min. 97% PTA (53597-69-6)  
(continued)



Tech. Note (4)  
Ref. (3)

## References:

1. *Org. Lett.*, **2011**, 13, 3418.
2. *J. Organometallic Chem.*, **2011**, 696, 1927.
3. *Inorg. Chem.*, **2013**, 52, 4534.

15-5730	<b>Tribenzylphosphine, 98% (7650-89-7)</b> ( $\text{C}_6\text{H}_5\text{CH}_2$ ) <sub>3</sub> P; FW: 304.37; white powdr.; m.p. 96-101° <i>air sensitive</i>		1g 5g
15-1330	<b>Tributyl(ethyl)phosphonium diethylphosphate, 95% (20445-94-7)</b> $\text{C}_{18}\text{H}_{42}\text{O}_4\text{P}_2$ ; FW: 384.47; colorless to pale-yellow liq.; d. 1.007 <i>hygroscopic</i>		5g 25g
15-1327	<b>Tributyl(methyl)phosphonium methylsulfate, min. 95% (69056-62-8)</b> HAZ $\text{C}_{14}\text{H}_{33}\text{O}_3\text{PS}$ ; FW: 328.18; white solid to pale-yellow liq.		5g 25g
15-1324	<b>Tri-<i>i</i>-butyl(methyl)phosphonium tosylate, min. 95% (374683-35-9)</b> $\text{C}_{20}\text{H}_{37}\text{O}_3\text{PS}$ ; FW: 388.54; white to yellow, waxy solid; d. 1.1		5g 25g
15-5750	<b>Tri-<i>i</i>-butylphosphine, min. 93% (4125-25-1)</b> HAZ ( <i>i</i> - $\text{C}_4\text{H}_9$ ) <sub>3</sub> P; FW: 202.32; colorless to light yellow liq.; b.p. 85°/7mm <i>air sensitive</i>		25g 100g
15-5801	<b>Tri-<i>n</i>-butylphosphine, min. 93% (998-40-3)</b> HAZ ( <i>n</i> - $\text{C}_4\text{H}_9$ ) <sub>3</sub> P; FW: 202.32; colorless to light yellow liq.; b.p. 110-115°/10-12 mm; f.p. 99°F; d. 0.817 <i>pyrophoric</i>	  	100g 500g
15-5813	<b>Tri-<i>t</i>-butylphosphine, min. 98% (13716-12-6)</b> HAZ ( <i>t</i> - $\text{C}_4\text{H}_9$ ) <sub>3</sub> P; FW: 202.32; colorless liq. to white solid; m.p. 30°; b.p. 102-103°/13 mm; f.p. 1°F; d. 0.812 <i>pyrophoric</i>	  	1g 5g
15-5818	<b>Tri-<i>t</i>-butylphosphine, min. 98% (50wt% in toluene) (13716-12-6)</b> $\text{C}_{12}\text{H}_{27}\text{P}$ ; FW: 202.32; colorless liq. <i>air sensitive</i>		2g 10g
15-5800	<b>Tri-<i>n</i>-butylphosphine, 99% (998-40-3)</b> HAZ ( <i>n</i> - $\text{C}_4\text{H}_9$ ) <sub>3</sub> P; FW: 202.32; colorless liq.; b.p. 110-115°/10-12 mm; f.p. 99°F; d. 0.817 <i>pyrophoric</i>	  	25g 100g 500g
15-5802	<b>Tri-<i>n</i>-butylphosphine, 99% (10 wt% in hexanes) (998-40-3)</b> HAZ ( <i>n</i> - $\text{C}_4\text{H}_9$ ) <sub>3</sub> P; FW: 202.32; colorless liq. <i>air sensitive</i>		250g 1kg

# PHOSPHORUS - Ligands and Compounds

15-5810

**Tri-*t*-butylphosphine, 99%** (13716-12-6)

1g

amp

( $t\text{-C}_4\text{H}_9$ )<sub>3</sub>P; FW: 202.32; colorless liq. to white solid; m.p. 30°;

HAZ

b.p. 102-103°/13 mm; f.p. 1°F; d. 0.812



pyrophoric

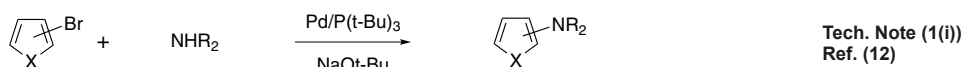
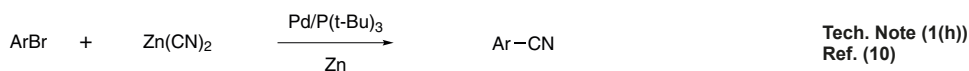
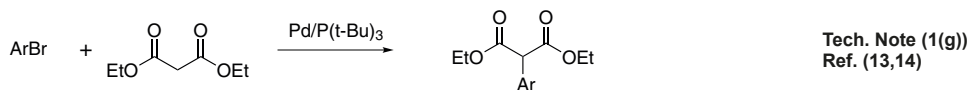
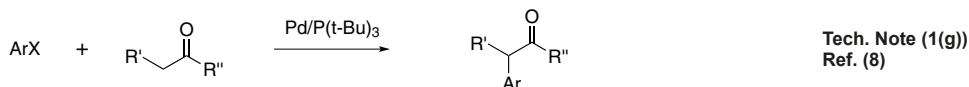
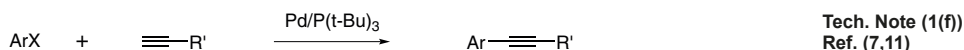
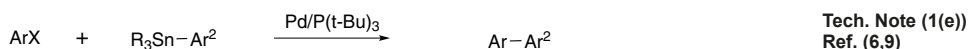
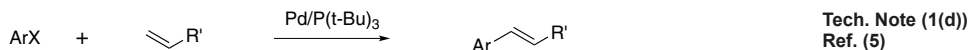
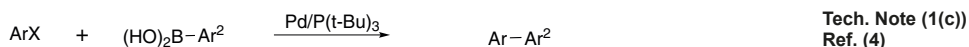
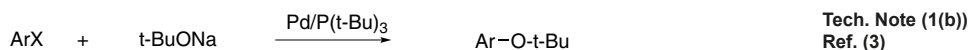
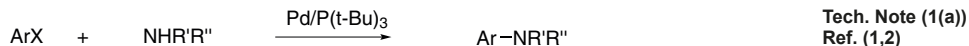


5g

25g

## Technical Note:

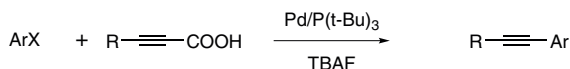
- Useful as a ligand in a variety of palladium-catalyzed C-N, C-O and C-C bond-forming reactions under mild conditions.
  - Amination of aryl halides.
  - Aryl ether formation from aryl halides.
  - Suzuki cross-coupling.
  - Heck reaction for aryl chlorides.
  - Stille cross-coupling of aryl chlorides.
  - Sonogashira reaction for aryl bromides.
  - Ketone and malonate arylation.
  - Cyanation of aryl bromides.
  - Heteroaryl bromide amination.
  - Decarboxylative coupling of alkynyl carboxylic acids and aryl halides.
  - Synthesis of benzosilolo[2,3-*b*]indoles
  - Borylative Ketone-Diene Coupling
  - Synthesis of diaryethynyl methanes



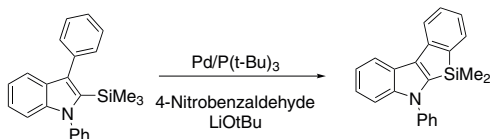
# PHOSPHORUS - Ligands and Compounds

**15-5810** Tri-*t*-butylphosphine, 99% (13716-12-6)

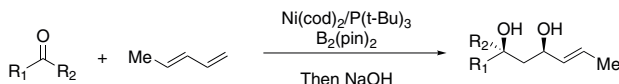
(continued)



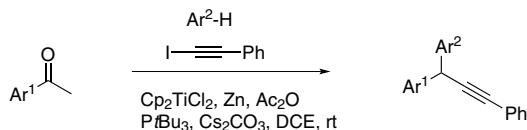
Tech. Note (1(j))  
Ref. (15)



Tech. Note (1(k))  
Ref. (16)



Tech. Note (1(l))  
Ref. (17)



Tech. Note (1(m))  
Ref. (18)

## References:

1. *J. Org. Chem.*, **1999**, *64*, 5575.
2. *Tetrahedron Lett.*, **1998**, *39*, 2367
3. *Tetrahedron Lett.*, **1999**, *40*, 8837.
4. *J. Am. Chem. Soc.*, **2000**, *122*, 4020.
5. *J. Org. Chem.*, **1999**, *64*, 10.
6. *Angew. Chem. Int. Ed.*, **1999**, *38*, 2411
7. *Org. Lett.*, **2000**, *2*, 1729.
8. *J. Am. Chem. Soc.*, **1999**, *121*, 1473
9. *J. Am. Chem. Soc.*, **2002**, *124*, 6343.
10. *Synlett.*, **2003**, 2237.
11. *Org. Lett.*, **2003**, *5*, 4191.
12. *J. Org. Chem.*, **2003**, *68*, 2861.
13. *J. Org. Chem.*, **2002**, *67*, 541.
14. *Chem. Commun.*, **2001**, 2704.
15. *J. Org. Chem.*, **2009**, *74*, 1403.
16. *J. Am. Chem. Soc.*, **2011**, *133*, 9204.
17. *Org. Lett.*, **2011**, *13*, 5267.
18. *J. Am. Chem. Soc.*, **2012**, *134*, 18217.

**15-5811** Tri-*t*-butylphosphine, 99% (10 wt% in hexanes) (13716-12-6)  
HAZ (t-C<sub>4</sub>H<sub>9</sub>)<sub>3</sub>P; FW: 202.32; colorless liq.; d. 0.680  
*air sensitive*

10g  
50g

## Technical Note:

1. See 15-5810 (page 271)

**15-5812** Tri-*t*-butylphosphine, 99% (10 wt% in hexanes) (Sure/Seal™ bottle)  
HAZ (13716-12-6)  
(t-C<sub>4</sub>H<sub>9</sub>)<sub>3</sub>P; FW: 202.32; colorless liq.; d. 0.680  
*air sensitive*

50g

## Technical Note:

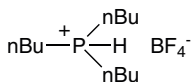
1. See 15-5810 (page 271)

**15-5950** Tri-*n*-butylphosphite, min. 94% (102-85-2)  
(n-C<sub>4</sub>H<sub>9</sub>O)<sub>3</sub>P; FW: 250.32; colorless liq.; b.p. 121-125°/6 mm; f.p. 197°F;  
d. 0.925  
*air sensitive*

250g  
1kg

# PHOSPHORUS - Ligands and Compounds

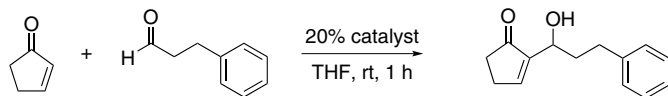
**15-5990** **Tri-n-butylphosphonium tetrafluoroborate,**  
**99% (113978-91-9)**  
 [(C<sub>4</sub>H<sub>9</sub>)<sub>3</sub>PH]<sup>+</sup>BF<sub>4</sub><sup>-</sup>; FW: 290.13; white powdr.;  
 m.p. 51-52°



1g  
5g

## Technical Notes:

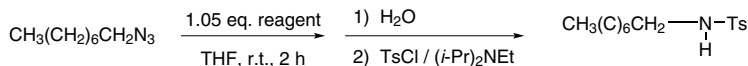
- Air-stable, non-pyrophoric precursor of the Tri-n-butylphosphine ligand which is used in a variety of catalytic processes.
- Catalyst in Baylis-Hillman reactions.
- Azide reductions.
- Acylation of alcohols by anhydrides.
- Ligand for formate reduction of allyl carbonates.
- Synthesis of aromatic nitriles via Pd C-H functionalization.



1.5 equiv

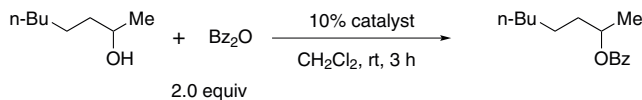
Catalyst	Yield
(n-Bu) <sub>3</sub> P / PhOH (1:1)	96%
[(n-Bu) <sub>3</sub> PH]BF <sub>4</sub> / PhONa (1:1)	94%

Tech. Note (2)



Reagent	Yield
(n-Bu) <sub>3</sub> P	77%
[(n-Bu) <sub>3</sub> PH]BF <sub>4</sub> / (i-Pr) <sub>2</sub> NEt	78%

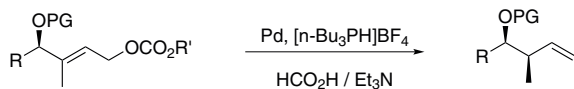
Tech. Note (3)



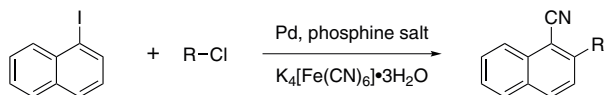
2.0 equiv

Catalyst	Yield
(n-Bu) <sub>3</sub> P	96%
[(n-Bu) <sub>3</sub> PH]BF <sub>4</sub> /NaOBz (1:1)	97%
[(n-Bu) <sub>3</sub> PH]BF <sub>4</sub> /(i-Pr) <sub>2</sub> NEt (1:1)	98%

Tech. Note (4)



Tech. Note (5)  
Ref. (2)



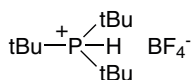
Tech. Note (6)  
Ref. (3)

## References:

- Org. Lett.*, **2001**, 3, 4295
- Org. Lett.*, **2003**, 5, 3391.
- J. Am. Chem. Soc.*, **2007**, 129, 15372.

# PHOSPHORUS - Ligands and Compounds

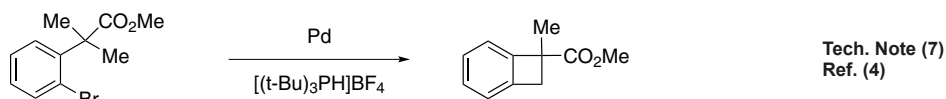
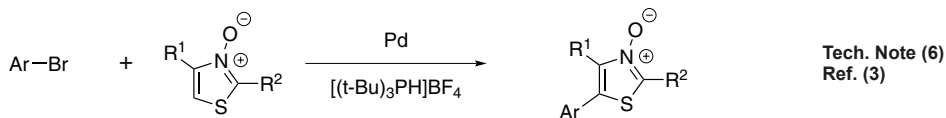
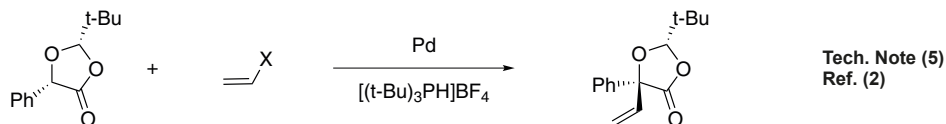
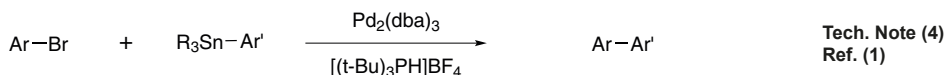
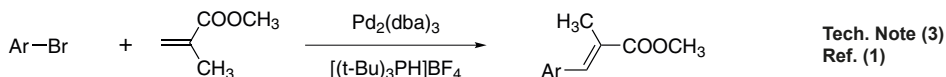
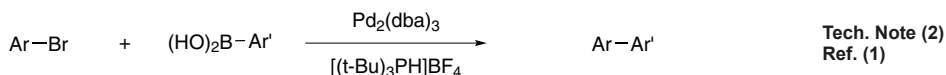
**15-6000** **Tri-*t*-butylphosphonium tetrafluoroborate, 99%**  
 (131274-22-1)  
 [(C<sub>4</sub>H<sub>9</sub>)<sub>3</sub>PH]<sup>+</sup>BF<sub>4</sub><sup>-</sup>; FW: 290.13; white powdr.;  
 m.p. 261° dec.  
 Note: Phosphine Ligand Kit component.



1g  
 5g  
 25g

## Technical Notes:

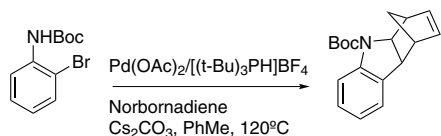
1. Air-stable, non-pyrophoric precursor of the Tri-*t*-butylphosphine ligand which is used in a variety of catalytic processes.
2. Ligand for Suzuki cross-couplings.
3. Ligand for Heck Reactions.
4. Ligand for Stille Cross-couplings.
5. Ligand for  $\alpha$ -Arylation and vinylation of arylmandelic acid derivatives.
6. Ligand for direct arylation of heterocycles
7. Synthesis of benzocyclobutenes by C-H activation.
8. Cross-coupling of Grignard reagents and aryl bromides.
9. Palladium catalyzed annulation of haloanilines.
10. Palladium-Catalyzed Acylation.
11. Palladium Catalyzed Carbonylative Heck Reaction
12. Palladium-catalyzed aminosulfonylation.
13. Palladium-catalyzed intramolecular C–O bond formation.
14. Ruthenium-catalyzed cross-coupling of aldehydes with arylboronic acid.



