



2010/11

molecular

Sample Preparation Products

Packed Pipette Tips

SpinColumns™

Filtration Products

DIALYZERS™

Liposomes

CoZap™

ElectroPrep™ System

Equilibrium DIALYZERS™

CPK® Atomic Models

HARVARD
APPARATUS

Call to receive other catalogs of interest:

Cell Biology
&
Electro-
physiology

Physiology
&
Pharma-
cology

Behavioral
Research

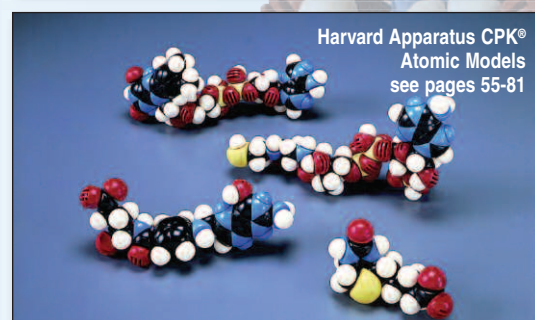
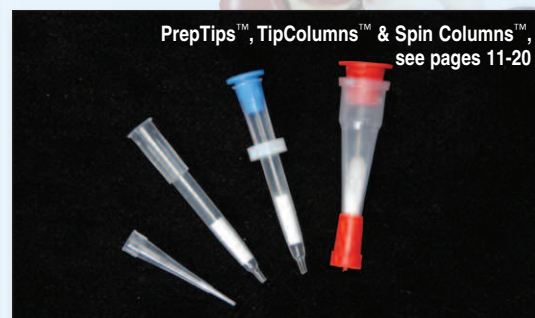
Micro/Nano
Fluidics

Electro-
poration
&
Electrofusion

Molecular
Sample
Preparation

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The Sample Preparation

Target materials in biological samples are commonly present in trace amounts among larger quantities of numerous impurities or components such as:

- **Salts**
- **Buffers**
- **Detergents**
- **Polyacrylamide Gels**
- **Excess Dyes**
- **Radiolabels**
- **Small undesired molecules like primers, peptides, inhibitors & drugs**

These impurities or components may have to be completely removed before analysis.

Some target materials must also be enriched before they can be quantified or characterized, for example, by mass spectrometry. Without sample preparation, some

instrumental methods like MS may not allow direct identification of specific molecules due to high background signals from contaminating molecules in the sample.

There is currently no single method of purification that is applicable to all samples. Appropriate sample preparation methods are used depending on the type of target material and the sample composition.

This is why the Harvard Apparatus Sample Preparation Group provides a broad range of solutions for your sample preparation needs. For example, our equilibrium dialysis products are widely used for measuring ligand binding between plasma proteins and drugs or drug candidates, Free T4, Free T3, Free Cortisol, Free Testosterone, to name a few.

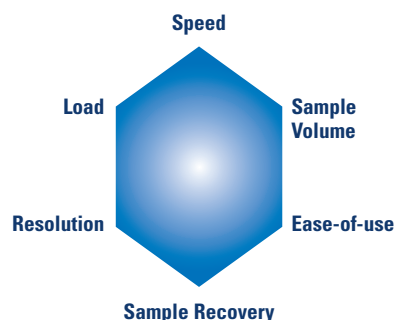
The following pages list the summary, features and ordering information for the range of Molecular Sample Preparation Products available from the Harvard Apparatus Sample Preparation Group.

Harvard Apparatus – Sample Preparation Solutions Matrix

Applications

- **Trace Enrichment**
- **De-salting**
- **Buffer Exchange**
- **Removal of Surfactants**
- **Removal of Detergents/SDS**
- **Removal of Unwanted Molecules**
- **Concentrating**
- **Destaining Gels**
- **Fractionation/Purification**
- **Binding Studies**

Advantages



Harvard Apparatus – Sample Preparation Tools

SPE: Solid Phase Extraction

Tips

- **PrepTips**
- **ProTips**
- **TipColumns**

SpinColumns

- **Single: Ultra-Micro, Micro, Macro**
- **96-Well: Micro, Macro**
- **384-Well**

Filtration

Dialysis

Re-Usable (PTFE)

- **Single Analysis**

Disposable

- **Single Analysis**
- **96-Well**

Liposome Prep

CoZap

Electro-dialysis

Equilibrium Dialysis

Re-Usable (PTFE)

- **Single Analysis**
- **20 Sample Analysis**

Disposable

- **Single Analysis**
- **96-Well**

Harvard Apparatus – CPK Models

The most accurate molecular models available!

CPK models are the American Society of Biological Chemists sanctioned models. They are accurate in size, bond angles and bond flexibility.

These models are Ideal for:

- **Court room models to explain chemical structures**
- **Teaching students molecular structure/ activity studies**
- **When models are needed for new drug presentations**
- **Verifying configurations created by computer models packages**

Application Guide for Sample Preparation of Biological Mixtures

i.e. Proteins, Nucleic Acids, Carbohydrates	Chromato-graphic	Dialysis	Equilibrium Dialysis	ElectroPrep	Liposomes	CoZap
Acrylamide Removal	•					
Affinity Purification	•					
Antibody Production					•	
Buffer Exchange		•		•		
Cancer Therapy					•	
Carbohydrate Purification	•					
Cell-Cell Interactions					•	
Cosmetics					•	
CsCl Removal				•		
Destaining Gels						•
Detergent Removal	•	•		•		
Diagnostics					•	
DNA Binding Assays			•			
Drug Delivery					•	
Drug Entrapment Studies					•	
Dye Removal	•	•		•		
Electrophoresis				•		
Enzyme Replacement Therapy					•	
Extraction from Gels				•		
Gene Therapy					•	
Glycoprotein/Glycopeptide Purification	•					
Immunoblotting				•		
In Vitro Cell-Liposome Interaction Studies					•	
Ligand Binding Assays			•			
Lipid Purification	•					
Mediated Delivery of Macromolecules					•	
Metal Chelation Therapy					•	
Nick Translation	•					
PCR Cleanup	•			•		
Peptide Removal	•	•		•		
Plasmid Purification	•					
Primer Removal	•			•		
Protein Binding Assays			•			
Protein Purification for HPLC/HPCE/GC	•	•		•		
Protein Purification for Mass Spectroscopy (MALDI, GC/MS, MS-NMR, ESI-MS)	•	•		•		
Protein-Drug Binding Assays			•			
Protein-Protein Interactions			•			
Purification of Samples with Unknown Isoelectric Points				•		
Pyridoxal-5-Phosphate Removal				•		
Radiolabel Removal	•	•				
Radiopharmaceutical Marker Tracing	•	•				
Receptor Binding Assays			•			
Reconstitution Experiments (for Ion Transport)					•	
Salt Removal	•	•		•		
Sample Concentration	•	•		•		
SDS Removal	•	•		•		
Silicate Removal after Chromatography				•		
Size Fractionation	•			•		
Small Molecule Removal	•	•		•		
Time-Dependent Release Studies					•	

Technology Selection Guide

Chromatography Methods (i.e., Tip Columns, PrepTips, ProTips and Spin Columns) Physical separation methods, such as: Hydrophilic - Molecules are bound to a functional group on a matrix in the organic phase and eluted in the aqueous phase; Hydrophobic - Molecules are bound to a functional group on a matrix in the aqueous phase and eluted in the organic phase; Gel Filtration - The smaller molecules diffuse into the pores of the support material making their path and elution time longer than the larger molecules that are excluded on the outside of the particle. Hence the larger molecules elute first and the smaller ones elute later; Ion Exchange - Molecules are bound to an ionic functional group on a matrix by charge.				Dialysis A physical separation method in which small molecules pass through the pores of a size selective membrane while the larger molecules are retained in the dialysis bag or chamber. In order to drive the equilibrium mechanism the volume on the outside must be about 200 x the volume of the retained volume and devoid of the small molecules of interest.	Electro Dialysis A physical separation method in which the movement of the molecules through a semi-permeable membrane is accelerated by an electric field so that molecules can be separated quickly by charge and size. This technique is useful in separation, collection and fractionation of large and small ionic molecules.	Equilibrium Dialysis A specific application of dialysis which is used to measure the amounts of ligand bound to macromolecules and the free ligand present in two compartments separated by a dialysis membrane. The concentrations of ligand provide information on various binding parameters such as binding constants binding capacity and the number of binding sites.
	Absorption	Size Exclusion	Ion Exchange			
1 Methods Development Time	Moderate to Considerable	Minimal	Moderate to Considerable	Minimal	Minimal in dialysis, size only mode; moderate to complex in size and charge mode	Minimal
2 Average Time/Speed of Separation	5 minutes	5 minutes	5 minutes	1 to 24 hours	3 to 5 minutes	3 to 24 hrs
3 Ability to Collect Specific Sample Fractions-Small Molecules	Excellent	Good	Excellent	Poor	Excellent	Fair
4 Ability to Collect Specific Sample Fractions-Large Molecules	Good	Good	Good	Good	Good	Good
5 Ability to Separate More Than One Set of Components Simultaneously	Excellent	Fair	Excellent	Poor	Excellent	Poor
6 Sample Volumes (non flow thru versions)	a few microliters to > 1 ml	a few microliters to > 5 ml	a few microliters to > 5 ml	a few microliters to > 5 ml	a few microliters to > 1 ml	96 well 50 to 200 µl
7 Number of Samples Run Simultaneously	1 to 96	1 to 96	1 to 96	1 to 96	1	1 to 96
8 Materials Compatibility for Maximum Activity Recovery	Medium to high	Medium to high	Medium to high	Medium to high	Medium to high	Medium to high
9 Auxiliary Equipment	centrifuge, pipettor	centrifuge, pipettor	centrifuge, pipettor	Stirrer, temperature controller	200 VDC, 100 mA power supply, rotator	200 VDC, 100 mA power supply, rotator
10 Sterilizable	CHEMICALLY	CHEMICALLY	CHEMICALLY	CHEMICALLY	CHEMICALLY	CHEMICALLY
11 Suitable for Organic & Aqueous Solutions	YES	YES	YES	YES	YES	YES
12 Suitable for High Throughput Screening (HTS)	YES	YES	YES	YES	YES	YES

Recommended Literature

SpinColumns

Sajith A. Jayasinghe and Ralf Langen; "Identifying Structural Features of Fibrillar Islet Amyloid Polypeptide Using Site-directed Spin Labeling", *Journal of Biological Chemistry*, Vol. 279, No. 46, pp. 48420-48425, 2004.

Dialysis

James B. Ames, Alexander M. Dizhoor, Mitsuhiro Ikura, Krzysztof Palczewski, and Lubert Stryer; "Three-dimensional Structure of Guanylyl Cyclase Activating Protein-2, a Calcium-sensitive Modulator of Photoreceptor Guanylyl Cyclases", *The Journal of Biological Chemistry*, Vol. 274, No. 27, pp. 19329-19337, 1999.

Electro Dialysis

Zuo, Xun & Speicher, David; "A Method for Global Analysis of Complex Proteomes Using Sample Prefractionation by Solution Isoelectrofocusing Prior to Two-Dimensional Electrophoresis", *Analytical Biochemistry*, Vol. 284, pp. 266-278, 2000.

Equilibrium Dialysis

1) Kariv, Hong, & Oldenburg; "Development of a High Throughput Equilibrium Dialysis Method", *Journal of Pharmaceutical Sciences*, Vol. 90, No. 5, pp. 580-587, 2001.
 2) Guide to Equilibrium Dialysis

Footnote: Membranes are used in Dialysis, Electro Dialysis and Equilibrium Dialysis and can be damaged by high temperature.

Guide to Sample Preparation Products



Ultra-Micro PrepTip™ (U.S. Patent 6,537,502)



Ultra-Micro/Micro/Macro ProTip™

Single-Use Disposable Chromatographic Products

	Tips			
	Ultra-Micro PrepTip™	Ultra-Micro ProTip™	Micro ProTip™	Macro ProTip™
	A revolutionary fritless chromatographic device. Does separation without clogging, see page 12-14			
	Contain a hydrophilic polymer material which binds 5 to 10x more protein than silica, see page 15			
Sample Volumes (µl)	1-10	1-10	10-100	100-500
Tip Volumes (µl)	10	10	200	1,000
Binding Capacity (µg)	0.5	0.2	1.5	9.0
Packing Materials				
Gel filtration (V0=KD) (Sephadex 45-90 microns)				
G10= (700D)				
G25= (5KD)				
G50= (30KD)				
G100= (100KD)				
P2= (2KD)				
P6= (6KD)				
Hydrophobic (particle size 15-20 microns)				
C18	•			
C8	•			
C4	•			
Hydrophilic				
Silica				
CN				
NH2				
PVOH*		•	•	•
PHEA**				
Ion exchange (Sephacrose): Q= Quaternary Amine; DEAE=cross-linked Diethylaminoethyl; SP=Sulphopropyl; CM=Carboxymethyl 12µm; 300A				
Strong Anion Q				
Strong Cation SP				
Weak Anion DEAE				
Weak Cation CM				
Ion exchange (Silica Based: Organic Compatible) PEI= linear Polyethyleneimine; SA= Sulfoethyl Aspartamide; AA= Aspartic Acid 20 µm, 300 Å				
Strong Cation SA				
Weak Anion PEI				
Weak Cation AA				
Miscellaneous IMAC= (Imidodiacetate on cross linked divinyl benzene)				
Activated Charcoal				
Cellulose				
Detergent Removal				
IMAC				

* Polyvinylalcohol **Polyhydroxyethyl Aspartamide

Guide to Sample Preparation Products



Ultra-Micro/Micro TipColumn™



Ultra-Micro/Micro SpinColumn™



Macro SpinColumn™

96-Well and 384-Well
SpinColumn™

Single-Use Disposable Chromatographic Products

	Tip Columns		SpinColumns					
	Ultra-Micro TipColumn™	Micro TipColumn™	Ultra-Micro SpinColumn™	Micro SpinColumn™	Macro SpinColumn™	384-Well SpinColumn™	96-Well & Micro SpinColumn™	96-Well Macro SpinColumn™
	A wide selection of pre-packed chromatographic materials in pipette tip formats, see page 16-17		A wide selection of pre-packed chromatographic materials in SpinColumn formats, see pages 18-20 & 22			A 96- or 384-well plate for HTS sample prep, see pages 21-22		
Sample Volumes (µl)	10-25	25-75	10-25	25-75	75-150	10-25	25-100	25-150
Tip Volumes (µl)	300	300	300	300	1,000	140	300	400
Binding Capacity (µg)	3-30	5-60	3-30	5-60	30-300	3-30	10-100	30-275
Packing Materials								
Gel filtration (V0=KD) (Sephadex 45-90 microns)								
G10= (700D)	•	•	•	•	•	•	•	•
G25= (5KD)	•	•	•	•	•	•	•	•
G50= (30KD)	•	•	•	•	•	•	•	•
G100= (100KD)	•	•	•	•	•	•	•	•
P2= (2KD)	•	•	•	•	•	•	•	•
P6= (6KD)	•	•	•	•	•	•	•	•
Hydrophobic (particle size 15-20 microns)								
C18	•	•	•	•	•	•	•	•
C8	•	•	•	•	•	•	•	•
C4	•	•	•	•	•	•	•	•
Hydrophilic								
Silica	•	•	•	•	•	•	•	•
CN	•	•	•	•	•	•	•	•
NH2	•	•	•	•	•	•	•	•
PVOH*								
PHEA**	•	•	•	•	•	•	•	•
Ion exchange (Sephacrose): SA= Quaternary Amine; DEAE=cross-linked Diethylaminoethyl; SP=Sulphopropyl; CM=Carboxymethyl 12mu; 300A								
Strong Anion Q	•	•	•	•	•	•	•	•
Strong Cation SP	•	•	•	•	•	•	•	•
Weak Anion DEAE	•	•	•	•	•	•	•	•
Weak Cation CM	•	•	•	•	•	•	•	•
Ion exchange (Silica Based: Organic Compatible) PEI= linear Polyethyleneimine; SA= Sulfoethyl Aspartamide; AA= Aspartic Acid 20 µm, 300 Å								
Strong Cation SA		•		•	•	•	•	•
Weak Anion PEI		•		•	•	•	•	•
Weak Cation AA		•		•	•	•	•	•
Miscellaneous IMAC= (Imidodiacetate on cross linked divinyl benzene)								
Activated Charcoal		•		•	•	•	•	•
Cellulose	•	•	•	•	•	•	•	•
Detergent Removal	•	•	•	•	•	•	•	•
IMAC	•	•	•	•	•	•	•	•

* Polyvinylalcohol **Polyhydroxyethyl Aspartamide

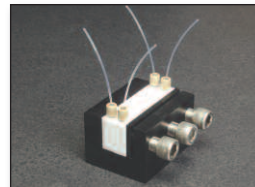
Guide to Sample Preparation Products



DIALYZER™



Ultra-Fast DIALYZER™

SpinDIALYZER™/
Fast SpinDIALYZER™

Flow-Thru DIALYZER™

DIALYSIS Products

Reusable DIALYSIS Chambers

	DIALYZER™ Drop-in dialysis chamber. 10 Available chamber sizes, see page 26	Ultra-Fast DIALYZER™ Drop-in two-sided dialysis chamber. 8 Available chamber sizes, see page 28	SpinDIALYZER™ Drop-in dialysis chamber with built-in magnet. 8 Available chamber sizes, see page 30	Fast SpinDIALYZER™ Drop-in two-sided dialysis chamber with built-in magnet. 6 Available chamber sizes, see page 30	Flow-Thru DIALYZER™ Continuous flow, high surface area, in-line dialysis system. 5 Available chamber sizes, see page 32
Sample Volumes (µl)	10-5,000	25-5,000	10-1,500	10-1,500	20->10,000
Number of Membranes	1	2	1	2	1
Materials	PTFE	PTFE	PTFE	PTFE	PTFE
Membranes (Da or µm)					
Regenerated Cellulose MWCO (Da), Aqueous/Organic					
1K	•	•	•	•	•
2K	•	•	•	•	•
5K	•	•	•	•	•
10K	•	•	•	•	•
25K	•	•	•	•	•
50K	•	•	•	•	•
Cellulose Acetate MWCO (Da), Aqueous					
100	•	•	•	•	•
500	•	•	•	•	•
1K	•	•	•	•	•
2K	•	•	•	•	•
5K	•	•	•	•	•
10K	•	•	•	•	•
25K	•	•	•	•	•
50K	•	•	•	•	•
100K	•	•	•	•	•
300K	•	•	•	•	•
Polycarbonate Pore Size, (µm)					
0.01 (100K)	•	•	•	•	•
0.05 (800K)	•	•	•	•	•
0.1 (1.1M)	•	•	•	•	•
0.6 (2.5M)	•	•	•	•	•
Ordering Information					
	Includes chamber and 1 cap (membranes, stirrer plate and stir bar sold separately), see page 27	Includes chamber and 2 caps (membranes, stirrer plate and stir bar sold separately), see page 29	Includes chamber with magnet and cap (membranes, stirrer plate and stir bar sold separately), see page 31	Includes chamber with magnet and two caps (membranes, stirrer plate and stir bar sold separately), see page 31	Includes 2 chambers, membranes, fittings, clamp and allen wrench (sold with or without pump), see page 33

PTFE= Teflon™; PP=Polypropylene; PE=Polyethylene; PC=Polycarbonate

Guide to Sample Preparation Products



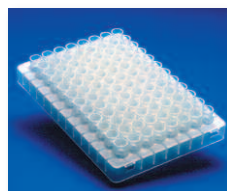
Ultra-Micro
DispoDIALYZER™



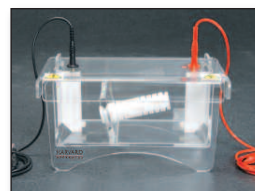
Micro
DispoDIALYZER™



Fast Macro DispoDIALYZER™



96-Well DispoDIALYZER™



Ultra-Fast DIALYZER
for Electroprep™ System

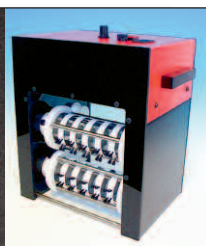
DIALYSIS Products

	Single Use DIALYSIS Products				Reusable Chambers for Electroprep	
	Ultra-Micro DispoDIALYZER™	Micro DispoDIALYZER™	Fast Macro DispoDIALYZER™	96-Well DispoDIALYZER™	Electroprep™ System	Fast Flow-Thru DIALYZER™
	Drop-in dialysis chamber. 10 Available chamber sizes, see page 35	Drop-in two-sided dialysis chamber. 8 Available chamber sizes, see page 36	Drop-in dialysis chamber with built-in magnet. 8 Available chamber sizes, see page 37	Drop-in two-sided dialysis chamber with built-in magnet. 6 Available chamber sizes, see page 38	Capable of separating by size and change. 6 Available chamber sizes, see pages 42-45	Continuous flow, single chambered dialysis system. 4 Available chamber sizes, see page 47
Sample Volumes (µl)	1-5	5-100	1,000-10,000	25-300	25-1500	50-1,000
Number of Membranes	1	1	2	1 per well	up to 6	2
Materials	PC	PC	PP	PP	PTFE	PTFE
Membranes (Da or µm)						
Regenerated Cellulose MWCO (Da), Aqueous/Organic						
1K	•	•		•	•	•
2K	•	•		•	•	•
5K	•	•	•	•	•	•
10K	•	•	•	•	•	•
25K	•	•		•	•	•
50K	•	•			•	•
Cellulose Acetate MWCO (Da), Aqueous						
100	•	•			•	•
500	•	•			•	•
1K					•	•
2K					•	•
5K					•	•
10K					•	•
25K					•	•
50K					•	•
100K					•	•
300K					•	•
Polycarbonate Pore Size, (µm)						
0.01 (100K)					•	•
0.05 (800K)					•	•
0.1 (1.1M)					•	•
0.6 (2.5M)					•	•
Ordering Information						
	Includes chamber with attached membrane and 2 sample tubes (centrifuge recommended, sold separately), see page 35	Includes chamber with attached membrane, flotation ring, cap and 2 sample tubes (stirrer plate and stir bar sold separately), see page 36	Includes chamber with 2 locking rings and 2 membranes (stirrer plate and stir bar sold separately), see page 37	Includes plate with membrane and 12 strip caps (stirrer plate and stir bar sold separately), see page 38	Includes chamber, 2 caps, membrane, tank with seal and lid with leads (power supply sold separately), see page 46	Includes chamber, fittings and 2 caps (membranes sold separately), see page 48

Guide to Sample Preparation Products



Fast Micro Equilibrium
DIALYZER™



Multi-Equilibrium
DIALYZER™



Dispo Equilibrium DIALYZER™



96-Well Equilibrium DIALYZER™

Equilibrium DIALYSIS Products

for binding studies, protein-protein interactions and protein-drug binding assays

	Reusable Products		Single-use Products	
	Fast Micro-Equilibrium DIALYZER™	Multi-Equilibrium DIALYZER™	DispoEquilibrium DIALYZER™	96-Well Equilibrium DIALYZER™
	A single sample re-usable equilibrium dialysis 2-chamber system for protein binding studies. Membrane assembly required, see page 50	Up to 20 parallel equilibrium assays. Re-usable chambers membrane assembly required, see page 52	Single sample, single use product for interaction studies. Ready-to-use: Preassembled with dialysis membrane, see page 53	Single use product for 96 simultaneous assays. Ready-to-use: Preassembled with dialysis membrane, see page 54
Sample Volumes (µl)	19-25 38-50 75-100 188-250 375-500	188-250 750-1,000 1,500-2,000 3,750-5,000	25-75	50-200
Number of Membranes	1	1/Chamber	1	1/Chamber
Stirring Device	No	Built-in	—	Rotator
Materials	PTFE Body	PTFE Chamber Delrin™ Plugs	PP Body PE Caps	PP Body PE Caps
Membranes MWCO (Da)				
Regenerated Cellulose	Regenerated Cellulose 1,000 to 50,000 Cellulose Acetate 100 to 300,000 Polycarbonate 0.01 µm to 0.60 µm	5,000 or 10,000	5,000 or 10,000	5,000 or 10,000
Specials Accepted	Yes	Yes	Yes	Yes
Ordering Information				
	Includes 1 chamber, 1 link and 2 solid caps per package; Membranes sold separately. See page 51	Includes Drive Unit, 1 package of 200 membranes (10,000 MWCO), 20 emptying stoppers, 4 carriers, 120 plugs, 24 spacers, 1 filling clamp and stand; 20 cells; (Tank for temperature control available as an option). See page 52	Includes chambers with membrane, 2 caps (one black, one white) and 2 sample tubes (0.65 ml) per chamber; 2 special pipette tips included; (centrifuge recommended and sold separately). See page 53	Includes plates with membranes, 12 top strips and 12 bottom strips; (rotator sold separately), see page 54

PTFE= Teflon™; PP=Polypropylene; PE=Polyethylene; PC=Polycarbonate

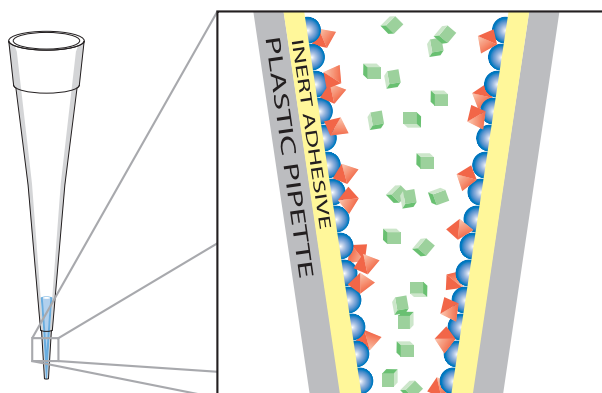
Sample Prep Pipette Tips

applications

- Protein purification
- Peptide purification
- Salt removal
- Detergent removal
- Dye-terminator removal
- Affinity purification
- Oligonucleotide purification
- DNA purification
- Carbohydrate purification
- Glycoprotein purification
- Glycopeptide purification
- Mass spectrometry (MALDI-TOF, ESI-MS)
- HPLC
- High performance capillary electrophoresis (HPCE)

Sample Prep Pipette Tips are easy to use; simply draw a mixed sample into the pipette tip and a material contained within the tip binds the desired component of the sample. The unbound components of the sample can then be washed away allowing the desired sample component to be eluted, free of contaminants. The speed and simplicity of this method, coupled with the wide-range of available binding materials, have made Harvard Apparatus sample prep tips an extremely popular product for a multitude of applications including:

Harvard Apparatus Pipette Tip Family

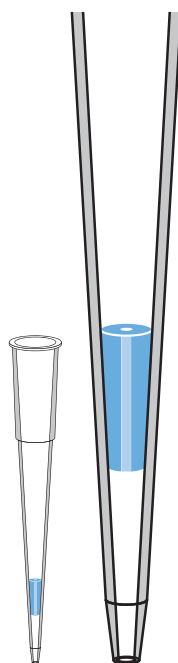


- ◆ RETAINED SAMPLE MOLECULE
- NON-RETAINED MOLECULES
- PACKING MATERIAL

PrepTip™

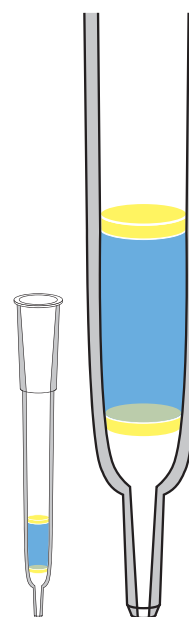
(U.S. Patent 6,537,502)

The revolutionary new interior surface coating of PrepTip pipette tip means your sample can flow freely through the tip opening allowing rapid and easy sample prep! see pages 12 to 14.



ProTip™

ProTip pipette tip contains a hydrophilic polymer material which binds 5 to 10 times more protein than silica based materials, see page 15.



Ultra-Micro and Micro TipColumn™

MicroTipColumn contains a packed column of chromatographic material from a wide selection offered by Harvard Apparatus. Simple, fast and easy to use – a SpinColumn in pipette tip format, see pages 16-17.

