| **Key Substrate Features** | **Recommended Condition 1** | **Recommended Condition 2** | **Recommended Condition 3** |
| --- | --- | --- | --- |
| **Electron-rich (unactivated) aryl halides** <br>*e.g., aryl chlorides with strong EDG* | Use highly active bulky ligands to promote oxidative addition. For example, a BrettPhos-based Pd(II) precatalyst (G3, ~1–5 mol%) with NaOtBu as base in 1,4-dioxane at ~100 °C is a robust standard for tough aryl chlorides[[1]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Standard%20Conditions1%20Solvent%20Dioxane%20,1%20M). Such dialkylbiaryl phosphine ligands favor a monoligated Pd(0) species and dramatically accelerate oxidative addition[[2]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,20). | Bulky electron-rich ligands can even enable milder conditions. For instance, XPhos or tBuBrettPhos with a weak base like Cs₂CO₃ or K₃PO₄ can couple electron-rich aryl halides at or near room temperature[[3]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Bulky%20tri,34) (these third-generation systems are so active they allow use of carbonates/phosphates instead of alkoxides). | Consider N-heterocyclic carbene (NHC) Pd catalysts for challenging unactivated substrates. For example, an air-stable Pd-PEPPSI-IPr precatalyst (∼2 mol%) with K₃PO₄ base in a polar solvent (e.g. tert-amyl alcohol) at 100–120 °C effectively couples electron-rich (or less reactive) aryl halides[[4]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=BrettPhos1%20shows%20excellent%20selectivity%20and,3). (PEPPSI-type Pd–NHC complexes rapidly generate the active Pd(0) and are ideal for such difficult C–N couplings[[4]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=BrettPhos1%20shows%20excellent%20selectivity%20and,3).) |
| **Electron-poor (activated) aryl halides** <br>*e.g., aryl bromides or triflates with EWG* | Less aggressive ligands often suffice for activated halides. For example, a catalyst generated from Pd₂(dba)₃ (0.5–1 mol%) and a bidentate phosphine like DPPF or BINAP (1–2 mol%) with NaOtBu in toluene at ~100 °C efficiently couples aryl iodides or triflates[[5]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20development%20of%20diphenylphosphinobinapthyl%20,for%20monoligated%20complexes%20serving%20as). (Bidentate ligands were key to early extensions of Buchwald–Hartwig coupling to aryl iodides and primary amines[[5]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20development%20of%20diphenylphosphinobinapthyl%20,for%20monoligated%20complexes%20serving%20as).) | For sensitive functional groups (often accompanying electron-poor rings), use milder inorganic bases. For instance, Pd(OAc)₂ or a G3 precatalyst with XantPhos ligand and K₃PO₄ or Cs₂CO₃ base in toluene at 80–110 °C can be employed[[6]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=The%20most%20widely%20used%20bases,boundary%20which%20gives%20a%20situation)[[7]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=tBuBrettPhos6%20is%20an%20excellent%20supporting,2%20%E2%80%93%201%20M). Weaker bases (carbonates, phosphates) broaden functional-group tolerance by avoiding decomposition of base-labile substituents[[6]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=The%20most%20widely%20used%20bases,boundary%20which%20gives%20a%20situation). Xantphos (wide bite-angle) is highly effective for activated aryl sulfonates or halides, facilitating difficult reductive eliminations[[7]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=tBuBrettPhos6%20is%20an%20excellent%20supporting,2%20%E2%80%93%201%20M). | When using aryl iodides (very activated but inhibitory due to PdI₂ formation), choose less polar solvents and appropriate bases. For example, Pd(PPh₃)₄ or Pd–Xantphos in toluene with K₃PO₄ at ~80 °C is recommended[[8]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Since%20amines%20themselves%20can%20act,situ%20formation%20of%20catalytically%20inactive). Nonpolar solvent prevents precipitation of inactive Pd–iodide salts that can occur in polar media[[8]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Since%20amines%20themselves%20can%20act,situ%20formation%20of%20catalytically%20inactive), thus maintaining catalyst turnover. |