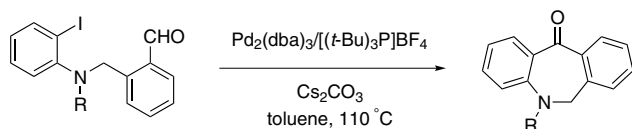
# PHOSPHORUS - Ligands and Compounds

15-6000 Tri-*t*-butylphosphonium tetrafluoroborate, 99% (131274-22-1)

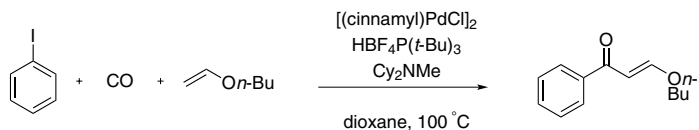
(continued)



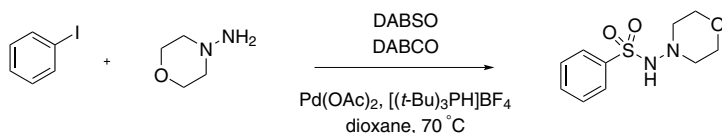
Tech. Note (9)  
Ref. (6)



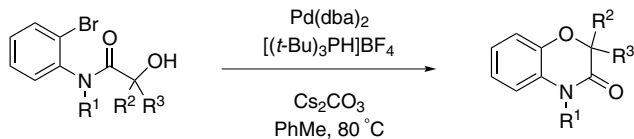
Tech. Note (10)  
Ref. (7)



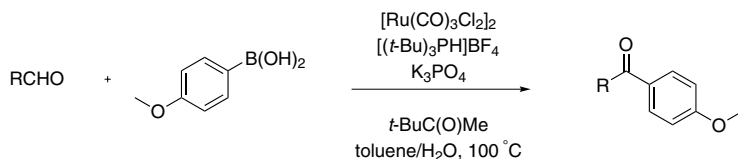
Tech. Note (11)  
Ref. (8)



Tech. Note (12)  
Ref. (9)



Tech. Note (13)  
Ref. (10)



Tech. Note (14)  
Ref. (11)

## References:

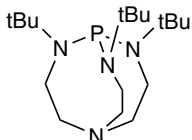
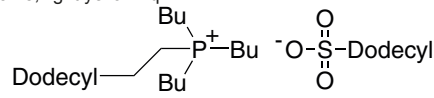
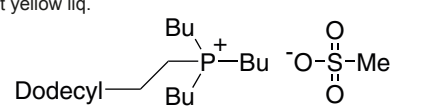
1. *Org. Lett.*, **2001**, 3, 4295.
2. *Org. Lett.*, **2009**, 11, 1543.
3. *J. Am. Chem. Soc.*, **2008**, 130, 3276.
4. *J. Am. Chem. Soc.*, **2008**, 130, 15157.
5. *J. Org. Chem.*, **2009**, 75, 6677.
6. *J. Org. Chem.*, **2009**, 74, 1673.
7. *J. Org. Chem.*, **2013**, 78, 8136.
8. *Org. Lett.*, **2012**, 14, 2536.
9. *Org. Biomol. Chem.*, **2012**, 10, 4007.
10. *Chem. Commun.*, **2011**, 47, 10608.
11. *Chem. Commun.*, **2011**, 47, 7880.

15-6010 Tri-*t*-butylphosphonium trifluoromethanesulfonate, 99% Stabiphos T  
 (1106696-25-6)  
 [(C<sub>4</sub>H<sub>9</sub>)<sub>3</sub>PH]<sup>+</sup>CF<sub>3</sub>SO<sub>3</sub><sup>-</sup>; FW: 352.40; white solid; m.p. 175°





1g  
5g



## PHOSPHORUS - Ligands and Compounds

15-6020	<b>2,8,9-Tri-<i>i</i>-butyl-2,5,8,9-tetraaza-1-phosphabicyclo[3.3.3]undecane, 97% (331465-71-5)</b> $C_{18}H_{39}N_4P$ ; FW: 342.50; cloudy yellow liq.; d. 0.964 <i>air sensitive, moisture sensitive</i>		250mg 1g 5g
<b>Technical Note:</b> 1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.			
<b>References:</b> 1. <i>Specialty Chemicals Magazine</i> , January/February 2006			
15-5960	<b>Tributyl(tetradecyl)phosphonium dodecylbenzenesulfonate, min. 98%</b> <b>CYPHOS® IL 203</b> $[(C_4H_9)_3(C_{14}H_{29})P]^+[(C_{12}H_{25}C_6H_4SO_3)]^-$ ; FW: 725.18; light yellow liq.		10g 50g
15-5970	<b>Tributyl(tetradecyl)phosphonium methanesulfonate, min. 98%</b> <b>CYPHOS® IL 203</b> $[(C_4H_9)_3(C_{14}H_{29})P]^+CH_3SO_3^-$ ; FW: 494.80; light yellow liq.		10g 50g
15-6030	<b>Tri(m-chlorophenyl)phosphine, min. 97% (29949-85-7)</b> $(m-ClC_6H_4)_3P$ ; FW: 365.63; white xtl.; m.p. 64-66° <i>air sensitive, (store cold)</i>		1g 5g
15-6050	<b>Tri(p-chlorophenyl)phosphine, 99% (1159-54-2)</b> $(p-ClC_6H_4)_3P$ ; FW: 365.63; white xtl.; m.p. 90-93°		1g 5g
15-6151	<b>Tricyclohexylphosphine (20% in toluene), min. 88% (2622-14-2)</b> HAZ $(C_6H_{11})_3P$ ; FW: 280.44; colorless to light yellow liq.; f.p. 40°F (toluene); d. 0.9 <i>air sensitive</i>		100g 500g
15-6150	<b>Tricyclohexylphosphine, 97% (2622-14-2)</b> $(C_6H_{11})_3P$ ; FW: 280.44; white xtl.; m.p. 76-78° <i>air sensitive</i>		5g 25g 250g
15-6160	<b>Tricyclohexylphosphonium tetrafluoroborate, 99% (58656-04-5)</b> $[(C_6H_{11})_3PH]^+BF_4^-$ ; FW: 368.24; white powdr.		1g 5g 25g
<b>Technical Note:</b> 1. Non-pyrophoric, air-stable derivative suitable as a replacement for the neat phosphine in a variety of stoichiometric and catalytic processes.			
15-6130	<b>Tricyclohexylphosphonium trifluoromethanesulfonate, 99%</b> <b>Stabiphos (952649-12-6)</b> $[(C_6H_{11})_3PH]^+CF_3SO_3^-$ ; FW: 430.51; white solid		1g 5g
15-6180	<b>Tricyclopentylphosphine, min. 95% (7650-88-6)</b> $(C_5H_9)_3P$ ; FW: 238.35; colorless liq. <i>pyrophoric</i>		1g 5g
15-6181	<b>Tricyclopentylphosphine, min. 95% (10wt% in hexanes) (7650-88-6)</b> HAZ $(C_5H_9)_3P$ ; FW: 238.35; colorless liq. <i>air sensitive</i>		10g 50g
93-1559	<b>Triethylphosphate, 99% (78-40-0)</b> $(C_2H_5O)_3PO$ ; FW: 182.16; colorless liq.; m.p. -56.4°; b.p. 215°; f.p. 240°F; d. 1.072		500g 4 x 500g

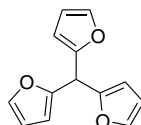
# PHOSPHORUS - Ligands and Compounds

<b>15-6300</b> amp HAZ  	<b>Triethylphosphine, 99% (554-70-1)</b> (C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> P; FW: 118.16; colorless liq.; b.p. 126-128°; f.p. 1°F; d. 0.81 <i>pyrophoric</i>	5g 25g
<b>15-6302</b> HAZ  	<b>Triethylphosphine, 99% (Sure/Seal™ bottle) (554-70-1)</b> (C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> P; FW: 118.16; colorless liq.; b.p. 126-128°; f.p. 1°F; d. 0.81 <i>pyrophoric</i>	25g
<b>15-6304</b> HAZ	<b>Triethylphosphine, 99% (20 wt% in ethanol) (554-70-1)</b> (C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> P; FW: 118.16; colorless liq. <i>air sensitive</i>	25g 125g
<b>15-6305</b> HAZ	<b>Triethylphosphine, 99% (10 wt% in hexanes) (554-70-1)</b> (C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> P; FW: 118.16; colorless liq. <i>air sensitive</i>	50g 250g
<b>15-6310</b>	<b>Triethylphosphine oxide, 98% (597-50-2)</b> (C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> PO; FW: 134.16; white xtl.; m.p. 52-53°; b.p. 84-85°/3 mm <i>hygroscopic</i>	1g 5g
<b>15-6350</b> HAZ	<b>Triethylphosphite, 98% (122-52-1)</b> (C <sub>2</sub> H <sub>5</sub> O) <sub>3</sub> P; FW: 166.16; colorless liq.; b.p. 156°; f.p. 130°F; d. 0.969 <i>air sensitive</i>	250g 1kg
<b>15-6355</b>	<b>Triethylphosphonium tetrafluoroborate, 99%</b> [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> PH] <sup>+</sup> BF <sub>4</sub> <sup>-</sup> ; FW: 205.97; white powd. <i>hygroscopic</i>	1g 5g

## Technical Note:

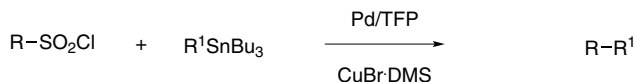
1. Non-pyrophoric, air-stable derivative suitable as a replacement for the neat phosphine in a variety of stoichiometric and catalytic processes.

<b>15-6372</b>	<b>Tri-2-furylphosphine, 98+% (5518-52-5)</b> (C <sub>2</sub> H <sub>3</sub> O) <sub>3</sub> P; FW: 232.17; white powdr.; m.p. 63-65°; b.p. 136°/4mm <i>air sensitive</i> Note: Phosphine Ligand Kit component.	500mg 2g 5g
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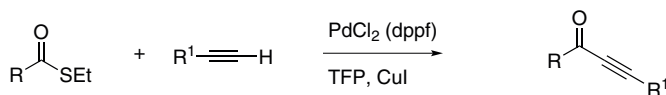


## Technical Notes:

1. Useful ligand for C-C coupling reactions.
2. Ligand used for the alkylation of thioesters.
3. Ligand used for enol ester formation.
4. Ligand for palladium-catalyzed 3-Component coupling.
5. Ligand for palladium-catalyzed C-C coupling reaction.
6. Ligand for trans-olefin formation.
7. Olefin formation from N-tosylhydrazones and benzyl halides.
8. C-H arylation/alkenylation of 1-substituted tetrazoles.
9. Tandem allylic amination/[2,3]-Stevens Rearrangement.
10. Ligand for palladium-catalyzed carbonylation of anilines.
12. Synthesis of Substituted Tetrahydrocyclobuta[b]benzofurans.
13. Palladium-Catalyzed Three-Component Reaction of Allenes, Aryl Iodides, and Diazo Compounds.
14. Synthesis of Benzocyclohepta[b]indoles.
15. Palladium-Catalyzed Decarboxylative Allylation and Benzylation.
16. Pd-catalyzed domino carbonylative-decarboxylative allylation.



Tech. Note (1)  
Ref. (1)

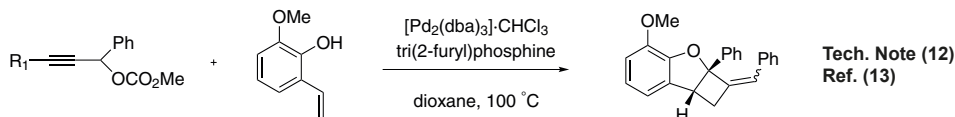
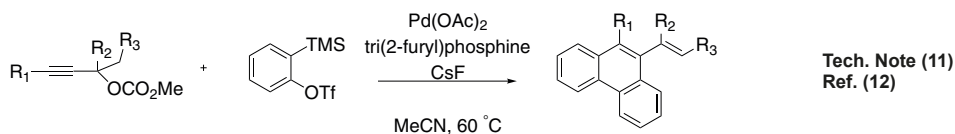
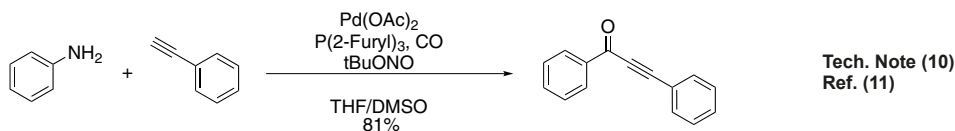
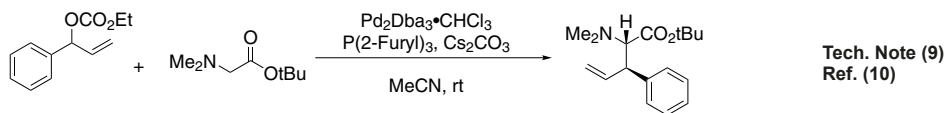
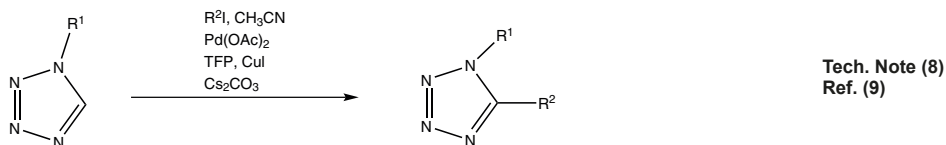
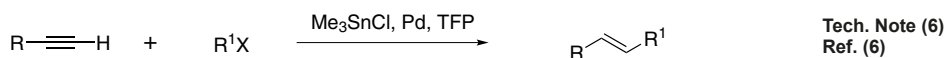
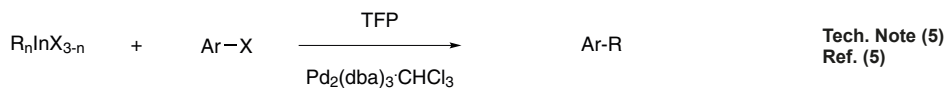
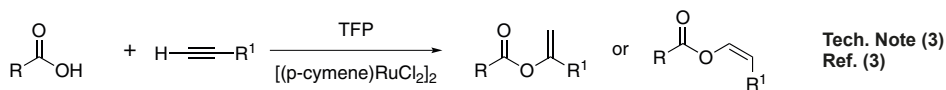


Tech. Note (2)  
Ref. (2)

# PHOSPHORUS - Ligands and Compounds

15-6372 Tri-2-furylphosphine, 98+% (5518-52-5)

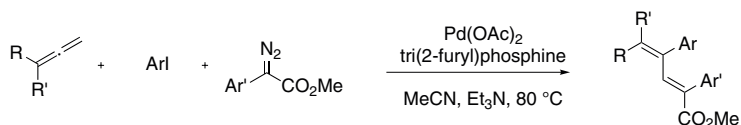
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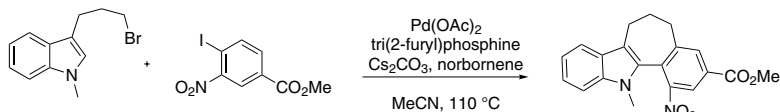
# PHOSPHORUS - Ligands and Compounds

15-6372 Tri-2-furylphosphine, 98+% (5518-52-5)

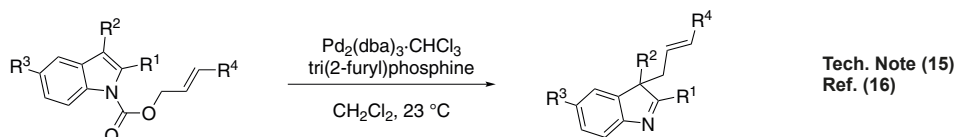
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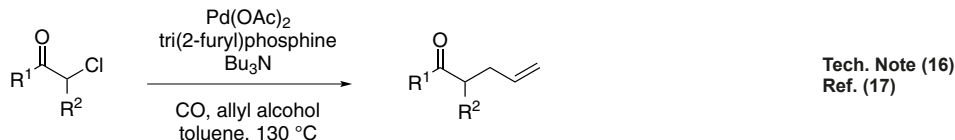
Tech. Note (13)  
Ref. (14)



Tech. Note (14)  
Ref. (15)



Tech. Note (15)  
Ref. (16)

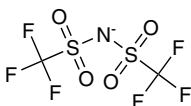


Tech. Note (16)  
Ref. (17)

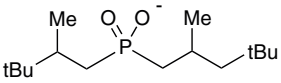
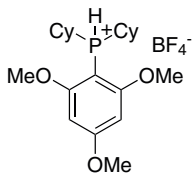
## References:

1. *J. Am. Chem. Soc.*, **2003**, *125*, 15292.
2. *Synlett.*, **2003**, 1512.
3. *Chem. Commun.*, **2003**, 706.
4. *Tetrahedron*, **2001**, *57*, 7965.
5. *Org. Lett.*, **2001**, *3*, 1997.
6. *J. Am. Chem. Soc.*, **2001**, *123*, 3194.
7. *Chem. Rev.*, **2001**, *101*, 997. (review)
8. *Org. Lett.*, **2009**, *11*, 4732.
9. *J. Org. Chem.*, **2010**, *75*, 241.
10. *J. Am. Chem. Soc.*, **2011**, *133*, 12956.
11. *Angew. Chem. Int. Ed.*, **2011**, *50*, 11142.
12. *Synlett*, **2013**, *24*, 2310.
13. *Angew. Chem. Int. Ed.*, **2013**, *52*, 13597.
14. *Angew. Chem. Int. Ed.*, **2013**, *52*, 9305.
15. *Synthesis*, **2013**, *45*, 1094.
16. *Org. Lett.*, **2013**, *15*, 1140.
17. *Chem. Commun.*, **2012**, *48*, 5889.