Key

- Frit
- Purification Media

PrepTip™

applications

- Patented
- Protein or peptide purification
- Salt removal
- Detergent removal
- Mass spectrometry
- Affinity purification
- Glycoprotein and glycopeptide purification
- MALDI-TOF
- HPLC
- High Performance Capillary Electrophoresis (HPCE)

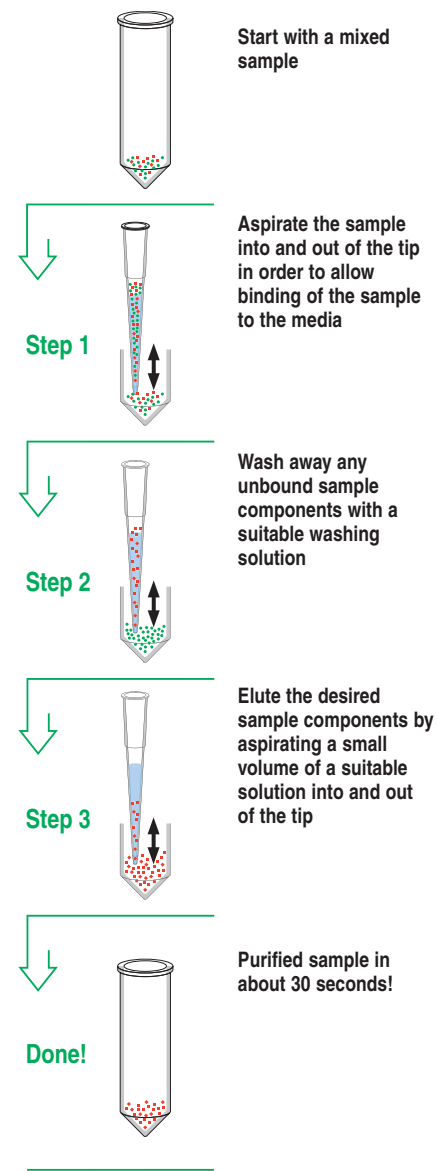
advantages

- Unique patented interior coating matrix means no more plugging of the tip opening
- Easy, rapid flow of sample due to the unobstructed tip opening of PrepTip
- Different sample binding media to suit many sample types
- Effective for small samples (even with volumes less than 1 µl)
- No special equipment necessary - uses standard micro-pipette tip format
- Suitable for use with single or multi-channel pipetting devices
- Virtually ANY sample-binding media can be used in the solid matrix
- Fast, simple, easy to use



PrepTip is a revolutionary new method for cleaning and concentrating proteins and other biological samples for further instrumental analysis. PrepTip's unique, patented feature is that the interior walls of the tip are coated with the sample-binding material. This interior coating technology makes PrepTip the only such product on the market, providing both speed and reliability. Since the tip opening is not plugged by the interior coating process, the sample can flow freely through the opening without back pressure. PrepTip can be used to clean or concentrate any biological sample since the interior walls of the tip can be coated with your choice of binding media. Different binding materials are offered by Harvard Apparatus. Due to its unique features, sample preparation with PrepTip is very fast, simple and highly effective. PrepTip is well suited for a range of applications including mass spectrometry, HPLC and automated sample preparation methods.

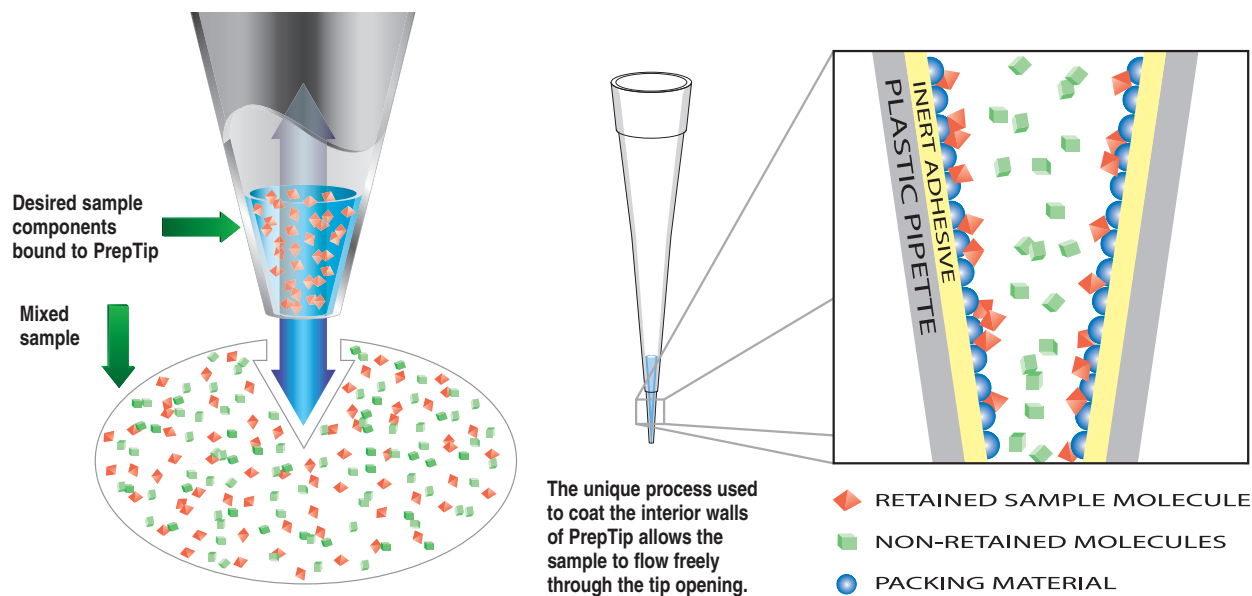
how to use



Key

- Desired Component
- Contaminants
- Purification Media

PrepTip™

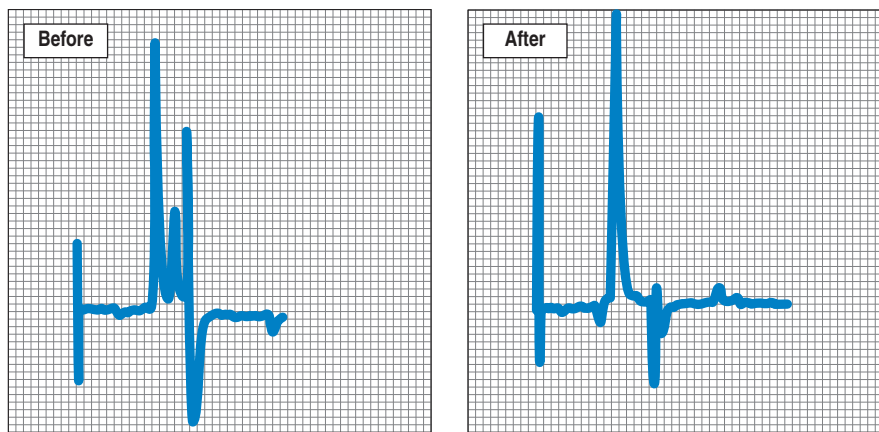


How PrepTips are Used

Mechanism of Binding	Type of Functional Groups Bound	Sample Solvents Bound from...	Elute Bound Compounds with...	Types of Tip Coating Available
Reverse Phase Extraction	Nonpolar groups (e.g. aromatic and alkyl groups)	Polar solutions (e.g. aqueous buffers)	Less polar solvents (e.g. aqueous buffers)	C4, C8, C18, Hydrophobic polymer



Sample Preparation for HPLC Using C-18 PrepTip



Sample Mixture: Aprotinin (MW 6,500) in 100mM phosphate/acetate buffer

PrepTip™



Harvard Apparatus offers PrepTips™ with C18 packing material to fit your specific applications:

- **Ultra-Micro PrepTip™**
For sample volumes from 1 µl to 10 µl,
Binding capacity 0.5 µg/tip

PrepTips are supplied in package of either 24 or 96 tips.

PrepTip™: Ordering Information

	Ultra-Micro PrepTips	
	Qty. of 24	Qty. of 96
Hydrophobic (non-polar)		
C18	SP1 74-3402	SP1 74-3403
C8	SP1 74-3404	SP1 74-3405
C4	SP1 74-3406	SP1 74-3407

ProTip™

advantages

- Fast, simple, easy to use
- Highly effective, non-silica based hydrophilic polymer material
- Easy, rapid flow of sample due to the unobstructed tip opening of ProTip
- Effective for small samples (even with volumes less than 1 µl)
- Tip sizes available to suit a range of sample volumes
- No special equipment necessary - uses standard micro-pipette tips
- Suitable for use with single or multi-channel pipetting devices

applications

- Protein purification
- Peptide purification
- Salt removal
- Detergent removal
- Mass spectrometry
- MALDI
- High performance liquid chromatography (HPLC)
- High performance capillary electrophoresis (HPCE)
- ESI-MS



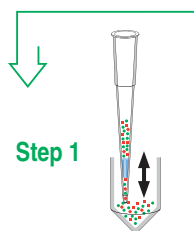
ProTip, one of Harvard Apparatus' latest patent-pending technologies, is a new method for cleaning and concentrating protein samples for further instrumental analysis. ProTip offers the same easy sample flow of our PrepTip, but contains a small quantity of a highly effective hydrophilic polymer material. The binding capacity of the polymer used in ProTip is 5 to 10 times higher than that of silica-based materials. This polymer binds proteins in the presence of organic solvents but does not bind impurities, such as salts and detergents, in the sample. After the protein is bound to the polymer it can easily be eluted in an aqueous solution, making purification and concentration of biological samples with ProTip fast, simple, and highly effective. Three sizes are offered to meet your specific application. The Ultra-Micro ProTip includes one micro pipett.



ProTip™

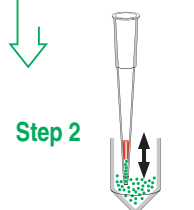


Start with a mixed sample



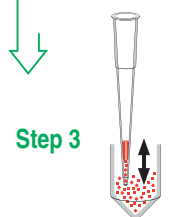
Step 1

Aspirate the sample into and out of the tip in order to allow binding of the sample to the media



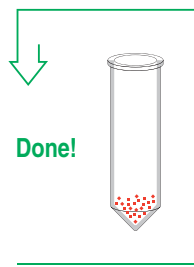
Step 2

Wash away any unbound sample components with a suitable washing solution



Step 3

Elute the desired sample components by aspirating a small volume of a suitable solution into and out of the tip

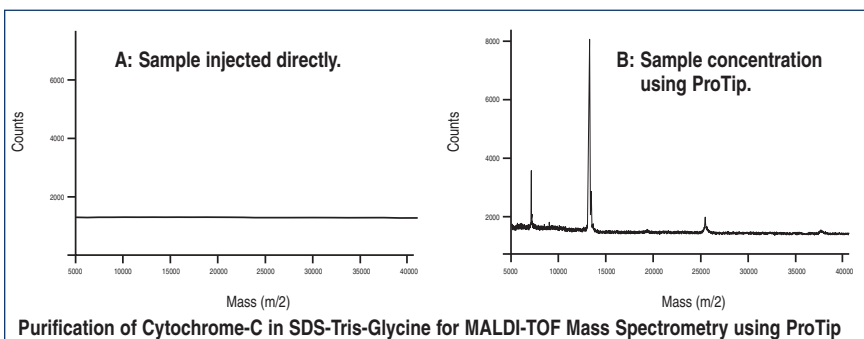


Done!

Purified sample in about 30 seconds!

Key

- Desired Component
- Contaminants
- Purification Media



Order # Product

SP1 74-3700	Ultra-Micro ProTip™ 1 to 10 µl, pkg. of 24
SP1 74-3701	Ultra-Micro ProTip™ 1 to 10 µl, pkg. of 96
SP1 74-3702	Micro ProTip™ 10 to 100 µl, pkg. of 24
SP1 74-3703	Micro ProTip™ 10 to 100 µl, pkg. of 96
SP1 74-3704	Macro ProTip™ 100 to 500 µl, pkg. of 24
SP1 74-3705	Macro ProTip™ 100 to 500 µl, pkg. of 96

Ultra-Micro & Micro TipColumns™

advantages

- Fast, simple, easy to use
- Unrivalled range of column materials available
- No special equipment necessary; uses standard pipette
- Suitable for samples from 10 to 25 µl and 25 to 75 µl

applications

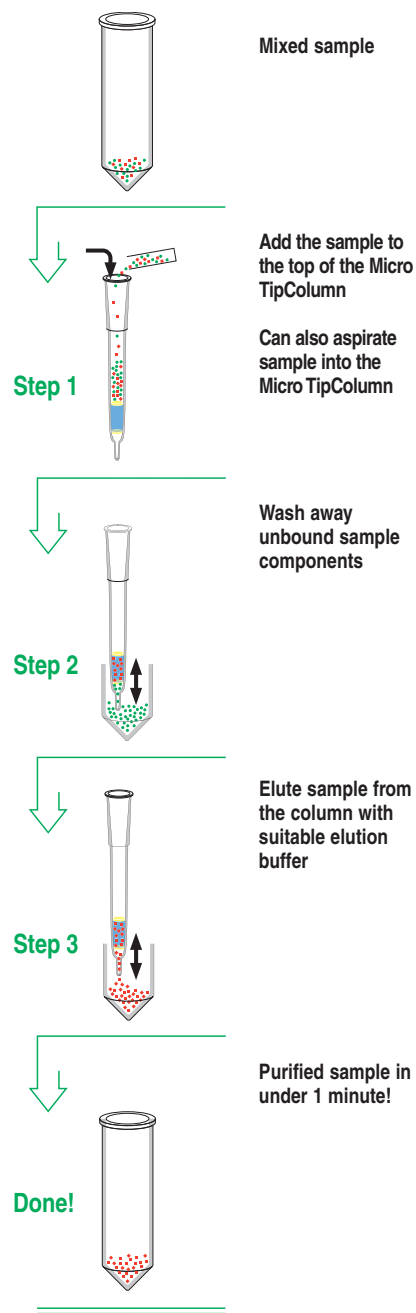
- Sample concentration
- Protein purification
- Peptide purification
- Salt removal
- Buffer exchange
- Radiolabel removal
- Detergent removal
- Dye-terminator removal
- Affinity purification
- Oligonucleotide purification
- DNA purification
- Carbohydrate purification
- Glycoprotein purification
- Glycopeptide purification
- Mass spectrometry (MALDI, ESI-MS)
- HPLC
- High performance capillary electrophoresis (HPCE)



Ultra-Micro and Micro TipColumns are a simple and fast way to perform small sample preparation based on the physical properties of the sample. The columns consist of micro-pipette tips containing one of a wide range of available column materials contained by frits and/or cap. The sample can be applied to the top of the column or suctioned through the column using a micro-pipette. The sample is then purified according to size and shape, chemical composition, charge or other physico-chemical properties by selecting the appropriate column material.



Ultra-Micro & Micro TipColumns

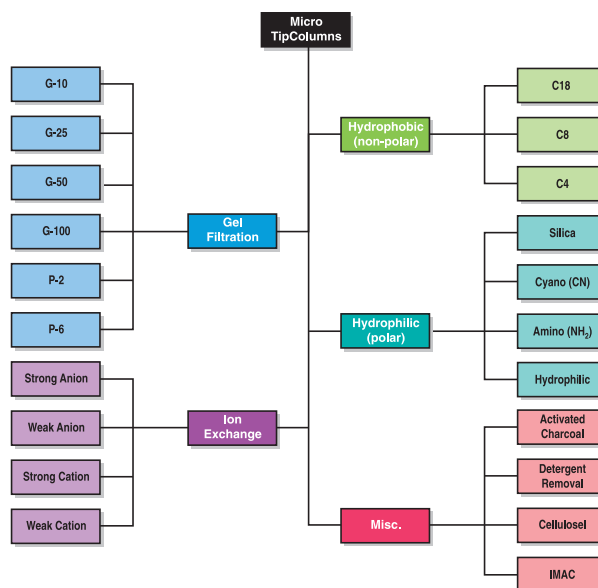


How Ultra-Micro TipColumns are Used

Mechanism of Binding	Type of Functional Groups Bound	Sample Solvents Bound from...	Elute Bound Compounds with...	Types of Packing Material Available
Reverse Phase Extraction	Nonpolar groups (e.g. aromatic and alkyl groups)	Polar solutions (e.g. aqueous buffers)	Less polar solvents (e.g. acetonitrile, methanol and water)	C4, C8, C18, Hydrophobic polymer
Normal Phase Extraction	Polar groups (e.g. hydroxyl and amine groups)	Nonpolar solvents	Polar solvent mixtures	Silica, Amino, Cyano, Hydrophilic
Cation Exchange	Positively charged groups (e.g. amines)	Low ionic strength aqueous solutions	Ionic buffers (e.g. acetate, citrate and phosphate)	Weak cation exchanger, Strong cation exchanger
Anion Exchange	Negatively charged groups (e.g. organic acids)	Low ionic strength aqueous solutions	Ionic buffers (e.g. phosphate and acetate)	Weak anion exchanger, Strong anion exchanger

Key	
	Desired Component
	Contaminants
	Frit
	Purification Media

Family of Tipcolumns



Family of TipColumns – Ordering Information

Sample Volume Sample Capacity	Ultra-Micro TipColumns		Micro TipColumns	
	10 ul to 25 µl 3 µg to 30 µg Qty. of 24	Qty. of 96	25 ul to 75 µl 5 µg to 60 µg Qty. of 24	Qty. of 96
Empty Column, 5um Frit	SP1 74-4921	SP1 74-4920	SP1 74-4921	SP1 74-4920
Empty Column, 20um Frit	SP1 74-4901	SP1 74-4900	SP1 74-4901	SP1 74-4900
Empty Column, 40um Frit	SP1 74-4931	SP1 74-4930	SP1 74-4931	SP1 74-4930
Packing Material				
G-10	SP1 74-7120	SP1 74-7100	SP1 74-5104	SP1 74-5100
G-25	SP1 74-7121	SP1 74-7101	SP1 74-5105	SP1 74-5101
G-50	SP1 74-7122	SP1 74-7102	SP1 74-5106	SP1 74-5102
G-100	SP1 74-7123	SP1 74-7103	SP1 74-5107	SP1 74-5103
P-2	SP1 74-7124	SP1 74-7104	SP1 74-5408	SP1 74-5402
P-6	SP1 74-7125	SP1 74-7105	SP1 74-5409	SP1 74-5403
C18	SP1 74-7126	SP1 74-7106	SP1 74-5207	SP1 74-5201
C8	SP1 74-7127	SP1 74-7107	SP1 74-5208	SP1 74-5202
C4	SP1 74-7128	SP1 74-7108	SP1 74-5209	SP1 74-5203
Silica	SP1 74-7129	SP1 74-7109	SP1 74-5206	SP1 74-5200
Cyano (CN)	SP1 74-7130	SP1 74-7110	SP1 74-5210	SP1 74-5204
Amino (NH ₂)	SP1 74-7131	SP1 74-7111	SP1 74-5211	SP1 74-5205
Hydrophilic	SP1 74-7132	SP1 74-7112	SP1 74-5411	SP1 74-5405
Strong Anion	SP1 74-7133	SP1 74-7113	SP1 74-5304	SP1 74-5300
Strong Cation	SP1 74-7135	SP1 74-7115	SP1 74-5306	SP1 74-5302
Weak Anion	SP1 74-7134	SP1 74-7114	SP1 74-5305	SP1 74-5301
Weak Cation	SP1 74-7136	SP1 74-7116	SP1 74-5307	SP1 74-5303
Strong Cation SA	SP1 74-7165	SP1 74-7145	SP1 74-5313	SP1 74-5312
Weak Anion LP	SP1 74-7164	SP1 74-7144	SP1 74-5311	SP1 74-5310
Weak Cation AA	SP1 74-7166	SP1 74-7146	SP1 74-5315	SP1 74-5314
Activated Charcoal	—	—	SP1 74-5406	SP1 74-5400
Cellulose	SP1 74-7137	SP1 74-7117	SP1 74-5407	SP1 74-5401
Detergent Removal	SP1 74-7138	SP1 74-7118	SP1 74-5410	SP1 74-5404
IMAC	SP1 74-7139	SP1 74-7119	SP1 74-5412	SP1 74-5413

Introduction to SpinColumns™

advantages

- Easy to use
- Multiple formats available – from single 10 µl sample volumes to high-throughput 96-well format
- Unrivalled selection of column packing materials
- Single use, disposable centrifuge tube formats
- Quick high sample recovery
- Rapid sample preparation time
- Custom packed columns are available on request

applications

- Protein purification
- Peptide purification
- DNA purification
- Small molecule, carbohydrate removal
- Radiolabel removal
- Nick translation
- Affinity separation
- Salt removal
- Buffer exchange

Harvard Apparatus offers six sizes of SpinColumns to fit your specific applications:

- **Ultra-Micro SpinColumns**
For sample volumes from 10 µl to 25 µl
- **Micro SpinColumns**
For sample volumes 25 µl to 75 µl
- **Macro SpinColumns**
For sample volumes from 75 µl to 150 µl
- **96-Well Micro SpinColumns**
For high throughput applications with sample volumes from 25 µl to 75 µl
- **96-Well Macro SpinColumns**
For high throughput applications with sample volumes from 75 µl to 150 µl
- **384-Well SpinColumns**
For high throughput applications with sample volumes from 10 µl to 25 µl

Harvard Apparatus SpinColumn Family



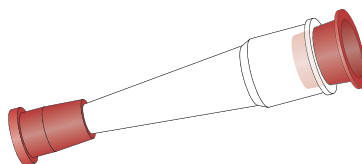
Ultra-Micro SpinColumn™

Volumes from 10 µl to 25 µl, see pages 19 & 22.



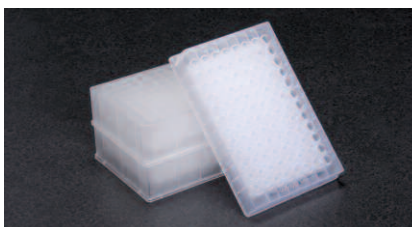
Micro SpinColumn™

Handles volumes from 25 µl to 75 µl, see pages 19 & 22.



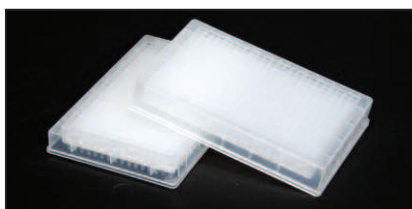
Macro SpinColumn™

Handles volumes from 75 µl to 150 µl, see pages 19-20 & 22.



96-Well SpinColumn™

High throughput sample prep applications, volumes 25 µl to 100 µl, see pages 21-22.



384-Well SpinColumn™

High throughput sample prep applications, volumes 10 µl to 25 µl, see pages 21-22.

Harvard Apparatus new generation of SpinColumns are designed for the purification of small samples (10 µl to 150 µl) in either single column or high-throughput 96-well or 384-well format with a standard centrifuge.

Our SpinColumns are pre-filled with a wide selection of chromatographic materials including gel-filtration, ion-exchange, silica-based reverse- and normal-phase materials, as well as specific materials, such as charcoal or cellulose contained by frits and/or caps. The columns can also be pre-filled with custom materials based on customer requests.

Simply place the SpinColumn in a centrifuge tube or plate and centrifuge briefly to separate your sample. The column material binds and purifies the sample according to size and shape, chemical composition, charge or other physiochemical properties.

SpinColumns™

Single SpinColumns

advantages

- Rapid sample preparation time
- Micro sample sizes
- Unrivalled selection of column packing materials; custom packed columns are available on request
- High sample recovery

applications

- DNA, protein and peptide purification
- Small molecule, carbohydrate, salt and radiolabel removal
- Nick translation
- Affinity separation
- Buffer exchange



Ultra-Micro SpinColumns™ - Samples from 10 µl to 25 µl

Ultra-Micro SpinColumns are best suited for sample volumes from 10 µl to 25 µl. Centrifugation or filtration under vacuum or pressure can be used to run the sample through the columns. Results obtained from the Micro SpinColumns are highly reproducible and there is minimal sample loss. Each column includes two 2 ml centrifuge tubes plus top caps (for Gel Filtration) or frit.



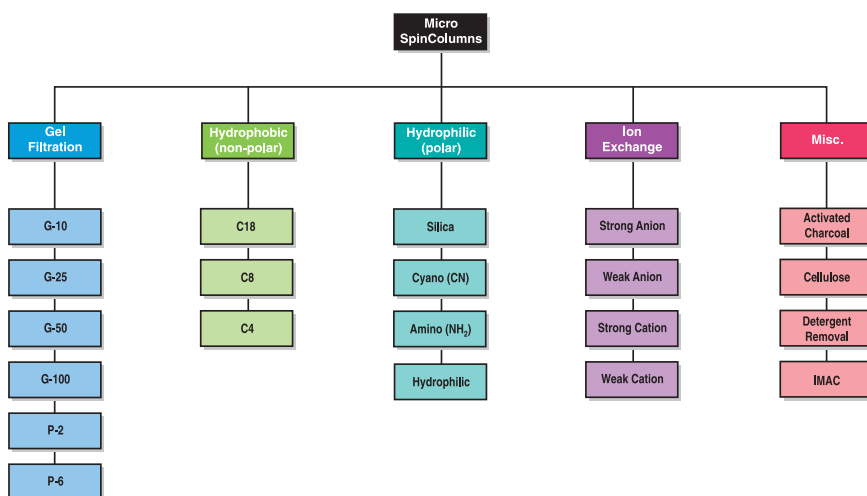
Micro SpinColumns™ - Samples from 25 µl to 75 µl

Micro SpinColumns are best suited for sample volumes from 25 to 75 µl. Centrifugation or filtration under vacuum or pressure can be used to run the sample through the columns. Results obtained from the Micro SpinColumns are highly reproducible and there is minimal sample loss. Each column includes two 2 ml centrifuge tubes plus top cap (for Gel Filtration) or frit.



Macro SpinColumn™ - Samples from 75 µl to 150 µl

Macro SpinColumns are best suited for samples with volumes from 75 to 150 µl. In addition to the standard packing materials described in the ordering information, Macro SpinColumns can be filled with custom packing materials as desired. Each column includes two 2 ml centrifuge tubes and top and bottom caps.



Macro SpinColumn™

Samples from 75 µl to 150 µl

advantages

- Easy to use
- Unrivalled selection of column packing materials
- High sample recovery
- Rapid sample preparation time
- Custom packed columns are available on request

applications

- DNA purification
- Protein purification
- Peptide purification
- Small molecule, carbohydrate removal
- Radiolabel removal
- Nick translation
- Affinity separation
- Salt removal
- Buffer exchange



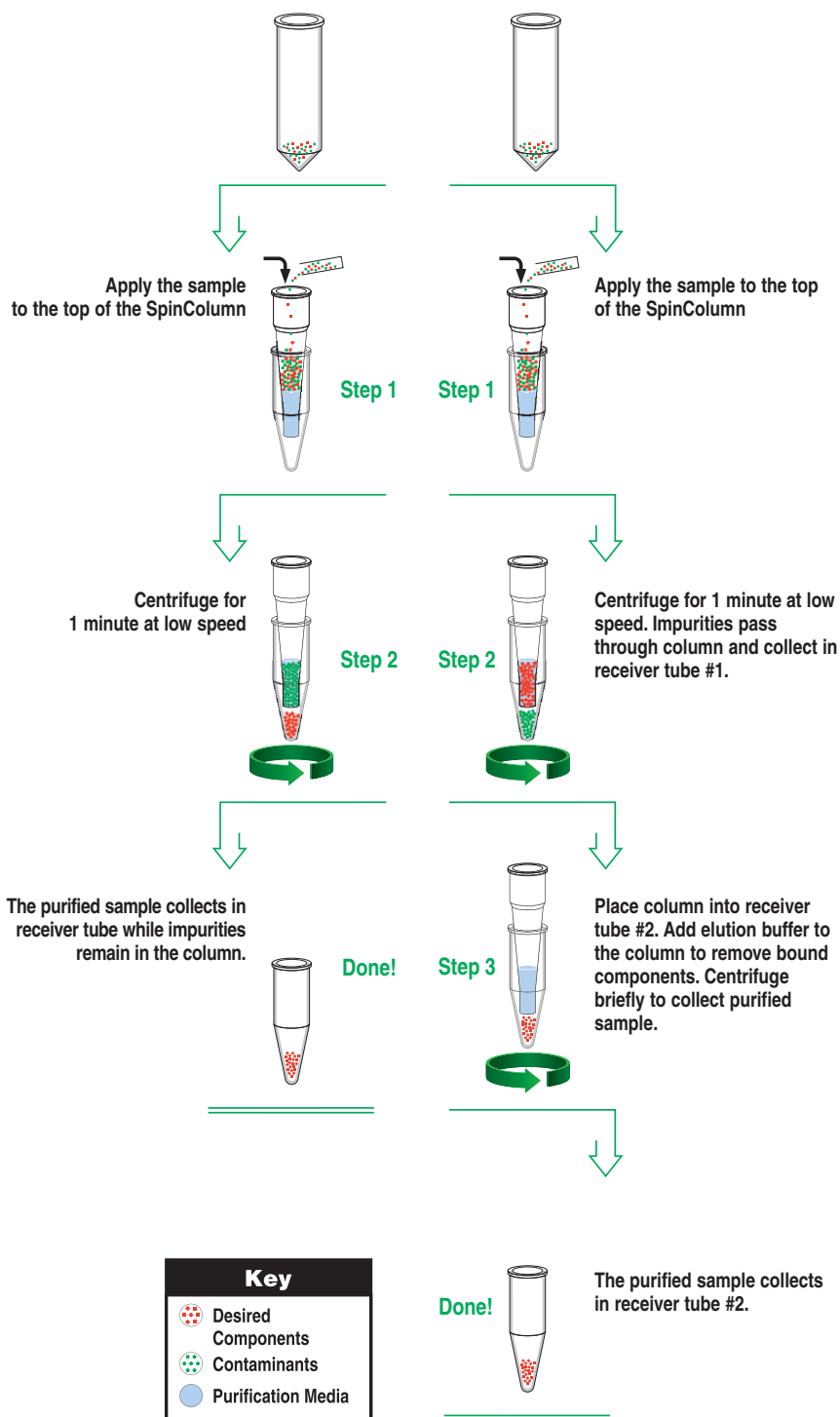
Simply place the SpinColumn in a centrifuge tube and centrifuge the tube briefly to separate your sample. The column material binds and purifies the sample according to size and shape, chemical composition, charge or other physiochemical properties.