| **Sterically hindered substrates** <br>*e.g., ortho-substituted aryl halides or bulky amines* | Increase catalyst steric bulk and base strength to overcome slow steps. A proven solution for hindered cases is using a dialkylbiaryl phosphine precatalyst designed for secondary amines (e.g. RuPhos Pd G3, ~1–5 mol%) with a strong base like NaOtBu in THF at 80–85 °C[[9]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=RuPhos1%20shows%20excellent%20selectivity%20and,an%20excellent%20supporting%20ligand%20for)[[10]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Standard%20Conditions1%20Solvent%20THF%20,Temperature%2085%C2%B0C). RuPhos (a bulky biaryl phosphine) is highly effective for coupling hindered secondary amines, giving excellent yields where smaller ligands fail[[9]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=RuPhos1%20shows%20excellent%20selectivity%20and,an%20excellent%20supporting%20ligand%20for). | Use higher catalyst loading and heat if needed. For example, Pd₃(dba)₂ (2–5 mol%) with a bulky monophosphine (e.g. XPhos or tBuBrettPhos, 5–10 mol%) and KOtBu (or NaOtBu) base in refluxing toluene (~110 °C) can drive couplings of ortho-substituted aryl halides[[2]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,20)[[11]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,of%20these%20ligands%20also%20seem). These sterically demanding ligands favor a monoligated Pd pathway, accelerating oxidative addition and reductive elimination even for heavily hindered substrates[[2]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,20)[[11]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,of%20these%20ligands%20also%20seem). | Leverage strongly-binding ligands to handle extreme sterics. NHC-based catalysts are particularly useful here: for instance, a Pd-PEPPSI-IPr catalyst (imidazolium carbene ligand) with a mild base (K₃PO₄ or K₂CO₃) at elevated temperature (~120 °C) effectively couples very bulky aryl halides with diarylamines[[12]](https://onlinelibrary.wiley.com/doi/10.1002/ajoc.201300162#:~:text=Amination%20of%20meso%E2%80%90Bromoporphyrins%20and%209%E2%80%90Haloanthracenes,PEPPSI%20catalyst.%20The%20reactions). (Such Pd–NHC systems are robust and have been shown to enable C–N coupling on hindered aromatic systems that standard Pd/phosphine catalysts struggle with[[12]](https://onlinelibrary.wiley.com/doi/10.1002/ajoc.201300162#:~:text=Amination%20of%20meso%E2%80%90Bromoporphyrins%20and%209%E2%80%90Haloanthracenes,PEPPSI%20catalyst.%20The%20reactions).) |
| **Heterocyclic substrates** <br>*e.g., heteroaryl halides (pyridines, indoles) or heteroaryl amines* | Employ ligands that minimize catalyst deactivation by heteroatoms. Buchwald’s dialkylbiaryl phosphines excel here: for example, a BrettPhos or XPhos-based Pd catalyst with NaOtBu (or K₃PO₄) base in a high-boiling solvent (toluene/dioxane, ~110 °C) can couple heteroaryl halides or amines in good yield[[13]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Even%20electron%20withdrawn%20amines%20and,36). Even traditionally troublesome partners (e.g. 2-halopyridines or heteroarylamines that bind Pd) are tolerated under these bulky ligand conditions[[13]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Even%20electron%20withdrawn%20amines%20and,36) (ref. 35 showed monodentate biarylphosphines efficiently coupling such heterocycles[[14]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=35.%20,45%20%2839%29%3A%206523%E2%80%936527)). | Use tailored mild bases and ligands for specific heterocycles. For instance, coupling five-membered heteroaromatics can be achieved with a specialized dialkylbiaryl ligand (“GPhos”) Pd precatalyst (G6 generation) and NaOTMS as base in THF, completing in just ~2 hours at 40 °C[[15]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=heteroarenes%2C%20the%20combination%20of%20Gphos,good%20retention%20of%20chiral%20configurations). This strategy avoids strong bases that could deprotonate or coordinate the heterocycle and instead uses a silyl amide base (pK\_a≈11) which, in combination with an optimized ligand, enables fast coupling even at low temperature[[15]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=heteroarenes%2C%20the%20combination%20of%20Gphos,good%20retention%20of%20chiral%20configurations). | Consider Pd–NHC or similarly robust catalysts to resist heteroatom poisoning. For example, an NHC-ligated Pd catalyst (such as Pd-PEPPSI-IPr, ~2 mol%) with an inorganic base (K₃PO₄ or Cs₂CO₃) in a polar aprotic solvent at 100–120 °C is effective for many (hetero)aryl aminations[[4]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=BrettPhos1%20shows%20excellent%20selectivity%20and,3). NHC complexes bind Pd strongly (preventing catalyst sequestration by heteroatoms) and have been successfully applied to challenging couplings like (hetero)aryl tosylates and halides under relatively mild conditions[[4]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=BrettPhos1%20shows%20excellent%20selectivity%20and,3). |