15-1312	Tri-n-hexylphosphine, min. 96% (4168-73-4) C <sub>18</sub> H <sub>39</sub> P; FW: 286.48; colorless liq.; b.p. 227° (50mm); d. 0.818 <i>air sensitive</i>	5g 25g
15-1337 HAZ	Tri-n-hexylphosphine oxide/tri-n-octylphosphine oxide, min. 92% [mixture R3P(O), R2R'P(O), RR'2P(O), R'3P(O)] (100786-00-3) colorless, viscous liq.; b.p. 310° (50mm); f.p. 182° C; d. 0.88	5g 25g
15-6370	Trihexyl(tetradecyl)phosphonium bis(trifluoromethanesulfonyl) amide, min. 97% CYPHOS® IL 109 (460092-03-9) [(C <sub>6</sub> H <sub>13</sub> ) <sub>3</sub> (C <sub>14</sub> H <sub>29</sub> )P] <sup>+</sup> [(CF <sub>3</sub> SO <sub>2</sub> ) <sub>2</sub> N] <sup>-</sup> ; FW: 764.00; colorless liq. Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.	10g 50g

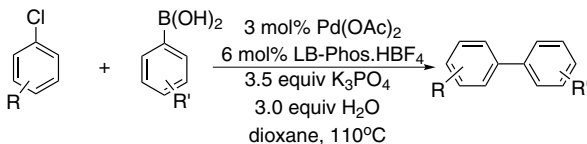


# PHOSPHORUS - Ligands and Compounds

15-6374	<b>Trihexyl(tetradecyl)phosphonium bis(2,4,4-trimethylpentyl)phosphinate, min. 95% CYPHOS® IL 104 (465527-59-7)</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ [((CH_3)_3CCH_2CH(CH_3)CH_2)_2P(O)O]^-$ ; FW: 773.27; pale yellow liq.; d. 0.887 Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.	$(n\text{-Tetradecyl}) - P^{\pm} (n\text{-Hexyl})_3$ 	10g 50g
15-6378	<b>Trihexyl(tetradecyl)phosphonium bromide, min. 95% CYPHOS® IL 102 (654057-97-3)</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ Br^-$ ; FW: 563.76; pale yellow liq.; d. 0.952 Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.		10g 50g
15-6382	<b>Trihexyl(tetradecyl)phosphonium chloride, min. 93% CYPHOS® IL 101 (258864-54-9)</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ Cl^-$ ; FW: 519.31; colorless liq.; d. 0.894 Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.		10g 50g
15-6386	<b>Trihexyl(tetradecyl)phosphonium decanoate, min. 95% CYPHOS® IL 103 (465527-65-5)</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ [CH_3(CH_2)_8COO]^-$ ; FW: 655.11; pale yellow semi solid; m.p. 24°; d. 0.883 Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.		10g 50g
15-6390	<b>Trihexyl(tetradecyl)phosphonium dicyanamide, min. 95% CYPHOS® IL 105</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ [NCNHCN]^-$ ; FW: 550.91; pale yellow liq. Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.		10g 50g
15-6394	<b>Trihexyl(tetradecyl)phosphonium hexafluorophosphate, min. 98% CYPHOS® IL 110 (374683-44-0)</b> $[(C_6H_{13})_3(C_{14}H_{29})P]^+ PF_6^-$ ; FW: 628.82; white solid; m.p. 50°; d. 1.013 Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component.		10g 50g
15-6520	<b>[2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF<sub>4</sub> (1217887-12-1)</b> $C_{21}H_{34}BF_4O_3P$ ; FW: 452.27; white solid; m.p. 142.6-143.4° Note: Sold under license from ZJU for research purposes only. Patents ZL200910154029.4, PCT/CN2009/001527		500mg 2g

## Technical Notes:

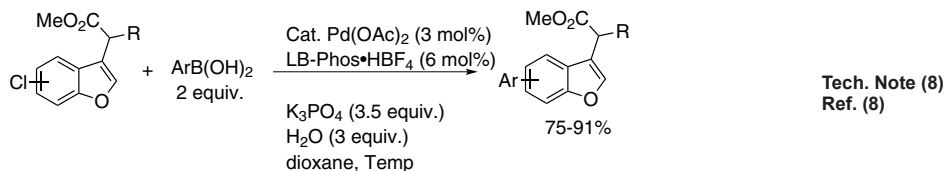
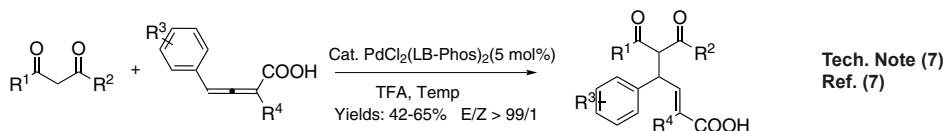
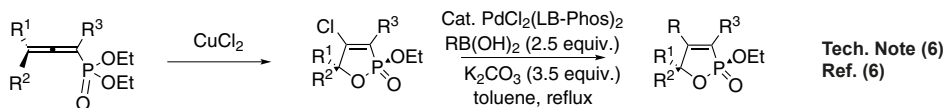
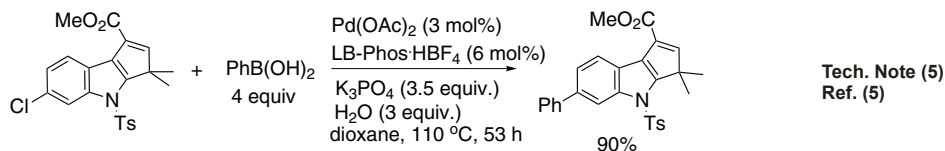
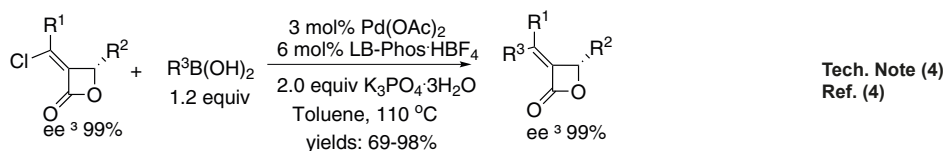
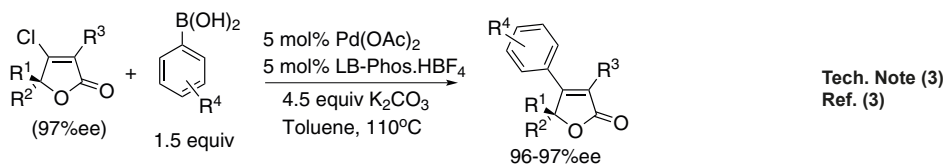
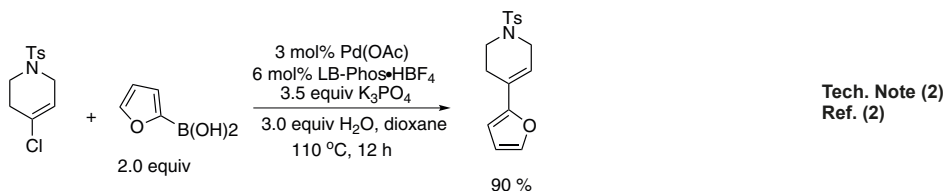
1. Suzuki-coupling reaction of aryl or 1-alkenyl chlorides.
2. Suzuki-coupling reactions of substituted furans.
3. Highly selective Suzuki-coupling of C-Cl bonds in  $\beta$ -chlorobutenelides.
4. Palladium-catalyzed Suzuki-coupling reactions of chloroalkylidene- $\beta$ -lactones.
5. Suzuki-coupling reactions of chloro-substituted cyclopentadienylindoles.
6. Efficient synthesis of 4-halo-2,5-dihydro-1,2-oxaphosphate-2-oxides from 1,2-allylphosphates.
7. Palladium-catalyzed reaction of 2,3-allynoates with a 1,3-diketone.
8. Suzuki-coupling of chloro-substituted benzofurans with arylboronic acids.
9. Suzuki-coupling of 2-bromoalken-3-ols with alkylboronic acids.
10. Copper-catalyzed hydroboration of alkynamides with  $B_2pin_2$ .



Tech. Note (1)  
Ref. (1)

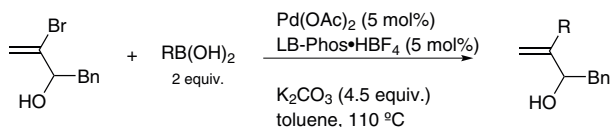
# PHOSPHORUS - Ligands and Compounds

15-6520 [2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF<sub>4</sub>  
(continued) (1217887-12-1)

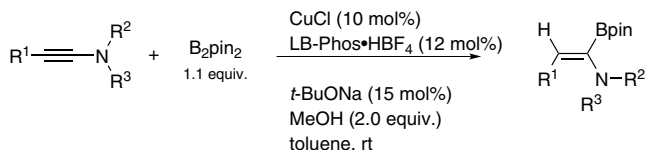


# PHOSPHORUS - Ligands and Compounds

**15-6520** [2,4,6-Trimethoxyphenyl]dicyclohexylphosphonium tetrafluoroborate, 98% LB-PhosHBF<sub>4</sub>  
(continued) (1217887-12-1)



Tech. Note (9)  
Ref. (9)



Tech. Note (10)  
Ref. (10)

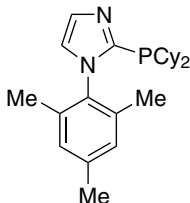
## References:

1. *Tetrahedron Lett.*, **2010**, 51, 1284.
2. *Chem. Commun.*, **2012**, 48, 12074.
3. *Chem. Eur. J.*, **2010**, 16, 6434.
4. *Org. Biomol. Chem.*, **2013**, 11, 98.
5. *Org. Lett.*, **2012**, 14, 3616.
6. *Eur. J. Org. Chem.*, **2012**, 3806.
7. *Eur. J. Org. Chem.*, **2012**, 2585.
8. *Org. Lett.*, **2012**, 14, 720.
9. *Eur. J. Org. Chem.*, **2012**, 4034.
10. *Org. Biomol. Chem.*, **2014**, 12, 5945.

**15-6360** 2,4,4-Trimethylpentylphosphine, 99% (8% isomers) (82164-75-8) 5g  
amp CH<sub>3</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH<sub>2</sub>PH<sub>2</sub>; FW: 146.21; colorless liq.; f.p. 1 °F 25g  
HAZ air sensitive, pyrophoric



**15-6362** 1-(2,4,6-Trimethylphenyl)-2-(dicyclohexylphosphino)imidazole, min. 95% [cataCXium® PICy] (794527-14-3) 500mg  
C<sub>24</sub>H<sub>35</sub>N<sub>2</sub>P; FW: 382.52; white powd.; 2g  
m.p. 109°  
air sensitive  
Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component.

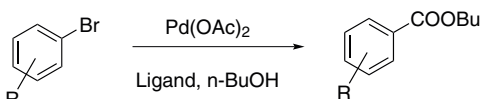


## Technical Notes:

1. An efficient ligand for the palladium-catalyzed amination reaction using aryl chlorides.
2. A ligand used in the carbonylation of aryl bromides.



Tech. Note (1)  
Ref. (1)

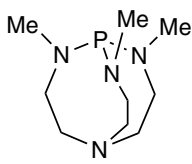


Tech. Note (2)  
Ref. (2)

## References:

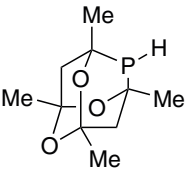



1. *Adv. Synth. Catal.*, **2004**, 346.
2. *Adv. Synth. Catal.*, **2006**, 348.

## PHOSPHORUS - Ligands and Compounds

15-6365	<b>Trimethylphenylphosphonium iodide, min. 97%</b> (1006-01-5) (CH <sub>3</sub> ) <sub>3</sub> C <sub>6</sub> H <sub>5</sub> PI; FW: 280.09; white xtl.; m.p. 218° <i>hygroscopic</i>	5g 25g
93-1561	<b>Trimethylphosphate, min. 97%</b> (512-56-1) (CH <sub>3</sub> O) <sub>3</sub> P(O); FW: 140.08; colorless liq.; m.p. -46°; b.p. 197°; d. 1.197	50g 250g
15-6500 amp HAZ	<b>Trimethylphosphine, min. 98%</b> (594-09-2) (CH <sub>3</sub> ) <sub>3</sub> P; FW: 76.08; colorless liq.; m.p. -85°; b.p. 38-40°; f.p. -22°F; d. 0.748 <i>air sensitive, STENCH</i>	5g 25g
15-6502 HAZ	<b>Trimethylphosphine, min. 98%</b> (Sure/Seal™ bottle) (594-09-2) (CH <sub>3</sub> ) <sub>3</sub> P; FW: 76.08; colorless liq.; m.p. -85°; b.p. 38-40°; f.p. -22°F; d. 0.748 <i>air sensitive, STENCH</i>	25g
15-6550 HAZ	<b>Trimethylphosphite, 97%</b> (121-45-9) (CH <sub>3</sub> O) <sub>3</sub> P; FW: 124.08; colorless liq.; b.p. 110-112°; f.p. 82°F; d. 1.052 <i>air sensitive, moisture sensitive</i>	250g 1kg
15-6558 <b>NEW</b> HAZ	<b>Trimethylphosphite, 99%</b> (121-45-9) (CH <sub>3</sub> O) <sub>3</sub> P; FW: 124.08; colorless liq.; b.p. 110-112°; f.p. 82°F; d. 1.052 <i>air sensitive</i>	50g 250g
15-6560	<b>Trimethylphosphonium tetrafluoroborate, 99%</b> (154358-50-6) (CH <sub>3</sub> ) <sub>3</sub> PH <sup>+</sup> BF <sub>4</sub> <sup>-</sup> ; FW: 163.89; white powdr. <i>hygroscopic</i>	1g 5g
Technical Note: 1. Non-pyrophoric, air-stable derivative suitable as a replacement for the neat phosphine in a variety of stoichiometric and catalytic processes.		
15-6400	<b>2,8,9-Trimethyl-2,5,8,9-tetraaza-1-phospha-bicyclo[3.3.3]undecane</b> <b>VERKADE SUPERBASE</b> (120666-13-9) C <sub>9</sub> H <sub>21</sub> N <sub>4</sub> P; FW: 216.26; white waxy solid; m.p. 110-115° <i>moisture sensitive, (store cold)</i>	250mg 1g
		
Technical Note: 1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.		
References: 1. <i>Specialty Chemicals Magazine</i> , January/February 2006.		
15-6610	<b>Tri(1-naphthyl)phosphine, min. 98%</b> (3411-48-1) (1-C <sub>10</sub> H <sub>7</sub> ) <sub>3</sub> P; FW: 412.47; white powdr.; m.p. 265-268°	1g 5g
15-6620	<b>Tri-neo-pentylphosphite, min. 90%</b> (14540-52-4) [(CH <sub>3</sub> ) <sub>3</sub> CCH <sub>2</sub> O] <sub>3</sub> P; FW: 292.40; white xtl.; m.p. 55-57°; b.p. 80°/0.15 mm <i>air sensitive</i>	1g 5g
15-6655 HAZ	<b>Tri-n-octylphosphine, min. 97%</b> TOP (4731-53-7) (C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> P; FW: 370.60; colorless to pale yellow liq.; m.p. 30°; b.p. 175°/0.3mm; f.p. 280°F; d. 0.83 <i>air sensitive</i> Note: Surfactant for nanomaterial synthesis.	25g 100g 500g
15-6660 HAZ	<b>Trioctylphosphine oxide, min. 90%</b> TOPO (78-50-2) (n-C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> PO (n-C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> PO; FW: 386.65; off-white xtl.; m.p. 51-52°; f.p. >230°F; d. 0.88 <i>hygroscopic</i> Note: Surfactant for nanomaterial synthesis.	100g 500g
15-6661 HAZ	<b>Trioctylphosphine oxide, 99%</b> TOPO (78-50-2) (n-C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> PO; FW: 386.65; white to off-white solid; m.p. 51-52°; f.p. >230°F; d. 0.88 <i>hygroscopic</i> Note: Surfactant for nanomaterial synthesis.	25g 100g

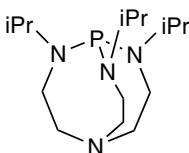


## PHOSPHORUS - Ligands and Compounds

15-1310 HAZ	<b>2,4,6-Trioxa-1,3,5,7-tetramethyl-8-phosphaadamantane (~32% in xylene)</b> (26088-25-5) $C_{10}H_{17}O_3P$ ; FW: 216.21; colorless liq. <i>air sensitive</i>		5g 25g
93-1562 HAZ	<b>Triphenylphosphate, 98% (115-86-6)</b> $(C_6H_5O)_3P(O)$ ; FW: 326.28; white xtl.; m.p. 49-51°; b.p. 244°/10 mm; f.p. 428°F		500g
15-6700	<b>Triphenylphosphine, 99% (603-35-0)</b> $(C_6H_5)_3P$ ; FW: 262.28; white xtl.; m.p. 79°; b.p. 360°; f.p. 359°F		100g 500g 2kg
15-6750	<b>Triphenylphosphine oxide, 98% (791-28-6)</b> $(C_6H_5)_3PO$ ; FW: 278.28; white xtl.; m.p. 151-154°; f.p. 356°F; d. 1.212		25g 100g
15-6730	<b>Triphenylphosphine, polymer-bound, on styrene-divinylbenzene copolymer (20% cross-linked)</b> $(C_6H_5)_3P$ ; off-white beads, 20-60 mesh <i>air sensitive</i>		1g 5g 25g
15-6850	<b>Triphenylphosphite, 97% (101-02-0)</b> $(C_6H_5O)_3P$ ; FW: 310.28; colorless to yellow, low melting solid; m.p. 22-24°; b.p. 360°; f.p. 425°F; d. 1.180-1.186		500g 2kg
15-6949 amp HAZ 	<b>Tri-i-propylphosphine, tech. gr., min. 90% (6476-36-4)</b> $(i-C_3H_7)_3P$ ; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82 <i>pyrophoric</i>		1g 5g 25g
15-6950 amp HAZ 	<b>Tri-i-propylphosphine, 98% (6476-36-4)</b> $(i-C_3H_7)_3P$ ; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82 <i>pyrophoric</i>		1g 5g 25g
15-6952 HAZ 	<b>Tri-i-propylphosphine, 98% (Sure/Seal™ bottle) (6476-36-4)</b> $(i-C_3H_7)_3P$ ; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82 <i>pyrophoric</i>		25g
15-6954 HAZ	<b>Tri-i-propylphosphine, 98% (10 wt% in hexanes) (6476-36-4)</b> $(i-C_3H_7)_3P$ ; FW: 160.24; colorless liq. <i>air sensitive</i>		10g 50g 250g
15-7050 amp HAZ	<b>Tri-n-propylphosphine, min. 95% (2234-97-1)</b> $(n-C_3H_7)_3P$ ; FW: 160.24; colorless liq.; b.p. 185-188°; f.p. 144°F; d. 0.807 <i>air sensitive</i>		10g 50g
15-7070	<b>Tri-n-propylphosphine oxide, min. 98% (1496-94-2)</b> $(n-C_3H_7)_3PO$ ; FW: 176.24; white xtl.; m.p. 39°; b.p. 280-282° <i>moisture sensitive</i>		1g 5g
15-7000 HAZ	<b>Tri-i-propylphosphite, min. 94% (116-17-6)</b> $[(CH_3)_2CHO]_3P$ ; FW: 208.24; colorless liq.; b.p. 63-64°/11 mm; f.p. 154°F; d. 0.844 <i>air sensitive</i>		50g 250g

# PHOSPHORUS - Ligands and Compounds

**15-7200**    **2,8,9-Tri-*i*-propyl-2,5,8,9-tetraaza-1-phosphabicyclo[3.3.3]undecane** (175845-21-3)  
 $C_{15}H_{33}N_4P$ ; FW: 300.42; yellow liq.; f.p. 185°F;  
 d. 0.922  
*moisture sensitive*



250mg  
1g

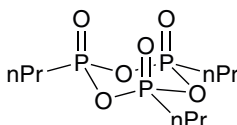
**Technical Note:**

1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.