Macro SpinColumns

Size Exclusion Chromatography SpinColumns

Solid Phase Extraction SpinColumns



SpinColumns

advantages

- Easy to use
- Unrivalled selection of column packing materials
- High sample recovery
- Rapid sample preparation time
- Custom packed columns are available on request



applications

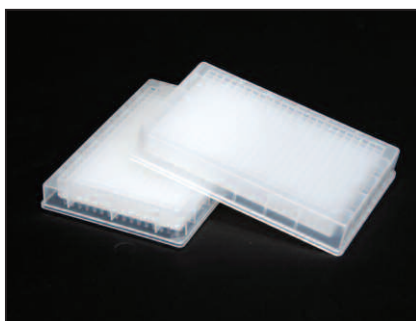
- DNA purification
- Protein purification
- Peptide purification
- Small molecule, carbohydrate removal
- Radiolabel removal
- Nick translation
- Affinity separation
- Salt removal
- Buffer exchange

96-Well Micro SpinColumns™ - Samples from 25 µl to 75 µl

96-Well Micro SpinColumn from Harvard Apparatus brings speed and simplicity to high-throughput micro-sample preparation. The 96-Well Micro SpinColumn is for 25 to 75 µl sample sizes and includes two 96-Well collection plates (1.1 ml per well). Additional 96-Well SpinColumns with 450 µl per well collection plates are available. The 96-Well Micro SpinColumns are suitable for automation and available with our complete range of packing materials or can be pre-packed with custom requested materials.

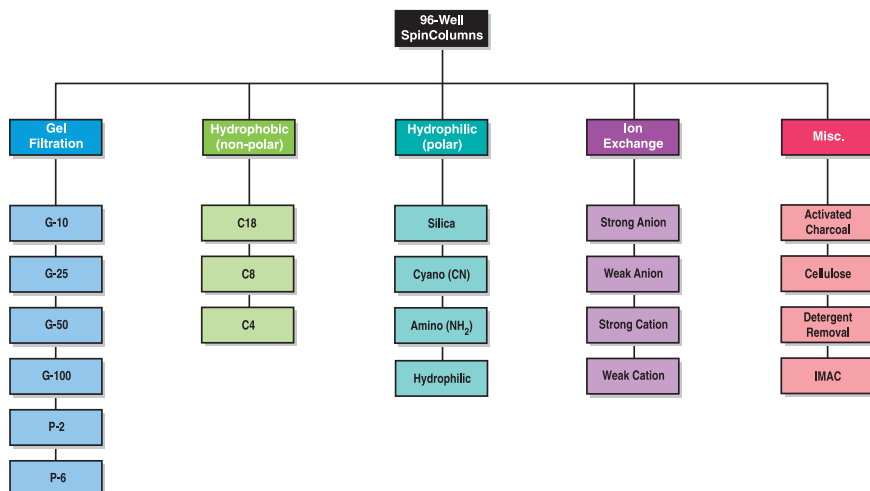
96-Well Macro SpinColumns™ - Samples from 75 µl to 150 µl

The 96-Well Macro SpinColumn is for 75 to 150 µl sample sizes and includes two 96-Well collection plates (1.1 ml per well). The 96-Well Macro SpinColumns are of SBS dimensions and suitable for automation and available with our complete range of packing materials or can be pre-packed with custom requested materials.



384-Well SpinColumns™ - Samples from 10 µl to 25 µl

Harvard Apparatus offers 384-Well SpinColumns for 10 to 25 µl sample sizes. These are of SBS dimensions for automation and available with our complete range of packing materials or can be pre-packed with custom requested materials. One Spin Column and 2 Collection Plates included.



Family of SpinColumns™

Family of SpinColumns – Ordering Information						
for Single Samples	Ultra-Micro SpinColumns		Micro SpinColumns		Macro SpinColumns	
Sample Volume	10 µl to 25 µl		25 µl to 75 µl		75 µl to 150 µl	
Sample Capacity	3 µg to 30 µg		5 µg to 60 µg		30 µg to 300 µg	
	Qty. of 24	Qty. of 96	Qty. of 24	Qty. of 96	Qty. of 24	Qty. of 96
Empty Column, 5 µm Frit	SP1 74-4421	SP1 74-4420	SP1 74-4421	SP1 74-4420	SP1 74-3821	SP1 74-3820
Empty Column, 20 µm Frit	SP1 74-4401	SP1 74-4400	SP1 74-4401	SP1 74-4400	SP1 74-3841	SP1 74-3840
Empty Column, 40 µm Frit	SP1 74-4431	SP1 74-4430	SP1 74-4431	SP1 74-4430	SP1 74-3801	SP1 74-3800
G-10	SP1 74-7220	SP1 74-7200	SP1 74-4504	SP1 74-4500	SP1 74-3904	SP1 74-3900
G-25	SP1 74-7221	SP1 74-7201	SP1 74-4505	SP1 74-4501	SP1 74-3905	SP1 74-3901
G-50	SP1 74-7222	SP1 74-7202	SP1 74-4506	SP1 74-4502	SP1 74-3906	SP1 74-3902
G-100	SP1 74-7223	SP1 74-7203	SP1 74-4507	SP1 74-4503	SP1 74-3907	SP1 74-3903
P-2	SP1 74-7224	SP1 74-7204	SP1 74-4808	SP1 74-4802	SP1 74-4308	SP1 74-4302
P-6	SP1 74-7225	SP1 74-7205	SP1 74-4809	SP1 74-4803	SP1 74-4309	SP1 74-4303
C18	SP1 74-7226	SP1 74-7206	SP1 74-4607	SP1 74-4601	SP1 74-4107	SP1 74-4101
C8	SP1 74-7227	SP1 74-7207	SP1 74-4608	SP1 74-4602	SP1 74-4108	SP1 74-4102
C4	SP1 74-7228	SP1 74-7208	SP1 74-4609	SP1 74-4603	SP1 74-4109	SP1 74-4103
Silica	SP1 74-7229	SP1 74-7209	SP1 74-4606	SP1 74-4600	SP1 74-4105	SP1 74-4100
Cyano (CN)	SP1 74-7230	SP1 74-7210	SP1 74-4610	SP1 74-4604	SP1 74-4110	SP1 74-4104
Amino (NH ₂)	SP1 74-7231	SP1 74-7211	SP1 74-4611	SP1 74-4605	SP1 74-4111	SP1 74-4106
Hydrophilic	SP1 74-7232	SP1 74-7212	SP1 74-4811	SP1 74-4805	SP1 74-4311	SP1 74-4305
Strong Anion	SP1 74-7233	SP1 74-7213	SP1 74-4704	SP1 74-4700	SP1 74-4204	SP1 74-4200
Strong Cation	SP1 74-7235	SP1 74-7215	SP1 74-4706	SP1 74-4702	SP1 74-4206	SP1 74-4202
Weak Anion	SP1 74-7234	SP1 74-7214	SP1 74-4705	SP1 74-4701	SP1 74-4205	SP1 74-4201
Weak Cation	SP1 74-7236	SP1 74-7216	SP1 74-4707	SP1 74-4703	SP1 74-4207	SP1 74-4203
Strong Cation SA	SP1 74-4426	SP1 74-4425	SP1 74-4413	SP1 74-4112	SP1 74-4153	SP1 74-4152
Weak Anion PEI	SP1 74-4424	SP1 74-4423	SP1 74-4411	SP1 74-4410	SP1 74-4151	SP1 74-4150
Weak Cation AA	SP1 74-4428	SP1 74-4427	SP1 74-4415	SP1 74-4414	SP1 74-4155	SP1 74-4154
Activated Charcoal	–	–	SP1 74-4806	SP1 74-4800	SP1 74-4306	SP1 74-4300
Cellulose	SP1 74-7237	SP1 74-7217	SP1 74-4807	SP1 74-4801	SP1 74-4307	SP1 74-4301
Detergent Removal	SP1 74-7238	SP1 74-7218	SP1 74-4810	SP1 74-4804	SP1 74-4310	SP1 74-4304
IMAC	SP1 74-7239	SP1 74-7219	SP1 74-4812	SP1 74-4813	SP1 74-4312	SP1 74-4313
for Multiple Samples	384-Well Ultra-Micro SpinColumns		96-Well Micro SpinColumns		96-Well Macro SpinColumns	
Sample Volume	10 µl to 25 µl		25 µl to 75 µl		75 µl to 100 µl	
Sample Capacity	3 µg to 30 µg		10 µg to 100 µg		30 µg to 275 µg	
	Qty. of 1		Qty. of 1		Qty. of 1	
Empty Column, 5 µm Frit	SP1 74-5679		SP1 74-5635		SP1 74-5649	
Empty Column, 20 µm Frit	SP1 74-5680		SP1 74-5610		SP1 74-5650	
Empty Column, 40 µm Frit	–		SP1 74-5636		–	
G-10	SP1 74-5681		SP1 74-5611		SP1 74-5651	
G-25	SP1 74-5682		SP1 74-5612		SP1 74-5652	
G-50	SP1 74-5683		SP1 74-5613		SP1 74-5653	
G-100	SP1 74-5684		SP1 74-5614		SP1 74-5654	
P-2	SP1 74-5685		SP1 74-5615		SP1 74-5655	
P-6	SP1 74-5686		SP1 74-5616		SP1 74-5656	
C18	SP1 74-5687		SP1 74-5617		SP1 74-5657	
C8	SP1 74-5688		SP1 74-5618		SP1 74-5658	
C4	SP1 74-5689		SP1 74-5619		SP1 74-5659	
Silica	SP1 74-5690		SP1 74-5620		SP1 74-5660	
Cyano (CN)	SP1 74-5691		SP1 74-5621		SP1 74-5661	
Amino (NH ₂)	SP1 74-5692		SP1 74-5622		SP1 74-5662	
Hydrophilic	SP1 74-5693		SP1 74-5623		SP1 74-5663	
Strong Anion	SP1 74-5694		SP1 74-5624		SP1 74-5664	
Strong Cation	SP1 74-5695		SP1 74-5625		SP1 74-5665	
Weak Anion	SP1 74-5696		SP1 74-5626		SP1 74-5666	
Weak Cation	SP1 74-5697		SP1 74-5627		SP1 74-5667	
Strong Cation SA	SP1 74-5675		SP1 74-5632		SP1 74-5672	
Weak Anion PEI	SP1 74-5676		SP1 74-5633		SP1 74-5673	
Weak Cation AA	SP1 74-5677		SP1 74-5634		SP1 74-5674	
Activated Charcoal	–		SP1 74-5629		SP1 74-5669	
Cellulose	SP1 74-5699		SP1 74-5630		SP1 74-5670	
Detergent Removal	SP1 74-5698		SP1 74-5628		SP1 74-5668	
IMAC	SP1 74-5678		SP1 74-5631		SP1 74-5671	

Membrane-Bottom Filter Plates

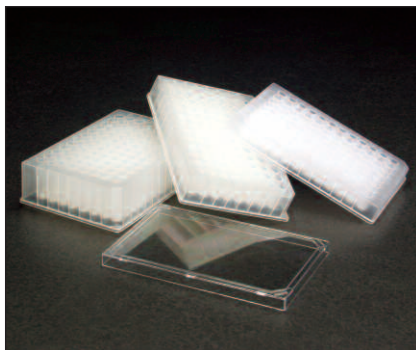
Samples from 50 µl to 5 ml

advantages

- High recoveries of both filtrates and particulate retentates
- Multi-well format for simultaneous filtration of 96 or 384 different samples
- Individual filter membranes to avoid cross-talk between adjacent wells
- High well-to-well reproducibility
- Membrane pore sizes of 0.45 – 25 µm (other pore sizes available on request)
- Suitable for vacuum manifold filtration or centrifugal filtration

applications

- Nucleic Acid Binding
- DNA Binding
- DNA/RNA Purification
- Purification of PCR Products
- High-Throughput Preparation of YAC DNA
- High-Throughput Synthesis of Drugs
- Bead/Resin Based Assays
- Cell-Based Receptor Binding Assays
- Size exclusion
- Concentrate, purify and desalt proteins, peptides, oligos, DNA and RNA
- Recover proteins, oligos and RNA from polyacrylamide gels
- Filtration and Filtrate Collection



Harvard Apparatus' new 96-WELL and 384-WELL FILTER PLATES bring speed and high throughput to sample filtration on a microliter to milliliter scale. The membrane-bottom individual sample wells or chambers have separate high-strength single or dual filter membranes to provide rapid filtration rates and to eliminate leakage or cross-talk between adjacent wells.

All Filter Plates feature rigid polypropylene construction for chemical resistance and low binding and meet SBS footprint for use in robotic systems. Standard filter media include: glass fiber, PVDF polypropylene, polyethylene and polyether sulfone. Patent pending sealing process guarantees no well-to-well cross talk and weeping and allows superior recovery performance.

96-Well Ultra-Filtration Plates with 6.24mm well size and 19.35 sq mm filter area are good for size exclusion, to concentrate, purify and desalt proteins, peptides, oligos, DNA and RNA and also to recover proteins, oligos and RNA from polyacrylamide gels. Plates comply with industry standard for automation and are available with 10,000 and 30,000 MWCO membranes.

96-Well 2 ml Filter Plates with 8.23 mm well size come with Polypropylene membrane for organic synthesis and with UHMW Polyethylene membrane good for solid phase extraction.

Distinctively constructed 384-Well Filter Plates have short drip directors, square to round wells for maximum working volumes and variety of filtration media and can also be used robotically as well as for vacuum or centrifuge filtrations.

Application specific Filter Plates and Filtration Devices to the biopharmaceutical industry can be custom ordered. Other package sizes and bar-coding are available.



96-Well or 384-Well Filter Plates

Step 1

Fill the wells of Filter Plate with the samples.

Step 2

Place a Filter Storage/Collection Plate inside the Manifold Filtration unit and then insert the filled Filter Plate.

Step 3

Apply vacuum to collect the filtrates in the Storage Plate wells.

Step 4

Remove the filtrates and/or re-suspend. Recover the retentate from the membranes for further analysis. Or use collected filtrate in appropriate applications.

Order # Product

Filter Plates

SP1 74-5551	96-Well, Ultra Filtration, PES membrane, 10K MWCO, pkg. of 5
SP1 74-5552	96-Well, Ultra Filtration, PES membrane, 30K MWCO, pkg. of 5
SP1 74-5553	96-Well, 300 µl, GF 1.2 µm, Short drip, pkg. of 10
SP1 74-5554	96-Well, 300 µl, Hydrophilic PVDF 0.45 µm, Short drip, pkg. of 10
SP1 74-5555	96-Well, 400 µl, Hydrophilic PVDF 0.45 µm, Long drip, pkg. of 5
SP1 74-5556	96-Well, 800 µl, Hydrophilic PVDF 0.45 µm, Long drip, pkg. of 5

Order # Product

Filter Plates

SP1 74-5557	96-Well, 2 ml, PP 0.45 µm, Long drip, pkg. of 5
SP1 74-5558	96-Well, 2 ml, UHMW PE 25 µm, Long drip, pkg. of 5
SP1 74-5559	48-Well, 5 ml, PE frit 25 µm, Long drip, pkg. of 5
SP1 74-5560	384-Well, 140 µl, GF 0.7 µm, Short drip, pkg. of 5
SP1 74-5578	384-Well, 140 µl, GF 1.2 µm, Short drip, pkg. of 5
SP1 74-5579	384-Well, 140 µl, GF 5.0 µm, Short drip, pkg. of 5
SP1 74-5580	384-Well, 140 µl, GF 0.7 µm, Long drip, pkg. of 5
SP1 74-5581	384-Well, 140 µl, GF 1.2 µm, Long drip, pkg. of 5
SP1 74-5582	384-Well, 140 µl, GF 5.0 µm, Long drip, pkg. of 5
SP1 74-5583	384-Well, 140 µl, UHMW PE 25 µm, Long drip, pkg. of 5

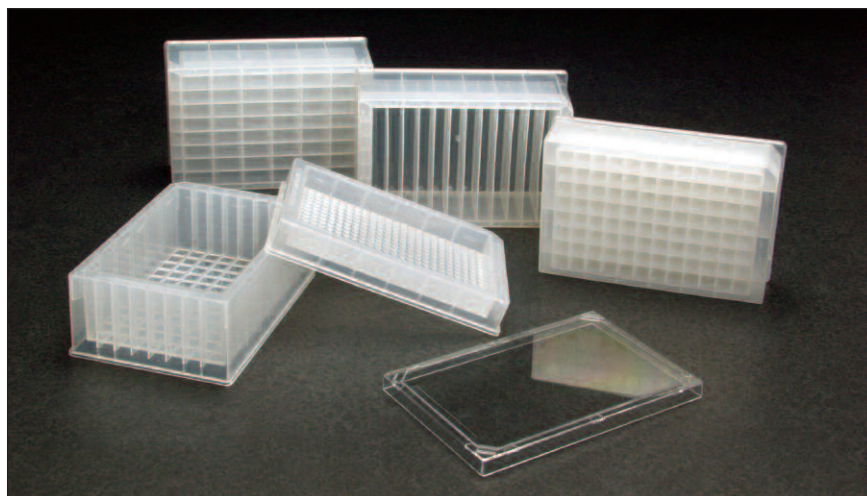
Filter Plate Accessories

advantages

- Collect into 2 ml storage plates
- Spacer included to collect into SBS standard microplates
- Robot compatible
- Cross talk prevention due to minimal distance between filter plate and collection plate
- Compatible with most filter plates
- Touch free start up

applications

- Combinatorial chemistry cleavage
- Final filtration for SPE
- High throughput screening preparation
- Sample preparation
- DNA purification
- Receptor binding assays
- Plasmid lysate cleaning



Reservoirs, Storage Plates and Lids

Reservoirs and Storage/Collection Plates constructed of natural polypropylene are low binding, resistant to heat, chemicals and biological materials and robotic friendly with industry standard dimensions. Pyramid or V-bottom format is for maximum recovery. Plate Seals and Seal Strips for every format are available.

Filtration is generally done in a custom-designed Manifold Filtration System (Catalog # SP1 74-5572) allowing both collection of the filtrates in a Filter Bottom Plate and retention of the particulates on the membrane. Optionally, low-speed centrifugation in microplate baskets may be used instead of vacuum filtration. Both the filtrates and the retentates are recovered at high recoveries and with high well-to-well reproducibility for further analysis.

A complete system includes Filter Plate, Storage/Collection Plate, Lid and Vacuum Manifold.

Order # Product

Reservoirs

SP1 74-5561	96 Well, Pyramid Bottom, pkg. of 5
SP1 74-5562	384 Well, Low Profile, Pyramid Bottom, pkg. of 5
SP1 74-5585	384 Well, Half Height, pkg. of 5
SP1 74-5564	8 Row, Partitioned, Pyramid Bottom, pkg. of 5
SP1 74-5563	12 Partitioned, Pyramid Bottom, pkg. of 5
SP1 74-5573	16 Partitioned, Pyramid Bottom, pkg. of 5
SP1 74-5574	24 Partitioned, Pyramid Bottom, pkg. of 5
SP1 74-5575	Reservoir, 85 ml, Flat Bottom, pkg. of 5

Storage/Collection Plates

SP1 74-5565	96 Well, 1.1 ml, Square Well, "V" Bottom, pkg. of 5
SP1 74-5566	96 Well, 2 ml, Square Well, Pyramid Bottom, pkg. of 5
SP1 74-5577	96 Well, 4 ml, Square Well, Pyramid Bottom, pkg. of 5
SP1 74-5568	384 Well, 35 µl, Square Well, Conical Bottom, pkg. of 10
SP1 74-5567	48 Well, 5 ml, Rectangle Well, Pyramid Bottom, pkg. of 5
SP1 74-5576	24 Well, 10 ml, Pyramid Bottom, pkg of 5

Accessories

SP1 74-5569	Universal Lid, Polystyrene, Clear, pkg. of 10
SP1 74-5570	96 Well, Pierceable Plate Seal for 2 ml Storage Plate, pkg. of 10
SP1 74-5571	96 Well, Solid Plate Seal for 2 ml Storage Plate, pkg. of 10
SP1 74-5572	Manifold Filtration System

Note: Other configurations for Plates and accessories are also available upon request.

Introduction to DIALYZERS

advantages

- Easy to use
- Leak-proof
- Low protein binding
- High sample recovery
- Rapid dialysis/purification

applications

- Exchange of buffers
- Concentration of samples
- Removal of detergents
- Removal of excess radiolabel or PCR-primers
- Removal of silicates after chromatography
- Removal of CsCl, agarose, pyridoxal-5-phosphate
- Purification of proteins, DNA/RNA
- Complex carbohydrate purification
- Sample prep for HPLC, HPCE
- GC, GC-MS, NMR
- On-Line concentration, on-line dialysis, dynamic dialysis
- Immunoblotting
- Electro-concentration
- Electrophoresis, electro-elution, electro-dialysis
- Elution of proteins and nucleic acids from gels
- Equilibrium dialysis
- Protein binding assays
- Protein-drug binding assays
- Serum protein binding
- Protein, receptor, and ligand binding assays
- Protein-protein interactions
- Protein-DNA interactions

Dialysis is a physical separation method in which small molecules pass through the pores of a selective membrane while larger molecules are retained in the dialysis chamber. Our dialyzer portfolio is a unique family of products for the dialysis of small sample volumes of proteins, peptides, nucleic acids, and other biomolecules. The system is suited for sample volumes from 10 μ l to 10 ml or higher. The DIALYZER family consists of over 50 different components that can be joined together to create hundreds of combinations for various applications.

Harvard Apparatus DIALYZER Family

Reusable DIALYZERS

DIALYZER™

For routine dialysis of volumes from 10 μ l to 5 ml, see pages 26-27.

Ultra Fast DIALYZER™

Routine dialysis at higher speeds due to an additional dialysis port, see pages 28-29.

SpinDIALYZER™ and Fast SpinDIALYZER™

These are our DIALYZER and Fast DIALYZER with an internal magnet that allows the entire unit to rotate on a magnetic stirrer for even faster dialysis, see pages 30-31.

Flow-Thru DIALYZER™

Larger Membrane for rapid dialysis of volumes up to 10 ml, see pages 32-33.

Disposable DIALYZERS

Ultra-Micro DispoDIALYZER™

Disposable, single use DIALYZERS for sample sizes from 1 μ l to 5 μ l, see page 35.

Micro DispoDIALYZER™

Disposable, single use DIALYZERS for sample sizes from 5 μ l to 100 μ l, see page 36.

Fast Macro DispoDIALYZER™

Disposable, single use DIALYZERS for sample sizes from 1 ml to 10 ml, see page 37.

96-Well DispoDIALYZER™

Disposable, single use DIALYZERS that utilize a 96-well format for high throughput applications and are for samples sizes from 25 μ l to 300 μ l, see page 38.

ElectroPrep™ (U.S. Patent 5,340,449) System

The ElectroPrep is an electrophoresis based dialysis system. It can be configured for a number of applications including desalting, sample concentration, filtration, separation, fractionation and elution, see pages 42 to 46.

Fast Flow-Thru DIALYZER™ for ElectroPrep

Used with single or multi-Fast DIALYZERS in the ElectroPrep system supporting continuous online sample detection, see pages 47-48.

EQUILIBRIUM DIALYZERS

Fast Micro-Equilibrium DIALYZER - Reusable

A reusable Fast Micro-Equilibrium DIALYZER suitable for 25 μ l to 500 μ l samples for quicker equilibration times using membranes w/larger surface areas, see pages 50-51.

Multi-Equilibrium DIALYZER™ - Reusable

For simultaneous and highly reproducible equilibrium dialysis of up to 20 samples with volumes up to 5 ml, see page 52.

DispoEquilibrium DIALYZER™ - Single Use

A disposable version of the Micro-Equilibrium DIALYZER suitable for samples up to 75 μ l, see page 53.

96-Well Equilibrium DIALYZER™ (U.S. Patent 5,340,449) - Single Use

A 96-well disposable equilibrium dialyzer for high throughput interaction studies. Suitable for samples up to 200 μ l, see page 54.

DIALYZER™ (Reusable)

advantages

- Easy to use
- Reusable
- Autoclaveable
- Available for wide range of sample sizes - 10 μ l to 5 ml
- High sample recovery
- Rapid dialysis/purification
- Made of Teflon - totally inert
- Low protein binding
- Membranes available with MWCO's to suit almost any application
- Leak-proof

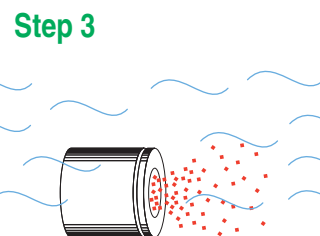
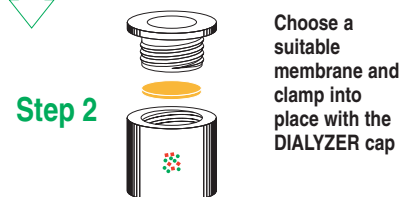
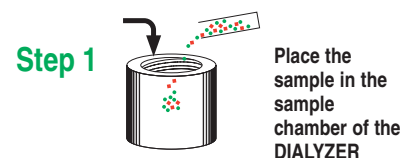
applications

- Purification of biomolecules
- Exchange of buffers
- Removal of detergents
- Sample concentration
- HPLC, HPCE
- Removal of excess radiolabel
- Post-PCR clean-up
- GC, GC-MS, NMR



The DIALYZER is a simple single-sided device for dialysis of biological samples. A broad range of DIALYZER sizes are available to accommodate sample volumes ranging from as little as 10 μ l up to 5 ml. Pre-cut dialysis membranes are available for the DIALYZER with Molecular Weight Cut-Off ranges from 100 to 300,000 Daltons. The entire unit is constructed of Teflon, a virtually unreactive material, which will not interfere with your valuable samples. Once assembled a Teflon-Teflon seal ensures that the DIALYZER is 100% leak-proof. The DIALYZER is ideal for the simple dialysis of salts, for the exchange of buffers, and for the concentration of samples. Includes chamber with cap.

how to use **DIALYZERS™**



Place the entire unit into a large beaker of dialysis buffer. Dialysis time is 3 hours to overnight depending upon sample and buffer chemistry, temperature and volume.

