SIGMA-ALDRICH®
LabwareNOTES
Delivering the Tools for Science

Dramatically Improve Mixing Results
Stirring bar design makes the difference

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Based on article originally published by Bel-Art

Magnetic stirring is used in a number of common laboratory procedures, but the importance of selecting the best stirring bar for each particular application is often overlooked. Varying the size, shape or length of the magnetic stirring bar alters the motion imparted in the solution. Thus, selection of the appropriate stirring bar for a given application should be done with great care.

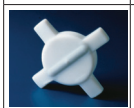
Understanding the principals of magnetism is important. On the most basic level, we are aware that opposite poles attract. However, we must also understand the significance of the drive element, magnetic coupling, "spin out", vessel shape, viscosity and turbulence.

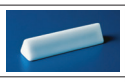
For optimum efficiency and magnetic coupling the distance between the magnetic poles of the drive magnet and the length of the stirring bar should be equal. The magnetic poles are typically two inches apart in bench top models but can be up to six inches apart in units designed to mix 50 L of liquid solution. A small metal washer on the surface plate of the stirrer will gravitate toward one of the poles and can be used to determine the approximate distance between poles.

Another important parameter in choosing a magnetic stirring bar is the vertical distance between the drive magnet and the stirring bar. The material and thickness of the cover plate and the containing vessel can also influence stirring efficiency. Cover plates are made of paramagnetic materials such as ceramic or aluminum, which offer better coupling of the drive magnet and stirring bar. The amount of magnetic energy that joins the two magnets (coupling) falls off as the distance between them increases. Stated mathematically, "The coupling energy or force is inversely proportional to the square of the distance between them." It stands to reason that for the best magnetic coupling, the distance between the magnets should be minimized.

Magnetic stirring bars are generally made of ALNICO (an alloy of aluminum, nickel, iron and cobalt) encapsulated in an FDA approved PTFE coating. This combination offers the best compromise of magnetic strength, usefulness and cost. The PTFE coating is only useful at temperatures up to 225 °C (437 °F). Other coatings or coverings such as glass tubing, polypropylene and polyethylene are also used. High-energy materials, such as Samarium Cobalt and Neodymium Iron Boron, have a higher energy than ALNICO but do not always work better as drive magnets. The geometry of the magnet, in the case of bar magnets, length/diameter (L/D), governs how effective the magnet will be. The aforementioned magnets have energy products of three to six times that of ALNICO in geometry of 1 to 1. When used in a 4 to 1 configuration, their relative levels are nearly the same or less than the ALNICO. Additionally, many of the exotic materials are extremely temperature sensitive and will demagnetize as the temperature increases.

Once a magnetic stirring bar has been placed in a container with a solution, it should be positioned directly over the center of the drive magnet. The stirring speed should be increased slowly, until the desired vortex pattern is achieved. If magnetic stirring bar lose its coupling with the drive magnet because of the speed of the drive magnet or the viscosity of the fluid, it is said to have "spun-out." Improperly selected stirring bars are the frequent cause of "spin-out", as well as a drive magnet speed that is too fast. Matching the drive and stirring magnet improves results dramatically. The selection of the shape of the magnetic stirring bar also influences the resulting vortex.

	Shape	Features and benefits
	Spinbar® Cylindrical (round)	Excellent centering and smooth running characteristics. Pivot ring minimizes contact area of bar to vessel, reducing friction and marring of plastic containers.
	Spinbar Octagonal, molded pivot ring	Interrupted profile provides greater surface area and added turbulence. Moulded pivot ring aids in reducing friction & chattering.
	Komet®	Eight edges generate strong turbulence and better stability in curved bottoms vessels. High-energy magnet increases torque loads 3X larger than conventional stirring bars of similar length.
	Spinplus®	The "+" shape creates a deep vortex for improved efficiency and provides stable, quiet operation.
	Spinstar® (star-shaped)	Atar shape creates deep vortex at slow speeds. Designed to fit inside diameter of most beakers. Perfect for applications requiring slow, thorough mixing.
	Spinbar Elliptical (egg-shaped)	Particularly well suited for round bottom flasks. Their shape mimics that of a flask & ensures complete mixing. They also offer minimal contact when used in plastic containers.
	Micro (flea style)	Designed for stirring small volumes in vials & tubes. Useful for applications in which small sample volumes need to be prepared.