**References:**

1. *Specialty Chemicals Magazine*, January/February 2006.

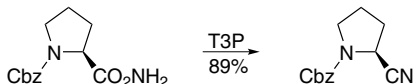
**15-9159**    **2,4,6-Tri-*n*-propyl-2,4,6-tri-oxo-1,3,5,2,4,6-trioxatrimphosphorinane**  
 HAZ    (Propylphosphonic acid anhydride  
**50% solution in N,N-dimethylformamide**) **T3P** (68957-94-8)  
 $(C_3H_7O_2P)_3$ ; FW: 318.20;  
 slightly yellow to brown liq.  
*moisture sensitive*



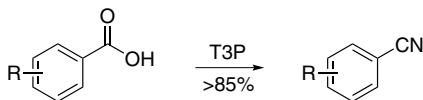
10g  
50g

**Technical Notes:**

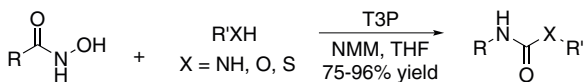
1. TP3 is an exceptional reagent for amide/peptide bond formation. The product is very easy to use and combines excellent reaction selectivity, low epimerization, high yields and high product purities.
2. Conversions of acids and amides to nitriles under mild conditions.
3. Synthesis of urea and carbamate derivatives.
4. Formation of thioacids from N-protected amino acids and peptides.



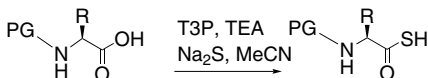
**Tech. Note (2)**  
**Ref. (1)**



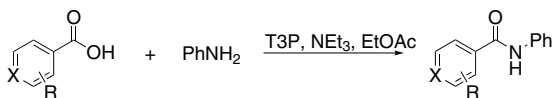
**Tech. Note (2)**  
**Ref. (1)**



**Tech. Note (3)**  
**Ref. (2)**



**Tech. Note (4)**  
**Ref. (3)**

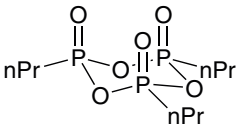
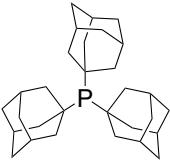
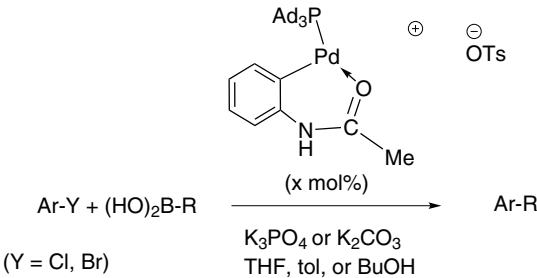
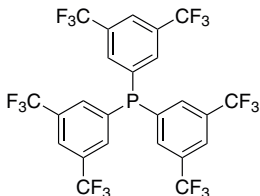
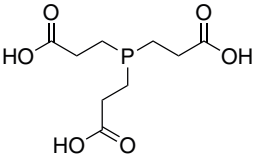


**Tech. Note (4)**  
**Ref. (1)**

**References:**

1. Unpublished work.
2. *Synthesis*, **2010**, 17, 2990.
3. *Tetrahedron Lett.*, **2012**, 53, 1406.

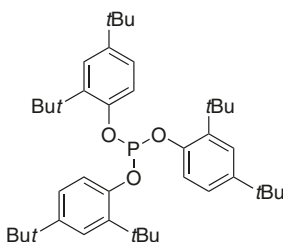
# PHOSPHORUS - Ligands and Compounds

15-9160 HAZ	<b>2,4,6-Tripropyl-2,4,6-trioxo-1,3,5,2,4,6-trioxatrichophosphorinane T3P</b> (Propylphosphonic acid anhydride 50% solution in ethyl acetate) (68957-94-8) (C <sub>3</sub> H <sub>7</sub> O <sub>2</sub> P) <sub>3</sub> ; FW: 318.20; slightly yellow to brown liq. <i>moisture sensitive</i>		10g 50g
15-0935 <b>NEW</b>	<b>Tris(1-adamantyl)phosphine, 97%</b> (897665-73-5) C <sub>30</sub> H <sub>45</sub> P; FW: 436.65; white to off-white powdr. <i>air sensitive</i> Note: Sold in collaboration with GreenCentre for research purposes only. Patents: 62248056.		250mg 1g 5g
<b>Technical Note:</b> 1. A stable phosphine ligand which can bind to metals such as palladium to be used in Suzuki-Miyaura couplings in making drug intermediates. Dramatic effects in catalysis are also accessible now by using Pd3 as a ligand during Suzuki-Miyaura cross-coupling of chloro(hetero)arenes. <sup>1,2</sup>			
		<b>Tech. Note (1)</b> <b>Ref. (1,2)</b>	
<b>References:</b> 1. <i>Synlett.</i> , <b>2017</b> , 28(3), 280-288. 2. <i>J. Am. Chem. Soc.</i> , <b>2016</b> , 138, 6392.			
15-9165	<b>Tris[3,5-bis(trifluoromethyl)phenyl]phosphine, 97%</b> (175136-62-6) C <sub>24</sub> H <sub>9</sub> F <sub>18</sub> P; FW: 670.37; brown solid		250mg 1g 5g
15-7400	<b>Tris(2-carboxyethyl)phosphine, hydrochloride, 99% TCEP</b> (51805-45-9) (HOOCCH <sub>2</sub> CH <sub>2</sub> ) <sub>3</sub> PH <sup>+</sup> Cl <sup>-</sup> ; FW: 286.65; white xtl.		1g 5g
93-1564	<b>Tris(2-chloroethyl)phosphate, 97%</b> (115-96-8) (ClCH <sub>2</sub> CH <sub>2</sub> O) <sub>3</sub> P(O); FW: 285.52; colorless liq.; m.p. -51°; b.p. 330°; f.p. 450°F; d. 1.39		500g 2kg
15-7680	<b>Tris(2-cyanoethyl)phosphine, min. 99%</b> (4023-53-4) P(CH <sub>2</sub> CH <sub>2</sub> CN) <sub>3</sub> ; FW: 193.19; white xtl.; m.p. 97-98°; b.p. 235°/0.9 mm		5g 25g

# PHOSPHORUS - Ligands and Compounds

15-7720

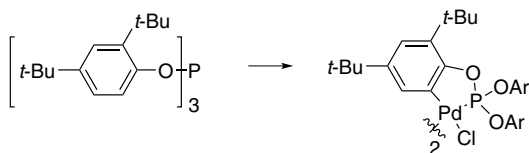
**Tris(2,4-di-*t*-butylphenyl) phosphite, 98%** (31570-04-4)  
 $[[(\text{CH}_3)_3\text{C}]_2\text{C}_6\text{H}_3\text{O}]_3\text{P}$ ; FW: 646.93;  
 white powdr.; m.p. 181-184°  
*moisture sensitive*  
 Note: Phosphine Ligand Kit component.



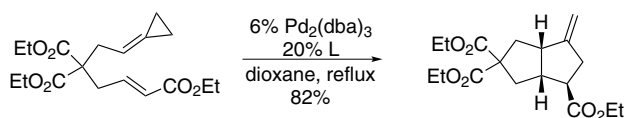
10g  
 250g  
 1kg

## Technical Notes:

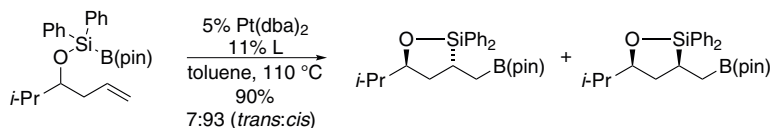
1. Precursor to a palladacyclic catalyst for Suzuki, Stille and Heck processes.
2. Ligand for Pd-catalyzed [3+2] intramolecular cycloaddition of alk-5-enylenecyclopropanes.
3. Ligand for Pt-catalyzed intramolecular silaboration of alkenes.
4. Ligand for Ni-catalyzed aminocarbonylation of aryl halides.
5. Ligand for the Au-catalyzed [4+2] intramolecular cycloaddition of allene-dienes.
6. Rhodium-Catalyzed Allylic Substitution with an Acyl Anion Equivalent.



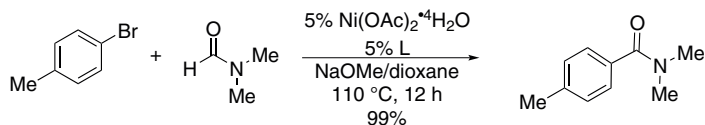
**Tech. Note (1)**  
**Ref. (1-3)**



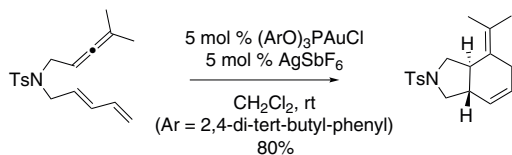
**Tech. Note (2)**  
**Ref. (4)**



**Tech. Note (3)**  
**Ref. (5)**



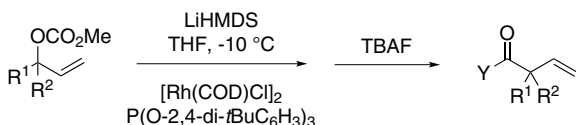
**Tech. Note (4)**  
**Ref. (6)**



**Tech. Note (5)**  
**Ref. (7)**

# PHOSPHORUS - Ligands and Compounds

**15-7720** **Tris(2,4-di-*t*-butylphenyl)phosphite, 98% (31570-04-4)**  
(continued)



**Tech. Note (6)**  
**Ref. (8)**

References:

1. *Chem. Commun.*, 1998, 2095.
2. *Tetrahedron Lett.*, **1998**, 39, 9793.
3. *Chem.-Eur. J.*, **2003**, 9, 3216.
4. *J. Am. Chem. Soc.*, **2006**, 128, 384.
5. *J. Am. Chem. Soc.*, **2006**, 128, 13366.
6. *Org. Lett.*, **2007**, 9, 4615.
7. *J. Am. Chem. Soc.*, **2009**, 131, 6348.
8. *J. Am. Chem. Soc.*, **2012**, 134, 19314.

<b>15-7725</b>	<b>Tris(2,6-dimethoxyphenyl)phosphine, min. 97% (85417-41-0)</b> C <sub>24</sub> H <sub>27</sub> O <sub>6</sub> P; white to off-white powdr.; m.p. 145-147° <b>NEW</b> <i>air sensitive</i>	5g
<b>15-7800</b>	<b>Tris(dimethylamino)phosphine, min. 98% HMPT (1608-26-0)</b> [(CH <sub>3</sub> ) <sub>2</sub> N] <sub>3</sub> P; FW: 163.21; yellow liq.; b.p. 49-51°/12 mm; f.p. 98°F; d. 0.898 <i>air sensitive, moisture sensitive</i>	1g 5g
<b>15-7830</b>	<b>Tris(2,4-dimethylphenyl) phosphine, 98% (49676-42-8)</b> [(CH <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> ] <sub>3</sub> P; FW: 346.45; white powdr.; m.p. 157-158°	500mg 2g
<b>15-7820</b>	<b>Tris(3,5-dimethylphenyl)phosphine, 98% (69227-47-0)</b> [(CH <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> ] <sub>3</sub> P; FW: 346.45; white xtl.; m.p. 160-163°	500mg 2g
<b>15-7860</b>	<b>Tris(4,6-dimethyl-3-sulfonato-phenyl)phosphine trisodium salt hydrate, min. 97% TXPTS (443150-11-6)</b> [(CH <sub>3</sub> ) <sub>2</sub> (C <sub>6</sub> H <sub>2</sub> )SO <sub>3</sub> Na] <sub>3</sub> P·XH <sub>2</sub> O; FW: 652.58; white powdr.	250mg 1g

Technical Note:

1. A water-soluble phosphine. Phosphine used in the efficient, aqueous-phase Heck and Suzuki couplings of aryl bromides.

References:

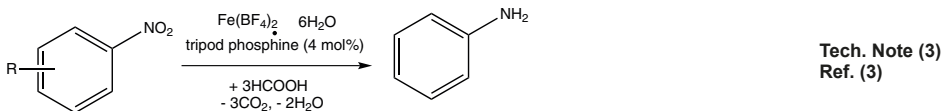
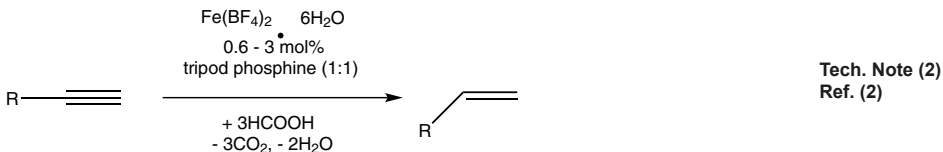
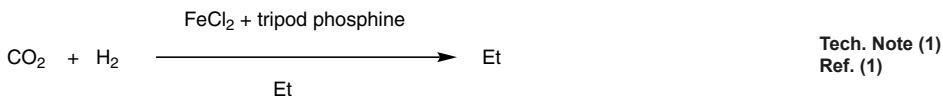
1. *Organic Lett.*, **2004**, 6(2), 225.

# PHOSPHORUS - Ligands and Compounds

**15-7888** **Tris[2-(diphenylphosphino)ethyl]phosphine, 98% PP<sub>3</sub> (23582-03-8)** 250mg  
 C<sub>42</sub>H<sub>42</sub>P<sub>4</sub>; FW: 670.68; white pwdr. 1g

## Technical Notes:

- Ligand used in the ruthenium-catalyzed hydrogenation of carbon dioxide facilitated by catalytic quantities of bicarbonate.
- Ligand used in the selective iron-catalyzed transfer hydrogenation of terminal alkynes.
- Ligand used in the selective iron-catalyzed transfer hydrogenation of nitoarenes, without base.

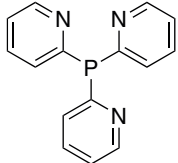

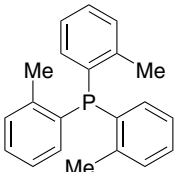


## References:

- Organometallics*, **2013**, 32, 6891.
- Chem. Commun.*, **2012**, 48, 4827.
- J. Am. Chem. Soc.*, **2011**, 133, 12875.