Key

- Desired Component
- Contaminants
- Dialysis Buffer
- Membrane

DIALYZER™ (Reusable) (continued)

Single-Sided DIALYZERS™ & Membranes

DIALYZERS™

Chamber Volume:	10 µl	20 µl	50 µl	100 µl	200 µl	500 µl	1000 µl	1500 µl	3000 µl	5000 µl
Qty. of 1	SP1 74-0210	SP1 74-0211	SP1 74-0212	SP1 74-0213	SP1 74-0214	SP1 74-0215	SP1 74-0216	SP1 74-0217	SP1 74-0218	SP1 74-0219
Qty. of 5	SP1 74-0200	SP1 74-0201	SP1 74-0202	SP1 74-0203	SP1 74-0204	SP1 74-0205	SP1 74-0206	SP1 74-0207	SP1 74-0208	SP1 74-0209

DIALYZER Membranes (pack of 25)

for Chamber Volume:	10 µl, 20 µl, 50 µl, 100 µl or 200 µl	500 µl, 1000 µl or 1500 µl	3000 µl or 5000 µl
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A. Regenerated Cellulose MEMBRANES:

1k Da MWCO	SP1 7424-RC1K	SP1 7425-RC1K	SP1 7420-RC1K
2k Da MWCO	SP1 7424-RC2K	SP1 7425-RC2K	SP1 7420-RC2K
5k Da MWCO	SP1 7424-RC5K	SP1 7425-RC5K	SP1 7420-RC5K
10k Da MWCO	SP1 7424-RC10K	SP1 7425-RC10K	SP1 7420-RC10K
25k Da MWCO	SP1 7424-RC25K	SP1 7425-RC25K	SP1 7420-RC25K
50k Da MWCO	SP1 7424-RC50K	SP1 7425-RC50K	SP1 7420-RC50K

B. Cellulose Acetate MEMBRANES:

100 Da MWCO	SP1 7424-CA100	SP1 7425-CA100	SP1 7420-CA100
500 Da MWCO	SP1 7424-CA500	SP1 7425-CA500	SP1 7420-CA500
1k Da MWCO	SP1 7424-CA1K	SP1 7425-CA1K	SP1 7420-CA1K
2k Da MWCO	SP1 7424-CA2K	SP1 7425-CA2K	SP1 7420-CA2K
5k Da MWCO	SP1 7424-CA5K	SP1 7425-CA5K	SP1 7420-CA5K
10k Da MWCO	SP1 7424-CA10K	SP1 7425-CA10K	SP1 7420-CA10K
25k Da MWCO	SP1 7424-CA25K	SP1 7425-CA25K	SP1 7420-CA25K
50k Da MWCO	SP1 7424-CA50K	SP1 7425-CA50K	SP1 7420-CA50K
100k Da MWCO	SP1 7424-CA100K	SP1 7425-CA100K	SP1 7420-CA100K
300k Da MWCO	SP1 7424-CA300K	SP1 7425-CA300K	SP1 7420-CA300K

C. Polycarbonate MEMBRANES:

0.01 µm Pore Size	SP1 7424-PC01	SP1 7425-PC01	SP1 7420-PC01
0.05 µm Pore Size	SP1 7424-PC05	SP1 7425-PC05	SP1 7420-PC05
0.10 µm Pore Size	SP1 7424-PC10	SP1 7425-PC10	SP1 7420-PC10
0.60 µm Pore Size	SP1 7424-PC60	SP1 7425-PC60	SP1 7420-PC60

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

Ultra-Fast DIALYZER™ (Reusable)

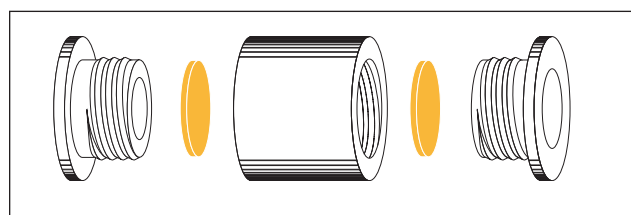
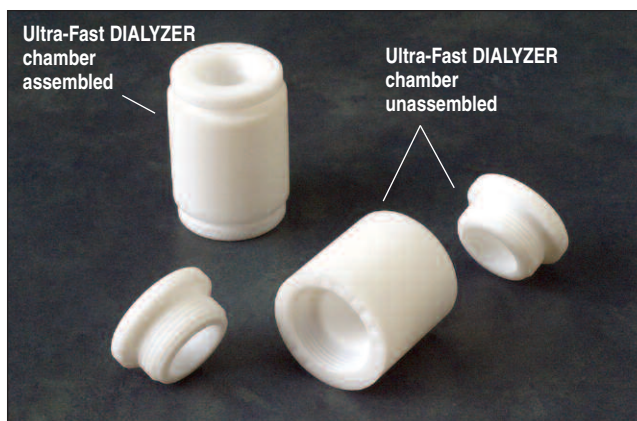
advantages

- 5-10 times quicker than DIALYZERS™
- Reusable
- Available for most sample sizes - large or small
- Membranes available with MWCO's to suit almost any application
- Easy to use
- Leak-proof
- Autoclaveable
- Low protein binding
- High sample recovery
- Rapid dialysis/purification
- Made of Teflon - totally inert

applications

- Exchange of buffers
- Concentration of samples
- Removal of detergents
- Removal of excess radiolabel
- Post-PCR clean-up
- Removal of silicates after chromatography*
- Removal of CsCl, agarose, pyridoxal-5-phosphate*
- Purification of proteins, DNA and RNA
- Complex carbohydrate purification*
- Immunoblotting*
- HPLC, HPCE
- GC, GC-MS, NMR

* When used in conjunction with the Harvard Apparatus ElectroPrep system.



The Ultra-Fast DIALYZER boasts all the features of the original DIALYZER plus an additional dialysis port. The Ultra-Fast double-sided DIALYZER thus has two dialysis membranes, one on either side of the sample chamber. The increased membrane surface area results in greater sample exposure and an enhanced rate of dialysis. The Ultra-Fast DIALYZER includes chamber and two caps.

Ultra-Fast DIALYZER™ (Reusable) (continued)

Double-Sided DIALYZERS™ & Membranes

Ultra-Fast DIALYZERS™

Chamber Volume:	25 µl	50 µl	100 µl	250 µl	500 µl	1000 µl	1500 µl	3000 µl	5000 µl
Qty. of 1	SP1 7404-251D	SP1 7404-501D	SP1 7404-1001D	SP1 7404-2501D	SP1 7404-5001D	SP1 7404-10001D	SP1 7404-15001D	SP1 7404-30001D	SP1 7404-50001D
Qty. of 5	SP1 7404-255D	SP1 7404-505D	SP1 7404-1005D	SP1 7404-2505D	SP1 7404-5005D	SP1 7404-10005D	SP1 7404-15005D	SP1 7404-30005D	SP1 7404-50005D

Ultra-Fast DIALYZER Membranes (pack of 25)

for Chamber Volume:	25 µl, 50 µl, or 100 µl	250 µl, 500 µl, 1000 µl, 1500 µl, 3000 µl or 5000 µl
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A. Regenerated Cellulose MEMBRANES:

1k Da MWCO	SP1 7404-RC1K	SP1 7403-RC1K
2k Da MWCO	SP1 7404-RC2K	SP1 7403-RC2K
5k Da MWCO	SP1 7404-RC5K	SP1 7403-RC5K
10k Da MWCO	SP1 7404-RC10K	SP1 7403-RC10K
25k Da MWCO	SP1 7404-RC25K	SP1 7403-RC25K
50k Da MWCO	SP1 7404-RC50K	SP1 7403-RC50K

B. Cellulose Acetate MEMBRANES:

100 Da MWCO	SP1 7404-CA100	SP1 7403-CA100
500 Da MWCO	SP1 7404-CA500	SP1 7403-CA500
1k Da MWCO	SP1 7404-CA1K	SP1 7403-CA1K
2k Da MWCO	SP1 7404-CA2K	SP1 7403-CA2K
5k Da MWCO	SP1 7404-CA5K	SP1 7403-CA5K
10k Da MWCO	SP1 7404-CA10K	SP1 7403-CA10K
25k Da MWCO	SP1 7404-CA25K	SP1 7403-CA25K
50k Da MWCO	SP1 7404-CA50K	SP1 7403-CA50K
100k Da MWCO	SP1 7404-CA100K	SP1 7403-CA100K
300k Da MWCO	SP1 7404-CA300K	SP1 7403-CA300K

C. Polycarbonate MEMBRANES:

0.01 µm Pore Size	SP1 7404-PC01	SP1 7403-PC01
0.05 µm Pore Size	SP1 7404-PC05	SP1 7403-PC05
0.10 µm Pore Size	SP1 7404-PC10	SP1 7403-PC10
0.60 µm Pore Size	SP1 7404-PC60	SP1 7403-PC60

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

SpinDIALYZER™ & Fast SpinDIALYZER™ (Reusable)

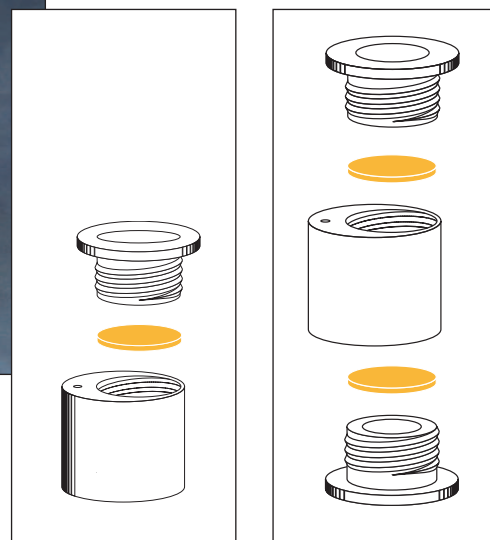
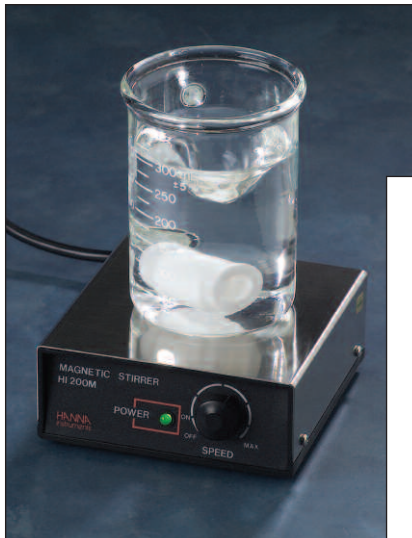
advantages

- Faster dialysis times due to an internal magnet
- Reusable
- Available for most sample sizes-large or small
- Membranes available with MWCO's to suit almost any application
- Easy to use
- Leak-proof
- Autoclaveable
- Low protein binding
- High sample recovery
- Rapid dialysis/purification
- Made of Teflon - totally inert

applications

- Exchange of buffers
- Removal of detergents
- Concentration of samples
- HPLC, HPCE
- Immunoblotting*
- Purification of proteins, DNA and RNA
- Removal of excess radiolabel
- GC, GC-MS, NMR
- Removal of CsCl, agarose, pyridoxal-5-phosphate*
- Removal of silicates after Chromatography*
- Complex carbohydrate purification*

* When used in conjunction with the Harvard Apparatus ElectroPrep system.



SpinDIALYZER™

The SpinDIALYZER is our high-quality DIALYZER with a magnetic feature incorporated internally and does not require an external stir bar. This enables the entire SpinDIALYZER unit to be rotated during dialysis using a magnetic stir plate (Catalog No. SP1 72-1975). The constant motion of the sample results in dialysis times that are 50 to 100% faster than with the DIALYZER. SpinDIALYZER includes chamber plus cap.

Fast SpinDIALYZER™

The Fast SpinDIALYZER is our high-quality Fast DIALYZER with a magnetic feature incorporated internally. This enables the entire Fast SpinDIALYZER unit to be rotated during dialysis using a magnetic stir plate (Catalog No. SP1 72-1975). The constant motion of the sample results in dialysis times that are 50 to 100% faster than with the Fast DIALYZER. As with the Fast DIALYZER, the Fast SpinDIALYZER has two dialysis ports and includes chamber plus two caps.

SpinDIALYZER™ & Fast SpinDIALYZER™ (Reusable)

SpinDIALYZER™ & Membranes

SpinDIALYZERS™ & Membranes

Chamber Volume:	10 µl	20 µl	50 µl	100 µl	200 µl	500 µl	1000 µl	1500 µl
Qty. of 1	SP1 74-0308	SP1 74-0309	SP1 74-0310	SP1 74-0311	SP1 74-0312	SP1 74-0313	SP1 74-0314	SP1 74-0315
Qty. of 5	SP1 74-0300	SP1 74-0301	SP1 74-0302	SP1 74-0303	SP1 74-0304	SP1 74-0305	SP1 74-0306	SP1 74-0307

Fast SpinDIALYZERS™

Chamber Volume:		50 µl	100 µl	200 µl	500 µl	1000 µl	1500 µl
Qty. of 1		SP1 74-0506	SP1 74-0507	SP1 74-0508	SP1 74-0509	SP1 74-0510	SP1 74-0511
Qty. of 5		SP1 74-0500	SP1 74-0501	SP1 74-0502	SP1 74-0503	SP1 74-0504	SP1 74-0505

SpinDIALYZER and Fast SpinDIALYZER Membranes (pack of 25)

for Chamber Volume:	10 µl, 20 µl, 50 µl, 100 µl or 200 µl	500 µl, 1000 µl or 1500 µl
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A. Regenerated Cellulose MEMBRANES:

1k Da MWCO	SP1 7424-RC1K	SP1 7425-RC1K
2k Da MWCO	SP1 7424-RC2K	SP1 7425-RC2K
5k Da MWCO	SP1 7424-RC5K	SP1 7425-RC5K
10k Da MWCO	SP1 7424-RC10K	SP1 7425-RC10K
25k Da MWCO	SP1 7424-RC25K	SP1 7425-RC25K
50k Da MWCO	SP1 7424-RC50K	SP1 7425-RC50K

B. Cellulose Acetate MEMBRANES:

100 Da MWCO	SP1 7424-CA100	SP1 7425-CA100
500 Da MWCO	SP1 7424-CA500	SP1 7425-CA500
1k Da MWCO	SP1 7424-CA1K	SP1 7425-CA1K
2k Da MWCO	SP1 7424-CA2K	SP1 7425-CA2K
5k Da MWCO	SP1 7424-CA5K	SP1 7425-CA5K
10k Da MWCO	SP1 7424-CA10K	SP1 7425-CA10K
25k Da MWCO	SP1 7424-CA25K	SP1 7425-CA25K
50k Da MWCO	SP1 7424-CA50K	SP1 7425-CA50K
100k Da MWCO	SP1 7424-CA100K	SP1 7425-CA100K
300k Da MWCO	SP1 7424-CA300K	SP1 7425-CA300K

C. Polycarbonate MEMBRANES:

0.01 µm Pore Size	SP1 7424-PC01	SP1 7425-PC01
0.05 µm Pore Size	SP1 7424-PC05	SP1 7425-PC05
0.10 µm Pore Size	SP1 7424-PC10	SP1 7425-PC10
0.60 µm Pore Size	SP1 7424-PC60	SP1 7425-PC60

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

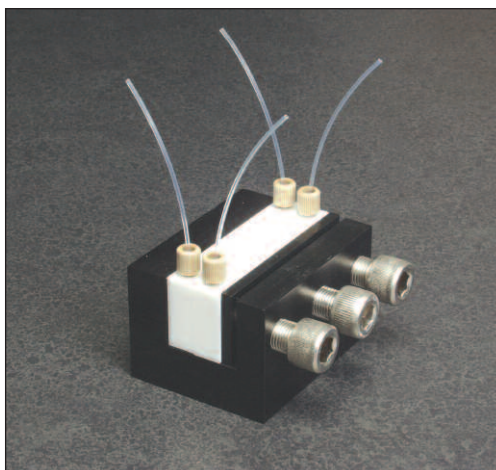
Flow-Thru DIALYZER™ (Reusable)

advantages

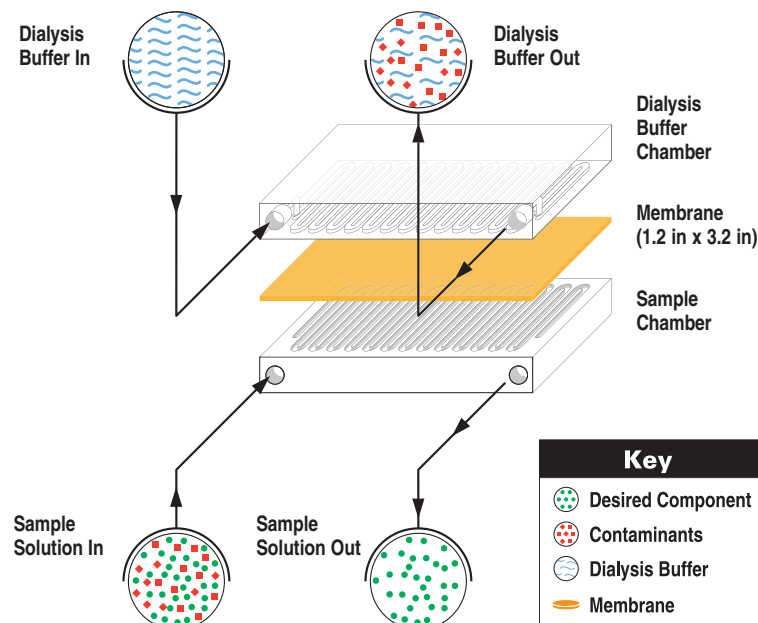
- Ultra fast dialysis times are possible due to large membrane surface area
- Automation ready
- Suitable for wide sample volume range
- Inert Teflon dialysis chamber – minimal sample loss
- Suitable for constant temperature dialysis

applications

- Dialysis
- Buffer exchange
- Salt removal
- Detergent removal
- On-line dialysis for HPLC
- On-line sample concentration
- And more...



Flow-Thru DIALYZER™



The Flow-Thru DIALYZER is a unique system for the rapid dialysis of sample volumes from 20 μ l to 100 ml. It provides a large surface area for Flow-Thru on-line dialysis with minimal sample loss. The entire dialysis unit is made of Teflon, an inert material, and has two separate serpentine channels superimposed on each other and separated by a dialysis membrane. The length of each channel is about 700 mm. Five different chambers are available (20 μ l, 75 μ l, 150 μ l, 300 μ l and 600 μ l). Chambers of different volumes can also be superimposed on each other for specific applications.

With the Flow-Thru DIALYZER more than 90% of salts or small molecules can be dialyzed from a sample in one cycle (about 10 minutes). Cycles can be repeated automatically through the use of continuous flow systems and the entire dialysis unit can be submerged in a water bath for constant temperature dialysis.

Flow-Thru DIALYZER™ (Reusable) (continued)

Flow-Thru DIALYZER™ & Membranes					
Chamber Volume:	20 µl	75 µl	150 µl	300 µl	600 µl
Flo-Thru DIALYZERS™ System with Pump, Clamps and 10k Da membranes					
Qty. of 1	SP1 74-1307	SP1 74-1308	SP1 74-1309	SP1 74-1301	SP1 74-1310
Flow-Thru DIALYZERS™ with Clamping System and 10k Da Membranes					
Qty. of 1	SP1 74-1303	SP1 74-1304	SP1 74-1305	SP1 74-1300	SP1 74-1306
Flow-Thru DIALYZERS™					
Qty. of 2	SP1 74-1400	SP1 74-1401	SP1 74-1402	SP1 74-1403	SP1 74-1404
Flow-Thru DIALYZER MEMBRANES (pack of 10)					
A. Regenerated Cellulose MEMBRANES:					
1k Da MWCO	SP1 74-1510				
2k Da MWCO	SP1 74-1511				
5k Da MWCO	SP1 74-1512				
10k Da MWCO	SP1 74-1513				
25k Da MWCO	SP1 74-1514				
50k Da MWCO	SP1 74-1515				
B. Cellulose Acetate MEMBRANES:					
100 Da MWCO	SP1 74-1508				
500 Da MWCO	SP1 74-1500				
1k Da MWCO	SP1 74-1501				
2k Da MWCO	SP1 74-1502				
5k Da MWCO	SP1 74-1503				
10k Da MWCO	SP1 74-1504				
25k Da MWCO	SP1 74-1505				
50k Da MWCO	SP1 74-1506				
100k Da MWCO	SP1 74-1507				
C. Polycarbonate MEMBRANES:					
0.01 µm	SP1 74-1520				
0.05 µm	SP1 74-1521				
0.60 µm	SP1 74-1522				

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

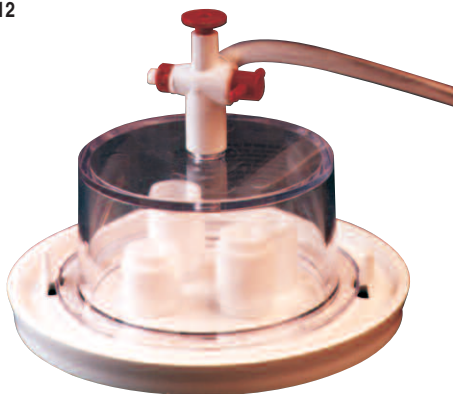
Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

Dialysis Accessories

Concentrator
SP1 74-1112



Concentrator

Sample concentration is easy with the Harvard Apparatus Concentrator. Simply place any DIALYZER, complete with membrane, into the Harvard Apparatus Concentrator. The liquid is evaporated through the membrane and removed by the concentrator. When concentration is complete simply puncture the membrane and remove your sample. This technique is superior to other concentration methods, such as centrifugation, in which the sample may stick to the membrane surface or burst through the membrane.

Order #	Product
SP1 74-1112	Concentrator, pkg. of 1

Membrane Minder
SP1 74-0109



Membrane Minder

The Membrane Minder is an ingenious device designed for the safe and easy movement and manipulation of delicate membranes. The Membrane Minder is also ideal for use with filters, gel pieces, small tissue samples and other small parts. The Membrane Minder utilizes a vacuum to gently manipulate small objects at the push of a button. A range of suction cups and vacuum needles are supplied with the Membrane Minder to ensure the right tool is available, whatever the application.

Order #	Product
SP1 74-0109	Membrane Minder, pkg. of 1

Magnetic Stirrers



Magnetic Stirrer and Stir Bars

Magnetic Stirrer for use with SpinDIALYZERS™ and Fast SpinDIALYZERS™ on page 30 is lightweight and compact (120 x 120 x 45 mm or 4.8 x 4.8 x 1.8 in) requiring less bench space. This stirrer has electronic speed controls for accuracy and precision with a limiting maximum speed of 1,000 rpm for safety. The stirrer has chemical resistant ABS plastic housing and is supplied with an AISI 316 stainless steel cover. PTFE coated Magnetic Stir Bar, 25 mm (1.0 in) long and 7 mm (0.3 in) diameter, is available for use with the stirrer.

Order #	Product
SP1 74-0106	Magnetic Stirrer, 110/115V
SP1 74-0111	Magnetic Stirrer, 220/240V
SP1 74-0110	Magnetic Stir Bar, 10pcs

Ultra-Micro DispoDIALYZER™

Samples from 1 µl to 5 µl (Single use)

advantages

- Micro-volume dialysis
- Economical
- Easy to use
- Leak-proof
- Low protein binding
- High sample recovery
- Rapid dialysis/purification

applications

- Exchange of buffers
- Removal of detergents
- Concentration of samples
- HPLC, HPCE
- Purification of proteins, DNA and RNA
- Removal of excess radiolabel or PCR-primers
- GC, GC-MS, NMR

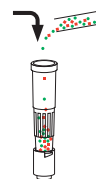


The 1 µl to 5 µl Ultra-Micro DispoDIALYZER is a unique disposable DIALYZER for the dialysis of very small samples. The entire dialysis unit installed with different MWCO membranes (0.025 cm² surface area) is small enough so that dialysis can be carried out in a microcentrifuge tube. Sample recovery is quick and easy with almost 100% of the sample recovered after only a short centrifugation step. Ultra-Micro DispoDIALYZER includes two 1.5 ml capped microcentrifuge collection tubes.

how to use

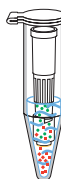
Ultra-Micro DispoDIALYZER™

Step 1



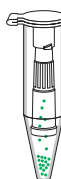
Place sample into the DispoDIALYZER

Step 2



Place the DispoDIALYZER into a microcentrifuge tube containing dialysis buffer

Step 3



Place the DispoDIALYZER inverted into a new tube and centrifuge for 1 minute at low speed

Done!



Key

- Desired Component
- Contaminants
- Dialysis Buffer
- Membrane

Ultra-Micro DispoDIALYZERS – Ordering Information

Membrane MWCO (Daltons)	Qty. of 25	Qty. of 50	Qty. of 100
Cellulose Acetate			
100	SP1 74-0603	SP1 74-0604	SP1 74-0605
500	SP1 74-0606	SP1 74-0607	SP1 74-0608
Regenerated Cellulose			
1,000	SP1 74-0609	SP1 74-0610	SP1 74-0611
2,000	SP1 74-0612	SP1 74-0613	SP1 74-0614
5,000	SP1 74-0615	SP1 74-0616	SP1 74-0617
10,000	SP1 74-0602	SP1 74-0600	SP1 74-0601
25,000	SP1 74-0618	SP1 74-0619	SP1 74-0620
50,000	SP1 74-0621	SP1 74-0622	SP1 74-0623

Micro DispoDIALYZER™

Samples from 5 µl to 100 µl (Single use)

advantages

- Economical
- Hassle-free
- Available for small sample sizes
- Membranes available with MWCO's to suit almost any application
- Easy to use
- Leak-proof
- Low protein binding
- High sample recovery
- Rapid dialysis/purification

applications

- Exchange of buffers
- Removal of detergents
- Concentration of samples
- Purification of proteins, DNA and RNA
- Removal of excess radiolabel or PCR-primers
- HPLC, HPCE
- GC, GC-MS, NMR

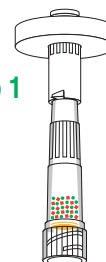


The Micro DispoDIALYZER is a unique disposable DIALYZER for the dialysis of small sample volumes from 5 µl to 100 µl. Sample recovery is quick and easy using the Micro DispoDIALYZER, almost 100% of the sample is recovered after a short centrifugation step. The Micro DispoDIALYZER includes installed membrane of different MWCO, foam float, cap and two 1.5 ml collection tubes.



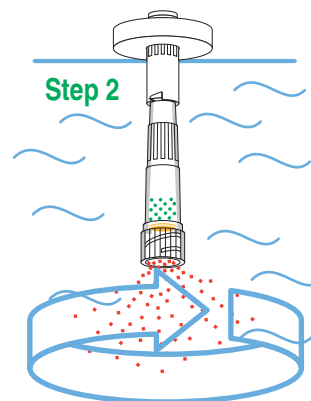
Micro DispoDIALYZER™

Step 1



The sample is placed in the sample chamber as shown in the diagram below. It is separated from the dialysis buffer by the membrane.

Step 2



The entire unit is placed in a beaker and floats vertically due to the flotation ring attached to the unit. Stirring the dialysis buffer results in faster dialysis times.

Done!



Simply invert the DispoDIALYZER in a microcentrifuge tube and centrifuge briefly to recover the sample.

Micro DispoDIALYZERS – Ordering Information

Membrane MWCO (Daltons)	Qty. of 25	Qty. of 50	Qty. of 100
Cellulose Acetate			
100	SP1 74-0714	SP1 74-0700	SP1 74-0701
500	SP1 74-0721	SP1 74-0722	SP1 74-0723
Regenerated Cellulose			
1,000	SP1 74-0715	SP1 74-0702	SP1 74-0703
2,000	SP1 74-0716	SP1 74-0704	SP1 74-0705
5,000	SP1 74-0717	SP1 74-0706	SP1 74-0707
10,000	SP1 74-0718	SP1 74-0708	SP1 74-0709
25,000	SP1 74-0719	SP1 74-0710	SP1 74-0711
50,000	SP1 74-0720	SP1 74-0712	SP1 74-0713

Key

- Desired Component
- Contaminants
- Dialysis Buffer
- Membrane

Fast Macro DispoDIALYZER™

Samples from 1 ml to 10 ml (Single use)

advantages

- Macro-volume dialysis
- Economical
- Easy to use
- Leak-proof
- Low protein binding
- High sample recovery
- Rapid dialysis/purification

applications

- Exchange of buffers
- Removal of detergents
- Concentration of samples
- HPLC, HPCE
- Purification of proteins, DNA and RNA
- Removal of excess radiolabel or PCR-primers
- GC, GC-MS, NMR



Fast Macro DispoDIALYZER™ Assembled

Fast Macro DispoDIALYZER



The Fast Macro DispoDIALYZER is also available for larger samples. This unit is available with 5,000 or 10,000 Dalton regenerated cellulose membranes. The other basic features of this unit are the same as those of the smaller volume DispoDIALYZERS described earlier. The Fast Macro DispoDIALYZER includes shell, two rings and two membranes of MWCO 5KDa or 10KDa (4.5 cm² surface area each). Assembly required.

