Phosphorus Ligands and Compounds

Since 1964, Strem Chemicals, Inc. has been providing fine chemicals for research as well as for commercial production. From our earliest beginnings we have provided a range of phosphorus-based ligands. We have continued to expand our offering as new applications have been found for this class of compounds. These include monodentate, multidentate, achiral and chiral ligands, some commercially available only from Strem.

Custom Synthesis
If you can't find the item you require in this brochure please let us know. We provide custom synthesis services to academic and government institutions, as well as some of the world's leading corporations under strict confidence. Key selection factors for these customers are Strem's experience with these compounds as well as our consistent focus on quality.

cGMP Facilities
Our FDA inspected current Good Manufacturing Practices facilities are available for pharmaceutical applications.

- FDA Inspected
- Drug Master Files
- Stability Studies
- Complete Documentation

MSDS Sheets, Technical Notes and Certificates of Analysis (CofA’s) On-Line - Search by our catalog number or CAS number, view the MSDS sheet or technical note, obtain CofA’s online.

Chemikers
Vol. XXV No. 2 Articles-
“Aminodiphosphines: Highly Versatile Ligands for Catalysis”
“Nanosprings™: A Versatile Nanomaterial Platform”
“Semiconductor Nanoparticles – A Review”

Vol. XXV No. 1 Articles-
“A RAFT Tutorial”
“Hybrid Organic-Inorganic Films Grown Using Molecular Layer Deposition”

Vol. XXIV Articles-
“The Revelance of Shape and Size of Gold Nanoparticles”
“Recent Developments in Gold Catalysis”
“Capabilities of AUROlite™ Catalysts”

Vol. XXIII Articles-
“Chiral Ligands and Their Complexes”

Kits available from Strem - Please see the back of this brochure.

Catalog - Please see our catalog for full product listing or visit our website www.strem.com.

Many New Products including Metal Catalysts for Organic Synthesis, Metals Scavenging Agents; Nanomaterials; Ionic Liquids, Metal Catalyst and Ligand Kits and more have been added.

Ephraim S. Honig, Ph.D., M.B.A.
Chief Operating Officer
<table>
<thead>
<tr>
<th>Amination</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0066</td>
<td>(R)-(+)-5.5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%</td>
</tr>
<tr>
<td>15-0067</td>
<td>(S)-(+)-5.5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%</td>
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<tr>
<td>15-0044</td>
<td>(R)-(+)-2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</td>
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<td>26-1150</td>
<td>(R)-(+)-1-[(S)-2-Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferroceny1]ethylidicyclohexylphosphine, min. 97%</td>
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<td>15-0433</td>
<td>racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP</td>
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<td>26-0965</td>
<td>(R)-(+)-1-[(S)-2-Bis(3,5-di-trifluoromethyphenyl)phosphino]ferroceny1]ethylidicyclohexylphosphine, min. 97%</td>
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<tr>
<td>26-0965</td>
<td>(R)-(+)-1-[(S)-2-Bis(3,5-di-trifluoromethyphenyl)phosphino]ferroceny1]ethylid-3,5-xlylphosphine, min. 97%</td>
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<tr>
<td>15-0415</td>
<td>4,5-Bis-(di-i-propylphosphinomethyl)acridine, 98%</td>
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<td>(R)-(+)-1-[(S)-2-Bis(3,5-di-trifluoromethyphenyl)phosphino]ferroceny1]ethylidicyclohexylphosphine, min. 97%</td>
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<tr>
<td>15-0478</td>
<td>(R)-(+)-5.5'-Bis[di(3,5-xlyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEPHOS</td>
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<tr>
<td>15-0477</td>
<td>(S)-(+)-2,2'-Bis[di(3,5-xlyl)phosphino]-1,1'-binaphthyl, 98% (S)-(+)-XylBINAP</td>
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<tr>
<td>26-0650</td>
<td>(R)-(+)-1-[(S)-2-Bis(4-trifluoromethylphenyl)phosphino]ferroceny1]ethylid-t-butylphosphine, min. 97%</td>
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<tr>
<td>15-0483</td>
<td>Butyld-i-1-adamantylphosphine, min. 95% [cataCXium® A]</td>
</tr>
<tr>
<td>15-1052</td>
<td>2-Di-t-butylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylXPhos</td>
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<tr>
<td>15-1062</td>
<td>Dicyclohexyl(2,2'-diphenyl-1-methylvinyl)phosphine Cy-vBRIDP</td>
</tr>
<tr>
<td>15-1145</td>
<td>2-(Dicyclohexylphosphino)-2'-N,N-dimethylaminobiphenyl, 98% DavePhos</td>
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<tr>
<td>15-1146</td>
<td>2-Dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98% RuPhos</td>
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<tr>
<td>26-0975</td>
<td>(R)-(+)-1-[(S)-2-Dicyclohexylphosphino]ferroceny1]ethylid-t-butylphosphine, min. 97%</td>
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<tr>
<td>15-1000</td>
<td>(R)-(+)-1-[(S)-2-Dicyclohexylphosphino]ferroceny1]ethylidicyclohexylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-1001</td>
<td>(S)-(+)-1-[(R)-2-Dicyclohexylphosphino]ferroceny1]ethylidicyclohexylphosphine, min. 97%</td>
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<tr>
<td>26-1230</td>
<td>(R)-(+)-1-[(S)-2-Dicyclohexylphosphino]ferroceny1]ethylidiphenylphosphine, min. 97%</td>
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<tr>
<td>15-1101</td>
<td>(S)-(+)-1-[(R)-2-Dicyclohexylphosphino]ferroceny1]ethylidiphenylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-1148</td>
<td>2-Dicyclohexylphosphino-2'-methylbiphenyl, min. 98% MePhos</td>
</tr>
<tr>
<td>15-1084</td>
<td>11-Dicyclohexylphosphino-12-phenyl-9,10-ethanoanthracene dichloromethane adduct, min. 98% KITPHOS</td>
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<tr>
<td>15-1149</td>
<td>2-(Dicyclohexylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% XPhos</td>
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<td>26-1170</td>
<td>(S)-(+)-1-[(R)-2-(Di-2-furylphosphino)ferroceny1]ethylid-t-butylphosphine, min. 97%</td>
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<td>15-1242</td>
<td>9,9-Dimethyl-4,5-bis(diphenylphosphino)anthene, min. 98% XANTPHOS</td>
</tr>
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<td>26-1175</td>
<td>(R)-(+)-1-[(S)-2-(Di-1-naphthylphosphino)ferroceny1]ethylid-3,5-xlylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-1745</td>
<td>2-Diphenylphosphino-2'-(N,N-dimethylamino)biphenyl, 98%</td>
</tr>
<tr>
<td>15-1765</td>
<td>2-[2-(Diphenylphosphino)ethy1]pyridine, min. 97%</td>
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<tr>
<td>26-1156</td>
<td>(R)-(+)-[R)-2-Diphenylphosphinoferrocy1]1(N,N-dimethylamino)[2-diphenyl phosphinophenyl)methane, min. 97%</td>
</tr>
<tr>
<td>26-1155</td>
<td>(S)-(S)-2-Diphenylphosphinoferroceny1]1(N,N-dimethylamino)[2-diphenyl phosphinophenyl)methane, min. 97% TANIAPHOS</td>
</tr>
<tr>
<td>26-1200</td>
<td>(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferroceny1]ethylid-t-butylphosphine, min. 97%</td>
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<tr>
<td>26-1201</td>
<td>(S)-(-)-1-[(R)-2-(Diphenylphosphino)ferroceny1]ethylid-t-butylphosphine, min. 97%</td>
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<td>26-1210</td>
<td>(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferroceny1]ethylidicyclohexylphosphine ethanol adduct, min. 97%</td>
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<td>26-1211</td>
<td>(S)-(-)-1-[(R)-2-(Diphenylphosphino)ferroceny1]ethylidicyclohexylphosphine ethanol adduct, min. 97%</td>
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<tr>
<td>26-1255</td>
<td>(R)-(-)-1-[(S)-2-(Diphenylphosphino)ferroceny1]ethylid-3,5-xlylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-1778</td>
<td>(R)-(+)-1-[(2-Diphenylphosphino-1-naphthyl)isoquinoline (R)-QUINAP</td>
</tr>
<tr>
<td>15-1777</td>
<td>(S)-(-)-1-[(2-Diphenylphosphino-1-naphthyl)isoquinoline (S)-QUINAP</td>
</tr>
<tr>
<td>26-2975</td>
<td>N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMetB]</td>
</tr>
<tr>
<td>26-3550</td>
<td>N-Pheny1-2-(di-t-butylphosphino)indol, min. 98% [cataCXium® PnB]</td>
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<tr>
<td>26-3605</td>
<td>N-Pheny1-2-(dicyclohexy1phosphino)indol, min. 95% [cataCXium® PnCy]</td>
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<tr>
<td>26-3610</td>
<td>N-Pheny1-2-(dicyclohexy1phosphino)pyrrole, 90% [cataCXium® PCy]</td>
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<tr>
<td>26-5810</td>
<td>Tri-t-butylphosphine, 99%</td>
</tr>
<tr>
<td>26-5811</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane)</td>
</tr>
<tr>
<td>26-5812</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane) (Sure/Seal™ bottle)</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
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<tr>
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<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>26-0150</td>
<td>1,1'-Bis(di-t-butylphosphino)ferrocene, min. 96%</td>
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<tr>
<td>26-1150</td>
<td>(R)-(S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocenyldicyclohexylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-0150</td>
<td>(R)-(S)-2'-Bis(di(dicyclohexylphosphino)-1,1'-binaphthyl, 98% (R)-(S)-BINAP</td>
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<tr>
<td>15-0151</td>
<td>(S)-(R)-2'-Bis(di(dicyclohexylphosphino)-1,1'-binaphthyl, 97% (S)-(R)-BINAP</td>
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<td>15-0145</td>
<td>2,2'-Bis(di(dicyclohexylphosphino)-1,1'-binaphthyl, 98% BIPHEP</td>
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<tr>
<td>26-0270</td>
<td>1,1'-Bis(dicyclohexylphosphino)ferrocene, 99% DPPF</td>
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<td>15-2972</td>
<td>(R)-(S)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (R)-(S)-H$_2$BINAP</td>
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<tr>
<td>15-0152</td>
<td>(R)-(S)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(S)-TolBINAP</td>
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<tr>
<td>15-0153</td>
<td>(S)-(R)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(R)-TolBINAP</td>
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<td>26-0960</td>
<td>(R)-(S)-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyldicyclohexylphosphine, min. 97%</td>
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<td>26-0965</td>
<td>(R)-(S)-[2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyldicyclohexylphosphine, min. 97%</td>
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<td>15-0476</td>
<td>(R)-(S)-2,2'-Bis(di[3,5-xylyl]phosphino)-1,1'-binaphthyl, 98% (R)-(S)-XYBINAP</td>
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<td>15-0477</td>
<td>(S)-(R)-2,2'-Bis(di[3,5-xylyl]phosphino)-1,1'-binaphthyl, 98% (S)-(R)-XYBINAP</td>
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<td>26-0650</td>
<td>(R)-(S)-[1,2,3,4,5-Pentaphenyl-1'-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS</td>
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<tr>
<td>15-0483</td>
<td>Butylid-1-adamantylphosphate, min. 95% [cataCXium® A]</td>
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<tr>
<td>15-1090</td>
<td>2-(Di-1-adamantylphosphino)dimethylaminobenzene, 97% Me-DaiPhos</td>
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<td>15-1005</td>
<td>Di-t-butyl(2,2-diphenyl-1-methyl-1-cyclopophosphine cBRIDP</td>
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<td>15-1023</td>
<td>Di-t-butylethylmethylphosphonium tetrafluoroborate, 99%</td>
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<td>15-1045</td>
<td>2-(Di-t-butylphosphino)biphenyl, 99% JohnPhos</td>
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<td>15-1164</td>
<td>2-(Di-t-butylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, 98% t-butylBrettPhos</td>
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<td>15-1162</td>
<td>2-(Di-t-butylphosphino)-3-methoxy-6-methyl-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, 98% RockPhos</td>
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<td>15-1100</td>
<td>Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine Cy-cBRIDP</td>
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<td>15-1140</td>
<td>2-(Dicyclohexylphosphino)biphenyl, 98%</td>
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<td>15-1086</td>
<td>2-(Dicyclohexylphosphino)-N,N-bis(1-methylhexyl)-1H-indole-1-carboxamide, min. 98% Amidole-Phos</td>
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<td>15-1143</td>
<td>2-Dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl, 98% SPhos</td>
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<td>15-1142</td>
<td>2',2'-Dicyclohexylphosphino-2,6-dimethoxy-3-sulfonato-1,1'-biphenyl hydrate sodium salt (water soluble SPhos), min. 98%</td>
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<tr>
<td>15-1145</td>
<td>2',2'-Dicyclohexylphosphino-2',3',3'-trimethoxy-1,1'-biphenyl, 98% DavePhos</td>
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<td>15-1146</td>
<td>2-Dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl, 98% RuPhos</td>
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<td>15-1135</td>
<td>2',2'-Dicyclohexylphosphino-2,6-di-i-propyl-4-sulfonato-1,1'-biphenyl hydrate sodium salt</td>
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<tr>
<td>26-0975</td>
<td>(R)-(S)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
</tr>
<tr>
<td>26-1000</td>
<td>(R)-(S)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldicyclohexylphosphine, min. 97%</td>
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<tr>
<td>15-1001</td>
<td>(S)-(R)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<td>15-1230</td>
<td>(R)-(S)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<td>15-1101</td>
<td>(S)-(R)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-diphenylphosphine, min. 97%</td>
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<td>26-1087</td>
<td>1-(Dicyclohexylphosphino)phosphino-2-(2-methoxyphenyl)-1H-indole, 98% NPCy o-Andole-Phos</td>
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<td>15-1148</td>
<td>2-Dicyclohexylphosphino-2'-methylbiphenyl, 98% MePhos</td>
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<td>15-1089</td>
<td>1-(Dicyclohexylphosphino)phosphino-2-phenyl-1H-indole, 98% NPCy Phenole-Phos</td>
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<td>15-1088</td>
<td>2-(Dicyclohexylphosphino)phenyl-1-methyl-1H-indole, 98% CM-Phos</td>
</tr>
<tr>
<td>15-1149</td>
<td>2-(Dicyclohexylphosphino)-2',4'-6'-tri-i-propyl-1,1'-biphenyl, 98% XPhos</td>
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<td>15-1170</td>
<td>(S)-(R)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<td>15-1242</td>
<td>9,9-Dimethyl-4,5-bis(diphenylphosphino)oxanthene, min. 98% XANTPHOS</td>
</tr>
<tr>
<td>15-1175</td>
<td>(R)-(S)-[(S)-2-(Dicyclohexylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-1146</td>
<td>2-Diphenylphosphino-2'-(N,N-dimethylamino)biphenyl, 98%.</td>
</tr>
<tr>
<td>26-1201</td>
<td>(S)-(R)-[(S)-2-(Diphenylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<td>15-1210</td>
<td>(S)-(R)-[(S)-2-(Diphenylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<td>15-1211</td>
<td>(S)-(R)-[(S)-2-(Diphenylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
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<tr>
<td>15-1255</td>
<td>(R)-(S)-[(S)-2-(Diphenylphosphino)ferrocenyldi-t-butylphosphine, min. 97%</td>
</tr>
<tr>
<td>15-2975</td>
<td>N-(2-Methoxy-phenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMetB]</td>
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<td>15-2980</td>
<td>N-(Phenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMeCy]</td>
</tr>
<tr>
<td>26-3575</td>
<td>1,2,3,4,5-Pentaphenyl-1'-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS</td>
</tr>
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<td>15-3550</td>
<td>N-Phenyl-2-(di-t-butylphosphino)indol, min. 98% [cataCXium® PlntB]</td>
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<td>15-3600</td>
<td>N-Phenyl-2-(di-t-butylphosphino)pyrrole, 95% [%cataCXium® PlTb]</td>
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<tr>
<td>15-3605</td>
<td>N-Phenyl-2-(dicyclohexylphosphino)indol, min. 95% [%cataCXium® PlnCy]</td>
</tr>
<tr>
<td>15-5810</td>
<td>Tri-t-butylphosphine, 99%</td>
</tr>
</tbody>
</table>
Carbon-carbon bond formation-General

Visit www.strem.com for new product announcements.
### Carbon-carbon bond formation-General

<table>
<thead>
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<th>Code</th>
<th>Compound</th>
<th>Purity</th>
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<tbody>
<tr>
<td>15-7720</td>
<td>Tris(2,4-di-t-butylphenyl)phosphite, 98%</td>
<td></td>
</tr>
<tr>
<td>15-6000</td>
<td>Tri-t-butylphosphonium tetrafluoroborate, 99%</td>
<td></td>
</tr>
<tr>
<td>15-5812</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane) (Sure/Seal ™ bottle)</td>
<td></td>
</tr>
<tr>
<td>15-5811</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane)</td>
<td></td>
</tr>
<tr>
<td>15-5810</td>
<td>Tri-t-butylphosphine, 99%</td>
<td></td>
</tr>
<tr>
<td>15-1822</td>
<td>(S)-(-)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98%</td>
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<tr>
<td>15-1821</td>
<td>(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98%</td>
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<tr>
<td>15-1505</td>
<td>(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%</td>
<td></td>
</tr>
<tr>
<td>15-0483</td>
<td>Butyldi-1-adamantylphosphine, min. 95% [cataCXium ® A]</td>
<td></td>
</tr>
<tr>
<td>15-0477</td>
<td>(S)-(-)-2,2'-Bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP</td>
<td></td>
</tr>
<tr>
<td>15-0153</td>
<td>(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP</td>
<td></td>
</tr>
<tr>
<td>15-0152</td>
<td>(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP</td>
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</tr>
<tr>
<td>15-0491</td>
<td>S-(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97%</td>
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<tr>
<td>26-1555</td>
<td>(R)-(+)-1-[(R)-2-(2'-Di-3,5-xylylphosphinophenyl)ferrocenyl]ethyldi-3,5-xylylphosphine, min. 97%</td>
<td></td>
</tr>
<tr>
<td>26-1310</td>
<td>(R)-(-)-1-[2-(2'-Diphenylphosphinophenyl)ferroceny]ethylbis(di-3,5-trifluoromethylphenyl)phosphate, min. 97%</td>
<td></td>
</tr>
<tr>
<td>15-3495</td>
<td>(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%</td>
<td></td>
</tr>
</tbody>
</table>

### Carbon-carbon bond formation-Heck Reaction

<table>
<thead>
<tr>
<th>Code</th>
<th>Compound</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0045</td>
<td>(S)-(-)-2,2'-Bis(di(3,5-di-t-butylphenyl)phosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</td>
<td></td>
</tr>
<tr>
<td>15-0150</td>
<td>(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP</td>
<td></td>
</tr>
<tr>
<td>15-0151</td>
<td>(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 97% (S)-(-)-BINAP</td>
<td></td>
</tr>
<tr>
<td>15-0490</td>
<td>R(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97%</td>
<td></td>
</tr>
<tr>
<td>15-0491</td>
<td>S(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97%</td>
<td></td>
</tr>
<tr>
<td>15-0152</td>
<td>(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-ToIBINAP</td>
<td></td>
</tr>
<tr>
<td>15-0153</td>
<td>(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-ToIBINAP</td>
<td></td>
</tr>
<tr>
<td>15-0477</td>
<td>(S)-(-)-2,2'-Bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl, 98% (S)-(-)-XylIBINAP</td>
<td></td>
</tr>
<tr>
<td>15-0483</td>
<td>Butylid-1-adamantylphosphine, min. 95% [cataCXium® A]</td>
<td></td>
</tr>
<tr>
<td>15-1055</td>
<td>(R)-(+)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95%</td>
<td></td>
</tr>
<tr>
<td>15-1056</td>
<td>(S)-(-)-5,5'-Dichloro-6,6'-dimethoxy-2,2'-bis(diphenylphosphino)-1,1'-biphenyl, min. 95%</td>
<td></td>
</tr>
<tr>
<td>15-1505</td>
<td>(3Ar,8Ar)-(-)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-[1,3]dioxolo[4,5-e][1,3,2]dioxaphosphine-6-yl)dimethylamine, min. 98%</td>
<td></td>
</tr>
<tr>
<td>15-1821</td>
<td>(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98%</td>
<td></td>
</tr>
<tr>
<td>15-1822</td>
<td>(S)-(-)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98%</td>
<td></td>
</tr>
<tr>
<td>15-5810</td>
<td>Tri-t-butylphosphine, 99%</td>
<td></td>
</tr>
<tr>
<td>15-5811</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane)</td>
<td></td>
</tr>
<tr>
<td>15-5812</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane) (Sure/Seal™ bottle)</td>
<td></td>
</tr>
<tr>
<td>15-6000</td>
<td>Tri-t-butylphosphonium tetrafluoroborate, 99%</td>
<td></td>
</tr>
<tr>
<td>15-7720</td>
<td>Tris(2,4-di-t-butylphenyl)phosphite, 98%</td>
<td></td>
</tr>
</tbody>
</table>
Carbon-heteroatom bond formation

<table>
<thead>
<tr>
<th>Page #</th>
<th>Compound Name</th>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-5186</td>
<td>(R)-(+)-[4(S)-(Benzylo)xazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobibindane</td>
<td>min. 97% (Ra,S)-Ph-Bn-SIPHOX</td>
<td></td>
</tr>
<tr>
<td>26-0150</td>
<td>1,1'-Bis(di-2-butylphosphino)ferrocene, min. 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0066</td>
<td>(R)-(+)-5,5'-Bis(di[3,5-di-t-butyl-4-methoxyphenyl]phosphino)-4,4'-bi-1,3-benzodioxole, min. 98%</td>
<td>(R)-DTMB-SEPHOS</td>
<td></td>
</tr>
<tr>
<td>15-0067</td>
<td>(S)-(+)-5,5'-Bis(di[3,5-di-t-butyl-4-methoxyphenyl]phosphino)-4,4'-bi-1,3-benzodioxole, min. 98%</td>
<td>(S)-DTMB-SEPHOS</td>
<td></td>
</tr>
<tr>
<td>15-0044</td>
<td>(R)-(+)-2,2'-Bis(di[3,5-di-t-butylphosphino]phenyl)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-0240</td>
<td>(S,S)-(+) 2,2'-Bis[(R)-(N,N-dimethylaminophenyl)phenyl]methyl]-1,1'-bis(dicyclohexylphosphino)ferrocene, min. 97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-0252</td>
<td>(S,S)-(+) 2,2'-Bis[(R)-(N,N-dimethylaminophenyl)phenyl]methyl]-1,1'-bis(diphenylphosphino)ferrocene, min. 97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-0248</td>
<td>(S,S)-(+) 2,2'-Bis[(R)-(N,N-dimethylaminophenyl)phenyl]methyl]-1,1'-bis(di[3,5-dimethyl-4-methoxyphenyl]phosphino)ferrocene, min. 97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-0244</td>
<td>(S,S)-(+) 2,2'-Bis[(R)-(N,N-dimethylaminophenyl)phenyl]methyl]-1,1'-bis(di[3,5-trifluoromethylphenyl]phosphino)ferrocene, min. 97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0140</td>
<td>(2R,3R)-(+) 2,2'-Bis(di[3,5-di-t-butyl-4-methoxyphenyl]phosphino)-cyclo[2.2.1].hept-5-ene, min. 95% (R,R)-NORPHOS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0141</td>
<td>(2S,3S)-(+) 2,2'-Bis(di[3,5-di-t-butyl-4-methoxyphenyl]phosphino)-cyclo[2.2.1].hept-5-ene, min. 95% (S,S)-NORPHOS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0433</td>
<td>racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0150</td>
<td>(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0151</td>
<td>(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 97% (S)-(-)-BINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0145</td>
<td>2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% BIPHEP</td>
<td></td>
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<tr>
<td>26-0270</td>
<td>1,1'-Bis(diphenylphosphino)ferrocene, 99% DPFF</td>
<td></td>
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</tr>
<tr>
<td>15-0380</td>
<td>Bis(2-diphenylphosphino)ethene, 98% DPEphos</td>
<td></td>
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</tr>
<tr>
<td>15-0486</td>
<td>R-(+)-5,5'-Bis(diphenylphosphino)-2,2'-2',4'-tetrafluoro-4,4'-bi-1,3-benzodioxole, dichloromethane adduct, min. 97% (R)-DIFLUORPHOS*</td>
<td></td>
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<tr>
<td>15-0442</td>
<td>12,12'-Bis(diphenylphosphino)-9,9',10,10'-tetrahydro-11,11'-bi-9,10-ethenoanthracene, min. 98% CATPHOS</td>
<td></td>
<td></td>
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<tr>
<td>26-0275</td>
<td>1,1'-Bis(di-i-propylphosphino)ferrocene, min. 98%</td>
<td></td>
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<tr>
<td>15-0415</td>
<td>4,5-Bis(di-i-propylphosphinomethyl)acridine, 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0152</td>
<td>(R)-(+)-2,2'-Bis(di-p-tolyldiphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0153</td>
<td>(S)-(-)-2,2'-Bis(di-p-tolyldiphenylphosphino)-1,1'-binaphthyl, 97% (S)-(-)-TolBINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0478</td>
<td>(R)-(+)-5,5'-Bis(di[3,5-xylyl]phosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEPHOS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0479</td>
<td>(S)-(-)-5,5'-Bis(di[3,5-xylyl]phosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-DM-SEPHOS</td>
<td></td>
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<tr>
<td>15-0476</td>
<td>(R)-(+)-2,2'-Bis(di[3,5-xylyl]phosphino)-1,1'-binaphthyl, 98% (R)-(+)-XyBINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0477</td>
<td>(S)-(-)-2,2'-Bis(di[3,5-xylyl]phosphino)-1,1'-binaphthyl, 98% (S)-(-)-XyBINAP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0552</td>
<td>(11bR)-N,N-Bis[(R)-(1-2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin-4-amine, min. 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0523</td>
<td>(11bS)-N,N-Bis[(S)-(+)-1-2-methoxyphenyl)ethyl]dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphin-4-amine, min. 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1090</td>
<td>2-(Di-1-adamantyldiphenyl)dimethylaminobenzene, 97% Me-DalPhos</td>
<td></td>
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</tr>
<tr>
<td>15-0960</td>
<td>(1R,2R)-(+) 1,1-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 98%</td>
<td>(R,R)-DACH-Phenyldinaphthyl Trost Ligand</td>
<td></td>
</tr>
<tr>
<td>15-0961</td>
<td>(S,S)-(+) 1,1-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 98%</td>
<td>(S,S)-DACH-Phenyldinaphthyl Trost Ligand</td>
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<tr>
<td>15-0963</td>
<td>(1R,2R)-(+) 1,1-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinopheno-1-naphthoyl), min. 94%</td>
<td>(R,R)-Naphthyl Trost Trost Lipid</td>
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</tr>
<tr>
<td>15-0964</td>
<td>(1S,2S)-(+) 1,1-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinopheno-1-naphthoyl), min. 94%</td>
<td>(S,S)-Naphthyl Trost Trost Lipid</td>
<td></td>
</tr>
<tr>
<td>15-1157</td>
<td>2-Di[3,5-di(trifluoromethyl)phenyl]phosphino]-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% JackiePhos</td>
<td></td>
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<tr>
<td>15-1005</td>
<td>Di-t-butyl(2,2-diphenyl-1-methyl-cyclopropophosphine) cBRIDP</td>
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</tr>
<tr>
<td>15-1065</td>
<td>Di-t-butyl(2,2-diphenyl-1-methylvinyl)phosphine vBRIDP</td>
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<td></td>
</tr>
<tr>
<td>15-1017</td>
<td>Di-t-butylnepentylphosphine, min. 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1019</td>
<td>Di-t-butylenepentylphosphonium tetrafluoroborate, min. 99%</td>
<td></td>
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</tr>
<tr>
<td>15-1043</td>
<td>racemic-2-Di-t-butylphosphino-1,1'-binaphthyl, 98% TriexPhos</td>
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</tr>
<tr>
<td>15-1045</td>
<td>2-Di-t-butylphosphino)biphenyl, 99% JohnPhos</td>
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<td></td>
</tr>
<tr>
<td>15-1164</td>
<td>2-(Di-t-butylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylBrettPhos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1048</td>
<td>2-Di-t-butylphosphino)-2'-(N,N-dimethylaminophenyl)biphenyl, 98%</td>
<td></td>
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<tr>
<td>15-1168</td>
<td>2-(Di-t-butylphosphino)-3-methoxy-6-methyl-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td>RockPhos</td>
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</tr>
<tr>
<td>15-1049</td>
<td>2-Di-t-butylphosphino)-2'-methylbiphenyl, 99%</td>
<td></td>
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</tr>
<tr>
<td>15-1051</td>
<td>2-Di-t-butylphosphino)-3,4,5,6-tetramethyl-2'-4',6'-tri-i-propylbiphenyl, min. 98% Me42-t-butylXPhos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1052</td>
<td>2-Di-t-butylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylXPhos</td>
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<tr>
<td>15-1007</td>
<td>Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine Cy-cBRIDP</td>
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</tr>
<tr>
<td>Code</td>
<td>Compound</td>
<td>Purity</td>
<td>Notes</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------</td>
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</tr>
<tr>
<td>15-1062</td>
<td>Dicyclohexyl(2,2-diphenyl-1-methylvinyl)phosphine (Cy-vBRIDP)</td>
<td>95%</td>
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</tr>
<tr>
<td>15-1140</td>
<td>2-(Dicyclohexylphosphino)biphenyl, 98%</td>
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</tr>
<tr>
<td>15-1152</td>
<td>2-(Dicyclohexylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td></td>
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</tr>
<tr>
<td>15-1145</td>
<td>2-(Dicyclohexylphosphino)-2'-N.N-dimethylamino)biphenyl, 98% DavePhos</td>
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<td></td>
</tr>
<tr>
<td>15-1146</td>
<td>2-Dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98% RuPhos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26-0975</td>
<td>(S)-[1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethylid]t-butylphosphine, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-1082</td>
<td>11-Dicyclohexylphosphino-12-(2-methoxyphenyl)-9,10-ethanoanthracene dichloromethane adduct, min. 98% o-MeO-KITPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1148</td>
<td>2-Dicyclohexylphosphino-2'-methylbiphenyl, min. 98% MePhos</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1084</td>
<td>11-Dicyclohexylphosphino-12-(2-hexyloxyphenyl)-9,10-ethanoanthracene dichloromethane adduct, min. 98% KITPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1088</td>
<td>2-{2-(Dicyclohexylphosphino)phenyl]-1-methyl-1H-indole, min. 98% CM-Phos</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1149</td>
<td>2-Dicyclohexylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% XPhos</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1242</td>
<td>9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1520</td>
<td>(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%</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>15-1521</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1S)-1-phenylethyl]amine, min. 95%</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>15-1745</td>
<td>2-Diphenylphosphino-2-(N,N-dimethylamino)biphenyl, 98%</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-1748</td>
<td>1-Diphenylphosphino-2-(N,N-dimethylamino)-1H-indene, 99% (contains vinylic isomer)</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>26-1200</td>
<td>(R)-(+)-1-{(S)-2-(Diphenylphosphino)ferroceny1}ethylid]t-butylphosphine, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-1778</td>
<td>(R)-(+)-(1,2-Diphenylphosphino-1-naphthyl)isoquinoline (R)-QUINAP</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-1777</td>
<td>(S)-(+)-(1,2-Diphenylphosphino-1-naphthyl)isoquinoline (S)-QUINAP</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-1802</td>
<td>1-Ii-propylphosphino-2-(N,N-dimethylamino)biphenyl, 96%</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td>15-5184</td>
<td>(11aR)-(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-di-indeno[7,1-cd:1',7'-ef]phosphocin, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-2975</td>
<td>N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium® POMetB]</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>26-3575</td>
<td>1,2,3,4,5-Pentaphenyl-1'-1-(di-t-butylphosphino)ferrocene, 95% CTC-Q-PHOS</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>15-3550</td>
<td>N-Pheny1-(di-t-butylphosphino)indol, min. 98% [cataCXium® PInB]</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-3600</td>
<td>N-Pheny1-(di-t-butylphosphino)pyrrole, 95% [cataCXium® PInB]</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-3605</td>
<td>N-Pheny1-(dicyclohexylphosphino)indol, min. 95% [cataCXium® PInCy]</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>15-5811</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane)</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>15-5812</td>
<td>Tri-t-butylphosphine, 99% (10 wt% in hexane) (Sure/Seal® bottle)</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td>15-7720</td>
<td>Tris(2,4-di-t-butylphenyl)phosphate, 98%</td>
<td>98%</td>
<td></td>
</tr>
</tbody>
</table>

### Cyclization

<table>
<thead>
<tr>
<th>Code</th>
<th>Compound</th>
<th>Purity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-5186</td>
<td>(R)-(+)-7-[(S)-(Benzy1)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spiropiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOX</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-0066</td>
<td>(R)-(+)-5,5'-Bis[dii(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzozidioxide, min. 98%</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0067</td>
<td>(S)-(+)-(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzozidioxide, min. 98%</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0044</td>
<td>(R)-(+)-2,2'-Bis[dii(3,5-di-t-butylphosphino)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-0045</td>
<td>(S)-(+)-2,2'-Bis[dii(3,5-di-t-butylphosphino)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-26110</td>
<td>(R)-(+)-(1-[(R)-2-2'-Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]phosphino)ferroceny1]ethylid]t-butylphosphine, min. 98%</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-5136</td>
<td>(R)-(+)-5,5'-Bis[dii(phosphino)phosphino]-4,4'-bi-1,3-benzozidioxide, min. 98% (R)-(+)-SEGPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-5137</td>
<td>(S)-(+)-5,5'-Bis[dii(phosphino)phosphino]-4,4'-bi-1,3-benzozidioxide, min. 98% (S)-(−)-SEGPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-4033</td>
<td>racem-2,2'-Bis[dii(phosphino)phosphino]-1,1'-binaphthyl, 98% rac-BINAP</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0490</td>
<td>R(+)-6,6'-Bis[dii(phosphino)phosphino]-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzozidizin, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-0491</td>
<td>S(-)-6,6'-Bis[dii(phosphino)phosphino]-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzozidizin, min. 97%</td>
<td>97%</td>
<td></td>
</tr>
<tr>
<td>15-0478</td>
<td>(R)-(+)-5,5'-Bis[dii(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzozidioxide, min. 98% (R)-(+)-DM-SEGPHOS</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0476</td>
<td>(R)-(+)-2,2'-Bis[dii(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XyBINAP</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0477</td>
<td>(S)-(-)-2,2'-Bis[dii(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XyBINAP</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>15-0135</td>
<td>Tris(2,4-di-t-butylphenyl)phosphine, 98%</td>
<td>98%</td>
<td></td>
</tr>
</tbody>
</table>

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Hydroboration

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### Hydroboration

| 15-1777 | (S)-(-)-1-(2-Diphenylphosphino-1-naphthyl)isoquinoline (S)-QUINAP | 159 |

### Hydroformylation

| 15-0057 | (R,R)-(+)-6,6’-[1,1’-Biphenyl-2,2’-diyl]bis(bis[4,8-di-t-butyl-1,2,10,11-tetramethyl]dibenzof)[f][1,3,2]dioxaphosphepin bisacetonitrile adduct, min. 95% (R,R)-Kelliphte | 20 |
| 15-0058 | (S,S)-(+)-6,6’-[1,1’-Biphenyl-2,2’-diyl]bis(bis[4,8-di-t-butyl-1,2,10,11-tetramethyl]dibenzof)[f][1,3,2]dioxaphosphepin bisacetonitrile adduct, min. 95% (S,S)-Kelliphte | 20 |
| 15-0175 | R-(-)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxin, 97% (R)-C-TUNEPHOS | 55 |
| 15-0176 | (S)-(+)-13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxin, 95% (S)-C-TUNEPHOS | 56 |
| 15-0437 | 4,6-Bis(diphenylphosphino)phenoxazinone, min. 98% NIXANTHOS | 62 |
| 15-0476 | (R)-(+)-2,2’-Bis[di(3,5-xyllyl)phosphino]-1,1’-binaphthyl, 98% (R)-(+)-XyBINAP | 78 |
| 15-0107 | 6,6’-[3,3’-Di-t-butyl-5,5’-dimethoxy-1,1’-biphenyl-2,2’-diyl]bis(bis[4,8-di-t-butyl-1,2,10,11-tetramethoxybifenzo][f][1,3,2]dioxaphosphine) hemi ethyl acetate adduct, min. 95% BiPHEPHOS | 94 |
| 15-1455 | (+)-6,6’-[[(1R,3R)-1,3-Dimethyl-1,3-propanediyli]bis(bis[4,8-di-t-butyl-2,10-dimethoxy-bifenzo][f][1,3,2]dioxaphosphine), min. 95% (R,R)-Chiraphite | 133 |
| 15-1456 | (-)-6,6’-[(1S,3S)-1,3-Dimethyl-1,3-propanediyli]bis(bis[4,8-di-t-butyl-2,10-dimethoxybifenzo][f][1,3,2]dioxaphosphine), min. 95% (S,S)-Chiraphite | 134 |

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| 15-5187 | (S)-(+)-7-[4-(S)-Benzoyloxazol-2-yl] -7-diphenylphosphino-2,2’,3,3’-tetrahydro-1,1’-spiroindane, min. 97% (Sa,Sa)-Ph-Bn-SIPHOX | 18 |
| 15-1672 | (R)-2,2’-Bis[bis[4-methoxy-3,5-di-t-butylphenylyphosphino][4,4’,6,6’-tetramethoxybiphenyl, min. 97% (R)-DTBM-Garphos | 21 |
| 15-1673 | (S)-2,2’-Bis[bis[4-methoxy-3,5-di-t-butylphenylyphosphino][4,4’,6,6’-tetramethoxybiphenyl, min. 97% (S)-DTBM-Garphos | 21 |
| 15-0126 | (R,R)-(+)-2,3-Bis(t-butylmethylphosphino)quinoxaline (R,R)-QuinoxP* | 24 |
| 15-0127 | (S,S)-(+)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (S,S)-QuinoxP* | 25 |
| 15-0166 | (R,R)-(+)-1,2-Bis(di-t-butylmethylphosphino)benzene (R,R)-BenzP* | 26 |
| 15-0167 | (S,S)-(-)-1,2-Bis(di-t-butylmethylphosphino)benzene (S,S)-BenzP* | 26 |
| 15-0066 | (R)-(+)-5,5’-Bis[bis[3,5-di-t-butyl-4-methoxyphenyl]phosphino][4,4’-bi-1,3-benzodioxole, min. 98% (R)-DTBM-SEPHOS | 30 |
| 15-0067 | (S)-(+)-5,5’-Bis[bis[3,5-di-t-butyl-4-methoxyphenyl]phosphino][4,4’-bi-1,3-benzodioxole, min. 98% (S)-DTBM-SEPHOS | 32 |
| 15-0044 | (R)-(+)-2,2’-Bis[di(3,5-di-t-butyl-4-methoxyphenyl]phosphino]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% | 33 |
| 15-0652 | (R)-(+)-2,2’-Bis[di(3,5-di-i-propyl-4-dimethyaminophenyl)phosphino]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% | 35 |
| 15-0653 | (S)-(+)-2,2’-Bis[di(3,5-di-i-propyl-4-dimethyaminophenyl)phosphino]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% | 35 |
| 15-0097 | (+)-1,2-Bis[2(2R,5R)-2,4-diythiophospholanophenyl, 98% (R,R)-Et-DUPHOS | 35 |
| 15-0098 | (+)-1,2-Bis[2(25,SS)-2,5-diythiophosphanolophenyl, 98% (S,S)-Et-DUPHOS | 36 |
| 15-0101 | (+)-1,2-Bis[2(2R,5R)-2,5-diythiophosphanolophenylethane, 98% (R,R)-Et-BPE | 36 |
| 15-0102 | (+)-1,2-Bis[2(25,SS)-2,5-diythiophosphanolophenylethane, 98% (S,S)-Et-BPE | 36 |
| 15-0112 | (R)-(+)-2,2’-Bis [di-2-furanlylphosphanol]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% | 36 |
| 26-0200 | (+)-1,1’-Bis[(2R,4R)-2,4-diythiophosphanolophenolferrocene, min. 95% (R,R)-Et-FerroTANE® | 37 |
| 26-0201 | (-)-1,1’-Bis[(2S,4S)-2,4-diythiophosphanolophenolferrocene, min. 95% (S,S)-Et-FerroTANE® | 37 |
| 15-0113 | (S,S)-(-)-2,2’-Bis[di-2-furanlylphosphanol]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% | 38 |
| 26-0240 | (S,S)-(+)-2,2’-Bis[(R)-(N,N-dimethylamino) [phenyl]methyl]-1,1’-bis(dicyclohexylphosphino)ferrocene, min. 97% | 38 |
| 15-0074 | (+)-1,2-Bis[(25,SS)-2,5-dimethyl-(3S,3S,3)-4-dihydroporphospholanophenyl, 97% (S,S,S,S)-OPHOS-bis(OTf) | 40 |
| 26-1150 | (R)-(-)-1-[(2S,2)-Bis[(3,5-dimethoxyphenyl]phosphinoyl]ferroceny]ethyldicyclohexylphosphine, min. 97% | 40 |
| 15-1130 | (R)-(-)-1-[(R,R)-2-2’-Bis[(3,5-dimethoxyphenyl]phosphinoyl]ferroceny]ethyl(diphenylmethyl)phosphine, min. 97% | 41 |
| 15-0096 | (+)-1,2-Bis[(2R,5R)-2,5-dimethylphosphanolophenyl, 98% (R,R)-Me-DUPHOS | 42 |
| 15-0092 | (+)-1,2-Bis[(25,SS)-2,5-dimethylphosphanolophenyl, 98% (S,S)-Me-DUPHOS | 45 |
| 15-0104 | (+)-1,2-Bis[(2R,5R)-2,5-dimethylphosphanolophenylethane, 98% (R,R)-Me-BPE | 45 |
| 15-0105 | (+)-1,2-Bis[(25,SS)-2,5-dimethylphosphanolophenylethane, 98% (S,S)-Me-BPE | 45 |
| 15-0401 | (R)-(+)-2,2’-Bis[N-diphenylphosphinoamin]-5,5’-6,6’,7,7’,8,8’-octahydro-1,1’-binaphthyl, min. 95% CTH-(R)-BINAM | 46 |

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Hydrogenation

26-1000 (R)-(-)-1-[[S]-2-(Dicyclohexylphosphino)ferroceny]ethylidicyclohexylphosphine, min. 97% .............................. 120
26-1001 (S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferroceny]ethylidicyclohexylphosphine, min. 97% ...................... 120
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15-5200 (R)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(diphenylphosphino), 3',3'-bipyridine, min. 95% CTH-(R)-P-Phos 181
15-5201 (S)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(diphenylphosphino), 3',3'-bipyridine, min. 95% CTH-(S)-P-Phos 181
15-5210 (R)-(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylolphosphate), 3',3'-bipyridine, min. 95% CTH-(R)-Xyl-P-Phos 183
15-5211 (S)-(+)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylolphosphate), 3',3'-bipyridine, min. 95% CTH-(S)-Xyl-P-Phos 183
96-7650 CATHY® Catalyst Kit for Asymmetric Transfer Hydrogenation of Ketones and Imines ............................... 210

Hydrosilation

26-1150 (R)-(-)-1-[(S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferroceny]ethylidicyclohexylphosphine, min. 97% .................................................................................................................................................. 41
26-0960 (R)-(-)-1-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferroceny]ethylidicyclohexylphosphine, min. 97% .................................................................................................................................................. 76
26-0965 (R)-(-)-1-[(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferroceny]ethylid-3,5-xylolphosphate, min. 97% .................................................................................................................................................. 76
### Hydrosilylation

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<tr>
<td>26-0650</td>
<td>(R)(-)-1-[(S)-2-[Bis(trifluoromethyl)phosphino]ferroceny]ethyl-di-t-butylphosphine, min. 97%</td>
<td>84</td>
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<tr>
<td>26-1000</td>
<td>(R)(-)-1-[(S)-2-(Dicyclohexylphosphino)ferroceny]ethylidicyclohexylphosphine, min. 97%</td>
<td>120</td>
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<tr>
<td>26-1001</td>
<td>(S)(+)-1-[(R)-2-(Dicyclohexylphosphino)ferroceny]ethylidicyclohexylphosphine, min. 97%</td>
<td>120</td>
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<tr>
<td>26-1230</td>
<td>(R)(-)-1-[(S)-2-(Dicyclohexylphosphino)ferroceny]ethylidiphenylphosphine, min. 97%</td>
<td>120</td>
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<tr>
<td>26-1110</td>
<td>(S)(+)-1-[(R)-2-(Dicyclohexylphosphino)ferroceny]ethylidiphenylphosphine, min. 97%</td>
<td>121</td>
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<tr>
<td>26-1170</td>
<td>(S)(+)-1-[(R)-2-(Di-2-furylphosphino)ferroceny]ethylid-3,5-xylylphosphine, min. 97%</td>
<td>128</td>
<td></td>
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<tr>
<td>26-1175</td>
<td>(R)(-)-1-[(S)-2-(Di-1-naphthylphosphino)ferroceny]ethylid-3,5-xylylphosphine, min. 97%</td>
<td>137</td>
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<tr>
<td>26-1210</td>
<td>(S)(+)-1-[(R)-2-(Di-phenylphosphino)ferroceny]ethylid-t-butylphosphine, min. 97%</td>
<td>150</td>
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<tr>
<td>26-1211</td>
<td>(S)(+)-1-[(R)-2-(Di-phenylphosphino)ferroceny]ethylidicyclohexylphosphine ethanol adduct, min. 97%</td>
<td>150</td>
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<tr>
<td>26-1255</td>
<td>(R)(-)-1-[(S)-2-(Di-phenylphosphino)ferroceny]ethylid-3,5-xylylphosphine, min. 97%</td>
<td>153</td>
<td></td>
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<tr>
<td>15-1775</td>
<td>(R)(-)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP</td>
<td>153</td>
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</tr>
<tr>
<td>15-1776</td>
<td>(S)(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (S)-MOP</td>
<td>154</td>
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<tr>
<td>15-5210</td>
<td>(R)(-)-2,2',6,6'-Tetramethoxy-4,4'-bis(di(3,5-xylyl)phosphino)-3,3'-bipyridine, min. 95% CTH-(R)-Xyl-P-Phos</td>
<td>183</td>
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### Kinetic Resolution

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<tr>
<td>15-0150</td>
<td>(R)(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)(+)-BINAP</td>
<td>51</td>
<td></td>
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<tr>
<td>15-0151</td>
<td>(S)(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 97% (S)(-)-BINAP</td>
<td>54</td>
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<tr>
<td>15-0490</td>
<td>R(+)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97%</td>
<td>64</td>
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</tr>
<tr>
<td>15-0491</td>
<td>S(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97%</td>
<td>65</td>
<td></td>
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<tr>
<td>15-0152</td>
<td>(R)(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)(+)-TolBINAP</td>
<td>73</td>
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<tr>
<td>15-0153</td>
<td>(S)(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)(-)-TolBINAP</td>
<td>74</td>
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<tr>
<td>15-0476</td>
<td>(R)(+)-2,2'-Bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl, 98% (R)(+)-XylBINAP</td>
<td>78</td>
<td></td>
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<tr>
<td>15-0477</td>
<td>(S)(-)-2,2'-Bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl, 98% (S)(-)-XylBINAP</td>
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### Oxidation

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<tbody>
<tr>
<td>15-0140</td>
<td>(2R,3R)(-)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (R,R)-NORPHOS</td>
<td>49</td>
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<tr>
<td>15-0141</td>
<td>(2S,3S)(+)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (S,S)-NORPHOS</td>
<td>50</td>
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### Ring Opening

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<tr>
<td>15-5186</td>
<td>(R)(+)-7-[((S)-Benzyl)oxazol-2-yl]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOX</td>
<td>18</td>
<td></td>
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<tr>
<td>15-5184</td>
<td>(11aR)(+)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diindeno[7,1-cd;1',7'-ef]phosphocin, min. 97% (R)-SITCP</td>
<td>168</td>
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| 96-6715 | BASF Blocking Group Removal Catalyst Kit  
See page 200 |
| 96-6717 | BASF Heterogeneous Catalyst Kit  
NEW→ See page 200 |
| 96-6700 | BASF Metals Scavenging Kit (MSA Kit)  
NEW→ See page 201 |
| 96-6719 | BASF Palladium Catalyst Kit  
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| 96-6721 | BASF Platinum Catalyst Kit  
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| 96-3730 | 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit  
NEW→ See page 202 |
| 96-3735 | [1,1'-Bis(dialkyl/diarylphosphino)ferrocene]palladium(II) dichloro Catalyst Kit  
NEW→ See page 202 |
| 96-5500 | Buchwald Biaryl Phosphine Ligand Master Kit for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling  
NEW→ See page 203 |
| 96-5485 | Buchwald Biaryl Phosphine Ligand Mini Kit 1 for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling (contains more recently developed ligands)  
NEW→ See page 205 |
| 96-5490 | Buchwald Biaryl Phosphine Ligand Mini Kit 2 for Aromatic Carbon-Heteroatom Bond Formation, Suzuki Coupling and Negishi Cross-coupling (contains more mature ligands)  
NEW→ See page 206 |
| 96-5503 | Buchwald Palladacycle Precatalyst Kit  
NEW→ See page 207 |
| 96-0800 | Cadmium selenide CANdot® Quantum Dot (core) Kit, 50umol/L in hexane, 500-600nm peak emissions  
NEW→ See page 208 |
| 96-0810 | Cadmium selenide/Cadmium sulfide CANdot® Quantum Dot (core/shell) Kit, 50umol/L in hexane, 550-625nm peak emissions  
NEW→ See page 208 |
| 96-0820 | Cadmium selenide/Cadmium sulfide/Zinc sulfide CANdot® Quantum Dot (core/shell/shell) Kit, 50umol/L in hexane, 550-650nm peak emissions  
NEW→ See page 209 |
| 96-7650 | CATHy™ Catalyst Kit for asymmetric transfer hydrogenation of ketones and imines.  
NEW→ See page 210 |
| 96-3790 | CatKits – Single use vials for low catalyst loading experiments  
NEW→ See page 211 |
| 96-5900 | Chiral Quest Catalyst and Ligand Toolbox Kit for Asymmetric Hydrogenation  
NEW→ See page 212 |
| 96-7054 | Cucurbituril Kit  
NEW→ See page 213 |
| 96-5650 | DSM MonoPhos™ Ligand Kit  
NEW→ See page 214 |
| 96-4730 | (R,R)-Duphos and BPE Rhodium Catalyst Kit  
NEW→ See page 216 |
| 96-4731 | (S,S)-Duphos and BPE Rhodium Catalyst Kit  
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<td>Gold Nanorods Kit (Axial Diameter - 25 nm, wavelength 550-700 nm)</td>
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<td>Long-Chain n-Alkylphosphonic Acid Kit</td>
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<td>Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit</td>
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<td>96-3760</td>
<td>NHC Ligand Kit 1: Chiral N-Heterocyclic Carbenes</td>
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<td>NHC Ligand Kit 2: “Free” Carbenes</td>
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<td>NHC Ligand Kit 3: Variety of N-Heterocyclic Carbenes</td>
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<td>Palladium Catalyst Kit for a variety of catalytic organic transformations.</td>
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<td>Phosphine Ligand Kit for Palladium-Catalyzed Carbon-Carbon and Carbon-Heteroatom Bond Formation</td>
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<td>96-3655</td>
<td>Solvias (R)-MeO-BIPHEP Ligand Kit</td>
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<td>96-3656</td>
<td>Solvias (S)-MeO-BIPHEP Ligand Kit</td>
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<td>Solvias cataCXium® Ligand Kit for C-X coupling reactions</td>
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<td>Solvias Josiphos Ligand Kit for asymmetric hydrogenations and other catalytic applications.</td>
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<td>Solvias Mandyphos™ Ligand Kit for asymmetric catalytic hydrogenations and other transformations.</td>
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<td>Spherical Gold Nanoparticles Kit (30-90 nm)</td>
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<td>Spiro Bisphosphine Ligand Kit</td>
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<td>Takasago BINAP Ligand Kit</td>
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<td>Takasago BINAP Ru Cymene Catalyst Kit for asymmetric hydrogenation and other catalytic applications.</td>
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<td>Takasago BINAP Ru Diammine Catalyst Kit for asymmetric hydrogenation and other catalytic applications.</td>
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<td>Takasago BINAP Ru Dimer Catalyst Kit for asymmetric hydrogenation and other catalytic applications.</td>
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<tr>
<td>15-7143</td>
<td>(R)-1-Amino-8-(diphenylphosphino)-1,2,3,4-tetrahydronaphthalene, min. 97%</td>
<td>250mg</td>
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<td>15-7144</td>
<td>(S)-1-Amino-8-(diphenylphosphino)-1,2,3,4-tetrahydronaphthalene, min. 97%</td>
<td>250mg</td>
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<tr>
<td>15-7107</td>
<td>(1R,2R)-2-Amino-1-phenylpropyl-diphenylphosphine, min. 97%</td>
<td>100mg</td>
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<td>15-7108</td>
<td>(1S,2S)-2-Amino-1-phenylpropyl-diphenylphosphine, min. 97%</td>
<td>100mg</td>
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<tr>
<td>15-7176</td>
<td>(2-Ammonioethyl)di-t-butyl-phosphonium bis(tetrafluoroborate), min. 97%</td>
<td>250mg</td>
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<tr>
<td>15-7178</td>
<td>(3-Ammoniopropyl)di-t-butyl-phosphonium bis(tetrafluoroborate), min. 97%</td>
<td>250mg</td>
</tr>
<tr>
<td>15-0038</td>
<td>Benzyldi-1-adamantylphosphine, min. 85% [cataCXium® ABn] (\text{[395116-70-8]})</td>
<td>1g</td>
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</table>
15-0038  Benzyldi-1-adamantylphosphine, min. 85% [cataCXium® ABn] [395116-70-8]  
(cont.)

Technical Note:
1. Useful ligand for Sonogashira coupling reaction.

References:

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%
C₃₆H₃₂N₃O₃P; FW: 561.61; white pwdr.  
moisture sensitive, (store cold)

Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

Technical Note:
1. See 15-2200 (page 135).

15-0040  Benzylidiphenylphosphine, 99% [7650-91-1]  
(C₆H₅CH₂)(C₆H₅)₂P; FW: 276.32; white pwdr.; m.p. 74-75°  
air sensitive

15-2210  1-Benzyl-3-[(1S,2S)-2-(di-o-tolylphosphinoamino)cyclohexyl]urea, min. 97%
C₂₉H₃₃N₃OP; FW: 459.56; white pwdr.  
moisture sensitive, (store cold)

Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

Technical Note:
1. See 15-2200 (page 135).

15-5190  (R)-(+)·7·[4(S)-(Benzyloxazol-2-yl)-7-di(3,5-di-t-butylphenyl)phosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-DTB-Bn-SIPHOX
C₅₅H₆₆NOP; FW: 788.09; white solid;  
moisture sensitive

[α]D +134.6° (c 0.5, CH₂Cl₂); m.p. 120-121°
**PHOSPHORUS – Ligands and Compounds**

15-5191  
**(S)-(-)-7'-[4(S)-(Benzyloxazol-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;  
\([\alpha]_D\) \(-185.6^\circ\) (c 0.5, CH\(_2\)Cl\(_2\)); m.p. 159-161\(^\circ\)

moisture sensitive

25mg  
100mg

15-5186  
**(R)-(+)-7-[4(S)-(Benzyloxazol-2-yl)]-7'-diphenylphosphino-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (Ra,S)-Ph-Bn-SIPHOX**  
\[913829-88-6\]  
C\(_{39}\)H\(_{34}\)NOP; FW: 563.67; white solid;  
\([\alpha]_D\) \(+167.8^\circ\) (c 0.51, CH\(_2\)Cl\(_2\)); m.p. 100-102\(^\circ\)

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 \(\alpha\)-oxy-\(\alpha\),\(\beta\)-unsaturated carboxylic acids.

![Schema](image)

**References:**
PHOSPHORUS – Ligands and Compounds

15-5187 (S)-(−)-7-[4(S)-(Benzyl)oxazol-2-yl]-7-diphenylphosphino-2,2′,3,3′-tetrahydro-1,1′-spiroindane, min. 97% (Sa,S)-Ph-Bn-SIPHOX [913829-88-6]

Technical Note:
1. Chiral Ligand for the iridium-catalyzed asymmetric hydrogenation of imines.

Reference:

93-1573 Benzyltriphenylphosphonium chloride, 99% [1100-88-5]

HAZ
(C6H5CH2)(C6H5)3PCl; FW: 388.88; white xtl.; m.p. 288°

Technical Notes:
1. Asymmetric hetero Diels-Alder reaction catalyzed by chiral lanthanide(III) complex.
2. Acidic Resolving agent for certain amine racemic mixtures. (Ref. 2,3)

Reference:
3. US 6,162,919.