<b>15-7880</b>	<b>1,1,1-Tris(diphenylphosphino)methane, 97% (28926-65-0)</b>	1g 5g
	HC[P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ] <sub>3</sub> ; FW: 568.58; white xtl.; m.p. 168-172°	
<b>15-7870</b>	<b>1,1,1-Tris(diphenylphosphinomethyl)ethane, min. 97% TRIPHOS (22031-12-5)</b>	1g 5g
	CH <sub>3</sub> C[CH <sub>2</sub> P(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ] <sub>3</sub> ; FW: 624.68; white pwdr.; m.p. 98-101°	
<b>15-7890</b>	<b>Tris(p-fluorophenyl)phosphine, 99% (18437-78-0)</b>	1g 5g
	(p-FC <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 316.27; off-white xtl.; m.p. 80-81°	
<b>15-7900</b>	<b>Tris(hydroxymethyl)phosphine, min. 85% (2767-80-8)</b>	1g 5g
HAZ	P(CH <sub>2</sub> OH) <sub>3</sub> ; FW: 124.08; colorless solid to viscous liq. <i>air sensitive</i>	
<b>15-7901</b>	<b>Tris(hydroxymethyl)phosphine, min. 95% (2767-80-8)</b>	250mg 1g
HAZ	P(CH <sub>2</sub> OH) <sub>3</sub> ; FW: 124.08; colorless to pale yellow solid <i>air sensitive</i>	
<b>15-6375</b>	<b>Tris(3-hydroxypropyl)phosphine, min. 80% (4706-17-6)</b>	2g 10g 50g
amp HAZ	(HOC <sub>3</sub> H <sub>6</sub> ) <sub>3</sub> P; FW: 208.24; viscous liq. <i>air sensitive</i> Note: Surfactant for nanomaterial synthesis.	
<b>15-7940</b>	<b>Tris(4-methoxy-3,5-dimethylphenyl)phosphine, min. 98% (121898-64-4)</b>	1g 5g
	[(CH <sub>3</sub> ) <sub>2</sub> (OCH <sub>3</sub> )C <sub>6</sub> H <sub>2</sub> ] <sub>3</sub> P; FW: 436.52; white xtl.; m.p. 175-177°	
<b>15-7975</b>	<b>Tris(m-methoxyphenyl)phosphine, 97+% (29949-84-6)</b>	1g 5g
	(m-CH <sub>3</sub> OC <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 352.37; white xtl.; m.p. 115°	
<b>15-7950</b>	<b>Tris(o-methoxyphenyl)phosphine, min. 98% (4731-65-1)</b>	1g 5g
	(o-CH <sub>3</sub> OC <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 352.37; white xtl.; m.p. 203-205°	

## PHOSPHORUS - Ligands and Compounds

15-8000	<b>Tris(p-methoxyphenyl)phosphine, 98%</b> (855-38-9) (p-CH <sub>3</sub> OC <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 352.37; white to pale yellow xtl.; m.p. 132-135°	1g 5g
15-8005	<b>Tris(pentafluorophenyl)phosphine, 98%</b> (1259-35-4) (C <sub>6</sub> F <sub>5</sub> ) <sub>3</sub> P; FW: 532.15; white powdr.; m.p. 117-119°	1g 5g
15-7945	<b>Tris(2-pyridyl)phosphine, min. 97%</b> (26437-48-9) (C <sub>5</sub> H <sub>4</sub> N) <sub>3</sub> P; FW: 265.25; white to off-white powdr.; m.p. 112-114° <i>air sensitive</i>	250mg 1g
		
15-8013	<b>Tris(3-sulfonatophenyl)phosphine hydrate, sodium salt (&lt;5% oxide)</b> (63995-70-0) Na <sub>3</sub> P(C <sub>6</sub> H <sub>4</sub> SO <sub>3</sub> ) <sub>3</sub> ·XH <sub>2</sub> O; FW: 568.40; white to off-white powdr.	250mg 1g
15-8007	<b>Tris(3-sulfonatophenyl)phosphine hydrate, sodium salt (&lt;10% oxide)</b> (63995-70-0) Na <sub>3</sub> P(C <sub>6</sub> H <sub>4</sub> SO <sub>3</sub> ) <sub>3</sub> ·XH <sub>2</sub> O; FW: 568.40; white to off-white powdr.	250mg 1g 5g
15-8010	<b>Tris(p-trifluoromethylphenyl)phosphine, min. 97%</b> (13406-29-6) (p-CF <sub>3</sub> C <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 466.28; pale yellow powdr.; m.p. 73-75°	1g 5g
15-8015	<b>Tris(2,4,6-trimethoxyphenyl)phosphine, min. 97%</b> (91608-15-0) [(CH <sub>3</sub> O) <sub>3</sub> C <sub>6</sub> H <sub>2</sub> ] <sub>3</sub> P; FW: 532.54; light yellow powdr.; m.p. 155-160° <i>air sensitive</i>	2g 10g
15-8017	<b>Tris(2,4,6-trimethylphenyl)phosphine, 98%</b> (23897-15-6) [(CH <sub>3</sub> ) <sub>3</sub> C <sub>6</sub> H <sub>2</sub> ] <sub>3</sub> P; FW: 388.53; white powdr.; m.p. 185°	1g 5g
15-8020	<b>Tris(trimethylsilyl)phosphine, min. 98%</b> (15573-38-3) [(CH <sub>3</sub> ) <sub>3</sub> Si] <sub>3</sub> P; FW: 250.54; colorless to pale yellow, low melting solid; m.p. 24°; b.p. 102-105°/16 mm; f.p. -1°F; d. 0.863 <i>pyrophoric</i>	250mg 1g 5g
		
15-8021	<b>Tris(trimethylsilyl)phosphine, min. 98% (10 wt% in hexanes)</b> (15573-38-3) [(CH <sub>3</sub> ) <sub>3</sub> Si] <sub>3</sub> P; FW: 250.54; colorless liq. <i>air sensitive</i>	10g 50g
15-8100	<b>Tri-m-tolylphosphine, 98%</b> (6224-63-1) (m-CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 304.37; white xtl.; m.p. 100° <i>air sensitive</i>	5g 25g
15-8120	<b>Tri-p-tolylphosphine, 98%</b> (1038-95-5) (p-CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 304.37; white xtl.; m.p. 145-148° <i>air sensitive</i>	5g 25g
15-8050	<b>Tri-o-tolylphosphine, 99%</b> (6163-58-2) (o-CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> ) <sub>3</sub> P; FW: 304.37; white xtl.; m.p. 125-128° <i>air sensitive</i> Note: Phosphine Ligand Kit component.	5g 25g
		
15-9150	<b>Vinyldiphenylphosphine, min. 97%</b> (2155-96-6) (CH <sub>2</sub> =CH)(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> P; FW: 212.23; colorless to yellow liq.; b.p. 135°/3.5 mm; f.p. >230°F; d. 1.067 <i>air sensitive, (store cold)</i>	1g 5g 25g
15-9155	<b>Vinylphosphonic acid, min. 90%</b> (1746-03-8) CH <sub>2</sub> =CHP(O)(OH) <sub>2</sub> ; FW: 108.00; colorless to pale-yellow liq.; m.p. 36°	50g 250g
15-9158	<b>Vinylphosphonic acid dimethyl ester, min. 90%</b> (4645-32-3) CH <sub>2</sub> =CHP(O)(OCH <sub>3</sub> ) <sub>2</sub> ; FW: 136.10; colorless liq. <i>(store cold)</i>	50g 250g

## CATALYST & ORGANOCATALYST KITS - BASF Blocking Group Removal Catalyst Kit

### 96-6715 BASF Blocking Group Removal Catalyst Kit

Sold in collaboration with BASF for research purposes only.  
Components also available for individual sale.  
Contains the following:

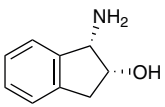
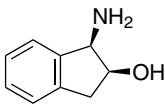
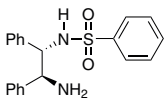
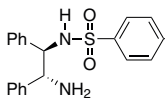
46-1905	Palladium, 10% on activated wood carbon, reduced, 50% water wet (Escat™ 1931) (7440-05-3)	10g
46-1906	Palladium, 10% on activated wood carbon, unreduced, 50% water wet (Escat™ 1921) (7440-05-3)	10g
46-1907	Palladium, 3% on activated carbon, reduced, 50% water wet paste (Escat™ 1911) (7440-05-3)	10g
46-1908	Palladium, 5% on activated carbon, reduced, 50% water wet paste (Escat™ 1941) (7440-05-3)	10g
46-1909	Palladium, 5% on activated carbon, reduced, 50% water wet paste (Escat™ 1961) (7440-05-3)	10g
46-1911	Palladium, 5% on activated carbon, reduced, 50% water wet paste (Escat™ 1971) (7440-05-3)	10g

## CATALYST & ORGANOCATALYST KITS - CATHy™ Catalyst Kit

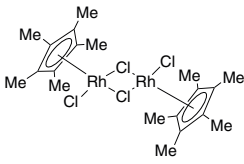
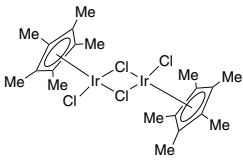
### 96-6715 CATHy™ Catalyst Kit for Asymmetric Transfer Hydrogenation of Ketones and Imines

For asymmetric transfer hydrogenation of ketones and imines.  
Components also available for individual sale. Contains the following:

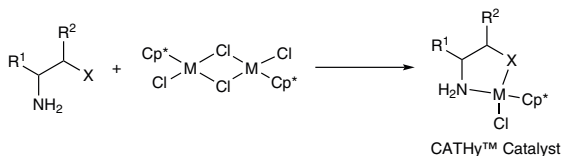
#### Chiral Bidentate Nitrogen Ligands

			
07-0200	07-0201	07-2370	07-2371
1g	1g	500mg	500mg

#### Rhodium & Iridium Components

	
45-0195	77-1060
500mg	500mg

#### Catalyst Preparation



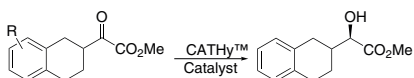
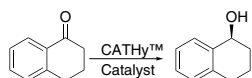
#### Technical Notes:

1. Catalyst for asymmetric ketone reduction in organic and aqueous media
2. Catalyst for asymmetric imine reduction in organic and aqueous media
3. Catalyst for asymmetric oxidative lactonizations of meso-diols
4. Catalyst for asymmetric transfer hydrogenation of quinolines

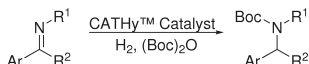
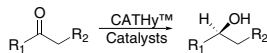
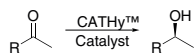


# CATALYST & ORGANOCATALYST KITS - CATHy™ Catalyst Kit

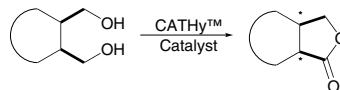
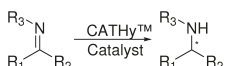
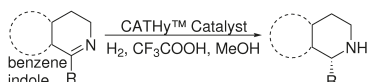
96-7650 CATHy™ Catalyst Kit for Asymmetric Transfer Hydrogenation of Ketones and Imines  
(continued)



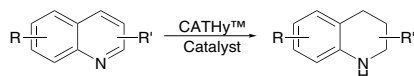
**Tech. Note (1)**  
**Ref. (1-7)**



**Tech. Note (2)**  
**Ref. (1, 8-10)**



**Tech. Note (3)**  
**Ref. (11)**



**Tech. Note (4)**  
**Ref. (12-13)**

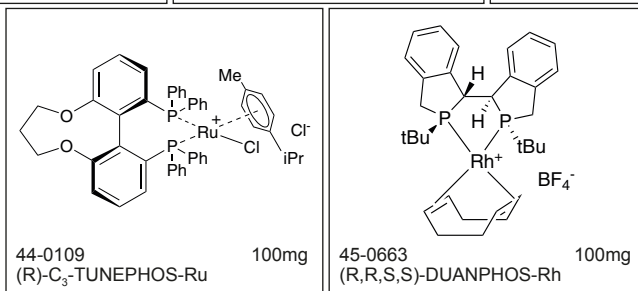
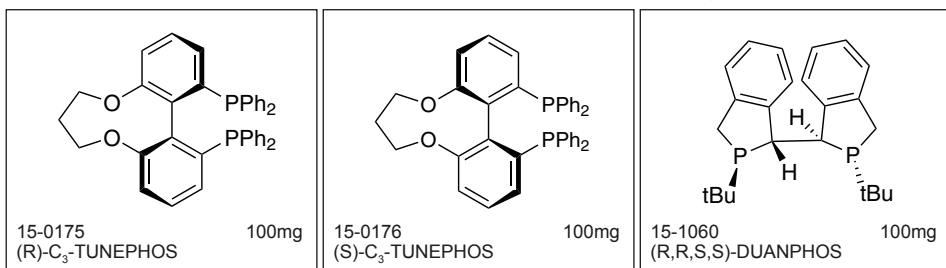
## References:

1. Blacker A.J., Mellor B.J. WO9842643A1, filed 26/03/97, Avecia Ltd.; Blacker A.J. Conf. Proceedings: The Scale up of Chemical Processes. Jersey 1998 ISBN 0953399400;
2. *Tetrahedron*, **2006**, 62, 1864
3. *Org. Lett.*, **2007**, 9, 2565
4. *Chem. Eur. J.* **2008**, 14, 2209
5. *J. Org. Chem.* **2010**, 75, 2981
6. *J. Org. Chem.* **2015**, 80, 4419
7. *J. Organometal. Chem.* **2016**, 810, 12
8. *Chem. Eur. J.* **2011**, 17, 1109
9. *Org. Lett.* **2015**, 17, 2878
10. *Chem. Commun.*, **2016**, 52, 362
11. *Organometallics* **2002**, 21, 3493
12. *Org. Lett.*, **2008**, 10, 5265
13. *Angew. Chem. Int. Ed.* **2009**, 48, 6524

## CATALYST & ORGANOCATALYST KITS - Chiral Quest Catalyst & Ligand Toolbox Kit

### 96-5900 Chiral Quest Catalyst and Ligand Toolbox Kit for Asymmetric Hydrogenation

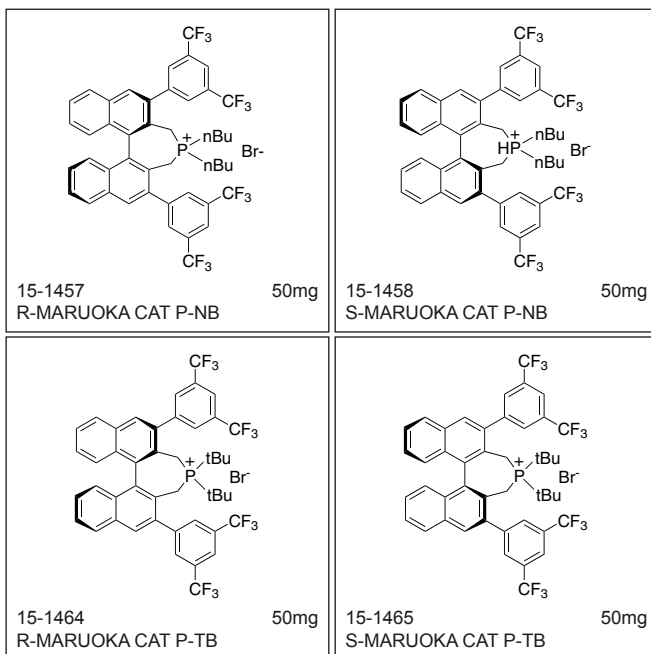
Components also available for individual sale. Contains the following:



## CATALYST & ORGANOCATALYST KITS - Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit

### 96-3750 Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit

Components also available for individual sale. Contains the following:



## CATALYST & ORGANOCATALYST KITS - Palladium Kit

96-4650

### Palladium Kit

For a variety of catalytic organic transformations.  
Components also available for individual sale.  
Contains the following:

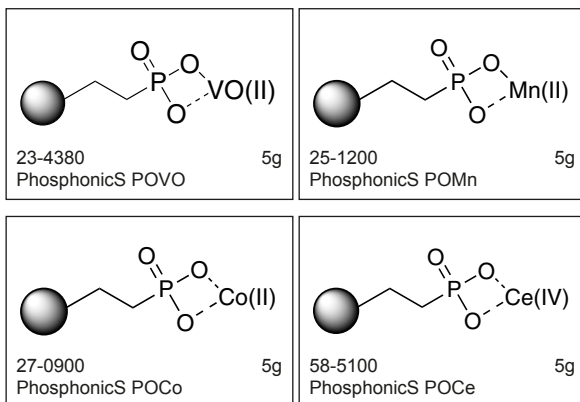
46-0100	Allylpalladium chloride dimer, min. 98% (12012-95-2)	500mg
46-0400	Dichlorobis(benzonitrile)palladium(II), 99% (14220-64-5)	1g
46-1780	Palladium(II) acetate, min. 98% (99.9+%-Pd) (3375-31-3)	1g
46-1850	Palladium(II) chloride (99.9%-Pd) (7647-10-1)	1g
46-2150	Tetrakis(triphenylphosphine)palladium(0), 99% (99.9+%-Pd) (14221-01-3)	5g
46-3000	Tris(dibenzylideneacetone)dipalladium(0) (51364-51-3)	5g
46-3010	Tris(dibenzylideneacetone)dipalladium(0) chloroform adduct (52522-40-4)	500mg

## CATALYST & ORGANOCATALYST KITS - PhosponicS Metal Oxidation Catalyst Kit

96-6770

### PhosponicS Metal Oxidation Catalyst Kit

Sold in collaboration with PhosponicS Ltd. for research purposes only.  
Components also available for individual sale. Contains the following:

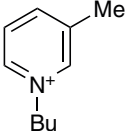
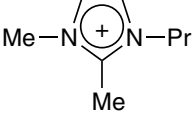
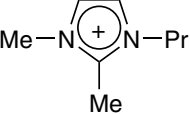


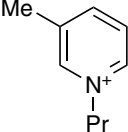


Reactions such as allylic and benzylic oxidations, alcohol oxidations and epoxidations are key chemical transformations in organic synthesis. In general these reactions are conducted by the use of stoichiometric, or even higher concentrations, of inorganic oxidants. Typical oxidizing agents include potassium permanganate, manganese dioxide, chromium trioxide, potassium chromate, potassium dichromate and peracids. These hazardous reagents produce large volumes of toxic wastes that are becoming increasingly costly to treat and dispose. In addition, difficulties are often encountered in the work up of reactions and purification of the products. There is a need for new heterogeneous oxidation catalysts that are not only effective, but exhibit ease of recovery and recyclability. PhosponicS has developed a number of novel heterogeneous oxidation catalysts for a wide range of applications in the pharmaceutical, fine chemicals and petrochemical industries. Reactions include allylic and benzylic oxidations, epoxidations and the selective oxidations of alcohols to ketones and sulfides to sulfoxides.

## IONIC LIQUID KITS - Ionic Liquid Kit 1: Hydrophobic (water-immiscible) Kit

96-6500 Ionic Liquid Kit 1: Hydrophobic (water-immiscible) Kit



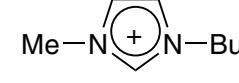

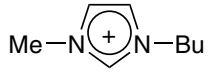
Components also available for individual sale. Contains the following:

 <p><math>[N(SO_2CF_3)_2]^-</math></p> <p>07-0180 1g [BMPIm]</p>	 <p><math>[NH(SO_2CF_3)_2]^-</math></p> <p>07-0465 1g [DMPIm]</p>	 <p><math>(CF_3SO_2)_3C^-</math></p> <p>07-0470 500mg [DMPIme]</p>
 <p><math>[(CF_3CF_2SO_2)_2N]^-</math></p> <p>07-0578 500mg [EMIBeti]</p>	 <p><math>[N(SO_2CF_3)_2]^-</math></p> <p>07-0579 1g [EMIm]</p>	 <p><math>[N(SO_2CF_3)_2]^-</math></p> <p>07-1775 1g [PMPIm]</p>

## IONIC LIQUID KITS - Ionic Liquid Kit 2: BMIM Kit

96-6510 Ionic Liquid Kit 2: BMIM Kit

Components also available for individual sale. Contains the following:

 <p><math>Cl^-</math></p> <p>07-0100 10g [BMIM]Cl</p>	 <p><math>MeOSO_3^-</math></p> <p>07-0140 5g [BMIM] [MeSO<sub>4</sub>]</p>	 <p><math>Me(CH_2)_7CH_2OSO_3^-</math></p> <p>07-0150 5g [BMIM] [OctSO<sub>4</sub>]</p>
 <p><math>PO_4^{3-}</math></p> <p>07-0160 5g [BMIM]<sub>3</sub> [PO<sub>4</sub>]</p>	 <p><math>BF_4^-</math></p> <p>07-0170 5g [BMIM] [BF<sub>4</sub>]</p>	

## IONIC LIQUID KITS - Ionic Liquid Kit 3: CYPHOS® IL Phosphonium Salt Kit

### 96-6520 Ionic Liquid Kit 3: CYPHOS® IL Phosphonium Salt Kit

Components also available for individual sale.