Fast Macro DispoDIALYZERS – Ordering Information

Membrane MWCO (Daltons)	Qty. of 25	Qty. of 50	Qty. of 100
5,000	SP1 74-0803	SP1 74-0804	SP1 74-0805
10,000	SP1 74-0802	SP1 74-0800	SP1 74-0801

96-Well DispoDIALYZER™

Samples from 25 µl to 300 µl (Single use)

advantages

- High recovery (> 95%)
- 96-well high-throughput format
- Individual membranes means no cross-contamination between wells
- High well to well reproducibility
- Range of possible sample volumes: 25 µl to 300 µl
- Range of membrane MWCO's available: 1K, 2K, 5K, 10K, and 25K Daltons
- High quality regenerated cellulose membranes
- Membranes are free from sulphur and heavy metal contamination



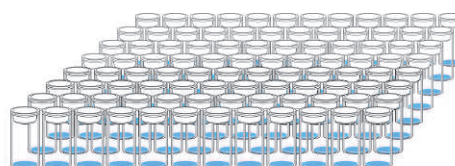
The 96-Well DispoDIALYZER is a novel product for the simultaneous preparation of 96 samples. Each well in this system has a separate membrane, thus eliminating the possibility of sample contamination and leakage. The 96-Well DispoDIALYZER provides very high reproducibility among different wells and sample recovery is excellent. Wells are sealed with twelve 8-cap strips (included).



96-Well DispoDIALYZER™

applications

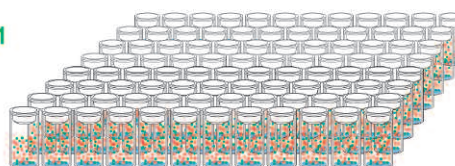
- Salt removal
- Buffer exchange
- Parallel sample prep after fraction collection
- Oligonucleotide purification
- Detergent removal
- HPLC
- HPLC-MS
- And more...



The 96-Well DispoDIALYZER



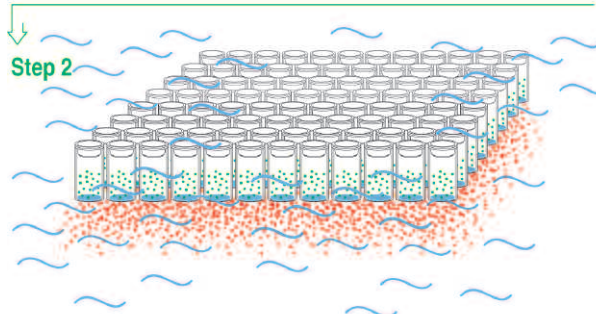
Step 1



Place the sample into the wells of the 96-Well DispoDIALYZER and assemble strip caps



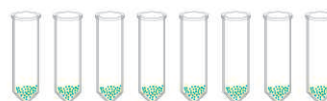
Step 2



Float the entire plate in dialysis buffer



Done!



Retrieve the purified samples for downstream applications

96-Well DispoDIALYZERS – Ordering Information

Membrane MWCO (Daltons)	Qty. of 2
1,000	SP1 74-0900
2,000	SP1 74-0901
5,000	SP1 74-0902
10,000	SP1 74-0903
25,000	SP1 74-0904

Key

- Desired Component
- Contaminants
- Dialysis Buffer
- Membrane

Liposome Preparation

Liposome Specifications

With a few exceptions, liposomes are composed of natural or synthetic phospholipids, mostly lecithins. Hence, they can be metabolized in vivo and are generally non-toxic and non-antigenic.

Agents can be entrapped in liposomes without the formation of chemical bonds and sensitive molecules can be protected within them. Because of their restricted permeability, liposomal preparations offer a controllable, time-dependent release system.

The entrapment of a drug within liposomes changes its pharmaco-kinetics and can result in a better therapeutic index and enhanced cellular uptake. Since different agents need different lipid agents to create an optimal coat, in vivo experiments following liposome preparation are often the optimal means of determining which lipid represents the best compromise between permeability and in vivo stability for any given agent.

Stability of Liposomes

No general rule for maintaining liposome stability exists since it depends on several parameters, such as the type of lipid used, the properties of the drug/agent in the liposomes, their size, lamellarity, and homogeneity, the electrolyte content and pH of the medium used, and also on the specifications of the desired application.

Size Control

The size of liposomes can be adjusted experimentally by varying several parameters: the dialysis rate, type of detergent, type of lipid(s), lipid/detergent molar ratio, lipid concentration, electrolyte content and pH.

Detergents

The detergents used are gentle in their action and are not expected to hydrolyze or peroxidize liposome components. The most frequently used detergents are sodium cholate, n-octyl-β-D-glucopyranoside and n-octyl-tetraoxyethylene (POE4). Other detergents are sodium salts of glycocholic acid, deoxycholic acid, taurocholic acid, chenoxcholic acid, n-hexyl- and n-heptyl-glucopyranoside and lauryldimethylamine oxide.

Unilamellar Liposomes of Various Lipid Mixtures Prepared by Controlled Detergent Removal Using the Liposomat
(total lipid concentration varied between 10 and 13 mg/ml)

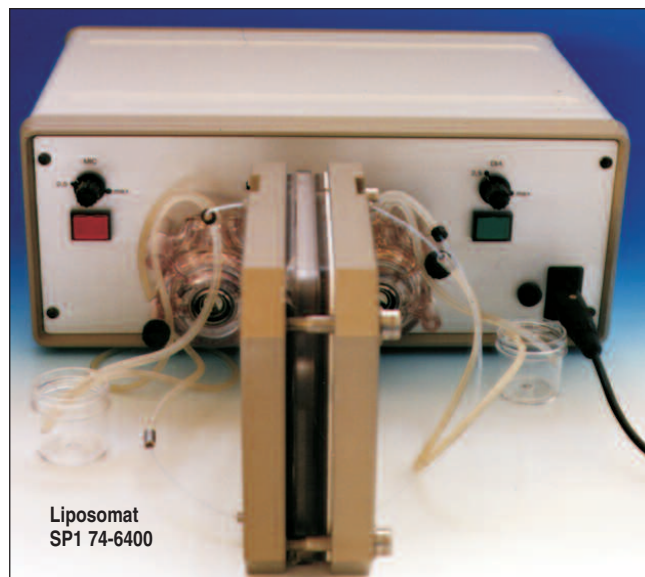
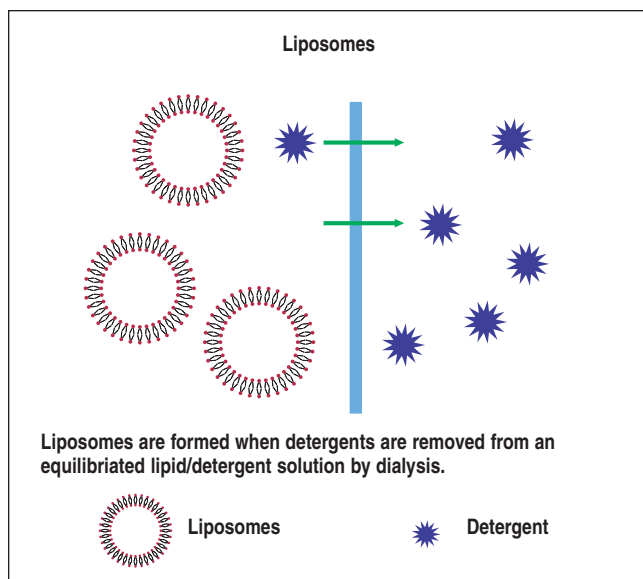
Lipid Composition	Molar Ratio	Detergent	Molar Lipid / Detergent Ratio	Liposome Diameter (nm)
EYL	-	cholate	0.60	55 ±3
EYL	-	cholate	0.76	68 ±3
EYL/chol	8:2	cholate	1.15	81 ±4
EYL/chol	7:3	cholate	0.52	61 ±4
EYL/PE	3:7	cholate	0.22	36 ±2
EYL/PI	8:2	cholate	0.60	59 ±2
EYL/PA	10:2	cholate	0.62	42 ±2
EYL/SA	10:2	cholate	0.62	49 ±2
EYL/cerebroside	-	cholate	0.60	81 ±4
DPPC/DMPA	9:1	cholate	0.20	97 ±4
DSPC/DCP	9:1	cholate	0.20	74 ±4
DPPC/DMPA	9:1	cholate	0.62	90 ±4
EYL	-	n-octyl-glucoside	0.20	176 ±3
EYL	-	n-octyl-glucoside/n-heptyl glucoside	0.80/0.17	117 ±3
EYL	-	n-heptyl glucoside	0.13	79 ±2
EYL	-	n-hexyl glucoside	0.05	59 ±2
DSPC/chol/DCP	7:2:1	n-octyl-glucoside	0.20	79 ±4
Hydrogenated soya Lecithin/DMPA	9:1	n-octyl-glucoside	0.20	130 ±5

EYL = egg yolk lecithin
chol = cholesterol
PE = phosphatidylethanolamine

PI = phosphatidylinositol
PA = phosphatidic acid
SA = stearylamine
DMPA = dimyristoyl phosphatidic acid

DPPC = dipalmitoyl phosphatidylcholine
DSPC = distearoyl phosphatidylcholine
DCP = dicetylphosphate

Liposome Preparation



Mini Lipoprep

- The Mini Lipoprep is well suited for the preparation of small volumes of liposomes (0.5 ml to 1.0 ml).
- It consists of a sample chamber, which is used with a membrane, and a motor to rotate the sample chamber at constant speed.
- Liposomes are formed during dialysis of the detergent in the lipid/detergent micelles through the membrane.
- Using the Mini Lipoprep, unilamellar homogeneous liposomes can be prepared in 2 to 3 hours.

Order # Product

Mini Lipoprep

SP1 74-6300	Mini Lipoprep with Dual Speed Drive Unit (10/20 rpm), Dialysis Cell (500 μ l to 1000 μ l) and 200 Membranes (MWCO 10,000 Daltons Very High Permeability), qty. of 1
SP1 74-2100	Membranes for Mini Lipoprep MWCO 5,000 Daltons, qty. of 200
SP1 74-2102	Membranes for Mini Lipoprep MWCO 10,000 Daltons Very High Permeability
SP1 74-6304	Kit for Liposome Preparation (for 20 Preparations); includes: 500mg Phosphatidylcholine from Soya-bean, and 800mg Cholic Acid Sodium Salt, qty. of 1

Liposomat

- The Liposomat is ideal for the preparation of liposomes of volumes from 3 ml to 50 ml or higher.
- The system has two serpentine channels superimposed on each other and separated by a membrane.
- Each channel has a volume of 3 ml and a length of 3 meters. The mixed lipid/detergent micelles run through one of the channels while the buffer flows through the other channel.
- Due to controlled dialysis and the high surface area in the system, liposomes can be formed within 30 minutes.
- The serpentine chambers can also be immersed in a water bath for liposome production at constant temperature.

Order # Product

Liposomat

SP1 74-6400	Liposomat Device for Preparation of Liposomes (3 ml to 50 ml) with Dual Pump, Flow-Through Dialysis Chamber and 100 Membranes (MWCO 5,000 Daltons), qty. of 1
SP1 74-6401	Membranes for Liposomat (MWCO 5,000 Daltons), qty. of 100
SP1 74-6402	Long Tubing for Use of Liposomat with Thermostat, qty. of 1

CoZap

applications

- No need to change the destaining solution!
- Fast and simple
- No charcoal or dye residues
- No subsequent destaining required
- One pad can destain up to 10 gels
- 20% faster than conventional methods

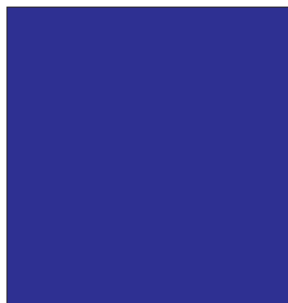
CoZap Pads



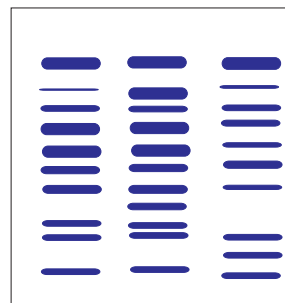
CoZap is used for rapid removal of Coomassie Blue stain from electrophoresis gels without the need to change the destaining solution. CoZap is a unique pad that has a high absorbance for Coomassie blue stain and is thus very effective in destaining gels. CoZap absorbs any free dye in the solution making gel destaining 20% faster than with conventional method. It is one of the most effective destaining methods on the market.

Using CoZap is easy:

1. Place the CoZap pad in your destaining tank.
2. Remove the gel after destaining.



BEFORE



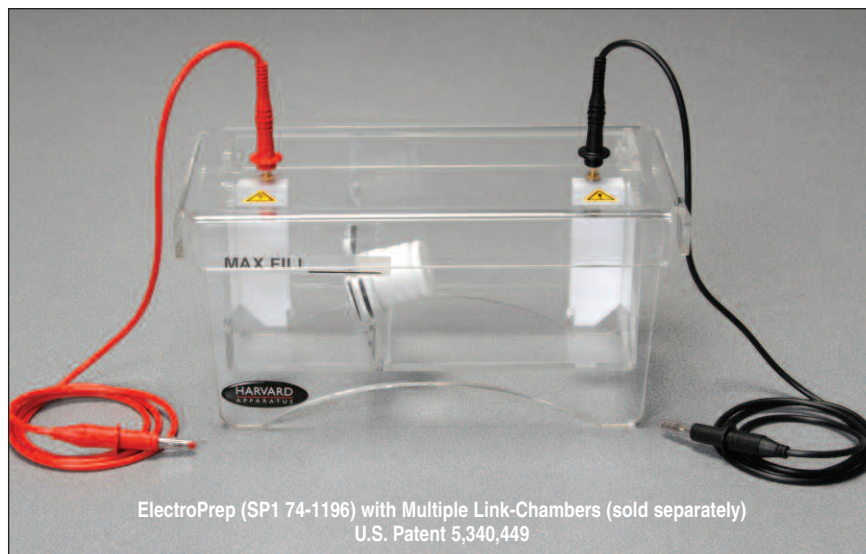
AFTER

Order #	Size	Product
SP1 74-6800	76 x 76 x 2 mm	CoZap Pads, pkg. of 25
SP1 74-6801	76 x 76 x 2 mm	CoZap Pads, pkg. of 100
SP1 74-6802	76 x 38 x 2 mm	CoZap Pads, pkg. of 100
SP1 74-6803	76 x 38 x 2 mm	Cozap Pads, pkg. of 200

ElectroPrep™ System

advantages

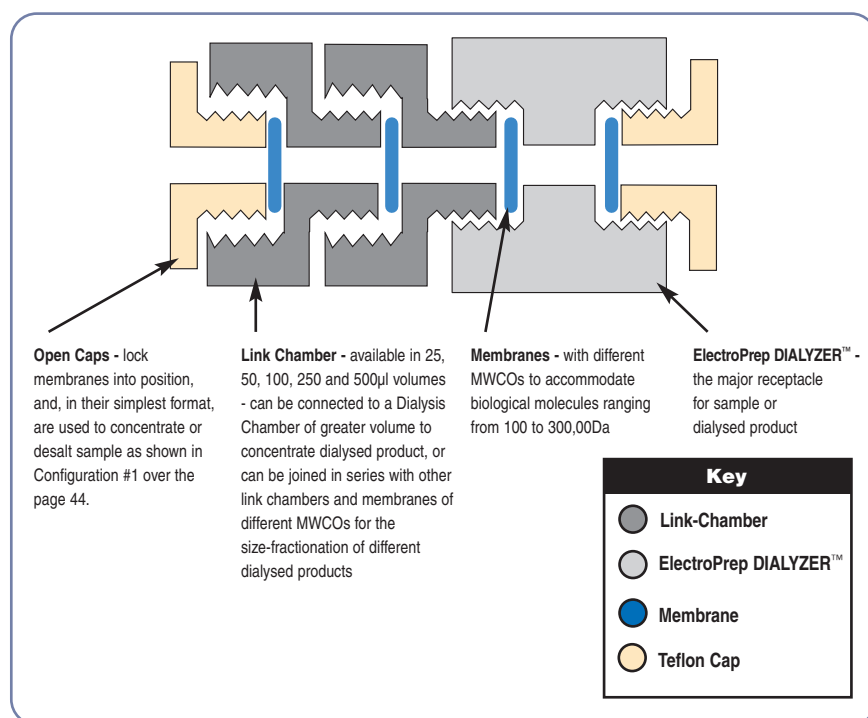
- Faster dialysis times due to movement of charged molecules in the electric field
- Re-usable
- Available for most sample sizes - large or small
- Membranes available with MWCO's to suit almost any application
- Easy to use
- Leak proof
- Autoclaveable
- Low protein binding
- High sample recovery
- Made of Teflon - totally inert



applications

- Electro-elution from gels and solutions
- Electro-dialysis (with an average buffer exchange time of 5 to 10 minutes)
- On-line electro-dialysis
- Electro-concentration
- Selective electro-filtration
- Size fractionation
- Primer removal
- Salt removal
- Detergent removal
- Dye-Terminator removal
- See some examples on the following pages

The ElectroPrep system from Harvard Apparatus is an extremely versatile patented sample prep technology. This ElectroPrep system is ideal for the rapid purification of proteins, nucleic acids, carbohydrates and other biomolecules. With a run-time of 5 to 10 minutes, ElectroPrep provides speed and convenience, even at the very low currents (5 to 10 mA) used with this system. The sample chambers are made of Teflon, a completely inert material especially suited for high sample recovery. Membranes of different MWCO (molecular weight cut off), from 100 to 300,000 Daltons, can be used for selective buffer exchange, dialysis, filtration, concentration, fractionation and elution. ElectroPrep DIALYZER can be joined with each other or with one or two link chambers in different combinations (see pages 43 & 44) and membranes (see page 46).



ElectroPrep™ System

Configurations

Electroprep System Configurations

1. Decide Application:

- Electro-Dialysis - **Configuration #1**
- Electro-Concentration - **Configuration #2**
- Electro-Separation - **Configuration #2**
- Electro-Elution - **Configuration #2**
- Electro-Filtration - **Configuration #3**
- Electro-Fractionation - **Configuration #4**

2. Select Dialysis Chamber Volume

50 µl to 1500 µl (a Chamber can be connected to an Union for increased volume)

3. Choose suitable size, type and MWCO Dialysis Membranes

for desired configurations

4. Connect Dialysis Chamber

- with a membrane and open-ended Caps for Desalting or Buffer Exchange (**Configuration #1**)
- with a membrane, Union and a smaller volume Chamber for Electro-Concentration (**Configuration #2**)
- with a membrane, Union and equal volume Chamber for Electro-Separation & Electro-Elution (**Configuration #2**)
- with a membrane and Link Chambers for Electro-Filtration (**Configuration #3**)
- with membranes of different MWCO and multiple Link Chambers for Electro-Fractionation (**Configuration #4**)

Example Configurations

Most Basic: To Desalt or Buffer Exchange



Configuration #1: Single Chamber with two matching open-ended Caps

Two Different Volume Chambers: To Selectively Concentrate



Configuration #3: One Chamber connected to a Link

Larger Volume Chambers: To Purify and Concentrate or Filter



Configuration #2: Two Chambers connected with an Union

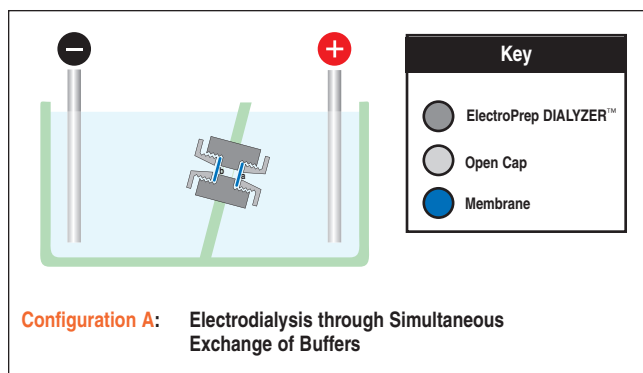
Complex Configuration: for Concentration/Filtration/Separation



Configuration #4: Two Chambers with an Union and two Links

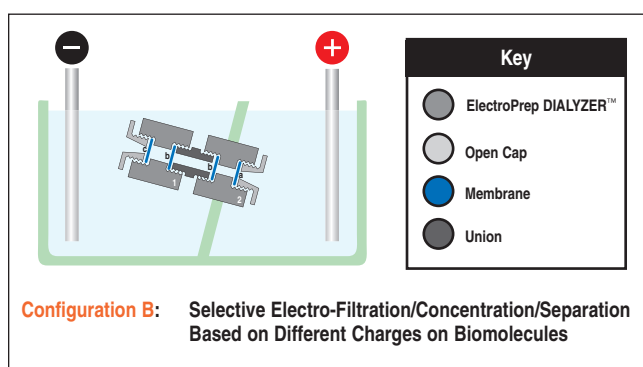
ElectroPrep™ System (continued)

Configurations



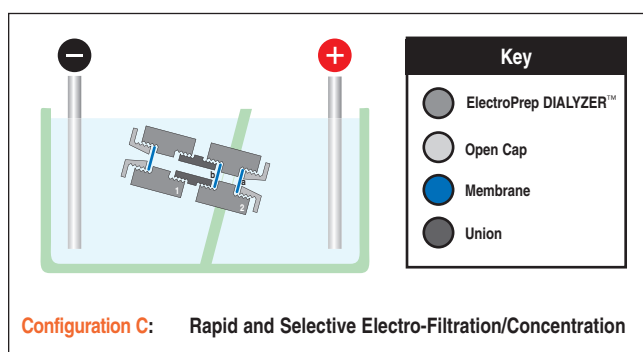
Electro-Dialysis through Simultaneous Exchange of Buffers

A sample is placed in the dialysis chamber between Membranes (a) and (b), both of which have MWCOs (Molecular Weight Cut-Off) lower than the molecular weight of the desired biomolecules. The sample is dialyzed through the simultaneous exchange of buffers in the electric field. This method is very fast and very effective. For example, after a PCR reaction, it can be used to rapidly (5 to 10 minutes) remove 100% of the primer. Electrodialysis is also effective for desalting neutral molecules that do not move in an electric field (such as sugars) or charged molecules at their isoelectric point.



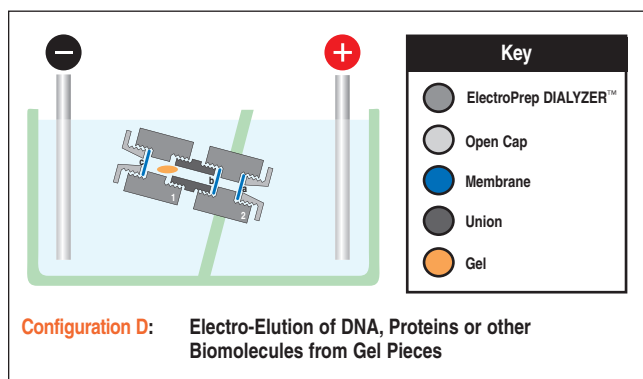
Selective Electro-Filtration/Concentration/ Separation Based on Different Charges of Biomolecules

In this configuration of the ElectroPrep, the sample is placed in an union between two membranes (b), both of which should have a MWCO larger than the desired biomolecules. Membranes (a) and (c) should have MWCOs smaller than the biomolecules. Based on their charges, the desired biomolecules will move to either dialysis Chamber (1) or Chamber (2), whereas the lowest molecular weight molecules will migrate through membranes (a) and (c) into the tank. Biomolecules with unknown isoelectric points can also be separated and purified using this method. Dialysis chambers of smaller volume can be used to concentrate samples.



Rapid and Selective Electro-Filtration or Concentration

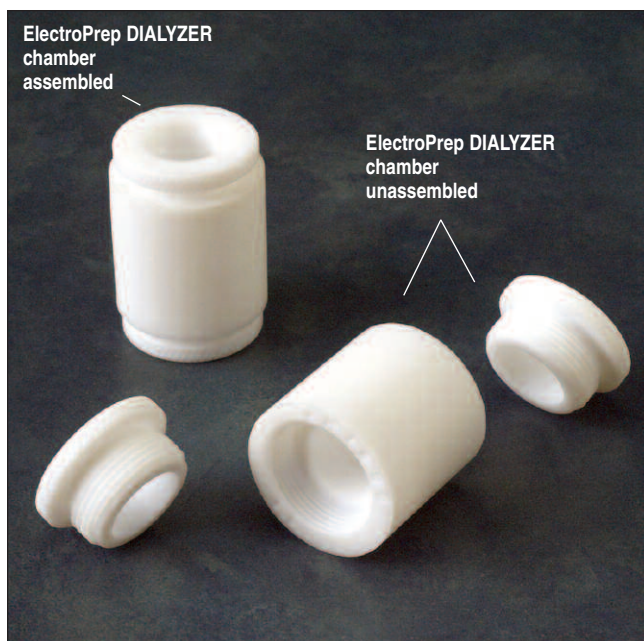
The sample is placed in the sample compartment comprised of a Chamber (1) and the Union connected to a receiving Chamber (2) of same or smaller volume. The MWCO of membrane (b) should be larger than the molecular weight of the biomolecules and the MWCO of membrane (a) should be smaller. Upon the passage of electric current, the biomolecules will pass through membrane (b) and collect in Chamber (2) while smaller molecules will continue to pass through membrane (b) and (a). This is a fast and effective method for selective filtration, and for the concentration of small samples.



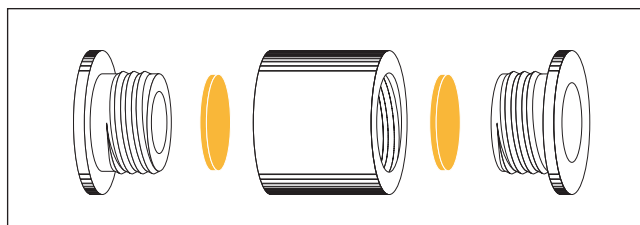
Electro-Fractionation During Elution of DNA, Proteins or Other Biomolecules from Gel Pieces

Using the ElectroPrep system in this configuration, elution of DNA, proteins, or any other biomolecules from a gel slice/plug can be achieved quickly and easily with excellent recovery. Using an union, Chambers can be joined in any combination necessary to accommodate the required gel volume. Samples can be concentrated if desired, by choosing a receiving chamber of suitable smaller volume. The MWCO of the membranes (a and b) can also be chosen to achieve very selective filtration or size fractionation during the electro-elution process.

ElectroPrep™ System (continued)



The ElectroPrep System must use at least one DIALYZER unit (range of 50 μ l to 1,500 μ l volume).



Union

Joins Dialysis Chambers of	Pkg of 2	Chamber Volume
Any two chambers with volume range of 50 μ l to 1500 μ l	SP1 74-1194	600 μ l, 3500 μ l

The joining of multiple ElectroPrep DIALYZERS units requires a Union. Union can join two main Dialysis Chambers:

- **Without membranes to make larger volume chambers, or**
- **With dialysis membranes of appropriate MWCO for serial dialysis.**

Union SP1 74-1194 with 600 μ l or 3500 μ l volume can join two Chambers with volumes from 50 μ l to 1500 μ l.

Dialysis Chambers

Chamber Volume	Pkg of 2
50 μ l	SP1 7411-502D
100 μ l	SP1 7411-1002D
250 μ l	SP1 7411-2502D
500 μ l	SP1 7411-5002D
1000 μ l	SP1 7411-10002D
1500 μ l	SP1 7411-15002D

Dialysis Chambers are the major receptacles for either samples or dialyzed materials. Included with each ElectroPrep DIALYZER are one main Chamber with two open ports and two matching end caps.

- Chambers can have dialysis membranes of appropriate MWCO at one or both ends.
- Chambers can be joined to each other with a Union or connected directly to one or more Link Chambers separated by dialysis membranes.
- Chambers of different volumes can be connected together or intermixed using Union.

Link Chambers

Chamber Volume	Pkg of 2
50 μ l	SP1 7411-502L
100 μ l	SP1 7411-1002L
250 μ l	SP1 7411-2502L
500 μ l	SP1 7411-5002L
1000 μ l	SP1 7411-10002L
1500 μ l	SP1 7411-15002L

Link Chambers of various volumes can be easily attached to a main Chamber of the ElectroPrep DIALYZERS when volumes smaller than that of the main Chamber are required, by placing membranes at either end.

- Links can be used as a single Link directly attached to one main Chamber without the need of a Union.
- Unlike Unions, Links do not connect to each other or to the main Chamber without a dialysis membrane.
- Without Unions, Links can be directly connected to main Dialysis Chambers. Only the 50 μ l or 100 μ l Links can be joined together or interchanged, but not other volume Links.

See next page for ElectroPrep Product List and Ordering Information.