| **Base-sensitive functional groups** <br>*e.g., –CHO, –NO₂, –COOR or other moieties unstable under strong base* | Swap strong alkoxide bases for weaker, more buffered bases. A typical solution is using Cs₂CO₃ or K₃PO₄ (2–3 equiv) in a protic or biphasic solvent. For example, running the amination in tert-butanol (0.5 M) with Cs₂CO₃ and a Buchwald G3 precatalyst (e.g. BrettPhos or RuPhos, 5–10 mol%) at ~100 °C often gives good results[[16]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Pd%20Source%20BrettPhos%20Pd%20G3,10%20mol). Such carbonate or phosphate bases are far milder than NaOtBu and dramatically improve tolerance of base-sensitive groups (avoiding side reactions like elimination or decomposition)[[6]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=The%20most%20widely%20used%20bases,boundary%20which%20gives%20a%20situation). | Use soluble organic bases or base combinations to moderate basicity. A notable approach is the use of DBU (a non-nucleophilic amidine base) in combination with an inorganic weak base additive. For instance, DBU with NaTFA (sodium trifluoroacetate) has been shown to effectively deprotonate an N–H (such as an amide N–H) without excess strong base in solution[[17]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=also%20severely%20impact%20the%20rate,as%20the%20first%20choices%2055). This buffered system can enable couplings of sensitive N–H substrates (like amides or sulfonamides) that would otherwise decompose under harsher base conditions[[17]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=also%20severely%20impact%20the%20rate,as%20the%20first%20choices%2055). | If a substrate is supplied as a protic salt or has an acidic proton, consider using a strong, non-nucleophilic base in situ at lower temperature. For example, an amine hydrochloride can be coupled by first deprotonating with LHMDS (Li hexamethyldisilazide) in THF, then coupling at 65–80 °C[[18]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Conditions%20for%20Protic%20Substrates4%20Solvent,BuOH%20%280.5%20M). Silylamide bases (LiHMDS, NaHMDS) will free the amine in a controlled fashion and minimize exposure of sensitive functional groups to strongly basic conditions (often crucial for protic or enolizable substrates)[[18]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Conditions%20for%20Protic%20Substrates4%20Solvent,BuOH%20%280.5%20M). |
| **Ammonia as N-source** <br>*direct NH₃ coupling or equivalents* | Use ammonia equivalents to circumvent NH₃’s coordination issues[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39). One proven strategy is to employ *N*-benzophenone imine (Ph₂C=NH) in place of NH₃. Under standard Buchwald–Hartwig conditions (e.g. BrettPhos/Pd catalyst, NaOtBu base, 100 °C), the aryl halide couples with Ph₂C=NH to give an N-arylimine, which is then hydrolyzed to the primary aryl amine[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39). This two-step approach effectively delivers aniline products while avoiding direct use of NH₃[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39). | Another ammonia surrogate is a silylamide reagent[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39). For example, tert-butyldimethylsilyl amine or hexamethyldisilazane (HMDS) can serve as an ammonia equivalent: in situ, a base (like NaOTMS) generates a silylamide anion that couples with the aryl halide, and subsequent hydrolysis releases the aniline[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39). This method also mitigates catalyst inhibition by free NH₃, since the actual coupling partner is a less coordinating amide anion. | Special catalyst systems enable *direct* coupling of ammonia. Notably, using a bulky bidentate ligand such as Josiphos (e.g. CyPF-tBu) with a Pd(0) source allows aryl halides to be coupled with aqueous or salt forms of NH₃[[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39)[[20]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=A%20catalyst%20system%20that%20can,type%20ligand.%5B%2040). In practice, one can employ a Pd–Josiphos precatalyst (2–5 mol%) with a strong base (e.g. NaOtBu) in a solvent like dioxane, adding NH₄OH or ammonium sulfate as the ammonia source. This approach (ref. 40) has demonstrated direct monoarylation of ammonia to form primary aryl amines[[20]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=A%20catalyst%20system%20that%20can,type%20ligand.%5B%2040), overcoming the long-standing challenge of NH₃’s tight binding to Pd. |