15-0052 (R)-(-)-1,1′-Binaphthyl-2,2′-diyl hydrogenphosphate, min. 98% [39648-67-4]

C20H13O4P; FW: 348.30; white pwdr.; [α]D -605° (c 1.35, CH3OH)

References:
3. US 6,162,919.

15-0053 (S)-(−)-1,1′-Binaphthyl-2,2′-diyl hydrogenphosphotane, min. 98% [35193-64-7]

C20H13O4P; FW: 348.30; white pwdr.; [α]D +595° (c 1.35, CH3OH)

Technical Note:
1. See 15-0052 (page 19).
PHOSPHORUS – Ligands and Compounds

15-0057  \((R,R)-(-)-6,6'\cdot[(1,1'-Biphenyl-2,2'-diyl)bis(oxy)]bis[4,8-di-t-butyl-1,2,10,11-tetramethyl]dibenzo[d,f][1,3,2]dioxaphosphepin bisacetonitrile adduct, min. 95% \((R,R)\)-Kelliphite [729572-46-7]  
\(\text{C}_{60}\text{H}_{72}\text{O}_{6}\text{P}_{2}\cdot 2\text{CH}_{3}\text{CN};\)  
FW: 951.16 (1033.26);  
white to off-white pwdr.;  
\([\alpha]_D\)\(^{-}\) -365° (c 1.0, CH\(_2\)Cl\(_2\)); m.p. 149-155°  
air sensitive, moisture sensitive  
Note: Sold in collaboration with Chirotech for research purposes only. US Patent 7015360B2.

Technical Note:  
1. Ligand used with rhodium to catalyze asymmetric hydroformylation of prochiral functional olefins under mild conditions. High substrate concentrations and a wide variety of functional groups are tolerated. High enantioselectivities and regioselectivities have been demonstrated.

\[
\begin{align*}
\text{AcO} & \quad 0.2 \text{ mol\% Rh, 0.4 mol\% (S,S)-L, 10 atm (1:1 H}_2\text{/CO), 70° 3 hr} \\
\text{CHO} & \quad \text{Toluene}
\end{align*}
\]

NCC \quad 0.066 \text{ mol\% Rh(CO)}_2\text{(acac), 0.073 mol\% (R,R)-L, 10 atm (1:1 H}_2\text{/CO), 30° 5 hr}

Ref. (1, 2)

References:  

15-0058  \((S,S)-(+)-6,6'\cdot[(1,1'-Biphenyl-2,2'-diyl)bis(oxy)]bis[4,8-di-t-butyl-1,2,10,11-tetramethyl]dibenzo[d,f][1,3,2]dioxaphosphepin bisacetonitrile adduct, min. 95% \((S,S)\)-Kelliphite [729572-33-2]  
\(\text{C}_{60}\text{H}_{72}\text{O}_{6}\text{P}_{2}\cdot 2\text{CH}_{3}\text{CN};\)  
FW: 951.16 (1033.26);  
white to off-white pwdr.;  
\([\alpha]_D\)\(^{+}\) +365° (c 1.0, CH\(_2\)Cl\(_2\)); m.p. 149-155°  
air sensitive, moisture sensitive  
Note: Sold in collaboration with Chirotech for research purposes only. US Patent 7015360B2.

Technical Note:  
1. See 15-0057 (page 20).

15-7320  \((1R,2R)-N,N-Bis\{2-[bis(3,5-dimethylphenyl)phosphino]benzyl\}cyclohexane-1,2-diamine, min. 97% [1150113-66-8]  
\(\text{C}_{32}\text{H}_{60}\text{N}_{2}\text{P}_{2};\)  
FW: 774.99; yellow solid  
air sensitive
PHOSPHORUS – Ligands and Compounds

15-7321  
(1S,2S)-N,N-Bis{2-[bis(3,5-dimethylphenyl)phosphino]benzyl}cyclohexane-1,2-diamine, min. 97%  
C_{52}H_{60}N_2P_2; FW: 774.99; yellow solid  
air sensitive  
100mg  
500mg

15-1661  
(R)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (R)-Xyl-Garphos™  
C_{48}H_{52}O_4P_2; FW: 754.87; white xtl.  
air sensitive  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component. See (page 222).  
100mg  
500mg

15-1662  
(S)-2,2'-Bis[bis(3,5-dimethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (S)-Xyl-Garphos™  
C_{48}H_{52}O_4P_2; FW: 754.87; white xtl.  
air sensitive  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component. See (page 222).  
100mg  
500mg

15-1672  
(R)-2,2'-Bis[bis(4-methoxy-3,5-di-t-butylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (R)-DTBM-Garphos™  
C_{76}H_{108}O_8P_2; FW: 1211.61; white xtl.  
air sensitive, light sensitive  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component see (page 222).  
100mg  
500mg

15-1673  
(S)-2,2'-Bis[bis(4-methoxy-3,5-di-t-butylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (S)-DTBM-Garphos™  
C_{76}H_{108}O_8P_2; FW: 1211.61; white xtl.  
air sensitive, light sensitive  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component see (page 222).  
100mg  
500mg

Technical Note:  
1. See 15-1653 (page 67).
**PHOSPHORUS – Ligands and Compounds**

**15-1666**  
(R)-2,2’-Bis[[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4’,6,6’-tetramethoxybiphenyl, min. 97% (R)-DMM-Garphos™  
C₅₂H₅₀O₈P₂; FW: 874.98; white xtl.  
*air sensitive*  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component.  
See (page 222).

**15-1667**  
(S)-2,2’-Bis[[bis(4-methoxy-3,5-dimethylphenyl)phosphino]-4,4’,6,6’-tetramethoxybiphenyl, min. 97% (S)-DMM-Garphos™  
C₅₂H₅₀O₈P₂; FW: 874.98; white xtl.  
*air sensitive*  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component.  
See (page 222).

Technical Note:  
1. See 15-1653 (page 67).

**26-0320**  
1,1'-Bis[[bis(5-methyl-2-furanyl)phosphino]ferrocene, 98% HiersoPHOS-3 [756824-22-3]  
C₃₀H₂₈FeO₄P₂; FW: 570.33; orange xtl.

Technical Notes:  
1. Amination of Allyl Acetates at Low Palladium Loading (0.01-1.0 mol%) and Mild Temperatures using allyl acetate, cinnamyl acetate, E-hex-2-en-1-yl acetate and monoterpines such as geranyl acetate with primary and secondary acyclic and cyclic alkyl and aryl amines.  
2. Heck Coupling Reaction of polyfunctionalized aryl halides bearing unprotected hydroxyl groups.  
3. Additional catalyzed reactions include Suzuki and Sonogashira Cross-Couplings of Aryl Bromides at Ultra-Low Palladium Loading (Ref. 2).
1,1'-Bis[bis(5-methyl-2-furanyl)phosphino]ferrocene, 98% HiersoPHOS-3

1 mol% [Pd(allyl)Cl]₂
HiersoPHOS-3
Cs₂CO₃, DMF
100 °C

R¹ = H, OH, OMe or CH₂OH
R² = H, OH, OMe or OAc
R₃ = H or OMe
R⁴ = H, OH or OMe
R⁵ = H or OMe

0.001-0.01 mol% [Pd(allyl)Cl]₂
HiersoPHOS-3
K₂CO₃, xylene
130 °C
R = OMe, COMe

0.0001-0.1 mol% [Pd(allyl)Cl]₂
HiersoPHOS-3
Cul, K₂CO₃, DMF
130 °C
R = OMe, COMe

References:

(R)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (R)-BTFM-Garphos™

C₄₈H₂₈F₂₄O₄P₂; FW: 1186.64; white xtl.
air sensitive
Note: Sold in collaboration with KCT.
Garphos™ Ligand Kit component. See (page 222).

Technical Note:
1. See 15-1653 (page 67).

(S)-2,2'-Bis[bis(3,5-trifluoromethylphenyl)phosphino]-4,4',6,6'-tetramethoxybiphenyl, min. 97% (S)-BTFM-Garphos™

C₄₈H₂₈F₂₄O₄P₂; FW: 1186.64; white xtl.
air sensitive
Note: Sold in collaboration with KCT.

Technical Note:
1. See 15-1653 (page 67).
**PHOSPHORUS – Ligands and Compounds**

**15-0126** *(R,R)-(-)-2,3-Bis(t-butylmethylphosphino)quinoxaline (R,R)-QuinoxP* [866081-62-1]

C_{18}H_{28}N_{2}P_{2}; FW: 334.38; orange pwdr.;

[\alpha]_D^{\circ} -54.3^\circ \text{ (c 1.0, CHCl}_3); m.p. 102-103^\circ

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.

---

**Ref. (1)**

**Ref. (2)**

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(R,R)-(-)-2,3-Bis(t-butylmethylphosphino)quinoxaline (R,R)-QuinoxP* [866081-62-1]

\[
\text{Ph} \quad \text{H} \quad + \quad \text{NPh}_2 \quad \text{O} \quad \text{O} \quad 5 \text{ mol}\% \text{Rh(L)BF}_4 \\
80 ^\circ \text{C}, 14\text{h, CH}_2\text{Cl}_2 \\
\text{Ph} \quad \text{O} \quad \text{O} \quad \text{NPh}_2 \quad \text{87\%, 98\%ee}
\]

References:

(S,S)-(+)-2,3-Bis(t-butylmethylphosphino)quinoxaline, min. 98% (S,S)-QuinoxP*
\[\text{C}_{18}\text{H}_{28}\text{N}_{2}\text{P}_{2}; \text{FW: 334.38; orange pwdr.;} \]
\[\alpha_\text{D} +54.3^\circ (\text{c 1.0, CHCl}_3); \text{m.p. 102-103}^\circ \]
Note: Sold in collaboration with JCI for research purposes only. US 7,608,709, JP4,500,289.

Bis(2-cyanoethyl)phenylphosphine, min. 97%
\[\text{[15909-92-9]} \]
\[\text{(NCCH}_2\text{CH}_2)_2\text{(C}_6\text{H}_5)\text{P}; \text{FW: 216.22; colorless xtl.;} \]
m.p. 72-73°; b.p. 176-178°/0.5 mm
air sensitive

Bis[2-(di-1-adamantylphosphino)ethyl]amine, min. 97%
\[\text{[1086138-36-4]} \]
\[\text{C}_{44}\text{H}_{69}\text{NP}_{2}; \text{FW: 673.97; white solid} \]
air sensitive
Note: Sold under license from Kanata for research purposes only. WO 2004096735.

2-[Bis(3,5-di-t-butyl-4-methoxyphenyl)phosphino]benzaldehyde, min. 97%
\[\text{[1202865-21-1]} \]
\[\text{C}_{37}\text{H}_{51}\text{O}_{3}\text{P}; \text{FW: 574.77; yellow solid} \]

Technical Note:
1. See 15-0126 (page 24).

15-0075
15-7312
15-7338
PHOSPHORUS – Ligands and Compounds

15-0166
(R,R)-(+-)1,2-Bis(di-t-butylmethylphosphino)benzene (R,R)-BenzP*
[919778-41-9]
C₁₆H₁₈P₂; FW: 282.34; white xtl.; [α]₀ +223° (c 0.54, AcOEt)
air sensitive

Technical Note:
1. The rhodium complex of BenzP is highly active in the asymmetric hydrogenation of various functionalized alkenes (ee >99%).

\[
\text{R}^1\text{COOR}^3 \quad \xrightarrow{\text{H}_2 (3-5 \text{ atm}), \text{RT, MeOH}} \quad \text{R}^1\text{COOR}^3
\]
\[
\text{AcHN} \quad \text{R}^1\text{COOR}^2 \quad \text{H}_2 (3-5 \text{ atm}), \text{RT, MeOH}
\]

Reference:

15-0167
(S,S)-(--)1,2-Bis(di-t-butylmethylphosphino)benzene (S,S)-BenzP*
C₁₆H₁₈P₂; FW: 282.34; white xtl.; [α]₀ -223° (c 0.54, AcOEt);
m.p. 125-126°
air sensitive

Technical Note:
1. See 15-0166 (page 26).

15-7309
Bis[2-(di-t-butylphosphino)ethyl] amine, min. 97% (10wt% in hexane)
[944710-34-3]
C₂₀H₄₅NP₂; FW: 361.53; colorless liq.
air sensitive
Note: Sold under license from Kanata for research purposes only. WO 2004096735.

26-0150
1,1’-Bis(di-t-butylphosphino)ferrocene, min. 98%
[84680-95-5]
[(C₅H₅)₂PC₆H₆]Fe; FW: 474.42
Note: 1,1’-Bis(diaryl/dialkylphosphino) ferrocene Ligand Kit component.
See (page 202).

Technical Notes:
1. Ligand used in the Pd-catalyzed α-arylation of ketones.
2. Ligand used in the Pd-catalyzed heteroannulation of 1,3-dienes to form α-alkylidene-γ-butyrolactones.
3. 1-Aminoindanol derivatives via Pd-catalyzed intramolecular cyclization.
4. Indoles via regioselective Pd-catalyzed coupling of 2-chloroanilines with internal alkynes.
5. Synthesis of heterobiaryl compounds containing an NH₂ group via a Suzuki-Miyaura reaction.
### 1,1'-Bis(di-t-butylphosphino)ferrocene, min. 98% [84680-95-5]

**Chemical Structure:**

![Chemical Structure](image)

**References:**


### 1,3-Bis(di-t-butylphosphinomethyl)benzene, 99% [149968-36-5]

**Chemical Structure:**

![Chemical Structure](image)

### 2,6-Bis(di-t-butylphosphinomethyl)pyridine, 99% [338800-13-8]

**Chemical Structure:**

![Chemical Structure](image)

### 1,5-Bis(di-t-butylphosphino)pentane, min. 97% [65420-68-0]

**Chemical Structure:**

![Chemical Structure](image)

**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.

**Reference:**


### α,α'-Bis(di-t-butylphosphino)-o-xylene, min. 97% [121954-50-5]

**Chemical Structure:**

![Chemical Structure](image)
15-0069 1,2-Bis(dichlorophosphino)benzene, min. 97%  
[82495-67-8]  
amp C₆H₄Cl₂P₂; FW: 279.85; colorless to pale yellow liq.  
moisture sensitive

15-0076 1,2-Bis(dichlorophosphino)-1,2-dimethylhydrazine, min. 98%  
[37170-64-2]  
Cl₂PN(CH₃)N(CH₃)PCl₂; FW: 261.84; colorless to slightly cloudy liq.  
air sensitive, moisture sensitive

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:

15-0082 1,2-Bis(dichlorophosphino)ethane, min. 97%  
[28240-69-9]  
amp Cl₂PCH₂CH₂PCl₂; FW: 231.81; colorless to pale yellow liq.; b.p. 70°/1 mm; d. 1.536  
air sensitive, moisture sensitive

15-0081 Bis(dichlorophosphino)methane, min. 90%  
[28240-68-8]  
amp Cl₂PCH₂PCl₂; FW: 217.78; colorless liq.; b.p. 101-105°/22mm; d. 1.601  
air sensitive, moisture sensitive

15-0116 Bis(dichlorophosphino)methylamine, min. 97%  
[17648-16-7]  
amp CH₃N(PCl₂)₂; FW: 232.80; colorless to pale yellow liq.  
moisture sensitive

15-9560 2,2'-Bis(dicyclohexylphosphino)-1,1'-biphenyl, min. 97%  
[255897-36-0]  
C₃₆H₅₂P₂; FW: 546.75; white to pale yellow pwdr.

15-9585 1,2-Bis(dicyclohexylphosphino)ethane, min. 98%  
[23743-26-2]  
(C₆H₁₁)₂PCH₂CH₂P(C₆H₁₁)₂; FW: 422.61; white xtl.; m.p. 96-97°  
air sensitive

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PHOSPHORUS – Ligands and Compounds

15-7310  Bis[2-(dicyclohexylphosphino)ethyl]amine, min. 97%  [550373-32-5]
    C_{28}H_{53}NP_{2}; FW: 465.67; white solid
    air sensitive
    Note: Sold under license from Kanata for research purposes only. WO 2004096735.

15-9590  Bis(dicyclohexylphosphino)methane, min. 97%
    (C_{6}H_{11})_{2}PCH_{2}P(C_{6}H_{11})_{2}; FW: 408.59; white xtl.
    air sensitive

15-0048  Bis(2-dicyclohexylphosphino-phenyl)ether, 98%
    C_{36}H_{52}OP_{2}; FW: 562.75; white pwdr.

15-9593  1,3-Bis(dicyclohexylphosphonium)propane bis(tetrafluoroborate), min. 97%
    [(C_{6}H_{11})_{2}PCH_{2}CH_{2}CH_{2}P(C_{6}H_{11})_{2}]·2HBF_{4}; FW: 612.26;
    white pwdr.
    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.
    References:

15-9595  1,3-Bis(dicyclopentylphosphino-methyl)benzene, 99%
    C_{10}H_{2}(CH_{2}P(C_{6}H_{5})_{2})_{2}; FW: 442.60; white, waxy solid
    air sensitive
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_{8}P_{2}; FW: 1179.53; off-white pwdr.
Note: Manufactured under license of Takasago patent. Takasago SEGPHOS Ligand Kit component see (page 251).

Technical Notes:
1. 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 a-substituted-β-ketoesters useful in the synthesis of carbapenum antibiotics.
2. With rhodium, preferential enantioselective hydrogenation of more reactive olefin of extended enone structure.
4. With copper, enantioselective cross Aldol-type reaction of acetonitrile.
5. With copper, enantioselective vinylsilane alkenylation of aldehydes.
7. Enantioselective fluorination of b β-keto esters, tert-butoxycarbonyl lactones and lactmes with Sodeoka's Pd-aqua complex and a fluorinating reagent.
8. With copper, catalytic enantioselective Mannich-type reaction.
9. With copper, enantioselective 1,2-reduction of ketones, and 1,4-reduction of a α,β-unsaturated esters.
10. Rh-catalyzed intramolecular olefin or carbonyl hydroacylation.
12. Involved in numerous conjugate alkynylation, and ring-opening alkynylation of azabenzenorbormadienes.
13. Involved in asymmetric hydroamination of bicyclic alkenes/dienes, diamination of conjugated dienes, and hydroalkoxylation/hydrosulfenylation of allenes.
14. Used in cycloaddition reactions such as 1,3-dipolar cycloaddition of azomethine ylides, and Au-catalyzed [2+2] cycoaddition of allenes.

\[
\text{Ketone} \xrightarrow{\text{H}_2, \text{Ru-(+)L}} \text{Aldol} \xrightarrow{\text{OTBS, OAco}} \text{Product}
\]

\[
\text{Ketone} \xrightarrow{\text{Rh(COD)\_2, L, H}_2} \text{Product}
\]

\[
\text{Alkyne} + \text{N\_Bz} \xrightarrow{[\text{Rh(cod)}\_2\text{BF}_4, L]} \text{Product}
\]
(R)-(-)-5,5’-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4’-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPHOS \[566940-03-2\]
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  \[566940-03-2\]

References:
2. U.S. Pat. 6342644.

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  \[210169-40-7\]

Technical Note:
1. See 15-0066 (page 30).

15-0042  (R)-(−)-2,2′-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6′-dimethoxy-1,1′-biphenyl, min. 97%  \[352655-61-9\]

Technical Notes:
1. See 15-0178 (page 56).
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.
7. Enantioselective Rh-catalyzed conjugate alkylation with TMS-acetylene.
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]

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

((S))-(-)-2,2'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [910134-30-4]

C₇₄H₁₀₄O₆P₂; FW: 1151.60; white xtl.

Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

100mg  500mg

References:
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### PHOSPHORUS – Ligands and Compounds

15-0652 (R)-(-)-2,2’-Bis[di(3,5-di-i-propyl-4-dimethylamino-phenyl)phosphino]-6,6’-dimethoxy-1,1’-biphenyl, min. 97% [352655-40-4]
C<sub>70</sub>H<sub>100</sub>N<sub>4</sub>O<sub>2</sub>P<sub>2</sub>; FW: 1091.55; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

Technical Note:
1. See 15-0178 (page 56).

<table>
<thead>
<tr>
<th>Amount</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

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<sub>70</sub>H<sub>100</sub>N<sub>4</sub>O<sub>2</sub>P<sub>2</sub>; FW: 1091.55; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

Technical Note:
1. See 15-0178 (page 56).

<table>
<thead>
<tr>
<th>Amount</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

15-0119 Bis(diethoxyphosphoryl)acetylene, 99% [4851-53-0]
C<sub>20</sub>H<sub>32</sub>O<sub>2</sub>P; FW: 298.21; yellow liq.
moisture sensitive

15-0084 Bis(diethylamino)chlorophosphine, min. 97% [685-83-6]
amp [(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>N]PCl; FW: 210.68; colorless to light yellow liq.
HAZ (may contain trace insolubles); b.p. 124-125°/15 mm; d. 1.002
air sensitive, moisture sensitive

15-0083 1,2-Bis(diethylphosphino)ethane, 98% [6411-21-8]
amp (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>PCH<sub>2</sub>CH<sub>2</sub>P(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>; FW: 206.25; colorless liq.;
HAZ b.p. 124-126°/10 mm; d. 0.884 (25°)
air sensitive

15-0097 (-)-1,2-Bis((2R,5R)-2,5-diethylphospholano)benzene, 98+% [136705-64-1]
C<sub>22</sub>H<sub>36</sub>P; FW: 362.48; colorless oil; [α]<sub>D</sub> -265° (c 1, hexane); d. 1.01
air sensitive

Technical Note:
1. See 15-0096 (page 42).

Reference:
<table>
<thead>
<tr>
<th>Code</th>
<th>Product Name</th>
<th>% Yield</th>
<th>CAS Number</th>
<th>MW</th>
<th>Color</th>
<th>mp (°C)</th>
<th>Density (g/mL)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0098</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-diethylphospholano)benzene, 98+% (S,S)-Et-DUPHOS</td>
<td>100mg</td>
<td>[136779-28-7]</td>
<td>362.48</td>
<td>colorless oil;</td>
<td>1.010</td>
<td>air sensitive</td>
<td>Technical Notes: 1. See 15-0096 (page 42). 2. Ligand used in rhodium catalyzed asymmetric hydrogenation of 2-methylenesuccinamic acid.</td>
</tr>
<tr>
<td>15-0101</td>
<td>(+)-1,2-Bis((2R,5R)-2,5-diethylphospholano)ethane, 98+% (R,R)-Et-BPE</td>
<td>100mg</td>
<td>[136705-62-9]</td>
<td>314.43</td>
<td>colorless to pale-yellow liq.;</td>
<td>1.039</td>
<td>air sensitive</td>
<td>Technical Note: 1. See 15-0096 (page 42).</td>
</tr>
<tr>
<td>15-0102</td>
<td>(-)-1,2-Bis((2S,5S)-2,5-diethylphospholano)ethane, 98+% (S,S)-Et-BPE</td>
<td>100mg</td>
<td>[147776-89-8]</td>
<td>314.43</td>
<td>colorless to pale-yellow liq.;</td>
<td>1.039</td>
<td>air sensitive</td>
<td>Technical Note: 1. See 15-0096 (page 42).</td>
</tr>
<tr>
<td>26-1625</td>
<td>1,1'-Bis((2R,5R)-2,5-diethylphospholano)ferrocene, min. 97%</td>
<td>250mg</td>
<td>147762-89-8</td>
<td>470.39</td>
<td>yellow solid</td>
<td></td>
<td>air sensitive</td>
<td>Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>26-1626</td>
<td>1,1'-Bis((2S,5S)-2,5-diethylphospholano)ferrocene, min. 97%</td>
<td>250mg</td>
<td>436863-50-2</td>
<td>470.39</td>
<td>yellow solid</td>
<td></td>
<td>air sensitive</td>
<td>Note: Sold under license from Kanata for research purposes only.</td>
</tr>
</tbody>
</table>
### 26-0200

**(+) -1,1'-Bis(2R,4R)-2,4-diethylphosphatano)ferrocene, min. 95% (R,R)-Et-FerroTANE®**

- Formula: \([C_5H_4(C_7H_{14}P)]_2Fe; FW: 442.35; yellow-orange pwdr.; \([\alpha]_D +660^\circ (c 1, \text{heptane}); m.p. 76^\circ\]

**Note:** Sold in collaboration with Chirotech for research purposes only. US Patent no. 5936109.

---

#### Technical Notes:

1. See 26-0201 (page 37).

26-0201

**(-) -1,1'-Bis(2S,4S)-2,4-diethylphosphatano)ferrocene, min. 95% (S,S)-Et-FerroTANE®**

- Formula: \([C_5H_4(C_7H_{14}P)]_2Fe; FW: 442.35; yellow-orange pwdr.; \([\alpha]_D -660^\circ (c 1, \text{heptane}); m.p. 76^\circ\]

**Note:** Sold in collaboration with Chirotech for research purposes only. US Patent no. 5936109.

---

#### Technical Notes:

1. Ligand for the asymmetric Rh-catalyzed hydrogenation of itaconates.
2. Ligand for the asymmetric Rh-catalyzed hydrogenation of \(\beta\)-aryl substituted \(\beta\)-amino acrylates.

#### References:


### 15-0112

**(R)-(+)-2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97% [145214-57-9]**

- Formula: \(C_{30}H_{24}O_8P_2; FW: 542.47; \text{off-white pwdr.}

**Note:** Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

---

#### Technical Note:

1. See 15-0178 (page 56).
### PHOSPHORUS – Ligands and Compounds

**15-0113**

(S)-(2,2',2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl), min. 97% [145214-59-1]

C\textsubscript{30}H\textsubscript{24}O\textsubscript{6}P\textsubscript{2}; FW: 542.47; off-white pwd.

Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

![Chemical Structure](image)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td>2g</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 15-0178 (page 56).

**15-7301**

Bis{2-[(11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethyl}amine, min. 97% [851870-89-8]

C\textsubscript{58}H\textsubscript{41}NP\textsubscript{2}; FW: 693.79; white solid

Note: Sold under license from Kanata for research purposes only. WO2004096735.

![Chemical Structure](image)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>500mg</td>
<td></td>
</tr>
</tbody>
</table>

**15-7302**

Bis{2-[(11bS)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethyl}amine, min. 97%

C\textsubscript{58}H\textsubscript{41}NP\textsubscript{2}; FW: 693.79; white solid

Note: Sold under license from Kanata for research purposes only. WO2004096735.

![Chemical Structure](image)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>500mg</td>
<td></td>
</tr>
</tbody>
</table>

**15-0089**

1,2-Bis(dimethoxyphosphoryl)benzene, 99% [15104-46-8]

C\textsubscript{6}H\textsubscript{4}[P(O)(OCH\textsubscript{3})\textsubscript{2}]\textsubscript{2}; FW: 294.18; white xtl.; m.p. 80-82°C

<table>
<thead>
<tr>
<th>Quantity</th>
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<tbody>
<tr>
<td>5g</td>
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<tr>
<td>25g</td>
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</table>

**26-0240**

(S,S)-(2,2',2'-Bis[(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(dicyclohexylphosphino)ferrocene, min. 97% [494227-35-9]

C\textsubscript{52}H\textsubscript{74}FeN\textsubscript{2}P\textsubscript{2}; FW: 844.95; orange-red solid; [\(\alpha\)]D   +54.6° (c 1.0, CHCl\textsubscript{3})

Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).

![Chemical Structure](image)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td>2g</td>
<td></td>
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</tbody>
</table>

Technical Notes:
1. Ligand for Rh-catalyzed hydrogenation of enamides and the Ru-catalyzed hydrogenation of tiglic acid.
2. Ligand for Cu-catalyzed enantioselective hydroboration.

References:
<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>MW</th>
<th>Solubility</th>
<th>Optical Rotation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0245</td>
<td>(R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(3,5-dimethylphenyl)phosphino) ferrocene, min. 97%</td>
<td>C_{60}H_{66}FeN_2P_2; FW: 932.99; orange pwdr.; [α]_D \ +164°</td>
<td>932.99</td>
<td>Solubility</td>
<td>Note: Sold in collaboration with Solvias for research purposes only.</td>
<td></td>
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</table>

Technical Note:
1. See 26-0240 (page 38).

<table>
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<th>Code</th>
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<th>MW</th>
<th>Solubility</th>
<th>Optical Rotation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0246</td>
<td>(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(3,5-dimethylphenyl)phosphino) ferrocene, min. 97%</td>
<td>C_{60}H_{66}FeN_2P_2; FW: 932.99; orange pwdr.</td>
<td>932.99</td>
<td>Solubility</td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 26-0240 (page 38).

<table>
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<tr>
<th>Code</th>
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<th>Formula</th>
<th>MW</th>
<th>Solubility</th>
<th>Optical Rotation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0252</td>
<td>(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(diphenylphosphino)ferrocene, min. 97%</td>
<td>C_{52}H_{50}FeN_2P_2; FW: 820.76; orange-red solid; [α]_D \ -320.0° (c 1.0, CHCl₃)</td>
<td>820.76</td>
<td>Solubility</td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 26-0240 (page 38).

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>MW</th>
<th>Solubility</th>
<th>Optical Rotation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0253</td>
<td>(R,R)-(+)-2,2'-Bis[(S)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(2-methylphenyl)phosphino)ferrocene, min. 97%</td>
<td>C_{56}H_{58}FeN_2P_2; FW: 876.88; orange pwdr.; [α]_D \ +196°</td>
<td>876.88</td>
<td>Solubility</td>
<td>Note: Sold in collaboration with Solvias for research purposes only.</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 26-0240 (page 38).

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>MW</th>
<th>Solubility</th>
<th>Optical Rotation</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>26-0254</td>
<td>(S,S)-(-)-2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis(di(2-methylphenyl)phosphino)ferrocene, min. 97%</td>
<td>C_{56}H_{58}FeN_2P_2; FW: 876.88; orange pwdr.</td>
<td>876.88</td>
<td>Solubility</td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 26-0240 (page 38).
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]
C₆₄H₇₄FeN₂O₄P₂; FW: 1053.08; orange-red solid; [α]D -61.5° (c 1.0, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).

Technical Note:
1. See 26-0240 (page 38).

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]
C₆₀H₄₂F₂₄FeN₂P₂; FW: 1364.74; orange-red solid; [α]D -250.2° (c 1.0, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only. Solvias MandyPhos™ Ligand Kit component. See (page 242).

Technical Note:
1. See 26-0240 (page 38).

15-0087 Bis(dimethylamino)phosphoryl chloride, 95+% [1605-65-8]
[(CH₃)₂N]₂P(O)Cl; FW: 170.58; colorless liq.; b.p. 85°/0.35 mm; f.p. >230°F; d. 1.17 moisture sensitive

15-0074 (+)-1,2-Bis[(2S,5S)-2,5-dimethyl-(3S,4S)-3,4-dihydroxyphospholano]benzene bis(trifluoromethanesulfonate)salt, min. 97% (S,S,S,S)-ROPHOS-bis(OTf) [552829-96-6]
[C₆H₄(C₆H₁₂O₂PH)₂]₂²⁺(CF₃SO₃)₂; FW: 670.52; white xtl.; [α]D +146° (c 0.5, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only.

Technical Note:
1. Ligand employed in rhodium-catalyzed hydrogenation of various substituted enamides.

\[ \text{CO}_2\text{Me}\] \[\text{NHAc}\] \[\text{[Rh(L)COD]BF}_4\] \[\text{H}_2, \text{MeOH}\] \[\rightarrow \text{CO}_2\text{Me}\] \[\text{NHAc}\] > 99% ee

Reference:
<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>CAS</th>
<th>Quantity:</th>
<th>500mg</th>
<th>2g</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0111</td>
<td>Bis(3,5-dimethyl-4-methoxyphenyl)chlorophosphine, min. 98%</td>
<td>[136802-85-2]</td>
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<tr>
<td></td>
<td>C₁₈H₂₂ClO₂P; FW: 336.79; colorless, viscous liq. moisture sensitive</td>
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<tr>
<td>26-1150</td>
<td>(R)-(−)-1-{[(S)-2-[Bis(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocenyl]ethylidicyclohexylphosphine, min. 97%}</td>
<td>[360048-63-1]</td>
<td>100mg</td>
<td>500mg</td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td>C₄₂H₅₆FeO₂P₂; FW: 710.71; orange pwdr.; [α]D -270° ±10° (c 0.5, CHCl₃)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>26-1130</td>
<td>(R)-(+)−1-{(R)-2-[2′-Bis(3,5-dimethyl-4-methoxyphenyl)phosphinophenyl]ferrocenyl}ethylbis(di-3,5-trifluoromethylphenyl)phosphine, min. 97%</td>
<td>[494227-30-4]</td>
<td>100mg</td>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₅₂H₄₄F₁₂FeO₂P₂; FW: 1046.68; [α]D +19° ±2° (c 0.5, CHCl₃)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0088</td>
<td>Bis(3,5-dimethylphenyl)phosphine, 99%</td>
<td>[71360-06-0]</td>
<td>500mg</td>
<td></td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td>[(CH₃)₂C₆H₃]₂PH; FW: 242.30; colorless liq. pyrophoric</td>
<td></td>
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</tr>
<tr>
<td>15-7340</td>
<td>2-[Bis(3,5-dimethylphenyl)phosphino]benzaldehyde, min. 97%</td>
<td>[669091-00-3]</td>
<td>100mg</td>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C₂₃H₂₃OP; FW: 346.40; yellow solid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-5180</td>
<td>(R)-(−)-7,7′-Bis[di(4-methylphenyl)phosphino]-2,2′,3,3′-tetrahydro-1,1′-spirobiindane, min. 97% (R)-Tol-SDP</td>
<td>[528521-87-1]</td>
<td>25mg</td>
<td>100mg</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td>C₄₅H₄₂P₂; FW: 644.76; white solid; [α]D +212° (c 0.53, CH₂Cl₂); m.p. 150-152° air sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note: Spiro Bisphosphine Ligand Kit component see (page 244).</td>
<td></td>
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</tr>
</tbody>
</table>

Technical Note:
1. See 26-1210 (page 150).
2. See 26-1315 (page 162).
**PHOSPHORUS – Ligands and Compounds**

15-5181  **(S)-(-)-7,7'-Bis[di(4-methylphenyl)phosphino]-2,2',3,3'-tetrahydro-1,1'-spirobiindane, min. 97% (S)-Tol-SDP**

C\textsubscript{43}H\textsubscript{42}P\textsubscript{2}; FW: 644.76; white solid; 
[\(\alpha\)]\textsubscript{D} -221° (c 0.54, CH\textsubscript{2}Cl\textsubscript{2}); m.p. 150-152°

*air sensitive*

Note: Spiro Bisphosphine Ligand Kit component see (page 244).

Technical Note:
1. See 15-5174 (page 66).

15-0090  **1,2-Bis(dimethylphosphino)ethane, 98% DMPE**

\[(CH_3)\textsubscript{2}PCH_2CH_2P(CH_3)\textsubscript{2}\]; FW: 150.14; colorless liq.; b.p. 180°;
f.p. 2°F; d. 0.90

*air sensitive*

15-0093  **Bis(dimethylphosphino)methane, min. 98%**

\[(CH_3)\textsubscript{2}PCH_2P(CH_3)\textsubscript{2}\]; FW: 136.12; colorless liq.;
b.p. 42°/12 mm; d. 0.86

*air sensitive*

15-0096  **(-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene, 98+% (R,R)-Me-DUPHOS**

C\textsubscript{18}H\textsubscript{28}P\textsubscript{2}; FW: 306.37; white xtl.; 
[\(\alpha\)]\textsubscript{D} -476° (c 1, hexane); m.p. 82-84°

*air sensitive*

**Technical Notes:**
1. The DUPHOS family of catalysts is highly efficient for the asymmetric hydrogenation of various substituted acetamido acrylates and enol acetates yielding products of high enantiomeric excesses. Efficient ligand for the asymmetric hydrogenation of tetrasubstituted enamides.
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.
7. Catalytic enantioselective addition of dialkylzinc to N-Diphenylphosphinoylimines.
8. Palladium catalyzed asymmetric phosphination.

\[\text{(COD)}\text{2}Rh^+ [SbF}_6^-, PF}_6^-, OTf^- + DUPHOS \rightarrow [(DUPHOS)Rh(COD)]^+ X^- ("CAT")\]

Ref. (1)

\[R = \text{C}_6\text{H}_5, R' = \text{CH}_3, R'' = \text{Ph}\]

Ref. (2)

Visit www.strem.com for new product announcements.
(-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene, 98+% (R,R)-Me-DUPHOS

\[ \text{[147253-67-6]} \]

Ref. (3)

Ref. (4)

Ref. (7)

Ref. (8)

Ref. (7)

Ref. (8)

Ref. (9)

Ref. (7)

Ref. (13)
(-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene, 98+% (R,R)-Me-DUPHOS

\[
\text{ref. (14)}
\]

Tech. Note (8)

\[
\text{ref. (15)}
\]

Ref. (16)

\[
\text{ref. (17)}
\]

Ref. (17)

References:
PHOSPHORUS – Ligands and Compounds

15-0092 (+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)benzene, 98+% (S,S)-Me-DUPHOS [136735-95-0]  
C18H28P2; FW: 306.37; white xtl.; [α]D +476° (c 1, hexane); m.p. 82-84°  
air sensitive

Technical Note:  
1. See 15-0096 (page 42).

15-0104 (+)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)ethane, 98+% (R,R)-Me-BPE [129648-07-3]  
(C6H12)PCH2CH2P(C6H12); FW: 258.33; colorless to pale-yellow liq.; [α]D +263° ±3° (c 1, hexane); b.p. 64-67°/0.06mm; d. 0.940  
air sensitive

Technical Note:  
1. See 15-0105 (page 45).

15-0105 (-)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)ethane, 98+% (S,S)-Me-BPE [136779-26-5]  
(C6H12)PCH2CH2P(C6H12); FW: 258.33; colorless to pale-yellow liq.; [α]D -263° ±3° (c 1, hexane); b.p. 64-67°/0.06mm; d. 0.938  
air sensitive

Technical Note:  
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.1

References:  
26-1618
1,1'-Bis((2R,5R)-2,5-dimethylphospholano)ferrocene, min. 97% [540475-45-4]
C_{22}H_{32}FeP_{2}; FW: 414.28; yellow solid
air sensitive
Note: Sold under license from Kanata for research purposes only.

26-1619
1,1'-Bis((2S,5S)-2,5-dimethylphospholano)ferrocene, min. 97%
C_{22}H_{32}FeP_{2}; FW: 414.28; yellow solid
air sensitive
Note: Sold under license from Kanata for research purposes only.

15-0117
(-)-2,3-Bis[(2R,5R)-2,5-dimethylphospholanyl]-1-[3,5-bis(trifluoromethyl)phenyl]-1H-pyrrole-2,5-dione, min. 95%
[catASium® MNXylF(R)]
C_{24}H_{27}F_{6}NO_{2}P_{2}; FW: 537.42; white pwdr.
air sensitive
Note: Sold in collaboration with Solvias for research purposes only. Patent US20050209455.

15-0109
(-)-2,3-Bis[(2R,5R)-2,5-dimethylphospholanyl]-1-(3,5-dimethylphenyl)-1H-pyrrole-2,5-dione, min. 97%
[catASium® MNXyl(R)]
C_{24}H_{33}NO_{2}P_{2}; FW: 429.47; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Patent US20050209455.

15-0108
(-)-2,3-Bis[(2R,5R)-2,5-dimethylphospholanyl]maleic anhydride, min. 97% [catASium® M(R)]
C_{16}H_{24}O_{3}P_{2}; FW: 326.31; brown pwdr.
air sensitive
Note: Sold in collaboration with Solvias for research purposes only. Patent WO 03084971.

Technical Note:
1. See 45-0173 (Visit www.strem.com).
**15-0099** Bis(4,6-dimethyl-3-sulfonatophenyl)(2,4-dimethylphenyl)phosphine, disodium salt hydrate, min. 95% TXPDS

C_{24}H_{29}Na_2O_6PS_2; FW: 550.54; white powdr.

Note: Water soluble phosphine.

1,2-Bis(dipentafluorophenylphosphino)ethane, 99%

(C_{6}F_{5})_{2}PCCH_{2}CH_{2}P(C_{6}F_{5})_{2}; FW: 758.26; off-white xtl.; m.p. 188-190°

**15-0094** Bis(diphenylphosphino)acetylene, 97% [5112-95-8]

(C_{6}H_{5})_{2}P=CP(C_{6}H_{5})_{2}; FW: 394.39; white xtl.; m.p. 85-87°

**15-0100** N,N-Bis(diphenylphosphino)amine, min. 98% [2960-37-4]

(C_{6}H_{5})_{2}PNHP(C_{6}H_{5})_{2}; FW: 385.38; white xtl.; m.p. 143-145°

**15-0110** N,N-Bis(diphenylphosphino)amine, min. 98%

(C_{6}H_{5})_{2}PNHP(C_{6}H_{5})_{2}; FW: 385.38; white xtl.; m.p. 143-145°

**15-0401** (R)-(+)–2,2’-Bis(N-diphenyl-phosphinoamino)-5,5’,6,6’,7,7’,8,8’-octahydro-1,1’-binaphthyl, min. 95% CTH-(R)-BINAM

C_{44}H_{42}N_{2}P_{2}; FW: 660.77

Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent US 5919981 and patents arising therefrom.

Technical Note:
1. Ligand used in the enantioselective, rhodium-catalyzed hydrogenation of α-phenylenamides.

Reference:

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

C_{44}H_{42}N_{2}P_{2}; FW: 660.77

Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent US 5919981 and patents arising therefrom.

Technical Note:
1. See 15-0401 (page 47).

**15-0130** 1,2-Bis(diphenylphosphino)benzene, 98% [13991-08-7]

o-C_{6}H_{4}[P(C_{6}H_{5})_{2}]_{2}; FW: 446.47; white xtl.; m.p. 185-187°
15-7325  
(1R,2R)-N,N-Bis[2-diphenylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%  
[C$_{63}$H$_{84}$N$_2$P$_2$; FW: 662.78; yellow solid, air sensitive]  
250mg  
1g  

15-7326  
(1S,2S)-N,N-Bis[2-(diphenylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%  
[C$_{63}$H$_{84}$N$_2$P$_2$; FW: 662.78; yellow solid, air sensitive]  
250mg  
1g  

15-0136  
(R)-(+)5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98%  
[R]-(+)-SEGPHOS  
[C$_{38}$H$_{28}$O$_4$P$_2$; FW: 610.57; off-white pwdr.  
Note: Manufactured under license of Takasago patent. Takasago SEGPHOS Ligand Kit component see (page 251)]  
250mg  
1g  
5g  

Technical Notes:
1. 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.

2. As ruthenium complex, SEGPHOS generally gives higher levels of chiral induction in asymmetric hydrogenations of α,β, and γ-functionalized ketones. See ruthenium complexes 44-0096, 44-0518, 44-0168 (Visit www.strem.com).

3. Used in Rh-catalyzed transformations such as: (a) 1,4-addition of boronic acids to coumarins, (b) addition of titanium reagents to imines, (c) co-trimerization of alkenes and acetylenes, (d) double [2+2+2] cycloaddition, (e) indanone formation.

4. Used in Pd-catalyzed transformations such as: (a) cycloaddition of 1,6-enyne, (b) arylative cyclization of allenyl aldehydes with boronic acids, (c) synthesis of chromans.

5. Used in Cu-catalyzed transformations such as: (a) nitroso Diels-Alder, (b) reductive aldol condensation, (c) conjugate reduction of unsaturated sulfones, and phosphonates.

6. Iridium catalyzed asymmetric hydrogenation of quinolines activated by chloroformates.

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(R)-(+) -5,5’-Bis(diphenyl-phosphino)-4,4’-bi-1,3-benzodioxole, min. 98% (R)-(+) -SEGPHOS [244261-66-3]

References:

(S)-(−)-5,5′-Bis(diphenylphosphino)-4,4′-bi-1,3-benzodioxole, min. 98% (S)-(−)-SEGPHOS [210169-54-3]

Technical Note:
1. See 15-0136 (page 48).

(2R,3R)-(−)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (R,R)-NORPHOS [71042-55-2]

Technical Notes:
1. Ligand used in the enantioselective rhodium catalyzed hydrogenation of α–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.
**PHOSPHORUS – Ligands and Compounds**

15-0140 (cont.) (2R,3R)-(−)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (R,R)-NORPHOS [71042-55-2]

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{H}_2 \\
\text{MeOOC} & \quad \rightarrow \\
\text{MeOOC} & \quad \rightarrow
\end{align*}
\]

References:

15-0141 (2S,3S)(+)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene, min. 95% (S,S)-NORPHOS [71042-54-1]

\[
\begin{align*}
\text{C}_3\text{H}_8\text{P}_2; \text{FW: 462.51; white xtl.; } [\alpha]_D & +47^\circ (c 1, \text{CHCl}_3); \\
\text{m.p. 112-115° air sensitive}
\end{align*}
\]

Technical Notes:
1. See 15-0140 (page 49).

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

\[
\begin{align*}
\text{C}_{44}\text{H}_{32}\text{P}_2; \text{FW: 622.70; white to light-yellow xtl.} \\
\text{Note: Phosphine Ligand Kit component. See (page 233).}
\end{align*}
\]

Technical Notes:
1. Useful ligand for palladium-catalyzed carbon-nitrogen bond formation.
2. Useful ligand for rhodium-catalyzed C-C bond formation.
3. Useful ligand for palladium-catalyzed intramolecular acylation of aryl bromides via C-H activation.

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 racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP

\[ \text{rac-BINAP} \] \[ \text{[98327-87-8]} \]

References:

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

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

\[ \text{[76189-55-4]} \]
\[ \text{C}_{44}\text{H}_{32}\text{P}_2; \text{FW: 622.70; white to light yellow xtl.;} \]
\[ \text{[\(\alpha\)]D} \text{ +224.5° (c 0.7, C6H6); m.p. 240.5-242°} \]

Note: Manufactured under license of Takasago patent.
Takasago BINAP Ligand Kit component see (page 246).

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.
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 a-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 b-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.
15. Ligand employed in rhodium-catalyzed asymmetric C-Si bond formation by conjugate silyl transfer using a Si-B linkage.

15-0433 racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP

(Cont.)
(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP

ArNH₂ + \( \text{PhC} = \text{C} \) \( \text{CF}_3 \) → 10% [(R)-BINAP]Pd(OTf)₂ → 80% yield 81% ee

But\( \text{O} = \text{Si(OH)₃} \) + PhCHO → AgOTf/BINAP KF 18-crown-6 MeOH → 84% yield >99/1 syn/anti 97% ee

\( \text{Me} = \text{C} = \text{C} \) ↓ [Rh(cod)Cl]₂/BINAP AgSbF₆ racemic → 99% ee

Me\( \text{CO}_₂\text{Me} \) + \( \text{Me} = \text{C} = \text{C} \) \( \text{B} = \text{H} \) → [Rh(cod)Cl]₂/BINAP THF, rt → 96% yield, 94% ee

O\( \text{SnBu₃} \) + Ph\( \text{CH} \) → AgClO₄/BINAP → 50% yield, 94% ee

Ph\( \text{C} = \text{C} \) \( \text{Br} \) + H\( \text{N} = \text{C} \text{O}_₂\text{Et} \) → Pd₂(dba)₃/BINAP Cs₂C₂Cl₂ → 75% yield, 89% ee

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(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+) BINAP

References:
1. CHEMTECH, 1992, 360.
PHOSPHORUS – Ligands and Compounds

15-0151  (S)-(−)-2,2′-Bis(diphenylphosphino)-1,1′-binaphthyl, 97%  
(S)-(−)-BINAP  [76189-56-5]  
C_{44}H_{32}P_{2}; FW: 622.70; white to light yellow xtl.; 
[α]_D  -228° (c 0.68, C_{6}H_{6}); m.p. 241-242°C  
Note: Manufactured under license of Takasago patent.  
Takasago BINAP Ligand Kit component see (page 246).

Technical Note:
1. See 15-0150 (page 51).

15-0145  2,2′-Bis(diphenylphosphino)-1,1′-biphenyl, 98% BIPHEP  [84783-64-2]  
C_{36}H_{28}P_{2}; FW: 522.57; white xtl.; 
m.p. 210-214°C

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 rhodium-catalyzed conjugate addition of boronic acids to enones.
4. Useful ligand for palladium-catalyzed synthesis of butatrenes.
5. Useful ligand for iridium-catalyzed C-C cross-coupling via transfer hydrogenation.

References:
PHOSPHORUS – Ligands and Compounds

15-0160  (2S,3S)-(−)-Bis(diphenyl-phosphino)butane (S,S)-CHIRAPHOS [64896-28-2]
(C₆H₅)₂PCH(CH₃)CH(CH₃)P(C₆H₅)₂; FW: 426.48; white xtl.; [α]D -190° (c 1.5, CHCl₃); m.p. 108-109°

air sensitive

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

Reference:

15-0170  1,4-Bis(diphenylphosphino)butane, 98% DPPB [7688-25-7]
(C₆H₅)₂PCH₂CH₂CH₂CH₂P(C₆H₅)₂; FW: 426.48; white xtl.; m.p. 132-134°

Technical Notes:
1. 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.
2. Ru-C₃-TUNEPHOS complexes are used for asymmetric hydrogenation of β-ketoesters, enol acetates, cyclic β-amino acids, α-phthalimide ketones, and α-keto esters.
3. Rh-catalyzed hydroformylation of cyclopropanes.

References:
5. Synlett., 2006, 126, 1169.
PHOSPHORUS – Ligands and Compounds

15-0176  
(S)-(+)-1,13-Bis(diphenylphosphino)-7,8-dihydro-6H-dibenzo[f,h][1,5]dioxonin, 95% (S)-C₃-TUNEPHOS

\[ \text{C}_{39}\text{H}_{32}\text{O}_{2}\text{P}_{2}; \text{FW: 594.62; white pwdr.} \]

*air sensitive*

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 see (page 212).

Technical Note:

1. See 15-0175 (page 55).

15-0178  
(R)-(+)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%

\[ \text{(R)-MeO-BIPHEP [133545-16-1]} \]

\[ \text{C}_{38}\text{H}_{32}\text{O}_{2}\text{P}_{2}; \text{FW: 582.53; off-white xtl.} \]

Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

Technical Notes:

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.

1. See 15-0042 (page 32).
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.

References:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Purity</th>
<th>500mg</th>
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<tbody>
<tr>
<td>15-0179</td>
<td>(S)-(−)-2,2′-Bis(diphenylphosphino)-6,6′-dimethoxy-1,1′-biphenyl, min. 97% (S)-MeO-BIPHEP</td>
<td>100mg</td>
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<td>[133545-17-2]</td>
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<tr>
<td></td>
<td>C_{38}H_{32}O_{2}P_{2}; FW: 582.53; white xtl.</td>
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<td></td>
</tr>
<tr>
<td>Note:</td>
<td>Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>component see (page 238).</td>
<td></td>
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<tr>
<td>15-0200</td>
<td>1,2-Bis(diphenylphosphino)ethane, 99% DIPHOS</td>
<td>5g</td>
<td>25g</td>
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<td></td>
<td>[1663-45-2]</td>
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<tr>
<td></td>
<td>(C_{6}H_{5})<em>{2}PCH</em>{2}CH_{2}P(C_{6}H_{5})_{2}; FW: 398.43; white pwdr.;</td>
<td>100g</td>
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<td>m.p. 143-145°</td>
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<tr>
<td>15-0205</td>
<td>1,2-Bis(diphenylphosphino)ethane monooxide, min. 97%</td>
<td>1g</td>
<td>5g</td>
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<td>[984-43-0]</td>
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<td>(C_{6}H_{5})<em>{2}PCH</em>{2}CH_{2}P(O)(C_{6}H_{5})_{2}; FW: 414.42; white pwdr.</td>
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<td>15-7306</td>
<td>Bis[(2-diphenylphosphino)ethyl]ammonium chloride, min. 97%</td>
<td>500mg</td>
<td>2g</td>
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<td>[66534-97-2]</td>
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<td></td>
<td>C_{28}H_{30}CINP_{2}; FW: 477.95; white solid</td>
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<td></td>
<td>air sensitive</td>
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<td>Note:</td>
<td>Sold under license from Kanata for research purposes only. WO2004096735.</td>
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<tr>
<td>15-0250</td>
<td>cis-1,2-Bis(diphenylphosphino)ethylene, min. 98%</td>
<td>1g</td>
<td>5g</td>
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<td>[983-80-2]</td>
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<tr>
<td></td>
<td>cis-(C_{6}H_{5})<em>{2}PCH=CHP(C</em>{6}H_{5})_{2}; FW: 396.41; white xtl.;</td>
<td>5g</td>
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<td>m.p. 125-126°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-0350</td>
<td>Bis(2-diphenylphosphinoethyl)phenylphosphine, 97% TRIPHOS</td>
<td>1g</td>
<td>5g</td>
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<tr>
<td></td>
<td>[23582-02-7]</td>
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<tr>
<td></td>
<td>(C_{6}H_{5})<em>{2}PCH</em>{2}CH_{2}P(C_{6}H_{5})CH_{2}CH_{2}P(C_{6}H_{5})_{2}; FW: 534.56; white pwdr.; m.p. 130-134°</td>
<td>25g</td>
<td></td>
</tr>
<tr>
<td>26-0270</td>
<td>1,1′-Bis(diphenylphosphino)ferrocene, 99% DPPF</td>
<td>1g</td>
<td>5g</td>
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<tr>
<td></td>
<td>[12150-46-8]</td>
<td></td>
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<tr>
<td></td>
<td>(C_{6}H_{5})<em>{2}PC</em>{3}H_{4}FeC_{3}H_{4}P(C_{6}H_{5})_{2}; FW: 554.39; yellow to orange xtl.; m.p. 180°</td>
<td>25g</td>
<td></td>
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<td>Note:</td>
<td>Phosphine Ligand Kit component.</td>
<td></td>
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<tr>
<td></td>
<td>See (page 233). 1,1′-Bis(dialkyl/diarylphosphino) ferrocene Ligand Kit component. See (page 202).</td>
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<td></td>
</tr>
</tbody>
</table>

**Technical Notes:**

1. Ligand for Pd-catalyzed cross-coupling.
3. Ligand for Ni-catalyzed amination of aryl chlorides.
4. Ligand for Pd-catalyzed conversion of aryl halides to aryl nitriles.
5. Ligand for Ni-catalyzed coupling of aryl halides to arylboronic acids.
6. Ni-catalyzed hydroamination of 1,3-dienes.
7. Pd-catalyzed hydrocarbonation and hydroamination of 3,3′-dihexylcyclopropene.
8. Pd-catalyzed g-arylation of b,g-unsaturated ketones.
1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF [12150-46-8] (cont.)

\[
\begin{align*}
\text{Ph} & \quad \text{Br} + \quad \text{RMgCl} \quad \xrightarrow{\text{Pd(dppf)Cl}_2, \text{Et}_2\text{O}, 2\text{h}} \quad \text{Ph} \quad \text{R} \\
\text{Ph} & \quad \text{Br} + \quad \text{C}_6\text{H}_{13} \quad \xrightarrow{1) \quad 9\text{-BBN} \quad 2) \quad \text{Pd(dppf)Cl}_2, \text{NaOH}} \quad \text{Ph} \quad \text{C}_8\text{H}_{17} \\
\text{R} & \quad \text{Br} + \quad \text{R'}\text{NH}_2 \quad \xrightarrow{0.25 \text{ mol} \% \quad \text{Pd}_3\text{(dba)}_3 \quad \text{dppf}, \text{NaO-t-Bu} \quad \text{toluene, 80} \quad \text{°C}} \quad \text{R} \quad \text{N(H)}\text{R'} \\
\text{Me} & \quad \text{Cl} + \quad \text{Ph} \quad \text{NH} \quad \xrightarrow{2\% \quad \text{Ni(COD)}_2 \quad 4\% \quad \text{dppf}} \quad \text{Me} \quad \text{N(CH}_3\text{)} \quad \text{Ph} \\
\text{R} & \quad \text{X} \quad \text{Br} \quad \xrightarrow{\text{Zn(CN)}_2, \ 2 \text{ mol} \% \quad \text{Pd}_3\text{(dba)}_3 \quad 4 \text{ mol} \% \quad \text{dppf}, \ 12 \text{ mol} \% \quad \text{Zn}} \quad \text{R} \quad \text{CN} \\
\text{R} & \quad \text{OMs} + \quad \text{R'}\text{B(OH)}_2 \quad \xrightarrow{\text{K}_3\text{PO}_4, \ 80-100} \quad \text{°C} \quad \text{R} \quad \text{H}_2\text{N}\text{Bu} \\
\text{Hex} & \quad \text{Hex} + \quad \text{NC} \quad \xrightarrow{2.5\% \quad \text{Pd(PPh}_3)_4 \quad 10\% \quad \text{dppf}} \quad \text{Hex} \quad \text{MeCN} \quad \text{CO}_2\text{Et} \\
\text{Hex} & \quad \text{Hex} + \quad \text{NC} \quad \xrightarrow{2.5\% \quad \text{Pd(PPh}_3)_4 \quad 10\% \quad \text{dppf}} \quad \text{Hex} \quad \text{MeCN} \quad \text{CO}_2\text{Et}
\end{align*}
\]
1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF [12150-46-8]

\[
\begin{align*}
\text{Hex} & \quad \text{Ph} & \quad \text{X} & \quad \text{Ph} \\
\text{Hex} & \quad \text{N} & \quad \text{Ts} & \quad \text{N} & \quad \text{Ts}
\end{align*}
\]

2.5% Pd(PPh\(_3\))\(_4\)
10% dppf
EtOH, 100 °C

\[
\begin{align*}
\text{Hex} & \quad \text{Ph} & \quad \text{N} & \quad \text{Ts} \\
\text{Hex} & \quad \text{N} & \quad \text{Ts}
\end{align*}
\]

81%

References:
PHOSPHORUS – Ligands and Compounds

15-0502 3,3’-Bis(diphenylphosphino)-5,5’,6,6’,7,7’,8,8’-octahydro[2,2’]binaphthalene chloroform adduct, 99%  [1067889-87-5]

C_{44}H_{40}P_2·0.5CHCl_3; FW: 630.74 (690.43); white to pale yellow powd.
Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.