DIALYZERS, Chambers & Membranes for ElectroPrep

Ordering Information

ElectroPrep DIALYZERS™ , Additional or Connector Chambers & Membranes for ElectroDialysis						
Chamber Volume:	50 µl	100 µl	250 µl	500 µl	1000 µl	1500 µl
ElectroPrep DIALYZER						
Qty. of 2	SP1 7411-502D	SP1 7411-1002D	SP1 7411-2502D	SP1 7411-5002D	SP1 7411-10002D	SP1 7411-15002D
Additional (Link)						
Qty. of 2	SP1 7411-502L	SP1 7411-2502L	SP1 7411-2502L	SP1 7411-5002L	SP1 7411-10002L	SP1 7411-15002L
Connector (Union)						
	600 µl, 3500 µl (to join 50 µl, 100 µl, 250 µl, 500 µl, 1000 µl or 1500 µl ElectroPrep DIALYZERS)					
Qty. of 2	SP1 74-1194					
Membranes: Pack of 25						
for Chamber Volume	50µl, 100µl, 250ul, 500ul, 1000µl or 1500ul					
A. Regenerated Cellulose MEMBRANES:						
1k Da MWCO				SP1 7410-RC1K		
2k Da MWCO				SP1 7410-RC2K		
5k Da MWCO				SP1 7410-RC5K		
10k Da MWCO				SP1 7410-RC10K		
25k Da MWCO				SP1 7410-RC25K		
50k Da MWCO				SP1 7410-RC50K		
B. Cellulose Acetate MEMBRANES:						
100 Da MWCO				SP1 7410-CA100		
500 Da MWCO				SP1 7410-CA500		
1k Da MWCO				SP1 7410-CA1K		
2k Da MWCO				SP1 7410-CA2K		
5k Da MWCO				SP1 7410-CA5K		
10k Da MWCO				SP1 7410-CA10K		
25k Da MWCO				SP1 7410-CA25K		
50k Da MWCO				SP1 7410-CA50K		
100k Da MWCO				SP1 7410-CA100K		
300k Da MWCO				SP1 7410-CA300K		
C. Polycarbonate MEMBRANES:						
0.01 um Pore Size				SP1 7410-PC01		
0.05 um Pore Size				SP1 7410-PC05		
0.10 um Pore Size				SP1 7410-PC10		
0.60 um Pore Size				SP1 7410-PC60		
Accessories: Quantity of 1						
ElectroPrep Tank				SP1 74-1196		
ElectroPrep Connector				SP1 74-1197		
Power Supply, 110V				SP1 74-1198		
Power Supply, 220V				SP1 74-1199		

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer. Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes. Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended. Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

Fast Flow-Thru DIALYZER™ for ElectroPrep™ (Reusable)

advantages

- Rapid sample preparation
- Minimal sample loss
- Inert sample and concentration chambers (made of Teflon)

applications

- Electro-elution
- Electro-dialysis
- Electro-concentration
- Electro-filtration
- Protein crystallization



The Fast Flow-Thru DIALYZER is a new and unique product that is ideal for electro-elution, electro-dialysis, electro-concentration and electro-filtration of larger sample volumes (from 50 μ l to 1 ml or more) and for protein crystallization when used with ElectroPrep, see page 44. The Fast Flow-Thru DIALYZER has an inlet and an outlet providing a flow-through system, which facilitates the continuous movement of the sample. Sample collection can be monitored through the use of an on-line detector, such as a photometer, conductivity meter or any other suitable equipment readily available in the laboratory. The Fast Flow-Thru DIALYZER can also be hooked to an HPLC sample loop for concentration of biological samples.

As shown in Figure 1, the sample from the sample reservoir (1) is pumped in continuous circulation through the sample chamber. The MWCO of membrane (a) is smaller than the molecular weight of the desired biomolecules. The MCWO membrane (b) is larger than the molecular weight of the desired biomolecules. The desired biomolecules will be collected in the concentration chamber (2) since membrane (c) also has a MWCO smaller than the desired biomolecules.

The setup in Figure 2 is similar. The sample from the sample reservoir (1) is pumped in continuous circulation through the sample chamber. In this instance, however, the concentration chamber (2) is also connected to a continuous on-line system with a sample detector such as an HPLC system. Therefore, the sample collected in the concentration chamber can be periodically measured and analyzed. Fast Flow-Thru DIALYZER includes chamber, two open-ended caps and two fittings.

Fast Flow-Thru DIALYZER

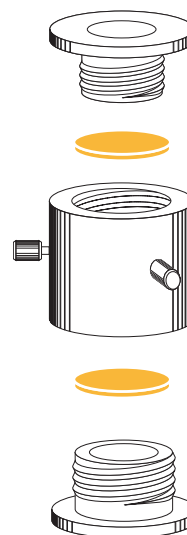
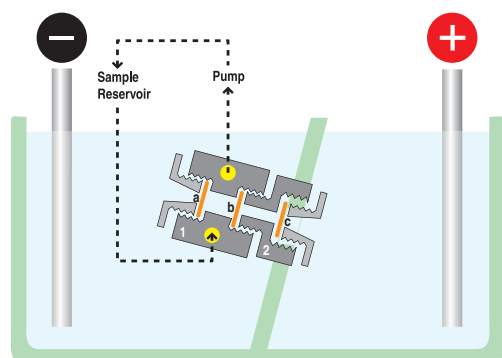


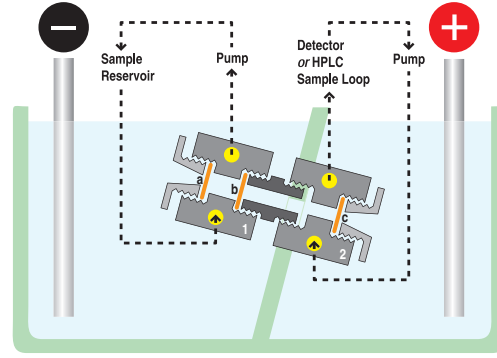
Figure 1



Key

- DIALYZER™
- Teflon Cap
- Membrane
- Union
- Port

Figure 2



Fast Flow-Thru DIALYZER™ for ElectroPrep™

Ordering Information

Fast Flow-Thru DIALYZERS for ElectroPrep				
Chamber Volume:	50 µl	100 µl	500 µl	1000 µl
Qty. of 1	SP1 74-1204	SP1 74-1205	SP1 74-1206	SP1 74-1207
Qty. of 5	SP1 74-1200	SP1 74-1201	SP1 74-1202	SP1 74-1203
Fast Flow-Thru DIALYZER Membranes: Pack of 25				
for Chamber Volume:	50 µl	100 µl	500 µl	1000 µl
A. Regenerated Cellulose MEMBRANES:				
1k Da MWCO	SP1 7424-RC1K	SP1 7425-RC1K		
2k Da MWCO	SP1 7424-RC2K	SP1 7425-RC2K		
5k Da MWCO	SP1 7424-RC5K	SP1 7425-RC5K		
10k Da MWCO	SP1 7424-RC10K	SP1 7425-RC10K		
25k Da MWCO	SP1 7424-RC25K	SP1 7425-RC25K		
50k Da MWCO	SP1 7424-RC50K	SP1 7425-RC50K		
B. Cellulose Acetate MEMBRANES:				
100 Da MWCO	SP1 7424-CA100	SP1 7425-CA100		
500 Da MWCO	SP1 7424-CA500	SP1 7425-CA500		
1k Da MWCO	SP1 7424-CA1K	SP1 7425-CA1K		
2k Da MWCO	SP1 7424-CA2K	SP1 7425-CA2K		
5k Da MWCO	SP1 7424-CA5K	SP1 7425-CA5K		
10k Da MWCO	SP1 7424-CA10K	SP1 7425-CA10K		
25k Da MWCO	SP1 7424-CA25K	SP1 7425-CA25K		
50k Da MWCO	SP1 7424-CA50K	SP1 7425-CA50K		
100k Da MWCO	SP1 7424-CA100K	SP1 7425-CA100K		
300k Da MWCO	SP1 7424-CA300K	SP1 7425-CA300K		
C. Polycarbonate MEMBRANES:				
0.01 µm	SP1 7424-PC01	SP1 7425-PC01		
0.05 µm	SP1 7424-PC05	SP1 7425-PC05		
0.10 µm	SP1 7424-PC10	SP1 7425-PC10		
0.60 µm	SP1 7424-PC60	SP1 7425-PC60		

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

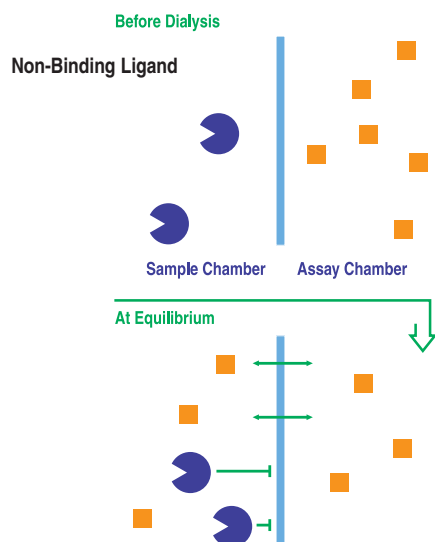
Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

Introduction to Equilibrium Dialysis

How Does Equilibrium Dialysis Work?



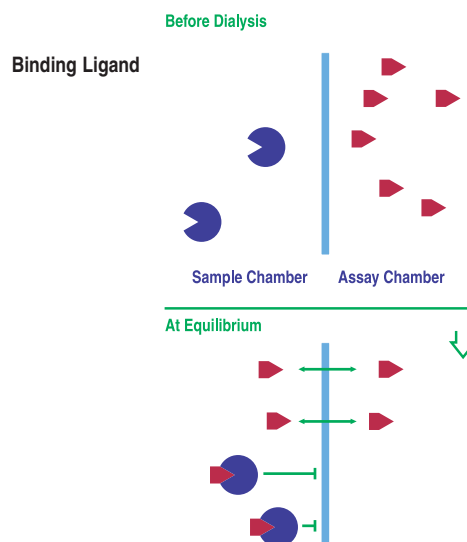
If the ligand and protein do not bind to each other the ligand is free to cross the membrane. At equilibrium, the concentration of the ligand in the assay chamber will be exactly half that initially placed in the sample chamber.



Protein



Protein-Ligand Complex



If the ligand and protein form a complex, the bound ligand will be unable to diffuse across the membrane and will remain in the sample chamber. The concentration of the ligand will still be equivalent on either side of the membrane upon reaching equilibrium. In this case, however, the ligand concentration in the assay chamber is reduced by the total amount of ligand bound to the protein divided by two.

Unbound Ligand

Unbound Ligand

applications

- Protein-drug binding assays
- Receptor binding assays
- Ligand binding assays
- Protein-protein interactions
- Protein-DNA interactions
- Serum protein binding

Equilibrium dialysis is a specific application of dialysis that is important for the study of the binding of small molecules and ions by proteins. It is one of several methods available

for this purpose, and its attractive feature continues to be its physical simplicity. Another attractive feature of equilibrium dialysis is the ability to perform interaction studies without the use of fluorescent or radiolabeled tags.

Generally, the objective of an equilibrium dialysis experiment is to measure the amount of a ligand bound to a macromolecule. This is typically done through an indirect process because in any mixture of the ligand and macromolecule, it is difficult to distinguish between the bound and free ligand. If, however, the free ligand can be dialyzed through a membrane, until its concentration across the membrane is at equilibrium, the free ligand concentration can be measured easily. Data obtained under different experimental conditions then provides

information on various binding parameters of the compounds such as the binding constants and the number of binding sites or binding capacity.

Harvard Apparatus offers five types of Equilibrium DIALYZERS™. These products can meet virtually all of your bind-interaction requirements:

Fast Micro-Equilibrium DIALYZER™ - Reusable

The reusable Micro-Equilibrium DIALYZER is available as 2-chamber system for quicker equilibration time using dialysis membranes with larger surface areas. It is used to study interactions between biomolecules such as the binding of a ligand to a protein. For sample volumes from 25 µl to 500 µl, see pages 50-51.

Multi-Equilibrium DIALYZER™ - Reusable

For simultaneous and highly reproducible equilibrium dialysis of up to 20 samples with volumes from 0.2 to 5 ml, see page 52.

DispoEquilibrium DIALYZER™ - Single Use

A disposable version of the Micro-Equilibrium DIALYZER suitable for samples from 25 to 75 µl, see page 53.

96-Well DispoEquilibrium DIALYZER™ - Single Use

A 96-well disposable equilibrium dialyzer for high throughput interaction studies. For samples from 50 µl to 300 µl, see page 54.

Fast Micro-Equilibrium DIALYZER

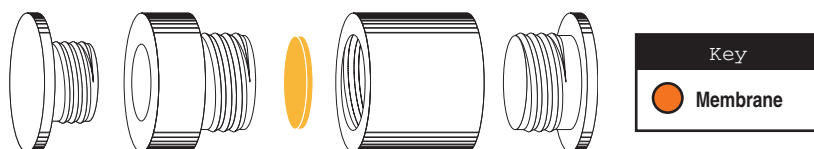
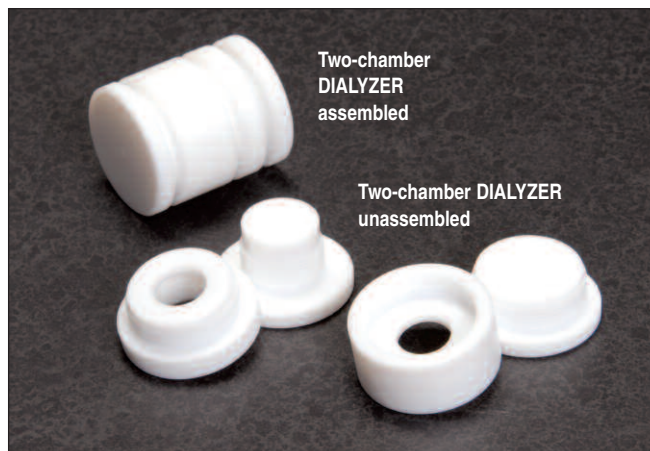
Samples from 25 μ l to 500 μ l (Reusable)

advantages

- Easy to use
- Leak-proof
- Reusable
- Available for a range of sample sizes
- Faster equilibration
- High membrane area/sample volume ratio
- Membranes available with MWCO's to suit almost any application
- Made of Teflon – totally inert
- High sample recovery
- Low protein binding
- Autoclaveable

applications

- Protein binding assays
- Protein-drug binding assays
- Receptor binding assays
- Ligand binding assays
- Protein-protein interactions
- Protein-DNA interactions



The binding and ligand elements are placed in one chamber (the sample chamber) while the other chamber (the assay chamber) contains an equivalent volume of the same buffer without either element. When equilibrium has been reached the concentration of the ligand in the assay chamber can be measured and analyzed to obtain the results of the assay. When the ligand is free in solution it can readily pass through the membrane, but when complexed, it is too large and is retained by the membrane.

The Fast Micro-Equilibrium DIALYZER is a unique equilibrium dialysis chamber for small samples (25 to 1500 μ l) and is simple to use.

Two chambers of equivalent volume are joined together with a membrane between them, as shown. Equal volumes of sample and buffer are loaded into respective chambers (the sample chamber and the assay chamber) and sealed by threaded solid caps. The DIALYZER assembly is rotated along the membrane axis from time to time. The entire system can also be placed in a thermostat for temperature-controlled dialysis. When equilibrium has been reached the chambers can be opened at each end to extract the sample for analysis. When the ligand is free in solution it can readily pass through the membrane, but when complexed, it is too large and is retained by the membrane.

The Fast Micro-Equilibrium DIALYZER uses membranes and chambers with high surface area to sample volume ratios. High ratio and short diffusion distances provide 2 to 5 times faster equilibration.

Each DIALYZER includes two chambers (body plus link) and two solid caps.

Fast Micro-Equilibrium DIALYZERS & Membranes

Ordering Information

Fast Micro-Equilibrium DIALYZERS & Membranes

Chamber Volume:	25 µl	50 µl	100 µl	250 µl	500 µl	1000 µl	1500 µl
Fast Micro-Equilibrium DIALYZERS							
Qty. of 1	SP1 7416-251D	SP1 7416-501D	SP1 7416-1001D	SP1 7416-2501D	SP1 7416-5001D	SP1 7416-10001D	SP1 7416-15001D
Qty. of 5	SP1 7416-255D	SP1 7416-505D	SP1 7416-1005D	SP1 7416-2505D	SP1 7416-5005D	SP1 7416-10005D	SP1 7416-15005D
Additional (Link) Chambers							
Qty. of 1	SP1 7416-251L	SP1 7416-501L	SP1 7416-1001L	SP1 7416-2501L	SP1 7416-5001L	SP1 7416-10001L	SP1 7416-15001L
Qty. of 5	SP1 7416-255L	SP1 7416-505L	SP1 7416-1005L	SP1 7416-2505L	SP1 7416-5005L	SP1 7416-10005L	SP1 7416-15005L
Membranes: Pack of 25							
for Chamber Volume:	25ul, 50pl or 100ul			250ul, 500ul, 1000 or 1500ul			
A. Regenerated Cellulose MEMBRANES:							
1k Da MWCO	SP1 7416-RC1K			SP1 7415-RC1K			
2k Da MWCO	SP1 7416-RC2K			SP1 7415-RC2K			
5k Da MWCO	SP1 7416-RC5K			SP1 7415-RC5K			
10k Da MWCO	SP1 7416-RC10K			SP1 7415-RC10K			
25k Da MWCO	SP1 7416-RC25K			SP1 7415-RC25K			
50k Da MWCO	SP1 7416-RC50K			SP1 7415-RC50K			
B. Cellulose Acetate MEMBRANES:							
100 Da MWCO	SP1 7416-CA100			SP1 7415-CA100			
500 Da MWCO	SP1 7416-CA500			SP1 7415-CA500			
1k Da MWCO	SP1 7416-CA1K			SP1 7415-CA1K			
2k Da MWCO	SP1 7416-CA2K			SP1 7415-CA2K			
5k Da MWCO	SP1 7416-CA5K			SP1 7415-CA5K			
10k Da MWCO	SP1 7416-CA10K			SP1 7415-CA10K			
25k Da MWCO	SP1 7416-CA25K			SP1 7415-CA25K			
50k Da MWCO	SP1 7416-CA50K			SP1 7415-CA50K			
100k Da MWCO	SP1 7416-CA100K			SP1 7415-CA100K			
300k Da MWCO	SP1 7416-CA300K			SP1 7415-CA300K			
C. Polycarbonate MEMBRANES:							
0.01 um Pore Size	SP1 7416-PC01			SP1 7415-PC01			
0.05 um Pore Size	SP1 7416-PC05			SP1 7415-PC05			
0.10 um Pore Size	SP1 7416-PC10			SP1 7415-PC10			
0.60 um Pore Size	SP1 7416-PC60			SP1 7415-PC60			

Membranes are supplied either as dry or in 0.05% sodium azide solution. They are ready to use after rinsing with deionized water and buffer.

Regenerated Cellulose membranes are more stable in organic solvents, but the MWCO range is not as sharply defined as that of Cellulose Acetate membranes.

Cellulose Acetate membranes have a sharp MWCO range. They are intended only for aqueous solutions, and the presence of an organic solvent is not recommended.

Polycarbonate membranes are more stable in organic solvents. They are available in four highly controlled pore sizes for a well defined MWCO range.

Multi-Equilibrium DIALYZER™

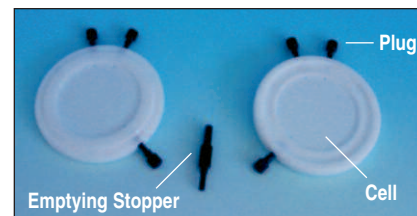
Samples from 0.25 ml to 5 ml (Reusable)

advantages

- Easy to use
- Leak-proof
- Reproducible
- Fast dialysis times
- Available for a range of sample sizes
- Up to 20 parallel, simultaneous assays
- Autoclavable
- Low protein binding
- High sample recovery
- Made of Teflon – totally inert

applications

- Protein binding assays
- Protein-drug binding assays
- Receptor binding assays
- Ligand binding assays
- Protein-protein interactions
- Protein-DNA interactions



The Harvard Apparatus Multi-Equilibrium DIALYZER provides highly standardized equilibrium dialysis conditions for up to 20 parallel assays. The instrument offers outstanding uniformity of: membrane area, sample volume, degree of agitation.

The advantages of this system are that up to 20 cells can be used simultaneously for rapid dialysis under standardized

conditions. Experiments conducted using the Multi-Equilibrium DIALYZER are extremely reproducible and leak-proof and can be performed at a constant temperature.

The dialyzer cells are made of Teflon, an extremely inert material, and will not interfere with the samples. Multiple cell systems are available (5, 10, 15, 20 cells) at various cell volumes (0.2, 1.0, 2.0 and 5.0 ml). The unit can be sterilized by autoclaving and the cells can be filled easily with a filling clamp. Custom systems with alternate chamber sizes, membranes and power supply are available.

Order # Product

Multi-Equilibrium DIALYZER Systems

SP1 74-1800 Complete Multi-Equilibrium DIALYZER System

- Ready-to-Use Teflon Macro Dialysis Cells (1 ml) with Large Surface Area and plugs, pkg. of 20
- Macro Spacers, pkg. of 24
- Carriers for 5 Teflon Dialysis Cells, pkg. of 4
- Variable Speed Drive Unit (12 x 12 x 7.5 in) for 20 Cells, and 110V power supply, pkg. of 1
- Power Supply Adapter (110 V)
- Stand, pkg. of 1
- Filling Clamp, pkg. of 1
- Emptying Stoppers, pkg. of 20
- Dialysis Membranes, MWCO 10,000 Daltons, pkg. of 200

Multi-Equilibrium DIALYZER Individual Components

SP1 74-1906	Macro Teflon Dialysis Cells, (1 ml), pkg. of 5
SP1 74-1904	Macro Teflon Dialysis Cells (2 ml), pkg. of 5
SP1 74-1905	Macro Teflon Dialysis Cells (5 ml), pkg. of 5
SP1 74-1909	Macro Spacer, pkg. of 6
SP1 74-1911	Macro Cell Carrier, pkg. of 1
SP1 74-1907	Micro Teflon Dialysis Cells (0.2 ml), pkg. of 5
SP1 74-1908	Micro Spacer, pkg. of 6
SP1 74-1910	Micro Cell Carrier, pkg. of 1

Multi-Equilibrium DIALYZER Individual Components Continued:

SP1 74-1912	Power Supply Adapter (110 V)
SP1 74-1912A	Power Supply Adapter (220 V)
SP1 74-1913	Filling Clamp, pkg. of 1
SP1 74-1914	Black Plugs, pkg. of 32
SP1 74-1901	Emptying Stoppers, pkg. of 5
SP1 74-1919	Tank with Fittings (14.5 x 9.5 x 8.25 in), pkg. of 1

Membranes for Multi-Equilibrium DIALYZER

SP1 74-2100	MWCO 5,000 Daltons, pkg. of 200
SP1 74-2102	MWCO 10,000 Daltons, pkg. of 200

DispoEquilibrium DIALYZER™

Samples from 25 µl to 75 µl (Single use)

advantages

- Easy to use & disposable
- Small sample volumes: 25 µl to 75 µl each chamber
- Rapid dialysis due to ultra-thin membrane
- High-quality regenerated cellulose membranes with MWCOs of 5,000 and 10,000 Daltons
- Leak-proof

applications

- Protein and Protein-drug binding assays
- Receptor binding assays
- Ligand binding assays
- Protein-protein and Protein-DNA interactions



Harvard Apparatus DispoEquilibrium DIALYZER is a single use product for interaction studies and is currently the only such device on the market. The DispoEquilibrium DIALYZER is leak-proof and provides high sample recovery (almost 100 percent). This system is designed for one-time use with samples such as radiolabeled compounds, avoiding the hassle associated with cleaning the dialyzer after use.

Each chamber has a capacity of 25 to 75 µl. The DispoEquilibrium DIALYZER utilizes high-quality regenerated cellulose membranes with MWCO's of 5,000 or 10,000 Daltons. Sample recovery is very easy through centrifugation or via removal with micropipettes. Includes two caps (one black, one white), two 0.65 ml sample tubes per chamber and two pipette tips for delivery/recovery.

DispoEquilibrium DIALYZERS – Ordering Information

Membrane MWCO (Daltons)	Qty. of 25	Qty. of 50	Qty. of 100
Regenerated Cellulose			
1,000	SP1 74-2206	SP1 74-2207	SP1 74-2208
5,000	SP1 74-2204	SP1 74-2200	SP1 74-2201
10,000	SP1 74-2205	SP1 74-2202	SP1 74-2203
25,000	–	–	SP1 74-2218
50,000	–	–	SP1 74-2217
Cellulose Acetate			
100	SP1 74-2209	–	–
500	SP1 74-2212	–	–
25,000	–	–	SP1 74-2210
50,000	–	–	SP1 74-2211
100,000	–	–	SP1 74-2219

Other MWCO available upon request.

96-Well DispoEquilibrium DIALYZER™

Samples from 50 µl to 300 µl (Single use)

advantages

- Patented
- 96-well format
- Individual membrane for each well
- Small sample volumes: 50 µl to 200 µl
- Ultra-thin regenerated cellulose membranes
- Membranes are free of sulfur and heavy metal contamination
- High well-to-well reproducibility
- Excellent sample recovery (>95%)

applications

- Protein and Protein-drug binding assays
- Receptor binding assays
- Ligand binding assays
- Protein-protein and Protein-DNA interactions

96-Well Equilibrium DIALYZER Plate
SP1 74-2330 & SP1 74-2331



8-Plate Rotator Oven
SP1 74-2335



Dual Plate Rotator SP1 74-2334



Plate Rotator
SP1 74-2302



The single use, 96-Well Equilibrium DIALYZER is a unique patented product for the simultaneous assay of 96 samples. Each well in this system has a separate membrane and thus eliminates the possibility of sample cross-contamination. Reproducibility is very high across the different wells of the Equilibrium DIALYZER and sample recovery is excellent. The 96-Wells are sealed with 8-cap strips or a single-well, pierceable, self-sealing plate seal mat. Thus some wells or all 96 wells can be used with samples or capped unused wells for future experiments. The 96-Well Equilibrium DIALYZER utilizes high-quality regenerated cellulose membranes available with MWCO's of 5,000 or 10,000 Daltons. Rotator is required. Includes twenty four 8-cap strips. Single plate seal mat is available.

Single and Dual Plate Rotators

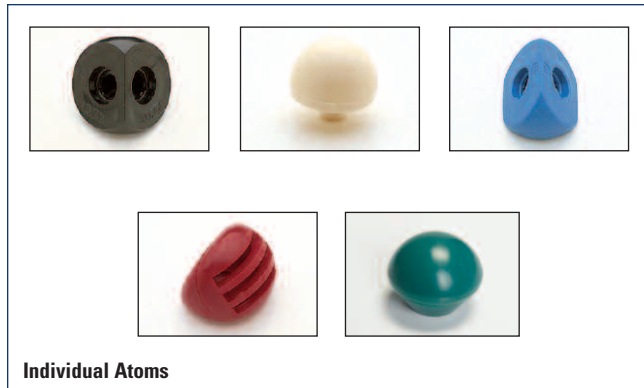
A Single or Dual Plate Rotator with variable rotation rates is available for use with the Harvard Apparatus 96-Well Equilibrium DIALYZER. The Rotator speeds up the equilibrium dialysis process by keeping the sample in constant motion thereby ensuring higher reproducibility of results.

8-Plate Rotator Incubator

The 8-Plate Rotator Incubator is used for temperature controlled studies in the 96-Well Equilibrium DIALYZER. The Rotator Incubator consists of an oven and a special carousel to hold up to 8 plates simultaneously.

Order #	Product
SP1 74-2330	96-Well Equilibrium Dialysis Plate, Membrane MWCO 5,000 Daltons, pkg. of 1
SP1 74-2331	96-Well Equilibrium Dialysis Plate, Membrane MWCO 10,000 Daltons, pkg. of 1
SP1 74-2323	8-Cap Strips, pkg. of 12
SP1 74-2322	Plate Seal Mat with Individual Well Inserts, Pierceable and Self-Sealable, pkg. of 2
SP1 74-2302	Single Plate Rotator, pkg. of 1
SP1 74-2334	Dual Plate Rotator, pkg. of 1
SP1 74-2335	8 Plate Rotator Incubator, 110 V, pkg. of 1
SP1 74-2336	8 Plate Rotator Incubator, 220 V, pkg. of 1
SP1 74-2337	Carousel, Only for 8-Plate Rotator

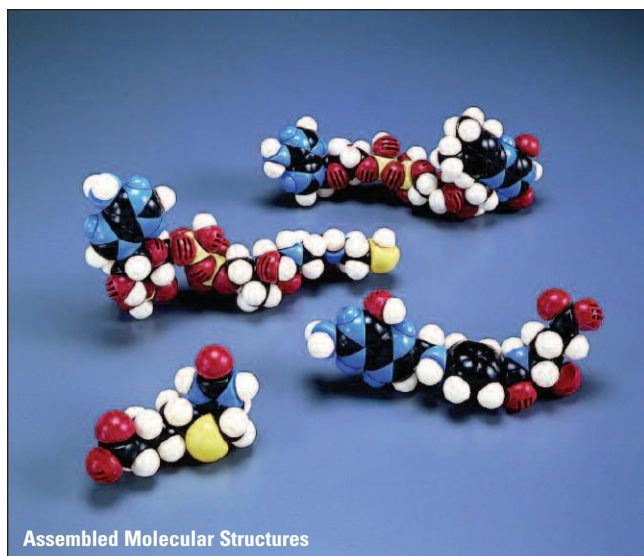
Harvard Apparatus CPK®



Individual Atoms



Sets for Specific Purposes



Assembled Molecular Structures

Harvard Apparatus is always ready to quote for custom products, pre-assembled or ready-to-assemble molecular structures.