Contains the following:

15-6370	Trihexyl(tetradecyl)phosphonium bis(trifluoromethanesulfonyl)amide, min. 97% CYPHOS® IL 109 (460092-03-9)	10g
15-6374	Trihexyl(tetradecyl)phosphonium bis(2,4,4-trimethylpentyl)phosphinate, min. 95% CYPHOS® IL 104 (465527-59-7)	10g
15-6378	Trihexyl(tetradecyl)phosphonium bromide, min. 95% CYPHOS® IL 102 (654057-97-3)	10g
15-6382	Trihexyl(tetradecyl)phosphonium chloride, min. 93% CYPHOS® IL 101 (258864-54-9)	10g
15-6386	Trihexyl(tetradecyl)phosphonium decanoate, min. 95% CYPHOS® IL 103 (465527-65-5)	10g
15-6390	Trihexyl(tetradecyl)phosphonium dicyanamide, min. 95% CYPHOS® IL 105	10g
15-6394	Trihexyl(tetradecyl)phosphonium hexafluorophosphate, min. 98% CYPHOS® IL 110 (374683-44-0)	10g

CYPHOS® IL Registered trademark of Cytec.

References:

1. The Strem Chemiker, Vol. XX, No. 1, 2003 for technical note.

## LIGAND KITS - AntPhos and WingPhos Kit

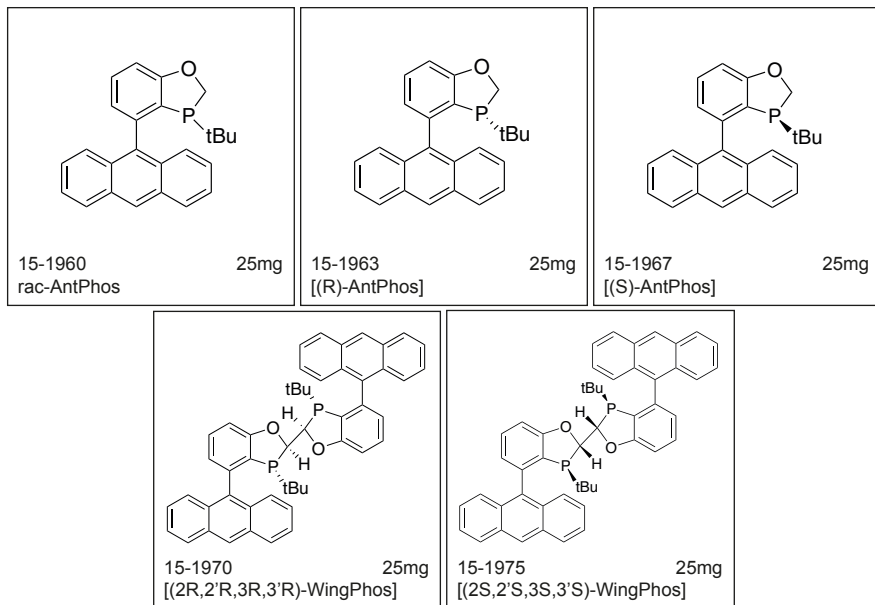
### 96-3810 AntPhos and WingPhos Kit

Sold in collaboration with Zejun for research purposes only.

Patents ZL201310020371.1, CN 201610056390.

Components also available for individual sale.

Contains the following:

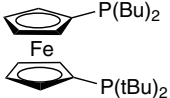
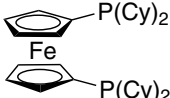
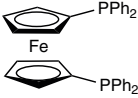
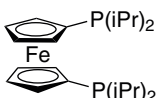


## LIGAND KITS - 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit

### 96-3730 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit

Components also available for individual sale.

Contains the following:

			
26-0150 DTBPF	26-0155	26-0270 DPPF	26-0275 DiIPPf
500mg	500mg	1g	500mg

## LIGAND KITS - Buchwald Biaryl Phosphine Ligand Master Kit

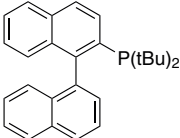
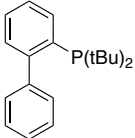
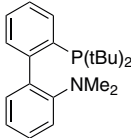
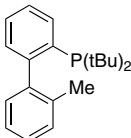
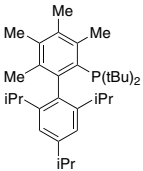
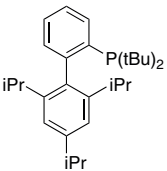
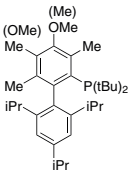
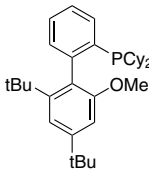
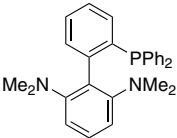
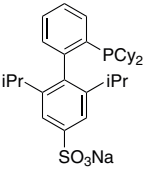
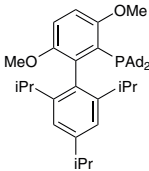
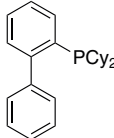
### 96-5500 Buchwald Biaryl Phosphine Ligand Master Kit for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling

For aromatic carbon-heteroatom bond formation and Suzuki Coupling.

Patents: US 6,395,916, US 6,307,087

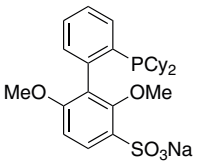
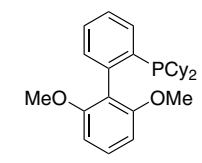
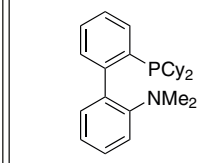
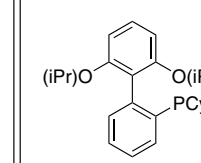
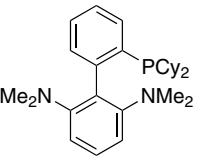
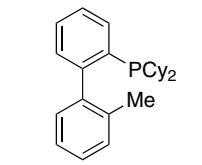
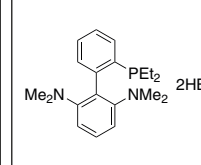
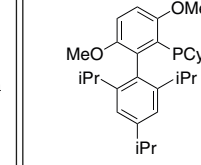
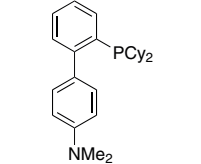
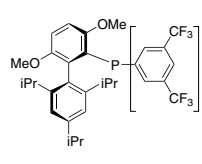
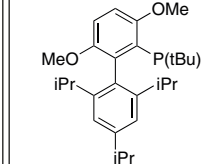
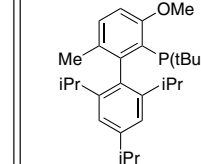
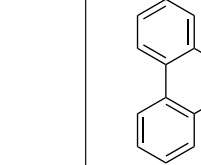
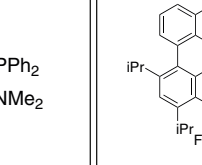
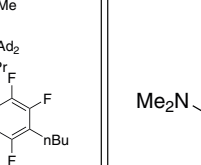

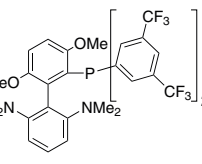
Components also available for individual sale.

Contains the following:

			
15-1043 TrixiePhos	15-1045 JohnPhos	15-1048 tBuDavePhos	15-1049 t-BuMePhos
250mg	500mg	500mg	500mg
			
15-1051 Me4-t-BuXPhos	15-1052 t-BuXphos	15-1063	15-1105 VPhos
250mg	500mg	250mg	250mg
			
15-1125 PhCPhos	15-1135 (XPhos-SO <sub>3</sub> Na)	15-1138 AdBrettPhos	15-1140 CyJohnPhos
100mg	100mg	100mg	1g

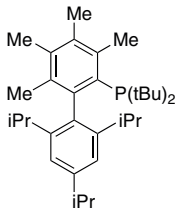
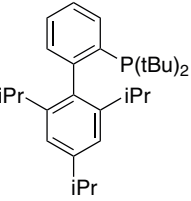
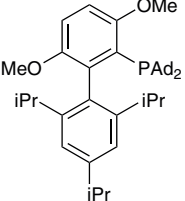
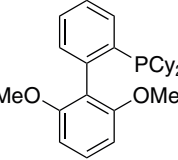
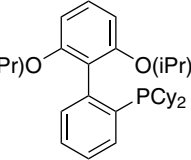
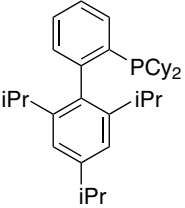
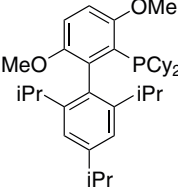
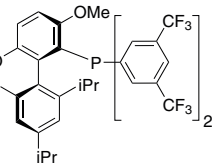
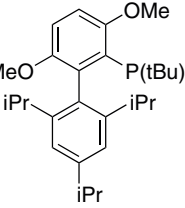
# LIGAND KITS - Buchwald Biaryl Phosphine Ligand Master Kit

96-5500 Buchwald Biaryl Phosphine Ligand Master Kit for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling  
(continued)

 <p>15-1142 500mg (water soluble SPhos)</p>	 <p>15-1143 500mg SPhos</p>	 <p>15-1145 500mg DavePhos</p>	 <p>15-1146 1g RuPhos</p>
 <p>15-1147 250mg CPhos</p>	 <p>15-1148 500mg MePhos</p>	 <p>15-1151 100mg EtCPhos</p>	 <p>15-1152 250mg BrettPhos</p>
 <p>15-1154 250mg</p>	 <p>15-1157 100mg JackiePhos</p>	 <p>15-1164 100mg t-BuBrettPhos</p>	 <p>15-1168 100mg RockPhos</p>
 <p>15-1745 500mg PhDavePhos</p>	 <p>15-2065 100mg AlPhos</p>	 <p>15-3010 250mg (t-Bu)PhCPhos</p>	
 <p>15-3015 100mg</p>	 <p>15-3020 250mg</p>		

# LIGAND KITS - Buchwald Biaryl Phosphine Ligand Mini Kit 1

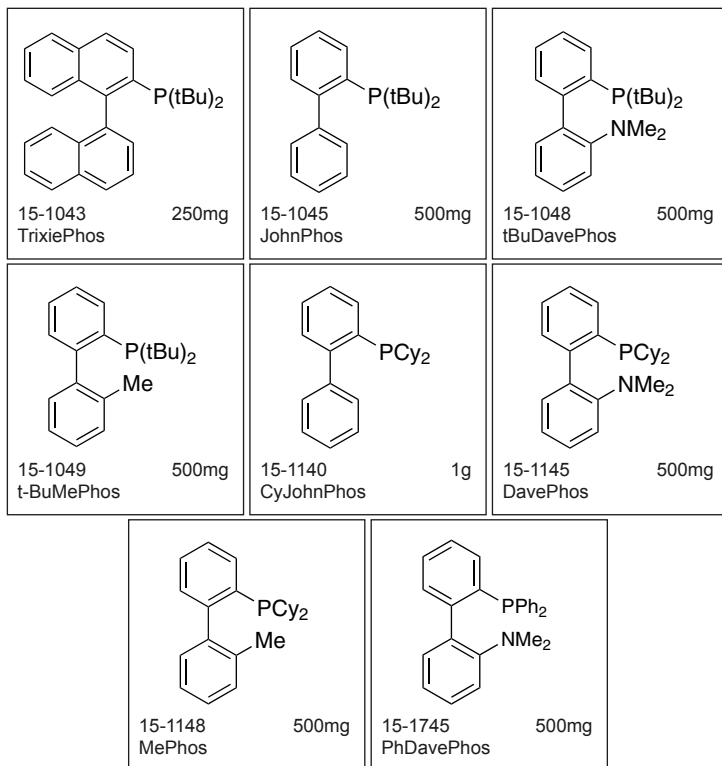
**96-5485 Buchwald Biaryl Phosphine Ligand Mini Kit 1 for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling**  
 For aromatic carbon-heteroatom bond formation and Suzuki Coupling.  
 Patents: US 6,395,916, US 6,307,087  
 Components also available for individual sale. Contains the following:

 <p>15-1051 Me<sub>4</sub> t-BuXPhos</p> <p>250mg</p>	 <p>15-1052 t-BuXPhos</p> <p>500mg</p>	 <p>15-1138 AdBrettPhos</p> <p>100mg</p>
 <p>15-1143 SPhos</p> <p>500mg</p>	 <p>15-1146 RuPhos</p> <p>1g</p>	 <p>15-1149 XPhos</p> <p>500mg</p>
 <p>15-1152 BrettPhos</p> <p>250mg</p>	 <p>15-1157 JackiePhos</p> <p>100mg</p>	 <p>15-1164 t-BuBrettPhos</p> <p>100mg</p>



## LIGAND KITS - Buchwald Biaryl Phosphine Ligand Mini Kit 2

96-5490 **Buchwald Biaryl Phosphine Ligand Mini Kit 2 for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling**  
For aromatic carbon-heteroatom bond formation and Suzuki Coupling.  
Patents: US 6,395,916, US 6,307,087  
Components also available for individual sale.  
Contains the following:



# LIGAND KITS - Buchwald Biaryl Phosphine Ligand Mini Kit 3

96-5495

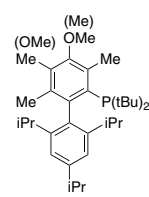
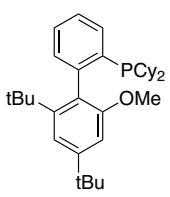
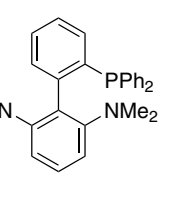
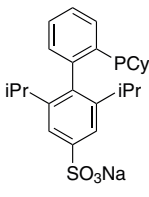
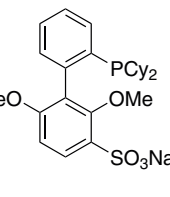
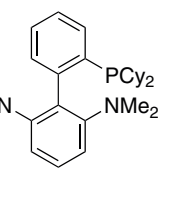
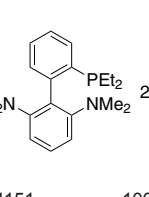
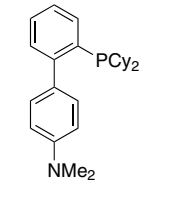
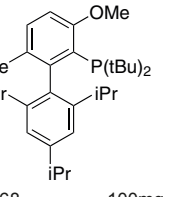
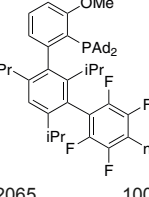
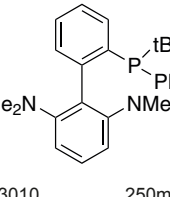
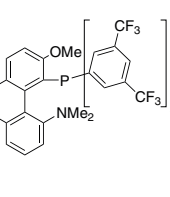
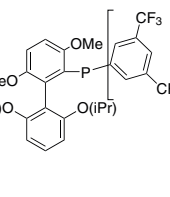
## Buchwald Biaryl Phosphine Ligand Mini Kit 3 for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling

NEW

For aromatic carbon-heteroatom bond formation and Suzuki Coupling.

Patents: US 6,395,916, US 6,307,087.

Components also available for individual sale. Contains the following:

 <p>15-1063 250mg</p>	 <p>15-1105 250mg VPhos</p>	 <p>15-1125 100mg PhCPhos</p>
 <p>15-1135 100mg (XPhos-SO<sub>3</sub>Na)</p>	 <p>15-1142 500mg (water soluble SPhos)</p>	 <p>15-1147 250mg CPhos</p>
 <p>15-1151 100mg EtCPhos</p>	 <p>15-1154 250mg</p>	 <p>15-1168 100mg RockPhos</p>
 <p>15-2065 100mg AlPhos</p>	 <p>15-3010 250mg (t-Bu)PhCPhos</p>	 <p>15-3015 100mg</p>
 <p>15-3020 250mg</p>		

# LIGAND KITS - DSM MonoPhos™ Ligand Kit

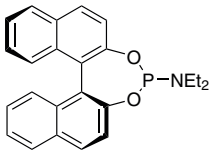
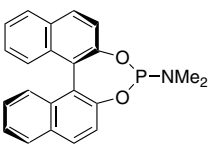
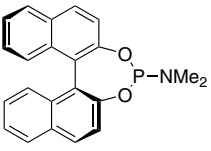
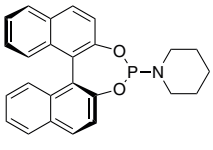
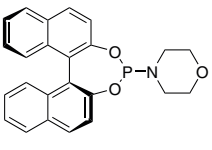
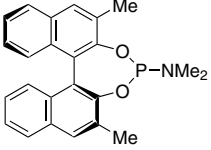
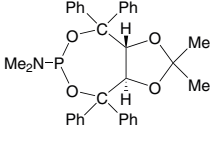
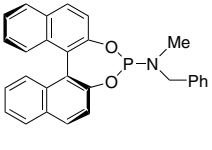
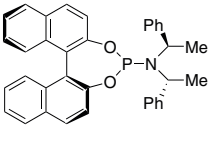
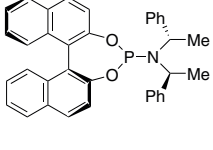
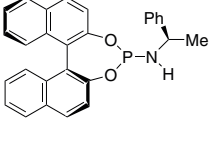
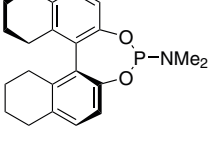
96-5650

## DSM MonoPhos™ Ligand Kit

For asymmetric catalytic hydrogenations and other transformations.