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

Reference:

15-2972 (R)-(+)2,2’-Bis(diphenylphosphino)-5,5’,6,6’,7,7’,8,8’-octahydro-1,1’-binaphthyl (R)-(+)H8-BINAP  [139139-86-9]

C_{44}H_{40}P_2; FW: 630.74; off-white powd.
Note: Manufactured under license of Takasago patent.

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.

References:
2. Topics Organomet. Chem. 2004, 6, 63 (review).

15-2973 (S)-(−)-2,2’-Bis(diphenylphosphino)-5,5’,6,6’,7,7’,8,8’-octahydro-1,1’-binaphthyl (S)-(−)H8-BINAP  [139139-93-8]

C_{44}H_{40}P_2; FW: 630.74; off-white powder.
Note: Manufactured under license of Takasago patent.

Technical Note:
1. See 15-2972 (page 60).

15-0420 1,8-Bis(diphenylphosphino)octane, 99%  [41625-30-3]  
C_{32}H_{36}P_2; FW: 482.58; white powd.

References:
2. Topics Organometal. Chem. 2004, 6, 63 (review).
### PHOSPHORUS – Ligands and Compounds

**15-0425** (R)-(-)-4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95% (R)-PHANEPHOS  
C₅₀H₅₄P₂; FW: 576.65; white solid;  
[α]₀ -62.6° (c 3.11, CH₂Cl₂); m.p. 222-225°  
Note: Sold in collaboration with Chirotech for research purposes only. US Patent no. 5874629.

Technical Note:
1. See 15-0426 (page 61).

**15-0426** (S)-(+)4,12-Bis(diphenylphosphino)-[2.2]-paracyclophane, min. 95%  
(S)-PHANEPHOS [192463-40-4]  
C₅₀H₅₄P₂; FW: 576.65; white solid;  
[α]₀ +63.2° (c 3.27, CH₂Cl₂); m.p. 222-225°  
Note: Sold in collaboration with Chirotech for research purposes only. US Patent no. 5874629.

Technical Notes:
1. Highly enantioselective catalyst for the hydrogenation of dehydroamino acids, methyl esters under mild conditions.
2. Asymmetric hydrogenation of a wide variety of aromatic, heteroaromatic, and α-β unsaturated ketones.

**References:**

**15-0430** 1,5-Bis(diphenylphosphino)pentane, min. 98%  
[C₆H₅]₂P(CH₂)₅P(C₆H₅)₂; FW: 440.51; white to off-white solid; m.p. 46-49°

**15-0432** (2R,4R)-(+)2,4-Bis(diphenylphosphino)pentane, 99%  
(R,R)-BDPP [96183-46-9]  
(C₆H₅)₂PCH(CH₃)CH₂CH(CH₃)P(C₆H₅)₂; FW: 440.49; white xtl.;  
[α]₀ +124° (c 4.0, CHCl₃); m.p. 78°  
air sensitive

**15-0431** (2S,4S)-(−)-2,4-Bis(diphenylphosphino)pentane, 99%  
(S,S)-BDPP [77876-39-2]  
(C₆H₅)₂PCH(CH₃)CH₂CH(CH₃)P(C₆H₅)₂; FW: 440.49; white xtl.;  
[α]₀ -124° (c 3.0, CHCl₃); m.p. 81°  
air sensitive

**Technical Note (1)**

**Tech. Note (1)**

**Ref. (1)**

**Technical Note (2)**

**Tech. Note (2)**

**Ref. (2)**

References:
**PHOSPHORUS – Ligands and Compounds**

**15-0437** 4,6-Bis(diphenylphosphino)phenoxazine, min. 98% NIXANTPHOS

\[ \text{C}_{36}	ext{H}_{27}	ext{NOP}_{2}; \text{FW: 551.55; white to off-white pwdr.} \]

Technical Note:
1. A large bite-angle chelating bisphosphine that provides high levels of linear-to-branched selectivity in the hydroformylation of alkenes.

\[ \text{Hex} \rightarrow \text{Hex} \]

\[ \text{Rh(CO)}_{2}(\text{acac}) \text{ ligand} \]

\[ 80^\circ \text{C} \]

\[ 20 \text{ bar} \]

1:1 CO/H₂

linear:branched 69:1

Reference:

**15-0380** Bis(2-diphenylphosphinophenyl)ether, 98% DPEphos

\[ \text{FW: 538.56; off-white pwdr.; m.p. 181-184^\circ} \]

Note: Phosphine Ligand Kit component. See (page 233).

Technical Note:
1. Useful as a ligand in the Pd-catalyzed formation of diaryl amines.

References:

**15-0450** 1,3-Bis(diphenylphosphino)propane, 98% DPPP

\[ \text{FW: 412.45; white xtl.; m.p. 60-63^\circ} \]

**15-0440** R-(+)-1,2-Bis(diphenylphosphino)propane, 99% (R)-PROPHOS

\[ \text{FW: 412.45; white xtl.; [α]D}^\circ +186^\circ \text{ (c 1.0, acetone); m.p. 69-71^\circ \text{ (sealed tube) air sensitive}} \]

**15-0449** 1,3-Bis(diphenylphosphino)propane monooxide, min. 97%

\[ \text{FW: 428.44; white pwdr.} \]

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PHOSPHORUS – Ligands and Compounds

15-5207 1,2-Bis[(Z)-1-(diphenylphosphino)prop-1-ylidene]cyclohexane, min. 98%
Et₂-CYCLO-NUPHOS [420120-78-1]
C₃₆H₃₈P₂; FW: 532.63; yellow xtl.

Technical Note:
1. See 15-5205 (page 68).

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]
C₃₈H₂₄F₄O₄P₂·XCH₂Cl₂; FW: 682.54; white pwdr.
air sensitive
**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.

**References:**

### 15-0491

**S-(-)-6,6'-Bis(diphenylphosphino)-2,2',3,3'-tetrahydro-5,5'-bi-1,4-benzodioxin, min. 97% (S)-SYNPHOS™**

[C₄₀H₃₂O₄P₂; FW: 638.63; white pwd.]

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 MSDS sheet available at www.strem.com

<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

Technical Note:
1. See 15-0490 (page 64).

### 15-0442

**12,12'-Bis(diphenylphosphino)-9,9',10,10'-tetrahydro-11,11'-bi-9,10-ethenoanthracene, min. 98% CATPHOS**

[C₅₆H₄₀P₂; FW: 774.86; white xtl.]

<table>
<thead>
<tr>
<th>Quantity</th>
<th>250mg</th>
<th>1g</th>
</tr>
</thead>
</table>

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 α-arylation of ketones.

Reference:

### 15-0504

**6,6'-Bis(diphenylphosphino)-1,1',3,3'-tetrahydro[5,5']biisobenzofuran, 99%**

[C₄₀H₃₂O₂P₂; FW: 606.63; white to off-white pwd.]

Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

Technical Note:
1. See 15-0502 (page 60).
PHOSPHORUS – Ligands and Compounds

15-5165  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] C₄₇H₄₆O₂P₂; FW: 704.81; white powd.

100mg
500mg

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 dimetallic complexes, e.g. in MCl₂(SPANphos) (M = Pd, Pt), Rh₂(μ-Cl)₂(CO)₂(SPANphos), the latter useful in, for example, the homogeneous catalytic carbynylation of methanol to acetic acid.

References:

15-5174  (R)-(+)–7,7’-Bis(diphenylphosphino)-2,2’,3,3’-tetrahydro-1,1’-spirobiindane, min. 97% (R)-SDP [917377-74-3] C₄₁H₃₄P₂; FW: 588.66; white solid; [α]D  +207° (c 0.5, CH₂Cl₂); m.p. 200-202° air sensitive

Note: Spiro Bisphosphine Ligand Kit component see (page 244).

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:

15-5175  (S)-(−)-7,7’-Bis(diphenylphosphino)-2,2’,3,3’-tetrahydro-1,1’-spirobiindane, min. 97% (S)-SDP [528521-86-0] C₄₁H₃₄P₂; FW: 588.66; white solid; [α]D  -203° (c 0.5, CH₂Cl₂); m.p. 206-208° air sensitive

Note: Spiro Bisphosphine Ligand Kit component see (page 244).

Technical Note:
1. See 15-5174 (page 66).
**PHOSPHORUS – Ligands and Compounds**

15-1653  
(RO)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxybiphenyl, min. 97%  
(RO)-Ph-Garphos™  
C₄₀H₃₆O₄P₂; FW: 642.66; white xtl.  
*air sensitive*  
Note: Sold in collaboration with KCT.  
Garphos™ Ligand Kit component.  
See (page 222).

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

![Chemical structure of (R)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxybiphenyl](image)

**Reference:**  

15-1654  
(S)-2,2'-Bis(diphenylphosphino)-4,4',6,6'-tetramethoxybiphenyl, min. 97% (S)-Ph-Garphos™  
C₄₀H₃₆O₄P₂; FW: 642.66; white xtl.  
*air sensitive*  
See (page 222).

Technical Note:  
1. See 15-1653 (page 67).
Technical Notes:
1. Highly efficient catalyst for the palladium-mediated cross-coupling reactions.
2. Efficient catalyst for the asymmetric Diels-Alder reaction.
3. Useful catalyst for the carbonyl-ene reaction.

References:
Technical Notes:
1. Phenyl-BPE exhibits enhanced activity and selectivity over existing members of the BPE ligand family in rhodium catalysed asymmetric hydrogenation.
2. This ligand is highly efficient for the hydrogenation of N-acyl aryl-enamides.
3. Molar substrate/catalyst ratios of up to 100,000/1 are achieved with excellent reactivity and enantioselectivity using commercial grade substrates and solvents.
4. Ligand in the rhodium-catalyzed asymmetric hydroformylation of olefins.

References:

15-0474  (+)-1,2-Bis((2S,5S)-2,5-diphenylphospholano)ethane, min. 98% (S,S)-Ph-BPE [824395-67-7]  
(C$_{16}$H$_{16}$)PCH$_2$CH$_2$P(C$_{16}$H$_{16}$); FW: 506.60; white solid;  
[α]$_D$ +182.7° (c 1.0, CH$_2$Cl$_2$); m.p. 144°C  
*air sensitive*  
**PHOSPHORUS – Ligands and Compounds**

**15-0654**  
(R)-(+) -2,2′-Bis(di-i-propylphosphino)-6,6′-dimethoxy-1,1′-biphenyl, min. 97%  
[C26H40O2P2; FW: 446.56; white pwdr.]

Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

Technical Note:  
1. See 15-0178 (page 56).

**15-0655**  
(S)-(−) -2,2′-Bis(di-i-propylphosphino)-6,6′-dimethoxy-1,1′-biphenyl, min. 97%  
[C26H40O2P2; FW: 446.56; white pwdr.]

Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

Technical Note:  
1. See 15-0178 (page 56).

**15-7304**  
Bis[(2-di-i-propylphosphino)ethyl]amine, min. 97%  
[C16H37NP2; FW: 305.42; pale yellow to colorless liq. air sensitive]

Note: Sold under license from Kanata for research purposes only. WO2004096735.

Technical Note:  
1. See 45-0205 (Visit www.strem.com).
2. Efficient Pd-catalyzed cross-coupling of thiols and secondary phosphines.
4. Preparation of tricyclic indolines.

**26-0275**  
1,1′-Bis(di-i-propylphosphino)ferrocene, min. 98%  
[(C3H7)2PC5H4]2Fe; FW: 418.33; orange-yellow pwdr.

Note: 1,1′-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit component. See (page 202).

Technical Note:  
1. See 45-0205 (Visit www.strem.com).
2. Efficient Pd-catalyzed cross-coupling of thiols and secondary phosphines.
4. Preparation of tricyclic indolines.

![Chemical Structures](image)

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1,1'-Bis(di-i-propylphosphino)ferrocene, min. 98%  [97239-80-0]

\[
\begin{align*}
\text{Br} & \quad \text{NH}_2 \\
\text{Ph} & \quad \text{O} \\
\text{P} & \quad \text{C}_6\text{H}_{15} \quad \text{P} \\
\end{align*}
\]

**References:**

**15-0415**  4,5-Bis-(di-i-propylphosphinomethyl)acridine, 98+%  [1101230-28-7]

C_{27}H_{39}N_{2}P_{2}; FW: 439.55; yellow xtl.

*air sensitive*


**Technical Note:**

**15-0680**  1,3-Bis(di-i-propylphosphino)propane, min. 98%

(C_{3}H_{7})_{2}PCH_{2}CH_{2}CH_{2}P(C_{3}H_{7})_{2}; FW: 276.38; colorless to pale yellow liq.

*air sensitive*

**Technical Note:**
1. See 15-0096 (page 42).

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

C_{26}H_{44}P_{2}; FW: 418.58; white xtl.; \([\alpha]_{D} +85^\circ \text{ (c 1, hexane)}\); m.p. 40°

*air sensitive*

**Technical Note:**
1. See 15-0096 (page 42).

**15-0411**  (-)-1,2-Bis((2S,5S)-2,5-di-i-propylphospholano)benzene, 98+%  (S,S)-i-Pr-DUPHOS

C_{26}H_{44}P_{2}; FW: 418.58; white xtl.; \([\alpha]_{D} -85^\circ \text{ (c 1, hexane)}\); m.p. 40°

*air sensitive*

**Technical Note:**
1. See 15-0096 (page 42).
# PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Description</th>
<th>Purity</th>
<th>Molecular Formula</th>
<th>Molecular Weight</th>
<th>Physical Properties</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-7357</td>
<td>1,2-Bis((2R,5R)-2,5-di-i-propylphospholano)ethane, min. 97%</td>
<td>100mg</td>
<td>C₂₂H₄₄P₂</td>
<td>370.53</td>
<td>white solid</td>
<td>air sensitive; Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-7358</td>
<td>1,2-Bis((2S,5S)-2,5-di-i-propylphospholano)ethane, min. 97%</td>
<td>100mg</td>
<td>C₂₂H₄₄P₂</td>
<td>370.53</td>
<td>white solid</td>
<td>air sensitive; Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>26-1610</td>
<td>1,1'-Bis((2R,5R)-2,5-di-i-propylphospholano)ferrocene, min. 97%</td>
<td>100mg</td>
<td>C₃₀H₄₈FeP₂</td>
<td>526.49</td>
<td>yellow solid</td>
<td>air sensitive; Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>26-1611</td>
<td>1,1'-Bis((2S,5S)-2,5-di-i-propylphospholano)ferrocene, min. 97%</td>
<td>100mg</td>
<td>C₃₀H₄₈FeP₂</td>
<td>526.49</td>
<td>yellow solid</td>
<td>air sensitive; Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-0683</td>
<td>1,2-Bis(di-2-pyridylphosphino)ethane, min. 98%</td>
<td>100mg</td>
<td>C₂₂H₂₀N₄P₂</td>
<td>402.37</td>
<td>white pwdr.</td>
<td></td>
</tr>
<tr>
<td>15-0155</td>
<td>1,2-Bis(di-4-sulfonatophenylphosphino) benzene tetrasodium salt DMSO adduct</td>
<td>1g</td>
<td>C₆H₄[P(C₆H₄SO₃⁻)₂]·4Na⁺·(CH₃SOCH₃)ₓ</td>
<td>854.65</td>
<td>off-white pwdr.</td>
<td>Technical Note: Highly, water-soluble phosphine ligand.</td>
</tr>
</tbody>
</table>
PHOSPHORUS – Ligands and Compounds

15-7328 (1R,2R)-N,N-Bis[2-(di-p-tolylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%  
C_{38}H_{52}N_2P_2; FW: 718.89; yellow solid air sensitive

15-7329 (1S,2S)-N,N-Bis[2-(di-p-tolylphosphino)benzyl]cyclohexane-1,2-diamine, min. 97%  
C_{38}H_{52}N_2P_2; FW: 718.89; yellow solid air sensitive

15-0152 (R)-(+-)2,2'-Bis(di-p-tolylphosphino)-1.1'-binaphthyl, 98% 
(R)-(+-)-TolBINAP [99646-28-3]  
C_{48}H_{40}P_2; FW: 678.79; white pwdr.;  
[α]_D +156° (c 0.5, C_6H_6); m.p. 255-257°  
Note: Manufactured under license of Takasago patent. Takasago BINAP Ligand Kit component see (page 246).

Technical Notes:
1. See 15-0150 (page 51).
2. Useful ligand for palladium-catalyzed carbon-oxygen bond formation.
3. Ligand for palladium-catalyzed α-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 α-Imino esters.
8. Catalytic Aldol reaction to ketones.

![Chemical Reaction](image)

Ref. (1)

Ref. (2)

Ref. (3)

Ref. (4)

Ref. (5)
15-0152 (cont.) (R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP [99646-28-3]

\[
\begin{align*}
\text{OMe} & \text{SiMe}_3 + \text{N} & \text{Ts} & \text{EtO}_2 \text{C} & \left[ \text{Cu(MeCN)}_4 \right] \text{BF}_4 \\
& & & & \text{THF}, \text{MS4A}
\end{align*}
\]

1) CuF 3PPh\textsubscript{3} 2EtOH
\[
\begin{align*}
\text{(S)-p-Tol-BINAP} & \text{CuF} 3\text{PPh}_{3} 2\text{EtOH} \\
& \text{OMe} & \text{SiMe}_3
\end{align*}
\]

2) 3HF.NEt\textsubscript{3}
\[
\begin{align*}
\text{TsN} & \text{OMe} & \text{Ph} & \text{Me} & \text{Me} & \text{OH} & \text{OMe} & \text{OMe} & \text{Ph} & \text{TsN}
\end{align*}
\]

81% 97% ee

References:

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

C\textsubscript{48}H\textsubscript{40}P\textsubscript{2}; FW: 678.79; white pwdr.; [\alpha]_D\textsuperscript{2} -160° (c 0.5, C\textsubscript{6}H\textsubscript{6}); m.p. 255-257°

Note: Manufactured under license of Takasago patent.

Takasago BINAP Ligand Kit component see (page 246).

Technical Notes:
1. See 15-0150 (page 51).
2. See 15-0152 (page 73).
## PHOSPHORUS – Ligands and Compounds

### 15-0156 (R)-(+-) -2,2'-Bis(di-p-tolylphosphino) -6,6'-dimethoxy-1,1'-biphenyl, min. 97%

- **CAS No.:** [133545-24-1]
- **Formula:** C_{42}H_{40}O_{2}P_{2}
- **Molecular Weight:** 638.73
- **Appearance:** white powder

Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

### Technical Note:
1. See 15-0178 (page 56).

### 15-0157 (S)-(--) -2,2'-Bis(di-p-tolylphosphino) -6,6'-dimethoxy-1,1'-biphenyl, min. 97%

- **CAS No.:** [133545-25-2]
- **Formula:** C_{42}H_{40}O_{2}P_{2}
- **Molecular Weight:** 638.73
- **Appearance:** white powder

Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

### Technical Note:
1. See 15-0178 (page 56).

### 15-1657 (R)-2,2'-Bis(di-p-tolylphosphino) -4,4',6,6'-tetramethoxybiphenyl, min. 97%

- **CAS No.:** [133545-25-2]
- **Formula:** C_{44}H_{44}O_{4}P_{2}
- **Molecular Weight:** 698.77
- **Appearance:** white crystalline
- **Stability:** air sensitive


<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

### Technical Note:
1. See 15-1653 (page 67).

### 15-1658 (S)-2,2'-Bis(di-p-tolylphosphino) -4,4',6,6'-tetramethoxybiphenyl, min. 97%

- **CAS No.:** [133545-25-2]
- **Formula:** C_{44}H_{44}O_{4}P_{2}
- **Molecular Weight:** 698.77
- **Appearance:** white crystalline
- **Stability:** air sensitive


<table>
<thead>
<tr>
<th>Quantity</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

### Technical Note:
1. See 15-1653 (page 67).

### 15-0114 Bis(3,5-di(trifluoromethyl)phenyl)chlorophosphine, min. 98%

- **CAS No.:** [142421-57-6]
- **Formula:** C_{16}H_{16}ClF_{12}P
- **Molecular Weight:** 492.63
- **Appearance:** colorless liquid
- **Stability:** moisture sensitive

| Quantity | 500mg | 2g |

|
PHOSPHORUS – Ligands and Compounds

26-0960  (R)-(−)-1-{(S)-2-[Bis(3,5-di-trifluoromethyl-phenyl)phosphino]ferrocenyl}ethyldicyclohexylphosphine, min. 97%
[292638-88-1]
C₄₀H₄₀F₁₂FeP₂; FW: 866.56; orange pwdr.;
[α]D   -260° ±15° (c 0.5, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).

Technical Note:
1. See 26-1210 (page 150).

26-0965  (R)-(−)-1-{(S)-2-[Bis(3,5-di-trifluoromethylphenyl)phosphino]ferrocenyldi-3,5-xylylphosphine, min. 97%
[166172-63-0]
C₄₄H₃₆F₁₂FeP₂; FW: 910.57; orange pwdr.;
[α]D   -280° ±10° (c 0.5, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).

Technical Note:
1. See 26-1210 (page 150).

15-0158  (R)-(+)2,2′-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6′-dimethoxy-1,1′-biphenyl, min. 97%
[256390-47-3]
C₅₀H₅₆O₁₄P₂; FW: 942.94; off-white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

Technical Note:
1. See 15-0178 (page 56).

15-0159  (S)-(−)-2,2′-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6′-dimethoxy-1,1′-biphenyl, min. 97%
[256235-61-7]
C₅₀H₅₆O₁₄P₂; FW: 942.94; off-white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

Technical Note:
1. See 15-0178 (page 56).

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]
C₄₆H₄₄O₄P₂; FW: 722.79; off white to pale yellow pwdr.
Note: Manufactured under license of Takasago patent. Takasago SEGPHOS Ligand Kit component see (page 251).
15-0478 (R)-(+) 5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (cont.) (R)-(+) DM-SEGPHOS [850253-53-1]

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 α-substituted-β-ketoesters. See 15-0066 (page 30).
2. Copper catalyzed enantioselective [3 + 2] cycloaddition as a route to γ-amino ketones and 3-pyrrolidinones.
3. Palladium catalyzed enantioselective addition of malonates to dihydroisoquinolines.
4. Ruthenium catalyzed enantioselective synthesis of β amino acids by hydrogenation.
5. Ruthenium catalyzed asymmetric hydrogenation of 3-quinuclidinone. See 44-0098 (Visit www.strem.com) for Ru catalyst.

References:
3. WIPO Pat. WO2005028419.

15-0479 (S)-(−) 5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(−) DM-SEGPHOS [210169-57-6]

C₈₈H₄₄O₆P₂; FW: 722.79; off-white to pale yellow powd.
Note: Manufactured under license of Takasago patent. Takasago SEGPHOS Ligand Kit component see (page 251).

Technical Note:
1. See 15-0478 (page 76).
**PHOSPHORUS – Ligands and Compounds**

15-0476  \((R)-(+)-2,2’-Bis\text{[di(3,5-xylyl)]}
phosphino}\)-1,1’-binaphthyl, 98%  
\((R)-(+)-\text{XylBINAP} \ [137219-86-4]
\[\text{C}_{52}\text{H}_{48}\text{P}_{2}; \text{FW: 734.90; white to pale yellow xtl.; m.p. 203-206°}
Note: Manufactured under license of Takasago patent.  
Takasago BINAP Ligand Kit component see (page 246).

Technical Notes:
1. See 15-0150 (page 51).
2. Ligand used in the asymmetric hydrogenation of amino ketones.
3. Ligand used with ruthenium in the synthesis of \(\beta\)-amino acids by hydrogenation.  
See 44-0164 (Visit www.strem.com).
4. Ligand used for asymmetric Pauson-Khand reactions.

\[
\begin{align*}
\text{Me} & \begin{array}{c}
\rightarrow \\
\text{Me} & \begin{array}{c}
\text{O} \\
\text{NMe}_2
\end{array}
\end{array}
\end{align*}
\]

**Catalyst, \(H_2\)**  
**Tech. Note (2)**

\[
\begin{align*}
\text{Me} & \begin{array}{c}
\rightarrow \\
\text{Me} & \begin{array}{c}
\text{O} \\
\text{Me}
\end{array}
\end{array}
\end{align*}
\]

\[
\begin{align*}
\text{Me} & \begin{array}{c}
\rightarrow \\
\text{Me} & \begin{array}{c}
\text{NH}_2 \\
\text{OMe}
\end{array}
\end{array}
\end{align*}
\]

**0.2 mol% \text{LRu(OAc)}_2, \text{NH}_4\text{OAc}**  
**30 atm \(H_2\), MeOH, 15 h, 80°C**  
**86%, 82% ee**  
**Tech. Note (3)**

\[
\begin{align*}
\text{X} & \begin{array}{c}
\rightarrow \\
\text{X} & \begin{array}{c}
\text{R} \\
\text{O}
\end{array}
\end{array}
\end{align*}
\]

**[\text{Rh}(\text{CO})_2\text{Cl}_2 (5 mol%)**  
**L (10 mol%), \text{AgOTf}**  
**Ar:CO (10:1, 1atm) THF, 18-20 °C**  
**Tech. Note (4)**

References:

15-0477  \((S)-(\text{-})-2,2’-\text{Bis[di(3,5-xylyl)]phosphino}\)-1,1’-binaphthyl, 98%  
\((S)-(\text{-})-\text{XylBINAP} \ [135139-00-3]
\[\text{C}_{52}\text{H}_{48}\text{P}_{2}; \text{FW: 734.90; white to pale yellow xtl.; m.p. 203-206°}
Note: Manufactured under license of Takasago patent.  
Takasago BINAP Ligand Kit component see (page 246).

Technical Notes:
1. See 15-0150 (page 51).
2. See 15-0476 (page 78).
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 tetrynes and hexaynes.

\[
\begin{align*}
\text{EtO} & \begin{array}{c}
\rightarrow \\
\text{Nu}
\end{array}
\end{align*}
\]

**\text{Cu - cat./ L (10 mol%)}**  
**76-81% Yield, 79-97% ee**  
**Tech. Note (3)**

Visit www.strem.com for new product announcements.
(S)-(−)-2,2′-Bis[di(3,5-xylyl)phosphino]-1,1′-binaphthyl, 98% (S)-(−)-XylBINAP
[135139-00-3]

15-0477 (cont.)

References:

15-0488 (R)-(+)2,2′-Bis[di(3,5-xylyl)phosphino]-6,6′-dimethoxy-1,1′-biphenyl, min. 97%
[394248-45-4]
C₄₆H₄₈O₂P₂; FW: 694.84; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only.
Solvias (R)-MeO BIPHEP Ligand Kit component see (page 237).

Technical Note:
1. See 15-0178 (page 56).

15-0489 (S)-(−)-2,2′-Bis[di(3,5-xylyl)phosphino]-6,6′-dimethoxy-1,1′-biphenyl, min. 97%
[362634-22-8]
C₄₆H₄₈O₂P₂; FW: 694.84; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only.
Solvias (S)-MeO BIPHEP Ligand Kit component see (page 238).

Technical Note:
1. See 15-0178 (page 56).

15-0730 (R)-(−)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclopipeline, min. 95%
CTH-(R)-3,5-xylyl-PHANEPHOS [325168-89-6]
C₄₈H₅₀P₂; FW: 688.86; white pwdr.
Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No 5874629 and patents arising therefrom.

Technical Notes:
1. See 15-0426 (page 61).
2. See 15-0731 (page 80).
15-0731  (S)-(−)-4,12-Bis(di(3,5-xylyl)phosphino)-[2.2]-paracyclocphane, min. 93%
CTH-(S)-3,5-xylyl-PHANEPHOS
[325168-88-5]
C₈₈H₅₀P₂; FW: 688.86; white pwd.
Note: Sold in collaboration with Johnson Matthey for research purposes only. US patent Application No 5874629 and patents arising therefrom.

Technical Notes:
1. See 15-0426 (page 61).
2. Chiral ligand employed in the enantioselective hydrogenation of various ketones.

\[
\begin{align*}
\text{cat. Ru(II) ligand} & \quad (R,R)-1,2\text{-diaminocyclohexane} \\
& \quad \text{t-BuOK} \\
& \quad \text{i-PrOH, } H_2 \\
\end{align*}
\]

\[
\begin{align*}
\text{98% ee} \\
\text{cat. Ru(II) ligand} & \quad (R,R)-1,2\text{-diaminocyclohexane} \\
& \quad \text{t-BuOK} \\
& \quad \text{i-PrOH, } H_2 \\
\end{align*}
\]

Reference:

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%
[736158-72-8]
C₃₈H₃₄NO₄P; FW: 599.65; white pwd. moisture sensitive

Technical Notes:
1. 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.
2. 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.

\[
\begin{align*}
\text{EtMgBr, 1% } L^* & \quad \text{1% Cu(I)Thiophene-2-COO}^- \\
& \quad \text{CH}_2\text{Cl}_2, -78 \degree C \\
& \quad 86\%, 99/1 \text{ S}_{2}/\text{S}_{2}, 96\% \text{ ee} \\
\end{align*}
\]

\[
\begin{align*}
\text{n-Hex-NH}_2, & \quad 1\% \text{[Ir(cod)Cl]}_2, 2\% L^* \\
& \quad \text{THF, rt, 16 h} \\
& \quad 99\%, 99/1 \text{ S}_{2}/\text{S}_{2}, 97\% \text{ ee} \\
\end{align*}
\]

References:
PHOSPHORUS – Ligands and Compounds

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%  [776316-48-4] C₃₈H₃₄NO₄P; FW: 599.65; white pwdr. moisture sensitive

100mg  500mg

Technical Note:
1. See 15-0522 (page 80).

15-0466  Bis(2-methoxyphenyl)phenylphosphine, min. 98%
[36802-41-2] (C₆H₄OCH₃)₂P(C₆H₅); FW: 322.34; white xtl.; m.p. 163-164°

1g  5g

Technical Note:
1. See 15-0522 (page 80).

15-0481  (R,R)-(−)-1,2-Bis[(2-methoxyphenyl)phenyl]phosphino]ethane, 98%
[55739-58-7] (C₆H₄OCH₃)(C₆H₅)PCH₂CH₂P(C₆H₄OCH₃)(C₆H₅);
FW: 458.47; white xtl.; [α]D -87° (c 1.0, CHCl₃); m.p. 102-103°

250mg  1g

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

References:

15-0482  (S,S)-(−)-1,2-Bis[(2-methoxyphenyl)(phenyl) phosphino]ethane, 98% (+)-DIPAMP  [97858-62-3] (C₆H₄OCH₃)(C₆H₅)PCH₂CH₂P(C₆H₄OCH₃)(C₆H₅); FW: 458.47; white xtl.; [α]D +87° (c 1.0, CHCl₃); m.p. 102-103°

250mg  1g

Technical Note:
1. See 15-0481 (page 81).

15-0115  Bis(1-naphthyl)chlorophosphine, min. 97%  [36042-99-6] C₃₀H₁₄ClP; FW: 320.75; white to pale yellow xtl. moisture sensitive

500mg  2g
N,N-Bis[(1R)-(+)−phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine

[376355-58-7]

C_{28}H_{26}NO_{2}P; FW: 439.49; white pdwr.

moisture sensitive

Technical Notes:
1. 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.
2. Ligand for the copper catalyzed, highly enantioselective, asymmetric conjugate addition of diethylzinc to enones and nitro-olefins.

\[
\begin{align*}
\text{Ar} &\xrightarrow{\text{i-PrMgBr,} \quad 1\% \text{Cu(1),} \quad 1\% \ L^*} \quad \text{CH}_2\text{Cl}_2, -78^\circ, 1h \\
\text{Ar} &\xrightarrow{\text{Et}_2\text{H}} \quad \text{Cl} \\
\text{Ar} &\xrightarrow{\text{CH}_2\text{Cl}_2, -78^\circ, 1h} \quad 98\%, 91/8 S_{N2}/S_{N2}, 86\% \text{ ee}
\end{align*}
\]

\[
\begin{align*}
\text{Et}_2\text{Zn} &\xrightarrow{2 \text{ mol}\% \text{ Cu(I)Thiophene-2-COO}^-} \quad \text{O} \\
\text{O} &\xrightarrow{4 \text{ mol}\% \ L} \quad \text{O} \\
\text{Et} &\xrightarrow{\text{THF, rt, 16 h}} \quad \text{99\%, 96\% ee}
\end{align*}
\]

References:

N,N-Bis[(1S)-(−)-phenylethyl]dibenzo[d,f][1,3,2]dioxaphosphepin-6-amine

[376355-58-7]

C_{28}H_{26}NO_{2}P; FW: 439.49; white pdwr.

moisture sensitive

Technical Note:
1. See 15-0518 (page 82).

1,2-Bis(phenylphosphino)ethane

[18899-64-4]

(C_{6}H_{5})HPCH_{2}CH_{2}PH(C_{6}H_{5}); FW: 246.22; colorless to yellow liq.

pyrophoric
| 15-0456 | 1,3-Bis(phenylphosphino)propane, 90-95% [28240-66-6] | 1g |
|  | C₆H₅P(H)CH₂CH₃CH₂(H)PC₆H₅; FW: 260.26; colorless liq.; b.p. 160-165°/1 mm | 5g |
| amp |  |  |
| HAZ | air sensitive |  |

| 15-0461 | 1,2-Bis(phosphino)benzene, 98+% [80510-04-9] | 1g |
|  | C₆H₄(PH₂)₂; FW: 142.08; colorless liq.; b.p. 53-55°/0.25mm; d. 1.101 | 5g |
| amp |  |  |
| HAZ | pyrophoric |  |

| 15-0462 | 1,2-Bis(phosphino)benzene, 98+% (10 wt% in hexane) [80510-04-9] | 10g |
|  | C₆H₄(PH₂)₂; FW: 142.08; colorless liq. | 50g |
| HAZ | air sensitive |  |

| 15-0459 | 1,2-Bis(phosphino)ethane, 99% [5518-62-7] | 250mg |
|  | H₂PCH₂CH₂PH₂; FW: 92.02; colorless liq.; b.p. 109-110° | 1g |
| amp |  |  |
| HAZ | pyrophoric |  |

| 15-0570 | Bis(3-sulfonatophenyl)(3,5-di-trifluoromethylphenyl)phosphine, disodium salt, min. 97% DANPHOS (water soluble) [1289463-82-6] | 100mg |
|  | C₂₀H₁₃F₆Na₂O₆PS₂; FW: 604.39; white pwdr. | 500mg |

Technical Note:
1. A water soluble phosphine.

| 15-0463 | Bis(p-sulfonatophenyl)phenylphospine dihydrate dipotassium salt, min. 97% [151888-20-9] | 500mg |
|  | C₆H₅P(C₆H₄SO₃K)₂·2H₂O; FW: 498.58 (534.62); white pwdr. | 2g |
| amp |  |  |
| HAZ |  | 10g |

Technical Note:
1. A water-soluble phosphine ligand used in the formation of water-soluble catalysts.
PHOSPHORUS – Ligands and Compounds

26-0650  (R)-(−)-1-{(S)-2-[Bis(4-trifluoromethylphenyl)phosphino]ferrocenyl}ethyl-di-t-butylphosphine, min. 97%
[246231-79-8]
C_{34}H_{38}F_{6}FeP_{2}; FW: 678.45; orange pwdr.;
[α]_{D} -352° ±10° (c 0.5, CHCl_{3})
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).

Technical Note:
1. See 26-1210 (page 150).

15-2216  1-(2S)-1-[(11bR)-2,6-Bis(trimethylsilyldinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy)propan-2-yl]-3-phenylurea, min. 97%
C_{36}H_{41}N_{2}O_{4}PSi_{2}; FW: 652.87; white pwdr.
moisture sensitive, (store cold)
Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

Technical Note:
1. See 15-2200 (page 135).

93-1570  Bis(triphenylphosphine)iminium borohydride, min. 97%
[{\text{C}_{6}H_{5}}_{3}P]_{2}NBH_{4}; FW: 553.44; white pwdr.
moisture sensitive

15-0455  Bis(triphenylphosphine)iminium chloride, 97%
[{\text{C}_{6}H_{5}}_{3}P]_{2}NCl; FW: 574.04; white pwdr.; m.p. 260-265°

15-0125  2-Bromophenyldiphenylphosphine, 98% [62336-24-7]
C_{18}H_{14}BrP; FW: 341.18; white pwdr.
Technical Note:
1. Sonogashira Cross-Coupling of Aryl (phenyl, naphtyl, anthracenyl) Bromides and Corides bearing alkyl, methoxy, halo, keto, and nitrile substitution in para-, meta- ortho-position at Ultra-Low Palladium Loading (Ref. 1,2).

$$R^1 + H\equiv + \text{HiersoPHOS-4} \rightarrow R^1$$

$0.0001-0.5 \text{ mol}\% [\text{Pd(allyl)}\text{Cl}]_2$

$\text{K}_2\text{CO}_3, (\text{CuI}) \text{DMF}$

$130 \text{ °C}$

$X = \text{Br}, \text{Cl}$

$R^1 = 4-\text{COMe}, 4-\text{CN}, 4-\text{F}, 2-\text{CF}_3, 2-\text{Me}, 3-\text{Me}, 4-\text{OMe}, 3-\text{OMe}$

$R^2 = \text{Ph}, -(\text{CH}_2)_7\text{CH}_3, -(\text{CH}_2)_2\text{OH}$

References:
Butyldi-1-adamantylphosphine, min. 95% [cataCXium® A]
[321921-71-5]
$C_4H_9(C_{10}H_{15})_2P$; FW: 358.54; white to yellow pwdr.; m.p. 100°
air sensitive
Note: Sold in collaboration with Solvias for research purposes only. Patent WO 0210178. Solvias cataCXium® Ligand Kit component see (page 239).

Technical Notes:
1. Ligand for the Pd-catalyzed Suzuki coupling reaction.
2. Ligand for the Pd-catalyzed formation of α-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.
### Butyldi-1-adamantylphosphine, min. 95% [cataCXium® A]

**References:**

### n-Butyl-di-(1-adamantyl)phosphonium iodide, min. 95% [cataCXium® AHI]

- **CAS No.:** [714951-87-8]
- **Formula:** [(C4H9)(C10H15)2PH]+I-
- **Molecular Weight:** 486.45
- **Color:** White powder
- **Note:** Sold in collaboration with Solvias for research purposes only. Patent US7148176. Solvias cataCXium® Ligand Kit component see (page 239).

### t-Butyldichlorophosphine, 98%

- **CAS No.:** [25979-07-1]
- **Formula:** (CH3)3CPCl2
- **Molecular Weight:** 159.00
- **Color:** White to pale yellow
- **Melting Point:** 47-48°C
- **Boiling Point:** 146-148°C
- **Note:** Air sensitive, moisture sensitive

### t-Butyldicyclohexylphosphine, min. 95%

- **CAS No.:** [93634-87-8]
- **Formula:** [(CH3)3C](C6H11)2P
- **Molecular Weight:** 254.40
- **Color:** Colorless liquid
- **Density:** 0.939
- **Note:** Air sensitive

### 4-Butyl-N-[(11bR)-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yl]benzene-sulfonamide triethylamine adduct, min. 97%

- **CAS No.:** [1150592-91-8]
- **Formula:** C30H26NO4PS·(CH3CH2)3N
- **Molecular Weight:** 527.57 (628.76)
- **Note:** Moisture sensitive, (store cold)
- **Technical Note:** Sold under license from InCatT for research purposes only. WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

### Technical Note:
1. See 15-2228 (page 136).
### PHOSPHORUS – Ligands and Compounds

**15-2220**

<table>
<thead>
<tr>
<th><strong>NEW</strong></th>
<th><strong>4-Butyl-N-(diphenylphosphino)benzenesulfonamide, min. 97%</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[1025096-61-0]</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;22&lt;/sub&gt;H&lt;sub&gt;28&lt;/sub&gt;NO&lt;sub&gt;2&lt;/sub&gt;PS; FW: 397.47; white pwdr.</td>
</tr>
<tr>
<td></td>
<td>moisture sensitive, <em>(store cold)</em></td>
</tr>
<tr>
<td>Note:</td>
<td>Sold under license from InCatT for research purposes only. WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).</td>
</tr>
</tbody>
</table>

**Technical Note:**

1. See 15-2228 (page 136).

**15-0966**

<table>
<thead>
<tr>
<th><strong>NEW</strong></th>
<th><strong>t-Butylphosphine, min. 95% TBP [2501-94-2]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(C&lt;sub&gt;4&lt;/sub&gt;H&lt;sub&gt;9&lt;/sub&gt;)PH&lt;sub&gt;2&lt;/sub&gt;; FW: 90.10; colorless liq.; b.p. 54°; d. 0.7;</td>
</tr>
<tr>
<td></td>
<td>HAZ STENCH</td>
</tr>
<tr>
<td></td>
<td>HAZ pyrophoric</td>
</tr>
</tbody>
</table>

**15-0685**

<table>
<thead>
<tr>
<th><strong>NEW</strong></th>
<th><strong>(R)-(+)4-Chlorodinaphthol, [2,1-d:1',2'-f][1,3,2]dioxaphosphepin, min. 97% [155613-52-8]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C&lt;sub&gt;20&lt;/sub&gt;H&lt;sub&gt;12&lt;/sub&gt;ClO&lt;sub&gt;2&lt;/sub&gt;P; FW: 350.74; white pwdr. moisture sensitive</td>
</tr>
</tbody>
</table>

**15-0686**

<table>
<thead>
<tr>
<th><strong>NEW</strong></th>
<th><strong>(S)-(+)-4-Chlorodinaphthol [2,1-d:1',2'-f][1,3,2]dioxaphosphepin, min. 97% [137156-22-0]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C&lt;sub&gt;20&lt;/sub&gt;H&lt;sub&gt;12&lt;/sub&gt;ClO&lt;sub&gt;2&lt;/sub&gt;P; FW: 350.74; white pwdr. moisture sensitive</td>
</tr>
</tbody>
</table>

**15-0695**

<table>
<thead>
<tr>
<th><strong>NEW</strong></th>
<th><strong>2-Cyanoethyl N,N,N',N'-tetra(i-propyl)phosphorodiamidite, min. 98% [102691-36-1]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>{[(CH&lt;sub&gt;3&lt;/sub&gt;)&lt;sub&gt;2&lt;/sub&gt;CH]N}POCH&lt;sub&gt;2&lt;/sub&gt;CH&lt;sub&gt;2&lt;/sub&gt;CN; b.p. 100° (0.5mm); d. 0.949 moisture sensitive, <em>(store cold)</em></td>
</tr>
</tbody>
</table>

**15-1010**

<table>
<thead>
<tr>
<th><strong>HAZ</strong></th>
<th><strong>Cyclohexyldi-t-butylphosphine, 98% [436865-11-1]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[<a href="%5BC%3Csub%3E6%3C/sub%3EH%3Csub%3E11%3C/sub%3E%5D">(CH&lt;sub&gt;3&lt;/sub&gt;)&lt;sub&gt;3&lt;/sub&gt;C</a>P; FW: 228.36; colorless liq. air sensitive</td>
</tr>
</tbody>
</table>

**15-0800**

<table>
<thead>
<tr>
<th><strong>amp</strong></th>
<th><strong>Cyclohexyldichlorophosphine, 98% [2844-89-5]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C&lt;sub&gt;6&lt;/sub&gt;H&lt;sub&gt;11&lt;/sub&gt;PCl&lt;sub&gt;2&lt;/sub&gt;; FW: 185.03; colorless liq.; b.p. 100°/17mm air sensitive, moisture sensitive</td>
</tr>
</tbody>
</table>

**15-0900**

<table>
<thead>
<tr>
<th><strong>amp</strong></th>
<th><strong>Cyclohexyldiphenylphosphine, 98% [6372-42-5]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(C&lt;sub&gt;6&lt;/sub&gt;H&lt;sub&gt;11&lt;/sub&gt;)(C&lt;sub&gt;6&lt;/sub&gt;H&lt;sub&gt;5&lt;/sub&gt;)&lt;sub&gt;2&lt;/sub&gt;P; FW: 268.34; white xtl.; m.p. 58-62° air sensitive</td>
</tr>
</tbody>
</table>

**15-0950**

<table>
<thead>
<tr>
<th><strong>amp</strong></th>
<th><strong>Cyclohexylphosphine, min. 97% [822-68-4]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C&lt;sub&gt;6&lt;/sub&gt;H&lt;sub&gt;11&lt;/sub&gt;PH&lt;sub&gt;2&lt;/sub&gt;; FW: 116.14; colorless liq.; b.p. 145°; d. 0.8750 pyrophoric</td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
15-0952  Cyclohexylphosphine, min. 97% (Sure/Seal™ bottle)  
[822-68-4]  
C₆H₁₁PH₂; FW: 116.14; colorless liq.; b.p. 145°; d. 0.8750 pyrophoric  
50g

15-0953  Cyclohexylphosphine, min. 97% (10 wt% in hexane)  
[822-68-4]  
C₆H₁₁PH₂; FW: 116.14; colorless liq.; d. 0.684  
air sensitive  
100g  
500g

15-0795  (2-Cyanophenyl)diphenylphosphine, min. 98%  
[34825-99-5]  
(C₆H₄(CN))(C₆H₅)₂P; FW: 287.30; white to off-white pwdr.  
500mg  
2g

15-0958  n-Decylphosphonic acid, min. 97%  
[6874-60-8]  
CH₃(CH₂)₉P(O)(OH)₂; FW: 222.26; white to off-white pwdr.; m.p. 103-104°  
Note: Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).  
1g  
5g

15-0954  Di-1-adamantylphosphine, min. 97%  
[131211-27-3]  
(C₁₀H₁₅)₂PH; FW: 302.43; white pwdr.  
air sensitive  
250mg  
1g

15-0956  Di-1-adamantylphosphine oxide, min. 90%  
[131266-79-0]  
(C₁₀H₁₅)₂P(O)H; FW: 318.43; white pwdr.  
air sensitive  
250mg  
1g

15-0955  Di-1-adamantylphosphinic chloride, 98%  
[126683-99-6]  
(C₁₀H₁₅)₂POCl; FW: 352.88; white xtl.; m.p. 214°  
moisture sensitive  
250mg  
1g

15-1090  2-(Di-1-adamantylphosphino)dimethylaminobenzene, 97% Me-DalPhos  
[1219080-77-9]  
C₂₈H₃₀NP; FW: 421.60; white to yellow xtl.  
air sensitive  
250mg  
1g

Technical Note:
1. 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.

Reference:
PHOSPHORUS – Ligands and Compounds

15-1092  N-[2-(di-1-adamantylphosphino)phenyl]morpholine, 98% Mor-DalPhos [1237588-12-3]
C_{30}H_{42}NOP; FW: 463.63; white to yellow xtl.
air sensitive

Technical Note:
1. P-N-ligand for use in the Pd-catalyzed cross-coupling of ammonia with a diverse range of sterically, unbiased aryl chlorides. Low catalyst loading and mild conditions.

Reference:

15-0960  (1R,2R)-(+)-1,2-Diaminocyclohexane-N,N'-bis(2'-diphenylphosphinobenzoyl), 98% (R,R)-DACH-Phenyl Trost Ligand
[138517-61-0]
C_{44}H_{40}N_{2}O_{2}P_{2}; FW: 690.76; white to off-white pwdr.;
[a]_{D} +130° (c 1.0, methanol); m.p. 134-136°
Note: Sold in collaboration with Chirotech for research purposes only. US Patent no. 5739396.

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

Carbon nucleophile

Ref. (1)

Nitrogen nucleophile

Ref. (2)

Oxygen nucleophile

Ref. (5)
(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphinobenzoyl), 98% (R,R)-DACH-Phenyl Trost Ligand [138517-61-0]

\[
\begin{array}{c}
\text{Phosphorus} \quad \text{Ligands and Compounds} \\
\text{15-0960} \\
(\text{cont.}) \\
(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphinobenzoyl), 98% (R,R)-DACH-Phenyl Trost Ligand [138517-61-0]
\end{array}
\]

Sulfur nucleophile

\[
\begin{array}{c}
\text{Phosphorus} \quad \text{Ligands and Compounds} \\
\text{15-0961} \\
(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphinobenzoyl), 95% (S,S)-DACH-Phenyl Trost Ligand [169689-05-8]
\end{array}
\]

Technical Note:
1. See 15-0960 (page 90).

---

(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphinobenzoyl), min. 94% (R,R)-DACH-Naphthyl Trost Ligand [174810-09-4]

\[
\begin{array}{c}
\text{Phosphorus} \quad \text{Ligands and Compounds} \\
\text{15-0963} \\
(1R,2R)-(+)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphino-1-naphthoyl), min. 94% (R,R)-DACH-Naphtyl Trost Ligand [174810-09-4]
\end{array}
\]

Technical Note:
1. See 15-0960 (page 90).

---

(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphino-1-naphthoyl), min. 94% (S,S)-DACH-Naphthyl Trost Ligand [205495-66-5]

\[
\begin{array}{c}
\text{Phosphorus} \quad \text{Ligands and Compounds} \\
\text{15-0964} \\
(1S,2S)-(-)-1,2-Diaminocyclohexane-N,N’-bis(2’-diphenylphosphino-1-naphthoyl), min. 94% (S,S)-DACH-Naphthyl Trost Ligand [205495-66-5]
\end{array}
\]

Technical Note:
1. See 15-0960 (page 90).
PHOSPHORUS – Ligands and Compounds

15-1157 2-Di[3,5-bis(trifluoromethyl)phenylphosphino]-3,6-dimethoxy-2’-4’-6’-tri-i-propyl-1,1’-biphenyl, min. 98% JackiePhos \( \{1160861-60-8\} \)
\( \text{C}_{39}\text{H}_{37}\text{F}_{12}\text{O}_{2}\text{P} \); FW: 796.66; white xtl.

Technical Notes:
1. Ligand used in the Pd-catalyzed coupling of aryl nonaflates and triflates with secondary amides.
2. Ligand used in the Pd-catalyzed coupling of aryl nonaflates and triflates with secondary ureas, carbamates, and sulfonamides.
3. Ligand used in the Pd-catalyzed coupling of aryl chlorides with secondary amides, carbamates, and sulfonamides.

References:

15-0990 Dibromotriphenylphosphorane, 98% \( \{1034-39-5\} \)
\( \text{(C}_{6}\text{H}_{5})_{3}\text{PBr}_{2} \); FW: 422.10; light brown pwdr.
air sensitive, moisture sensitive

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**PHOSPHORUS – Ligands and Compounds**

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 \[1110711-01\]

\[C_{46}H_{38}F_{12}P\]^+Br^-; FW: 929.65; white xtl.; \([\alpha]_D^{20} +29.8^\circ\) (c 0.5, CHCl_3); m.p. 262-263\(^\circ\)

Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component. See (page 226).

Technical Note:

1. See 15-1458 (page 93).

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

\[1110813-90-5\]

\[C_{36}H_{36}F_{12}P\]^+Br^-; FW: 929.65; white xtl.; m.p. 262-263\(^\circ\)

Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component. See (page 226).

Technical Note:

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

Reference:

15-1464  (11bR)-(+) - 4,4-Di-t-butyl-2,6-bis[3,5-bis(trifluoro-methyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99%  
R-MARUOKA CAT P-TB  
[CsH38F12P]+Br−; FW: 929.65; white xtl.;  
[α]D -13.8° (C 0.5, CHCl3); m.p. 202-204°  
Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component. See (page 226).

Technical Note:  
1. See 15-1458 (page 93).

15-1465  (11bS)-(−) - 4,4-Di-t-butyl-2,6-bis[3,5-bis(trifluoro-methyl)phenyl]-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]phosphepinium bromide, 99%  
S-MARUOKA CAT P-TB  
[C46H38F12P]+Br−; FW: 929.65; white xtl.;  
[α]D +14.3° (c 0.5, CHCl3); m.p. 202-203°  
Note: Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit component. See (page 226).

Technical Note:  
1. See 15-1458 (page 93).

15-1000  Di-t-butylchlorophosphine, min. 98%  
amp  
[(CH3)3C]2PCl; 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

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  
[C48H44O8P2·EtOAc]; FW: 786.78 (830.84);  
white to off-white pwdr.; m.p. 188-190°  
air sensitive, moisture sensitive  
Note: Sold in collaboration with Chirotech.

Technical Notes:  
1. With rhodium forms a highly active catalyst for the hydroformylation of α-olefins.  
2. The hydroformylation of functionalized α-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.

0.015% Rh, 1.0% L,  
ester solvent  
11 atm (1:1 H2/CO), 100° cont.  
CHO + CHO  
L/B =1  
Tech. Note (1)  
Ref. (1)
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]

References:

Di-t-butyl(2,2-diphenyl-1-methyl-1-cyclopropyl)phosphine cBRIDP [742103-27-1]
C24H33P; FW: 352.49; off-white pwdr.
air sensitive, (store cold)
Note: Manufactured under license of Takasago patent US7129367B2.

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.

Reference:
PHOSPHORUS – Ligands and Compounds

15-1065  Di-t-butyl(2,2-diphenyl-1-methylvinyl)phosphine (vBRIDP)
[384842-25-5]
C_{21}H_{31}P; FW: 314.45; off-white pwdr.
_air sensitive, (store cold)_
Note: Manufactured under license of Takasago patent US6455720.

250mg  1g  5g

Technical Note:
1. See 15-1005 (page 95) .

15-1015  (1S,1’S,2R,2’R)-(+)1,1’-Di-t-butyl-[2,2’]-diphospholane, min. 95%
(S,S,R,R)-TANGPHOS
[470480-32-1]
C_{16}H_{32}P_{2}; FW: 286.37; white xtl.
_air sensitive_
Note: Sold in collaboration with Chiral Quest for research purposes only. Patents pending. Chiral Quest Catalyst and Ligand Toolbox Kit component see (page 212).

100mg  500mg

Technical Notes:
1. Phosphorus chirality restricts rotation of adjacent substituents leading to effective chiral induction, and the highly electron-donating bisphosgene leads to high activities.
2. Rh-TangPhos complexes form excellent catalysts for asymmetric hydrogenation of enamides\(^1\), dehydroamino acids\(^1\), itaconic acids\(^2\) and \(\alpha\) and \(\beta\)-amino acids\(^3\).
3. Effective catalyst for the asymmetric hydrogenation of N-tosylimines.
4. Asymmetric arylcyanation of unactivated olefins.
5. Rh-catalyzed enantioselective cyclization of imidazoles via C-H bond activation.
6. Used in the regio- and enantioselective Cu-catalyzed hydroboration of styrenes.

\[
\begin{align*}
\text{Ar}^+\text{CH}_3\text{COOMe} & \xrightarrow{\text{Rh, L, H}_2} \text{Ar}\text{CH}_3\text{COOMe} \\
\text{N}^\text{Ts} & \xrightarrow{\text{Pd, L, H}_2} \text{N}^\text{Ts} \\
\text{Ar} & \xrightarrow{\text{Ni, L}} \text{CN} \\
\text{R}_1\text{R}_2\text{N} & \xrightarrow{\text{Rh, L}} \text{R}_1\text{R}_2\text{N} \\
\text{Ar} & \xrightarrow{\text{Cu, L, PinBH}} \text{BPin}
\end{align*}
\]

Tech. Note (3)  Ref. (1)
Tech. Note (3)  Ref. (4)
Tech. Note (4)  Ref. (5)
Tech. Note (5)  Ref. (6)
Tech. Note (6)  Ref. (7)
PHOSPHORUS – Ligands and Compounds

15-1015  (1S,1'S,2R,2'R)-(+)1,1'-Di-t-butyl-[2,2']-diphospholane, min. 95%  
(cont.)  (S,S,R,R)-TANGPHOS  [470480-32-1]

References:

15-1020  Di-t-butylmethylphosphine, 98+%  [6002-40-0]  
amp  [(CH₃)₃C]₂(CH₃)P; FW: 160.26; colorless liq.; d. 0.824
HAZ  air sensitive

15-1023  Di-t-butylmethylphosphonium tetrafluoroborate, 99%  
[870777-30-3]  
(C₄H₉)₂(CH₃)PH⁺BF₄⁻; FW: 248.05; white pwdr.
Note: Phosphine Ligand Kit component. See (page 233).