Harvard Apparatus CPK® Atomic Models are sold four ways:

1. **Individual Atomic Models, Connectors and Accessories.** These are specified on pages 62 to 71.
2. **Sets for Specific Purposes,** see pages 72, 73, 77 and 78.
3. **Assembled Molecular Structures.**
It is often more convenient to buy fully pre-assembled molecular structures. There is a large selection of these on pages 74, 75 and 79 to 81.
4. **Unassembled Nucleic Acid Helix Kits and Accessories** are specified on page 76.

Literature References

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15. Smythies JR. (1974), *Annual Review of Pharmacology*, Vol. 14, pp. 9-21. *Relationships Between the Chemical Structure and Biological Activity of Convulsants.*

Specifications and Assembly



Scale

1.25 cm/Å. Large enough to maintain high accuracy, yet small enough so that macromolecules are not unwieldy. For example, a model 20 x 40 x 100 Å can be built on a table top.

Accuracy

Bond Angles $\pm 0^\circ 30'$; Covalent radii $\pm 0.01 \text{ Å}$; van der Waals radii $\pm 0.03 \text{ Å}$. These are as they occur in most biomolecular structures, and these data agree generally with those published by Corey & Pauling. However, several changes reflecting recent observations have been incorporated by Koltun.

Density

Less than 1.0 gram/ml for a molecule as a whole. For maximum strength with minimum weight, the atoms are hollow. Except for hydrogen, they are injection-molded in Implex, a hard and durable modified acrylic polyester. Hydrogen has an elastically-compressible polyethylene shell.

Color

Atoms and connectors are easily identified since each component is color-coded. The color cannot be worn away since it is an integral part of the plastic. Further, atom surfaces are satin-finished so that they can be lighted easily for vivid photography to illustrate journal articles.

Restricted Rotation

The rotation of certain atoms may be prevented with a special keyed link, see SP1 67-7039 Connector Link, Locking on page 70. The rotation of tetrahedral carbons in C-C bonds may be hindered with a special carbon link to produce the three-fold rotational potential characteristic of such bonds, see SP1 67-7047 Connector Link, Carbon on page 70.



Hydrogen Bonding

Linear and non-linear bonded hydrogen species provide functional H-bonds to the appropriate species of nitrogen and oxygen. H-bond distance is adjustable.

Special Atom Species

A user may construct additional atom species not offered as regular CPK® Atomic Models and use them with the regular CPK® Atomic Models by attaching the SP1 67-7088 Socket. This Socket takes all seven of the connector links offered on page 70.

Assembling or Taking Apart CPK® Atomic Models is Easy

Assembly

A Connector Link is placed in the well on the end of the handle of the SP1 67-7120 Construction Tool, see page 71. The Connector Link is then pressed into the female socket of the atom. The second atom is simply pressed onto the first with a slight twist, and the bond is made.

Taking Apart












To remove a Connector Link, the forked end of the SP1 67-7120 Construction Tool, see page 71, is slipped around the center groove of the link, and the tool is pried upward.

The atoms are held together with great tenacity. A force of 5 to 7 kg is required to separate them. This force is readily furnished by the levering blade of the SP1 67-7120 Construction Tool.




Guide to CPK[®] Atomic Models

Summary of Individual Atoms





Carbon

Atom Species	Bond Arrangement	Order #	Page #
C-Tetrahedral		SP1 67-6577	62
C-Ethylenic Double Bond		SP1 67-6585	62
C-Acetylenic Triple Bond		SP1 67-6593	62
C-Aromatic-6		SP1 67-6569	62
C-Aromatic-5		SP1 67-6551	63
C-Fused 6-6 Rings		SP1 67-6619	63
C-Fused 5-5 Rings		SP1 67-6600	63
C-Fused 6-5 Rings		SP1 67-6601	63
C-Tetrahedral-4		SP1 67-6528	63
C-Trigonal-4		SP1 67-6544	63
C-Amide		SP1 67-6536	63









Hydrogen

Hydrogen		SP1 67-6692	64
H-Bond Bayonet Type		SP1 67-6684	64
H-Bond Hook Type		SP1 67-6726	64




Halogen

Fluoride		SP1 67-6676	65
Chloride		SP1 67-6650	65
Bromide		SP1 67-6510	65
Iodide		SP1 67-6734	65

Nitrogen

N-Tetrahedral		SP1 67-6841	66
N-Nitrile Triple Bond		SP1 67-6792	66
N-Aromatic-6		SP1 67-6833	66
N-Aromatic-5		SP1 67-6825	66
N-Tetrahedral-4		SP1 67-6858	67
N-Trigonal-4		SP1 67-6866	67
N-Amide		SP1 67-6791	67
Amine Cap		SP1 67-6601	67






Oxygen

O-Single Bond		SP1 67-6874	68
O-Double Bond		SP1 67-6890	68
O-Indented Double Bond		SP1 67-6916	68





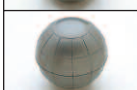
Guide to CPK[®] Atomic Models

Summary of Individual Atoms (continued)

Phosphorus & Sulfur

	Phosphorus Tetrahedral		SP1 67-6924	69
	Sulfur Digonal		SP1 67-6957	69
	Sulfur Tetrahedral		SP1 67-9004	69

Metal Atoms

	Metal, Covalent		SP1 67-6973	69
	Metal, Ionic		SP1 67-6981	69
	Metal, All Purpose	Non-specific	SP1 67-6999	69

Connector Links

	Connector Link, Standard		SP1 67-7005	70
	Connector Link, Long		SP1 67-7021	70
	Connector Link, Short		SP1 67-7013	70
	Connector Link, Carbon		SP1 67-7047	70
	Connector Link, Locking		SP1 67-7039	70
	Connector Link, Gluing		SP1 67-7054	70
	Connector Link, Bayonet H-Bond Replacement		SP1 67-7062	70

Accessories & Tools

	H-Bond Spacer		SP1 67-7096	71
	Screw for Amine Cap		SP1 67-7187	71
	Metal Atom Connector Link		SP1 67-7161	71
	Socket		SP1 67-7088	71
	Hydrogen Wrench		SP1 67-7138	71
	Construction Tool		SP1 67-7120	71
	Angstrom Unit Scale Caliper		SP1 67-7146	71
	Pamphlet: "Molecules in Three Dimensions"		SP1 67-7179	71

CPK[®] Atomic Model Sets



Summary of CPK[®] Atomic Model Sets

Multiple individual atoms, connectors and necessary accessories are available in varying quantities as sets for different needs.

- These sets come packaged in a sturdy wooden box.
- For a complete list of kit components, see the noted pages.

Research and Teaching Sets

Order #	Product	See Page
SP1 67-6015	Research and Teaching Set 1	72-73
SP1 67-6023	Research and Teaching Set 2	72-73
SP1 67-6031	Research and Teaching Set 3	72-73
SP1 67-6056	Research and Teaching Set 4	72-73
SP1 67-6064	Research and Teaching Set 5	72-73

Nucleic Acid Sets

Order #	Product	See Page
SP1 67-6213	Nucleic Acid Set No. 1	77-78
SP1 67-6221	Nucleic Acid Set No. 2	77-78

Protein Sets

Order #	Product	See Page
SP1 67-6114	Protein Set No. 1	77-78
SP1 67-6122	Protein Set No. 2	77-78
SP1 67-6130	Protein Set No. 3	77-78

Thirty-two different sets are offered for general chemistry and biochemical investigations. Each set is provided in one or more sturdy partitioned wooden box for convenient storage of the models.

- 2 Organic Sets
- Polymer Set
- 4 Steroid Sets
- 3 Carbohydrate Sets
- Surfactant Set
- 3 Vitamin Sets
- Enzyme Cofactor Set
- 3 Fatty Acids and Derivative Sets
- Organic Acid Set
- 3 Hydrocarbon Sets
- 3 Ring System Sets
- 3 Porphyrin Ring System Sets
- Alcohol, Aldehydes, Ketones and Ether Set
- TCA Cycle Intermediates Set
- Glycolysis Intermediate Set
- Bile Acid Set

Contact us for the contents and cost of each set.

Summary of Fully Assembled Models



Nucleic Acid Helices

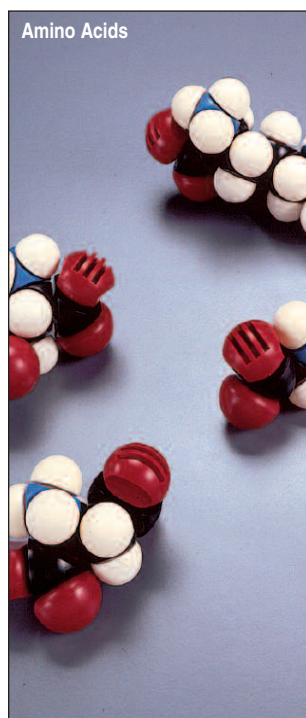
Order # Page # Product

Assembled Nucleic Acid Helices

SP1 67-8268	74	DNA Helix, 1.0 Turn
SP1 67-8276	74	DNA Helix, 1.5 Turns
SP1 67-8284	74	DNA Helix, 2.0 Turns
SP1 67-9000	74	RNA Helix, 1.0 Turn
SP1 67-9001	74	RNA Helix, 1.5 Turns
SP1 67-9002	74	RNA Helix, 2.0 Turns
SP1 67-8270	74	DNA-RNA Helix, 1.0 Turn
SP1 67-8278	74	DNA-RNA Helix, 1.5 Turns
SP1 67-8286	74	DNA-RNA Helix, 2.0 Turns

Assembled Nucleic Acid Components

SP1 67-8300	75	2'-Deoxy-D-Ribose Phosphate Unit
SP1 67-8326	75	Guanine-Cytosine Base Pair
SP1 67-8318	75	Adenine-Thymine Base Pair
SP1 67-8334	75	Adenine-Uracil Base Pair
SP1 67-8243	75	D-Ribose Phosphate Unit

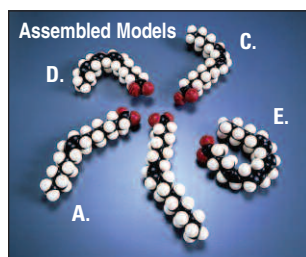


Amino Acids

Order # Page # Individual L-Amino Acids Order # Page # L-Amino Acid Functional Group

Assembled Amino Acids

SP1 67-3772	79	Glycine	SP1 67-6692	79	Glycyl (Hydrogen)
SP1 67-3707	79	L-Alanine	SP1 67-8128	79	L-Alanyl
SP1 67-3897	79	L-Valine	SP1 67-3898	79	L-Valyl
SP1 67-3798	79	L-Isoleucine	SP1 67-3799	79	L-Isoleucyl
SP1 67-3806	79	L-Leucine	SP1 67-3807	79	L-Leucyl
SP1 67-3855	79	L-Serine	SP1 67-3856	79	L-Seryl
SP1 67-3863	79	L-Threonine	SP1 67-3864	79	L-Threonyl
SP1 67-3723	79	L-Aspartic Acid	SP1 67-3724	79	L-Aspartyl
SP1 67-3731	79	L-Asparagine	SP1 67-3732	79	L-Asparaginyl
SP1 67-3756	79	L-Glutamic Acid	SP1 67-3757	79	L-Glutamyl
SP1 67-3764	79	L-Glutamine	SP1 67-3765	79	L-Glutaminyl
SP1 67-3830	79	L-Phenylalanine	SP1 67-3831	79	L-Phenylalanyl
SP1 67-3889	79	L-Tyrosine	SP1 67-3890	79	L-Tyrosyl
SP1 67-3871	79	L-Tryptophan	SP1 67-8102	79	L-Tryptophanyl
SP1 67-3749	79	L-Cysteine	SP1 67-3750	79	L-Cysteinyl
SP1 67-3822	79	L-Methionine	SP1 67-3823	79	L-Methionyl
SP1 67-3848	79	L-Proline	SP1 67-8094	79	L-Prolyl
SP1 67-3780	79	L-Histidine	SP1 67-8086	79	L-Histidyl
SP1 67-3715	79	L-Arginine	SP1 67-3716	79	L-Arginyl
SP1 67-3814	79	L-Lysine	SP1 67-3815	79	L-Lysyl



Custom Assembled Models

Custom assembled models are available for various molecules including those shown on pages 80 and 81.

Just give us the name of the molecule of interest and we can give you a fully assembled model.

Summary of Unassembled Models, Components & Kits

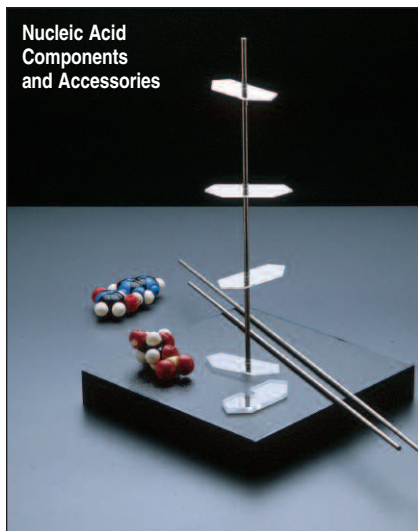
Nucleic Acid Helices



Nucleic Acid Helices, Unassembled, see page 76

Order #	Product
SP1 67-6387	DNA Helix, 1.0 Turn
SP1 67-6395	DNA Helix, 1.5 Turn
SP1 67-6403	DNA Helix, 2.0 Turn
SP1 67-6388	RNA Helix, 1.0 Turn
SP1 67-6396	RNA Helix, 1.5 Turn
SP1 67-6404	RNA Helix, 2.0 Turn
SP1 67-6389	DNA-RNA Helix, 1.0 Turn
SP1 67-6397	DNA-RNA Helix, 1.5 Turn
SP1 67-6405	DNA-RNA Helix, 2.0 Turn

Nucleic Acid Components and Accessories



Nucleic Acid Helix Assembly Components, see page 76

Order #	Product
SP1 67-8342	Helix Support Base
SP1 67-8227	Helix Assembly Support Plate, Acrylic
SP1 67-6189	Central Support Rod, 70 cm (27.6 in) for 1.5 Turn Helix
SP1 67-6198	Central Support Rod, 110 cm (43.3 in) for 2.0 Turn Helix
SP1 67-7120	Construction Tool
SP1 67-7138	Wrench
SP1 67-7146	Angstrom Unit Scale Caliper

Nucleic Acid and Protein Sets



Nucleic Acid Sets, see pages 77-78

Order #	Product
SP1 67-6213	Nucleic Acid Set No. 1
SP1 67-6221	Nucleic Acid Set No. 2

Protein Sets, see pages 77-78

Order #	Product
SP1 67-6114	Protein Set No. 1
SP1 67-6122	Protein Set No. 2
SP1 67-6130	Protein Set No. 3

Carbon Atoms

Carbon Atoms						Covalent Radii, Å		
Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Single Bond	Double Bond	Triple Bond
C-Tetrahedral	SP1 67-6577		Black	109°30'	—	0.77	—	—
C-Ethylenic Double Bond	SP1 67-6585		Black	125°15' 109°30'	1.60	0.73	0.67	—
C-Acetylenic Triple Bond	SP1 67-6593		Black	180°	1.60	0.70	—	0.60
C-Aromatic-6	SP1 67-6569		Black	120°	1.70	0.73	0.69 (partial)	—
C-Aromatic-5	SP1 67-6551		Black	108° 126°	1.70	0.73	0.68 (partial)	—
C-Fused 6-6 Rings	SP1 67-6619		Black	120° 120°	1.70 1.70	0.69	—	—
C-Fused 5-5 Rings	SP1 67-6600		Black	108° 108°	1.70 1.70	—	—	—
C-Fused 6-5 Rings	SP1 67-6601		Black	120° 120°	1.70 1.70	—	—	—
C-Tetrahedral-4	SP1 67-6528		Black	114° 114°	1.25	0.76 0.77	—	—
C-Trigonal-4	SP1 67-6544		Black	134° 134°	1.48	0.73 0.73	0.65	—
C-Amide	SP1 67-6536		Black	115° 120°	1.50	0.72 0.75	0.67	—



Carbon, Tetrahedral

Connector sockets triple-notched for simulation of restricted rotational potential. For special connector link, see SP1 67-7047 Connector Link, Carbon on page 70. Covalent radius 0.77Å; bond angle 109°30'. Black.

Order #	Product
SP1 67-6577	Carbon, Tetrahedral



Carbon, Acetylenic Triple Bond

Covalent radius 0.60Å along triple bond; this face marked 'C'; second socket notched to accept restricted rotation connectors. Covalent radius 0.70Å along

single bond. Black.

Order #	Product
SP1 67-6593	Carbon, Acetylenic Triple Bond

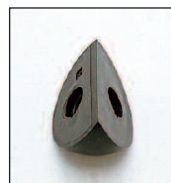


Carbon, Ethylenic Double Bond

Covalent radius 0.67Å along the double bond; this face marked 'C=' and connector socket is notched to accept restricted rotation connectors; covalent radius 0.73Å along single bonds; bond angle

125°15' between the double and single bonds; bond angle 109°30' between single bonds. Black.

Order #	Product
SP1 67-6585	Carbon, Ethylenic Double Bond



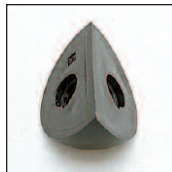
Carbon, Aromatic-6

For constructing six-membered rings such as SP1 67-8250 Benzene, SP1 67-8255 Pyridine and SP1 67-8263 Pyrimidine. Covalent radius 0.69Å within ring and covalent radius 0.73Å to single atoms

outside ring; symbol '6' stamped on one inner face. Partial double bond sockets are notched to accept restricted rotation connectors. Black.

Order #	Product
SP1 67-6569	Carbon, Aromatic-6

Carbon Atoms (continued)



Carbon, Aromatic-5

For constructing unsaturated five-member rings such as SP1 67-8266 Imidazole, SP1 67-8272 Pyrazole, and C-8 carbon in SP1 67-8262 Purine. Covalent radius 0.68Å to atoms within ring and covalent radius

0.73Å to atoms outside ring; bond angle 108° between atoms within ring and 126° between single-bonded atom outside ring and double-bonded ring atoms; symbol '5' stamped on one inner face. Partial double bond sockets notched to accept restricted rotation connectors. Black. Same as SP1 67-6825 Nitrogen, Aromatic-5, listed on page 66 except for color.

Order #	Product
SP1 67-6551	Carbon, Aromatic-5



Carbon, Special for Fused 6-6 Rings

A special double-atom unit representing the carbons common to fused 6-membered unsaturated rings, e.g., SP1 67-8252 Anthracene, SP1 67-8253 Phenanthrene,

SP1 67-8251 Naphthalene. The unit is stamped '6-6' for identification. Covalent radius 0.69Å with a bond angle of 120°. Black.

Order #	Product
SP1 67-6619	Carbon, Special for Fused 6-6 Rings



Carbon, Special for Fused 5-5 Rings

A special double-atom unit representing carbon atoms common to both rings. The 108° face bonds in the two five-member

rings, e.g. pentalenes. Black.

Order #	Product
SP1 67-6600	Carbon, Special for Fused 5-5 Rings



Carbon, Special for Fused 6-5 Rings

A special double-atom unit representing the carbons common to both rings. The 120° face bonds in the six-member ring;

the 108° face bonds in the five-member ring, e.g., SP1 67-8262 Purine and SP1 67-8291 Indole. Black.

Order #	Product
SP1 67-6601	Carbon, Special for Fused 5-6 Rings



Carbon, Tetrahedral-4

For constructing four-membered ring structures such as beta-lactams or SP1 67-0400 Cyclobutane. Covalent radii 0.77Å to atoms within the ring and 0.76Å to

atoms outside the ring. Each face of the atom is marked with the appropriate covalent radius. Intraring bond angle is 88°. Black.

Order #	Product
SP1 67-6528	Carbon, Tetrahedral-4



Carbon, Trigonal-4

For constructing four-membered rings. Intraring covalent radii 0.73Å stamped on one face. A permanent connector molded into the other intraring surface provides the same bond length as the SP1 67-7005

Connector Link, Standard, see page 70. Exocyclic face is stamped with the covalent radius 0.65Å. Angle between two intraring bond axes is 92°; bond angle 134° between the intraring bond axis and the axis of the atom outside the ring. Black.

Order #	Product
SP1 67-6544	Carbon, Trigonal-4



Carbon, Amide

Covalent radii stamped on each face of this atom as follows: 0.72Å to amide nitrogen, 0.67Å to oxygen, 0.75Å to chain carbon; bond angle 115° between amide nitrogen and chain carbon; bond angle

120° between oxygen and chain carbon; bond angle 125° between oxygen and amide nitrogen; also used for general planar carbon, e.g., carboxylate carbon. Sockets notched to accept restricted rotation connectors. Black.

Order #	Product
SP1 67-6536	Carbon, Amide

Hydrogen Atoms

Hydrogen Atoms						Covalent Radii, Å		
Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Single Bond	Double Bond	Triple Bond
Hydrogen	SP1 67-6692	—H	White	—	1.00	0.33	—	—
H-Bond Bayonet Type	SP1 67-6684	—H—	White	—	1.00	0.33	—	—
H-Bond Hook Type	SP1 67-6726	—H—	White	—	1.00	0.33	—	—



Hydrogen

Single bond; shell is elastically-compressible; a connector link is incorporated. The new model is good for long term storage. White.

Order #	Product
SP1 67-6692	Hydrogen



Hydrogen H-Bond, Bayonet Type

Indentation radius 1.35Å about a center 1.66Å from spherical center of hydrogen atom; using upper sets of barbs on shank lengthens H-bond either by 0.20Å or by

0.40Å. Connector link incorporated.

The bayonet connector link fits the slot in the top of the SP1 67-7112 Amine Cap, see page 67, the slots of the SP1 67-6874 Oxygen, Single Bond or the slots of the SP1 67-6916 Oxygen, Indented Double Bond. If the bayonet type connector breaks, it is a simple matter to replace it with a SP1 67-7062 Connector Link, Bayonet H-Bond Replacement which is offered separately, see page 70. White.

Order #	Product
SP1 67-6684	Hydrogen H-Bond, Bayonet Type



Hydrogen H-Bond, Hook Type

Indentation radius 1.35Å about a center 1.66Å from spherical center of hydrogen atom. This

hook-type hydrogen is designed to add substantial structural strength to the CPK® hydrogen bonding system. White.

To connect the SP1 67-7112 Amine Cap to the hydrogen body of the SP1 67-6726 Hydrogen H-Bond, Hook Type:

- (1) Unscrew and remove the metal hook from the hydrogen body.
- (2) The SP1 67-7112 Amine Cap has a connector link as part of it. This connector link is hollow. Place a SP1 67-7187 Screw for Amine Cap in the hollow connector link with the end of the screw protruding from the slot in the top of the SP1 67-7112 Amine Cap, and use a slim screwdriver to turn this screw into the hole in the hydrogen body from which the hook was removed.

The SP1 67-6874 Oxygen, Single Bond and the SP1 67-6916 Oxygen, Indented Double Bond have strong ribs to accept the metal hook of this SP1 67-6726 H-Bond, Hook Type, Hydrogen. When the metal hook is placed over the rib of either of these oxygen atoms, the SP1 67-7138 Hydrogen Wrench, see page 71, then fits over the eight-sided face of the basic hydrogen body, and this body is turned until the hook is brought up securely against the oxygen atom.

Note that one or more SP1 67-7096 H-Bond Spacers, see page 71, can be put on over the hook to increase the bond distance by 0.2Å for each spacer used.

Order #	Product
SP1 67-6726	Hydrogen H-Bond, Hook Type

Halogen Atoms

Halogen Atoms						Covalent Radii, Å		
Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Single Bond	Double Bond	Triple Bond
Fluoride	SP1 67-6676	—F	Pale Green	—	1.35	0.57	—	—
Chloride	SP1 67-6650	—	Green	—	1.80	0.99	—	—
Bromide	SP1 67-6510	—	Brown	—	1.95	1.14	—	—
Iodide	SP1 67-6734	—I	Violet	—	2.15	1.35	—	—



Fluoride

Covalent radius 0.57Å along single bond. Pale Green.

Order # Product

SP1 67-6676 Fluoride



Bromide

'Br' stamped near socket. Covalent radius 1.14Å along single bond. Brown.

Order # Product

SP1 67-6510 Bromide



Chloride

'Cl' stamped near socket. Covalent radius 0.99Å along single bond. Green.

Order # Product

SP1 67-6650 Chloride










Iodide

'I' stamped near socket. Covalent radius 1.35Å along single bond. Violet.

Order # Product

SP1 67-6734 Iodide

Nitrogen Atoms

Nitrogen Atoms						Covalent Radii, Å		
Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Single Bond	Double Bond	Triple Bond
N-Tetrahedral*	SP1 67-6841		Blue	109°30'	—	0.70	—	—
N-Nitrile Triple Bond	SP1 67-6792		Blue	180°	1.60	0.70	—	0.60
N-Aromatic-6*	SP1 67-6833		Blue	120°	1.70	0.73	0.69 (partial)	—
N-Aromatic-5*	SP1 67-6825		Blue	108° 126°	1.70	0.73	0.68 (partial)	—
N-Tetrahedral-4	SP1 67-6858		Blue	114° 112° 114° 88°	1.25	0.76 0.77	—	—
N-Trigonal-4	SP1 67-6866		Blue	134° 92° 134°	1.48	0.73 0.7	0.65	—
N-Amide*	SP1 67-6791		Blue	123° 114° 123°	1.45	0.70 0.70	0.60 (partial)	—
Amine Cap	SP1 67-7112	—	Blue	—	—	—	—	—

* For nitrogen conversion, see SP1 67–7112 Amine Cap on page 67.

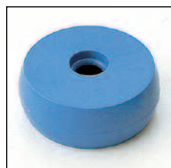


Nitrogen, Tetrahedral

Connector sockets notched for simulation of restricted rotational potential. Covalent radius 0.70Å; bond angle 109°30'. SP1 67-7112 Amine Cap, see page 67, converts SP1 67-6841 Nitrogen, Tetrahedral to

amino nitrogen. Blue.

Order #	Product
SP1 67-6841	Nitrogen, Tetrahedral

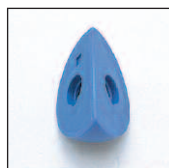


Nitrogen, Nitrile Triple Bond

Covalent radius 0.60Å along triple bond; this face marked 'CJ' for triple bonding with SP1 67-6593 Carbon, Acetylenic Triple Bond to form nitriles or 'cyano' compounds; second socket notched to

accept restricted rotation connectors. Covalent radius 0.70Å along single bond. Blue.

Order #	Product
SP1 67-6792	Nitrogen, Nitrile Triple Bond

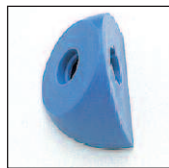


Nitrogen, Aromatic-6

For use in six-membered rings such as SP1 67-8255 Pyridine and SP1 67-8263 Pyrimidine. Covalent radius 0.69Å within ring and covalent radius 0.73Å to single atoms outside ring; symbol '6' stamped on

one inner face. Partial double-bond sockets notched to accept restricted rotation connectors. SP1 67-7112 Amine Cap, see page 67, converts SP1 67-6833 Nitrogen, Aromatic-6 to azo nitrogen. Blue.

Order #	Product
SP1 67-6833	Nitrogen, Aromatic-6



Nitrogen, Aromatic-5

For use in five-membered rings such as in SP1 67-8266 Imidazole or in positions 7 and 9 in SP1 67-8262 Purine. Covalent radius 0.68Å to atoms within ring and covalent radius 0.73Å to atoms outside

ring; bond angle 108° between atoms within ring and 126° between single-bonded atom outside ring and double-bonded ring atoms; symbol '5' stamped on one inner face. Partial double-bond sockets notched. SP1 67-7112 Amine Cap converts SP1 67-6825 Nitrogen, Aromatic-5 to azo nitrogen. For details of the SP1 67-7112 Amine Cap, see page 67. Blue.