Sold in collaboration with DSM for research purposes only.

Components also available for individual sale. Contains the following:

 <p>15-1231      250mg</p>	 <p>15-1232      1g</p>	 <p>15-1233      1g</p>
 <p>15-1234      100mg</p>	 <p>15-1235      100mg</p>	 <p>15-1255      100mg</p>
 <p>15-1505      100mg</p>	 <p>15-1510      100mg</p>	 <p>15-1520      100mg</p>
 <p>15-1521      100mg</p>	 <p>15-1525      100mg</p>	 <p>15-3495      100mg</p>

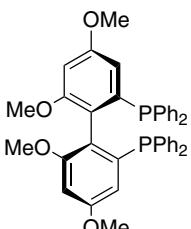
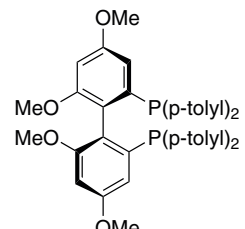
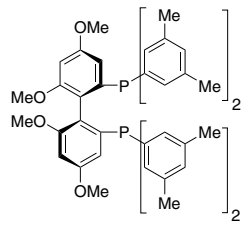
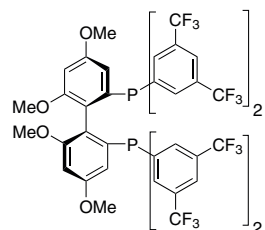
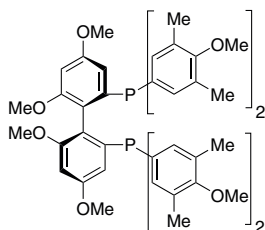
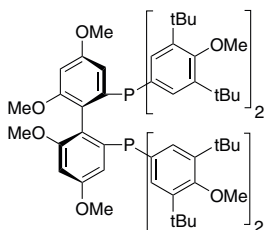
## LIGAND KITS - Garphos™ Ligand Kit

### 96-4100 Garphos™ Ligand Kit

Sold in collaboration with KCT. Patent US App No. 61/381,493.

Components also available for individual sale.

Contains the following:

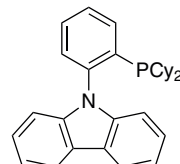
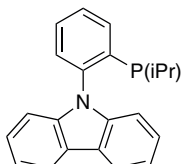
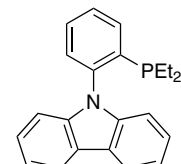
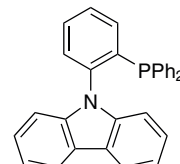
 <p>15-1653 (R)-Ph-Garphos™ 15-1654 (S)-Ph-Garphos™</p> <p style="text-align: right;">100mg</p>	 <p>15-1657 (R)-Tol-Garphos™ 15-1658 (S)-Tol-Garphos™</p> <p style="text-align: right;">100mg</p>	 <p>15-1661 (R)-Xyl-Garphos™ 15-1662 (S)-Xyl-Garphos™</p> <p style="text-align: right;">100mg</p>
 <p>15-1663 (R)-BTFM-Garphos™ 15-1664 (S)-BTFM-Garphos™</p> <p style="text-align: right;">100mg</p>	 <p>15-1666 (R)-DMM-Garphos™ 15-1667 (S)-DMM-Garphos™</p> <p style="text-align: right;">100mg</p>	 <p>15-1672 (R)-DTBM-Garphos™ 15-1673 (S)-DTBM-Garphos™</p> <p style="text-align: right;">100mg</p>

## LIGAND KITS - PhenCar-Phos Ligand Kit

### 96-3780 PhenCar-Phos Ligand Kit

Components also available for individual sale.

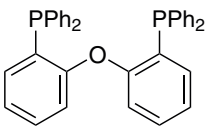
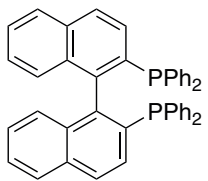
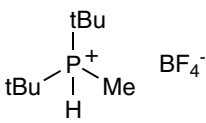
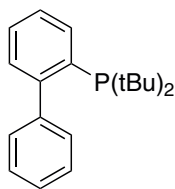
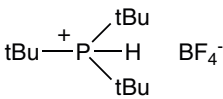
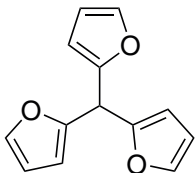
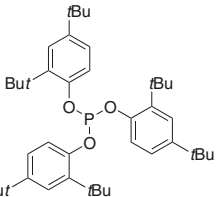
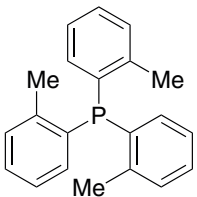
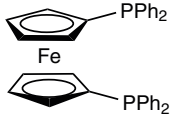
Contains the following:

 <p>15-0445 PhenCar-Phos</p> <p style="text-align: right;">250mg</p>	 <p>15-0493 i-Pr PhenCar-Phos</p> <p style="text-align: right;">250mg</p>	 <p>15-0496 Et PhenCar-Phos</p> <p style="text-align: right;">100mg</p>	 <p>15-0498 Ph PhenCar-Phos</p> <p style="text-align: right;">250mg</p>
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## LIGAND KITS - Phosphine Ligand Kit

### 96-1650 Phosphine Ligand Kit for Palladium-Catalyzed Carbon-Carbon and Carbon-Heteroatom Bond Formation

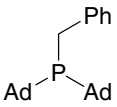
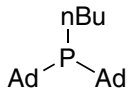
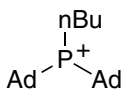
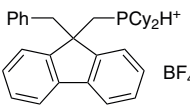
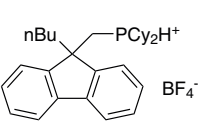
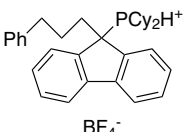
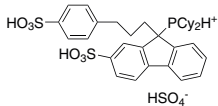
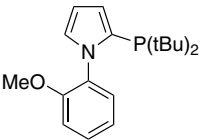
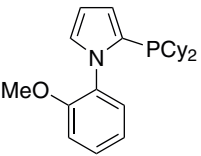
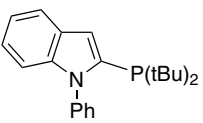
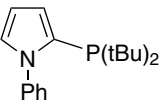
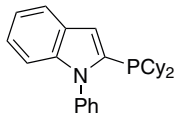
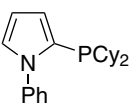
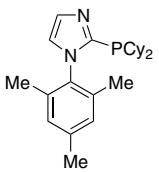
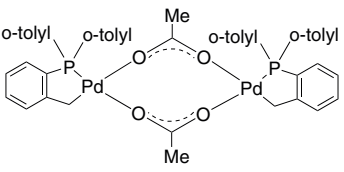
For Palladium-catalyzed carbon-carbon and carbon-heteroatom bond formation. Components also available for individual sale. Contains the following:

 <p>15-0380 DPEphos</p> <p style="text-align: right;">5g</p>	 <p>15-0433 rac-BINAP</p> <p style="text-align: right;">1g</p>	 <p>15-1023</p> <p style="text-align: right;">1g</p>
 <p>15-1045 JohnPhos</p> <p style="text-align: right;">500mg</p>	 <p>15-6000</p> <p style="text-align: right;">1g</p>	 <p>15-6372</p> <p style="text-align: right;">500mg</p>
 <p>15-7720</p> <p style="text-align: right;">10g</p>	 <p>15-8050</p> <p style="text-align: right;">5g</p>	 <p>26-0270 DPPF</p> <p style="text-align: right;">1g</p>

# LIGAND KITS - Solvias cataCXium® Ligand Kit

## 96-6651 Solvias cataCXium® Ligand Kit for C-X coupling reactions

For C-X coupling reactions. Sold in collaboration with Solvias for research purposes only.  
Components also available for individual sale. Contains the following:

 <p>15-0038 500mg [cataCXium® ABn]</p>	 <p>15-0483 1g [cataCXium® A]</p>	 <p>15-0495 250mg [cataCXium® AHI]</p>	 <p>15-1072 500mg [cataCXium® FBn]</p>
 <p>15-1074 500mg [cataCXium® FBu]</p>	 <p>15-1076 500mg [cataCXium® FPrPh]</p>	 <p>15-1078 500mg [cataCXium® FSulf]</p>	 <p>15-2975 500mg [cataCXium® POMeB]</p>
 <p>15-2980 500mg [cataCXium® POMeCy]</p>	 <p>15-3550 500mg [cataCXium® PIntB]</p>	 <p>15-3600 500mg [cataCXium® PtB]</p>	 <p>15-3605 500mg [cataCXium® PInCy]</p>
 <p>15-3610 500mg [cataCXium® PCy]</p>	 <p>15-6362 500mg [cataCXium® PICy]</p>	 <p>46-0290 250mg [cataCXium® C]</p>	

# LIGAND KITS - Solvias Josiphos Ligand Kit

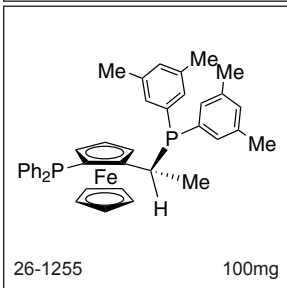
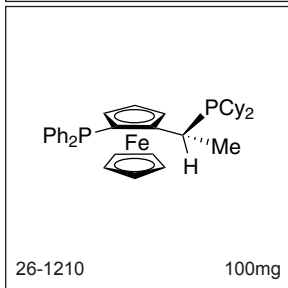
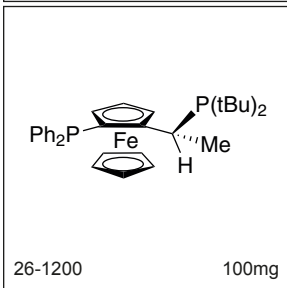
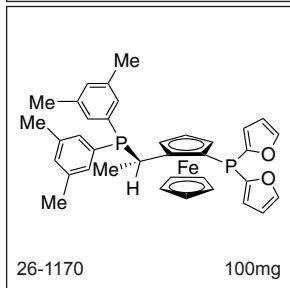
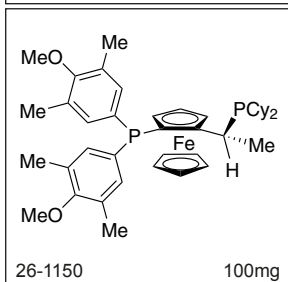
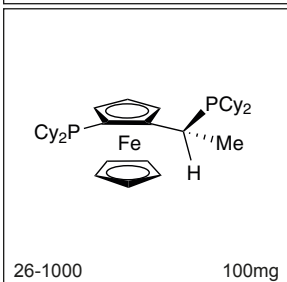
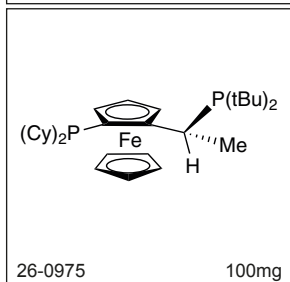
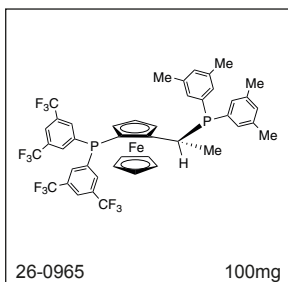
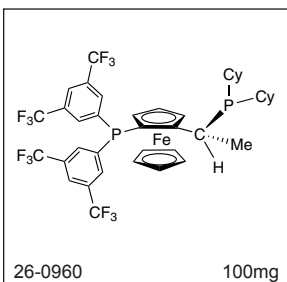
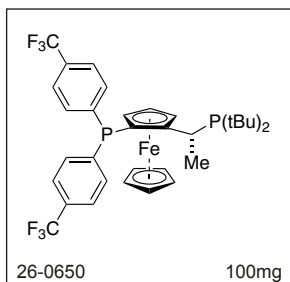
## 96-3650 Solvias Josiphos Ligand Kit

For asymmetric catalytic hydrogenations and other transformations.

Sold in collaboration with Solvias for research purposes only.

Components also available for individual sale.

Contains the following:



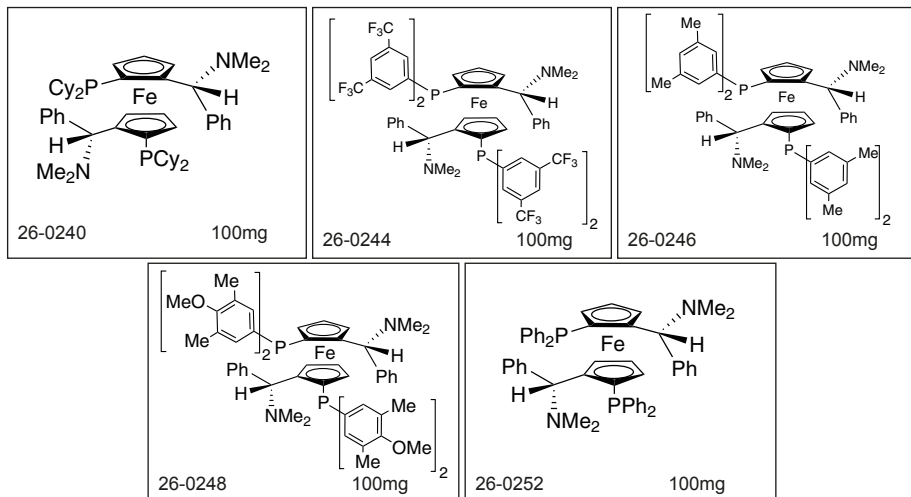
## LIGAND KITS - Solvias MandyPhos™ Ligand Kit

### 96-3652 Solvias MandyPhos™ Ligand Kit

For asymmetric catalytic hydrogenations and other transformations.

Sold in collaboration with Solvias for research purposes only.

Components also available for individual sale. Contains the following:



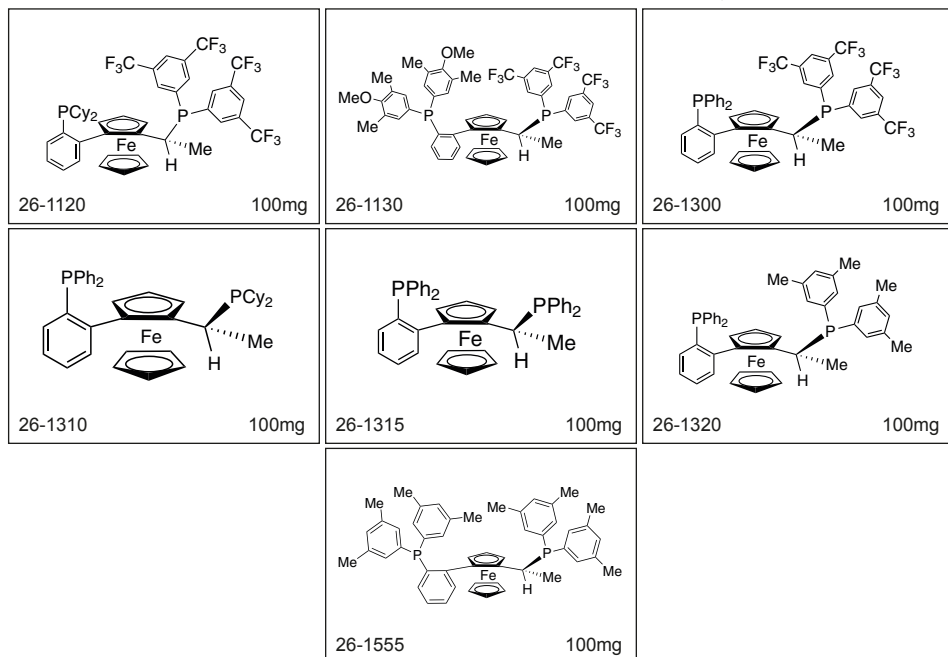
## LIGAND KITS - Solvias Walphos Ligand Kit

### 96-3651 Solvias Walphos Ligand Kit

For asymmetric catalytic hydrogenations and other transformations.

Sold in collaboration with Solvias for research purposes only.

Components also available for individual sale. Contains the following:



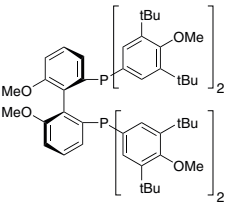
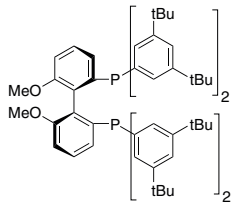
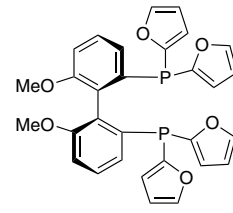
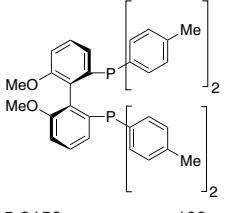
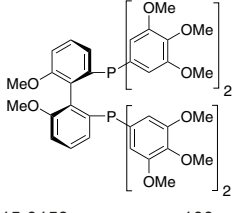
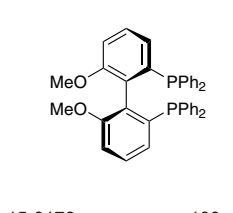
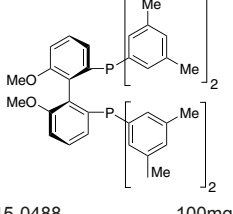
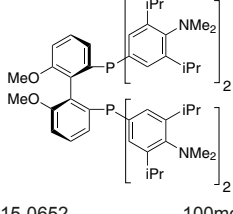
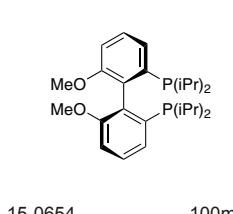


## LIGAND KITS - Solvias (R)-MeO-BIPHEP Ligand Kit

### 96-3655 Solvias (R)-MeO-BIPHEP Ligand Kit

Sold in collaboration with Solvias for research purposes only.