Technical Note:
1. 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.

References:

15-1017  Di-t-butylneopentylphosphine, min. 95%  [60633-21-8]  
amp  (C₅H₁₁)₂(C₃H₇)P; FW: 216.35; colorless to yellow liq.
HAZ  pyrophoric

Technical Notes:
1. 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. 
2. Phosphine used in the palladium-catalyzed, Suzuki cross-coupling reaction.

References:

ArBr + Ar¹NH₂ → H N Ar Ar¹  
Ar¹Br + F-B(OH)₂ → Ar¹F

Technical Note (1)  Ref. (1)

Technical Note (2)  Ref. (2)
### PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Form</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1018</td>
<td><strong>Di-t-butylneopentylphosphine, min. 95%</strong>&lt;br&gt;(10 wt% in hexane) [60633-21-8]&lt;br&gt;(C₆H₁₃)₂(C₅H₁₁)P; FW: 216.35; colorless to pale yellow liq.</td>
<td>10g</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>Technical Note:&lt;br&gt;1. See 15-1017 (page 97).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1019</td>
<td><strong>Di-t-butylneopentylphosphonium tetrafluoroborate, min. 95%</strong>&lt;br&gt;[(C₆H₁₃)₂(C₅H₁₁)PH]⁺BF₄⁻; FW: 304.17; white solid</td>
<td>1g</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>Technical Note:&lt;br&gt;1. See 15-1017 (page 97).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1028</td>
<td><strong>Di-t-butylphenylphosphonium tetrafluoroborate, 97%</strong>&lt;br&gt;[(C₆H₅)₂(C₅H₁₁)PH]⁺BF₄⁻; FW: 310.12; white solid</td>
<td>1g</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>Technical Note:&lt;br&gt;1. Non-pyrophoric, air-stable derivative suitable as a replacement for the neat phosphine in a variety of stoichiometric and catalytic processes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1030</td>
<td><strong>Di-i-butylphosphine, min. 97%</strong>&lt;br&gt;(C₄H₉)₂PH; FW: 146.21; colorless liq.; f.p. -1°F</td>
<td>5g</td>
<td>25g</td>
</tr>
<tr>
<td></td>
<td>Technical Note: air sensitive, pyrophoric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1031</td>
<td><strong>Di-i-butylphosphine, min. 97% (10 wt% in hexane)</strong>&lt;br&gt;(C₄H₉)₂PH; FW: 146.22; colorless liq.</td>
<td>50g</td>
<td>250g</td>
</tr>
<tr>
<td></td>
<td>Technical Note: air sensitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1040</td>
<td><strong>Di-t-butylphosphine, 98+%</strong>&lt;br&gt;[(CH₃)₃C]₂PH; FW: 146.22; colorless liq.; f.p. -1°F; d. 0.790</td>
<td>1g</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>Technical Note: pyrophoric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1042</td>
<td><strong>Di-t-butylphosphine, 98+% (10 wt% in hexane)</strong>&lt;br&gt;[(CH₃)₃C]₂PH; FW: 146.22; colorless liq.</td>
<td>50g</td>
<td>250g</td>
</tr>
<tr>
<td></td>
<td>Technical Note: air sensitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1041</td>
<td><strong>Di-t-butylphosphine oxide, 98%</strong>&lt;br&gt;(C₄H₉)₂P(O)H; FW: 162.21; white xtl.</td>
<td>250mg</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td>Technical Note: hygroscopic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1043</td>
<td><strong>racemic-2-Di-t-butylphosphino-1, 1'-binaphthyl, 98% TrixiePhos</strong>&lt;br&gt;[255836-67-0]&lt;br&gt;C₂₈H₃₁P; FW: 398.53; white xtl.; m.p. 147-149°</td>
<td>250mg</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td>Technical Notes:&lt;br&gt;1. Ligand for the Pd-catalyzed formation of oxygen heterocycles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Ligand for the intermolecular Pd-catalyzed synthesis of aryl ethers.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3. Ligand for the intramolecular Pd-catalyzed synthesis of aryl ethers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Ligand for the synthesis of carbazoles by Pd-catalyzed double N-arylation reaction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Ligand for the Pd-catalyzed cyanation of (hetero)arylchlorides.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PHOSPHORUS – Ligands and Compounds

15-1043 racemic-2-Di-t-butylphosphino-1,1’-binaphthyl, 98% TrixiePhos [255836-67-0] (cont.)

\[
\begin{align*}
\text{racemic-2-Di-t-butylphosphino-1,1’-binaphthyl, 98% TrixiePhos} & \quad [255836-67-0] \\
\text{Tech. Note (1)} \quad & \text{Ref. (1)} \\
\text{Tech. Note (2,3)} \quad & \text{Ref. (2,3)} \\
\text{Tech. Note (4)} \quad & \text{Ref. (4)} \\
\text{Tech. Note (5)} \quad & \text{Ref. (5)}
\end{align*}
\]

References:

15-1045 2-(Di-t-butylphosphino)biphenyl, 99% JohnPhos [224311-51-7]

C\(_{20}\)H\(_{27}\)P; FW: 298.41; colorless xtl.; m.p. 85°


Technical Notes:
1. Ligand used in the palladium-catalyzed synthesis of aromatic amines from aryl chlorides, bromides and triflates.
2. Ligand employed in a very active and general catalyst for Suzuki coupling reactions using aryl chlorides, bromides and triflates.
3. Ligand for the palladium-catalyzed formation of diarylethers from aryl chlorides and bromides.
4. Ligand used in palladium-catalyzed synthesis of oxindoles from \(\alpha\)-chloroacetanilides.
5. Effective ligand used in palladium-catalyzed arylation of thiazoles.
6. Used in the formation of 2-benzylindolines via sequential palladium-catalyzed N-arylation/cyclization/C-arylation.
7. Selective in the palladium-catalyzed arylation of silyl enol ethers formed from copper-catalyzed reduction of enones.
**PHOSPHORUS – Ligands and Compounds**

15-1045 2-(Di-t-butylphosphino)biphenyl, 99% JohnPhos [224311-51-7] (cont.)

Technical Notes:
8. Ligand used in the palladium-catalyzed vinylation of aryl bromides.
9. Ligand used in the platinum-catalyzed synthesis of indolizinones.
10. Ligand used in the palladium-catalyzed diarylation of thiophenes.
11. Ligand used in the amination of vinyl halides by carbazates.
12. Ligand used in the regioselective synthesis of 2,4-disubstituted styroles.

\[
\begin{align*}
\text{MeO} & \quad \text{Cl} \\
\text{PdOAc}_2, \ 15-1045, \ NaO-t-Bu & \quad \text{MeO} \\
\text{Toluene, 80 °C} & \quad \text{MeO}
\end{align*}
\]

\[
\begin{align*}
\text{R} & \quad X \quad \text{R'} \\
\text{PdOAc}_2, \ 15-1045 & \quad \text{PdOAc}_2, \ 15-1045 \\
\text{NaH or K}_3\text{PO}_4 & \quad \text{NaO-t-Bu}
\end{align*}
\]

\[
\begin{align*}
\text{X} = \text{Cl, Br} & \quad \text{R} = \text{Cl, Br} \\
\text{R'} = \text{Cl, Br} & \quad \text{R'} = \text{Cl, Br}
\end{align*}
\]

\[
\begin{align*}
\text{F}_3\text{C} & \quad \text{N} \quad \text{Cl} \\
\text{PdOAc}_2, \ 15-1045 & \quad \text{PdOAc}_2, \ 15-1045 \\
\text{NMe}_3, \text{Toluene, 80 °C} & \quad \text{NMe}_3, \text{Toluene, 80 °C}
\end{align*}
\]

\[
\begin{align*}
\text{R} & \quad \text{NH}_2 \\
(1) \text{Pd}_2\text{(dba)}_3, \ 15-1045, \text{ArBr,} & \quad (2) \text{Ar}^1\text{Br, dpe-phos, Toluene, 105 °C}
\end{align*}
\]

\[
\begin{align*}
\text{CuCl, s-Tol-BINAP} & \quad \text{CuCl, s-Tol-BINAP} \\
\text{NaO-t-Bu, Ph}_2\text{SiH}_2 & \quad \text{NaO-t-Bu, Ph}_2\text{SiH}_2 \\
\text{PdOAc}_2, \ 15-1045 & \quad \text{PdOAc}_2, \ 15-1045 \\
\text{CsF, ArBr} & \quad \text{CsF, ArBr}
\end{align*}
\]

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{PdBr}_2, \ 15-1045, \text{TBAF, D}_4\text{V} & \quad \text{PdBr}_2, \ 15-1045, \text{TBAF, D}_4\text{V} \\
\text{THF, 50 °C} & \quad \text{THF, 50 °C}
\end{align*}
\]

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{PhH, 100 °C, 48h} & \quad \text{PhH, 100 °C, 48h}
\end{align*}
\]
PHOSPHORUS – Ligands and Compounds

15-1045 2-(Di-t-butylphosphino)biphenyl, 99% JohnPhos \([224311-51-7]\)
(cont.)

![Chemical structure diagram]

**References:**

15-1164 2-(Di-t-butylphosphino)-3,6-dimethoxy-2′-4′-6′-tri-i-propyl-1,1′-biphenyl, min. 98% t-butylBrettPhos \([1160861-53-9]\)

**References:**

**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 acetohydroximates.
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.
2-(Di-t-butylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylBrettPhos [1160861-53-9]

References:

2-Di-t-butylphosphino-2'- (N,N-dimethylamino)biphenyl, 98% [224311-49-3] (CH3)2NC6H4C6H4P(C4H9)2 FW: 341.47; white xtl.

PHOSPHORUS – Ligands and Compounds

15-1048  2-Di-t-butylphosphino-2'-(N,N-dimethylamino)biphenyl, 98% [224311-49-3]  (cont.)

Technical Notes:
1. Useful ligand for Pd-catalyzed carbon-oxygen bond forming reactions.
2. Ligand used selective Pd-catalyzed arylation of ammonia.
3. Ligand used for selective Pd-catalyzed silylation of aryl chlorides.

**Technical Note:**

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

**Reference:**


15-7128  2-(Di-t-butylphosphino)ethylamine, min. 97% (10 wt% in THF)  [1053658-84-6]  C_{10}H_{24}P; FW: 189.28; pale yellow to colorless liq. air sensitive

**Technical Note:**

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

**Reference:**


15-1168  2-(Di-t-butylphosphino)-3-methoxy-6-methyl-2'4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98%  [1262046-34-3]  C_{31}H_{49}OP; FW: 468.69; white xtl.; m.p. 129-130°

**Technical Note:**

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

**Reference:**

**PHOSPHORUS – Ligands and Compounds**

**15-1049 2-Di-t-butylphosphino-2'-methylbiphenyl, 99% [255837-19-5]**

C₂₁H₂₉P; FW: 312.43; white xtl.


<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500mg</td>
<td>2g</td>
</tr>
<tr>
<td>2g</td>
<td>10g</td>
</tr>
<tr>
<td>10g</td>
<td>50g</td>
</tr>
</tbody>
</table>

Technical Notes:
1. Ligand used in the Pd-catalyzed arylation 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 α-arylations of nitroalkanes.

![Chemical Structure](image)

References:

**15-0073 2-(Di-t-butylphosphinomethyl)-6-(diethylaminomethyl)pyridine, 98% [863971-66-8]**

C₁₉H₃₅N₂P; FW: 322.47; yellow liq. air sensitive

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mg</td>
<td>500mg</td>
</tr>
</tbody>
</table>

Technical Note:
1. See 44-0091 (Visit www.strem.com).

**15-7130 3-(Di-t-butylphosphino)propylamine, min. 97% (10 wt% in THF) [1196147-72-4]**

C₁₁H₁₉N₅P; FW: 203.30; pale yellow to colorless liq air sensitive

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5g</td>
<td>25g</td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
5-(Di-t-butylphosphino)-1',3',5'-triphenyl-1,4'-bi-1H-pyrazole, min. 95% t-Bu-BippyPhos

[C₃₂H₃₈N₄P] FW: 506.62; white pwdr.

*air sensitive*

References:
15-1052 2-Di-t-butylphosphino-2’,4’,6’-tri-i-propyl-1,1’-biphenyl, min. 98% 
t-butylXPhos [564483-19-8] 
C_{29}H_{48}P; FW: 424.64; white xtl.; 
m.p. 147-149° 
Note: Note: Buchwald Biaryl 
Phosphine Ligand Master Kit 
component. See (page 203). 
Buchwald Biaryl Phosphine Ligand Mini Kit 1 component. 

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 CO2.

References:

93-1518 Di-n-butylphosphite, 96% [1809-19-4] 
(C_{4}H_{9})_{2}P(O)H; FW: 194.21; colorless liq.; b.p. 118-119°/11 
mm; f.p. 250°F; d. 0.995

15-1054 Di-t-butyl(i-propyl)phosphine, min. 98% [25032-49-9] 
(C_{4}H_{9})(C_{3}H_{7})P; FW: 118.29; colorless liq. 
pyrophoric

15-1067 Di-t-butyl(3-sulfonato-
propyl)phosphine, min. 98% [1055888-89-5] 
(C_{4}H_{9})PCH_{2}CH_{2}CH_{2}SO_{3}H; 
FW: 268.35; white solid 
moisture sensitive

500mg 
2g 
10g
15-1053 (3S,3’S,4S,4’S,11bS,11’bS)-(+)-4,4’-Di-t-butyl-4,4’,5,5’-tetrahydro-3,3’-bi-3H-dinaphtho[2,1-c:1’,2’-e]phosphepin, 97% (S)-BINAPINE [610304-81-9]

C_{32}H_{48}P_{2}; FW: 734.89; white pwdr.

Note: Sold in collaboration with Chiral Quest for research purposes only. Patents pending. Chiral Quest Catalyst and Ligand Toolbox Kit component see (page 212).

Technical Notes:
1. Phosphorus chirality restricts rotation of adjacent substituents leading to effective chiral induction, and the highly electron-donating bisphosphate leads to high activities.
2. Rh-BINAPINE complexes form excellent catalyst for asymmetric hydrogenation of aryl substituted β-amino acids.

Reference:

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_{38}H_{30}Cl_{2}O_{2}P_{2}; FW: 651.50; yellow-white pwdr.; m.p. 178°

Note: Sold in collaboration with Lanxess for research purposes only. US Patents 5,710,339 and 5,801,261.

Technical Notes:
1. Ligand used in the ruthenium catalyzed, enantioselective hydrogenation of alkenes, carbonyls, and imines.
2. Ligand used in the rhodium-catalyzed cyclization of acetylenic aldehydes.
3. Ligand used in the iridium-catalyzed hydrogenative coupling of alkenes to aromatic and aliphatic N-arylsulfonyl aldimines.
4. Asymmetric Cu-catalyzed propargylic substitution with amines, and enamines.
5. Catalytic desymmetrizing intramolecular Heck reaction.
6. Assembly of 1,3-polyols.
7. Pd-catalyzed diastereo/enantioselective allylic alkylations of ketone enolates.
15-1055  (R)-(+)‐5,5′‐Dichloro‐6,6′‐dimethoxy‐2,2′‐bis(diphenylphosphino)‐1,1′‐biphenyl, min. 95% (R)‐Cl‐MeO‐BIPHEP  \[185913‐97‐7\]

References:
1. Patents (Bayer) EP 0749973, DE 10027154.

15-1056  (S)‐(‐)‐5,5′‐Dichloro‐6,6′‐dimethoxy‐2,2′‐bis(diphenylphosphino)‐1,1′‐biphenyl, min. 95% (S)‐Cl‐MeO‐BIPHEP  \[185913‐98‐8\]

Technical Note:
1. See 15-1055 (page 107).

26-0985  Dichlorophosphinoferrocene, 98%  \[1291‐31‐2\]

New –

HAZ  \( \text{C}_{10} \text{H}_{10} \text{Cl}_{2} \text{FeP} \); FW: 286.90; red‐brown solid  

moisture sensitive
Dichlorophosphinoferrocene, 98% \([1291-31-2]\)

Technical Note:

1. Ferrocene organophosphorus building block.

References:

1. See above.

15-1072  Dicyclohexyl(9-benzylfluoren-9-yl) phosphonium tetrafluoroborate, min. 97%
[**cataCXium® FBN**] \([93778-18-2]\)

\(C_{22}H_{38}BF_4P\); FW: 540.42; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component see (page 239).

15-1074  Dicyclohexyl(9-butylfluoren-9-yl) phosphonium tetrafluoroborate, min. 97%
[**cataCXium® FBu**] \([1007311-98-9]\)

\(C_{29}H_{40}BF_4P\); FW: 506.41; white pwdr.
Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCXium® Ligand Kit component see (page 239).
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Amount</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1050</td>
<td>Dicyclohexylchlorophosphine, min. 98% [16523-54-9]</td>
<td>1g, 5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C₆H₁₁)₂PCl; FW: 232.74; colorless to pale yellow, cloudy liq.;</td>
<td></td>
<td>b.p. 96-99°C/0.1 mm; d. 1.054</td>
</tr>
<tr>
<td></td>
<td><em>air sensitive, moisture sensitive</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1007</td>
<td>Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine Cy-cBRIDP [1023330-38-2]</td>
<td>250mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C₂₈H₃₇P; FW: 404.57; off-white pwdr.</td>
<td>1g, 5g</td>
<td><em>air sensitive, (store cold)</em></td>
</tr>
<tr>
<td></td>
<td>Note: Manufactured under license of Takasago patent US7129367B2.</td>
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<tr>
<td></td>
<td>Technical Note:</td>
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<tr>
<td></td>
<td>1. See 15-1005 (page 95).</td>
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</tr>
<tr>
<td>15-1062</td>
<td>Dicyclohexyl(2,2-diphenyl-1-methylvinyl)phosphine Cy-vBRIDP [384842-24-4]</td>
<td>250mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C₂₅H₃₅P; FW: 366.52; off-white pwdr.</td>
<td>1g, 5g</td>
<td><em>air sensitive, (store cold)</em></td>
</tr>
<tr>
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<td>Note: Manufactured under license of Takasago patent US6455720.</td>
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<tr>
<td></td>
<td>Technical Note:</td>
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<td></td>
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<tr>
<td></td>
<td>1. Ligand used in the Pd-catalyzed amination of aryl halides.</td>
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<tr>
<td></td>
<td>[R] + R₂NH → [R]⁻ + [R]₂NH⁺</td>
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<tr>
<td></td>
<td>Pd(OAc)₂</td>
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<tr>
<td></td>
<td>Ligand</td>
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<td></td>
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<td></td>
<td>NaOt-Bu, toluene</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Reference:</td>
<td></td>
<td></td>
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<tr>
<td>15-1076</td>
<td>Dicyclohexyl[9-(3-phenylpropyl)fluoren-9-yl]phosphonium tetrafluoroborate, min. 95% [cataCXium® FPrPh] [1007311-95-6]</td>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C₃₄H₄₂BF₄P; FW: 568.48; white pwdr.</td>
<td>2g</td>
<td><em>air sensitive</em></td>
</tr>
<tr>
<td></td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Patented</td>
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</tr>
<tr>
<td></td>
<td>Application Pending. Solvias cataCXium® Ligand Kit component see (page 239).</td>
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<td></td>
</tr>
<tr>
<td>15-1120</td>
<td>Dicyclohexylphosphine, 98% [829-84-5]</td>
<td>10g, 50g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C₆H₁₁)₂PH; FW: 198.29; colorless liq.; b.p. 129°C/8 mm;</td>
<td></td>
<td>d. 0.98</td>
</tr>
<tr>
<td></td>
<td><em>pyrophoric</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1122</td>
<td>Dicyclohexylphosphine, 98% (10 wt% in hexane)</td>
<td>100g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[829-84-5]</td>
<td>500g</td>
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</tr>
<tr>
<td></td>
<td>(C₆H₁₁)₂PH; FW: 198.29; colorless liq.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td><em>air sensitive</em></td>
<td></td>
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</tbody>
</table>

Visit www.strem.com for new product announcements.
2-(Dicyclohexylphosphino)biphenyl, 98% [247940-06-3]

C_{12}H_{9}[P(C_6H_{11})_2]; FW: 350.49; white xtl.; m.p. 103°


Technical Notes:
2. Ligand used in the palladium-catalyzed synthesis of aromatic amines from aryl chlorides, bromides and triflates.
3. Ligand employed in Suzuki coupling reactions involving aryl chlorides, bromides and triflates.
4. Useful ligand for the Pd-catalyzed oxidation of alcohols in the presence of chlorobenzenes.
5. Useful ligand for the Pd-catalyzed amination with ammonia equivalents.
7. Ligand used in the palladium-catalyzed borylation of aryl bromides.
8. Ligand used in the palladium-catalyzed silylation of aryl chlorides.

\[
\begin{align*}
\text{Cl} & + \text{N} & \xrightarrow{\text{Pd(dba)}_2, 15-1140, \text{K}_3\text{PO}_4, \text{DME, 100 °C}} & \text{N} \\
\text{Cl} & \text{CO}_2\text{Me} & \text{CO}_2\text{Me} & \text{CO}_2\text{Me} \\
\end{align*}
\]

Tech. Note (2) Ref. (2)

\[
\begin{align*}
\text{Cl} & + \text{B(OH)}_2 & \xrightarrow{\text{PdOAc}_2, 15-1140, \text{K}_3\text{PO}_4, \text{Toluene, 100 °C}} & \text{Me}
\end{align*}
\]

Tech. Note (3) Ref. (3)

\[
\begin{align*}
\text{OH} & \xrightarrow{\text{Pd}_2(\text{dba})_3, 15-1140, \text{C}_6\text{H}_5\text{Cl}, \text{K}_3\text{PO}_4, \text{Toluene, 105 °C}} & \text{H}
\end{align*}
\]

Tech. Note (4) Ref. (4)

\[
\begin{align*}
\text{Cl} & \text{MeO} & \xrightarrow{(1) \text{Pd}_2(\text{dba})_3, 15-1140, \text{LiHMDS}, (2) \text{H}^+, \text{cleavage}} & \text{NH}_2
\end{align*}
\]

Tech. Note (5) Ref. (5)

\[
\begin{align*}
\text{Cl} & + \text{MeO}_2\text{C} & \text{MeO}_2\text{C} & \text{MeO}_2\text{C} \\
\text{MeO}_2\text{C} & \text{MeO}_2\text{C} & \text{MeO}_2\text{C} & \text{MeO}_2\text{C} \\
\text{Me} & \text{Me} & \text{Me} & \text{Me} \\
\text{(CH}_2\text{)}_2\text{CH}=\text{CMe}_2 & & & \\
\end{align*}
\]

Au(L)Cl \xrightarrow{\text{AgSbF}_6} \text{MeO}_2\text{C} \text{L} = 15-1140

Tech. Note (6) Ref. (6)
PHOSPHORUS – Ligands and Compounds

15-1140  2-(Dicyclohexylphosphino)biphenyl, 98%  [247940-06-3]  (cont.)

\[
\begin{align*}
\text{Br} & \quad + \quad \text{O} \quad \text{B-H} \quad \xrightarrow{\text{Pd(OAc)}_2, 15-1140, \text{Et}_3\text{N}, 1,4-\text{dioxane, 80 } ^\circ\text{C}} \\
\text{OMe} & \quad \text{MeO} \quad \text{Cl} \quad \xrightarrow{\text{Me}_6\text{Si}_2, \text{Pd}_2\text{dba}_3, 15-1140, \text{H}_2\text{O}, \text{KF}, \text{dioxane}} 
\end{align*}
\]

References:

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_{2}OP; FW: 440.60;  
white to off-white pwdr.;  
m.p. 192.1-193.8°

Technical Note:

Reference:
PHOSPHORUS – Ligands and Compounds

15-1143 2-Dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl, min. 98% SPhos [657408-07-6]
C_{26}H_{35}O_{2}P; FW: 410.53; white xtl.; m.p. 164-166°

Note: Buchwald Biaryl Phosphine Ligand Master Kit component. See (page 203).
Buchwald Biaryl Phosphine Ligand Mini Kit 1 component. See (page 205). Patents: US 6,395,916,
US 6,307,087.

Technical Notes:
2. Ligand used in the Suzuki cross-coupling of heteroaryl substrates.
3. Ligand used in the Suzuki cross-coupling of aryl potassium trifluoroborates.
4. Effective ligand for the Pd-catalyzed borylation of aryl chlorides.
5. Ligand used in the Pd-catalyzed Kumada-Corriru reaction of functionalized aryl Grignard reagents at low temperature.

References:
PHOSPHORUS – Ligands and Compounds

15-1142 2’-Dicyclohexylphosphino-2,6-dimethoxy-3-sulfonato-1,1'-biphenyl hydrate sodium salt (water soluble SPhos), min. 98% [870245-75-3]
C_{26}H_{34}NaO_{5}PS·XH_{2}O; FW: 512.58; light yellow solid

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.

2. Ligand used in the Pd-catalyzed Suzuki coupling and animation of unactivated aryl chlorides. The reactions generally occur at room temperature and give high yields of product.

3. Ligand used in Pd-catalyzed C-N bond formation. A general synthesis of N6-aryl-2'-deoxyadenosine analogues.

4. Ligand used in Pd-catalyzed N-arylation of indoles.

5. Ligand used in Pd-catalyzed synthesis of aryl-tert-butyl ethers.

References:

15-1152 2-(Dicyclohexylphosphino)-2’-(N,N-di-methylamino)biphenyl, 98% DavePhos
[213697-53-1]
(CH_{3})_{2}NC_{6}H_{4}C_{6}H_{4}P(C_{6}H_{11})_{2}; FW: 393.55; white xtl.; m.p. 115-119°

Technical Notes:

15-1145 2-(Dicyclohexylphosphino)-2’-(N,N-dimethylamino)biphenyl, 98% DavePhos
[213697-53-1]
(CH_{3})_{2}NC_{6}H_{4}C_{6}H_{4}P(C_{6}H_{11})_{2}; FW: 393.55; white xtl.; m.p. 115-119°

Technical Notes:
1. Ligand used in the Pd-catalyzed Suzuki coupling and animation of unactivated aryl chlorides. The reactions generally occur at room temperature and give high yields of product.


3. Ligand used in Pd-catalyzed N-arylation of indoles.

4. Ligand used in Pd-catalyzed synthesis of aryl-tert-butyl ethers.
2-(Dicyclohexylphosphino)-2'-(N,N-dimethylamino)biphenyl, 98% DavePhos

Technical Notes:
5. Effective ligand in the Pd-catalyzed arylation of ester enolates.
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.
2-(Dicyclohexylphosphino)-2'-N,N-dimethylamino)biphenyl, 98% DavePhos
[213697-53-1]

References:

2-Dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98% RuPhos [787618-22-8]
C_{30}H_{43}O_{2}P; FW: 466.64; white pwdr.; m.p. 123-124°
Note: Note: Buchwald Biaryl Phosphine Ligand Master Kit component. See (page 203).
**Technical Notes:**

1. Ligand used for the Pd-catalyzed Negishi cross-coupling reaction of (hetero)aryl chlorides.
2. Ligand used for the Pd-catalyzed synthesis of N-aryl benzimidazoles.
3. Ligand used for the Pd-catalyzed synthesis of heteroacenes.
4. Ligand used for the Pd-catalyzed C-N coupling reaction at low temperature with the Pd precatalyst.

**References:**

**PHOSPHORUS – Ligands and Compounds**

15-1135 2’-Dicyclohexylphosphino-2,6-di-i-propyl-4-sulfonato-1,1’-biphenyl hydrate sodium salt

[870245-84-4]  
C₃₀H₄₂NaO₃PS·XH₂O;  
FW: 536.68; white solid  
Note: Water soluble phosphine.  
Buchwald Biaryl Phosphine  
Ligand Master Kit component.  

Technical Notes:
1. Water soluble catalyst for Sonogashira coupling reactions  
2. Water soluble catalyst for coupling of benzyl chloride and terminal alkynes.

![Chemical structure](image)

**References:**

15-1144 [2-(Dicyclohexylphosphino)ethyl]trimethylammonium chloride, min. 95%  
[181864-78-8]  
(C₆H₁₁)₂PCH₂CH₂N(CH₃)₃Cl⁺;  
FW: 319.89; white pwdr.  
hygroscopic  
Technical Note: Water soluble phosphine.

26-0956 (R)-(+)-[(R)-2-Dicyclohexylphosphinoferrocenyl](N,N-dimethylamino)(2-dicyclohexylphosphinophenyl)methane, min. 97%  
[1016985-24-2]  
C₃₃H₆₃FeNP₂; FW: 711.76; orange pwdr.;  
[α]D +110° ±10° (c 0.5, CHCl₃)  
Note: Sold in collaboration with Solvias for research purposes only.

Technical Note:
1. See 26-0955 (page 119).
PHOSPHORUS – Ligands and Compounds

26-0955  (S)-(−)-[(S)-2-Dicyclohexylphosphinoferrocenyl][N,N-dimethylamino] (2-dicyclohexylphosphinophenyl) methane, min. 97% [914089-00-2]
C_{43}H_{63}FeNP_2; FW: 711.76; orange pwdr.;
\([\alpha]_D\) -110° ±10° (c 0.5, CHCl_3)
Note: Sold in collaboration with Solvias for research purposes only.

Technical Note:
1. See 26-1315 (page 162).

26-0975  (R)-(−)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldi-t-butylphosphine, min. 97% [158923-11-6]
C_{32}H_{52}FeP_2; FW: 554.56; orange pwdr.;
\([\alpha]_D\) -185° ±10° (c 0.5, CHCl_3)
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).

Technical Notes:
1. Ligand used in the preparation of palladium catalysts for the coupling of heteroaryl and aryl chlorides / tosylates with primary nitrogen nucleophiles.
2. Ligand used in the preparation of palladium catalysts for the coupling of aryl halides and thiols.
3. Ligand used in the preparation of palladium catalysts for Kumada coupling of aryl and vinyl tosylates.
4. Ligand used in the preparation of palladium catalysts for the coupling of ammonia with aryl chlorides, bromides, iodides and sulfonates.

```
\begin{align*}
\text{Cl} & + \text{RNH}_2 \xrightarrow{\text{Pd(OAc)}_2, \text{NaOtf-Bu, toluene/DME}} \text{NHR} \\
\text{OTs} & + \text{RNH}_2 \xrightarrow{\text{Pd(OAc)}_2, \text{NaOtf-Bu, toluene, } 25^\circ C} \text{NHR} \\
\text{Cl} & + \text{HSR} \xrightarrow{\text{Pd(OAc)}_2, \text{MOtf-Bu, toluene/DME, } 110^\circ C} \text{SR} \\
\text{OTs} & + \text{BrMgR}_4 \xrightarrow{\text{Pd(OAc)}_2, \text{Ligand}} \text{R}_1\text{R}_2\text{R}_3\text{OTs}
\end{align*}
```
26-0975  (R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldi-t-butylphosphine, min. 97%  [158923-11-6]

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{NH}_3 \\
\text{Pd}[\text{P(o-tol)}_3]_2 \\
\text{Ligand} \\
\text{NaOtf-Bu,1,4-dioxane} \\
50-100°C
\end{align*}
\]

References:

26-1000  (R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldicyclohexylphosphine, min. 97%  [167416-28-6]

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{NH}_3 \\
\text{Pd}[\text{P(o-tol)}_3]_2 \\
\text{Ligand} \\
\text{NaOtf-Bu,1,4-dioxane} \\
50-100°C
\end{align*}
\]

References:

26-1001  (S)-(+)1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldicyclohexylphosphine, min. 97%  [158923-07-0]

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{NH}_3 \\
\text{Pd}[\text{P(o-tol)}_3]_2 \\
\text{Ligand} \\
\text{NaOtf-Bu,1,4-dioxane} \\
50-100°C
\end{align*}
\]

Technical Notes:
1. See 26-1210 (page 150).
2. Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.

Reference:

26-1230  (R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldiphenylphosphine, min. 97%  [158923-09-2]

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{NH}_3 \\
\text{Pd}[\text{P(o-tol)}_3]_2 \\
\text{Ligand} \\
\text{NaOtf-Bu,1,4-dioxane} \\
50-100°C
\end{align*}
\]

Technical Notes:
1. See 26-1210 (page 150).
2. Ligand for the asymmetric hydroformylation reactions.
3. Ligand for asymmetric intramolecular amide arylation.
26-1230 (cont.) (R)-(-)-1-[(S)-2-(Dicyclohexylphosphino)ferrocenyl]ethylidiphenylphosphine, min. 97% [158923-09-2]

References:

26-1101 (S)-(+)-1-[(R)-2-(Dicyclohexylphosphino)ferrocenyl]ethylidiphenylphosphine, min. 97%
{162291-01-2}
C_{36}H_{44}FeP_{2}; FW: 594.59; orange pwdr.; 
[α]_{D} +100° ±5° (c 0.5, CHCl_{3})
Note: Sold in collaboration with Solvias for research purposes only.

Technical Note:
1. See 26-1210 (page 150).

15-1082 11-Dicyclohexylphosphino-12-(2-methoxyphenyl)-9,10-ethenoanthracene dichloromethane adduct, min. 98%
{o-MeO-KITPHOS} [1166994-78-0]
C_{35}H_{39}OP; FW: 506.66; white pwdr.
Note: Sold under license from NCL for research purposes only. Patent Pending.

Technical Note:
1. See 15-1084 (page 122).

15-1087 1-(Dicyclohexylphosphino)-2-(2-methoxyphenyl)-1H-indole, min. 98% NPCy o-Andole-Phos
{947402-60-0}
C_{27}H_{34}NOP; FW: 419.54; white to off-white pwdr.; m.p. 131.1-132.5°

Technical Note:
1. Suzuki-Miyaura Coupling of Aryl and Hetero-aryl Chlorides.

R^{1} = Me, MeO, NH_{2}, CO_{2}Me, COMe, pyr; R^{2} = Me, Np, Bu

Reference:
15-1148 2-Dicyclohexylphosphino-2'-methylbiphenyl, min. 98% MePhos [251320-86-2]
C_{25}H_{33}P; FW: 364.51; white xtl.; m.p. 107-110°
Note: Buchwald Biaryl Phosphine Ligand Master Kit component. See (page 203).
Buchwald Biaryl Phosphine Ligand Mini Kit 2 component. See (page 206).

Technical Notes:
1. Ligand used for the Pd-catalyzed formation of a-arylketones.
2. Ligand used for the Pd-catalyzed amination reaction (see 15-1045 page 99).
3. Ligand used for the Pd-catalyzed hydrazone arylation.
4. Ligand used for the Pd-catalyzed synthesis of 5,5-disubstituted butenolides.

References:

15-1084 11-Dicyclohexylphosphino-12-phenyl-9,10-ethenoanthracene dichloromethane adduct, min. 98% KITPHOS [1166994-77-9]
C_{34}H_{37}P; FW: 476.63; white pwdr.
Note: Sold under license from NCL for research purposes only. Patent Pending.
PHOSPHORUS – Ligands and Compounds

15-1084  11-Dicyclohexylphosphino-12-phenyl-9,10-ethenoanthracene dichloromethane adduct, min. 98% KITPHOS [1166994-77-9]

Technical Notes:
1. Useful ligand for the palladium-catalyzed amination reaction.
2. Useful ligand for the palladium-catalyzed Suzuki cross-coupling reaction.

![Chemical Structure](image1)

![Chemical Structure](image2)

References:

26-1120  (R)-(+) 1-(R)-2-(2'-Dicyclohexylphosphino-phenyl)ferrocenyl] ethyldi(bis-3,5-trifluoromethylphenyl) phosphine, min. 97% [494227-32-6]

C₆₅H₄₅F₁₂FeP₂;
FW: 942.62; orange pwdr.; [α]D  +10° ±2° (c 0.5, CHCl₃)
Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).

Technical Note:
1. See 26-1315 (page 162).

15-1089  1-(Dicyclohexylphosphino)-2-phenyl-1H-indole, min. 98% NPCy Phendole-Phos [947402-57-5]

C₂₆H₃₂NP; FW: 389.51; white to off-white pwdr.

Technical Note:
1. Suzuki-Miyaura Coupling of Aryl and Hetero-aryl Chlorides.

Reference:
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 pwd.;
m.p. 171.9-174.9°

Technical Notes:
1. Suzuki-Miyaura Coupling of Aryl Mesylates bearing alkyl, methoxy, aldehyde, keto, nitrile, ester, and heteroaryl substitution.
2. Sonogashira Coupling of Aryl Mesylates, R' = alkyl, aryl; R = C(O)R, COOMe, CHO, CN.
3. Buchwald-Hartwig Amination of Aryl Mesylates, R = cyano, chloro, methoxy, keto, ester and etc.
4. 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).

References:
15-1149 2-(Dicyclohexylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% XPhos [564483-18-7]
C₃₃H₄₉P; FW: 476.72; white pwd.; m.p. 185°
Note: Note: Buchwald Biaryl Phosphine Ligand
Master Kit component. See (page 203). Buchwald
Biaryl Phosphine Ligand Mini Kit 1 component.

Technical Notes:
1. Exceptional ligands for Pd-catalyzed amination and amidation of aryl sulfonates.
2. Ligand used for the Pd-catalyzed Suzuki-Miyaura coupling reaction and carbonyl enolate coupling.
3. Ligand used for the chemoselective amination of aryl chlorides.
4. Ligand used for the Pd-catalyzed borylation of aryl chlorides.
5. Ligand used for the Pd-catalyzed amination of vinyl halides and triflates.
7. Ligand used for the Pt-catalyzed regioselective hydrosilylation of functionalized terminal arylalkynes.
8. Ligand used for the Pd-catalyzed synthesis of carbazoles.

Tech. Note (1) Ref. (1)
Tech. Note (2) Ref. (2)
Tech. Note (2) Ref. (3,4)
Tech. Note (3) Ref. (3)
Tech. Note (4) Ref. (5)
2-(Dicyclohexylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% XPhos

References:

Dicyclohexyl-[9-[3-(4-sulfonylphenyl)propyl]-2-sulfonylfluoren-9-yl]phosphonium hydrogen sulfate, min. 95% [cataCium® FSulf]

C34H43O10PS3; FW: 738.87

Note: Sold in collaboration with Solvias for research purposes only. Patent Application Pending. Solvias cataCium® Ligand Kit component see (page 239).
<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Chemical Formula</th>
<th>CAS Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Quantity</th>
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<tr>
<td>15-1130</td>
<td>Dicyclopentylphosphine, 97+%</td>
<td>(C₅H₉)₂PH; FW: 170.23; colorless liq.; d. 0.933</td>
<td>[39864-68-1]</td>
<td>5g</td>
<td>25g</td>
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<td><em>air sensitive, pyrophoric</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1131</td>
<td>Dicyclopentylphosphine, 97+% (10 wt% in hexane)</td>
<td>(C₅H₉)₂PH; FW: 170.23; colorless liq.</td>
<td>[39864-68-1]</td>
<td>50g</td>
<td>250g</td>
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<td></td>
<td><em>air sensitive</em></td>
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<tr>
<td>15-1150</td>
<td>Diethylchlorophosphine, min. 95%</td>
<td>(C₂H₅)₂PCl; FW: 124.55; colorless to light yellow liq.;</td>
<td>[686-69-1]</td>
<td>1g</td>
<td></td>
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<td><em>air sensitive</em></td>
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<td></td>
<td><em>moisture sensitive</em></td>
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<tr>
<td>93-1520</td>
<td>Di-(2-ethylhexyl)phosphoric acid (contains some mono)</td>
<td>[C₆H₁₃CH(C₂H₅)CH₂O]₂P(O)(OH); FW: 322.42; colorless liq.; d. 0.974</td>
<td>[298-07-7]</td>
<td>100g</td>
<td>500g</td>
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<td><em>air sensitive</em></td>
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<tr>
<td>15-1210</td>
<td>Diethylphosphine, 99%</td>
<td>(C₂H₅)₂PH; FW: 90.11; colorless liq.; b.p. 85°; d. 0.7862;</td>
<td>[627-49-6]</td>
<td>1g</td>
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<td><em>pyrophoric</em></td>
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<tr>
<td>15-1211</td>
<td>Diethylphosphine, 99% (10 wt% in hexane)</td>
<td>(C₂H₅)₂PH; FW: 90.11; colorless liq.; d. 0.66</td>
<td>[627-49-6]</td>
<td>5g</td>
<td></td>
<td></td>
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<td></td>
<td><em>air sensitive</em></td>
<td></td>
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<tr>
<td>93-1521</td>
<td>Diethylphosphite, min. 95%</td>
<td>(C₂H₅O)₂P(O)H; FW: 138.11; colorless liq.; b.p. 50-51°/2 mm; f.p. 195°F; d. 1.072</td>
<td>[762-04-9]</td>
<td>100g</td>
<td>500g</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><em>air sensitive</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-7332</td>
<td>2-[(2R,5R)-2,5-diethyl-1-phospholano]phenyl]1,3-dioxolane, min. 97%</td>
<td>C₁₇H₂₅O₂P; FW: 292.35; pale yellow to colorless liq.</td>
<td>[1217655-83-8]</td>
<td>100mg</td>
<td>500mg</td>
<td></td>
</tr>
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<td></td>
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<td></td>
<td><em>air sensitive</em></td>
<td></td>
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</tr>
<tr>
<td>15-7333</td>
<td>2-[(2S,5S)-2,5-diethyl-1-phospholano]phenyl]1,3-dioxolane, min. 97%</td>
<td>C₁₇H₂₅O₂P; FW: 292.35; pale yellow to colorless liq.</td>
<td>[1217655-83-8]</td>
<td>100mg</td>
<td>500mg</td>
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<td><em>air sensitive</em></td>
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<tr>
<td>15-7354</td>
<td>[1-(2R,5R)-2,5-Diethylphospholanyl][2-(2R,5R)-2,5-diethylphospholanyl-1-oxide]benzene, min. 97%</td>
<td>C₂₂H₃₈OP₂; FW: 378.47; pale yellow to colorless liq.</td>
<td>[924294-55-3]</td>
<td>100mg</td>
<td>500mg</td>
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<td>Note: Sold under license from Kanata for research purposes only.</td>
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### PHOSPHORUS – Ligands and Compounds

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<tr>
<th>Code</th>
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<th>Formula</th>
<th>Mass</th>
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<tbody>
<tr>
<td><strong>NEW</strong></td>
<td>[1-(2S,5S)-2,5-Diethylphospholanyl]-[2-(2S,5S)-2,5-diethylphospholanyl-1-oxide]benzene, min. 97%</td>
<td>C&lt;sub&gt;22&lt;/sub&gt;H&lt;sub&gt;36&lt;/sub&gt;OP&lt;sub&gt;2&lt;/sub&gt;; FW: 378.47; pale yellow to colorless liq.</td>
<td>100mg 500mg</td>
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<tr>
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<td><strong>air sensitive</strong></td>
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<td>Note: Sold under license from Kanata for research purposes only.</td>
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<tbody>
<tr>
<td>93-1571</td>
<td>Difluorophosphoric acid hemihydrate, tech. gr.</td>
<td>HPO&lt;sub&gt;2&lt;/sub&gt;F&lt;sub&gt;2&lt;/sub&gt;·0.5H&lt;sub&gt;2&lt;/sub&gt;O; FW: 101.98 (110.99); yellow fuming liq.; m.p. -96.5°; b.p. 115.9°; d. 1.583 (25°)</td>
<td>250g 1kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Formula</th>
<th>Mass</th>
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<tbody>
<tr>
<td>26-1170</td>
<td>(S)-(+)1-[(R)-2-(Di-2-furylphosphino)ferrocenyl]ethylid-3,5-xlylphosphine, min. 97%</td>
<td>C&lt;sub&gt;36&lt;/sub&gt;H&lt;sub&gt;36&lt;/sub&gt;FeO&lt;sub&gt;2&lt;/sub&gt;P&lt;sub&gt;2&lt;/sub&gt;; FW: 618.46; orange pwd.; [α]&lt;sub&gt;0&lt;/sub&gt; +376° (c 0.5, CHCl&lt;sub&gt;3&lt;/sub&gt;)</td>
<td>100mg 500mg 2g</td>
</tr>
<tr>
<td></td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).</td>
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</table>

**Technical Note:**
1. See 26-1210 (page 150).

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<tr>
<td>15-7137</td>
<td>(1R,2R)-2-[(4S,11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphetin-4-yl]-1,2-diphenylethanamine, min. 97%</td>
<td>C&lt;sub&gt;38&lt;/sub&gt;H&lt;sub&gt;38&lt;/sub&gt;NP; FW: 507.60; white solid</td>
<td>100mg 500mg</td>
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<tr>
<td></td>
<td><strong>air sensitive</strong></td>
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<td>Note: Sold under license from Kanata for research purposes only. WO 2008148202.</td>
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<tr>
<td>15-7136</td>
<td>(1S,2S)-2-[(4R,11bS)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphetin-4-yl]-1,2-diphenylethanamine, min. 97%</td>
<td>C&lt;sub&gt;38&lt;/sub&gt;H&lt;sub&gt;38&lt;/sub&gt;NP; FW: 507.60; white solid</td>
<td>100mg 500mg</td>
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<td><strong>air sensitive</strong></td>
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<tbody>
<tr>
<td>15-7141</td>
<td>(1R,2R)-2-[(4S,11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphetin-4-yl]-1-phenylpropan-2-amine, min. 97%</td>
<td>C&lt;sub&gt;31&lt;/sub&gt;H&lt;sub&gt;28&lt;/sub&gt;NP; FW: 445.53; white solid</td>
<td>100mg 500mg</td>
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<td><strong>air sensitive</strong></td>
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<td>Note: Sold under license from Kanata for research purposes only. WO 2008148202.</td>
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<tr>
<td>15-7187</td>
<td>(1R,2R)-2-[(4S,11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1-phenylpropan-2-aminium tetrafluoroborate, min. 97%</td>
<td>C₃₁H₂₉BF₄NP</td>
<td>97%</td>
</tr>
<tr>
<td>15-7186</td>
<td>(1S,2S)-2-[(4R,11bS)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]-1-phenylpropan-2-aminium tetrafluoroborate, min. 97%</td>
<td>C₃₁H₂₉BF₄NP</td>
<td>97%</td>
</tr>
<tr>
<td>15-7180</td>
<td>2-[(11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethaminium tetrafluoroborate, min. 97%</td>
<td>C₂₄H₂₃BF₄NP</td>
<td>97%</td>
</tr>
<tr>
<td>15-7181</td>
<td>2-[(11bS)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethaminium tetrafluoroborate, min. 97%</td>
<td>C₂₄H₂₃BF₄NP</td>
<td>97%</td>
</tr>
<tr>
<td>15-7132</td>
<td>2-[(11bR)-3,5-dihydro-4H-dinaphtho[2,1-c:1',2'-e]phosphepin-4-yl]ethylamine, min. 97%</td>
<td>[1092064-00-0]</td>
<td>97%</td>
</tr>
</tbody>
</table>
PHOSPHORUS – Ligands and Compounds

C_{24}H_{22}NP; FW: 355.41; pale yellow solid
air sensitive
Note: Sold under license from Kanata for research purposes only. WO2008148202.

15-1241 9,9-Dimethyl-4,5-bis(di-t-butyolphosphino)xanthene, min. 97% t-Bu-XANTPHOS
[856405-77-1]
C_{31}H_{48}OP_2; FW: 498.66; white to light yellow pwdr.

15-1242 9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98%
XANTPHOS [161265-03-8]
C_{39}H_{32}OP_2; FW: 578.63; light-yellow xtl.; m.p. 221-222°

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 heteroarylamines and aryl halides.
5. Ligand used in the hydrophosphinylation of alkenes and alkynes.
6. Ligand used for the Au(I)-catalyzed dehydrogenative silation of alcohols.
7. Ligand used for the sulfynylation of aryl iodides.
8. Ligand used for the Pd-catalyzed carbylation reaction of aryl bromides and amines.
9. Ligand used for the Ni-catalyzed alkynylcyanation of alkenes.

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PHOSPHORUS – Ligands and Compounds

9,9-Dimethyl-4,5-bis(diphenylphosphino)xanthene, min. 98% XANTPHOS

[161265-03-8]

References:
PHOSPHORUS – Ligands and Compounds

15-1250  Dimethylchlorophosphine, min. 97%  [811-62-1]
amp  (CH₃)₂PCL; FW: 96.50; colorless to pale yellow liq.;
HAZ  b.p. 76-77°; f.p. -1°F; d. 1.22
moisture sensitive, pyrophoric

15-2206  1-{(1S,2R)-1-[(11bR)-2,6-Dimethylphin-4-yloxy]-1-
Dimethyldinaphtho [2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]-1-
phenylpropan-2-yl}-3-phenylurea, min. 97%
CH₃
C₃₈H₃₃N₂O₄P; FW: 612.65;
white pwdr.
moisture sensitive, (store cold)
Note: Sold under license from InCatT for research purposes
only. WO2004/103559. UREAPhos and METAMORPhos
Ligand Kit component. See (page 254).
Technical Note:
1. See 15-2200 (page 135).

15-2204  1-{(2S)-1-[(11bS)-2,6-Dimethylphin-4-yloxy]-propan-2-yl}-3-
Dimethyldinaphtho [2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]-
phenylurea, min. 97%
C₃₂H₂₉N₂O₄P; FW: 536.56;
white pwdr.
moisture sensitive, (store cold)
Note: Sold under license from InCatT for research purposes
only. WO2004/103559. UREAPhos and METAMORPhos
Ligand Kit component. See (page 254).
Technical Note:
1. See 15-2200 (page 135).

15-1255  (S)-(+)-(2,6-Dimethyl-3,5-dioxo-4-phospha-cyclohepta[2,1-a:3,4-a']
dinaphthalen-4-yl)dimethylamine,
min. 98%  [185449-86-9]
C₂₄H₂₂NO₂P; FW: 387.41;
off-white pwdr.;
[α]D  +636° (c 0.30, CH₂Cl₂);
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. See (page 214).
Technical Note:
1. See 15-1232 (page 140).

15-1280  Dimethylidiphenylphosphonium iodide, 98%  [1017-88-5]
(CH₃)₂(C₆H₅)₂P; FW: 342.16; white xtl.
hygroscopic

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<table>
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<tr>
<th>Code</th>
<th>Description</th>
<th>Formula</th>
<th>Purity</th>
<th>Molecular Mass</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>93-1523</td>
<td>Dimethylmethylphosphonate, 97% [756-79-6]</td>
<td>(CH₃O)₂P(O)(CH₃);</td>
<td>100%</td>
<td>124.08</td>
<td>colorless liq.; b.p. 92-97°/50 mm; f.p. 156°F; d. 1.160</td>
</tr>
<tr>
<td>15-1400</td>
<td>Dimethylphenylphosphine, 99% [672-66-2]</td>
<td>(CH₃)₂(C₆H₅)P;</td>
<td></td>
<td>138.15</td>
<td>colorless liq.; b.p. 75-79°/12 mm; f.p. 122°F; d. 0.967</td>
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<tr>
<td>15-7335</td>
<td>2-[(2R,5R)-2,5-dimethyl-1-phospholano]phenyl]1,3-dioxolane, min. 97% [1044256-04-3]</td>
<td>C₁₅H₂₁O₂P;</td>
<td>100%</td>
<td>264.30</td>
<td>pale yellow to colorless liq. Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-7336</td>
<td>2-[(2S,5S)-2,5-dimethyl-1-phospholano]phenyl]1,3-dioxolane, min. 97% [695816-47-8]</td>
<td>C₁₅H₂₁O₂P;</td>
<td>100%</td>
<td>264.30</td>
<td>pale yellow to colorless liq. air sensitive Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-7360</td>
<td>[1-(2R,5R)-2,5-dimethylphospholanyl]-[2-(2R,5R)-2,5-dimethylphospholanyl-1-oxide]benzene, min. 97% [638132-66-8]</td>
<td>C₁₈H₂₈OP₂;</td>
<td>100%</td>
<td>322.36</td>
<td>white solid air sensitive Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-7361</td>
<td>[1-(2S,5S)-2,5-dimethylphospholanyl]-[2-(2S,5S)-2,5-dimethylphospholanyl-1-oxide]benzene, min. 97%</td>
<td>C₁₈H₂₈OP₂;</td>
<td>100%</td>
<td>322.36</td>
<td>white solid air sensitive Note: Sold under license from Kanata for research purposes only.</td>
</tr>
<tr>
<td>15-1455</td>
<td>(+)-6,6′-((((1R,3R)-1,3-Dimethyl-1,3-propanediyl)bis(oxy))bis[4,8-bis(t-butyl)-2,10-dimethoxybibenzo[d,f][1,3,2]dioxaphosphetin], min. 95% (R,R)-Chiraphite [149646-83-3]</td>
<td>C₄₉H₆₆O₁₆P₂;</td>
<td>100%</td>
<td>876.99</td>
<td>off-white pwdr.; [α]D +35.4° (c 1.0, CH₂Cl₂) air sensitive, moisture sensitive Note: Sold in collaboration with Chirotech for research purposes only. US Patent No. 5,491,266.</td>
</tr>
</tbody>
</table>
15-1455  (+)-6,6’-([[(1R,3R)-1,3-Dimethyl-1,3-propanediyl]bis(oxy)]bis[4,8-bis(t-butyl)-2,10-dimethoxybenzo[d,f][1,3,2]dioxaphosphepin], min. 95% (R,R)-Chiraphite [149646-83-3]

Technical Note:
1. 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.

\[
\begin{align*}
\text{X} & \quad \text{CHO} \\
\text{CO/H}_2 (1:1), 10 \text{ bar} & \quad \text{up to 90% ee} \\
& \quad >50 \text{iso/n}
\end{align*}
\]

References:

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

Technical Note:
1. See 15-1455 (page 133).

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% [213843-90-4]

Technical Notes:
1. Monodendate ligand for the enantioselective intramolecular reaction of prochiral cyclohexadienones.
2. Ligand use in the palladium-catalyzed, enantioselective diboration of allenes.
15-1505  (3R,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%  [213843-90-4]

References:

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_{2}O_{4}P; FW: 584.60; white pwdr.
moisture sensitive, (store cold)
Note: Sold under license from InCatT for research purposes only. WO2004/103559.
UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

Technical Note:
1.  See 15-2200 (page 135).

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_{2}O_{4}P; FW: 508.50; white pwdr.
moisture sensitive, (store cold)
Note: Sold under license from InCatT for research purposes only. WO2009/065856.
UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

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.
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]**

\[
\text{[Rh(nbd)\textsubscript{2}]BF\textsubscript{4} (4 mol\%)} \quad \text{UREAPhos (8.4 mol\%)}
\]

\[
\begin{array}{c}
\text{CH\textsubscript{2}Cl\textsubscript{2}, 30 bar H\textsubscript{2}, 45\degree C, 5 h} \\
84\%, 96\% \text{ ee}
\end{array}
\]

**References:**
2. WO2004103559A2.

**Technical Note:**
1. See 15-2200 (page 135).

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%**

\[
\text{C\textsubscript{30}H\textsubscript{25}N\textsubscript{2}O\textsubscript{4}P; FW: 508.50; white pwdr.}
\]

*moisture sensitive, (store cold)*

**Note:** Sold under license from InCatT for research purposes only. WO2009/065853. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

**Technical Note:**
1. See 15-2200 (page 135).

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%**

\[
\text{METAMORPhos}
\]

\[
\begin{array}{c}
\text{C\textsubscript{21}H\textsubscript{28}F\textsubscript{3}N\textsubscript{2}O\textsubscript{4}PS·(C\textsubscript{2}H\textsubscript{5})\textsubscript{3}N}; \\
\text{FW: 463.37(564.56)}
\end{array}
\]

*moisture sensitive, (store cold)*

**Note:** Sold under license from InCatT for research purposes only. WO2009/065856. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).