	Shape	Features and benefits
	Spinbar Pyrex® Glass Bars	Completely encapsulated in Pyrex® glass. Useful for high temperature applications in excess of 225 °C (437 °F) where Teflon® PTFE is not stable. Glass bars also offer, "zero absorption" of the stirred solution.
	Spinwedge® (triangular-shaped)	Provide strong turbulence at fairly low speeds and are well suited for churning sediment or dissolving salts.
	Spinbar Circulus™ (dumbbell-shaped)	Provide strong turbulence at relatively low speeds, offer reduced surface contact & have excellent centering characteristics, particularly in vessels with convex bottoms.
	Spinfin® (cross-shaped)	For use in round bottom flasks as well as rounded vessels such as test tubes or cylinders.
	Spinvane® (vane-shaped)	Designed for test tubes, micro vials and conical bottom centrifuge tubes. Can be modified if needed without affecting the magnet.
	Spinring®	A "hoop" around an octagonal bar maximises stability. A greater surface area and wider profile eliminates "spin out." Best for open-neck vessels, such as beakers.

For more detailed information on the products featured here, visit ***sigma-aldrich/labwarenotes***

Paula's Pointers

Z648280
Spinbar® magnetic stirring bar garage

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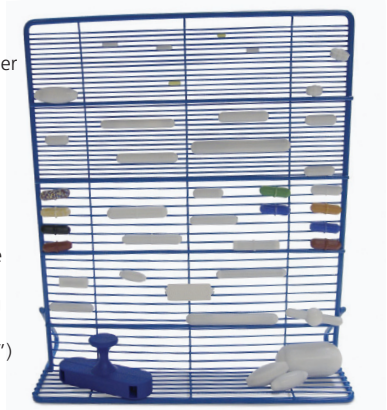
Storing stirring bars can be a problem. They usually end up rolling around in the bottom of a drawer. This not only leads to them being difficult to find, but can also lead to de-magnetisation and render the bar useless. A simple way to keep all your magnetic stirring bars safe and accessible is with the Spinbar magnetic stirring bar garage. Multiple sizes and shapes of magnetic stirring bars from 159 mm (6") to tiny 10 mm (0.5") bars can be stored on the dedicated rack which stands freely on the bench or can be mounted to a vertical surface. Tight wire spacing in the upper section of the rack holds smaller magnetic stirs bars, keeping them separate from larger bars stored below. A lower wire shelf holds small lab tools and prevents stirring bars from accidentally falling.



Background Reading

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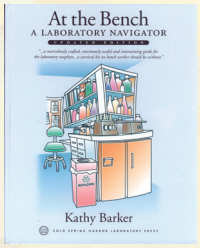
***At the Bench: a Laboratory Navigator,* updated edition**



At the Bench is the unique and extremely successful handbook for living and working in the laboratory, an essential aid to understanding basic lab techniques and how research groups work at a human level. In this newly revised edition, chapters have been rewritten to accommodate the impact of computer technology and the Internet, not only on the acquisition and analysis of data, but also on its organization and presentation. Alternatives to the use of radiation have been expanded, and figures and illustrations have been redrawn to reflect changes in laboratory equipment and procedures.

Latest News

The 2009-2010 Labware Catalog and Aldrich® Handbook of Fine Chemicals set is now available!
Labware Catalog content includes:

- Approximately 1,300 pages with over 16,000 carefully selected products for Chemistry and Life Science customers/applications
- Comprehensive index and thumbnail pictures for easy navigation
- New technical information section with12 pages of useful charts, graphs and section guides

To request your 2009-2010 Labware Catalog and Aldrich Handbook of Fine Chemicals, visit ***sigma-aldrich.com/aldrich_handbook***

Research is easier when you use the right tools!

Labware Listens

In response to a huge increase in customers asking for small footprint mixing equipment, Labware has increased the range of mini-units offered. Joining the Lab Dancer vortexer from IKA we have the new mini-LabRoller and Gyro-mini units from Labnet. These models enable you to make the best use of your bench space by combining full operational specifications with a highly compact footprint.

More details can be found at
sigma-aldrich.com/labwarenotes

Labware Links

For more detailed information on the products featured in this newsletter along with back issues and many useful Labware web links and protocols visit ***sigma-aldrich.com/labwarenotes***

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	2		9	8	5			6
7			4			1		
8						5	6	2
3	5							
2	3	1		9				
5								1
4			8			7		

Down Time

Sudoku is a logic-based number-placement puzzle. The objective is to fill a 9×9 grid so that each column, each row, and each of the nine 3×3 boxes contains the digits from 1 to 9 only one time each. Completed Sudoku puzzles are usually a type of Latin square with an additional constraint on the contents of individual regions. Sudoku means "single number" in Japanese.

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