Components also available for individual sale. Contains the following:

	15-0042	100mg		15-0044	100mg		15-0112	100mg
	15-0156	100mg		15-0158	100mg		15-0178	100mg
	15-0488	100mg		15-0652	100mg		15-0654	100mg

## LIGAND KITS - Solvias (S)-MeO-BIPHEP Ligand Kit

### 96-3656 Solvias (S)-MeO-BIPHEP Ligand Kit

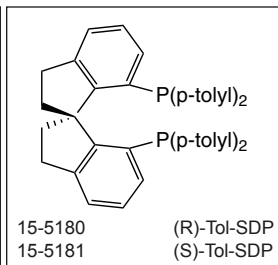
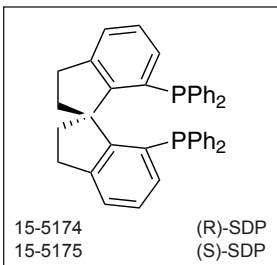
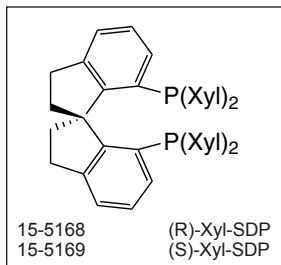
Sold in collaboration with Solvias for research purposes only.

Components also available for individual sale. Contains the following:

15-0043	(S)-(+)-2,2'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (910134-30-4)	100mg
15-0045	(S)-(-)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (167709-31-1)	100mg
15-0113	(S)-(-)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (145214-59-1)	100mg
15-0157	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (133545-25-2)	100mg
15-0159	(S)-(-)-2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (256235-61-7)	100mg
15-0179	(S)-(-)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (S)-MeO-BIPHEP (133545-17-2)	100mg
15-0489	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (362634-22-8)	100mg
15-0653	(S)-(+)-2,2'-Bis[di(3,5-di-i-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (919338-66-2)	100mg
15-0655	(S)-(-)-2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% (150971-43-0)	100mg

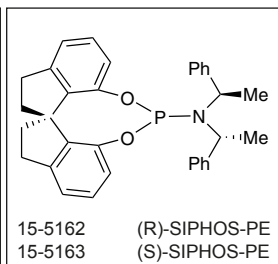
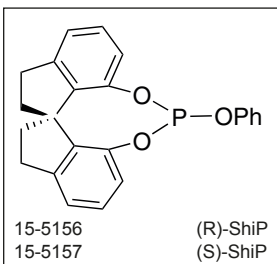
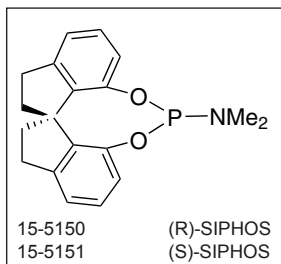
## LIGAND KITS - Spiro Biphosphine Ligand Kit

**96-0060 Spiro Bisphosphine Ligand Kit**  
 Components also available for individual sale.  
 Contains the following:



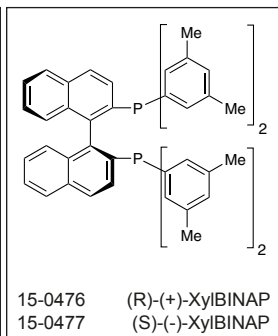
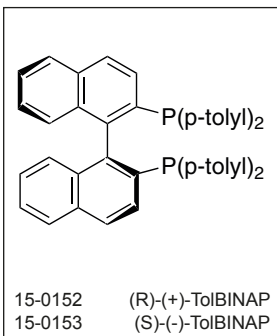
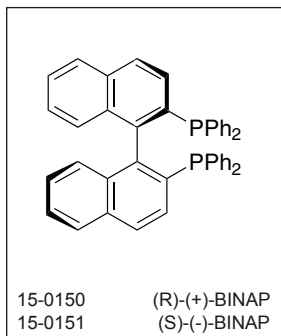
## LIGAND KITS - Spiro Monophosphite & Monophosphoramidite Ligand Kit

**96-0065 Spiro Monophosphite and Monophosphoramidite Ligand Kit**  
 Components also available for individual sale.  
 Contains the following:



## LIGAND KITS - Takasago BINAP Ligand Kit

**96-6950 Takasago BINAP Ligand Kit**  
 Manufactured under license of Takasago patent.  
 Components also available for individual sale.  
 Contains the following:



## LIGAND KITS - Takasago SEGPHOS® Ligand Kit

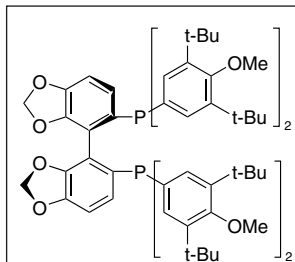
96-6900

### Takasago SEGPHOS® Ligand Kit

Manufactured under license of Takasago patent.

Components also available for individual sale.

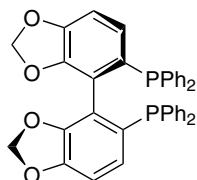
Contains the following:



250mg

15-0066 (R)-(-)-DTBM-SEGPHOS®

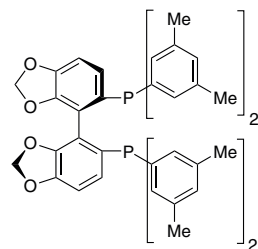
15-0067 (S)-(+)-DTBM-SEGPHOS®



250mg

15-0136 (R)-(+)-SEGPHOS®

15-0137 (S)-(-)-SEGPHOS®



250mg

15-0478 (R)-(+)-DM-SEGPHOS®

15-0479 (S)-(-)-DM-SEGPHOS®

## LIGAND KITS - UREAphos & METAMORPhos Ligand Kit

96-3740

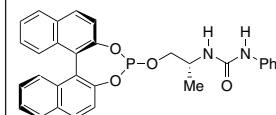
### UREAphos and METAMORPhos Ligand Kit for Asymmetric Hydrogenation

Sold under license from InCatT for research purposes only.

WO2004/103559, WO2009/065853

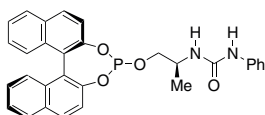
Components also available for individual sale.

Contains the following:



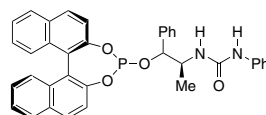
15-2200

50mg



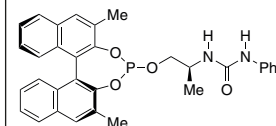
15-2201

50mg



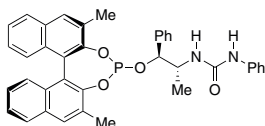
15-2202

50mg



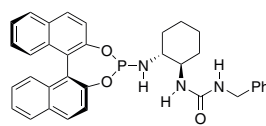
15-2204

50mg



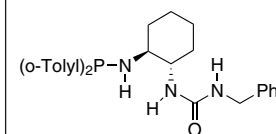
15-2206

50mg



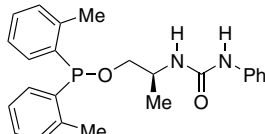
15-2208

50mg



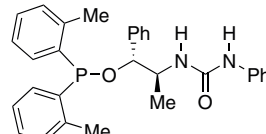
15-2210

50mg



15-2212

50mg

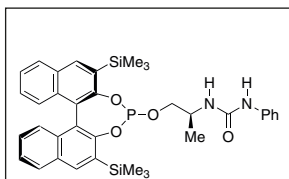


15-2214

50mg

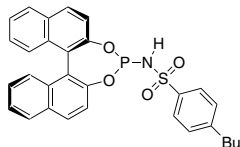
## LIGAND KITS - UREAphos & METAMORPhos Ligand Kit

96-3740 UREAphos and METAMORPhos Ligand Kit for Asymmetric Hydrogenation  
(continued)



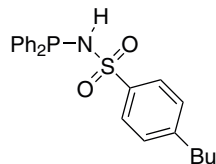
15-2216

50mg



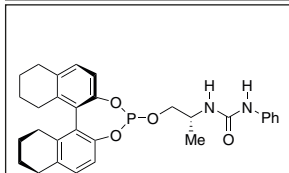
15-2218

50mg



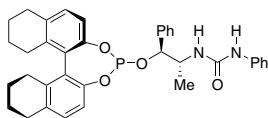
15-2220

50mg



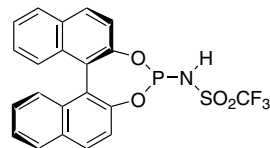
15-2222

50mg



15-2224

50mg



15-2228

50mg

## METAL SCAVENGING KITS - BASF Metals Scavenging Agent Kit (MSA Kit)

96-6700 BASF Metals Scavenging Agent Kit (MSA Kit)

Sold in collaboration with BASF for research purposes only.

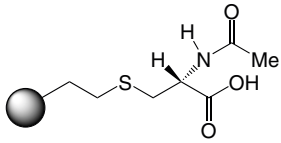
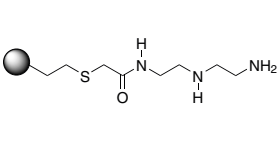
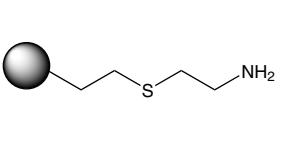
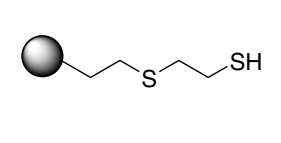
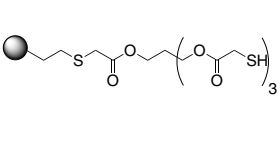
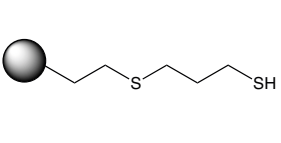
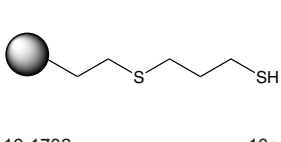
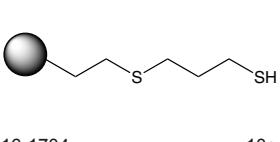
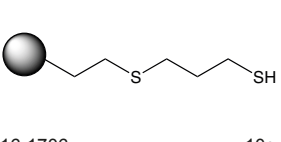
Components also available for individual sale. Contains the following:

06-0805	Metals scavenging agent, Phosphotungstic acid modified activated carbon (BASF MSA-FC C-1) (7440-44-0)	10g
13-6300	Metals scavenging agent, Phosphotungstic acid modified alumina (BASF MSA-FC Al-1) (1344-28-1)	10g
14-4353	Metals scavenging agent, Mercaptopropyl modified silica (BASF MSA-FC Si-3) (112926-00-8)	10g

## METAL SCAVENGING KITS - PhosphonicS Metals Scavenging Agent Kit

### 96-6750 PhosphonicS Metals Scavenging Kit

Sold in collaboration with PhosphonicS Ltd. for research purposes only.  
Components also available for individual sale. Contains the following:

 <p>16-0200 (PhosphonicS SCYT1) 10g</p>	 <p>16-0210 (PhosphonicS STA3) 10g</p>	 <p>16-0215 (PhosphonicS SEA) 10g</p>
 <p>16-0650 (PhosphonicS SEM26) 10g</p>	 <p>16-1540 (PhosphonicS SET) 10g</p>	 <p>16-1700 (PhosphonicS SPM36) 10g</p>
 <p>16-1702 (PhosphonicS SPM36f) 10g</p>	 <p>16-1704 (PhosphonicS SPM32f) 10g</p>	 <p>16-1706 (PhosphonicS SPM32) 10g</p>

Metal scavengers are increasingly used as an effective way to solve metal removal problems associated with Active Pharmaceutical Ingredients (API's) and synthetic intermediates. This is an often complex technical challenge, influenced by a number of factors including the significant structural variations with API's, the polar functional groups which APIs tend to contain, the environment (solvent and pH) and potential incompatibilities within the API. PhosphincS has designed a portfolio of silica-based materials containing a diverse range of functional groups to address effective metal scavenging.

#### Properties of PhosphonicS' Broad Portfolio of Metal Scavengers

- High affinity for a wide range of metals, in different oxidation states
- Fast kinetics - highly active at ambient temperatures
- High selectivity for the metal, meaning minimal loss of the API/compound
- Broad solvent and pH compatibility with both organic and aqueous formulations, reducing the requirements of time-consuming and costly solvent switches
- No swelling of the materials are required
- Excellent stability - thermal, physical, chemical and mechanical
- Very high purity - eliminating issues of extractable impurities
- Enhanced performance, due to multiple functional groups and higher effective loadings
- Metal recycling options
- Availability on process scale

#### Performance Benefits from using PhosphonicS' Metal Scavengers

- **Faster:** purification, batch processing, problem-solving, market introduction
- **Reduced:** development time, valuable API losses, total manufacturing costs, environmental burden
- **Enhanced:** process, productivity, compliance

## OTHER KITS - Long-Chain n-Alkylphosphonic Acid Kit

96-1525

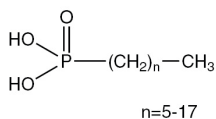
### Long-Chain n-Alkylphosphonic Acid Kit

Components also available for individual sale. Contains the following:

15-0958	n-Decylphosphonic acid, min. 97% (6874-60-8)	1g
15-1835	n-Dodecylphosphonic acid, min. 97% DDPA (5137-70-2)	1g
15-2400	n-Hexadecylphosphonic acid, min. 97% HDPA (4721-17-9)	1g
15-2410	n-Hexylphosphonic acid, min. 97% HPA (4721-24-8)	1g
15-3510	n-Octadecylphosphonic acid, min. 97% ODPa (4724-47-4)	1g
15-3520	n-Octylphosphonic acid, min. 97% OPA (4724-48-5)	1g
15-5145	n-Tetradecylphosphonic acid, min. 97% TDPA (4671-75-4)	1g

#### General Use:

Linear alkyl Phosphonic acids and their phosphonate salts are surfactants because of their classic bifunctional chemical structure,  $RP(O)(OH)_2$ , consisting of both non-polar organic hydrophobic groups and anionic inorganic hydrophilic groups. Like the related alkyl sulfonates, they are used as detergents, dispersants, emulsifiers, and chelating agents. Alkyl phosphonic acids are typically sparingly soluble in both organic solvents and water, but become more soluble in water when neutralized to phosphonates at neutral to high pH.



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# Available Booklets

**Metal Catalysts for Organic Synthesis**



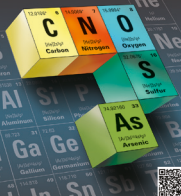


Many New Products!

Including Organocatalysts

**Other Ligands**

Phosphorus Ligands Appear in their Own Booklet

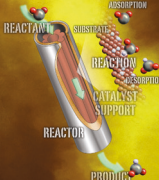


**Phosphorus Ligands and Compounds**

Many New Products!





**Heterogeneous Catalysts**

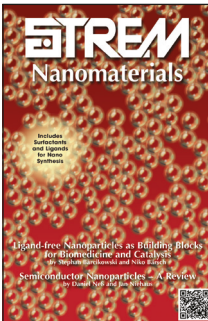






**STREM Nanomaterials**

Includes Nanomaterials and Ligands for Metal Synthesis

Ligand-free Nanoparticles as Building Blocks for Biomedicine and Catalysis in Nanoparticle Growth and Size Control

Semiconductor Nanoparticles – A Review by Zhewei Li, Jie Fan, and William

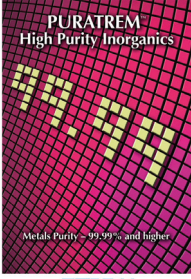




**Kits**






**PURATREM High Purity Inorganics**




Metals Purity >99.99% and Higher




**NEW PRODUCTS 2017**

**STREM**

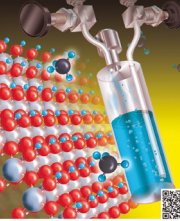


High Quality Chemicals for Research Since 1964



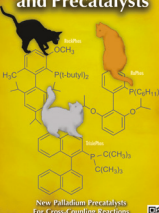
In Customer's Best Interest



**MOCVD, CVD & ALD Precursors**







**Buchwald Ligands and Precatalysts**




New Palladium Precatalysts for Cross-Coupling Reactions

By Nicholas C. Brown and Stephen J. Buchwald

**Materials for Energy Applications**



Photovoltaics, Fuel Cells, LED/Quantum Dots, Energy Storage, Hydrogen Storage, Metal Organic Frameworks



Disubstituted PI core-shell nanoparticles: Active and durable electrocatalysts for low-temperature Polymer Electrolyte Membrane Fuel Cells (PEMFCs) by Peizhen Qi, Ben Wang

Strem Chemicals Chemist Finds New Way to Drive to Work

By Dr. Steve Wright



# The Strem Product Line

## OUR LINE OF RESEARCH CHEMICALS

Biocatalysts & Organocatalysts  
Electronic Grade Chemicals  
Fullerenes  
High Purity Inorganics & Alkali Metals  
Ionic Liquids  
Ligands & Chiral Ligands  
Metal Acetates & Carbonates  
Metal Alkoxides & beta-Diketonates  
Metal Alkyls & Alkylamides  
Metal Carbonyls & Derivatives  
Metal Catalysts & Chiral Catalysts  
Metal Foils, Wires, Powders & Elements  
Metal Halides, Hydrides & Deuterides  
Metal Oxides, Nitrates, Chalcogenides  
Metal Scavengers  
Metallocenes  
Nanomaterials  
Organofluorines  
Organometallics  
Organophosphines & Arsines  
Porphines & Phthalocyanines  
Precious Metal & Rare Earth Chemicals  
Volatile Precursors for MOCVD, CVD & ALD

Custom Synthesis  
cGMP Facilities  
FDA Inspected  
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