**Technical Note:**
1. Chiral ligand for the rhodium-catalyzed asymmetric hydrogenation of \(\alpha-\beta\) unsaturated substrates.

\[
\begin{array}{c}
\text{Ac(H)N} \\
\text{CO\textsubscript{2}Me} \\
\text{[Rh(nbd)\textsubscript{2}]BF\textsubscript{4} (2 mol\%)} \quad \text{METAMORPhos (4.4 mol\%)}
\end{array}
\]

\[
\text{CH\textsubscript{2}Cl\textsubscript{2}, 10 bar H\textsubscript{2}, rt, 12 h} \\
>99\%, 96\% \text{ ee}
\]

\[
\begin{array}{c}
\text{Ac(H)N} \\
\text{CO\textsubscript{2}Me} \\
\text{[Rh(nbd)\textsubscript{2}]BF\textsubscript{4} (1 mol\%)} \quad \text{METAMORPhos (2.2 mol\%)}
\end{array}
\]

\[
\text{CH\textsubscript{2}Cl\textsubscript{2}, 50 bar H\textsubscript{2}, rt, 18 h} \\
56\%, >99\% \text{ ee}
\]

**References:**
### PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
<td>15-7184</td>
<td>(1R,2R)-2-((4S,11bR)-3H-dinaphtho[2,1-c:1',2'-e]phosphepin-4(5H)-yl)-1,2-diphenylethannium tetrafluoroborate, min. 97%</td>
<td>C₃₆H₃₁BF₄NP; FW: 595.42; white solid</td>
<td>air sensitive</td>
<td>Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
<td></td>
</tr>
<tr>
<td>15-7183</td>
<td>(1S,2S)-2-((4R,11bS)-3H-dinaphtho[2,1-c:1',2'-e]phosphepin-4(5H)-yl)-1,2-diphenylethannium tetrafluoroborate, min. 97%</td>
<td>C₃₆H₃₁BF₄NP; FW: 595.42; white solid</td>
<td>air sensitive</td>
<td>Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
<td></td>
</tr>
<tr>
<td>26-1175</td>
<td>(R)-(-)-1-[(S)-2-(Di-1-naphthylphosphino)ferrocenyl]ethylidene-3,5-xylylphosphine, min. 97%</td>
<td>C₄₈H₄₄FeP₂; FW: 738.68; orange pwdr.;</td>
<td>[α]D -163° ±10° (c 0.5, CHCl₃)</td>
<td>Note: Sold in collaboration with Solvias for research purposes only.</td>
<td></td>
</tr>
<tr>
<td>15-1460</td>
<td>Di-2-norbomylphosphine, min. 98% (mixture of endo and exo isomers)</td>
<td>(C₇H₁₁)₂PH; FW: 222.31; colorless liq.; d. 0.88</td>
<td>pyrophoric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1461</td>
<td>Di-2-norbomylphosphine, min. 98% (mixture of endo and exo isomers) (10 wt% in hexane)</td>
<td>(C₇H₁₁)₂PH; FW: 222.31; colorless liq.</td>
<td>air sensitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1510</td>
<td>(S)-(+-)(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl(methyl)amine, 99%</td>
<td>C₂₈H₂₂NO₂P; FW: 435.45; white pwdr.;</td>
<td>[α]D +356° (c 0.32, CHCl₃); m.p. 155°</td>
<td>moisture sensitive</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).</td>
<td></td>
</tr>
</tbody>
</table>
15-1510  (S)-(−)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl (methyl)amine, 99% [490023-37-5]

Technical Note:
1. A ligand used in the rhodium-catalyzed enantioselective hydrogenation of (E)-N-acylated dehydro-β-amino acid esters. For (Z) isomer, use 15-1525 (page 142).

\[
\begin{align*}
\text{AchN} & \overset{1\% \text{ L}^*/0.5\% \text{ [Rh(cod)\textsubscript{2}BF\textsubscript{4}]} \overset{\text{H}_2 25\ \text{atms}, 6\ \text{hrs.}}{\longrightarrow} \text{AchN} \\
& & \text{100\% conv. 98\% ee}
\end{align*}
\]

Reference:

15-1527  (S)-(−)-(3,5-Dioxa-4-phosphacyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-(1-naphthlenyl)ethyl]amine, min. 97%

[342813-25-6]
C\textsubscript{44}H\textsubscript{34}NO\textsubscript{2}P; FW: 639.72;
white pwdr.
moisture sensitive

Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).

1. Useful ligand for the ruthenium-catalyzed, enantioselective cyclopropanation of styrenes.

\[
\begin{align*}
\text{Ph} & \overset{\text{R} = \text{H, Me}}{\longrightarrow} \text{N\textsubscript{2}CHCO\textsubscript{2}Et} \\
& \overset{\text{"RuL" (5 mol\%) (Et\textsubscript{3}O)PF\textsubscript{6} (1.1 equiv)}}{\longrightarrow} \text{Ph} + \text{R} \\
& \text{COOEt} \quad \text{COOEt}
\end{align*}
\]

Reference:

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\textsubscript{36}H\textsubscript{30}NO\textsubscript{2}P; FW: 539.60;
white pwdr.;
[α]\textsubscript{D} +427° (c 0.83, CHCl\textsubscript{3});
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. See (page 214).

100mg
500mg
2g
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-phenylethyl)amine, dichloromethane adduct, min. 95% [415918-91-1]

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, and Rh-catalyzed [5+2] cycloaddition of alkyne-vinyl-cyclpropanes.

References:
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]
\[\text{C}_{36}\text{H}_{50}\text{NO}_{2}\text{P} \text{; FW: 539.60; off-white pwdr.} \]
\[\text{[\(\alpha\)}_{D}] +13.1^\circ \text{ (c 1.01, CHCl}_3) ; \text{ m.p. 88-89^\circ} \]

moisture sensitive

Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).

Technical Note:

15-1231 (S)-(+-)(3,5-Dioxa-4-phospha-cyclohepta [2,1-a;3,4-a']dinaphthalen-4-yl) diethylamine, min. 97% [252288-04-3]
\[\text{C}_{32}\text{H}_{22}\text{NO}_{2}\text{P} \text{; FW: 387.41; white pwdr.} \]

moisture sensitive

Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).

Technical Note:
1. See 15-1232 (page 140) and 15-1235 (page 141).

15-1232 (R)-(+-)(3,5-Dioxa-4-phospha-cyclohepta [2,1-a;3,4-a']dinaphthalen-4-yl)dimethylamine, min. 97% (R)-MONOPHOS
[157488-65-8]
\[\text{C}_{22}\text{H}_{18}\text{NO}_{2}\text{P} \text{; FW: 359.36; white xtl.} \]
\[\text{[\(\alpha\)}_{D}] -583^\circ \text{ (c 0.06, CHCl}_3) ; \text{ m.p. 190^\circ} \]

air sensitive

Note: Sold in collaboration with DSM for research purposes only. Patent no. WO02 04466. DSM's MonoPhos™ Ligand Kit component. See (page 214).

Technical Notes:
1. Ligand used in the enantioselective, rhodium-catalyzed hydrogenation of substituted olefins, such as N-acetyldihydroamino acids, enamides, and unsaturated acids.
2. Ligand used in the enantioselective, iridium-catalyzed allylic substitution of allyl acetates containing only a single substituent in the 1 or 3 position.
3. Ligand use in the rhodium-catalyzed, amide directed, asymmetric hydroboration reaction.

\[
\text{R} = \text{H, Ph} \quad \text{R'} = \text{H, CH}_3 \quad \text{Z} = \text{NHC}O\text{CH}_3, \text{CH}_2\text{COOH} \quad >97\% \text{ ee}
\]

\[
\text{NaCH(COOMe)}_2 \quad \text{[Ir(COD)Cl]}_2 \text{L} \quad \text{THF, RT, 3 hours} \quad \text{PhCH}_2\text{CH}_2\text{CH(CH(COOMe)}_2 \quad 93\% \text{ ee}
\]

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

**Technical Note (2)**
Ref. (4,5)
(R)-(−)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a’]dinaphthalen-4-yl)dimethylamine, min. 97% (R)-MONOPHOS [157488-65-8]

References:

(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a’]dinaphthalen-4-yl)dimethylamine, min. 97% (S)-MONOPHOS [185449-80-3]

C22H18NO2P; FW: 359.36; white xtl.; [α]D +587° (c 0.06, CHCl3); 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. See (page 214).

Technical Notes:
1. See 15-1232 (page 140).
2. Asymmetric hydrogenation of ketones and β-keto esters.

References:

(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a’]dinaphthalen-4-yl) morpholine, min. 97% (S)-MorfPhos [185449-81-4]

C24H20NO3P; FW: 401.39; white pwdr. moisture sensitive

Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM’s MonoPhos™ Ligand Kit component. See (page 214).

Technical Notes:
1. See 15-1232 (page 140).
2. Ligand used in the enantioselective rhodium catalyzed low pressure high activity hydrogenation of α–dehydroaminoesters, enamides, and dimethylitaconate. See 15-1234 (page 142).

Reference:
### PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>CAS</th>
<th>Formula</th>
<th>Purity</th>
<th>Molecular Weight</th>
<th>Physical Properties</th>
<th>Storage Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1525</td>
<td>(S)-(+-)(3,5-Dioxa-4-phosphacyclohepta[2,1-α;3,4-α]* dinaphthalen-4-yl)[(1R)-1-phenylethyl]amine, min. 95%</td>
<td>[422509-53-3]</td>
<td>C_{28}H_{22}NO_{2}P; FW: 435.45</td>
<td>White powder; [α]D +3.5° (c 1.01, CHCl_{3}); m.p. 212-213°C</td>
<td>Moisture sensitive</td>
<td>Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).</td>
<td></td>
</tr>
<tr>
<td>15-1234</td>
<td>(S)-(+-)(3,5-Dioxa-4-phosphacyclohepta[2,1-α;3,4-α]* dinaphthalen-4-yl)piperidine, min. 97% (S)-PipPhos</td>
<td>[284472-79-3]</td>
<td>C_{28}H_{22}NO_{2}P; FW: 399.42</td>
<td>White powder.</td>
<td>Moisture sensitive</td>
<td>Note: Sold in collaboration with DSM for research purposes only. Patent WO 0204466. DSM's MonoPhos™ Ligand Kit component. See (page 214).</td>
<td></td>
</tr>
<tr>
<td>15-1551</td>
<td>Diphenylchlorophosphine, min. 95% [1079-66-9]</td>
<td>(C_{6}H_{5})_{2}PCl; FW: 220.64; yellow liq.; b.p. 100-102°/1 mm; f.p. &gt;230°F; d. 1.19</td>
<td>Moisture sensitive</td>
<td>Air sensitive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1550</td>
<td>Diphenylchlorophosphine, 99% [1079-66-9]</td>
<td>(C_{6}H_{5})_{2}PCl; FW: 220.64; colorless to light yellow liq.; b.p. 100-102°/1 mm; f.p. &gt;230°F; d. 1.19</td>
<td>Moisture sensitive</td>
<td>Air sensitive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1700</td>
<td>Diphenylphosphine, 99% [829-85-6]</td>
<td>(C_{6}H_{5})_{2}PH; FW: 186.20; colorless liq.; b.p. 116-119°/2.6 mm; d. 1.07</td>
<td>Pyrophoric</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1702</td>
<td>Diphenylphosphine, 99% (10 wt% in hexane) [829-85-6]</td>
<td>(C_{6}H_{5})_{2}PH; FW: 186.20; colorless liq.; d. 0.68</td>
<td>Moisture sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1740</td>
<td>Diphenylphosphinic chloride, 98% [1499-21-4]</td>
<td>(C_{6}H_{5})_{2}P(O)Cl; FW: 236.64; colorless liq.; b.p. 138-139°/0.15 mm; f.p. 79°F; d. 1.240</td>
<td>Moisture sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-7153</td>
<td>(1R,2R)-2-(Diphenylphosphino)-1-aminocyclohexane, min. 97% [452304-59-5]</td>
<td>C_{18}H_{22}N_{2}P; FW: 283.35; white solid</td>
<td>Air sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 15-1510 (page 137).
2. See 15-1232 (page 140) and 15-1235 (page 141).
## PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product Name</th>
<th>CAS Number</th>
<th>Molecular Formula</th>
<th>Molecular Weight</th>
<th>Description</th>
<th>Purity</th>
<th>Form</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-7154</td>
<td>(1S,2S)-2-(Diphenylphosphino)-1-aminocyclohexane, min. 97%</td>
<td>[452304-63-1]</td>
<td>C_{18}H_{22}NP</td>
<td>283.35</td>
<td>white solid</td>
<td>100mg</td>
<td>500mg</td>
<td></td>
</tr>
</tbody>
</table>
| 15-7253  | (R)-1-(Diphenylphosphino)-2-amino-3,3-dimethylbutane, min. 97% (10wt% in hexane) | [286454-86-2] | C_{18}H_{24}NP; FW: 285.36 |  | colorless liq. | 1g | 5g | air sensitive  
| 15-7255  | (S)-1-(Diphenylphosphino)-2-amino-3,3-dimethylbutane, min. 97% (10wt% in hexane) | [146476-37-1] | C_{18}H_{24}NP; FW: 285.36 |  | colorless liq. | 1g | 5g | air sensitive  
| 15-7146  | (R)-1-(Diphenylphosphino)-2-amino-3-methylbutane, min. 97% |  | C_{17}H_{22}NP; FW: 271.34 |  | colorless oil | 100mg | 500mg | air sensitive  
| 15-7147  | (S)-1-(Diphenylphosphino)-2-amino-3-methylbutane, min. 97% |  | C_{17}H_{22}NP; FW: 271.34 |  | colorless oil | 100mg | 500mg | air sensitive  
| 15-0120  | 2-(Diphenylphosphino)benzaldehyde, min. 97% | [50777-76-9] | (C_{6}H_{5})_{2}P(C_{6}H_{5}COH); FW: 290.30 |  | white to yellow pwdr.; m.p. 112-115° | 250mg | 1g |  
| 15-0133  | 2-(Diphenylphosphino)benzoic acid, min. 97% | [17261-28-8] | (C_{6}H_{5})_{2}P(C_{6}H_{5}COOH); FW: 306.30 |  | white to yellow solid; m.p. 174-181° | 1g | 5g |  
| 15-7195  | (1R,2R)-2-(Diphenylphosphino)cyclohexanaminium tetrafluoroborate, min. 97% |  | C_{18}H_{23}BF_{4}NP; FW: 371.16 |  | white to pale yellow solid | 100mg | 500mg | air sensitive  
| 15-7196  | (1S,2S)-2-(Diphenylphosphino)cyclohexanaminium tetrafluoroborate, min. 97% |  | C_{18}H_{23}BF_{4}NP; FW: 371.16 |  | white to pale yellow solid | 100mg | 500mg | air sensitive  

Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
<table>
<thead>
<tr>
<th>Product ID</th>
<th>Description</th>
<th>Purity</th>
<th>CAS Number</th>
<th>Molecular Formula</th>
<th>Molecular Weight</th>
<th>Physical State</th>
<th>Note</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-7110</td>
<td>(1R,2R)-2-(Diphenylphosphino)-2,3-dihydro-1H-inden-1-amine, min. 97% (10wt% in THF)</td>
<td>1g</td>
<td>1091606-70-0</td>
<td>C_{21}H_{20}NP</td>
<td>317.36</td>
<td>colorless to pale yellow liq.</td>
<td>air sensitive</td>
<td>Sold under license from Kanata for research purposes only. WO2008148202.</td>
</tr>
<tr>
<td>15-7111</td>
<td>(1S,2S)-2-(Diphenylphosphino)-2,3-dihydro-1H-inden-1-amine, min. 97% (10wt% in THF)</td>
<td>1g</td>
<td>1091606-69-7</td>
<td>C_{21}H_{20}NP</td>
<td>317.36</td>
<td>colorless to pale yellow liq.</td>
<td>air sensitive</td>
<td>Sold under license from Kanata for research purposes only. WO2008148202.</td>
</tr>
<tr>
<td>15-7162</td>
<td>(1R,2R)-2-(Diphenylphosphino)-2,3-dihydro-1H-inden-1-aminium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1091606-71-9</td>
<td>C_{21}H_{21}BF_{4}NP</td>
<td>405.17</td>
<td>white solid</td>
<td>air sensitive</td>
<td>Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
</tr>
<tr>
<td>15-7163</td>
<td>(1S,2S)-2-(Diphenylphosphino)-2,3-dihydro-1H-inden-1-aminium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1091606-72-0</td>
<td>C_{21}H_{21}BF_{4}NP</td>
<td>405.17</td>
<td>white solid</td>
<td>air sensitive</td>
<td>Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
</tr>
</tbody>
</table>

Technical Notes:
1. Useful ligand for sterically hindered substrates in the Pd-catalyzed amination reactions of aryl bromides.
2. Ligand employed in the coupling of enantiomerically pure cis-dimethylpiperazine with bromobenzene. Epimerization was not observed.
3. Ligand employed for the Pd-catalyzed heteroarylation of acetone.
4. Ligand used for the Cu-catalyzed phosphorylation of alcohols.
15-1745  2-Diphenylphosphino-2’-(N,N-dimethylamino)biphenyl, 98%  [240417-00-9]

References:

15-1748  1-Diphenylphosphino-2-(N,N-dimethylamino)-1H-indene, 99% (contains vinylic isomer)  [628323-64-8]
C_{23}H_{22}NP; FW: 343.40; off-white xtl. (store cold)

Technical Note:
1. See 45-0197 (Visit www.strem.com).

15-7193  (R)-1-(Diphenylphosphino)-3,3-dimethylbutan-2-aminium tetrafluoroborate, min. 97%
C_{18}H_{25}BF_{4}NP; FW: 373.18; white solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

15-7194  (S)-1-(Diphenylphosphino)-3,3-dimethylbutan-2-aminium tetrafluoroborate, min. 97%
C_{18}H_{25}BF_{4}NP; FW: 373.18; white solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
## PHOSPHORUS – Ligands and Compounds

### 15-1452

(+)-(1S,4R)-3-[4-(Diphenylphosphino)-2,5-dimethyl-3-thienyl]-4,7,7-trimethylbicyclo[2.2.1]hept-2-en-2-yl]bis(3,5-dimethylphenylphosphine, min. 98% [catASium® T2]  
[C₄₄H₄₈P₂S; FW: 670.87;  
white to yellow pwdr.;  
[α]D  +99.1 (c 1.0, CHCl₃)  
air sensitive  

Technical Note:  
1. Highly enantioselective catalyst for the hydrogenation of α- and β-acylamido acrylates or less functionalized olefins under mild conditions.

Reference:  

### 15-0162

(+)-(1S,4R)-3-[4-(Diphenylphosphino)-2,5-dimethyl-3-thienyl]-4,7,7-trimethylbicyclo[2.2.1]hept-2-en-2-yl]diphenylphosphine, min. 96% [catASium® T1]  
[C₃₀H₄₀P₂S; FW: 614.76;  
white pwdr.  
light sensitive  
Note: Sold in collaboration with Solvias for research purposes only. Patent WO2005/108407.

### 15-7102

(1R,2R)-2-(Diphenylphosphino)-1,2-diphenylethylamine, min. 97%  
[C₂₆H₂₄NP; FW: 318.45; white solid  
air sensitive  
Note: Sold under license from Kanata for research purposes only. WO2008148202.

### 15-7103

(1S,2S)-2-(Diphenylphosphino)-1,2-diphenylethylamine, min. 97%  
[C₂₆H₂₄NP; FW: 318.45; white solid  
air sensitive  
Note: Sold under license from Kanata for research purposes only. WO2008148202.

### 15-7156

(1R,2R)-2-(Diphenylphosphino)-1,2-diphenylethylaminium tetrafluoroborate, min. 97%  
[C₂₆H₂₈BF₄NP; FW: 469.26;  
white solid  
air sensitive  
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
15-7157  (1S,2S)-2-(Diphenylphosphino)-1,2-diphenylethylaminium tetrafluoroborate, min. 97%
C_{26}H_{25}BF_4NP; FW: 469.26; white solid
\textit{air sensitive}
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

15-7174  2-(Diphenylphosphino)ethanaminium tetrafluoroborate, min. 97%
C_{14}H_{17}BF_4NP; FW: 317.06; white to beige solid
\textit{air sensitive}
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

15-1762  2-(Diphenylphosphino)ethylamine, min. 95% [4848-43-5]
(C_{6}H_{5})_{2}PCH_{2}CH_{2}NH_{2}; FW: 229.26; colorless to yellow liq.
\textit{air sensitive}

Technical Note:
1. Ligand used in the preparation of a highly efficient ruthenium catalyst for the chemoselective hydrogenolysis of epoxides.

Reference:

15-1765  2-[2-(Diphenylphosphino)ethyl]pyridine, min. 97% [10150-27-3]
C_{19}H_{18}NP; FW: 291.33; white pwdr.
\textit{air sensitive}

Technical Note:
1. Catalyst used for the room temperature cross-coupling of organozinc reagents with carboxylic fluorides, chlorides, anhydrides and thioesters.

References:

26-1151  (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]benzylamine, min. 98%
C_{26}H_{22}FeNP; FW: 475.34; yellow to orange pwdr.

Technical Note:
1. Precursor ligand for the preparation of catalysts used in palladium-catalyzed asymmetric allylic alkylations.
**PHOSPHORUS – Ligands and Compounds**

26-1152 *(S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]benzylamine, min. 98%*

C_{29}H_{26}FeNP; FW: 475.34; yellow to orange pwdr.

100mg
500mg

Technical Note:
1. See 26-1151 (page 148).

26-1153 *(S)-(−)-[(S)-2-Diphenylphosphinoferrocenyl][2-bis(3,5-dimethyl-4-methoxyphenyl)phosphino-phenyl]methanol, min. 97% [851308-47-9]*

C_{57}H_{47}FeO_{2}P_{2}; FW: 777.68; orange foam; 
\([\alpha]_{D} -32^\circ\) (c 0.5, CHCl_{3})

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

100mg
500mg

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 pwdr.; 
\([\alpha]_{D} +312^\circ\) ±15° (c 0.5, CHCl_{3})

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

100mg
500mg
2g

Technical Note:
1. See 26-1155 (page 148).

26-1155 *(S)-(−)-[(S)-2-Diphenylphosphinoferrocenyl](N,N-dimethylamino)(2-diphenylphosphinophenyl)methane, min. 97% TANIAPHOS [850444-36-9]*

C_{43}H_{39}FeNP_{2}; FW: 687.57; orange pwdr.; 
\([\alpha]_{D} -312^\circ\) ±15° (c 0.5, CHCl_{3})

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

100mg
500mg
2g

Technical Notes:
1. Ligand for the Ru-catalyzed hydrogenation of β-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.

\[
\begin{align*}
\text{[Ru(cod)(C_4H_7)_2]} / \text{HBr} & \quad \text{L, H}_2 \\
\text{O} & \quad \text{OH} \\
\text{OEt} & \quad \text{OEt} \\
\end{align*}
\]

Tech. Note (1)
Ref. (1)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{Et} & \quad \text{Et} \\
\text{+} & \quad \text{R} \\
\text{RMgBr} & \quad \text{CuCl} / \text{L} \\
\text{O} & \quad \text{R} \\
\end{align*}
\]

Tech. Note (2)
Ref. (2)
### PHOSPHORUS – Ligands and Compounds

**26-1155** (S)-(−)−[(S)-2-Diphenylphosphinoferrocenyl](N,N-dimethylamino)(2-diphenylphosphinophenyl)methane, min. 97% TANIAPHOS [850444-36-9]

![Chemical Structure](image)

**References:**

**26-1160** (S)-(−)-[(S)-2-Diphenylphosphinoferrocenyl][2-diphenylphosphinophenyl]methanol, min. 97% [851308-43-5]

C_{31}H_{34}FeOP_2; FW: 660.50; yellow pwdr.; [α]_D^-70° (c 0.5, CHCl_3)

**Note:** Air-stable. Sold in collaboration with Solvias for research purposes only.

**26-1425** (R)-1-((S)-2-Diphenylphosphino)ferrocenylethylamine, min. 97%

C_{24}H_{24}FeNP; FW: 413.27; yellow solid

**26-1426** (S)-1-((R)-2-Diphenylphosphino)ferrocenylethylamine, min. 97%

C_{24}H_{24}FeNP; FW: 413.27; yellow solid

**26-1704** (R)-1-((S)-2-Diphenylphosphino)ferrocenylethylaminium tetrafluoroborate, min. 97%

C_{24}H_{25}BF_4FeNP; FW: 501.08; orange solid

**Note:** Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

**26-1705** (S)-1-((R)-2-Diphenylphosphino)ferrocenylethylaminium tetrafluoroborate, min. 97%

C_{24}H_{25}BF_4FeNP; FW: 501.08; orange solid

**Note:** Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
26-1200  (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethylid-t-butylphosphine, min. 97%  [155830-69-6]  
C_{32}H_{40}FeP_{2}; FW: 542.46; orange pwdr.;  
\([\alpha]_D -412^\circ \pm 15^\circ (c 0.5, \text{CHCl}_3)\)  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).  

Technical Notes:  
1. See 26-1210 (page 150).  
2. Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.  
3. Extremely efficient ligand used for the CuH catalyzed asymmetric conjugate reduction of acyclic enones.  
4. Efficient ligand for the asymmetric hydrogenation of hydrazones.  

\[
\begin{align*}  
R & \quad \xrightarrow{CuCl, NaOtfBu, PMHS, Ligand} \quad R^1 \\
R^2 & \quad \text{87-98% e.e.} 
\end{align*}
\]

References:  

26-1201  (S)-(+)-1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethylid-t-butylphosphine, min. 97%  [277306-29-3]  
C_{32}H_{40}FeP_{2}; FW: 542.46; orange pwdr.;  
\([\alpha]_D +412^\circ \pm 15^\circ (c 0.5, \text{CHCl}_3)\)  
Note: Sold in collaboration with Solvias for research purposes only.  

Technical Note:  
1. See 26-1210 (page 150).  

26-1210  (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethylidicyclohexylphosphine ethanol adduct, min. 97%  [155806-35-2]  
C_{38}H_{44}FeP_{2}-CH_{3}CH_{2}OH; FW: 594.59 (640.66); orange pwdr.;  
\([\alpha]_D -360^\circ (c 0.5, \text{CHCl}_3)\)  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component. See (page 241).
(R)-(−)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyldicyclohexylphosphine ethanol adduct, min. 97% (R)-(S)-JOSIPHOS [155806-35-2]

Technical Notes:
1. Ferrocenylphosphine ligands of the type cpFecp(PR₂)(CH(CH₃)PR′₂) are a class of asymmetric ligands developed at Solvias in Basel, Switzerland¹. Ligands of this type are currently used industrially in the stereoselective synthesis of commercial products²³. 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(PR₂)(CH(CH₃)X) [X = OAc or NR₂], a variety of donor atoms can be introduced into the side chain.⁴ These ferrocene based phosphine ligands have wide application in the stereoselective hydrogenation of substituted acetamidoacrylates, enol acetates, β-ketoesters and simple alkenes⁵⁻⁹.

2. Useful as a ligand in Pd-catalyzed C-N bond-forming reactions.


4. Asymmetric hydrogenation of ketones and phosphinylketimines.

5. Michael addition of Grignard reagents to α,β-unsaturated esters and thioesters.


7. Reaction of aryl halides with ammonia.

8. Cu-catalyzed reduction of activated C=C bonds with PMHS.


11. 1,2-Migrations in Pd-catalyzed Negishi couplings with JosiPhos ligands.
26-1210  (R)-(S)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyldicyclohexylphosphine ethanol adduct, min. 97% (R)-(S)-JOSIPHOS  [155806-35-2]

[Diagram of chemical reactions]

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.
26-1211  (S)-(+-)1-[(R)-2-(Diphenylphosphino)ferrocenyl]ethyldicyclohexylphosphine ethanol adduct, min. 97%  
(S)-(R)-JOSIPHOS [162291-02-3]  
C_{36}H_{44}FeP_{2}·CH_{3}CH_{2}OH; FW: 594.59 (640.66); orange pwdr.;  
[α]D +360° (c 0.5, CHCl₃)  
Note: Sold in collaboration with Solvias for research purposes only.

Technical Note:
1. See 26-1210 (page 150).

26-1255  (R)-(-)-1-[(S)-2-(Diphenylphosphino)ferrocenyl]ethyldi-3,5-xylylphosphine, min. 97% [184095-69-0]  
C_{40}H_{40}FeP_{2}; FW: 638.56; orange pwdr.;  
[α]D -310° ±10° (c 0.5, CHCl₃)  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Josiphos Ligand Kit component.  
See (page 241).

Technical Note:
1. See 26-1210 (page 150).

15-1775  (R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99%  
(R)-MOP [145964-33-6]  
C_{33}H_{25}OP; FW: 468.53; white pwdr.;  
[α]D +67° ±2° (c 1, toluene); 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:
1. Efficient catalyst for the enantioselective hydrosilylation of 1-alkenes to optically active 2-alcohols.
2. Ligand for palladium-catalyzed asymmetric reduction of allylic esters.
3. Ligand for the rhodium-catalyzed asymmetric alylation of imines with organostannanes.
4. Ligand for the rhodium-catalyzed asymmetric addition of aryl- and alkenylboronic acids to Isatins.

\[
\text{Pd/MOP} + \text{EtOH/} \text{Et}_{3}\text{N} \rightarrow \text{SiCl}_{3} \rightarrow \text{OH} \rightarrow 70\%, 94\% \text{ ee}
\]

\[
\text{R}^{1} \text{OCO}_{2}\text{Me} \rightarrow \text{Pd/MOP}^{+} \rightarrow \text{R}^{1} \text{R}^{2} \rightarrow 70\%, 94\% \text{ ee}
\]

\[
\text{Ar}^{1} \text{H} + \text{Ar}^{3} \text{SnMe}_{3} \rightarrow \text{Rh/MOP}^{+} \rightarrow \text{HN}^{+} \text{SO}_{3}\text{Ar}^{2}
\]

info@strem.com · technical@strem.com · quotation@strem.com
(R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99%

(R)-MOP [145964-33-6]

References:

(S)-(-)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99%
(S)-MOP [134484-36-9]

C₃₃H₂₅OP; FW: 468.53; white pwdr.;
[α]D -67° ±2° (c 1, toluene); m.p. 175-179°

air sensitive
Note: Sold in collaboration with Takasago for research purposes only. Patents US 5231202, EP 0503884, JP 05-017491.

15-7191

(NEW) (R)-1-(Diphenylphosphino)-3-methylbutan-2-aminium tetrafluoroborate, min. 97%

C₁₇H₂₃BF₄NP; FW: 359.15;
white to pale yellow solid

air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

15-7192

(NEW) (S)-1-(Diphenylphosphino)-3-methylbutan-2-aminium tetrafluoroborate, min. 97%

C₁₇H₂₃BF₄NP; FW: 359.15; white to pale yellow solid

air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

15-7220

(NEW) (2R,4R)-(+)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-(t-butoxy carbonyl) pyrrolidine, min. 97%

(R,R-BCPM) [114751-47-2]

C₃₄H₄₉NO₂P₂; FW: 565.71; white pwdr.

air sensitive

Visit www.strem.com for new product announcements.
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<th>Code</th>
<th>Name</th>
<th>CAS Number</th>
<th>Formula</th>
<th>MW</th>
<th>Description</th>
<th>Specifications</th>
<th>Quantity</th>
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<td>15-7224</td>
<td>(2R,4R)-(−)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-methyl-1-pyrrolidine-carboxamide, min. 97% (R,R-MCCPM)</td>
<td>[122709-72-2]</td>
<td>C₃₁H₄₄N₂O₂P₂</td>
<td>522.64</td>
<td>white pwdr.</td>
<td>air sensitive</td>
<td>50mg</td>
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<td>250mg</td>
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<td>15-7225</td>
<td>(2S,4S)-(−)-2-(Diphenylphosphinomethyl)-4-(dicyclohexylphosphino)-N-methyl-1-pyrrolidine-carboxamide, min. 97% (S,S-MCCPM)</td>
<td>[112521-97-8]</td>
<td>C₃₁H₄₄N₂O₂P₂</td>
<td>522.64</td>
<td>white pwdr.</td>
<td>air sensitive</td>
<td>50mg</td>
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</tr>
<tr>
<td>15-7216</td>
<td>(2R,4R)-(−)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)-N-(t-butoxycarbonyl) pyrrolidine, min. 97% (R,R-BPPM)</td>
<td>[72598-03-9]</td>
<td>C₃₄H₄₉O₂P₂</td>
<td>565.71</td>
<td>white pwdr.</td>
<td>air sensitive</td>
<td>100mg</td>
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<td>500mg</td>
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<td>15-7217</td>
<td>(2S,4S)-(−)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino)-N-(t-butoxycarbonyl) pyrrolidine, min. 97% (S,S-BPPM)</td>
<td>[61478-28-2]</td>
<td>C₃₄H₄₉NO₂P₂</td>
<td>565.71</td>
<td>white pwdr.</td>
<td>air sensitive</td>
<td>100mg</td>
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<td>500mg</td>
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<td>15-7210</td>
<td>(2R,4R)-(−)-2-(Diphenylphosphinomethyl)-4-(diphenylphosphino) pyrrolidine, min. 97% (R,R-PPM)</td>
<td>[77450-05-6]</td>
<td>C₂₉H₂₉NP₂</td>
<td>453.50</td>
<td>white pwdr.</td>
<td>air sensitive</td>
<td>100mg</td>
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<tr>
<td>15-7211</td>
<td>(2S,4S)-(−)-2-(Diphenylphosphinomethyl)4-(diphenylphosphino)pyrrolidine, min. 97% (S,S-PPM)</td>
<td>97%</td>
<td>61478-29-3</td>
<td>C_{29}H_{29}NP_{2}</td>
<td>453.50</td>
<td>white powder</td>
<td>100mg, 500mg</td>
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<tr>
<td>15-1804</td>
<td>2-Diphenylphosphino-6-methylpyridine, 98%</td>
<td>98%</td>
<td>132682-77-0</td>
<td>C_{18}H_{16}NP</td>
<td>277.30</td>
<td>white to off-white crystal; m.p. 81-83°</td>
<td>500mg, 2g</td>
</tr>
<tr>
<td>15-7115</td>
<td>(R)-2-[(Diphenylphosphino)methyl]pyrrolidine, min. 97%</td>
<td>97%</td>
<td>428514-91-4</td>
<td>C_{17}H_{20}NP</td>
<td>269.32</td>
<td>colorless oil</td>
<td>250mg, 1g</td>
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<tr>
<td>15-7116</td>
<td>(S)-2-[(Diphenylphosphino)methyl]pyrrolidine, min. 97%</td>
<td>97%</td>
<td>60261-46-3</td>
<td>C_{17}H_{20}NP</td>
<td>269.32</td>
<td>colorless oil</td>
<td>250mg, 1g</td>
</tr>
<tr>
<td>15-7165</td>
<td>(R)-2-[(Diphenylphosphino)methyl]pyrrolidinium tetrafluoroborate, min. 97%</td>
<td>97%</td>
<td></td>
<td>C_{17}H_{21}BF_{4}NP</td>
<td>357.13</td>
<td>white solid</td>
<td>100mg, 500mg</td>
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</tr>
<tr>
<td>15-7166</td>
<td>(S)-2-[(Diphenylphosphino)methyl]pyrrolidinium tetrafluoroborate, min. 97%</td>
<td>97%</td>
<td></td>
<td>C_{17}H_{21}BF_{4}NP</td>
<td>357.13</td>
<td>white solid</td>
<td>100mg, 500mg</td>
</tr>
<tr>
<td>Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
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</table>
PHOSPHORUS – Ligands and Compounds

15-1782  
(R)-(+)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,R)-O-PINAP  
[C₃₈H₂₉N₂OP; FW: 560.62; colorless xtl.;  
[α]D +78.5° (c 0.25, CHCl₃);  
m.p. 64-65°  
air sensitive  
Note: PINAP Ligand Kit component (see page 235).

250mg  
1g

Technical Note:
1. See 15-1783 (page 157).

15-1783  
(S)-(-)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,S)-O-PINAP  
[C₃₈H₂₉N₂OP; FW: 560.62; colorless xtl.;  
[α]D -160.4° (c 0.53, CHCl₃);  
m.p. 178-181°  
air sensitive  
Note: PINAP Ligand Kit component (see page 235).

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..

Reference:
### PHOSPHORUS – Ligands and Compounds

#### 15-1784
(R)-(+)4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97%

*(R,R)-N-PINAP [828927-97-5]*

C\textsubscript{38}H\textsubscript{30}N\textsubscript{3}P; FW: 559.64; colorless xtl.; m.p. 185-188°

**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.

**References:**

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#### 15-1787
**NEW**

(S)-(-)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(S)-1-phenylethyl]-1-phthalazinamine, min. 97%

*(S,R)-N-PINAP [828927-96-4]*

C\textsubscript{38}H\textsubscript{30}N\textsubscript{3}P; FW: 559.64; colorless xtl.; m.p. >210°

**Technical Note:**
1. See 15-1786 (page 158).

---

#### 15-1786
(R,)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97%

*(R,S)-N-PINAP [828927-96-4]*

C\textsubscript{38}H\textsubscript{30}N\textsubscript{3}P; FW: 559.64; colorless xtl.; [\(\alpha\)]\textsubscript{D} -162° (c 0.54, CHCl\textsubscript{3}); m.p. >210°

**Technical Note:**
1. See 15-1784 (page 158).
PHOSPHORUS – *Ligands and Compounds*

15-1778  (R)-(−)-1-(2-Diphenylphosphino-1-naphthyl)isoquinoline (R)-QUINAP \[149341-34-4\]

C\textsubscript{31}H\textsubscript{22}NP; FW: 439.50; white pwdr.;
[\(\alpha\)]\textsubscript{D}\textsuperscript{0} +155\(^{\circ}\) (c 1.0, CHCl\textsubscript{3}); m.p. 226-230°

*air sensitive*

Technical Notes:
1. Ligand used for the catalytic, asymmetric hydroboration of electron-rich styrenes, vinylenes and \(\beta\)-substituted vinyl arenes. The chiral borane intermediates can be oxidized to secondary alcohols, or converted to primary amines, with full retention of chirality.
2. Ligand for the copper-catalyzed enantioselective addition of alkynes to enamines.

\[
\begin{align*}
\text{Ph}_2\text{P} & \quad \text{Ph}_2\text{P} \\
\text{H}_2\text{O}_2 & \quad \text{OH} \\
\text{MeMgCl} & \quad \text{H}_2\text{NOSO}_3\text{H}
\end{align*}
\]

References:

15-1777  (S)-(−)-1-(2-Diphenylphosphino-1-naphthyl)isoquinoline (S)-QUINAP \[149341-33-3\]

C\textsubscript{31}H\textsubscript{22}NP; FW: 439.50; white pwdr.;
[\(\alpha\)]\textsubscript{D}\textsuperscript{0} -155\(^{\circ}\) (c 1.0, CHCl\textsubscript{3});
m.p. 226-230°

*air sensitive*

Technical Note:
1. See 15-1778 (page 159).
15-7168  (R)-1-[2-(Diphenylphosphino)phenyl]ethanaminium tetrafluoroborate, min. 97%
C_{20}H_{21}BF_4NP; FW: 393.16; white solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

100mg
500mg

15-7169  (S)-1-[2-(Diphenylphosphino)phenyl]ethanaminium tetrafluoroborate, min. 97%
C_{20}H_{21}BF_4NP; FW: 393.16; white solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

100mg
500mg

15-3152  4-Diphenylphosphinophenyl (2-methyl-3-[polyisobutyl (21)]propyl)ether (50% in heptane/polyisobutylene)
FW: 1513; colorless liq.

1g
5g

Technical Note:
1. Recyclable phosphine catalyst for use in allylic aminations.

15-7171  (R)-2-(Diphenylphosphino)-1-phenylethanaminium tetrafluoroborate, min. 97%
C_{20}H_{21}BF_4NP; FW: 393.16; white to pale yellow solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

100mg
500mg

15-7172  (S)-2-(Diphenylphosphino)-1-phenylethanaminium tetrafluoroborate, min. 97%
C_{20}H_{21}BF_4NP; FW: 393.16; white to pale yellow solid
air sensitive
Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.

100mg
500mg

Reference:
PHOSPHORUS – Ligands and Compounds

15-7118  (R)-1-[2-(Diphenylphosphino)phenyl]ethylamine, min. 97%  
[192057-60-6]  
C_{20}H_{20}NP; FW: 305.35; white solid  
air sensitive  

15-7119  (S)-1-[2-(Diphenylphosphino)phenyl]ethylamine,  
min. 97%  
[913196-43-7]  
C_{20}H_{20}NP; FW: 305.35; white solid  
air sensitive  

15-7121  (R)-2-(Diphenylphosphino)-1-phenylethylamine, min. 97%  
[141096-35-7]  
C_{20}H_{20}NP; FW: 381.45; white solid  
air sensitive  

15-7122  (S)-2-(Diphenylphosphino)-1-phenylethylamine, min. 97%  
[1103533-85-2]  
C_{20}H_{20}NP; FW: 381.45; white solid  
air sensitive  

26-1300  (R)-(-)-1-[(R)-2-(2’-Diphenylphosphino-phenyl)ferrocenyl]ethylbis(di-3,5-trifluoromethylphenyl)phosphine, min. 97%  
[387868-06-6]  
C_{46}H_{32}F_{12}FeP_{2}; FW: 930.52; orange pwdr.;  
[\alpha]D  -2° ±0.5° (c 0.5, CHCl_{3})  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).  

Technical Note:  
1. See 26-1315 (page 162).  

26-1310  (R)-(-)-1-[(R)-2-(2’-Diphenylphosphino-phenyl)ferrocenyl]ethylidicyclohexylphosphine, min. 97%  
[388079-60-5]  
C_{42}H_{48}FeP_{2}; FW: 670.62;  
orange pwdr.; [\alpha]D  -8° ±2° (c 0.5, CHCl_{3})  
Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).  

Technical Note:  
1. See 26-1315 (page 162).
### 26-1315

(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylidiphenylphosphine, min. 97% *[388079-58-1]*

C<sub>42</sub>H<sub>36</sub>FeP<sub>2</sub>; FW: 658.53; orange pwdr.; 

\[ \alpha_D^0 \quad +14^\circ \pm 1.5^\circ \quad (c 0.5, \text{CHCl}_3) \]

Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).

**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.

**References:**

### 26-1320

(R)-(+)-1-[(R)-2-(2'-Diphenylphosphinophenyl)ferrocenyl]ethylid(3,5-xylyl)phosphine, min. 97% *[494227-31-5]*

C<sub>46</sub>H<sub>44</sub>FeP<sub>2</sub>; FW: 714.63; orange pwdr.; 

\[ \alpha_D^0 \quad +21^\circ \pm 2^\circ \quad (c 0.5, \text{CHCl}_3) \]

Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).

**Technical Note:**
1. See 26-1315 (page 162).

### 15-1821

(R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydrooxazole, 98% *[164858-78-0]*

C<sub>24</sub>H<sub>24</sub>NOP; FW: 373.44; white pwdr.; 

\[ \alpha_D^0 \quad +44^\circ \quad (c 1.4, \text{CHCl}_3) \]

m.p. 77-80° air sensitive

Note: Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).
15-1821 (R)-(+)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydroxazole, 98% [164858-78-0]

Technical Notes:
1. Chiral ligand used in the asymmetric reduction of highly substituted olefins.
2. 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.

References:

15-1822 (S)-(-)-2-[2-(Diphenylphosphino)phenyl]-4-(1-methylethyl)-4,5-dihydroxazole, 98% [148461-14-7]

Technical Note:
1. See 15-1821 (page 162).

15-7159 (1R,2R)-1-(Diphenylphosphino)-1-phenylpropan-2-aminium tetrafluoroborate, min. 97%

NEW→

15-7160 (1S,2S)-1-(Diphenylphosphino)-1-phenylpropan-2-aminium tetrafluoroborate, min. 97%

NEW→

15-1767 3-(Diphenylphosphino)propylamine, min. 97% [16605-03-1]

NEW→

Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
### PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>Purity</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1769</td>
<td>3-(Diphenylphosphino)propylammonium tetrafluoroborate</td>
<td>((\text{C}_6\text{H}_5)_2\text{PCH}_2\text{CH}_2\text{CH}_2\text{NH}_3^+\text{(BF}_4^-);)</td>
<td>(331.10)</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{FW}: 331.10; \text{white solid air sensitive, hygroscopic})</td>
<td></td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-7189</td>
<td>(R)-8-(Diphenylphosphino)-1,2,3,4-tetrahydronaphthalen-1-aminium tetrafluoroborate, min. 97%</td>
<td>(\text{C}<em>{22}\text{H}</em>{23}\text{BF}_4\text{NP}; \text{FW: 419.20; white solid air sensitive})</td>
<td>(97%)</td>
<td>100mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.})</td>
<td></td>
<td>500mg</td>
</tr>
<tr>
<td>15-7190</td>
<td>(S)-8-(Diphenylphosphino)-1,2,3,4-tetrahydronaphthalen-1-aminium tetrafluoroborate, min. 97%</td>
<td>(\text{C}<em>{22}\text{H}</em>{23}\text{BF}_4\text{NP}; \text{FW: 419.20; white solid air sensitive})</td>
<td>(97%)</td>
<td>100mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.})</td>
<td></td>
<td>500mg</td>
</tr>
<tr>
<td>15-0164</td>
<td>((+)-(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]</td>
<td>(\text{C}<em>{44}\text{H}</em>{48}\text{P}_2\text{S}; \text{FW: 670.87; white pwdr. air sensitive, light sensitive})</td>
<td>(95%)</td>
<td>100mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{Note: Sold in collaboration with Solvias for research purposes only. Patent WO2005/108407.})</td>
<td></td>
<td>500mg</td>
</tr>
<tr>
<td>15-1827</td>
<td>Diphenyl(m-sulfonatophenyl)phosphine dihydrate sodium salt, min. 95% ([63995-75-5])</td>
<td>((\text{C}_6\text{H}_5)_2\text{P(}\text{C}_6\text{H}_5\text{SO}_3\text{Na})\cdot\text{H}_2\text{O}; \text{FW: 364.33 (400.36); white pwdr. Technical Note: A water-soluble phosphine ligand used in the formation of water-soluble catalysts.})</td>
<td>(95%)</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{FW: 364.33 (400.36); white pwdr. Technical Note: A water-soluble phosphine ligand used in the formation of water-soluble catalysts.})</td>
<td></td>
<td>5g</td>
</tr>
<tr>
<td>15-1825</td>
<td>Diphenyl(p-sulfonatophenyl)phosphine monohydrate dimethylsulfoxide adduct, potassium salt</td>
<td>((\text{C}_6\text{H}_5)_2\text{P(}\text{C}_6\text{H}_5\text{SO}_3\text{K})\cdot\text{H}_2\text{O}\cdot\text{CH}_3\text{SOCH}_3; \text{FW: 380.44 (476.59); white pwdr.})</td>
<td></td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\text{Note: Water soluble phosphine.})</td>
<td></td>
<td>5g</td>
</tr>
</tbody>
</table>
### PHOSPHORUS – Ligands and Compounds

15-1823 Diphenyl[3-(triethoxysilyl)propyl]phosphine, 98% [52090-23-0]
(C₆H₅)₂P(CH₂)₃Si(OCH₂CH₃)₃; FW: 390.53; colorless, oily liq.
*air sensitive, moisture sensitive*

Technical Note:
1. Useful ligand for the preparation of silica-immobilized metal catalysts.

<table>
<thead>
<tr>
<th>15-1800</th>
<th>Di-i-propylchlorophosphine, min. 98% [40244-90-4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>amp</td>
<td>(C₃H₇)₂PCl; FW: 152.60; colorless liq.; f.p. 39°F; d. 0.959</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-1795</th>
<th>Di-i-propylphosphine, 98% [20491-53-6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇)₂PH; FW: 118.16; colorless liq.<em>air sensitive, pyrophoric</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-1796</th>
<th>Di-i-propylphosphine, 98% (10 wt% in hexane) [20491-53-6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇)₂PH; FW: 118.16; colorless liq.<em>air sensitive</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-1802</th>
<th>1-Di-i-propylphosphino-2-(N,N-dimethylamino)-1H-indene, 99% [540492-51-1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁₇H₂₆NP; FW: 275.37; off-white xtl.<em>air sensitive</em></td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 45-0197 (Visit www.strem.com).

<table>
<thead>
<tr>
<th>15-1812</th>
<th>2-(Di-i-propylphosphino)ethylamine, min. 97% (10 wt% in THF) [1053657-14-9]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇)₂PCH₂CH₂NH₂; FW: 161.23; pale yellow to colorless liq.<em>air sensitive</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-1831</th>
<th>3-(Di-i-propylphosphino)propylamine, min. 97% (10 wt% in THF) [1196147-69-9]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇)₂PCH₂CH₂CH₂NH₂; FW: 175.25; colorless to pale yellow liq.<em>air sensitive</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>93-1527</th>
<th>Di-i-propylphosphite, min. 98% [1809-20-7]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇O)₂P(O)H; FW: 166.16; colorless liq.; b.p. 70-71°/9 mm; f.p. 156°F; d. 0.997</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-1813</th>
<th>2-(Di-i-propylphosphonium)ethalammonium bis(tetrafluoroborate), min. 97%</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZ</td>
<td>(C₃H₇)₂PH⁺CH₃CH₂NH₃⁺(BF₄)₂; FW: 336.85; white to beige solid<em>air sensitive, hygroscopic</em></td>
</tr>
</tbody>
</table>

Note: Sold under license from Kanata for research purposes only. PCT/CA2009/001412.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Formula</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1832</td>
<td>3-(Di-i-propylphosphonium)propylammonium bis(tetrafluoroborate)</td>
<td>(C₃H₇)₂PH⁺CH₂CH₂CH₂NH₃⁺(BF₄)₂; FW: 350.88; white solid</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Sold under license from Kanata for research purposes only. PCT/CA2009/001412.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1815</td>
<td>Di-o-tolylchlorophosphate, min. 98%</td>
<td>(CH₃C₆H₄)₂PCl; FW: 248.69; white solid to viscous liq.</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td><strong>HAZ</strong></td>
<td></td>
<td>5g</td>
</tr>
<tr>
<td>15-1820</td>
<td>Di-p-tolylphosphine, 99%</td>
<td>(CH₃C₆H₄)₂PH; FW: 214.25; colorless liq.</td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td><strong>amp</strong></td>
<td></td>
<td>10g</td>
</tr>
<tr>
<td></td>
<td><strong>HAZ</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1819</td>
<td>Di-p-tolylphosphine, 99% (10 wt% in hexane)</td>
<td>(CH₃C₆H₄)₂PH; FW: 214.25; colorless liq.</td>
<td>20g</td>
</tr>
<tr>
<td></td>
<td><strong>HAZ</strong></td>
<td></td>
<td>100g</td>
</tr>
<tr>
<td>15-7344</td>
<td>2-(Di-p-tolylphosphino)benzaldehyde, min. 97%</td>
<td>C₂₁H₁₉OP; FW: 318.12; yellow solid</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2g</td>
</tr>
<tr>
<td>15-2214</td>
<td>1-[(1R,2S)-1-(Di-o-tolylphosphinoxy)-1-phenylpropan-2-yl]-3-phenylurea, min. 97%</td>
<td>C₉₅H₉₃N₂O₂P; FW: 482.55; white pwdr.</td>
<td>50mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>250mg</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Sold under license from InCatT for research purposes only. WO2004/103559. UREAPHOS and METAMORPHOS Ligand Kit component. See (page 254).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-2212</td>
<td>1-[(2S)-1-(Di-o-tolylphosphinoxy)propan-2-yl]-3-phenylurea, min. 97%</td>
<td>C₂₉H₂₇N₂P; FW: 406.46; white pwdr.</td>
<td>50mg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>250mg</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Sold under license from InCatT for research purposes only. WO2004/103559. UREAPHOS and METAMORPHOS Ligand Kit component. See (page 254).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 15-2200 (page 135).
### PHOSPHORUS – Ligands and Compounds

#### 26-1560

(S)-(-)-[(S)-2-Di(3,5-xylyl)phosphino-ferroceny][2-di(4-trifluoromethyl-phenyl)phosphinophenyl]methanol, min. 97%  [851308-48-0]

- Chemical formula: $C_{53}H_{40}F_{6}FeOP_{2}$  
  - Molecular weight: 852.60
- Physical form: yellow powder
- $\left[\alpha\right]_D$ -44° (c 0.5, CHCl$_3$)

**Note:** Air-stable. Sold in collaboration with Solvias for research purposes only.

<table>
<thead>
<tr>
<th>Amount</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

#### 26-1565

(S)-(-)-[(S)-2-Di(3,5-xylyl)phosphino-ferroceny][2-di(3,5-xylyl)phosphinophenyl]methanol, min. 97%  [851308-45-7]

- Chemical formula: $C_{56}H_{50}FeOP_{2}$  
  - Molecular weight: 772.71
- Physical form: orange foam
- $\left[\alpha\right]_D$ -51° (c 0.5, CHCl$_3$)

**Note:** Air-stable. Sold in collaboration with Solvias for research purposes only.

<table>
<thead>
<tr>
<th>Amount</th>
<th>100mg</th>
<th>500mg</th>
</tr>
</thead>
</table>

#### 26-1555

(R)-(+)1-[(R)-2-(2'-Di-3,5-xylyl-phosphinophenyl)ferroceny] ethyldi-3,5-xylylphosphine, min. 97%  [494227-33-7]

- Chemical formula: $C_{50}H_{52}FeP_{2}$  
  - Molecular weight: 770.74
- Physical form: orange-red solid
- $\left[\alpha\right]_D$ +7° ±2° (c 0.5, CHCl$_3$)

**Note:** Sold in collaboration with Solvias for research purposes only. Solvias Walphos Ligand Kit component. See (page 243).

<table>
<thead>
<tr>
<th>Amount</th>
<th>100mg</th>
<th>500mg</th>
<th>2g</th>
</tr>
</thead>
</table>

**Technical Note:**
1. See 26-1315 (page 162).

#### 15-1835

n-Dodecylphosphonic acid, min. 97%  [5137-70-2]

- Chemical formula: $CH_{3}(CH_{2})_{11}P(O)(OH)_{2}$
- Molecular weight: 250.31
- Physical form: white to off-white powder
- Melting point: 96-98°

**Note:** Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).

<table>
<thead>
<tr>
<th>Amount</th>
<th>1g</th>
<th>5g</th>
</tr>
</thead>
</table>

---

info@strem.com  ·  technical@strem.com  ·  quotation@strem.com
PHOSPHORUS – Ligands and Compounds

15-0011 Ethyl/butyl phosphonic acid
Silica (PhosphonicS POH1)
white solid; S.A. 380 m²/g
Note: Sold in collaboration with PhosphonicS Ltd. for research purposes only. Also see 16-0760 (Visit www.strem.com).

- Particle size range: 60-200 microns
- Average pore size: 60Å
- Functional group loading: 0.8 to 1.0 mmol/g

Technical Note:
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.

Reference:

15-2100 Ethylidichlorophosphine, 98% [1498-40-4]
amp C₂H₅PCl₂; FW: 130.94; colorless liq.; b.p. 113-116°; f.p. 91°F; d. 1.26
air sensitive, moisture sensitive

15-2150 Ethylidiphenylphosphine, 99% [607-01-2]
HAZ (C₂H₅)(C₆H₅)₂P; FW: 214.25; colorless liq.; b.p. 130-132°/1 mm; f.p. >230°F; d. 1.04
air sensitive

15-2301 Ethyltriphenylphosphonium bromide, 99% [1530-32-1]
C₂H₅(C₆H₅)₃PBr; FW: 371.26; white to off-white pwdr.; m.p. 206-208°

93-1529 Fluorophosphoric acid, 60-70% [13537-32-1]
HAZ (HO)₂P(O)F; FW: 100.00; yellow liq.

93-1531 Hexafluorophosphoric acid, 60-70% [16940-81-1]
HAZ HPF₆; FW: 145.97; colorless to pale yellow liq.

15-2400 n-Hexadecylphosphonic acid, min. 97% [4721-17-9]
CH₃(CH₂)₁₅P(O)(OH)₂; FW: 306.42; white to off-white pwdr.; m.p. 96-99°
Note: Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).

93-1581 Hexadecyltri-n-butylphosphonium bromide, 98+% [14937-45-2]
(C₁₆H₃₃)(C₄H₉)₃PBr; FW: 507.65; white xtl.; m.p. 54-56°

93-1531 Hexafluorophosphoric acid, 60-70% [16940-81-1]
HAZ HPF₆; FW: 145.97; colorless to pale yellow liq.

15-5184 (11aR)-(−)-5,6,10,11,12,13-Hexahydro-5-phenyl-4H-diinden-7,1-cd:1’,7’-ef phosphocin, min. 97% (R)-SITCP [856407-37-9]
C₂₅H₂₃P; FW: 354.42; white solid; [α]₀ +6° (c 0.5, CH₂Cl₂);
m.p. 148-149°
moisture sensitive

NEW: 25mg

Visit www.strem.com for new product announcements.
PHOSPHORUS – Ligands and Compounds

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 [856407-37-9]

(cont.)

Technical Notes:
1. Chiral ligands for palladium-catalyzed, asymmetric, umpolung allylation of aldehydes.
2. Chiral ligands for copper-catalyzed, asymmetric ring-opening of oxabicyclic alkenes with Grignard reagents.
3. Chiral catalyst for cyclization reactions.

\[
\begin{align*}
R^1-\text{CHO} + R^2\text{C=CH(OH)} &\xrightarrow{5 \text{ mol}\% \text{ Pd(OAc)}_2, \text{10 mol}\% (R)-\text{SITCP}, \text{Et}_3\text{B, THF, 25 }^\circ\text{C}} \text{OH} \\
 &\quad \rightarrow \text{yield: 50-99%} \\
R^1 = \text{aryl, c-Hex} \\
R^2 = \text{Ph, H}
\end{align*}
\]

Technical Note (1)

Refernece:

15-2410 n-Hexylphosphonic acid, min. 97% [4721-24-8]
CH\(_3\)(CH\(_2\))\(_3\)P(O)(OH)\(_2\); FW: 166.16; white to off-white pwd.; m.p. 105-106°

Note: Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).