[[1]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk" \l ":~:text=Standard%20Conditions1%20Solvent%20Dioxane%20,1%20M) [[4]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=BrettPhos1%20shows%20excellent%20selectivity%20and,3) [[7]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=tBuBrettPhos6%20is%20an%20excellent%20supporting,2%20%E2%80%93%201%20M) [[8]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Since%20amines%20themselves%20can%20act,situ%20formation%20of%20catalytically%20inactive) [[9]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=RuPhos1%20shows%20excellent%20selectivity%20and,an%20excellent%20supporting%20ligand%20for) [[10]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Standard%20Conditions1%20Solvent%20THF%20,Temperature%2085%C2%B0C) [[16]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Pd%20Source%20BrettPhos%20Pd%20G3,10%20mol) [[18]](https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk#:~:text=Conditions%20for%20Protic%20Substrates4%20Solvent,BuOH%20%280.5%20M) Cross-Coupling Reaction Manual: Desk Reference

<https://www.sigmaaldrich.com/deepweb/assets/sigmaaldrich/marketing/global/documents/142/660/cross-coupling-reaction-manual-ms.pdf?srsltid=AfmBOorPdbPwI3xPySjApKjw1kg2SxiiJcPpGlHhntifhem4OJ1VyEzk>

[[2]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,20) [[3]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Bulky%20tri,34) [[5]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20development%20of%20diphenylphosphinobinapthyl%20,for%20monoligated%20complexes%20serving%20as) [[11]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=The%20dramatic%20increase%20in%20activity,of%20these%20ligands%20also%20seem) [[13]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Even%20electron%20withdrawn%20amines%20and,36) [[14]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=35.%20,45%20%2839%29%3A%206523%E2%80%936527) [[19]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=Ammonia%20%20remains%20one%20of,39) [[20]](https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination#:~:text=A%20catalyst%20system%20that%20can,type%20ligand.%5B%2040) Buchwald–Hartwig amination - Wikipedia

<https://en.wikipedia.org/wiki/Buchwald%E2%80%93Hartwig_amination>

[[6]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=The%20most%20widely%20used%20bases,boundary%20which%20gives%20a%20situation) [[15]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=heteroarenes%2C%20the%20combination%20of%20Gphos,good%20retention%20of%20chiral%20configurations) [[17]](https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/#:~:text=also%20severely%20impact%20the%20rate,as%20the%20first%20choices%2055) Chemical Insights | How to Wisely Design Conditions for Buchwald-Hartwig Couplings？ - RCS Research Chemistry Services

<https://rcs.wuxiapptec.com/resources/literature/chemical-insights-how-to-wisely-design-conditions-for-buchwald-hartwig-couplings/>

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