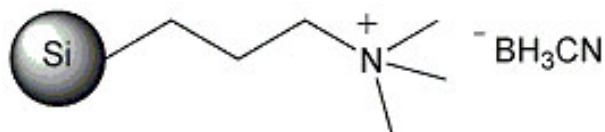
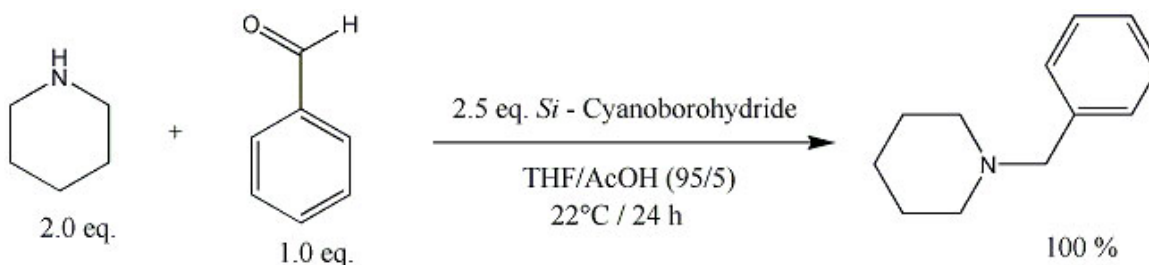


Use of SiliaBond[®] Cyanoborohydride


SiliaBond[®] Cyanoborohydride is the silica bound equivalent of sodium cyanoborohydride. Bound cyanoborohydride is very useful in reductive amination and in the reduction of imines. Cyanide contamination of the product is a concern when using the solution phase equivalent. This problem is minimized with the use of silica bound materials since the toxic cyanide residue remains on the silica. Additionally, it may be used to reduce α,β -unsaturated carbonyls to the corresponding unsaturated alcohols.



Reaction	Starting Materials		Solvent	Yield ^a
	Amine	Carbonyl		
1	Piperidine	Benzaldehyde	THF/AcOH (95/5)	100 %
2	1-Benzyl-3-propylamine	Cyclohexanone	THF/AcOH (75/25)	100 %
3	N-Benzylmethylamine	Cyclohexanone	THF/AcOH (95/5)	100 %
4	N-Benzylmethylamine	Benzaldehyde	DCM/AcOH (90/10)	96 %

^aYield determined by GC-MS
 All reactions used the following conditions: RT/24 h, 2.5 eq. of *Si*-Cyanoborohydride. For reactions 1-3 : 2.0 eq. of the amine and 1 eq. of the carbonyl. For reaction 4 : 1.0 eq. of the amine and 3.0 eq. of the carbonyl.

Reactions 2 and 3 were used to monitor **SiliaBond[®] Cyanoborohydride**'s reactivity in different conditions as an indication of its stability. The results are shown in the following table:

Test	Reaction	SiliaBond[®] Cyanoborohydride was ...	% Yield
A	3	Left uncapped on the lab bench for 3 days	99.7
B	3	Washed with water and methanol prior to use	97.8
C	3	Stored in the fridge under argon for 10 days	100
D	2	Stored in the fridge under argon for 2 months	88.3

To see if any cyanide ion was leaching from the silica, 1 g of **SiliaBond[®] Cyanoborohydride** was washed in 10 mL of methanol for 24 hours. Cyanide strips indicated less than 3 ppm in each test performed.

Purification

In the crude mixture, the amine is present as an acetate salt. Different procedures may be used to obtain the free amine after filtration of the silica:

- 1) *Acid-base extraction.*
Evaporation of the solvent under reduced pressure, addition of 20 % NaOH, followed by extraction with ether (3×) and evaporation.
- 2) *Catch and release with SiliaBond[®] TsOH.*
First, conditioning the cartridge with the reaction solvent. Second, application of the sample. Third, washing the cartridge to eliminate impurities, and finally, product elution with 2M NH₃/MeOH.
- 3) *Neutralization with SiliaBond[®] Carbonate.*
Add 3 equivalents of SiliaBond[®] Carbonate, stir for 30 minutes, and filter.

Pure product is obtained after purification by column chromatography with silica gel.