15-2900 1-Hydroxyethylidene-1,1-diphosphonic acid, min. 95% HEDP [2809-21-4]
C(OH)(CH\(_3\))(PO\(_3\)H\(_2\))\(_2\); FW: 206.03; white pwd.

15-2975 N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 95% [cataCXium\(^\circledR\) POMetB] [1053658-91-5]
C\(_{18}\)H\(_{28}\)NOP; FW: 317.41; white to yellowish pwd.

air sensitive

Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium\(^\circledR\) Ligand Kit component see (page 239).

Technical Note:
1. See 15-3550 (page 173).
### PHOSPHORUS – Ligands and Compounds

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-2980</td>
<td>1-(2-Methoxyphenyl)-2-(dicyclohexylphosphino)pyrrole, min. 95% [cataCXium® POMeCy]</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td>[672937-63-2]</td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td>C_{23}H_{32}NOP; FW: 369.48; white to yellow pwd.; m.p. 96-97° air sensitive</td>
<td>1-(2-Methoxyphenyl)-2-(dicyclohexylphosphino)pyrrole, min. 95% [cataCXium® POMeCy]</td>
</tr>
<tr>
<td></td>
<td>Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component see (page 239).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical Note:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Highly efficient ligand for the palladium-catalyzed Suzuki reaction using aryl chlorides.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Chemical structure" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reference:</td>
<td></td>
</tr>
<tr>
<td>15-3220</td>
<td>Methyldichlorophosphine, 98+% [676-83-5]</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>amp CH_{3}PCl_{2}; FW: 116.92; colorless liq.; b.p. 81°C; d. 1.31</td>
<td>25g</td>
</tr>
<tr>
<td></td>
<td>HAZ air sensitive, moisture sensitive</td>
<td></td>
</tr>
<tr>
<td>15-3250</td>
<td>Methyltriphenylphosphine, 99% [1486-28-8]</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>CH_{3}(C_{6}H_{5})_{2}P; FW: 200.22; colorless liq.; b.p. 118-120°C/2.2 mm; f.p. &gt;230°F; d. 1.065</td>
<td>25g</td>
</tr>
<tr>
<td></td>
<td>air sensitive</td>
<td>100g</td>
</tr>
<tr>
<td>15-3300</td>
<td>Methyl α-D-glucopyranoside-2,6-dibenzoate-3,4-di(bis(3,5-di-methylphenyl)phosphinite), min. 95% CARBOPHOS</td>
<td>100mg</td>
</tr>
<tr>
<td></td>
<td>[158214-06-3]</td>
<td>500mg</td>
</tr>
<tr>
<td></td>
<td>C_{53}H_{56}O_{8}P_{2}; FW: 882.98; white pwd.; m.p. 162-164°C air sensitive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical Note:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Sugar-based phosphinite ligand used in the asymmetric reduction of prochiral acetamidoacrylates.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>References:</td>
<td></td>
</tr>
<tr>
<td>15-3155</td>
<td>{2-Methyl-3-[polyisobutyl (20)]propyl}diphenylphosphate</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td>NEW-&gt; amp (50% in heptane/polyisobutylene)</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>(50% in heptane/polyisobutylene) FW: 1364; colorless liq.</td>
<td></td>
</tr>
<tr>
<td>15-3400</td>
<td>Methyltriphenylphosphonium bromide, 98+% [1779-49-3]</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>CH_{3}(C_{6}H_{5})_{3}PBr; FW: 357.23; white xtl.; m.p. 234-235°C</td>
<td>250g</td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
### 15-1530 (S)-2-(1-Naphthyl)-8-diphenylphosphino-1-((R)-3,5-dioxo-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl]-1,2-dihydroquinoline toluene adduct, min. 97% (Ra,Sc)-(1-Nph)-Quinaphos

\[ \text{C}_9\text{H}_{35}\text{NO}_2\text{P}_2\cdot\frac{1}{2}\text{C}_7\text{H}_8\text{H}_6; \]  
FW: 755.78 (801.85); white pwdr.  
moisture sensitive

Technical Note:

### 15-3490 (S)-(+)–Neomenthyldiphenylphosphine, 98% (S)-NMDPP

\[ \text{C}_{10}\text{H}_{19}\text{P(C}_6\text{H}_5)\text{2}; \]  
FW: 324.25; white xtl.;  
\([\alpha]_D +95.5^\circ \ (c \ 1.26, \text{CH}_2\text{Cl}_2); \] m.p. 90-92°C  
air sensitive

Technical Note:

### 15-3510 n-Octadecylphosphonic acid, min. 97% [4724-47-4]

\[ \text{CH}_3\text{(CH}_2)_{17}\text{P(O)(OH)}_2; \]  
FW: 334.47; white to off-white pwdr.;  
m.p. 100-101°C  
Note: Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).

Technical Note:
1. A ligand for enantioselective hydrogenation of prochiral functional olefins.

Reference:

### 12-Molybdophosphoric acid hydrate (ACS) [51429-74-4]

HAZ  
H$_3$PO$_4$·12MoO$_3$·XH$_2$O; FW: 1825.25; yellow xtl.

### 93-0739 Nitronium hexafluorophosphate, min. 97% [19200-21-6]

HAZ  
NO$_2$PF$_6$; FW: 190.97; white xtl.  
moisture sensitive

### 93-0736 Nitrosonium hexafluorophosphate, min. 97% [16921-91-8]

HAZ  
NOPF$_6$; FW: 174.96; white xtl.  
moisture sensitive

### 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% [389130-06-7]

\[ \text{C}_{22}\text{H}_{26}\text{NO}_2\text{P}; \]  
FW: 367.42; white pwdr.;  
\([\alpha]_D +318^\circ \ (c \ 0.63, \text{THF}); \] m.p. 112-113°C  
moisture sensitive, (store cold)  
Note: Sold in collaboration with DSM for research purposes only.  Patent WO 0204466.  
DSM's MonoPhos™ Ligand Kit component. See (page 214).

Technical Note:
## PHOSPHORUS – Ligands and Compounds

**15-2224**

<table>
<thead>
<tr>
<th>1-((1S,2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodi-naphtho[2,1-d:1’,2’-f][1,3,2]dioxaphosphepin-4-olox]-1-phenylpropan-2-yl)-3-phenylurea, min. 97%</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₃₆H₃₇N₂O₄P; FW: 592.86; white pwdr.</td>
</tr>
<tr>
<td>moister sensitive, (store cold)</td>
</tr>
<tr>
<td>Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).</td>
</tr>
</tbody>
</table>

**15-2222**

<table>
<thead>
<tr>
<th>1-((2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodi-naphtho[2,1-d:1’,2’-f][1,3,2]dioxaphosphepin-4-olox]propan-2-yl)-3-phenylurea, min. 97%</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₃₄H₃₃N₂O₄P; FW: 516.57; white pwdr.</td>
</tr>
<tr>
<td>moister sensitive, (store cold)</td>
</tr>
<tr>
<td>Note: Sold under license from InCatT for research purposes only. WO2004/103559. UREAPhos and METAMORPhos Ligand Kit component. See (page 254).</td>
</tr>
</tbody>
</table>

**15-3500**

<table>
<thead>
<tr>
<th>Octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide, min. 97% CMPO [83242-95-9]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₈H₁₇)(C₆H₅)P(O)CH₂CON[CH₂CH(CH₃)₂]₂; FW: 407.58; colorless to light yellow solid</td>
</tr>
</tbody>
</table>

**15-3520**

<table>
<thead>
<tr>
<th>n-Octylphosphonic acid, min. 97% [4724-48-5]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH₃(CH₂)₇P(O)(OH)₂; FW: 194.21; white to off-white pwdr.; m.p. 102-103°</td>
</tr>
<tr>
<td>Note: Long-Chain n-Alkylphosphonic Acid Kit component see (page 225).</td>
</tr>
</tbody>
</table>

**26-3575**

<table>
<thead>
<tr>
<th>1,2,3,4,5-Pentaphenyl-1’-(di-t-butylphosphino)ferrocene, 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₇₈H₇₀FeP; FW: 710.71; pink pwdr.</td>
</tr>
<tr>
<td>Note: Sold in collaboration with Johnson Matthey for research purposes only. Patent Application No WO 02/11883.</td>
</tr>
</tbody>
</table>

### Technical Notes:

1. Ligand used in the preparation of active Pd catalysts for C-C, C-N and C-O bond formation.
2. Ligand used in Pd-catalyzed α-arylation of azlactones.
3. Pd-catalyzed α-arylation of esters, amides and aldehydes.
PHOSPHORUS – Ligands and Compounds

1,2,3,4,5-Pentaphenyl-1’-(di-t-butylphosphino)ferrocene, 95%
CTC-Q-PHOS [312959-24-3]

References:

N-Phenyl-2-(di-t-butylphosphino)indol, min. 98%
[cataCXium® PlntB]
[740815-37-6]
C22H28NP; FW: 394.55;
white to yellow pwdr. 
air sensitive
Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component see (page 239).
Technical Notes:
1. Useful ligand for the Pd-catalyzed amination reaction.
2. Ligand used for the Pd-catalyzed arylation of phenols.
4. Ligand used for the Sonagashira reaction of aryl bromides.

References:

Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending.
PHOSPHORUS – Ligands and Compounds

15-3600  N-Phenyl-2-(di-t-butylphosphino)pyrrole, 95+% [cataCXium® PtB] [672937-61-0]

(cont.)

Technical Notes:
1. Ligand for Suzuki reaction of aryl chlorides.
2. Ligand for Pd-catalyzed amination of aryl and heteroaryl chlorides.

References:

15-4150  Phenylidichlorophosphine, 97% [644-97-3]
HAZ  C₆H₅PCl₂; FW: 178.99; yellow liq.; m.p. -51°; b.p. 225°; f.p. >230°F; d. 1.319 (20°)
air sensitive, moisture sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>50g</td>
<td>97%</td>
</tr>
<tr>
<td>250g</td>
<td>97%</td>
</tr>
<tr>
<td>1kg</td>
<td>97%</td>
</tr>
</tbody>
</table>

15-4155  Phenylidichlorophosphine, 99% [644-97-3]
HAZ  C₆H₅PCl₂; FW: 178.99; colorless to light yellow liq.; m.p. -51°; b.p. 225°; f.p. >230°F; d. 1.319 (20°)
air sensitive, moisture sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>50g</td>
<td>99%</td>
</tr>
<tr>
<td>250g</td>
<td>99%</td>
</tr>
</tbody>
</table>

15-4158  Phenylidichlorophosphine oxide, min. 94% [824-72-6]
HAZ  C₆H₅P(O)Cl₂; FW: 194.99; colorless to light yellow liq.; m.p. 3°; b.p. 258°; f.p. >230°F; d. 1.394 (25°)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>50g</td>
<td>94%</td>
</tr>
<tr>
<td>250g</td>
<td>94%</td>
</tr>
</tbody>
</table>

15-3605  N-Phenyl-2-(dicyclohexylphosphino)indol, min. 95% [cataCXium® PinCy]
C₂₆H₃₂NP; FW: 389.51; white to yellow pwdr.
air sensitive

Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component see (page 239).

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>500mg</td>
<td>95%</td>
</tr>
<tr>
<td>2g</td>
<td></td>
</tr>
</tbody>
</table>

15-3610  N-Phenyl-2-(dicyclohexylphosphino)pyrrole, 90% [cataCXium® PCy]
C₂₂H₃₀NP; FW: 339.45; white to yellow pwdr.; 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 see (page 239).

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Purity</th>
</tr>
</thead>
<tbody>
<tr>
<td>500mg</td>
<td>90%</td>
</tr>
<tr>
<td>2g</td>
<td></td>
</tr>
</tbody>
</table>
N-Phenyl-2-(dicyclohexylphosphino)pyrrole, 90% [cataCXium® PCy]

Technical Note:
1. Useful ligand for the Ru-catalyzed amination of diols.

Reference:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Formula</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-4250</td>
<td>Phenylidimethoxyphosphine, 98% [2946-61-4]</td>
<td>C₆H₅(CH₃O)₂P</td>
<td>1g, b.p. 77-79°/7 mm; f.p. &gt;230°F; d. 1.072</td>
</tr>
<tr>
<td>15-4400</td>
<td>Phenylphosphine, 99% [638-21-1]</td>
<td>C₆H₅PH₂</td>
<td>2g, b.p. 160°; f.p. 165°F; d. 1.001; STENCH</td>
</tr>
<tr>
<td>15-4402</td>
<td>Phenylphosphine, 99% (Sure/Seal™ bottle) [638-21-1]</td>
<td>C₆H₅PH₂</td>
<td>25g, b.p. 160°; f.p. 165°F; d. 1.001; STENCH</td>
</tr>
<tr>
<td>93-1537</td>
<td>Phenylphosphonic acid, 98% [1571-33-1]</td>
<td>(C₆H₅)₃P(O)(OH)₂</td>
<td>50g, m.p. 163-166°</td>
</tr>
<tr>
<td>15-4510</td>
<td>Phosphaadamantane ethyl Silica</td>
<td></td>
<td>500mg, white solid</td>
</tr>
</tbody>
</table>

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:
1. Supported, free phosphine used in the preparation of immobilized phosphine metal complexes.
26-3620  Phosphinoferrocene, 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.

15-4530  Phosphonitrilic chloride trimer, 98.5%
\[940-71-6\]
(PNCl$_2$)$_3$; FW: 347.66; white xtl.; m.p. 128.8°;
b.p. 127°/12 mm; d. 1.98
moisture sensitive

10g
50g

93-1541  Phosphoric acid (ACS), 85%
\[7664-38-2\]
H$_3$PO$_4$; FW: 98.00; colorless liq.; d. 1.685

1kg

93-1550  Phosphorus(III) bromide, 97+%  
\[7789-60-8\]
PBr$_3$; FW: 270.70; colorless to pale yellow liq.; m.p. -40°;
b.p. 172.9°; d. 2.852 (15°)
moisture sensitive

100g
500g

93-1587  Phosphorus(III) chloride, 98+%  
\[7719-12-2\]
PCl$_3$; FW: 137.33; colorless liq.; m.p. -111.8°; b.p. 76°;
d. 1.574
moisture sensitive

250g

93-1588  Phosphorus(III) chloride (99.999%-P) PURATREM  
\[7719-12-2\]

10g
50g
<table>
<thead>
<tr>
<th>Reference</th>
<th>Product Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>93-1545</td>
<td>Phosphorus(V) chloride, 98% [10026-13-8]</td>
</tr>
<tr>
<td></td>
<td>HAZ PCl₅; FW: 208.24; white to pale yellow xtl.; m.p. 166.8° subl. moisture sensitive</td>
</tr>
<tr>
<td>15-4560</td>
<td>Phosphorus(III) fluoride, 99% [7783-55-3]</td>
</tr>
<tr>
<td></td>
<td>HAZ PF₃; FW: 87.98; colorless gas; m.p. -151.30°; b.p. -101.38°; d. 3.90g/L air sensitive, moisture sensitive</td>
</tr>
<tr>
<td>93-1551</td>
<td>Phosphorus(III) iodide, 98+% [13455-01-1]</td>
</tr>
<tr>
<td></td>
<td>amp Pi₃; FW: 411.58; black xtl.; m.p. 61°; d. 4.18 moisture sensitive</td>
</tr>
<tr>
<td>93-1548</td>
<td>Phosphorus(V) oxide, 98+% (ACS) [1314-56-3]</td>
</tr>
<tr>
<td></td>
<td>HAZ P₂O₅; FW: 141.95; white pwdr.; m.p. 580-585°; b.p. 300° subl.; d. 2.39 hygroscopic</td>
</tr>
<tr>
<td>93-1592</td>
<td>Phosphorus(V) oxide (99.99%-P) PURATREM [1314-56-3]</td>
</tr>
<tr>
<td></td>
<td>HAZ P₂O₅; FW: 141.95; white pwdr.; m.p. 580-585°; b.p. 300° subl.; d. 2.39 hygroscopic</td>
</tr>
<tr>
<td>93-1586</td>
<td>Phosphorus oxybromide, 99% [7789-59-5]</td>
</tr>
<tr>
<td></td>
<td>amp POBr₃; FW: 286.73; colorless to light yellow xtl.; m.p. 56°; b.p. 193°; d. 2.822 moisture sensitive</td>
</tr>
<tr>
<td>93-1543</td>
<td>Phosphorus oxychloride, 98+% [10025-87-3]</td>
</tr>
<tr>
<td></td>
<td>amp POCl₃; FW: 153.35; colorless liq.; m.p. 2°; b.p. 105.3°; d. 1.675 moisture sensitive</td>
</tr>
<tr>
<td>97-8875</td>
<td>Phosphorus oxychloride, elec. gr. (99.999%-P) PURATREM [10025-87-3]</td>
</tr>
<tr>
<td></td>
<td>HAZ POCl₃; FW: 153.35; colorless liq.; m.p. 2°; b.p. 105.3°; d. 1.675 moisture sensitive</td>
</tr>
<tr>
<td>93-1552</td>
<td>Polyphosphoric acid (83% P₂O₅) [8017-16-1]</td>
</tr>
<tr>
<td></td>
<td>HAZ H₃PO₄·P₂O₅; FW: 239.95; viscous liq. moisture sensitive</td>
</tr>
<tr>
<td>19-2610</td>
<td>Potassium di-t-butylphosphate, min. 91% (contains &lt;5% water) [33494-80-3]</td>
</tr>
<tr>
<td></td>
<td>HAZ K[OP(O)(OC₄H₉)₂]; FW: 248.30; white pwdr. moisture sensitive</td>
</tr>
<tr>
<td>15-4581</td>
<td>n-Propyldichlorophosphine, min. 98% [15573-31-6]</td>
</tr>
<tr>
<td></td>
<td>HAZ n-C₃H₇PCl₂; FW: 144.97; colorless liq.; b.p. 133°; d. 1.118 air sensitive, moisture sensitive</td>
</tr>
<tr>
<td>26-4011</td>
<td>(R,R)-[2-(4’-i-Propyl-oxazolin-2’-yl) ferrocenyl]diphenylphosphine, min. 97% [541540-70-9]</td>
</tr>
<tr>
<td></td>
<td>HAZ C₆₀H₂₈FeNOP; FW: 481.35; orange solid air sensitive</td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Purity</th>
<th>Molecular Formula</th>
<th>FW</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-4010</td>
<td>(S,S)-[2-(4'-i-Propyloxazolin-2'-yl)ferrocenyldiphenylphosphine, min. 97% [163169-29-7]</td>
<td></td>
<td>C_{28}H_{28}FeNOP</td>
<td>481.35</td>
<td>100mg 500mg</td>
</tr>
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</tr>
<tr>
<td>93-1579</td>
<td>Tetra-n-butylphosphonium bromide, 98% [3115-68-2]</td>
<td></td>
<td>(C_{4}H_{9})_{4}PBr</td>
<td>339.35</td>
<td>25g 100g</td>
</tr>
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<tr>
<td>15-5145</td>
<td>n-Tetradecylphosphonic acid, min. 97% [4671-75-4]</td>
<td></td>
<td>CH_{3}(CH_{2})<em>{13}P(O)(OH)</em>{2}</td>
<td>278.37</td>
<td>1g 5g 25g</td>
</tr>
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</tr>
<tr>
<td>15-5162</td>
<td>(11aR)-(+)10,11,12,13-Tetrahydrodiindenol[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (R)-SIPHOS-PE [500997-69-3]</td>
<td></td>
<td>C_{33}H_{32}NO_{2}P</td>
<td>505.59</td>
<td>100mg 500mg</td>
</tr>
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</tbody>
</table>

**Technical Notes:**

1. Ligand used for the asymmetric palladium-catalyzed hydrosilylation of styrenes. Preparation of chiral alcohols.
2. Ligand used for the highly enantioselective nickel-catalyzed hydrovinylation of \( \alpha \)-alkyl vinylarenes.

**References:**


<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Purity</th>
<th>Molecular Formula</th>
<th>FW</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-5163</td>
<td>(11aS)-(-)-10,11,12,13-Tetrahydrodiindenol[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin-5-bis[(R)-1-phenylethyl]amine, min. 98% (S)-SIPHOS-PE [500997-70-6]</td>
<td></td>
<td>C_{33}H_{32}NO_{2}P</td>
<td>505.59</td>
<td>100mg 500mg</td>
</tr>
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</tbody>
</table>

**Technical Notes:**

1. See 15-5162 (page 180).
**PHOSPHORUS – Ligands and Compounds**

**15-5150**

(11aR)-(+)\text{-}10,11,12,13-Tetrahydrodiindenol[7,1-de:1\text{'}-de:1\text{'}-fg][1,3,2]dioxaphosphocin-5-dimethylamine, min. 98%

**(R)**\text{-}SIPHOS \[443965-14-8\]

C_{19}H_{20}NO_{2}P; FW: 325.34; white solid; \([\alpha]_D^{+505^\circ} (c \ 0.5, \text{CH}_2\text{Cl}_2); \ m.p. 95-96^\circ\text{C}

*moisture sensitive*

Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component see (page 244).

**Technical Notes:**

1. Ligand used for the rhodium-catalyzed asymmetric Pauson-Khand reaction.
2. Ligand used for the rhodium-catalyzed asymmetric hydrogenation of \(\beta\)-dehydroamino esters.

**References:**


**15-5151**

(11aS)-(\text{-})\text{-}10,11,12,13-Tetrahydrodiindenol[7,1-de:1\text{'}-de:1\text{'}-fg][1,3,2]dioxaphosphocin-5-dimethylamine, min. 98%

**(S)**\text{-}SIPHOS \[443965-10-4\]

C_{19}H_{20}NO_{2}P; FW: 325.34; white solid; \([\alpha]_D^{-502^\circ} (c \ 0.5, \text{CH}_2\text{Cl}_2); \ m.p. 95-96^\circ\text{C}

*moisture sensitive*

Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component see (page 244).

**Technical Note:**

1. See 15-5150 (page 181).

**15-5156**

(11aR)-(\text{-})\text{-}10,11,12,13-Tetrahydrodiindenol[7,1-de:1\text{'}-de:1\text{'}-fg][1,3,2]dioxaphosphocin-5-phenoxy, min. 98%

**(R)**\text{-}ShiP \[656233-53-3\]

C_{23}H_{19}O_{3}P; FW: 374.37; white solid; \([\alpha]_D^{+216^\circ} (c \ 0.5, \text{CH}_2\text{Cl}_2); \ m.p. 104-106^\circ\text{C}

*moisture sensitive*

Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component see (page 244).

**Technical Notes:**

1. Ligand used in the enantioselective rhodium-catalyzed addition of arylboronic acids to aldehydes.
2. Ligand used in the palladium-catalyzed asymmetric hydrovinylation under mild conditions.
3. Ligand used in the highly regioselective, asymmetric copper-catalyzed allylic alkylation with dialkylzincs.

**References:**


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PHOSPHORUS – Ligands and Compounds

15-5157  (11aS)–(-)-10,11,12,13-Tetrahydrodiindenol[7,1-de:1′,7′-fg] [1,3,2]dioxaphosphocin-5-phenoxy, min. 98% (S)-ShiP [885701-71-3]
C_{23}H_{19}O_3P; FW: 374.37; white solid; [α]_D -213° (c 0.5, CH_2Cl_2); m.p. 102-103° moisture sensitive
Note: Spiro Monophosphite and Monophosphoramidite Ligand Kit component see (page 244).

Technical Note:

15-5200  (R)-(+)-2,2′,6,6′-Tetramethoxy-4,4′-bis(diphenylphosphino)-3,3′-bipyridine, min. 95% CTH-(R)-P-Phos [221012-82-4]
C_{30}H_{34}N_2O_4P_2; FW: 644.64; white to pale yellow pwdr.
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. New class of highly effective chiral dipyridylphosphine ligands used in the asymmetric hydrogenation of 2-arylacrylic acids, β-ketoesters, aryl ketones, and α-dehydroamino acids.
2. Ligand used in the Pd-catalyzed asymmetric bis-alkoxycarbonylation of styrene.

![Chemical Structures](image_url)
R)-(+)-2,2',6,6'-Tetramethoxy-4,4′-bis(diphenylphosphino)-3,3′-bipyridine, min. 95% CTH-(R)-P-Phos [221012-82-4]

C30H34N2O4P2; FW: 644.64; white to pale yellow pwdr.

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.

References:

(S)-(-)-2,2',6,6'-Tetramethoxy-4,4′-bis(diphenylphosphino)-3,3′-bipyridine, min. 95% CTH-(S)-P-Phos [362524-23-0]

C30H34N2O4P2; FW: 644.64; white to pale yellow pwdr.

Technical Notes:
1. Ligand used in the asymmetric hydrogenation of 2-arylacrylic acids, aryl ketones, and β-ketoesters.
2. Ligand used in the asymmetric 1,4-addition of arylboronic acids to α,β-unsaturated ketones.

References:
15-5210 (R)-(+)-2,2’,6,6’-Tetramethoxy-4,4’-bis(di(3,5-xylyl)phosphino)-3,3’-bipyridine, min. 95%  
CTH-(R)-Xylyl-P-Phos  
[442905-33-1]  
C₄₆H₅₀N₂O₄P₂; FW: 756.85; white to pale yellow pwdr.  
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 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.

References:

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]  
C₄₆H₅₀N₂O₄P₂; FW: 756.85; white to pale yellow pwdr.  
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 β-keto esters.
3. Chiral ligand for ruthenium catalyzed hydrogenation of (E)-β-(acylamino)acrylates to β-amino acids.
4. The Rhodium complex gives higher enantioselectivity for hydrogenation of (Z)-β-(acylamino)acrylates to β-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.
(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]

\[
\text{MeO}_2\text{C} \quad \text{Me} \quad \text{NHAc} \quad \text{MeO}_2\text{C} \quad \text{Me} \quad \text{NHAc}
\]
1 mol% RuLC\(_6\)H\(_6\)Cl
1 atm H\(_2\), THF, 12 h
99.4%, 97.3% ee

\[
\text{R}^1 \quad \text{O} \quad \text{R}^2
\]
1. CuF\(_2\), L, PhSiH\(_3\)
PhMe, air
2. aq. HCl
70 - 97% ee

\[
\text{OCO}_2\text{Et}
\quad \text{O}
\quad \text{OCO}_2\text{Et}
\]
5 mol% [Rh(cod)OH]\(_2\)
12 mol% L
Cs\(_2\)CO\(_3\), THF, 50 °C
25 - 95% ee
70 - 92% ee

References:
### 15-0506

**Tetramethyl 6,6'-bis(diphenylphosphino)-1,1',3,3'--tetrahydro[5,5']biindenyl-2,2',2,2'-tetracarboxylate, 99%**

C₄₈H₄₄O₈P₂; FW: 810.81; white to pale yellow pwdr.

Note: Sold under license from NCL for research purposes only. Patent Pending GB 0719134.9 and its international derivatives.

#### Technical Note:
1. See 15-0502 (page 60).

### 15-5355

**1,3,5,7-Tetramethyl-6-phenyl-2,4,8-trioxa-6-phosphaadamantane, 99%**

[C₉H₁₇O₃P; FW: 292.31; white pwdr.; m.p. 107-109°

Air sensitive, moisture sensitive

#### Technical Note:
1. A bulky, robust, and electron-poor ligand that gives efficient rhodium hydroformylation and palladium cross-coupling catalysts.

#### References:

### 15-5360

**Tetramethylphosphonium bromide, 98% [4519-28-2]**

(CH₃)₄P⁺Br⁻; FW: 171.02; colorless xtl.

Hygroscopic

### 15-5450

**Tetraphenylphosphonium bromide, 99% [2751-90-8]**

(C₆H₅)₄P⁺Br⁻; FW: 419.30; white xtl.; m.p. 294-296°

Hygroscopic

### 93-1591

**Thiophosphoryl chloride, 98% [3982-91-0]**

PSCl₃; FW: 169.40; colorless liq.; m.p. -35°; b.p. 125°; d. 1.668

Moisture sensitive

### 15-5600

**p-Tolylidiphenylphosphine, min. 96% [1031-93-2]**

(p-C₇H₅C₆H₄)(C₆H₅)₂P; FW: 276.32; white xtl.; m.p. 64-66°

### 15-5700

**Triallylphosphine, min. 97% [16523-89-0]**

(CH₂=CHCH₂)₃P; FW: 154.19; colorless to pale yellow liq.; b.p. 69°/13 mm; d. 0.861

Air sensitive

### 93-1556

**Tri-n-amylphosphate, min. 97% [2528-38-3]**

(C₅H₁₁O)₃P(O); FW: 308.40; colorless liq.
15-5710 1,3,5-Triaza-7-phosphaadamantane, min. 97%  
[53597-69-6]  
C₈H₁₂N₃P; FW: 157.15; white xtl.  

Technical Note:  
1. Air-stable, water soluble version of trimethylphosphine.

15-5750  
<table>
<thead>
<tr>
<th>HAZ</th>
<th>Tri-i-butylphosphine, min. 93% [4125-25-1]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(i-C₄H₉)₃P; FW: 202.32; colorless to light yellow liq.;</td>
</tr>
<tr>
<td></td>
<td>b.p. 85°/7mm</td>
</tr>
</tbody>
</table>

15-5801  
| HAZ | Tri-n-butylphosphine, min. 93% [998-40-3] |
|     | (n-C₄H₉)₃P; FW: 202.32; colorless to light yellow liq.; |
|     | b.p. 110-115°/10-12 mm; f.p. 99°F; d. 0.817 |

15-5800  
| HAZ | Tri-n-butylphosphine, 99% [998-40-3] |
|     | (n-C₄H₉)₃P; FW: 202.32; colorless liq.; |
|     | b.p. 110-115°/10-12 mm; f.p. 99°F; d. 0.817 |

15-5802  
| HAZ | Tri-n-butylphosphine, 99% (10 wt% in hexane) [998-40-3] |
|     | (n-C₄H₉)₃P; FW: 202.32; colorless liq. |

15-5810  
| HAZ | Tri-t-butylphosphine, 99% [13716-12-6] |
|     | (t-C₄H₉)₃P; FW: 202.32; colorless liq. to white solid; m.p. 30°; |
|     | b.p. 102-103°/13 mm; f.p. 1°F; d. 0.812 |

Technical Note:  
1. Useful as a ligand in a variety of palladium-catalyzed C-N, C-O and C-C bond-forming reactions under mild conditions.  
   (a) Amination of aryl halides.  
   
   \[
   \text{ArX} + \text{NHR''} \xrightarrow{\text{Pd/P(t-Bu)}_3} \text{Ar} - \text{NR''R''} \quad \text{Ref. (1,2)}
   \]
   
   (b) Aryl ether formation from aryl halides.  
   
   \[
   \text{ArX} + \text{t-BuONa} \xrightarrow{\text{Pd/P(t-Bu)}_3} \text{Ar} - \text{O-t-Bu} \quad \text{Ref. (3)}
   \]
   
   (c) Suzuki cross-coupling.  
   
   \[
   \text{ArX} + (\text{HO})_2B - \text{Ar}^2 \xrightarrow{\text{Pd/P(t-Bu)}_3} \text{Ar} - \text{Ar}^2 \quad \text{Ref. (4)}
   \]
   
   (d) Heck reaction for aryl chlorides.  
   
   \[
   \text{ArX} + \text{R'} \xrightarrow{\text{Pd/P(t-Bu)}_3} \text{Ar} - \text{R'} \quad \text{Ref. (5)}
   \]
   
   (e) Stille cross-coupling of aryl chlorides.  
   
   \[
   \text{ArX} + R_3\text{Sn} - \text{Ar}^2 \xrightarrow{\text{Pd/P(t-Bu)}_3} \text{Ar} - \text{Ar}^2 \quad \text{Ref. (6,9)}
   \]
**Tri-t-butylphosphine, 99% [13716-12-6]**

**HAZ**

- **(f)** Sonogashira reaction for aryl bromides.

\[
\text{ArX} + \text{Pd/P(t-Bu)}_3 \quad \xrightarrow{\text{Pd/P(t-Bu)}_3} \quad \text{Ar} + R' \quad \text{Ref. (7,11)}
\]

- **(g)** Ketone and malonate arylation.

\[
\text{ArX} + \text{R'COOH} + \text{R''COOEt} \quad \xrightarrow{\text{Pd/P(t-Bu)}_3} \quad \text{R'} \quad \text{Ref. (8)}
\]

- **(h)** Cyanation of aryl bromides.

\[
\text{ArBr} + \text{Zn(CN)}_2 \quad \xrightarrow{\text{Pd/P(t-Bu)}_3} \quad \text{Ar} - \text{CN} \quad \text{Ref. (10)}
\]

- **(i)** Heterocycle amination.

\[
\text{Br} + \text{NHR}_2 \quad \xrightarrow{\text{Pd/P(t-Bu)}_3} \quad \text{NR}_2 \quad \text{Ref. (12)}
\]

- **(j)** Decarboxylative coupling of alkynyl carboxylic acids and aryl halides.

\[
\text{ArX} + \text{R} - \text{COOH} \quad \xrightarrow{\text{Pd/P(t-Bu)}_3} \quad \text{R} - \text{Ar} \quad \text{Ref. (15)}
\]

**References:**


**Tri-t-butylphosphine, 99% (10 wt% in hexane)**

**HAZ**

- **(t-C_4H_9)_{3}P; FW: 202.32; colorless liq.; d. 0.680 air sensitive**

**Technical Note:**

1. See 15-5810 (page 186).
Phosphorus – Ligands and Compounds

15-5812 Tri-t-butylphosphine, 99% (10 wt% in hexane) (Sure/Seal™ bottle) [13716-12-6]
(t-C₄H₉)₃P; FW: 202.32; colorless liq.; d. 0.680
air sensitive

Technical Note:
1. See 15-5810 (page 186).

15-5813 Tri-t-butylphosphine, min. 98% [13716-12-6]
(t-C₄H₉)₃P; FW: 202.32; colorless liq. to white solid; m.p. 30°C;
b.p. 102-103°C/13 mm; f.p. 1°F; d. 0.812
pyrophoric

15-5950 Tri-n-butylphosphite, min. 94% [102-85-2]
(n-C₄H₉O)₃P; FW: 250.32; colorless liq.; b.p. 121-125°C/6 mm;
f.p. 197°F; d. 0.925
air sensitive

15-5990 Tri-n-butylphosphonium tetrafluoroborate, 99%
[(C₄H₉)₃PH]BF₄⁻; FW: 290.13; white pwdr.; m.p. 51-52°C

Technical Notes:
1. Air-stable, non-pyrophoric precursor of the Tri-n-butylphosphine ligand which is used in a variety of catalytic processes.
2. Baylis-Hillman reactions.
3. Azide reductions.
4. Acylation of alcohols by anhydrides.
5. Formate reduction of allyl carbonates.

O

H

O

OHO

1.5 equiv

20% catalyst

THF, rt, 1 h

Tech. Note (2)

Catalyst
(n-Bu)₃P / PhOH (1:1)
[n-(Bu)₃PH]BF₄ / PhONa (1:1)

Yield
96%
94%

CH₃(CH₂)₆CH₂N₃ + 1.05 eq. reagent
1) H₂O
2) TsCl / (i-Pr)₂NEt

CH₃(CH₂)₆CH₂N–Ts

Reagent
(n-Bu)₃P
[(n-Bu)₃PH]BF₄ / (i-Pr)₂NEt

Yield
77%
78%

Tech. Note (3)

n-BuMeOH + Bz₂O
10% catalyst

CH₂Cl₂, rt, 3 h

n-BuMeOBz

Catalyst
(n-Bu)₃P
[(n-Bu)₃PH]BF₄/NaOBz (1:1)
[(n-Bu)₃PH]BF₄/(i-Pr)₂NEt (1:1)

Yield
96%
97%
98%

Tech. Note (4)
15-5990 Tri-n-butylphosphonium tetrafluoroborate, 99% [113978-91-9]
(cont.)

Tri-n-butylphosphonium tetrafluoroborate, 99% [113978-91-9]

\[ ([\text{C}_6\text{H}_{10})_3\text{PH}]^+\text{BF}_4^-; \text{FW: 290.13; white pwdr.; m.p. 261° dec.} \]

Note: Phosphine Ligand Kit component. See (page 233).

References:

15-6000 Tri-t-butylphosphonium tetrafluoroborate, 99%

\[ ([\text{C}_4\text{H}_9)_{3}\text{PH}]^+\text{BF}_4^-; \text{FW: 290.13; white pwdr.; m.p. 261° dec.} \]

Technical Notes:
1. Air-stable, non-pyrophoric precursor of the Tri-t-butylphosphine ligand which is used in a variety of catalytic processes.
3. Heck Reactions.
5. α-Arylation and vinylation of arylmandelic acid derivatives.
6. Direct arylation.
7. Synthesis of benzocyclobutenes by C-H activation.

Ar—Br + (HO)\_2B—Ar' \overset{\text{Pd}_2(\text{dba})_3}{\longrightarrow} \text{Ar—Ar'}

Ar—Br + \overset{\text{COOCH}_3}{\text{CH}_3} \overset{\text{Pd}_2(\text{dba})_3}{\longrightarrow} \text{H}_3\text{C—COOCH}_3

Ar—Br + \overset{\text{R}_3\text{Sn—Ar'}}{\longrightarrow} \text{Ar—Ar'}

\[ \text{t-Bu} \overset{\text{Pd}}{\longrightarrow} \text{Ph} \]

\[ \text{Ph} \overset{\text{Pd}}{\longrightarrow} \]

\[ \text{Ph} \]

\[ \text{Ph} \]

\[ \text{Ph} \]

\[ \text{Ph} \]

\[ \text{Ph} \]

\[ \text{Ph} \]
**Tri-t-butylphosphonium tetrafluoroborate, 99% [131274-22-1]**

\[
\begin{align*}
\text{Ar-Br} & \quad \overset{\text{Pd}}{\underset{[(t-Bu)_3PH]BF_4}{\longrightarrow}} \quad (t-Bu)_3PN=NR^1\rightarrow R^2
\end{align*}
\]

Technical Note (6)  
Ref. (3)

**Tri-t-butylphosphonium trifluoromethanesulfonate, 99%**

**Stabiphos T [1106696-25-6]**

\[
[(C_4H_9)_3PH]^+CF_3SO_3^-; \text{FW: 352.40; white solid}
\]

1g  
5g

**Technical Note:**
1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.

Reference:

**Tributyl(tetradecyl)phosphonium dodecylbenzenesulfonate, min. 98% CYPHOS® IL 201**

\[
[(C_4H_9)_3(C_{16}H_{25})P]^+[(C_{12}H_{25}C_6H_4SO_3)]^-; \text{FW: 725.18; light yellow liq.}
\]

10g  
50g

**Tributyl(tetradecyl)phosphonium methanesulfonate, min. 98% CYPHOS® IL 203**

\[
[(C_4H_9)_3(C_{16}H_{25})P]^+CH_3SO_3^-; \text{FW: 494.80; light yellow liq.}
\]

10g  
50g

**Tri(m-chlorophenyl)phosphine, min. 97% [29949-85-7]**

\[
(m-ClC_6H_4)_3P; \text{FW: 365.63; white xtl.; m.p. 64-66°}
\]

1g  
5g

**Tri(p-chlorophenyl)phosphine, 99% [1159-54-2]**

\[
(p-ClC_6H_4)_3P; \text{FW: 365.63; white xtl.; m.p. 90-93°}
\]

1g  
5g

**Tricyclohexylphosphine, 97% [2622-14-2]**

\[
(C_6H_{11})_3P; \text{FW: 280.44; white xtl.; m.p. 76-78°}
\]

5g  
25g
# PHOSPHORUS – Ligands and Compounds

## 15-6151
**HAZ**

<table>
<thead>
<tr>
<th>Tricyclohexylphosphine (20% in toluene), min. 88%</th>
<th>100g</th>
<th>500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₆H₁₁)₃P; FW: 280.44; colorless to light yellow liq.; f.p. 40°F (toluene); d. 0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>air sensitive</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6160
**Tricyclohexylphosphonium tetrafluoroborate, 99%**

<table>
<thead>
<tr>
<th>[58656-04-5]</th>
<th>1g</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td>[(C₆H₁₁)₃PH]⁺BF₄⁻; FW: 368.24; white pwdr.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

## 15-6130
**NEW**

<table>
<thead>
<tr>
<th>Tricyclohexylphosphonium trifluoromethanesulfonate, 99% Stabiphos</th>
<th>1g</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td>[(C₆H₁₁)₃PH]⁺CF₃SO₃⁻; FW: 430.51; white solid</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6180
**Tricyclopentylphosphine, min. 95%**

<table>
<thead>
<tr>
<th>[7650-88-6]</th>
<th>5g</th>
<th>25g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₅H₉)₃P; FW: 238.35; colorless liq.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>pyrophoric</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6181
**Tricyclopentylphosphine, min. 95% (10wt% in hexane)**

<table>
<thead>
<tr>
<th>[7650-88-6]</th>
<th>50g</th>
<th>250g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₅H₉)₃P; FW: 238.35; colorless liq.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>air sensitive</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 93-1559
**Triethylphosphate, 99%**

<table>
<thead>
<tr>
<th>[78-40-0]</th>
<th>500g</th>
<th>4 x 500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅O)₃PO; FW: 182.16; colorless liq.; b.p. 215°; f.p. 240°F; d. 1.072</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6300
**Triethylphosphine, 99%**

<table>
<thead>
<tr>
<th>[554-70-1]</th>
<th>5g</th>
<th>25g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅)₃P; FW: 118.16; colorless liq.; b.p. 126-128°; f.p. 1°F; d. 0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>pyrophoric</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6302
**Triethylphosphine, 99% (Sure/Seal™ bottle)**

<table>
<thead>
<tr>
<th>[554-70-1]</th>
<th>25g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅)₃P; FW: 118.16; colorless liq.; b.p. 126-128°; f.p. 1°F; d. 0.81</td>
<td></td>
</tr>
<tr>
<td><strong>pyrophoric</strong></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6304
**Triethylphosphine, 99% (20 wt% in ethanol)**

<table>
<thead>
<tr>
<th>[554-70-1]</th>
<th>25g</th>
<th>125g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅)₃P; FW: 118.16; colorless liq.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>air sensitive</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6305
**Triethylphosphine, 99% (10 wt% in hexane)**

<table>
<thead>
<tr>
<th>[554-70-1]</th>
<th>50g</th>
<th>250g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅)₃P; FW: 118.16; colorless liq.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>air sensitive</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6310
**Triethylphosphine oxide, 98%**

<table>
<thead>
<tr>
<th>[597-50-2]</th>
<th>1g</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅)₂PO; FW: 134.16; white xtl.; m.p. 52-53°; b.p. 84-85°/3 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>hygroscopic</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 15-6350
**Triethylphosphite, 98%**

<table>
<thead>
<tr>
<th>[122-52-1]</th>
<th>250g</th>
<th>1kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C₂H₅O)₃P; FW: 166.16; colorless liq.; b.p. 156°; f.p. 130°F; d. 0.969</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>air sensitive</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PHOSPHORUS – Ligands and Compounds

15-6355 Triethylphosphonium tetrafluoroborate, 99%  
[(C₂H₅)₃PH]⁺BF₄⁻; FW: 205.97; white pwdr.  
hygroscopic

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

15-6372 Tri-2-furylphosphine, 98+% [5518-52-5]  
(C₄H₃O)₃P; FW: 232.17; white pwdr.; m.p. 63-65°;  
b.p. 136°/4mm  
air sensitive

Technical Notes:
1. Useful ligand for C-C coupling reactions.
2. Ligand used for the alkyne addition of thioesters.
3. Ligand used for enol ester formation.
4. 3-Component coupling.
5. C-C coupling reaction.
6. Trans-olefin formation.
7. Olefin formation from N-tosylhydrazones and benzyl halides.

\[
\begin{align*}
\text{R} - \text{SO}_2\text{Cl} & \quad + \quad \text{R}^1\text{SnBu}_3 & \quad \text{Pd/TFP} & \quad \text{CuBr} & \quad \text{DMS} & \quad \text{R} - \text{R}^1 \\
\text{O} & \quad + \quad \text{R}^1\text{C}=\text{C}=\text{H} & \quad \text{PdCl}_2(\text{dppf}) & \quad \text{TFP, Cul} & \quad \text{R} - \text{R}^1 \\
\text{O} & \quad + \quad \text{H} - \text{R} & \quad \text{TFP} & \quad [(\text{p-cymene})\text{RuCl}_2]_2 & \quad \text{R} - \text{R}^1 \\
\text{ArOH} & \quad + \quad 2 & \quad \text{TFP} & \quad \text{Pd(OAc)}_2 & \quad \text{ArO} - \text{Me} \\
\text{R}_n\text{InX}_{3-n} & \quad + \quad \text{Ar} - \text{X} & \quad \text{TFP} & \quad \text{Pd}_2(\text{dba})_3\text{CHCl}_3 & \quad \text{Ar-R} \\
\text{R} - \text{H} & \quad + \quad \text{R}^1\text{X} & \quad \text{Me}_3\text{SnCl, Pd, TFP} & \quad \text{R} - \text{R}^1
\end{align*}
\]
Tri-2-furylphosphine, 98+% [5518-52-5]

\[
\begin{align*}
\text{Ar} & \quad \text{X} \\
\text{Ph} & \quad \text{HN} \quad \text{N} \\
\text{Ph} & \quad \text{HN} \quad \text{N} \quad \text{N} \quad \text{N}
\end{align*}
\]

References:

15-6370 Trihexyl(tetradecyl)phosphonium bis(trifluoromethanesulfonyl)amide, min. 97% CYPHOS® IL 109
\[
\left[\text{CF}_{3}\text{SO}_{2}\text{N}\right]^{-}\text{FW: }764.00; \text{colorless liq.}
\]
Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).

15-6374 Trihexyl(tetradecyl)phosphonium bis(2,4,4-trimethylpentyl)phosphinate, min. 95% CYPHOS® IL 104
\[
\left[\text{CH}_{3}\text{CH}_{2}\text{CH}_{2}\text{CH}_{2}\text{CH}_{2}\text{P}\left(\text{O}\right)\text{O}\right]^{-}\text{FW: }773.27; \text{pale yellow liq.; d. }0.887
\]
Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).

15-6378 Trihexyl(tetradecyl)phosphonium bromide, min. 97% CYPHOS® IL 102
\[
\left[\text{Br}^{-}\text{FW: }563.76; \text{pale yellow liq.; d. }0.952
\]
Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).

15-6382 Trihexyl(tetradecyl)phosphonium chloride, min. 93% CYPHOS® IL 101
\[
\left[\text{Cl}^{-}\text{FW: }519.31; \text{colorless liq.; d. }0.894
\]
Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).

15-6386 Trihexyl(tetradecyl)phosphonium decanoate, min. 95% CYPHOS® IL 103
\[
\left[\text{CH}_{3}\text{CH}_{2}\text{COO}^{-}\text{FW: }655.11; \text{pale yellow semi solid; m.p. }24^\circ; \text{d. }0.883
\]
Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).
<table>
<thead>
<tr>
<th>15-6390</th>
<th>Trihexyl(tetradecyl)phosphonium dicyanamide, min. 95% CYPHOS® IL 105</th>
<th>10g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[(C₆H₁₃)₃(C₁₄H₂₉)P][NCNHCN]⁻</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>FW: 550.91; pale yellow liq.</td>
<td></td>
</tr>
<tr>
<td>Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6392</th>
<th>Trihexyl(tetradecyl)phosphonium dodecylbenzenesulfonate, min. 98% CYPHOS® IL 202</th>
<th>10g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[(C₆H₁₃)₃(C₁₄H₂₉)P][(C₁₂H₂₅)C₆H₄SO₃]⁻</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>FW: 809.34; light yellow liq.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6394</th>
<th>Trihexyl(tetradecyl)phosphonium hexafluorophosphate, min. 98% CYPHOS® IL 110</th>
<th>10g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[(C₆H₁₃)₃(C₁₄H₂₉)P]PF₆⁻</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>FW: 628.82; white solid; m.p. 50°; d. 1.013</td>
<td></td>
</tr>
<tr>
<td>Note: CYPHOS® IL Phosphonium Salt Ionic Liquid Kit 3 component. See (page 225).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6396</th>
<th>Trihexyl(tetradecyl)phosphonium methanesulfonate, min. 98% CYPHOS® IL 204</th>
<th>10g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[(C₆H₁₃)₃(C₁₄H₂₉)P]CH₃SO₃⁻</td>
<td>50g</td>
</tr>
<tr>
<td></td>
<td>FW: 578.96; light yellow liq.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6360</th>
<th>2,4,4-Trimethylpentylphosphine, 99% (8% isomers) [amp] [82164-75-8]</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HAZ CH₃C(CH₃)₂CH₂CH(CH₃)CH₂PH₂; FW: 146.21; colorless liq.; f.p. 1°F</td>
<td>25g</td>
</tr>
<tr>
<td></td>
<td>air sensitive, pyrophoric</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6362</th>
<th>1-(2,4,6-Trimethylphenyl)-2-(dicyclohexylphosphino)imidazole, min. 95% [cataCXium® PICy]</th>
<th>500mg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C₂₉H₃₅N₂P; FW: 382.52; white pwdr.; m.p. 109°</td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td>air sensitive</td>
<td></td>
</tr>
<tr>
<td>Note: Sold in collaboration with Solvias for research purposes only. Patent Application pending. Solvias cataCXium® Ligand Kit component see (page 239).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. See 15-2980 (page 170).

<table>
<thead>
<tr>
<th>15-6365</th>
<th>Trimethylphenylphosphonium iodide, min. 97% [1006-01-5]</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CH₃)₃C₆H₅PI; FW: 280.09; white xtl. hygroscopic</td>
<td>25g</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>93-1561</th>
<th>Trimethylphosphate, min. 97% [512-56-1]</th>
<th>50g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CH₃O)₃P(O); FW: 140.08; colorless liq.; m.p. -46°; b.p. 197°; d. 1.197</td>
<td>250g</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6500</th>
<th>Trimethylphosphine, min. 99% [594-09-2]</th>
<th>5g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CH₃)₃P; FW: 76.08; colorless liq.; m.p. -85°; b.p. 38-40°; f.p. -22°F; d. 0.748; STENCH</td>
<td>25g</td>
</tr>
<tr>
<td></td>
<td>air sensitive</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-6502</th>
<th>Trimethylphosphine, min. 99% (Sure/Seal™ bottle)</th>
<th>25g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CH₃)₃P; FW: 76.08; colorless liq.; m.p. -85°; b.p. 38-40°; f.p. -22°F; d. 0.748; STENCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>air sensitive</td>
<td></td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
### Trimethylphosphite, 97% [121-45-9]
- (CH₃O)₃P; FW: 124.08; colorless liq.; b.p. 110-112°; f.p. 82°F; d. 1.052
- air sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>250g</td>
<td></td>
</tr>
<tr>
<td>1kg</td>
<td></td>
</tr>
</tbody>
</table>

### Trimethylphosphonium tetrafluoroborate, 99% [154358-50-6]
- (CH₃)₃PHBF₄; FW: 163.89; white pwdr.
- hygroscopic

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1g</td>
<td></td>
</tr>
<tr>
<td>5g</td>
<td></td>
</tr>
</tbody>
</table>

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

### 2,8,9-Trimethyl-2,5,8,9-tetraaza-1-phospha-bicyclo[3.3.3]undecane VERKADE SUPERBASE [120666-13-9]
- C₉H₂₁N₄P; FW: 216.26; white waxy solid
- moisture sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>250mg</td>
<td></td>
</tr>
<tr>
<td>1g</td>
<td></td>
</tr>
</tbody>
</table>

Technical Note:
1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.

Reference:

### Tri(1-naphthyl)phosphine, min. 98% [3411-48-1]
- (1-C₁₀H₇)₃P; FW: 412.47; white powdr.; m.p. 265-268°

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1g</td>
<td></td>
</tr>
<tr>
<td>5g</td>
<td></td>
</tr>
</tbody>
</table>

### Tri-neo-pentylphosphite, min. 90% [14540-52-4]
- [(CH₃)₃CCH₂O]₃P; FW: 292.40; white xtl.; m.p. 55-57°; b.p. 80°/0.15 mm
- air sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1g</td>
<td></td>
</tr>
<tr>
<td>5g</td>
<td></td>
</tr>
</tbody>
</table>

### Tri-n-octylphosphine, min. 97% TOP [4731-53-7]
- (C₈H₁₇)₃P; FW: 370.60; colorless to pale yellow liq.; b.p. 175°/0.3mm; f.p. 280°F; d. 0.83
- air sensitive

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25g</td>
<td></td>
</tr>
<tr>
<td>100g</td>
<td></td>
</tr>
<tr>
<td>500g</td>
<td></td>
</tr>
</tbody>
</table>

Note: Surfactant for nanomaterial synthesis.

### Triocylphosphine oxide, min. 90% TOPO [78-50-2]
- (n-C₈H₁₇)PO; FW: 386.65; off-white xtl.; f.p. >230°F; d. 0.88
- hygroscopic

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100g</td>
<td></td>
</tr>
<tr>
<td>500g</td>
<td></td>
</tr>
</tbody>
</table>

Note: Surfactant for nanomaterial synthesis.

### Triocylphosphine oxide, 99% TOPO [78-50-2]
- (n-C₈H₁₇)PO; FW: 386.65; white to off-white solid; f.p. >230°F; d. 0.88
- hygroscopic

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25g</td>
<td></td>
</tr>
<tr>
<td>100g</td>
<td></td>
</tr>
</tbody>
</table>

Note: Surfactant for nanomaterial synthesis.

### Triphenylphosphate, 98% [115-86-6]
- (C₆H₅O)₃P(O); FW: 326.28; white xtl.; m.p. 49-51°; b.p. 244°/10 mm; f.p. 428°F

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500g</td>
<td></td>
</tr>
</tbody>
</table>

### Triphenylphosphine, 99% [603-35-0]
- (C₆H₅)₃P; FW: 262.28; white xtl.; m.p. 79°; b.p. 360°; f.p. 359°F

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100g</td>
<td></td>
</tr>
<tr>
<td>500g</td>
<td></td>
</tr>
<tr>
<td>2kg</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>15-6750</td>
<td>Triphenylphosphine oxide, 98% [791-28-6]</td>
</tr>
<tr>
<td></td>
<td>(C₆H₅)₃PO; FW: 278.28; white xtl.; m.p. 151-154°; d. 1.212</td>
</tr>
<tr>
<td>15-6730</td>
<td>Triphenylphosphine, polymer-bound, on styrene-divinylbenzene copolymer (20% cross-linked)</td>
</tr>
<tr>
<td></td>
<td>(C₆H₅)₃P; off-white beads, 20-60 mesh</td>
</tr>
<tr>
<td></td>
<td>air sensitive</td>
</tr>
<tr>
<td>15-6850</td>
<td>Triphenylphosphite, 97% [101-02-0]</td>
</tr>
<tr>
<td></td>
<td>(C₆H₅O)₃P; FW: 310.28; white to yellow xtl.; m.p. 22-24°; b.p. 360°; f.p. 425°F; d. 1.180-1.186</td>
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<tr>
<td>15-6949</td>
<td>Tri-i-propylphosphine, tech. gr., min. 90% [6476-36-4]</td>
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<td></td>
<td>(i-C₃H₇)₃P; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82</td>
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<tr>
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<td>pyrophoric</td>
</tr>
<tr>
<td>15-6950</td>
<td>Tri-i-propylphosphine, 98% [6476-36-4]</td>
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<td>(i-C₃H₇)₃P; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82</td>
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<td>pyrophoric</td>
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<tr>
<td>15-6952</td>
<td>Tri-i-propylphosphine, 98% (Sure/Seal™ bottle)</td>
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<td>[6476-36-4]</td>
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<td>(i-C₃H₇)₃P; FW: 160.24; colorless liq.; b.p. 176-178°; d. 0.82</td>
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<td>pyrophoric</td>
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<tr>
<td>15-6954</td>
<td>Tri-i-propylphosphine, 98% (10 wt% in hexane)</td>
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<td>[6476-36-4]</td>
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<td>(i-C₃H₇)₃P; FW: 160.24; colorless liq.</td>
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<tr>
<td>15-7050</td>
<td>Tri-n-propylphosphine, min. 95% [2234-97-1]</td>
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<td></td>
<td>(n-C₃H₇)₃P; FW: 160.24; colorless liq.; b.p. 185-188°; d. 0.807</td>
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<td>air sensitive</td>
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<tr>
<td>15-7070</td>
<td>Tri-n-propylphosphine oxide, min. 98% [1496-94-2]</td>
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<td>(n-C₃H₇)₃PO; FW: 176.24; white xtl.; m.p. 39°; b.p. 280-282°</td>
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<td>15-7000</td>
<td>Tri-i-propylphosphite, min. 94% [116-17-6]</td>
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<td>[(CH₃)₂CHO]₃P; FW: 208.24; colorless liq.; b.p. 63-64°/11 mm; f.p. 154°F; d. 0.844</td>
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<td>moisture sensitive</td>
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<tr>
<td>15-7200</td>
<td>2,8,9-Tri-i-propyl-2,5,8,9-tetraaza-1-phosphabicyclo[3.3.3]undecane [175845-21-3]</td>
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<tr>
<td></td>
<td>C₁₉H₃₂N₄P; FW: 300.42; yellow liq.; f.p. 185°F; d. 0.922</td>
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<td>moisture sensitive</td>
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Technical Note:
1. Exceedingly strong, non-ionic Brønsted and Lewis base useful in a variety of organic transformations.

Reference:
### PHOSPHORUS – Ligands and Compounds

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Amount</th>
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<tr>
<td>15-9159</td>
<td>2,4,6-Tripropyl-2,4,6-trioxo-1,3,5,2,4,6-trioxatriphosphorinane (Propylphosphonic acid anhydride 50% solution in N,N-dimethylformamide)</td>
<td>10g</td>
</tr>
<tr>
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<td>(C₃H₇O₂P)₃; FW: 318.20; slightly yellow to brown liq.</td>
<td>50g</td>
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<td>15-9160</td>
<td>2,4,6-Tripropyl-2,4,6-trioxo-1,3,5,2,4,6-trioxatriphosphorinane (Propylphosphonic acid anhydride 50% solution in ethyl acetate)</td>
<td>10g</td>
</tr>
<tr>
<td></td>
<td>(C₃H₇O₂P)₃; FW: 318.20; slightly yellow to brown liq.</td>
<td>50g</td>
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<tr>
<td>15-7400</td>
<td>Tris(2-carboxyethyl)phosphine, hydrochloride, 99%</td>
<td>1g</td>
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<tr>
<td></td>
<td>[51805-45-9] (HOOCCH₂CH₂)₃PH⁺Cl⁻; FW: 286.65; white xtl.</td>
<td>5g</td>
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<td>Technical Note:</td>
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<td></td>
<td>1. A water-soluble phosphine. Has been used in the selective reduction of disulfides.</td>
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<td>References:</td>
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<tr>
<td></td>
<td>2. Synthetic Communications, 2003, 33(20), 3503.</td>
<td></td>
</tr>
<tr>
<td>93-1564</td>
<td>Tris(2-chloroethyl)phosphine, 97% [115-96-8]</td>
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<tr>
<td></td>
<td>(CICH₂CH₂)₃P(O); FW: 285.52; colorless liq.; b.p. 330°; f.p. 450°F; d. 1.39</td>
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<tr>
<td>15-7680</td>
<td>Tris(2-cyanoethyl)phosphine, min. 99% [4023-53-4]</td>
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<td>P(CH₂CH₂CN)₃; FW: 193.19; white xtl.; m.p. 97-98°; b.p. 235°/0.9 mm</td>
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<tr>
<td>15-7720</td>
<td>Tris(2,4-di-t-butylphenyl)phosphite, 98% [31570-04-4]</td>
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<td></td>
<td>[[(CH₃)₂C₆H₃]₃P; FW: 646.93; white pwdr.; m.p. 181-184° moisture sensitive</td>
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<td></td>
<td>Note: Phosphine Ligand kit component. See (page 233).</td>
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<td>Technical Notes:</td>
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<td></td>
<td>2. Ligand for Pt-catalyzed intramolecular silaboration of alkenes.</td>
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<td></td>
<td>3. Ligand for Ni-catalyzed aminocarbonylation of aryl halides.</td>
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<td>References:</td>
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<td>15-7800</td>
<td>Tris(dimethylamino)phosphine, min. 98% HMPT</td>
<td>1g</td>
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<td>[1608-26-0] [(CH₃)₂N]₃P; FW: 163.21; yellow liq.; b.p. 49-51°/12 mm; f.p. 98°</td>
<td>5g</td>
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<td>air sensitive, moisture sensitive</td>
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<td>15-7830</td>
<td>Tris(2,4-dimethylphenyl)phosphine, 98% [49676-42-8]</td>
<td>500mg</td>
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<td>[[(CH₃)₂C₆H₃]₃P; FW: 346.45; white pwdr.; m.p. 157-158°</td>
<td>2g</td>
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<tr>
<td>15-7820</td>
<td>Tris(3,5-dimethylphenyl)phosphine, 98% [69227-47-0]</td>
<td>500mg</td>
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<tr>
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<td>[[(CH₃)₂C₆H₃]₃P; FW: 346.45; white xtl.; m.p. 160-163°</td>
<td>2g</td>
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<tr>
<td>Code</td>
<td>Description</td>
<td>Formula</td>
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<tr>
<td>15-7860</td>
<td>Tris(4,6-dimethyl-3-sulfonatophenyl)phoshine trisodium salt hydrate, min. 97% TXPTS</td>
<td>(CH₃)₂(C₆H₃)SO₃Na₃P·XH₂O</td>
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<td>15-7880</td>
<td>1,1,1-Tris(diphenylphosphino)methane, 97%</td>
<td>H₃C[P(C₆H₅)₂]₃</td>
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<td>15-7870</td>
<td>1,1,1-Tris(diphenylphosphinomethyl)ethane, min. 97%</td>
<td>CH₃C[CH₃P(C₆H₅)₂]₃</td>
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<td>15-7890</td>
<td>Tris(p-fluorophenyl)phoshine, 99%</td>
<td>(p-FC₆H₄)₃P</td>
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<tr>
<td>15-7900</td>
<td>Tris(hydroxymethyl)phoshine, min. 85%</td>
<td>P(CH₂OH)₃</td>
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<td>15-7901</td>
<td>Tris(hydroxymethyl)phoshine, min. 95%</td>
<td>P(CH₂OH)₃</td>
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<td>15-6375</td>
<td>Tris(3-hydroxypropyl)phoshine, min. 80%</td>
<td>(HOC₃H₆)₃P</td>
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<td>15-7940</td>
<td>Tris(4-methoxy-3,5-dimethylphenyl)phoshine, min. 98%</td>
<td>(OCH₃C₆H₄)₃P</td>
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<tr>
<td>15-7950</td>
<td>Tris(o-methoxyphenyl)phoshine, min. 98%</td>
<td>(o-CH₃OOC₆H₄)₃P</td>
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<td>15-7975</td>
<td>Tris(m-methoxyphenyl)phoshine, min. 97+%</td>
<td>(m-CH₃OOC₆H₄)₃P</td>
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<tr>
<td>15-8000</td>
<td>Tris(p-methoxyphenyl)phoshine, 98%</td>
<td>(p-CH₃OC₆H₄)₃P</td>
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<td>15-8005</td>
<td>Tris(pentafluorophenyl)phoshine, 98%</td>
<td>(C₆F₅)₃P</td>
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<td>15-8013</td>
<td>Tris(3-sulfonatophenyl)phoshine hydrate, sodium salt (&lt;5% oxide)</td>
<td>Na₃P(C₆H₃SO₃)₃·XH₂O</td>
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<tr>
<td>Code</td>
<td>Description</td>
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<tr>
<td>15-8007</td>
<td>Tris(3-sulfonatophenyl)phosphine hydrate, sodium salt (10-15% oxide) [63995-70-0]</td>
<td>250mg</td>
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<td>Na₃P(C₆H₄SO₃)₃·XH₂O; FW: 568.40; white to off-white pwdr.</td>
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<td>15-8010</td>
<td>Tris(p-trifluoromethylphenyl)phosphine, min. 97% [13406-29-6]</td>
<td>1g</td>
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<tr>
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<td>(p-CF₃C₆H₄)₃P; FW: 466.28; pale yellow pwdr.; m.p. 73-75°</td>
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<tr>
<td>15-8015</td>
<td>Tris(2,4,6-trimethoxyphenyl)phosphine, min. 97% [91608-15-0]</td>
<td>2g</td>
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<tr>
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<td>[[CH₃O]₃C₆H₂]₃P; FW: 532.54; light yellow pwdr.; m.p. 155-160°</td>
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<tr>
<td>15-8017</td>
<td>Tris(2,4,6-trimethylphenyl)phosphine, 98% [23897-15-6]</td>
<td>1g</td>
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<td>([CH₃]₃C₆H₂)₃P; FW: 388.53; white pwdr.; m.p. 185°</td>
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<tr>
<td>15-8020</td>
<td>Tris(trimethylsilyl)phosphine, min. 98% [15573-38-3]</td>
<td>250mg</td>
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<tr>
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<td>([CH₃)₃Si]₃P; FW: 250.54; colorless liq.; m.p. 24°C</td>
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<td>b.p. 102-105.5/16 mm; f.p. -1°F; d. 0.863</td>
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<tr>
<td>15-8021</td>
<td>Tris(trimethylsilyl)phosphine, min. 98% (10 wt% in hexane) [15573-38-3]</td>
<td>10g</td>
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<td>([CH₃)₃Si]₃P; FW: 250.54; colorless liq.</td>
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<td>air sensitive</td>
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<td>15-8050</td>
<td>Tri-o-tolylphosphine, 99% [6163-58-2]</td>
<td>5g</td>
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<td>(o-CH₃C₆H₄)₃P; FW: 304.37; white xtl.; m.p. 125-128°</td>
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<td>Note: Phosphine Ligand Kit component. See (page 233).</td>
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<td>15-8100</td>
<td>Tri-m-tolylphosphine, 98% [6224-63-1]</td>
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<td>(m-CH₃C₆H₄)₃P; FW: 304.37; white xtl.; m.p. 100°</td>
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<td>air sensitive</td>
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<tr>
<td>15-8120</td>
<td>Tri-p-tolylphosphine, 98% [1038-95-5]</td>
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<td>(p-CH₃C₆H₄)₃P; FW: 304.37; white xtl.; m.p. 145-148°</td>
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<td>air sensitive</td>
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<td>15-9150</td>
<td>Vinyldiphenylphosphine, min. 97% [2155-96-6]</td>
<td>1g</td>
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<td>(CH₂=CH)(C₆H₅)₃P; FW: 212.23; colorless to yellow liq.; b.p. 135°/3.5 mm; f.p. &gt;230°F; d. 1.067</td>
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<td>air sensitive, (store cold)</td>
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<td>15-9155</td>
<td>Vinylphosphonic acid, min. 90% [1746-03-8]</td>
<td>50g</td>
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<td>CH₂=CHP(O)(OH)₂; FW: 108.00; colorless to pale-yellow liq.</td>
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<td>(store cold)</td>
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<tr>
<td>15-9158</td>
<td>Vinylphosphonic acid dimethyl ester, min. 90% [4645-32-3]</td>
<td>50g</td>
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<td>CH₂=CHP(O)(OCH₃)₂; FW: 136.10; colorless liq.</td>
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<td>(store cold)</td>
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</table>
## 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 available for individual sale.

Contains the following:

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<th>Description</th>
<th>Quantity</th>
<th>Note</th>
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</thead>
<tbody>
<tr>
<td>46-1905</td>
<td>Palladium, 10% on activated wood carbon, reduced, 50% water wet</td>
<td>10g</td>
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<tr>
<td></td>
<td>(Escat™ 1931) [7440-05-3]</td>
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<tr>
<td>46-1906</td>
<td>Palladium, 10% on activated wood carbon, unreduced, 50%</td>
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<td>water wet (Escat™ 1921) [7440-05-3]</td>
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<tr>
<td>46-1907</td>
<td>Palladium, 3% on activated carbon, reduced, 50% water wet paste</td>
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<td>(Escat™ 1911) [7440-05-3]</td>
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<td>46-1908</td>
<td>Palladium, 5% on activated carbon, reduced, 50% water wet paste</td>
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<td>(Escat™ 1941) [7440-05-3]</td>
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<td>46-1909</td>
<td>Palladium, 5% on activated carbon, reduced, 50% water wet paste</td>
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<td>(Escat™ 1961) [7440-05-3]</td>
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<tr>
<td>46-1911</td>
<td>Palladium, 5% on activated carbon, reduced, 50% water wet paste</td>
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<td>(Escat™ 1971) [7440-05-3]</td>
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## BASF HETEROGENEOUS CATALYST KIT

**96-6717  BASF Heterogeneous Catalyst Kit**

Sold in collaboration with BASF for research purposes only. Components available for individual sale.

Contains the following:

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<td>44-4065</td>
<td>Ruthenium, 5% on activated carbon, reduced, 50% water wet paste</td>
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<td>(Escat™ 4401) [7440-18-8]</td>
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<td>45-1875</td>
<td>Rhodium, 5% on activated wood carbon, reduced,</td>
<td>1g</td>
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<td>50% water wet paste (Escat™ 3401) [7440-16-6]</td>
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<tr>
<td>46-1707</td>
<td>Palladium, 20% on activated carbon (Pearlman's catalyst), reduced,</td>
<td>5g</td>
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<td>50% water wet paste (Escat™ 1951) [7440-05-3]</td>
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<td>46-1710</td>
<td>Palladium, 0.6% on activated carbon, 50% water-wet paste</td>
<td>5g</td>
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<td>(NanoSelect LF 100) [7440-05-3]</td>
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<td>46-1901</td>
<td>Palladium, 5% on activated peat carbon, reduced,</td>
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<td>50% water wet paste (Escat™ 1621) [7440-05-3]</td>
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<td>46-1902</td>
<td>Palladium, 5% on activated wood carbon, reduced, dry</td>
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<td>(Escat™ 1431) [7440-05-3]</td>
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<td>46-1903</td>
<td>Palladium, 5% on activated wood carbon, reduced,</td>
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<td>50% water wet paste (Escat™ 1421) [7440-05-3]</td>
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<td>46-1904</td>
<td>Palladium, 5% on activated wood carbon, unreduced,</td>
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<td>50% water wet paste (Escat™ 1471) [7440-05-3]</td>
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<tr>
<td>46-1905</td>
<td>Palladium, 10% on activated wood carbon, reduced,</td>
<td>10g</td>
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<tr>
<td></td>
<td>50% water wet (Escat™ 1931) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1951</td>
<td>Palladium, 5% on alumina powder, reduced, dry</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1241) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1611</td>
<td>Platinum, 5% on activated wood carbon, reduced, dry</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 2431) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1612</td>
<td>Platinum, 5% on activated wood carbon, reduced,</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% water wet paste (Escat™ 2421) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1613</td>
<td>Platinum, 5% on activated carbon, unreduced,</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% water wet paste (Escat™ 2441) [7440-06-4]</td>
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</tr>
</tbody>
</table>
### BASF Metals Scavenging Agent Kit (MSA Kit)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>96-6700</td>
<td>BASF Metals Scavenging Agent Kit (MSA Kit)</td>
<td></td>
<td>Contains the following:</td>
</tr>
<tr>
<td></td>
<td>Metals removal for heterogeneous and homogeneous applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Components available for individual sale.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BASF metals scavenging agents (MSA’s) are alumina, carbon, or silica-based</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>air stable free flowing powders with proprietary surface coatings. These</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>are suitable for the removal of precious and base metal species from</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>organic, aqueous, protic and aprotic reaction mixtures with metal loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>capacities up to 13 wt% (depending on metal and process conditions).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MSA’s are designed for fixed bed or slurry applications, temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>stable up to 150°C and do not exhibit swelling seen with polymer-based</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>systems. Metals removed include: Pt, Pd, Rh, Ru, Ir, Ni, Cu, Fe.</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Research quantities available from Strem.</td>
<td></td>
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<tr>
<td></td>
<td>Commercial quantities available from BASF.</td>
<td></td>
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</tr>
<tr>
<td>06-0805</td>
<td>Metals scavenging agent, Phosphotungstic acid modified activated carbon</td>
<td>10g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>13-6300</td>
<td>Metals scavenging agent, Phosphotungstic acid modified alumina</td>
<td>10g</td>
<td></td>
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<tr>
<td>14-4351</td>
<td>Metals scavenging agent, Ethylenediamine modified silica</td>
<td>10g</td>
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</tr>
<tr>
<td>14-4353</td>
<td>Metals scavenging agent, Mercaptopropyl modified silica</td>
<td>10g</td>
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</table>

### BASF Palladium Catalyst Kit

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
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<tbody>
<tr>
<td>96-6719</td>
<td>BASF Palladium Catalyst Kit</td>
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<td>Contains the following:</td>
</tr>
<tr>
<td></td>
<td>Sold in collaboration with BASF for research purposes only.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Components available for individual sale.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1707</td>
<td>Palladium, 20% on activated carbon (Pearman’s catalyst), unreduced, 50%</td>
<td>5g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td></td>
<td>water wet paste (Escat™ 1951) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1710</td>
<td>Palladium, 0.6% on activated carbon, 50% water-wet paste (NanoSelect LF</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1901</td>
<td>Palladium, 5% on activated peat carbon, reduced, 50% water wet paste</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1621) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1902</td>
<td>Palladium, 5% on activated wood carbon, reduced, dry</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1431) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1903</td>
<td>Palladium, 5% on activated wood carbon, reduced, 50% water wet paste</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1421) [7440-05-3]</td>
<td></td>
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</tr>
<tr>
<td>46-1904</td>
<td>Palladium, 5% on activated wood carbon, unreduced, 50% water wet paste</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1471) [7440-05-3]</td>
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<td></td>
</tr>
<tr>
<td>46-1905</td>
<td>Palladium, 10% on activated wood carbon, reduced, 50% water wet</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1931) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1906</td>
<td>Palladium, 10% on activated wood carbon, unreduced, 50% water wet</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 1921) [7440-05-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46-1951</td>
<td>Palladium, 5% on alumina powder, reduced, dry (Escat™ 1241) [7440-05-3]</td>
<td>5g</td>
<td></td>
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</tbody>
</table>

### BASF Platinum Catalyst Kit

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<th>Notes</th>
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<tbody>
<tr>
<td>96-6721</td>
<td>BASF Platinum Catalyst Kit</td>
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<td>Contains the following:</td>
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<td></td>
<td>Sold in collaboration with BASF for research purposes only.</td>
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<tr>
<td></td>
<td>Components available for individual sale.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1611</td>
<td>Platinum, 5% on activated wood carbon, reduced, dry</td>
<td>5g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 2431) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1612</td>
<td>Platinum, 5% on activated wood carbon, reduced, 50% water wet paste</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Escat™ 2421) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1613</td>
<td>Platinum, 5% on activated carbon, unreduced, 50% water wet</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>paste (Escat™ 2441) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1614</td>
<td>Platinum, 3% on activated wood carbon, reduced, 70% water wet</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>paste (Escat™ 2931) [7440-06-4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-1661</td>
<td>Platinum, 5% on alumina powder, reduced, dry (Escat™ 2941) [7440-06-4]</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>78-1892</td>
<td>Platinum(IV) oxide hydrate (~80-82% Pt) (99.95+% Pt) [1314-15-4]</td>
<td>1g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ADAMS’ CATALYST [BASF C7018] [1314-15-4]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KITS - 1,1'-BIS(DIALKYL/DIARYLPHOSPHINO)FERROCENE LIGAND KIT

**96-3730 1,1'-Bis(dialkyl/diarylphosphino)ferrocene Ligand Kit**
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0150</td>
<td>500mg</td>
<td>1,1'-Bis(di-t-butylphosphino)ferrocene, min. 98% [84680-95-5]</td>
</tr>
<tr>
<td>26-0155</td>
<td>500mg</td>
<td>1,1'-Bis(dicyclohexylphosphino)ferrocene, min. 98% [146960-90-9]</td>
</tr>
<tr>
<td>26-0270</td>
<td>1g</td>
<td>1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF [12150-46-8]</td>
</tr>
<tr>
<td>26-0275</td>
<td>500mg</td>
<td>1,1'-Bis(di-i-propylphosphino)ferrocene, min. 98% [97239-80-0]</td>
</tr>
</tbody>
</table>

**[1,1'-BIS(DIALKYL/DIARYLPHOSPHINO)FERROCENE]PALLADIUM(II) DICHLORO CATALYST KIT**

**96-3735 [1,1'-Bis(dialkyl/diarylphosphino)ferrocene]palladium(II) dichloro Catalyst Kit**
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>46-0445</td>
<td>500mg</td>
<td>Dichloro[1,1'-bis(di-t-butylphosphino)ferrocene]palladium(II), 99% [95408-45-0]</td>
</tr>
<tr>
<td>46-0450*</td>
<td>1g</td>
<td>Dichloro[1,1'-bis(diphenylphosphino)ferrocene]palladium(II) dichloromethane adduct [95464-05-4]</td>
</tr>
<tr>
<td>46-0455*</td>
<td>250mg</td>
<td>Dichloro[1,1'-bis(dicyclohexylphosphino)ferrocene]palladium(II), dichloromethane adduct, 99% [917511-90-1]</td>
</tr>
<tr>
<td>46-0460</td>
<td>500mg</td>
<td>Dichloro[1,1'-bis(di-i-propylphosphino)ferrocene]palladium (II), 99% [215788-65-1]</td>
</tr>
</tbody>
</table>

*Note: CH2Cl2 adduct

Visit www.strem.com for new product announcements.
### Buchwald Biaryl Phosphine Ligand Master Kit

for Aromatic Carbon-Heteroatom Formation, Suzuki Coupling and Negishi Cross-coupling.


Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1152</td>
<td>PCy₂OMe</td>
<td>250mg</td>
</tr>
<tr>
<td>15-1043</td>
<td>PCy₂</td>
<td>250mg</td>
</tr>
<tr>
<td>15-1045</td>
<td>PCy₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1048</td>
<td>PCy₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1049</td>
<td>PCy₃CH₃</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1051</td>
<td>PCy₃CH₃</td>
<td>250mg</td>
</tr>
<tr>
<td>15-1052</td>
<td>PCy₃CH₃</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1135</td>
<td>PCy₃CH₃</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1140</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1142</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1143</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1145</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1146</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1148</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1149</td>
<td>P(C₆H₁₁)₂</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1157</td>
<td>P(C₆H₁₁)₂</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1164</td>
<td>P(t-buty)_2</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1745</td>
<td>P(C₆H₅)_2</td>
<td>500mg</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>CAS Number</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>15-1043</td>
<td>racemic-2-Di-t-butylphosphino-1,1'-binaphthyl, 98% TrixiePhos</td>
<td>[255836-67-0]</td>
</tr>
<tr>
<td>15-1048</td>
<td>2-(Di-t-butylphosphino)-2'-(N,N-dimethylamino)biphenyl, 98%</td>
<td>[224311-49-3]</td>
</tr>
<tr>
<td>15-1049</td>
<td>2-(Di-t-butylphosphino)-2'-methylbiphenyl, 99%</td>
<td>[255837-19-5]</td>
</tr>
<tr>
<td>15-1051</td>
<td>2-(Di-t-butylphosphino)-3,4,5,6-tetramethyl-2',4',6'-tri-i-propylbiphenyl, min. 98%</td>
<td>[857356-94-6]</td>
</tr>
<tr>
<td>15-1052</td>
<td>2-(Di-t-butylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td>[564483-19-8]</td>
</tr>
<tr>
<td>15-1135</td>
<td>2-((Dicyclohexylphosphino)phenyl)-2,6-di-i-propyl-4-sulfonato-1,1'-biphenyl hydrate sodium salt</td>
<td>[870245-84-4]</td>
</tr>
<tr>
<td>15-1140</td>
<td>2-(Dicyclohexylphosphino)biphenyl, 98%</td>
<td>[247940-06-3]</td>
</tr>
<tr>
<td>15-1142</td>
<td>2'-((Dicyclohexylphosphino)phenyl)-2,6-dimethoxy-3-sulfonato-1,1'-biphenyl hydrate sodium salt (water soluble SPhos), min. 98%</td>
<td>[870245-75-3]</td>
</tr>
<tr>
<td>15-1143</td>
<td>2-(Dicyclohexylphosphino)-2',6'-dimethoxy-1,1'-biphenyl, min. 98%</td>
<td>[657408-07-6]</td>
</tr>
<tr>
<td>15-1145</td>
<td>2-(Dicyclohexylphosphino)-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98%</td>
<td>[870245-84-4]</td>
</tr>
<tr>
<td>15-1146</td>
<td>2-(Dicyclohexylphosphino)-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98%</td>
<td>[213697-53-1]</td>
</tr>
<tr>
<td>15-1148</td>
<td>2-(Dicyclohexylphosphino)-2'-methylbiphenyl, min. 98%</td>
<td>[251320-86-2]</td>
</tr>
<tr>
<td>15-1149</td>
<td>2-(Dicyclohexylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td>[564483-18-7]</td>
</tr>
<tr>
<td>15-1152</td>
<td>2-(Dicyclohexylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td>[1070663-78-3]</td>
</tr>
<tr>
<td>15-1157</td>
<td>2-[3,5-Bis(trifluoromethyl)phenyl]phosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98%</td>
<td>[1160861-80-8]</td>
</tr>
</tbody>
</table>
**KITS - BUCHWALD BIARYL PHOSPHINE LIGAND MINI KIT 1**

96-5485  
**Buchwald Biaryl Phosphine Ligand Mini Kit 1** (contains more recently developed ligands) for aromatic carbon-heteroatom bond formation and Suzuki Coupling.

Components available for individual sale.  

Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Quantity</th>
<th>See Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1051</td>
<td>2-Di-t-butylphosphino-3,4,5,6-tetramethyl-2',4',6'-tri-i-propylbiphenyl, min. 98% [857356-94-6]</td>
<td>250mg</td>
<td>105</td>
</tr>
<tr>
<td>15-1052</td>
<td>2-Di-t-butylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylXPhos [564483-19-8]</td>
<td>500mg</td>
<td>106</td>
</tr>
<tr>
<td>15-1143</td>
<td>2-Dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl, min. 98% SPhos [657408-07-6]</td>
<td>500mg</td>
<td>113</td>
</tr>
<tr>
<td>15-1146</td>
<td>2-Dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl, min. 98% RuPhos [787618-22-8]</td>
<td>500mg</td>
<td>116</td>
</tr>
<tr>
<td>15-1149</td>
<td>2-(Dicyclohexylphosphino)-2',4',6'-tri-i-propyl-1,1'-biphenyl, min. 98% XPhos [564483-18-7]</td>
<td>500mg</td>
<td>125</td>
</tr>
<tr>
<td>15-1152</td>
<td>2-(Dicyclohexylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% BrettPhos [1070663-78-3]</td>
<td>250mg</td>
<td>114</td>
</tr>
<tr>
<td>15-1157</td>
<td>2-[3,5-Bis(trifluoromethyl)phenylphosphino]-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% JackiePhos [1160861-60-8]</td>
<td>100mg</td>
<td>92</td>
</tr>
<tr>
<td>15-1164</td>
<td>2-(Di-t-butylphosphino)-3,6-dimethoxy-2'-4'-6'-tri-i-propyl-1,1'-biphenyl, min. 98% t-butylBrettPhos [1160861-53-9]</td>
<td>100mg</td>
<td>101</td>
</tr>
</tbody>
</table>
**KITS - BUCHWALD BIARYL PHOSPHINE LIGAND MINI KIT 2 (CONTAINS MORE MATURE LIGANDS)**

**NEW**  96-5490  Buchwald Biaryl Phosphine Ligand Mini Kit 2 (contains more mature ligands) for aromatic carbon-heteroatom bond formation and Suzuki Coupling. Contains the following:

<table>
<thead>
<tr>
<th>Components available for individual sale. Patents: US 6,395,916, US 6,307,087.</th>
<th><img src="image1" alt="Chemical Structure" /></th>
<th><img src="image2" alt="Chemical Structure" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Buchwald Biaryl Phosphine Ligand Mini Kit 2 (contains more mature ligands)</td>
<td>15-1043</td>
<td>15-1045</td>
</tr>
<tr>
<td>500mg</td>
<td>250mg</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1048 500mg</td>
<td>15-1049 500mg</td>
<td>15-1140 500mg</td>
</tr>
<tr>
<td>15-1148 500mg</td>
<td>15-1745 500mg</td>
<td></td>
</tr>
</tbody>
</table>

15-1043 racemic-2-Di-t-butylphosphino-1,1'-binaphthyl, 98% TrixiePhos [255836-67-0] See page 98
15-1048 2-Di-t-butylphosphino-2'-(N,N-dimethylamino)biphenyl, 98% See page 102
15-1049 2-Di-t-butylphosphino-2'-methylbiphenyl, 99% [255837-19-5] See page 104
15-1140 2-(Dicyclohexylphosphino)biphenyl, 98% [247940-06-3] See page 111
15-1145 2-(Dicyclohexylphosphino)-2'-((N,N-dimethylamino)biphenyl, 98% DavePhos [213697-53-1] See page 114
15-1148 2-Dicyclohexylphosphino-2'-methylbiphenyl, min. 98% MePhos [251320-86-2] See page 122
15-1745 2-Diphenylphosphino-2'-(N,N-dimethylamino)biphenyl, 98% [240417-00-9] See page 144
**KITS - BUCHWALD PALLADACYCLE PRECATALYST KIT**

**96-5503**  
Buchwald Palladacycle Precatalyst Kit

Components available for individual sale.

Note:
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Mass</th>
<th>Formula</th>
<th>Description</th>
<th>Patent Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>46-0264</td>
<td>100mg</td>
<td>46-0264</td>
<td>Chloro(2-di-t-butylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl)[2-(2-aminoethyl)phenyl]palladium(II), min. 98%</td>
<td>[1142811-12-8]</td>
</tr>
<tr>
<td>46-0266</td>
<td>100mg</td>
<td>46-0266</td>
<td>Chloro(2-dicyclohexylphosphino-2',6'-di-i-propoxy-1,1'-biphenyl)[2-(2-aminoethylphenyl)]palladium(II), methyl-t-butylether adduct, min. 98%</td>
<td>[1028206-60-1]</td>
</tr>
<tr>
<td>46-0267</td>
<td>100mg</td>
<td>46-0267</td>
<td>Chloro[2-(dicyclohexylphosphino)-3,6-dimethoxy-2'-4',6'-tri-i-propyl-1,1'-biphenyl][2-(2-aminoethyl)phenyl]palladium(II), min. 98%</td>
<td>[1148148-01-9]</td>
</tr>
<tr>
<td>46-0268</td>
<td>250mg</td>
<td>46-0268</td>
<td>Chloro(2-dicyclohexylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl)[2-(2-aminoethyl)phenyl]palladium(II) methyl-t-butylether adduct, min. 98%</td>
<td>[1028206-56-5]</td>
</tr>
<tr>
<td>46-0269</td>
<td>250mg</td>
<td>46-0269</td>
<td>Chloro(2-dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl)[2-(2-aminoethylphenyl)]palladium(II) methyl-t-butylether adduct, min. 98%</td>
<td>[1028206-58-7]</td>
</tr>
</tbody>
</table>

Visit [www.strem.com](http://www.strem.com)
KITS - CADMIUM SELENIDE CANdot® QUANTUM DOT (core) KIT, 50µmol/L in hexane, 500-625nm peak emissions

<table>
<thead>
<tr>
<th>Peak Emission</th>
<th>Particle Size (diameter)</th>
<th>Strem Catalog No. (in hexane)†</th>
<th>Quantum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>CdSe core</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500nm</td>
<td>2.7nm</td>
<td>48-1005</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>525nm</td>
<td>2.8nm</td>
<td>48-1011</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>550nm</td>
<td>3.5nm</td>
<td>48-1017</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>575nm</td>
<td>3.9nm</td>
<td>48-1023</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>600nm</td>
<td>4.7nm</td>
<td>48-1030</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>625nm</td>
<td>5.3nm</td>
<td>48-1035</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>Kit: 500-625nm</td>
<td></td>
<td>96-0800</td>
<td>&gt;10%</td>
</tr>
</tbody>
</table>

Kit contains 5ml of each of the above 6 products. Ligand capping agent oleylamine. Stable in dispersions 6 months.

*Particle size reported excludes ligand capping agent.
All sizes determined by TEM except for 650nm CdSe/CdS/ZnS which is calculated.
† Available at nanoparticle concentration of 50µmol per liter.

96-0800 Cadmium selenide CANdot® quantum dot (core) Kit, 50µmol/L in hexane, 500-625nm peak emissions

Components available for individual sale. Contains the following:

- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 500nm peak emission
- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 525nm peak emission
- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 550nm peak emission
- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 575nm peak emission
- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 600nm peak emission
- Cadmium selenide CANdot® quantum dot (core), 50µmol/L in hexane, 625nm peak emission

air sensitive, (store cold in dark under inert atmosphere)

**CADMIUM SELENIDE/CADMIUM SULFIDE CANdot® QUANTUM DOT (core/shell) KIT, 50µmol/L in hexane, 550-625nm peak emissions**

<table>
<thead>
<tr>
<th>Peak Emission</th>
<th>Particle Size (diameter)</th>
<th>Strem Catalog No. (in hexane)†</th>
<th>Quantum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>CdSe/CdS core/shell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>550nm</td>
<td>3.7nm</td>
<td>48-1040</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>575nm</td>
<td>4.1nm</td>
<td>48-1046</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>600nm</td>
<td>4.9nm</td>
<td>48-1052</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>625nm</td>
<td>5.6nm</td>
<td>48-1057</td>
<td>&gt;30%</td>
</tr>
<tr>
<td>Kit: 550-625nm</td>
<td></td>
<td>96-0810</td>
<td>&gt;30%</td>
</tr>
</tbody>
</table>

Kit contains 1ml of each of the above 4 products. Ligand capping agent oleylamine. Stable in dispersions >6 months.

*Particle size reported excludes ligand capping agent.
All sizes determined by TEM except for 650nm CdSe/CdS/ZnS which is calculated.
† Available at nanoparticle concentration of 50µmol per liter.

96-0810 Cadmium selenide/cadmium CANdot® sulfide quantum dot (core/shell) kit, 50µmol/L in hexane, 550-625nm peak emissions

Components available for individual sale. Contains the following:

- Cadmium selenide/cadmium sulfide CANdot® quantum dot (core/shell), 50µmol/L in hexane, 550nm peak emission
- Cadmium selenide/cadmium sulfide CANdot® quantum dot (core/shell), 50µmol/L in hexane, 575nm peak emission
- Cadmium selenide/cadmium sulfide CANdot® quantum dot (core/shell), 50µmol/L in hexane, 600nm peak emission
- Cadmium selenide/cadmium sulfide CANdot® quantum dot (core/shell), 50µmol/L in hexane, 625nm peak emission

air sensitive, (store cold in dark under inert atmosphere)

Sold in collaboration with CAN for research purposes.
KITS - CADMIUM SELENIDE/CADMIUM SULFIDE/ZINC SULFIDE CANdot® QUANTUM DOT (core/shell/shell) KIT, 50µmol/L in hexane, 550-650nm peak emissions

<table>
<thead>
<tr>
<th>Peak Emission</th>
<th>Particle Size (diameter)</th>
<th>Strem Catalog No. (in hexane)†</th>
<th>Quantum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>CdSe/CdS/ZnS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>core/shell/shell</td>
<td>550nm</td>
<td>4.6nm</td>
<td>&gt;40%</td>
</tr>
<tr>
<td></td>
<td>575nm</td>
<td>5.1nm</td>
<td>&gt;40%</td>
</tr>
<tr>
<td></td>
<td>600nm</td>
<td>6.0nm</td>
<td>&gt;40%</td>
</tr>
<tr>
<td></td>
<td>625nm</td>
<td>6.6nm</td>
<td>&gt;40%</td>
</tr>
<tr>
<td></td>
<td>650nm</td>
<td>8.5nm</td>
<td>&gt;40%</td>
</tr>
<tr>
<td>Kit: 550-650nm</td>
<td></td>
<td>96-0820</td>
<td>&gt;30%</td>
</tr>
</tbody>
</table>

*Particle size reported excludes ligand capping agent.

All sizes determined by TEM except for 650nm CdSe/CdS/ZnS which is calculated.

† Available at nanoparticle concentration of 50µmol per liter.

96-0820 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell) kit, 50µmol/L in hexane, 550-650nm peak emissions

Components available for individual sale.

Contains the following:

48-1063 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell), 50µmol/L in hexane, 550nm peak emission

48-1070 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell), 50µmol/L in hexane, 575nm peak emission

48-1075 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell), 50µmol/L in hexane, 600nm peak emission

48-1080 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell), 50µmol/L in hexane, 625nm peak emission

48-1086 Cadmium selenide/cadmium sulfide/zinc sulfide CANdot® quantum dot (core/shell/shell), 50µmol/L in hexane, 650nm peak emission

*air sensitive. (store cold in dark under inert atmosphere)*

Sold in collaboration with CAN for research purposes.
KITS - CATHy™ CATALYST KIT

96-7650 CATHy™ Catalyst Kit
for asymmetric transfer hydrogenation of ketones and imines.

Chiral Bidentate Nitrogen Ligands

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Purity</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0200</td>
<td>(1S,2R)-(−)-cis-1-Aminooindan-2-ol, 98%</td>
<td>[126456-43-7]</td>
<td>98%</td>
</tr>
<tr>
<td>07-0201</td>
<td>(1R,2S)-(−)-cis-1-Aminooindan-2-ol, 98%</td>
<td>[136030-00-7]</td>
<td>98%</td>
</tr>
<tr>
<td>07-2370</td>
<td>(S,S)-(−)-N-(4-toluenesulfonyl)-1,2-diphenylethylenediamine, 98%</td>
<td>[167316-27-0]</td>
<td>98%</td>
</tr>
<tr>
<td>07-2371</td>
<td>(R,R)-(−)-N-(4-toluenesulfonyl)-1,2-diphenylethylenediamine, 98%</td>
<td>[144222-34-4]</td>
<td>98%</td>
</tr>
</tbody>
</table>

Rhodium & Iridium Components

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Purity</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-0195</td>
<td>Dichloro(pentamethylcyclopentadienyl)rhodium(III) dimer, 99%</td>
<td>[12354-85-7]</td>
<td>99%</td>
</tr>
<tr>
<td>77-1060</td>
<td>Dichloro(pentamethylcyclopentadienyl)iridium(III) dimer, 98%</td>
<td>[12354-84-6]</td>
<td>98%</td>
</tr>
</tbody>
</table>

Technical Notes:
1. CATHy™ catalysts are prepared in-situ by combining a chiral bidentate nitrogen ligand with Rh(III) or Ir(III) metal complex containing a substitute cyclopentadienyl ligand. Catalysts demonstrate robust stability to air and moisture. Reaction details are available. Please inquire or visit www.strem.com.
2. CATHy™ catalysts are highly efficient for the asymmetric transfer hydrogenation of a broad range of ketones and imines to chiral alcohols and amines in high optical purities. They also provide functional group tolerance.
3. CATHy™ catalysts can be used for research without a license. Commercial use, including manufacture for clinical trials, requires a license from Piramal Healthcare.

Catalyst Preparation Example

Hydrogenation Examples

References:
KITS - CatKits – SINGLE USE VIALS for LOW CATALYST LOADING EXPERIMENTS

96-3790

Kit of CatKits – Single-Use Vials for low catalyst loading experiments

Components available for individual sale.

<table>
<thead>
<tr>
<th>Components</th>
<th>46-2040</th>
<th>46-2038</th>
<th>46-2030</th>
<th>46-2033</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Precursor</td>
<td>(C₆H₅)₃P·Pd·Cl</td>
<td>(C₆H₅)₃P·Pd·Cl</td>
<td>Pd(OAc)₂</td>
<td>Pd(OAc)₂</td>
</tr>
<tr>
<td>Ligand</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>K₃PO₄</td>
<td>K₃PO₄</td>
<td>K₃PO₄</td>
<td>K₃PO₄</td>
</tr>
</tbody>
</table>

This Kit contains 4 different type of Single-Use Vials. Each type has 5 x 1 vials.

Contains the following:

46-2040  trans-Dichlorobis(tricyclohexylphosphino)palladium(II)/potassium phosphate admixture [CatKit single-use vials - 6.62 wt% Pd complex] [29934-17-6] 5 x 1vial Visit www.strem.com

46-2038  trans-Dichlorobis(triphenylphosphine)palladium(II)/potassium phosphate admixture [CatKit single-use vials - 6.32 wt% Pd complex] [13965-03-2] 5 x 1vial

46-2030  Palladium(II) acetate/1,1'-bis(di-t-butylphosphino)ferrocene/potassium phosphate admixture [CatKit single-use vials - 2.02 wt% Pd(OAc)₂] [95408-45-0] 5 x 1vial

46-2033  Palladium(II) acetate/2-dicyclohexylphosphino-2,6-dimethoxy-1,1'-biphenyl (SPhos)/potassium phosphate admixture [CatKit single-use vials - 1.96 wt% Pd(OAc)₂] [1028206-58-7] 5 x 1vial

info@strem.com · technical@strem.com · quotation@strem.com
**KITS - CHIRAL QUEST CATALYST and LIGAND TOOLBOX KIT**

**96-5900 Chiral Quest Catalyst and Ligand Toolbox Kit**

for Asymmetric Hydrogenation

Sold in collaboration with Chiral Quest for research purposes only.

Components available for individual sale.

Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Page Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0175</td>
<td>(R)-C₃-TUNEPHOS</td>
<td>100mg</td>
<td>Page 55</td>
</tr>
<tr>
<td>15-0176</td>
<td>(S)-C₃-TUNEPHOS</td>
<td>100mg</td>
<td>Page 56</td>
</tr>
<tr>
<td>15-1053</td>
<td>(S)-BINAPINE</td>
<td>100mg</td>
<td>Page 107</td>
</tr>
<tr>
<td>44-0109</td>
<td>(R)-C₃-TUNEPHOS-Ru</td>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>45-0653</td>
<td>(S,S,R,R)-TANGPHOS-Rh</td>
<td>100mg</td>
<td>Page 55</td>
</tr>
<tr>
<td>45-0657</td>
<td>(S)-BINAPINE-Rh</td>
<td>100mg</td>
<td></td>
</tr>
<tr>
<td>45-0663</td>
<td>(R,R,S,S)-DUANPHOS-Rh</td>
<td>100mg</td>
<td></td>
</tr>
</tbody>
</table>

**Chemical Structures:**

- (R)-C₃-TUNEPHOS
- (S)-BINAPINE
- (R)-C₃-TUNEPHOS-Ru
- (S,S,R,R)-TANGPHOS-Rh
- (S)-BINAPINE-Rh
- (R,R,S,S)-DUANPHOS-Rh

Visit www.strem.com for new product announcements.
**KITS - CUCURBITURIL KIT**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>[CAS Number]</th>
</tr>
</thead>
<tbody>
<tr>
<td>96-7054</td>
<td><strong>Cucurbituril Kit</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Components available for individual sale.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Contains the following:</td>
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<tr>
<td></td>
<td><img src="image1.png" alt="Image" /></td>
<td></td>
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<tr>
<td></td>
<td><img src="image2.png" alt="Image" /></td>
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<td></td>
</tr>
<tr>
<td></td>
<td><img src="image3.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07-1310</td>
<td>Cucurbit[5]uril (CB[5]) ammonium sulfate hydrate, 99+%</td>
<td>100mg</td>
<td>[259886-49-2]</td>
</tr>
<tr>
<td>07-1320</td>
<td>Cucurbit[6]uril (CB[6]) hydrate, 99+%</td>
<td>500mg</td>
<td>[80262-44-8]</td>
</tr>
<tr>
<td>07-1322</td>
<td>Perallyloxycucurbit[6]uril (AOCB[6]) potassium sulfate, 94+%</td>
<td>25mg</td>
<td></td>
</tr>
<tr>
<td>07-1325</td>
<td>Cucurbit[7]uril (CB[7]) hydrate, 99+%</td>
<td>50mg</td>
<td>[259886-50-5]</td>
</tr>
<tr>
<td>07-1330</td>
<td>Cucurbit[8]uril (CB[8]) hydrate, 99+%</td>
<td>25mg</td>
<td>[259886-51-6]</td>
</tr>
</tbody>
</table>

Visit [www.strem.com](http://www.strem.com)
**KITS - DSM MonoPhos™ LIGAND KIT**

**96-5650 DSM MonoPhos™ Ligand Kit**
for asymmetric hydrogenation and other catalytic applications. Sold in collaboration with DSM for research purposes only. Patent WO 02 04466

Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Weight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1231</td>
<td>250mg</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) diethylamine, min. 97% [252288-04-3]</td>
</tr>
<tr>
<td>15-1232</td>
<td>1g</td>
<td>(R)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) dimethylamine, min. 97% (R)-MONOPHOS [157488-65-8]</td>
</tr>
<tr>
<td>15-1233</td>
<td>1g</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl) dimethylamine, min. 97% (S)-MONOPHOS [185449-80-3]</td>
</tr>
<tr>
<td>15-1234</td>
<td>100mg</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)piperidine, min. 97% (S)-PipPhos [284472-79-3]</td>
</tr>
<tr>
<td>15-1235</td>
<td>100mg</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)morpholine, min. 97% (S)-MorfPhos [185449-81-4]</td>
</tr>
</tbody>
</table>

**Visit www.strem.com for new product announcements.**
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1255</td>
<td>(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]</td>
<td>See page 132</td>
</tr>
<tr>
<td>15-1505</td>
<td>(3aR,8aR)-(−)-(2,2-Dimethyl-4,4,8,8-tetraphenyl-tetrahydro-1,3]dioxolof[4,5-e]dinaphosphinepin-6-yl)dimethylamine, min. 98% [213843-90-4]</td>
<td>See page 134</td>
</tr>
<tr>
<td>15-1510</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)benzyl(methyl)amine, 99% [490023-37-5]</td>
<td>See page 137</td>
</tr>
<tr>
<td>15-1520</td>
<td>(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]</td>
<td>See page 138</td>
</tr>
<tr>
<td>15-1521</td>
<td>(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]</td>
<td>See page 140</td>
</tr>
<tr>
<td>15-1525</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-phenylethyl]amine, min. 95% [422509-53-3]</td>
<td>See page 142</td>
</tr>
<tr>
<td>15-1527</td>
<td>(S)-(+)-(3,5-Dioxa-4-phospha-cyclohepta[2,1-a;3,4-a']dinaphthalen-4-yl)bis[(1R)-1-(1-naphthalenyl)ethyl]amine, min. 97% [342813-25-6]</td>
<td>See page 138</td>
</tr>
<tr>
<td>15-3495</td>
<td>(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% [389130-06-7]</td>
<td>See page 171</td>
</tr>
</tbody>
</table>
## KITS - (R,R)-DUPHOS and BPE RHODIUM CATALYST KIT

96-4730  **(R,R)-Duphos and BPE Rhodium Catalyst Kit**

Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Structure 1</th>
<th>Structure 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-0148</td>
<td>(-)-1,2-Bis((2R,5R)-2,5-diethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0150</td>
<td>(-)-1,2-Bis((2R,5R)-2,5-diethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) trifluoromethanesulfonate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0158</td>
<td>(-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0160</td>
<td>(-)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) trifluoromethanesulfonate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0168</td>
<td>(+)-1,2-Bis((2R,5R)-2,5-dimethylphospholano)ethane (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0201</td>
<td>(-)-1,2-Bis((2R,5R)-2,5-diphenylphospholano)ethane (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, min. 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0210</td>
<td>(+)-1,2-Bis((2R,5R)-2,5-di-i-propylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, min. 98%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Components available for individual sale. Sample structures shown.

Visit [www.strem.com](http://www.strem.com) for new product announcements.

## (S,S)-DUPHOS AND BPE RHODIUM CATALYST KIT

96-4731  **(S,S)-Duphos and BPE Rhodium Catalyst Kit**

Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Structure 1</th>
<th>Structure 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-0149</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-diethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0151</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-diethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) trifluoromethanesulfonate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0159</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0161</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) trifluoromethanesulfonate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0169</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-dimethylphospholano)ethane (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, 98%+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0202</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-diphenylphospholano)ethane (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, min. 98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-0211</td>
<td>(+)-1,2-Bis((2S,5S)-2,5-di-i-propylphospholano)benzene (1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, min. 98%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Components available for individual sale. Visit [www.strem.com](http://www.strem.com) for new product announcements.
KITS - ENANTIOTECH BIMAH LIGAND KIT for ASYMMETRIC HYDROGENATION

96-3700  Enantiotech BIMAH Ligand Kit for Asymmetric Hydrogenation

Sold under license from Enantiotech for research purposes only.
Components available for individual sale.
Contains the following:

07-1234  (R)-Me-BIMAH
07-1232  (S)-Me-BIMAH

07-1233  (S)-(+)-2-(α-methylmethanamine)-1H-benzimidazole, min. 98%
          (S)-Me-BIMAH  [925689-54-9]  250mg  Visit www.strem.com
07-1234  (R)-(+)-2-(α-methylmethanamine)-1H-benzimidazole, min. 98%
          (R)-Me-BIMAH  [163959-79-3]  250mg
07-1236  (S)-(-)-2-(α-(i-propyl)methanamine)-1H-benzimidazole, min. 98%
          (S)-Pr-BIMAH  [184686-11-8]  250mg
07-1238  (R)-(+)-2-(α-(i-propyl)methanamine)-1H-benzimidazole, min. 98%
          (R)-Pr-BIMAH  250mg
07-1240  (S)-(-)-2-(α-(i-butyl)methanamine)-1H-benzimidazole, min. 98%
          (S)-Bu-BIMAH  [59592-31-3]  250mg
07-1242  (R)-(+)-2-(α-(i-butyl)methanamine)-1H-benzimidazole, min. 98%
          (R)-Bu-BIMAH  100mg
07-1245  (S)-(-)-2-(α-(t-butyl)methanamine)-1H-benzimidazole, min. 95%
          (S)-t-Bu-BIMAH  [1118114-88-7]  100mg

ENANTIOTECH BIMAH Ru BINAP CATALYST KIT for ASYMMETRIC HYDROGENATION

96-3705  Enantiotech BIMAH Ru BINAP Catalyst Kit for Asymmetric Hydrogenation

Sold under license from Enantiotech for research purposes only.
Contains the following:

Components available for individual sale.

44-0910  Dichloro[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II), min. 95%
44-0905  Dichloro[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II), min. 95%

44-0915  Dichloro[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II), min. 95%
44-0920  Dichloro[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II), min. 95%
44-0925  Dichloro[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II), min. 95%
          100mg  Visit www.strem.com
KITS - ENANTIOTECH BIMAH Ru DIOP CATALYST KIT for ASYMMETRIC HYDROGENATION

96-3715  Enantiotech BIMAH Ru DIOP Catalyst Kit for Asymmetric Hydrogenation

Sold under license from Enantiotech for research purposes only.
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Mole Mass</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0960</td>
<td>100mg</td>
<td>Dichloro[(4S,5S)-(+)-4,5-bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane][(S)-(-)-2-(a-methylmethanamine)-1H-benzimidazole] ruthenium(II), min. 98%</td>
</tr>
<tr>
<td>44-0955</td>
<td>100mg</td>
<td>Dichloro[(4R,5R)-(-)-4,5-bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane][(R)-(+)-2-(a-methylmethanamine)-1H-benzimidazole] ruthenium(II), min. 95%</td>
</tr>
<tr>
<td>44-0970</td>
<td>100mg</td>
<td>Dichloro[(4S,5S)-(+)-4,5-bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane][(S)-(-)-2-(i-propyl)methanamine)-1H-benzimidazole] ruthenium(II), min. 95%</td>
</tr>
<tr>
<td>44-0980</td>
<td>100mg</td>
<td>Dichloro[(4S,5S)-(+)-4,5-bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane][(S)-(-)-2-(t-butyl)methanamine)-1H-benzimidazole] ruthenium(II), min. 97%</td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
## Enantiotech BIMAH Ru Tol-BINAP Catalyst Kit for Asymmetric Hydrogenation

Sold under license from Enantiotech for research purposes only. Components available for individual sale. Contains the following:

### Components

<table>
<thead>
<tr>
<th>Code</th>
<th>Formula</th>
<th>Concentration</th>
<th>Molar Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0930</td>
<td>Dichloro[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] [(S)-(-)-2- (α-methylmethanamine)-1H-benzimidazole] ruthenium(II), min. 97%</td>
<td>100mg</td>
<td>1000</td>
</tr>
<tr>
<td>44-0935</td>
<td>Dichloro[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] [(R)-(+)-2- (α-methylmethanamine)-1H-benzimidazole] ruthenium(II), min. 95%</td>
<td>100mg</td>
<td>1000</td>
</tr>
<tr>
<td>44-0940</td>
<td>Dichloro[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] [(S)-(-)-2- (α-(i-propyl) methanamine)-1H-benzimidazole] ruthenium(II), min. 95%</td>
<td>100mg</td>
<td>1000</td>
</tr>
<tr>
<td>44-0945</td>
<td>Dichloro[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] [(R)-(+)-2- (α-(i-propyl) methanamine)-1H-benzimidazole] ruthenium(II), min. 95%</td>
<td>100mg</td>
<td>1000</td>
</tr>
<tr>
<td>44-0950</td>
<td>Dichloro[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] [(S)-(-)-2- (α-(t-butyl) methanamine)-1H-benzimidazole] ruthenium(II), min. 97%</td>
<td>100mg</td>
<td>1000</td>
</tr>
</tbody>
</table>

Visit www.strem.com
KITS - EVONIK HETEROGENEOUS CATALYST KIT

96-6670  Evonik Heterogeneous Catalyst Kit
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-4060</td>
<td>Ruthenium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>45-1863</td>
<td>Rhodium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1703</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1706</td>
<td>Palladium, 10% on activated carbon, Pearlman</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1740</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1743</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1744</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1745</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1530</td>
<td>Platinum, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1534</td>
<td>Platinum, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1536</td>
<td>Platinum 1% and vanadium 2%, on activated carbon (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1540</td>
<td>Platinum, 3% on activated carbon, sulfided (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
</tbody>
</table>

EVONIK HETEROGENEOUS CATALYST KIT for SELECTIVE HYDROGENATION

96-6674  Evonik Heterogeneous Catalyst Kit for Selective Hydrogenation
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-4060</td>
<td>Ruthenium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>45-1863</td>
<td>Rhodium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1530</td>
<td>Platinum, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1534</td>
<td>Platinum, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1536</td>
<td>Platinum 1% and vanadium 2%, on activated carbon (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>78-1540</td>
<td>Platinum, 3% on activated carbon, sulfided (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
</tbody>
</table>

EVONIK HETEROGENEOUS PALLADIUM CATALYST KIT

96-6672  Evonik Heterogeneous Palladium Catalyst Kit
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>46-1703</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>46-1706</td>
<td>Palladium, 10% on activated carbon, Pearlman</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1740</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1743</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1747</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
<tr>
<td>46-1750</td>
<td>Palladium, 5% on activated carbon, (50-70% wetted powder)</td>
<td>10g</td>
<td></td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
<table>
<thead>
<tr>
<th>Application</th>
<th>Catalyst</th>
<th>E.T.</th>
<th>Hydrogenation of olefins</th>
<th>Hydrogenation of aromatics</th>
<th>Hydrogenation of nitriles</th>
<th>Hydrogenation of nitro groups</th>
<th>Hydrogenation of acrylonitrile</th>
<th>Hydrogenation of cyanides</th>
<th>Hydrogenation of the CO group</th>
</tr>
</thead>
<tbody>
<tr>
<td>#96-6672 - Palladium Catalyst Kit</td>
<td>#96-6670 - Heterogeneous Catalyst Kit</td>
<td>E.T.</td>
<td>Hydrogenation of olefins</td>
<td>Hydrogenation of aromatics</td>
<td>Hydrogenation of nitriles</td>
<td>Hydrogenation of nitro groups</td>
<td>Hydrogenation of acrylonitrile</td>
<td>Hydrogenation of cyanides</td>
<td>Hydrogenation of the CO group</td>
</tr>
</tbody>
</table>
KITS - Garphos™ LIGAND KIT

96-4100 Garphos™ Ligand Kit

Sold in collaboration with KCT.


Components available for individual sale.

Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Component Name</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1653</td>
<td>(R)-Ph-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1654</td>
<td>(S)-Ph-Garphos™</td>
<td></td>
</tr>
<tr>
<td>15-1657</td>
<td>(R)-Tol-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1658</td>
<td>(S)-Tol-Garphos™</td>
<td></td>
</tr>
<tr>
<td>15-1661</td>
<td>(R)-Xyl-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1662</td>
<td>(S)-Xyl-Garphos™</td>
<td></td>
</tr>
<tr>
<td>15-1663</td>
<td>(R)-BTFM-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1664</td>
<td>(S)-BTFM-Garphos™</td>
<td></td>
</tr>
<tr>
<td>15-1666</td>
<td>(R)-DMM-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1667</td>
<td>(S)-DMM-Garphos™</td>
<td></td>
</tr>
<tr>
<td>15-1672</td>
<td>(R)-DTBM-Garphos™</td>
<td>100mg</td>
</tr>
<tr>
<td>15-1673</td>
<td>(S)-DTBM-Garphos™</td>
<td></td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
### Gold Nanorods Kit (Axial Diameter - 10 nm, Wavelength 700-808 nm)

**96-1535**  
**NEW**

Gold Nanorods Kit (Axial Diameter - 10 nm, wavelength 700-808 nm)

Components available for individual sale.  
Contains the following:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-6020</td>
<td>Gold Nanorods (Axial Diameter - 10 nm) (Wavelength 700 nm)</td>
<td>25ml</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>79-6025</td>
<td>Gold Nanorods (Axial Diameter - 10 nm) (Wavelength 750 nm)</td>
<td>25ml</td>
<td></td>
</tr>
<tr>
<td>79-6030</td>
<td>Gold Nanorods (Axial Diameter - 10 nm) (Wavelength 780 nm)</td>
<td>25ml</td>
<td></td>
</tr>
<tr>
<td>79-6035</td>
<td>Gold Nanorods (Axial Diameter - 10 nm) (Wavelength 808 nm)</td>
<td>25ml</td>
<td></td>
</tr>
</tbody>
</table>

### Gold Nanorods Kit (Axial Diameter - 25 nm, Wavelength 550-700 nm)

**96-1530**  
**NEW**

Gold Nanorods Kit (Axial Diameter - 25 nm, wavelength 550-700 nm)

Components available for individual sale.  
Contains the following:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-6000</td>
<td>Gold Nanorods (Axial Diameter - 25 nm) (Wavelength 550 nm)</td>
<td>25ml</td>
<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
</tr>
<tr>
<td>79-6005</td>
<td>Gold Nanorods (Axial Diameter - 25 nm) (Wavelength 600 nm)</td>
<td>25ml</td>
<td></td>
</tr>
<tr>
<td>79-6010</td>
<td>Gold Nanorods (Axial Diameter - 25 nm) (Wavelength 650 nm)</td>
<td>25ml</td>
<td></td>
</tr>
<tr>
<td>79-6015</td>
<td>Gold Nanorods (Axial Diameter - 25 nm) (Wavelength 700 nm)</td>
<td>25ml</td>
<td></td>
</tr>
</tbody>
</table>
KITS - IONIC LIQUID KIT 1: HYDROPHOBIC (WATER-IMMISCIBLE) KIT

96-6500 Ionic Liquid Kit 1: Hydrophobic (water-immiscible) Kit
Note: Ionic Liquid Kit 1 products protected by U.S. Patent 5,827,602 assigned to Covalent Associates, Inc. Contains the following:

Components available for individual sale. The items contained in this kit are hydrophobic (water-immiscible) ionic liquids and are more thermally and hydrolytically stable than their PF₆ counterparts.

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0180 N-Butyl-3-methylpyridinium bis(trifluoromethylsulfonyl)imide, 99% [BMPIm]</td>
<td>[N(SO₂CF₃)₂]⁺</td>
<td>5g</td>
</tr>
<tr>
<td>07-0465 1,2-Dimethyl-3-propylimidazolium bis(trifluoromethylsulfonyl)imide, 99% [DMPIIm]</td>
<td>[N(SO₂CF₃)₂]⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0470 1,2-Dimethyl-3-propylimidazolium tris(trifluoromethylsulfonyl)methide, 99% [DMPIMe]</td>
<td>[(CF₃SO₂)₃C]⁻</td>
<td>2g</td>
</tr>
<tr>
<td>07-0578 1-Ethyl-3-methylimidazolium bis(pentafluoroethylsulfonyl)imide, 99% [EMIBeti]</td>
<td>([CF₃CF₂SO₂]N)⁺</td>
<td>2g</td>
</tr>
<tr>
<td>07-0579 1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, 99% [EMIIm]</td>
<td>[N(SO₂CF₃)₂]⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-1775 N-Propyl-3-methylpyridinium bis(trifluoromethylsulfonyl)imide, 99% [PMPIm]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IONIC LIQUID KIT 2: BMIM KIT

96-6510 Ionic Liquid Kit 2: BMIM Kit
Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0100 1-Butyl-3-methylimidazolium chloride, 98% [BMIM]Cl</td>
<td>[N(CH₂)₃]⁺Cl⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0110 1-Butyl-3-methylimidazolium diethyleneglycolmonomethyl-ethersulfate, 98% [BMIM] [MDEGSO₄]</td>
<td>[CH₂O(CH₂)₂O(CH₂)₂SO₃]⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0140 1-Butyl-3-methylimidazolium methanesulfonate, 98% [BMIM]</td>
<td>[MeSO₄]⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0150 1-Butyl-3-methylimidazolium octylsulfate, 98% [BMIM]</td>
<td>[OcSO₄]⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0160 1-Butyl-3-methylimidazolium phosphate, 99% [BMIM]</td>
<td>[PO₄]³⁻</td>
<td>5g</td>
</tr>
<tr>
<td>07-0170 1-Butyl-3-methylimidazolium tetrafluoroborate, 98% [BMIM]</td>
<td>[BF₄]⁻</td>
<td>5g</td>
</tr>
</tbody>
</table>

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KITS - IONIC LIQUID KIT 3: CYPHOS® IL PHOSPHONIUM SALT KIT

96-6520 Ionic Liquid Kit 3: CYPHOS® IL Phosphonium Salt Kit
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Concentration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-6370</td>
<td>Trihexyl(tetradecyl)phosphonium bis(trifluoromethanesulfonyl)amide, min. 97% CYPHOS® IL 109 [460092-03-9]</td>
<td>10g</td>
<td>See page 193</td>
</tr>
<tr>
<td>15-6374</td>
<td>Trihexyl(tetradecyl)phosphonium bis(2,4,4-trimethylpentyl)phosphinate, min. 95% CYPHOS® IL 104 [465527-59-7]</td>
<td>10g</td>
<td>See page 193</td>
</tr>
<tr>
<td>15-6378</td>
<td>Trihexyl(tetradecyl)phosphonium bromide, min. 97% CYPHOS® IL 102</td>
<td>10g</td>
<td>See page 193</td>
</tr>
<tr>
<td>15-6382</td>
<td>Trihexyl(tetradecyl)phosphonium chloride, min. 93% CYPHOS® IL 101 [258864-54-9]</td>
<td>10g</td>
<td>See page 193</td>
</tr>
<tr>
<td>15-6386</td>
<td>Trihexyl(tetradecyl)phosphonium decanoate, min. 95% CYPHOS® IL 103 [465527-65-5]</td>
<td>10g</td>
<td>See page 193</td>
</tr>
<tr>
<td>15-6390</td>
<td>Trihexyl(tetradecyl)phosphonium dicyanamide, min. 95% CYPHOS® IL 105</td>
<td>10g</td>
<td>See page 194</td>
</tr>
<tr>
<td>15-6394</td>
<td>Trihexyl(tetradecyl)phosphonium hexafluorophosphate, min. 98% CYPHOS® IL 110 [374683-44-0]</td>
<td>10g</td>
<td>See page 194</td>
</tr>
</tbody>
</table>

CYPHOS® IL Registered trademark of Cytec.

References:

LONG-CHAIN n-ALKYLPHOSPHONIC ACID KIT

96-1525 Long-Chain n-Alkylphosphonic Acid Kit
Components available for individual sale.
Contains the following:

General Use:
Linear alkyl Phosphonic acids and their phosphonate salts are surfactants because of their classic bifunctional chemical structure, \( \text{RP(O})(\text{OH})_2 \), 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.

\[
\text{HO} \quad \text{O} \quad \text{P} \quad \text{HO} \\
\quad \text{HO} \quad \text{(CH}_2\text{)}_n \quad \text{CH}_3
\]

\( n = 5-17 \)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Concentration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0958</td>
<td>n-Decylphosphonic acid, min. 97% [5874-60-8]</td>
<td>1g</td>
<td>See page 89</td>
</tr>
<tr>
<td>15-1835</td>
<td>n-Dodecylphosphonic acid, min. 97% [5137-70-2]</td>
<td>1g</td>
<td>See page 167</td>
</tr>
<tr>
<td>15-2400</td>
<td>n-Hexadecylphosphonic acid, min. 97% [4721-17-9]</td>
<td>1g</td>
<td>See page 168</td>
</tr>
<tr>
<td>15-2410</td>
<td>n-Hexylphosphonic acid, min. 97% [4721-24-8]</td>
<td>1g</td>
<td>See page 169</td>
</tr>
<tr>
<td>15-3510</td>
<td>n-Octadecylphosphonic acid, min. 97% [4724-47-4]</td>
<td>1g</td>
<td>See page 171</td>
</tr>
<tr>
<td>15-3520</td>
<td>n-Octylphosphonic acid, min. 97% [4724-48-5]</td>
<td>1g</td>
<td>See page 172</td>
</tr>
<tr>
<td>15-5145</td>
<td>n-Tetradecylphosphonic acid, min. 97% [4671-75-4]</td>
<td>1g</td>
<td>See page 179</td>
</tr>
</tbody>
</table>

## KITS - MARUOKA CHIRAL PHASE-TRANSFER PHOSPHONIUM ORGANOCATALYST KIT

### Maruoka Chiral Phase-Transfer Phosphonium Organocatalyst Kit

Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Kit Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1457</td>
<td>(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&lt;br&gt;R-MARUOKA CAT P-NB</td>
<td>50mg</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
<tr>
<td>15-1458</td>
<td>(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&lt;br&gt;S-Maruoka CAT P-NB [1110813-90-5]</td>
<td>50mg</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
<tr>
<td>15-1464</td>
<td>(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&lt;br&gt;R-MARUOKA CAT P-TB</td>
<td>50mg</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
<tr>
<td>15-1465</td>
<td>(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&lt;br&gt;S-MARUOKA CAT P-TB [1110711-01-7]</td>
<td>50mg</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
</tbody>
</table>

Also Available

<table>
<thead>
<tr>
<th>Kit Code</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0380</td>
<td>(R-showed)</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
<tr>
<td>07-0381</td>
<td>(S-not shown)</td>
<td><a href="#">Chemical Structure</a></td>
</tr>
</tbody>
</table>

Visit www.strem.com for new product announcements.
KITS - NHC LIGAND KIT 1: CHIRAL N-HETEROCYCLIC CARBENES

96-3760 NHC Ligand Kit 1: Chiral N-Heterocyclic Carbenes
Components available for individual sale.
Contains the following:

**NN**

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Concentration</th>
<th>Formula</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-4021</td>
<td>(2S,5S)-1-{[(2S,5S)-2,5-Dimethylpyrrolidin-1-yl]methylene}-2,5-dimethylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-12-8</td>
<td></td>
</tr>
<tr>
<td>07-4022</td>
<td>(2R,5R)-1-{[(2R,5R)-2,5-Dimethylpyrrolidin-1-yl]methylene}-2,5-dimethylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-14-0</td>
<td></td>
</tr>
<tr>
<td>07-4024</td>
<td>(2R,5R)-1-{[(2R,5R)-2,5-Diethylpyrrolidin-1-yl]methylene}-2,5-diethylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-20-8</td>
<td></td>
</tr>
<tr>
<td>07-4025</td>
<td>(2S,5S)-1-{[(2S,5S)-2,5-Diethylpyrrolidin-1-yl]methylene}-2,5-diethylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-18-4</td>
<td></td>
</tr>
<tr>
<td>07-4026</td>
<td>(2R,5R)-1-{[(2R,5R)-2,5-Diphenylpyrrolidin-1-yl]methylene}-2,5-diphenylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-08-2</td>
<td></td>
</tr>
<tr>
<td>07-4027</td>
<td>(2S,5S)-1-{[(2S,5S)-2,5-Diphenylpyrrolidin-1-yl]methylene}-2,5-diphenylpyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-10-6</td>
<td></td>
</tr>
<tr>
<td>07-4029</td>
<td>(2S,5S)-1-{[(2S,5S)-2,5-Di(naphthalen-1-yl)pyrrolidin-1-yl]methylene}-2,5-di(naphthalen-1-yl)pyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-24-2</td>
<td></td>
</tr>
<tr>
<td>07-4030</td>
<td>(2R,5R)-1-{[(2R,5S)-2,5-Di(naphthalen-1-yl)pyrrolidin-1-yl]methylene}-2,5-di(naphthalen-1-yl)pyrrolidinium tetrafluoroborate, min. 97%</td>
<td>100mg</td>
<td>1204324-26-4</td>
<td></td>
</tr>
</tbody>
</table>

Sold under reuse from Kanata for research purposes only. WO2010/003226.
<table>
<thead>
<tr>
<th>Component Code</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0324</td>
<td>250mg</td>
<td>1,3-Bis(1-adamantyl)imidazol-2-ylidene, min. 98% [131042-77-8]</td>
</tr>
<tr>
<td>07-0333</td>
<td>250mg</td>
<td>1,3-Di-t-butylimidazol-2-ylidene, min. 98% [157197-53-0]</td>
</tr>
<tr>
<td>07-0593</td>
<td>500mg</td>
<td>1,3-Bis(2,6-di-i-propylphenyl)-4,5-dihydroimidazol-2-ylidene, min. 98% [258278-28-3]</td>
</tr>
<tr>
<td>07-0595</td>
<td>250mg</td>
<td>1,3-Bis(2,6-di-i-propylphenyl)imidazol-2-ylidene, min. 98% [244187-81-3]</td>
</tr>
<tr>
<td>07-0600</td>
<td>500mg</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)imidazol-2-ylidene, min. 98% [141556-42-5]</td>
</tr>
<tr>
<td>07-0605</td>
<td>500mg</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene, min. 98% [173035-11-5]</td>
</tr>
</tbody>
</table>
**NHC Ligand Kit 3: Variety of N-Heterocyclic Carbenes**

Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0322</td>
<td>250mg</td>
<td>1,3-Bis(1-adamantyl)imidazolium chloride, min. 97% [131042-78-9]</td>
</tr>
<tr>
<td>07-0368</td>
<td>250mg</td>
<td>1,3-Bis(t-butyl)imidazolium tetrafluoroborate, min. 97% ItBuHBF$_4$ [263163-17-3]</td>
</tr>
<tr>
<td>07-0590</td>
<td>500mg</td>
<td>1,3-Bis(2,6-di-i-propylphenyl)imidazolium chloride, min. 97% [250285-32-6]</td>
</tr>
<tr>
<td>07-0598</td>
<td>500mg</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)imidazolium chloride, min. 97% [173035-10-4]</td>
</tr>
<tr>
<td>07-0299</td>
<td>1g</td>
<td>1,3-Bis(2,6-di-i-propylphenyl)-4,5-dihydroimidazolium chloride, min. 97% [258278-25-0]</td>
</tr>
<tr>
<td>07-4007</td>
<td>500mg</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazolium tetrafluoroborate, min. 95% [245679-18-9]</td>
</tr>
<tr>
<td>07-4011</td>
<td>500mg</td>
<td>1,3-Di-t-butylbenzimidazolium chloride, min. 97% [946607-10-9]</td>
</tr>
<tr>
<td>07-4009</td>
<td>500mg</td>
<td>1,3-Dicyclohexylbenzimidazolium chloride, min. 97% [1034449-15-4]</td>
</tr>
<tr>
<td>07-4013</td>
<td>1g</td>
<td>1,3-Bis(t-butyl)imidazolium tetrafluoroborate, min. 97% ItBuHBF$_4$ [286014-38-8]</td>
</tr>
<tr>
<td>07-4020</td>
<td>1g</td>
<td>1,3-Dicyclohexylbenzimidazolium chloride, min. 97% [1034449-15-4]</td>
</tr>
<tr>
<td>07-0597</td>
<td>1g</td>
<td>1,3-Bis(cyclohexyl)imidazolium tetrafluoroborate, min. 95% ICyHBF$_4$ [286014-38-8]</td>
</tr>
<tr>
<td>07-0302</td>
<td>1g</td>
<td>Di-i-propylaminomethylene(di-i-propyl)aminium tetrafluoroborate, min. 97% [369405-27-6]</td>
</tr>
</tbody>
</table>

Also Available:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-0587</td>
<td>1,3-Di-cyclohexyl-4,5-dihydroimidazolium chloride, min. 97% [258278-35-6]</td>
</tr>
<tr>
<td>07-4015</td>
<td>1,3-Dicyclohexylbenzimidazolium chloride, min. 97% [1034449-15-4]</td>
</tr>
<tr>
<td>07-0302</td>
<td>1g</td>
</tr>
<tr>
<td>07-0598</td>
<td>1g</td>
</tr>
<tr>
<td>07-0302</td>
<td>1g</td>
</tr>
</tbody>
</table>

Visit www.strem.com
**NHC Ligand Kit 4: Bis Carbenes**

Components available for individual sale.

Contains the following:

<table>
<thead>
<tr>
<th>Compound Description</th>
<th>Catalog Number</th>
<th>Quantity</th>
<th>Molecular Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>11,12-Bis[N-benzyl-1H-imidazolium-3-methylene]-9,10-dihydro-9,10-ethanoanthracene bis(trifluoromethanesulfonate)</td>
<td>07-0076</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[N-(2,2-diphenyl-1-ethyl)-1H-benzimidazolium-3-methylene]-9,10-dihydro-9,10-ethanoanthracene bis(trifluoromethanesulfonate)</td>
<td>07-0078</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[N-methyl-1H-benzimidazolium-3-methylene]-9,10-dihydro-9,10-ethanoanthracene bis(trifluoromethanesulfonate)</td>
<td>07-0080</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[N-(2-methylbenzyl)-1H-benzimidazolium-3-methylene]-9,10-dihydro-9,10-ethanoanthracene bis(trifluoromethanesulfonate)</td>
<td>07-0082</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[3-methylimidazolium]-9,10-dihydro-9,10-ethanoanthracene bis(iodide)</td>
<td>07-0083</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[N-(i-propyl)-1H-benzimidazolium-3-methylene]-9,10-dihydro-9,10-ethanoanthracene bis(trifluoromethanesulfonate)</td>
<td>07-0084</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>(12a,18a)-5,6,12,12a,13,18,18a,19-Octahydro-5,6-dimethyl-13,18[1',2']-benzenobisbenzimidazo [1,2-b:2',1'-d][benzo][2,5]benzdiazocine potassium triflate adduct</td>
<td>07-0086</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
<tr>
<td>11,12-Bis[1,3-dihydro-3-(i-propyl)-2H-benzimidazol-2-ylidene-3-methylene]-9,10-dihydro-9,10-ethanoanthracene</td>
<td>07-0088</td>
<td>100mg</td>
<td><img src="image" alt="Molecular Structure" /></td>
</tr>
</tbody>
</table>

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KITS - NITRIC OXIDE SENSOR (INTRACELLULAR) KIT (NO-ON KIT)

96-0293 Nitric Oxide Sensor (Intracellular) Kit (NO-ON Kit)
Contains the following:

Active Ingredient: 2-{2-Chloro-6-hydroxy-5-[2-methylquinolin-8-ylamino)methyl]-3-oxo-3H-xanthen-9-yl} benzoic acid (FL)
Catalog number - 07-0293

![Chemical Structure of 2-{2-Chloro-6-hydroxy-5-[2-methylquinolin-8-ylamino)methyl]-3-oxo-3H-xanthen-9-yl} benzoic acid (FL)](image)

Introduction: The copper complex of FL is a novel, cell-permeable system that allows direct imaging of nitric oxide produced in living cells through fluorescence turn on. A solution of the copper (II) complex of FL can be readily prepared using this kit. For additional information, consult the following references:

Contents:
- Ligand FL: 5 x 0.5mg
- Dimethylsulfoxide (ACS spectrophotometric grade): 5 x 1.0ml
- Copper (II) chloride (1.0 mM solution in water): 5 x 1.0ml

MSDS:
The Material Safety Data Sheets for the three products contained in this kit can be downloaded from the Strem Chemicals Web Site at www.strem.com. Locate the MSDS using the following catalog numbers:
- FL: 07-0293
- Dimethylsulfoxide (ACS spectrophotometric grade): 97-4940
- Copper (II) chloride as a 1.0 mM solution in water: 97-3060

Storage conditions: The kit should be stored at -20°C and protected from light.

Preparation of the active copper complex of FL:

**Step I**
Allow the kit to warm to room temperature. Add 931 microliters of DMSO to a 0.5mg vial of FL (resulting concentration - 1.0 mM). The FL is readily soluble in the DMSO. The solution can be partitioned into aliquots of 40-300 µL as required. These solutions must be stored in the freezer at <-20°C. The DMSO solution of FL is stable for three months at -80°C. It is advisable to check the extinction coefficient of the solution before preparing the copper complex. (log ε(504 nm) = 4.6)

**Step II**
A CuFL solution should be freshly prepared by adding 1:1 FL solution (1.0 mM) to the copper (II) solution (1.0 mM) at room temperature. Note: The prepared DMSO/water stock solution of CuFL solution [log ε(499 nm) = 4.6] can be kept at room temperature, but should be protected from light. The solution can be diluted with media to provide the concentration required for cell sensing experiments. When the extinction coefficient of the red solution of CuFL diminishes by 20% of the original value, the solution should be discarded. Do not use the solution after 1 hour, and do not freeze the solution.

07-0293 2-{2-Chloro-6-hydroxy-5-[2-methylquinolin-8-ylamino)methyl]-3-oxo-3H-xanthen-9-yl} benzoic acid 0.5mg Visit www.strem.com
**KITS - PALLADIUM CATALYST KIT**

**96-4650  Palladium Catalyst Kit**

for a variety of catalytic organic transformations. Components available for individual sale. Contains the following:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>46-0100</td>
<td>Allylpalladium chloride dimer, min. 98% [12012-95-2]</td>
<td>500mg</td>
</tr>
<tr>
<td>46-0400</td>
<td>Dichlorobis(benzonitrile)palladium(II), 99% [14220-64-5]</td>
<td>1g</td>
</tr>
<tr>
<td>46-1780</td>
<td>Palladium(II) acetate, min. 98% (99.9+%Pd) [3375-31-3]</td>
<td>1g</td>
</tr>
<tr>
<td>46-1850</td>
<td>Palladium(II) chloride (99.9%-Pd) [7647-10-1]</td>
<td>1g</td>
</tr>
<tr>
<td>46-2150</td>
<td>Tetrakis(triphenylphosphine)palladium (0), 99% (99.9+%Pd) [14221-01-3]</td>
<td>5g</td>
</tr>
<tr>
<td>46-3000</td>
<td>Tris(dibenzylideneacetone)dipalladium (0) [51364-51-3]</td>
<td>500mg</td>
</tr>
<tr>
<td>46-3010</td>
<td>Tris(dibenzylideneacetone)dipalladium (0) chloroform adduct [52522-40-4]</td>
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**PARACYCLOPHANE KIT**

**96-7052  Paracyclophane Kit**

Components available for individual sale. Contains the following:

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<thead>
<tr>
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<tbody>
<tr>
<td>06-0104</td>
<td>500mg</td>
<td></td>
</tr>
<tr>
<td>06-0460</td>
<td>250mg</td>
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</tr>
<tr>
<td>08-0700</td>
<td>100mg</td>
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</tr>
<tr>
<td>08-2027</td>
<td>250mg</td>
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Visit www.strem.com for new product announcements.
### KITS - PHOSPHINE LIGAND KIT

**96-1650 Phosphine Ligand Kit**
for Palladium-catalyzed carbon-carbon and carbon-heteroatom bond formation.
Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0380</td>
<td>Bis(2-diphenylphosphinophenyl)ether, 98% DPEphos</td>
<td>5g</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>[166330-10-5]</td>
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<td></td>
</tr>
<tr>
<td>15-0433</td>
<td>racemic-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% rac-BINAP</td>
<td>1g</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>[98327-87-8]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1023</td>
<td>Di-t-butylmethylphosphonium tetrafluoroborate, 99%</td>
<td>1g</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>[870777-30-3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-1045</td>
<td>2-(Di-t-butylphosphino)biphenyl, 99% JohnPhos</td>
<td>500mg</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>[224311-51-7]</td>
<td></td>
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<tr>
<td>15-6000</td>
<td>Tri-t-butylphosphonium tetrafluoroborate, 99%</td>
<td>1g</td>
<td>189</td>
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<tr>
<td></td>
<td>[131274-22-1]</td>
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</tr>
<tr>
<td>15-6372</td>
<td>Tri-2-furylphosphine, 98+% [5518-52-5]</td>
<td>500mg</td>
<td>192</td>
</tr>
<tr>
<td>15-7720</td>
<td>Tris(2,4-di-t-butylphenyl)phosphite, 98% [31570-04-4]</td>
<td>10g</td>
<td>197</td>
</tr>
<tr>
<td>26-0270</td>
<td>1,1'-Bis(diphenylphosphino)ferrocene, 99% DPPF</td>
<td>1g</td>
<td>57</td>
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<tr>
<td></td>
<td>[12150-46-8]</td>
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<td></td>
</tr>
</tbody>
</table>

### PhosphonicS METAL OXIDATION CATALYST KIT

**96-6770 PhosphonicS Metal Oxidation Catalyst Kit**
Sold in collaboration with PhosphonicS Ltd. for research purposes only.
Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-4380</td>
<td>Vanadyl(II) ethyl/butyl phosphonate Silica (PhosphonicS POVO)</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>25-1200</td>
<td>Manganese(II) ethyl/butyl phosphonate Silica (PhosphonicS POMn)</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>27-0900</td>
<td>Cobalt(II) ethyl/butyl phosphonate Silica (PhosphonicS POCo)</td>
<td>5g</td>
<td></td>
</tr>
<tr>
<td>58-5100</td>
<td>Cerium(IV) ethyl/butyl phosphonate Silica (PhosphonicS POCe)</td>
<td>5g</td>
<td></td>
</tr>
</tbody>
</table>

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 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 recycleability. PhosphonicS has developed a number of novel heterogeneous oxidation catalysts for a wide range of applications in the pharmaceutical, fine chemicals and petrochemicals industries. Reactions include allylic and benzylic oxidations, epoxidations and the selective oxidations of alcohols to ketones and sulfides to sulfoxides.
## KITS - PHOSPHONICS METALS SCAVENGING KIT

**96-6750 PhosphonicS Metals Scavenging Kit**

Sold in collaboration with PhosphonicS Ltd. for research purposes only.

Components available for individual sale.

Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-0200</td>
<td>N-Acetyl-L-cysteine ethyl Silica (PhosphonicS SCYT1)</td>
<td>10g</td>
</tr>
<tr>
<td>16-0210</td>
<td>Triamine ethyl sulfide amide Silica (PhosphonicS STA3)</td>
<td>10g</td>
</tr>
<tr>
<td>16-0215</td>
<td>2-Aminoethyl sulfide ethyl Silica (PhosphonicS SEA)</td>
<td>10g</td>
</tr>
<tr>
<td>16-0650</td>
<td>2-Mercaptoethyl ethyl sulfide Silica (PhosphonicS SEM26)</td>
<td>10g</td>
</tr>
<tr>
<td>16-1540</td>
<td>Pentaerythritol 2-mercaptopropanoate ethyl sulfide Silica</td>
<td>10g</td>
</tr>
<tr>
<td></td>
<td>(PhosphonicS SET)</td>
<td></td>
</tr>
<tr>
<td>16-1700</td>
<td>3-Mercaptopropyl ethyl sulfide Silica (60Å, high-cross linking) (PhosphonicS SPM36)</td>
<td>10g</td>
</tr>
<tr>
<td>16-1702</td>
<td>3-Mercaptopropyl ethyl sulfide Silica (90 Å, high-cross linking) (PhosphonicS SPM36f)</td>
<td>10g</td>
</tr>
<tr>
<td>16-1704</td>
<td>3-Mercaptopropyl ethyl sulfide Silica (90 Å, low-cross linking)  (PhosphonicS SPM32f)</td>
<td>10g</td>
</tr>
<tr>
<td>16-1706</td>
<td>3-Mercaptopropyl ethyl sulfide Silica (60 Å, low-cross linking)  (PhosphonicS SPM32)</td>
<td>10g</td>
</tr>
</tbody>
</table>

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. PhosphonicS 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

Visit [www.strem.com](http://www.strem.com) for new product announcements.
**KITS - PINAP LIGAND KIT**

**96-7050**  PINAP Ligand Kit

for a variety of asymmetric C-C bond formations. Contains the following:

<table>
<thead>
<tr>
<th>Components available for individual sale.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Chemical Structure 1" /></td>
</tr>
<tr>
<td><img src="image2.png" alt="Chemical Structure 2" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-1782</td>
<td>(R)+(+)4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethoxy]phthalazine, min. 97% (R,R)-O-PINAP [828927-95-3]</td>
<td>250mg See page 157</td>
</tr>
<tr>
<td>15-1784</td>
<td>(R)+(+)4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenyl-ethyl]-1-phthalazinamine, min. 97% (R,R)-N-PINAP [828927-97-5]</td>
<td>250mg See page 158</td>
</tr>
<tr>
<td>15-1786</td>
<td>(S)-(−)-4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(R)-1-phenylethyl]-1-phthalazinamine, min. 97% (R,S)-N-PINAP [828927-96-4]</td>
<td>250mg See page 158</td>
</tr>
<tr>
<td>15-1787</td>
<td>(R)+(+)4-[2-(Diphenylphosphino)-1-naphthalenyl]-N-[(S)-1-phenyl-ethyl]-1-phthalazinamine, min. 97% (S,R)-N-PINAP</td>
<td>250mg See page 158</td>
</tr>
</tbody>
</table>
**KITS - RAFT AGENT KIT**

**96-4700**  
RAFT Agent Kit for controlling polymerizations at the molecular level  
Components available for individual sale. Contains the following:

- 16-0415 500mg
  - HOOCH₂CH₂C–S–C–S–CH₂(CH₂)₁₀CH₃
  - 4-Cyano-4-(dodecylsulfanylthiocarbonyl)sulfanylpentanoic acid, min. 97% [870196-80-8]

- 16-0422 500mg
  - HOOCH₂CH₂C–S–C–S–CH₂(CH₂)₁₀CH₃
  - 4-Cyano-4-(thiobenzoylthio)pentanoic acid, min. 97% [201611-92-9]

- 16-0423 500mg
  - NCH₂C–S–C–S–CH₂(CH₂)₁₀CH₃
  - 2-Cyanomethyl-N-methyl-N-phenyldithiocarbamate, min. 97% [76926-16-4]

- 16-0425 500mg
  - NCH₂C–S–C–S–CH₂(CH₂)₁₀CH₃
  - S-Cyanomethyl-S-dodecyltrithiocarbonate, min. 97% [796045-97-1]

- 16-0430 500mg
  - H₃C–S–C–S–C–S–CH₂(CH₂)₁₀CH₃
  - 2-Cyanoprop-2-yl-dithiobenzoate, min. 97% [201611-85-0]

- 16-0460 500mg
  - HOOC–C–S–C–S–CH₂(CH₂)₁₀CH₃
  - 2-Methyl-2-[(dodecylsulfanylthiocarbonyl)sulfanyl]propanoic acid, min. 97% [461642-78-4]

- 16-0610 500mg
  - H₃C–S–C–S–C–S–CH₂(CH₂)₁₀CH₃
  - S-(2-Cyanoprop-2-yl)-S-dodecylthiocarbonate, min. 97% [870196-83-1]

- 16-0617 500mg
  - S,S-Dibenzyltrithiocarbonate, min. 97% [26504-29-0]

*Strem offers the following RAFT agents for research purposes only under license from CSIRO.*
KITS - SOLVIAS (R)-MeO-BIPHEP LIGAND KIT

96-3655 Solvias (R)-MeO-BIPHEP Ligand Kit
for asymmetric hydrogenation and other catalytic applications.
Sold in collaboration with Solvias for research purposes only.
Components available for individual sale. Contains the following:
**KITS - SOLVIAS (S)-MeO-BIPHEP LIGAND KIT**

**96-3656 Solvias (S)-MeO-BIPHEP Ligand Kit**

for asymmetric hydrogenation and other catalytic applications. Sold in collaboration with Solvias for research purposes only. Components available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0043</td>
<td>(S)-(+)2,2'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [910134-30-4]</td>
<td>100mg</td>
<td>See page 33</td>
</tr>
<tr>
<td>15-0045</td>
<td>(S)-(+)2,2'-Bis[di(3,5-di-t-butylphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [167709-31-1]</td>
<td>100mg</td>
<td>See page 34</td>
</tr>
<tr>
<td>15-0113</td>
<td>(S)-(+)2,2'-Bis(di-2-furanylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [145214-59-1]</td>
<td>100mg</td>
<td>See page 38</td>
</tr>
<tr>
<td>15-0157</td>
<td>(S)-(+)2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [133545-25-2]</td>
<td>100mg</td>
<td>See page 75</td>
</tr>
<tr>
<td>15-0159</td>
<td>(S)-(+)2,2'-Bis[di(3,4,5-trimethoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [256235-61-7]</td>
<td>100mg</td>
<td>See page 76</td>
</tr>
<tr>
<td>15-0179</td>
<td>(S)-(+)2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [S]-MeO-BIPHEP  [133545-17-2]</td>
<td>100mg</td>
<td>See page 57</td>
</tr>
<tr>
<td>15-0489</td>
<td>(S)-(+)2,2'-Bis[di(3,5-xylyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [36263-22-8]</td>
<td>100mg</td>
<td>See page 79</td>
</tr>
<tr>
<td>15-0653</td>
<td>(S)-(+)2,2'-Bis[di(3,5-di-i-propyl-4-dimethylaminophenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [919338-66-2]</td>
<td>100mg</td>
<td>See page 35</td>
</tr>
<tr>
<td>15-0655</td>
<td>(S)-(+)2,2'-Bis(di-i-propylphosphino)-6,6'-dimethoxy-1,1'-biphenyl, min. 97%  [150971-43-0]</td>
<td>100mg</td>
<td>See page 70</td>
</tr>
</tbody>
</table>
KITS - SOLVIAS cataCXium® LIGAND KIT

96-6651 Solvias cataCXium® Ligand Kit
for C-X coupling reactions.
Sold in collaboration with Solvias for research purposes only.
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
<th>Purity</th>
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</thead>
<tbody>
<tr>
<td>[cataCXium® ABn]</td>
<td>15-0038</td>
<td>500mg</td>
</tr>
<tr>
<td>[cataCXium® A]</td>
<td>15-0483</td>
<td>1g</td>
</tr>
<tr>
<td>[cataCXium® AHI]</td>
<td>15-0495</td>
<td>250mg</td>
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<tr>
<td>[cataCXium® FBn]</td>
<td>15-1072</td>
<td>500mg</td>
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<td>[cataCXium® FBu]</td>
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<tr>
<td>[cataCXium® C]</td>
<td>46-0290</td>
<td>250mg</td>
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<tr>
<td>Code</td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>---------</td>
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<td>----------</td>
</tr>
<tr>
<td>15-0038</td>
<td>Benzylid-1-adamantylphosphine, min. 85% [cataCXium® ABn]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-0483</td>
<td>Butylidi-1-adamantylphosphine, min. 95% [cataCXium® A]</td>
<td>1g</td>
</tr>
<tr>
<td>15-0495</td>
<td>n-Butyl-di-(1-adamantyl)phosphonium iodide, min. 95% [cataCXium® AHI]</td>
<td>250mg</td>
</tr>
<tr>
<td>15-1072</td>
<td>Dicyclohexyl(9-benzylfluoren-9-yl)phosphonium tetrafluoroborate, min. 97%</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1074</td>
<td>Dicyclohexyl(9-butylfluoren-9-yl)phosphonium tetrafluoroborate, min. 97%</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1076</td>
<td>Dicyclohexyl[9-(3-phenylpropyl)fluoren-9-yl]phosphonium tetrafluoroborate, min. 95% [cataCXium® FPrPh]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-1078</td>
<td>Dicyclohexyl-[9-[3-(4-sulfonylphenyl)propyl]-2-sulfonylfluoren-9-yl] phosphonium hydrogen sulfate, min. 95% [cataCXium® FSulf]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-2975</td>
<td>N-(2-Methoxyphenyl)-2-(di-t-butylphosphino)pyrrole, min. 92% [cataCXium® POMetB]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-2980</td>
<td>1-(2-Methoxyphenyl)-2-(dicyclohexylphosphino)pyrrole, min. 95% [cataCXium® POMeCy]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-3550</td>
<td>N-Phenyl-2-(di-t-butylphosphino)indol, min. 98% [cataCXium® PInB]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-3600</td>
<td>N-Phenyl-2-(di-t-butylphosphino)pyrrole, 95+% [cataCXium® PtB]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-3605</td>
<td>N-Phenyl-2-(dicyclohexylphosphino)indol, min. 95% [cataCXium® PInCy]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-3610</td>
<td>N-Phenyl-2-(dicyclohexylphosphino)pyrrole, 90% [cataCXium® PCy]</td>
<td>500mg</td>
</tr>
<tr>
<td>15-6362</td>
<td>1-(2,4,6-Trimethylphenyl)-2-(dicyclohexylphosphino)imidazole, min. 95% [cataCXium® PCy]</td>
<td>500mg</td>
</tr>
<tr>
<td>46-0290</td>
<td>trans-Di(µ-acetato)bis[o-(di-o-tolylphosphino)benzyl]di-palladium(II), 97+% [cataCXium® C]</td>
<td>250mg</td>
</tr>
</tbody>
</table>
Solvias Josiphos Ligand Kit
for asymmetric catalytic hydrogenations and other transformations.

Components available for individual sale. Sold in collaboration with Solvias for research purposes only. Ligands are air-stable.

Contains the following:

26-0650 (R)-(-)-1-{(S)-2-[(4-trifluoromethyl)phenyl]phosphino}ferrocenyl)ethyl-dit-butylphosphine, min. 97% [2623-79-8]
26-0960 (R)-(-)-1-{(S)-2-[(3,5-di-trifluoromethyl)phenyl]phosphino}ferrocenyl)ethylidicyclohexylphosphine, min. 97% [292638-88-1]
26-0965 (R)-(-)-1-{(S)-2-[(3,5-di-trifluoromethyl)phenyl]phosphino}ferrocenyl)ethylid-3,5-xylylphosphine, min. 97% [166172-63-0]
26-0975 (R)-(-)-1-{(S)-2-[(dicyclohexylphosphino)ferrocenyl]ethyl-d-t-butylphosphine, min. 97% [158923-11-6]
26-1000 (R)-(-)-1-{(S)-2-[(dicyclohexylphosphino)ferrocenyl]ethylidicyclohexylphosphine, min. 97% [167416-28-6]
26-1150 (R)-(-)-1-{(S)-2-[(3,5-dimethyl-4-methoxy)phenyl]phosphino}ferrocenyl)ethylidicyclohexylphosphine, min. 97% [360048-63-1]
26-1170 (S)+-1-{(R)-2-[(Di-2-furylphosphino)ferrocenyl]ethylid-3,5-xylylphosphine, min. 97% [649559-66-0]
26-1200 (R)-(-)-1-{(S)-2-[(diphenylphosphino)ferrocenyl]ethylid-t-butyolphosphate, min. 97% [155830-69-6]
26-1210 (R)-(-)-1-{(S)-2-[(diphenylphosphino)ferrocenyl]ethylidicyclohexylphosphine ethanol adduct, min. 97% (R)-(S)-JOSIPHOS [155806-35-2]
26-1255 (R)-(-)-1-{(S)-2-[(diphenylphosphino)ferrocenyl]ethylid-3,5-xylylphosphine, min. 97% [184095-69-0]
Solvias MandyPhos™ Ligand Kit

for asymmetric catalytic hydrogenations and other transformations.

Sold in collaboration with Solvias for research purposes only.

Components available for individual sale.

Contains the following:

Ligands are air-stable.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-0240</td>
<td>(S,S)-(+)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[dicyclohexylphosphino]ferrocene, min. 97%</td>
<td>[494227-35-9]</td>
</tr>
<tr>
<td>26-0244</td>
<td>(S,S)-(--)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-trifluoromethylphenyl)phosphino]ferrocene, min. 97%</td>
<td>[494227-36-0]</td>
</tr>
<tr>
<td>26-0246</td>
<td>(S,S)-(--)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-dimethylphenyl)phosphino]ferrocene, min. 97%</td>
<td>[793718-16-8]</td>
</tr>
<tr>
<td>26-0248</td>
<td>(S,S)-(--)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(3,5-dimethyl-4-methoxyphenyl)phosphino]ferrocene, min. 97%</td>
<td>[494227-37-1]</td>
</tr>
<tr>
<td>26-0252</td>
<td>(S,S)-(--)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[diphenylphosphino]ferrocene, min. 97%</td>
<td>[210842-74-3]</td>
</tr>
<tr>
<td>26-0254</td>
<td>(S,S)-(--)-(2,2'-Bis[(R)-(N,N-dimethylamino)(phenyl)methyl]-1,1'-bis[di(2-methylphenyl)phosphino]ferrocene, min. 97%</td>
<td>[831226-37-0]</td>
</tr>
</tbody>
</table>

See page 38
See page 40
See page 39
See page 40
See page 39
See page 39
**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 available for individual sale. Ligands are air-stable. Contains the following:

<table>
<thead>
<tr>
<th>Component ID</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-1120</td>
<td>(R)-(+)-1-[(R)-2-(2’-Dicyclohexylphosphinophenyl)ferrocenyl] ethyldi(bis-3,5-trifluoromethylphenyl)phosphine, min. 97%</td>
<td>100mg</td>
<td>[494227-32-6] See page 123</td>
</tr>
<tr>
<td>26-1130</td>
<td>(R)-(+)-1-[(R)-2-[2’-Bis(3,5-dimethyl-4-methoxyphenyl)phosphinophenyl]ferrocenyl]ethylbis(di-3,5-trifluoromethylphenyl)phosphine, min. 97%</td>
<td>100mg</td>
<td>[494227-30-4] See page 41</td>
</tr>
<tr>
<td>26-1300</td>
<td>(R)-(-)-1-[(R)-2-(2’-Diphenylphosphinophenyl)ferrocenyl]ethylbis(di-3,5-trifluoromethylphenyl)phosphine, min. 97%</td>
<td>100mg</td>
<td>[387868-06-6] See page 161</td>
</tr>
<tr>
<td>26-1310</td>
<td>(R)-(-)-1-[(R)-2-(2’-Diphenylphosphinophenyl)ferrocenyl] ethyldicyclohexylphosphine, min. 97%</td>
<td>100mg</td>
<td>[388079-60-5] See page 161</td>
</tr>
<tr>
<td>26-1315</td>
<td>(R)-(+)-1-[(R)-2-(2’-Diphenylphosphinophenyl)ferrocenyl] ethyldiphenylphosphine, min. 97%</td>
<td>100mg</td>
<td>[388079-58-1] See page 162</td>
</tr>
<tr>
<td>26-1320</td>
<td>(R)-(+)-1-[(R)-2-(2’-Diphenylphosphinophenyl)ferrocenyl] ethyldi(3,5-xylyl)phosphine, min. 97%</td>
<td>100mg</td>
<td>[494227-31-5] See page 162</td>
</tr>
<tr>
<td>26-1555</td>
<td>(R)-(+)-1-[(R)-2-(2’-Di-3,5-xylylphosphinophenyl)ferrocenyl] ethyldi-3,5-xylylphosphine, min. 97%</td>
<td>100mg</td>
<td>[494227-33-7] See page 167</td>
</tr>
</tbody>
</table>
**KITS - SPHERICAL GOLD NANOPARTICLES KIT (30-90 nm)**

**96-1540**  
**Spherical Gold Nanoparticles Kit (30-90 nm)**  
Components available for individual sale. Contains the following:

- 79-6040  Spherical Gold Nanoparticles (30 nm)  
  25ml  Visit www.strem.com
- 79-6045  Spherical Gold Nanoparticles (50 nm)  
  25ml
- 79-6050  Spherical Gold Nanoparticles (70 nm)  
  25ml
- 79-6055  Spherical Gold Nanoparticles (90 nm)  
  25ml

**SPIROBISPHOSPHINE LIGAND KIT**

**96-0060**  
**Spiro Bisphosphine Ligand Kit** for asymmetric catalytic hydrogenations and other transformations. Components available for individual sale. Contains the following:

- 79-6040  Spherical Gold Nanoparticles (30 nm)  
  25ml  Visit www.strem.com
- 79-6045  Spherical Gold Nanoparticles (50 nm)  
  25ml
- 79-6050  Spherical Gold Nanoparticles (70 nm)  
  25ml
- 79-6055  Spherical Gold Nanoparticles (90 nm)  
  25ml

**SPIRO MONOPHOSPHITE and MONOPHOSPHORAMIDITE LIGAND KIT**

**96-0065**  
**Spiro Monophosphite and Monophosphoramidite Ligand Kit** for asymmetric catalytic hydrogenations and other transformations. Components available for individual sale. Contains the following:
## KITS - TAKASAGO ATH (ASYMMETRIC TRANSFER HYDROGENATION) CATALYST KIT

96-6955  Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit  
Manufactured under license of Takasago patents.  
Contains the following:

Components available for individual sale.

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Weight</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0148</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(R,R)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0149</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(S,S)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0154</td>
<td>250mg</td>
<td>RuCl<a href="mesitylene">(R,R)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0155</td>
<td>250mg</td>
<td>RuCl<a href="mesitylene">(S,S)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0156</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(R,R)-Fsdpen</a></td>
</tr>
<tr>
<td>44-0157</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(S,S)-Fsdpen</a></td>
</tr>
<tr>
<td>44-0148</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(R,R)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0149</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(S,S)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0154</td>
<td>250mg</td>
<td>RuCl<a href="mesitylene">(R,R)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0155</td>
<td>250mg</td>
<td>RuCl<a href="mesitylene">(S,S)-Tsdpen</a></td>
</tr>
<tr>
<td>44-0156</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(R,R)-Fsdpen</a></td>
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<tr>
<td>44-0157</td>
<td>250mg</td>
<td>RuCl<a href="p-cymene">(S,S)-Fsdpen</a></td>
</tr>
</tbody>
</table>

Visit [www.strem.com](http://www.strem.com)
KITS - TAKASAGO BINAP LIGAND KIT

96-6950  Takasago BINAP Ligand Kit
for asymmetric hydrogenation and other catalytic applications.
Manufactured under license of Takasago patents.
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Component Code</th>
<th>Description</th>
<th>Concentration</th>
<th>Quantity</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0150</td>
<td>(R)-(+)BINAP 15-0150</td>
<td>250mg</td>
<td>See page 51</td>
<td></td>
</tr>
<tr>
<td>15-0151</td>
<td>(S)-(+)BINAP 15-0151</td>
<td>250mg</td>
<td>See page 54</td>
<td></td>
</tr>
<tr>
<td>15-0152</td>
<td>(R)-(+)TolBINAP 15-0152</td>
<td>250mg</td>
<td>See page 73</td>
<td></td>
</tr>
<tr>
<td>15-0153</td>
<td>(S)-(+)TolBINAP 15-0153</td>
<td>250mg</td>
<td>See page 74</td>
<td></td>
</tr>
<tr>
<td>15-0476</td>
<td>(R)-(+)XylBINAP 15-0476</td>
<td>250mg</td>
<td>See page 78</td>
<td></td>
</tr>
<tr>
<td>15-0477</td>
<td>(S)-(+)XylBINAP 15-0477</td>
<td>250mg</td>
<td>See page 78</td>
<td></td>
</tr>
</tbody>
</table>

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Takasago BINAP Ru Acetate Catalyst Kit
for asymmetric hydrogenation and other catalytic applications.
Manufactured under license of Takasago patents.
Components available for individual sale.
Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Amount</th>
<th>Purity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0152</td>
<td>[Ru(OAc)₂{(R)-binap}]</td>
<td>250mg</td>
<td></td>
<td>[325146-81-4]</td>
</tr>
<tr>
<td>44-0153</td>
<td>[Ru(OAc)₂{(S)-binap}]</td>
<td>250mg</td>
<td></td>
<td>[261948-85-0]</td>
</tr>
<tr>
<td>44-0162</td>
<td>[Ru(OAc)₂{(R)-tolbinap}]</td>
<td>250mg</td>
<td></td>
<td>[116128-29-1]</td>
</tr>
<tr>
<td>44-0163</td>
<td>[Ru(OAc)₂{(S)-tolbinap}]</td>
<td>250mg</td>
<td></td>
<td>[106681-15-6]</td>
</tr>
<tr>
<td>44-0164</td>
<td>[Ru(OAc)₂{(R)-xylbinap}]</td>
<td>250mg</td>
<td></td>
<td>[374067-50-2]</td>
</tr>
<tr>
<td>44-0165</td>
<td>[Ru(OAc)₂{(S)-xylbinap}]</td>
<td>250mg</td>
<td></td>
<td>[374067-49-9]</td>
</tr>
</tbody>
</table>

Visit www.strem.com
KITS - TAKASAGO BINAP Ru CYMENE CATALYST KIT

96-6951 Takasago BINAP Ru Cymene Catalyst Kit
for asymmetric hydrogenation and other catalytic applications.
Manufactured under license of Takasago patents.
Components available for individual sale.
Contains the following:

![Chemical structure of BINAP Ru Cymene Catalyst](image)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0084</td>
<td>[RuCl(p-cymene)((R)-binap)]Cl</td>
<td>250mg Chloro<a href="p-cymene">(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl</a> ruthenium(II) chloride [RuCl(p-cymene)((R)-binap)]Cl [145926-28-9]</td>
</tr>
<tr>
<td>44-0086</td>
<td>[RuCl(p-cymene)((S)-binap)]Cl</td>
<td>250mg Chloro<a href="p-cymene">(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl</a> ruthenium(II) chloride [RuCl(p-cymene)((S)-binap)]Cl [130004-33-0]</td>
</tr>
<tr>
<td>44-0088</td>
<td>[RuCl(p-cymene)((R)-tolbinap)]Cl</td>
<td>250mg Chloro<a href="p-cymene">(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl</a> ruthenium(II) chloride [RuCl(p-cymene)((R)-tolbinap)]Cl [131614-43-2]</td>
</tr>
<tr>
<td>44-0089</td>
<td>[RuCl(p-cymene)((S)-tolbinap)]Cl</td>
<td>250mg Chloro<a href="p-cymene">(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl</a> ruthenium(II) chloride [RuCl(p-cymene)((S)-tolbinap)]Cl [228120-95-4]</td>
</tr>
<tr>
<td>44-0092</td>
<td>[RuCl(p-cymene)((R)-xylbinap)]Cl</td>
<td>250mg Chloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}(p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-xylbinap)]Cl [944451-24-5]</td>
</tr>
<tr>
<td>44-0093</td>
<td>[RuCl(p-cymene)((S)-xylbinap)]Cl</td>
<td>250mg Chloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}(p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-xylbinap)]Cl [944451-25-6]</td>
</tr>
</tbody>
</table>

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**KITS - TAKASAGO BINAP Ru DIAMINE CATALYST KIT**

96-6954 Takasago BINAP Ru Diamine Catalyst Kit for asymmetric hydrogenation and other catalytic applications. Manufactured under license of Takasato patents. Components available for individual sale. Contains the following:

- 250mg 44-0217 ((R)-RUCY™-XylBINAP)
- 250mg 44-0218 ((S)-RUCY™-XylBINAP)
- 250mg 44-0212 Dichloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2R)-(-)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl2[(R)-xylbinap][(R)-daipen] [220114-32-9]
- 250mg 44-0213 Dichloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2S)-(+)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl2[(S)-xylbinap][(S)-daipen] [220114-01-2]
- 250mg 44-0224 Dichloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(1S,2S)-(-)-1,2-diphenylethylenediamine]ruthenium(II) RuCl2[(S)-xylbinap][[(S,S)-dpen] [220114-03-4]
- 250mg 44-0226 Dichloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) RuCl2[(R)-xylbinap][[(R,R)-dpen] [220114-38-5]

Visit www.strem.com
KITS - TAKASAGO BINAP Ru DIMER CATALYST KIT

96-6952 Takasago BINAP Ru Dimer Catalyst Kit
for asymmetric hydrogenation and other catalytic applications.
Manufactured under license of Takasago patents.
Components available for individual sale.
Contains the following:

- [NH₂Me₂]₂[RuCl((R)-binap)]₂(µ-Cl)₃ [199684-47-4] 250mg
- [NH₂Me₂]₂[RuCl((S)-binap)]₂(µ-Cl)₃ [199541-17-8] 250mg
- [NH₂Me₂]₂[RuCl((R)-tolbinap)]₂(µ-Cl)₃ [749935-02-2] 250mg
- [NH₂Me₂]₂[RuCl((S)-tolbinap)]₂(µ-Cl)₃ [309735-86-2] 250mg
- [NH₂Me₂]₂[RuCl((R)-xylbinap)]₂(µ-Cl)₃ [944451-08-5] 250mg
- [NH₂Me₂]₂[RuCl((S)-xylbinap)]₂(µ-Cl)₃ [944451-10-9] 250mg

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**KITS - TAKASAGO SEGPHOS LIGAND KIT**

96-6900  **Takasago SEGPHOS Ligand Kit**  
for asymmetric hydrogenation and other catalytic applications.  
Manufactured under license of Takasago patents.  
Components available for individual sale.  
Contains the following:

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Pages</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-0066</td>
<td>(R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPHOS</td>
<td>250mg</td>
<td>See page 30</td>
<td>[566940-03-2]</td>
</tr>
<tr>
<td>15-0067</td>
<td>(S)-(+)5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)DTBM-SEGPHOS</td>
<td>250mg</td>
<td>See page 32</td>
<td>[210169-40-7]</td>
</tr>
<tr>
<td>15-0136</td>
<td>(R)-(+)5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)SEGPHOS</td>
<td>250mg</td>
<td>See page 48</td>
<td>[244261-66-3]</td>
</tr>
<tr>
<td>15-0137</td>
<td>(S)-(+)5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)SEGPHOS</td>
<td>250mg</td>
<td>See page 49</td>
<td>[210169-54-3]</td>
</tr>
<tr>
<td>15-0478</td>
<td>(R)-(+)5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)DM-SEGPHOS</td>
<td>250mg</td>
<td>See page 76</td>
<td>[850253-53-1]</td>
</tr>
<tr>
<td>15-0479</td>
<td>(S)-(+)5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)DM-SEGPHOS</td>
<td>250mg</td>
<td>See page 77</td>
<td>[210169-57-6]</td>
</tr>
</tbody>
</table>
# KITS - TAKASAGO SEGPHOS Ru CATALYST KIT

## 96-6901 Takasago SEGPHOS Ru Catalyst Kit

for asymmetric hydrogenation and other catalytic applications.

Manufactured under license of Takasago patents.

Components available for individual sale.

Contains the following:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Formula</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>[RuCl(p-cymene)((R)-segphos)]Cl</td>
<td>44-0096</td>
<td>250mg</td>
</tr>
<tr>
<td>[RuCl(p-cymene)((S)-segphos)]Cl</td>
<td>44-0097</td>
<td>250mg</td>
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<td>Visit <a href="http://www.strem.com">www.strem.com</a></td>
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<td>44-0097</td>
<td>Chloro<a href="p-cymene">(S)-(−)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole</a> ruthenium(II) chloride [RuCl(p-cymene)(S-segphos)]Cl [944451-29-0]</td>
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<td>Dimethylammonium dichlorotri(µ-chloro)bis[(S)-(−)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH2Me2][{RuCl((S)-segphos)}2(µ-Cl)3] [488809-34-3]</td>
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<td>Dimethylammonium dichlorotri(µ-chloro)bis[(R)-(+)−5,5'-bis(di(3,5-xylyl)phosphino)-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH2Me2][{RuCl((R)-dm-segphos)}2(µ-Cl)3] [935449-46-0]</td>
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NEW

UREAPhos and METAMORPhos Ligand Kit for Asymmetric Hydrogenation
Components available for individual sale. Contains the following:

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]
See page 135

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%
See page 136

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]
See page 135

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%
See page 132

15-2206 1-[(15,2R)-1-{[(11bR)-2,6-Dimethyldinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]-1-phenylpropan-2-yl]-3-phenylurea, min. 97%
See page 132

15-2208 1-Benzyl-3-{[(1S,2R)-2-{(di-o-tolylphosphinooxy)cyclohexyl]urea, min. 97%
See page 17

15-2210 1-Benzyl-3-{[(1S,2S)-2-{(di-o-tolyolphosphinoamino)cyclohexyl]urea, min. 97%
See page 17

15-2212 1-{[(2S)-1-{(Di-o-tolyolphosphinoxy)propan-2-yl]-3-phenylurea, min. 97%
See page 166

15-2214 1-[(1R,2S)-1-{(Di-o-tolyolphosphinoxy)}-1-phenylpropan-2-yl]-3-phenylurea, min. 97%
See page 166

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%
See page 84

15-2218 4-Butyl-N-{[(11bR)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphexpin-4-yloxy]benzenesulfonamide triethylamine adduct, min. 97% [1150592-91-8]
See page 87

15-2220 4-Butyl-N(diphenylphosphino)benzenesulfonamide, min. 97% [1025096-61-0]
See page 88

15-2222 1-[(2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl]-3-phenylurea, min. 97%
See page 172

15-2224 1-[(15,2R)-1-[(11bR)-8,9,10,11,12,13,14,15-Octahydrodinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin-4-yloxy]propan-2-yl]-3-phenylurea, min. 97%
See page 172

15-2228 N-{[(11bS)-Dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphexpin-4-yloxy]-1,1-trifluoro-methanesulfonamide triethylamine adduct, min. 97% METAMORPhos
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