Order #	Product
SP1 67-6825	Nitrogen, Aromatic-5

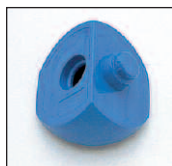
Nitrogen Atoms (continued)



Nitrogen, Tetrahedral-4

For constructing four-membered rings. Identical to SP1 67-6528 Carbon, Tetrahedral-4, see page 63, except for color. With SP1 67-7112 Amine Cap, see right, it is converted to a trivalent nitrogen for use in certain structures such as β -lactam ring in penicillin. Blue.

Order #	Product
SP1 67-6858	Nitrogen, Tetrahedral-4



Nitrogen, Trigonal-4

For constructing four-membered rings. Identical to SP1 67-6544 Carbon, Trigonal-4, see page 63, except for color. For constructing models such as free β -lactam and the four-membered ring in Δ^2 -cephalosporins. Blue.

Order #	Product
SP1 67-6866	Nitrogen, Trigonal-4



Nitrogen, Amide

Covalent radii stamped on each face of this atom as follows: 0.60Å to amide carbon, 0.70Å to hydrogen bond hydrogen; 0.70Å to chain carbon. Bond angle 123° between amide carbon and H-bond hydrogen; 114°

between chain carbon and H-bond hydrogen. One face has an 'H' stamped to facilitate construction of transpeptide linkages. Also used for general planar trigonal nitrogen as in NO_2 and with the SP1 67-7112 Amine Cap as azo nitrogen. For details of the SP1 67-7112 Amine Cap see right. Blue.

Order #	Product
SP1 67-6791	Nitrogen, Amide



Amine Cap

Hemisphere with hollow connector link inserted into flat face and small slot in curved surface. Blue.

The slot in the top of the Amine Cap accepts the bayonet of the SP1 67-6684

Hydrogen H-Bond, Bayonet Type, for temporary connections and the SP1 67-6726 Hydrogen H-Bond, Hook Type, after the hook has been removed and replaced by a SP1 67-7187 Screw for Amine Cap, for permanent connections. For details, see SP1 67-6726 Hydrogen H-Bond, Hook Type, on page 64.

The Amine Cap is also used with:

- SP1 67-6791 Nitrogen, Amide, see left, to convert to azo nitrogen
- SP1 67-6825 Nitrogen, Aromatic-5 on page 66 to convert to azo nitrogen
- SP1 67-6833 Nitrogen, Aromatic-6 on page 66 to convert to azo nitrogen
- SP1 67-6841 Nitrogen, Tetrahedral on page 66 to convert to amino nitrogen
- SP1 67-6858 Nitrogen, Tetrahedral-4, see left, to convert to trivalent nitrogen

Order #	Product
SP1 67-7112	Amine Cap

Oxygen Atoms

Oxygen Atoms						Covalent Radii, Å		
Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Single Bond	Double Bond	Triple Bond
O-Single Bond	SP1 67-6874	--O<	Red	110°	1.35	0.66	—	—
O-Double Bond	SP1 67-6890	=O	Red	—	1.35	—	0.57	—
O-Indented Double Bond	SP1 67-6916	—O=	Red	—	1.35	—	0.57	—



Oxygen, Single Bond

Triple-slotted to accept SP1 67-6684 H-Bond, Bayonet Type, Hydrogen and SP1 67-6726 H-Bond, Hook Type, Hydrogen for H-bonding. Center slot extends $\pm 48^\circ$; side slots $\pm 35^\circ$ at $\pm 15^\circ$ displacement from center line; Covalent radius 0.66Å; bond angle 110°. Red.

Order #	Product
SP1 67-6874	Oxygen, Single Bond



Oxygen, Double Bond

Also serves as negatively-charged oxygen. Covalent radius 0.57Å. Red.

Order #	Product
SP1 67-6890	Oxygen, Double Bond



Oxygen, Indented Double Bond

With indented sides; indentations on radii of 1.15Å about centers spaced laterally, 2.1Å from spherical center of atom. Three slots on the surface of the atom and parallel to the long axis of the indentations accept SP1 67-6684 H-Bond, Bayonet Type, Hydrogen and SP1 67-6726 H-Bond, Hook Type, Hydrogen for H-bonding. All three slots extend $+48^\circ$ and the side slots are displaced $+15^\circ$ from the center line. Connector socket is notched to accept restricted rotation connectors. Covalent radius 0.57Å. Red.

Order #	Product
SP1 67-6916	Oxygen, Indented Double Bond

Phosphorus, Sulfur and Metal Atoms

Phosphorus and Sulfur Atoms

Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Covalent Radii, Å		
						Single Bond	Double Bond	Triple Bond
Phosphorus Tetrahedral	SP1 67-6924		Pale Yellow	109°30'	—	0.96	—	—
Sulfur Digonal	SP1 67-6957		Yellow	104°	—	1.04	—	—
Sulfur Tetrahedral	SP1 67-9004		Pale Yellow	109°30'	1.70	0.96	—	—



Phosphorus, Tetrahedral

Covalent radius 0.96Å, bond angle 109°30'. Pale yellow.

Order #	Product
SP1 67-6924	Phosphorus, Tetrahedral



Sulfur, Digonal

Notches every 90° in sockets. Covalent radius 1.04Å; bond angle 104°. Yellow.

Order #	Product
SP1 67-6957	Sulfur, Digonal

Sulfur, Tetrahedral

Tetrahedral Sulfur, SP1 67-96958, is represented by Tetrahedral Phosphorous, SP1 67-6924 (see SP1 67-6924 to the left) when used with four Long Connector Link, SP1 67-7021 (see SP1 67-7021 on page 70) resulting in a covalent radius of 1.04Å; double-bond face not differentiated.

Order #	Product
SP1 67-6958	Sulfur, Tetrahedral

Metal Atoms

Atom Species	Order #	Bond Arrangement	Color	Bond Angle	van der Waals Radii, Å	Covalent Radii, Å		
						Single Bond	Double Bond	Triple Bond
Metal, Covalent	SP1 67-6973		Silver	90°	1.70*	1.32	—	—
Metal, Ionic	SP1 67-6981		Silver	90°	1.46*	1.32	—	—
Metal, All-Purpose	SP1 67-6999	Non-Specific	Silver	Non-Specific	—	—	*	—

* Note: Radius of sphere for constructing atom, all bond angles equal.



Metal, Covalent

For chelates (Fe, Co, Ni, Cu) or for covalent octahedral bonds. Can also be used for planar configurations. Covalent radius 1.32Å; bond angle 90°; van der Waals radius 1.70Å. Silver.

Order #	Product
SP1 67-6973	Metal, Covalent



Metal, Ionic

For ionic octahedral bonds. Can also be used for planar configurations. Covalent radius 1.32Å; bond angle 90°; van der Waals radius 1.46Å. Silver.

Order #	Product
SP1 67-6981	Metal, Ionic



Metal, All Purpose

A sphere with a diameter corresponding to 2.7Å. Lines of longitude and latitude are embossed at 30° intervals over the surface of the sphere. An indent is at one pole of the sphere. With the aid of the lines of latitude and longitude, the user may orient the sphere in any direction required by a particular construction.

This metal atom has a special connector. It is the SP1 67-7161 Metal Atom Connector Link, see page 71, and consists of a connector link one-half the length of a normal link plus a self-tapping screw. A 1/16 inch hole must be drilled in the sphere in order to accommodate the self-tapping screw.

Two SP1 67-7161 Metal Atom Connector Links are included with each SP1 67-6999 Metal, All Purpose. Silver.

Order #	Product
SP1 67-6999	Metal, All Purpose, with Connector Links

Connector Links

The marked superiority of the CPK® Atomic Models derives largely from Dr. Koltun's Connector Links. His analysis of the engineering problems involved led him to combine new plastic materials with innovative link designs which satisfy four critical requirements simultaneously:

- **Hold atoms together with great tenacity.** A force of 5 to 7 kg is required to separate them. This force is readily furnished by the levering blade of the SP1 67-7120 Construction Tool, see page P18.
- **Permit distortions of bond angles to vary up to $\pm 8^\circ$ with negligible loss in bond strength.**
- **Develop sufficient rotational friction to assure that large, extended side chains, often attached by a single bond, will remain indefinitely in proper steric orientation.**
- **Allow bond distances to be shortened or lengthened.** The connectors are made of Texin®, a hard, rubber-like elastomer which is strong but resilient and flexible.

Since bond distances and angles for particular atoms are known to vary even in similar structures, two special links, in addition to the standard link, are provided to increase or decrease the normal bond distance by $+0.08\text{\AA}$ or -0.05\AA .

A special 'gluing' link is also available for permanently connecting atoms at standard bond distances.

The various link types are color-coded to aid identification.



Connector Link, Standard

Provides standard bond distance. Off-white.

Order

Product

SP1 67-7005

Connector Link, Standard



Connector Link, Long

Lengthens bond distance by 0.08\AA . Red.

Order

Product

SP1 67-7021

Connector Link, Long



Connector Link, Short

Shortens bond distance by 0.05\AA . Blue.

Order

Product

SP1 67-7013

Connector Link, Short



Connector Link, Carbon

Provides standard bond distance. Has locking splines at each end placed 180° out of phase that restrict rotation of SP1 67-6577 Carbon, Tetrahedral. Black.

Order

Product

SP1 67-7047

Connector Link, Carbon



Connector Link, Locking

Provides standard bond distance and has locking splines that mate with keyways in the female socket of the atoms to prevent rotation. Gray.

Order

Product

SP1 67-7039

Connector Link, Locking



Connector Link, Gluing

For constructing permanent structures at standard bond distance using trichlorethylene 'glue' or Testor's® Polystyrene Cement. Black.

Order

Product

SP1 67-7054

Connector Link, Gluing



Connector Link, Bayonet H-Bond Replacement

This is the connector that is supplied with the SP1 67-6684 H-Bond, Bayonet Type, Hydrogen atom. It is for replacement if the tip of the connector supplied with the atom breaks. Off-white.

Order

Product

SP1 67-7062

Connector Link, Bayonet H-Bond Replacement

Accessories & Tools



H-Bond Spacer

For use with the SP1 67-6726 Hydrogen H-Bond, Hook Type, see page 64. One or more of these spacers can be put on over the hook of the SP1 67-6726 to increase the bond distance by 0.2Å for each spacer used. White.

Order #	Product
SP1 67-7096	H-Bond Spacer



Screw for Amine Cap

This screw is used to connect the SP1 67-7112 Amine Cap, see page 67, to the SP1 67-6726 Hydrogen H-Bond, Hook Type when the hook is removed.

Order #	Product
SP1 67-7187	Amine Cap Screw



Metal Atom Connector Link

Supplied with self-tapping screw. For use with SP1 67-6999 Metal, All Purpose, see page 69. Note that two of these connectors are supplied with each SP1 67-6999 Metal, All Purpose. White.

Order #	Product
SP1 67-7161	Metal Atom Connector Link
SP1 67-7229	Single Metal Atom, No Connector Link



Socket

Standard female socket to be mounted on special atom species fabricated by the user. This socket takes all of the Connector Links listed on page 70. White.

Order #	Product
SP1 67-7088	Socket



Hydrogen Wrench

This wrench is for use with the SP1 67-6726 Hydrogen H-Bond, Hook Type, see page 64. When the hook of that atom is placed in the slot of the SP1 67-6874 Oxygen, Single Bond or SP1 67-6916 Oxygen, Indented Double Bond atom, this wrench fits over the eight-sided face of the basic hydrogen body, and the body is turned until the hook is brought up securely against the oxygen atom.

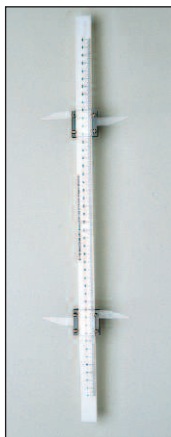
Order #	Product
SP1 67-7138	Hydrogen Wrench



Construction Tool

To assemble the models, a Connector Link is placed in the well on the end of the handle of this Construction Tool. The Connector Link is then pressed into the female socket of the atom. The second atom is simply pressed onto the first with a slight twist, and the bond is made. To separate the atoms, the blade of the Construction Tool is merely inserted between the atoms to pry them apart. A Connector Link may be completely removed by slipping the forked end of the Construction Tool around the center groove of the link, and the tool is pried upward.

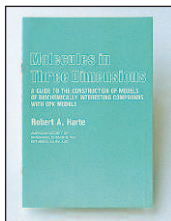
Order #	Product
SP1 67-7120	Construction Tool



Angstrom Unit Scale Caliper

An Angstrom Unit Scale caliper calibrated at 1.25 cm/Å (the scale of the CPK® models) which offers a convenient way to make direct measurements in Angstroms on CPK® structures. Range 0 to 30Å graduated in 0.1Å with each Å numbered. Sturdy bar engraved with black-filled graduations. Accurate measurement is attained by two spring-loaded cursors with long transparent plastic jaws. One cursor is reversible to make internal and external measurements. Overall length 64 cm (25 in).

Order #	Product
SP1 67-7146	Angstrom Unit Scale Caliper



Pamphlet: "Molecules in Three Dimensions"

A 20-page pamphlet subtitled A Guide to the Construction of Models of Biochemically Interesting Compounds with CPK® Models. Written by Robert A. Harte of the American Society for Biochemistry and Molecular Biology.

Order #	Product
SP1 67-7179	Molecules in 3 Dimensions

Research & Teaching Sets

Research and Teaching Set



Harvard Apparatus offers a complete line of sets with various individual atoms.

- The five most popular Teaching Sets are described below.
- For component details, see next page.
- The contents of each set are indicated by reading down the column under the set.
- Each set is supplied in one or more sturdy, partitioned, wooden box for convenient storage of the models.

Research and Teaching Set 1

For students.

Contains sufficient atoms and connectors to build SP1 67-8205 ATP, a twelve-residue alpha-helix back-bone or the base pairs of the nucleic acids, but not simultaneously.

Order #	Product
SP1 67-6015	Research and Teaching Set 1

Research and Teaching Set 2

For the smaller laboratory.

This Set builds 36 peptide backbone segments in helix forms, three base-pair residues of nucleic acid in double helix form, SP1 67-8205 ATP, steroids, etc.

Order #	Product
SP1 67-6023	Research and Teaching Set 2

Research and Teaching Set 3

For the larger laboratory or department where a number of structures, once built, are likely to be left permanently assembled.

Constructs 60 peptide backbone segments in helix form.

Order #	Product
SP1 67-6031	Research and Teaching Set 3

Research and Teaching Set 4

Includes the atoms to build small-ring compounds such as SP1 67-0400 Cyclobutane, cyclobutanone, ketenedimer, and derivatives in addition to β -lactams. Also constructs molecules containing functional groups as in alcohols, ketones, aldehydes, esters and amines including their unsaturated derivatives. Useful for demonstrating compounds which undergo photochemical or electron-induced polymerizations as in the acrylates, methacrylates, and other SP1 67-0426 Ethene (vinyl) derivatives.

Order #	Product
SP1 67-6056	Research and Teaching Set 4

Research and Teaching Set 5

Includes the atoms in SP1 67-6056 CPK® Models Research and Teaching Set 4 above, but in greater quantity to permit construction of compounds of significant biological interest. For example, antibiotics based on small ring compounds such as those found in the penicillins and cephalosporins.

There are sufficient compounds to build simultaneously two penicillin and two cephalosporin base structures so that the various side chain compounds such as penicillin B, F, K, and flavidicin can be assembled and compared.

This Set also contains components to build 36 peptide backbone segments in helix forms, three base-pair residues of the nucleic acids in double helix form, SP1 67-8205 ATP, steroids, prostaglandins, and many other important, naturally-occurring compounds.

Order #	Product
SP1 67-6064	Research and Teaching Set 5

Other sets are available. Please call for details.

Research and Teaching Sets (continued)

Check List for Ordering Individual Components

		Research and Teaching Sets				
	Set No.	1	2	3	4	5
	Order #	SP1 67-6015	SP1 67-6023	SP1 67-6031	SP1 67-6056	SP1 67-6064
Order #	Product					
SP1 67-6577	C-Tetrahedral	30	60	500	100	100
SP1 67-6585	C-Ethylenic Double Bond	8	20	60	10	30
SP1 67-6593	C-Acetylenic Triple Bond	4	6	20	10	10
SP1 67-6569	C-Aromatic-6	18	36	400	15	50
SP1 67-6551	C-Aromatic-5	6	18	100	15	20
SP1 67-6619	C-Fused 6-6 Rings	4	8	15	2	10
SP1 67-6601	C-Fused 5-6 Rings	4	8	20	2	10
SP1 67-6528	C-Tetrahedral-4	—	—	—	4	10
SP1 67-6544	C-Trigonal-4	—	—	—	4	10
SP1 67-6536	C-Amide	12	36	60	15	50
SP1 67-6692	Hydrogen	40	120	1000	175	150
SP1 67-6684	H-Bond, Bayonet Type	2	5	10	—	10
SP1 67-6726	H-Bond, Hook Type	20	50	100	—	50
SP1 67-6676	Fluoride	4	10	70	5	15
SP1 67-6650	Chloride	4	15	60	5	15
SP1 67-6510	Bromide	4	15	60	5	15
SP1 67-6734	Iodide	4	10	30	5	15
SP1 67-6841	N-Tetrahedral	4	12	50	10	15
SP1 67-6833	N-Aromatic-6	6	18	100	5	20
SP1 67-6825	N-Aromatic-5	3	9	50	5	10
SP1 67-6858	N-Tetrahedral-4	—	—	—	4	6
SP1 67-6866	N-Trigonal-4	—	—	—	4	6
SP1 67-6791	N-Amide	12	36	60	5	40
SP1 67-7112	Amine Cap	4	12	40	15	15
SP1 67-6874	O-Single Bond	10	36	150	15	40
SP1 67-6890	O-Double Bond	8	18	100	25	30
SP1 67-6916	O-Indented Double Bond	12	36	100	10	40
SP1 67-6924	Phosphorus, Tetrahedral	4	10	40	—	10
SP1 67-6957	Sulfur, Digonal	4	8	20	2	15
SP1 67-6973	Metal, Covalent	2	4	20	—	5
SP1 67-6981	Metal, Ionic	2	4	20	—	5
SP1 67-7005	Connector Link, Standard	200	500	150	250	550
SP1 67-7021	Connector Link, Long	10	50	100	5	50
SP1 67-7013	Connector Link, Short	10	50	100	5	50
SP1 67-7047	Connector Link, Carbon	30	60	500	—	60
SP1 67-7039	Connector Link, Locking	10	50	100	—	50
SP1 67-7054	Connector Link, Gluing	—	50	300	—	50
SP1 67-7062	Connector Link, H-Bond	10	25	50	—	25
SP1 67-7096	H-Bond Spacer	30	75	150	—	80
SP1 67-7187	Screws For Amine Cap		Not supplied with sets			
SP1 67-7088	Socket	—	25	100	—	30
SP1 67-7138	Wrench, H-Bond	1	1	3	1	1
SP1 67-7120	Construction Tool	1	1	3	1	1
SP1 67-7146	Caliper		Not supplied with sets			
SP1 67-7179	Pamphlet: Molecules in 3-D	1	1	1	1	1

Fully Assembled Nucleic Acid Helices

SP1 67-8284
Assembled
DNA Helix,
2.0 Turns



- Assembled DNA helix is a unique teaching tool
- Available as fully assembled models or as unassembled kits

The fully assembled models are shipped complete with stable base plate.

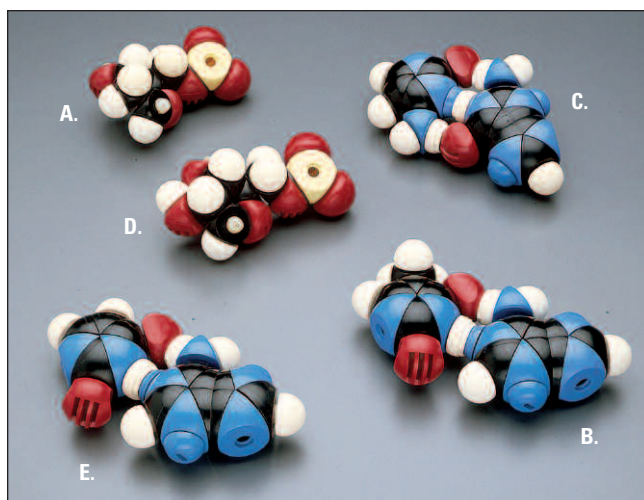
A one-turn helix is 47 cm (18.5 in) high and approximately 30.5 cm (12 in) diameter. Allow about 42.5 cm (17 in) for each additional turn. The models are supplied with approximately equal numbers of G-C (SP1 67-8326 Guanine-Cytosine Base Pair) and A-T bases (SP1 67-8318 Adenine-Thymine Base Pair).

There is no extra cost if you wish to specify the sequence of base pairs; merely indicate it on your order.

Assembled Nucleic Acid Helices

Order #	Product
SP1 67-8268	DNA Helix, 1.0 Turn
SP1 67-8276	DNA Helix, 1.5 Turns
SP1 67-8284	DNA Helix, 2.0 Turns
SP1 67-9000	RNA Helix, 1.0 Turn
SP1 67-9001	RNA Helix, 1.5 Turns
SP1 67-9002	RNA Helix, 2.0 Turns
SP1 67-8270	DNA-RNA Helix, 1.0 Turn
SP1 67-8278	DNA-RNA Helix, 1.5 Turns
SP1 67-8286	DNA-RNA Helix, 2.0 Turns

Assembled Nucleic Acid Components



Nucleic Acid Helix Components

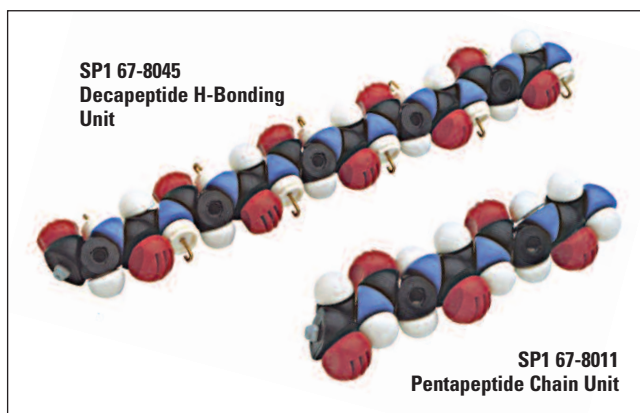
- A. **SP1 67-8300** 2'-Deoxy-D-Ribosephosphate Unit
- B. **SP1 67-8318** Adenine-Thymine Base Pair
- C. **SP1 67-8326** Guanine-Cytosine Base Pair
- D. **SP1 67-8243** D-Ribosephosphate Unit
- E. **SP1 67-8334** Adenine-Uracil Base Pair

Polypeptide Backbone Units

Assembled simple polypeptide backbone segments for helix construction are favorite combinations with the L-Amino Acid Functional Groups (see page 79) and find paramount utility and versatility in polypeptide construction.

Assembled Polypeptides

Order #	Product
SP1 67-8011	Pentapeptide Chain Unit
SP1 67-8045	Decapeptide H-Bonding Unit



The purine and pyrimidine derivatives are the nitrogen base building blocks for their nucleosides, nucleotides and nucleic acids, DNA and RNA.

Pre-Assembled Purine Models

Order #	Product
Purine Nitrogen Base	
SP1 67-8204	Hypoxanthine (6-Oxypurine)
SP1 67-8203	Guanine
SP1 67-8202	Adenine
Purine Nucleosides	
SP1 67-8216	Inosine
SP1 67-8215	Guanosine
SP1 67-8214	Adenosine
Purine Nucleotide Monophosphates	
SP1 67-8213	IMP: Inosine-5'-Monophosphate
SP1 67-8210	GMP: Guanosine-5'-Monophosphate
SP1 67-8207	AMP: Adenosine-5'-Monophosphate
Purine Nucleotide Diphosphates	
SP1 67-8212	IDP: Inosine-5'-Diphosphate
SP1 67-8209	GDP: Guanosine-5'-Diphosphate
SP1 67-8206	ADP: Adenosine-5'-Diphosphate
Purine Nucleotide Triphosphates	
SP1 67-8211	ITP: Inosine-5'-Triphosphate
SP1 67-8208	GTP: Guanosine-5'-Triphosphate
SP1 67-8205	ATP: Adenosine-5'-Triphosphate

Pre-assembled Pyrimidine Models

Order #	Product
Pyrimidine Nitrogen Bases	
SP1 67-8220	Thymine
SP1 67-8221	Cytosine
Pyrimidine Nucleosides	
SP1 67-8232	Thymidine
SP1 67-8233	Cytidine
SP1 67-8234	Uridine
Pyrimidine Nucleotide Monophosphates	
SP1 67-8225	TMP: Thymidine-5'-Monophosphate
SP1 67-8228	CMP: Cytidine-5'-Monophosphate
SP1 67-8231	UMP: Uridine-5'-Monophosphate
Pyrimidine Nucleotide Diphosphates	
SP1 67-8224	TDP: Thymidine-5'-Diphosphate
SP1 67-8200	CDP: Cytidine-5'-Diphosphate
SP1 67-8230	UDP: Uridine-5'-Diphosphate
Pyrimidine Nucleotide Triphosphates	
SP1 67-8223	TTP: Thymidine-5'-Triphosphate
SP1 67-8226	CTP: Cytidine-5'-Triphosphate
SP1 67-8229	UTP: Uridine-5'-Triphosphate

Unassembled Models, Components & Kits

Nucleic Acid Components and Accessories



Nucleic Acid Helix Assembly Components

Order #	Product
SP1 67-8342	Helix Support Base
SP1 67-8227	Helix Assembly Support Plate, Acrylic
SP1 67-6189	Central Support Rod, 70 cm (27.6 in) for 1.5 Turn Helix
SP1 67-6198	Central Support Rod, 110 cm (43.3 in) for 2.0 Turn Helix
SP1 67-7120	Construction Tool
SP1 67-7138	Wrench
SP1 67-7146	Angstrom Unit Scale Caliper

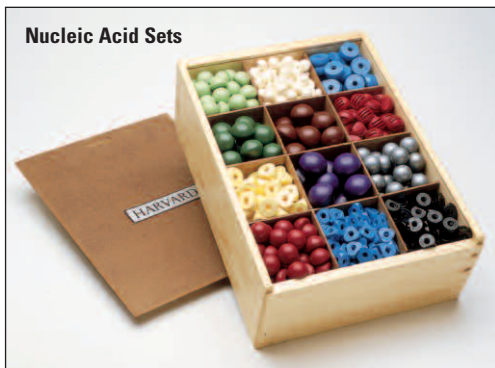
The Nucleic Acid Kits enable the assembly of durable, attractive helix models of great utility in the classroom as well as the research laboratory. These kits are complete and accommodate the construction of 1.0, 1.5 and 2.0 turn helices for DNA, RNA and DNA-RNA hybrids.

Each kit is supplied in a sturdy wooden box.

Unassembled Nucleic Acid Helix Kits

Order #	Product
SP1 67-6387	DNA Helix Kit, 1.0 Turn, unassembled
SP1 67-6395	DNA Helix Kit, 1.5 Turn, unassembled
SP1 67-6403	DNA Helix Kit, 2.0 Turn, unassembled
SP1 67-6388	RNA Helix Kit, 1.0 Turn, unassembled
SP1 67-6396	RNA Helix Kit, 1.5 Turn, unassembled
SP1 67-6404	RNA Helix Kit, 2.0 Turn, unassembled
SP1 67-6389	DNA-RNA Helix Kit, 1.0 Turn, unassembled
SP1 67-6397	DNA-RNA Helix Kit, 1.5 Turn, unassembled
SP1 67-6405	DNA-RNA Helix Kit, 2.0 Turn, unassembled

Unassembled Models, Components & Kits (continued)



Harvard Apparatus offers two complete Nucleic Acid Sets and three Protein Sets with multiple individual atoms.

- For component details, see next page.
- Each set is supplied in a sturdy, partitioned, wooden box.

Nucleic Acid Set No. 1

Builds 30 assorted SP1 67-8262 Purine and SP1 67-8263 Pyrimidine base units with associated pentose sugar phosphate chains or several peptide units.

Order #	Product
SP1 67-6213	Nucleic Acid Set No. 1

Nucleic Acid Set No. 2

Builds 100 assorted SP1 67-8262 Purine and SP1 67-8263 Pyrimidine base units, pentose sugar phosphate linkages, or up to 45 peptide units.

Order #	Product
SP1 67-6221	Nucleic Acid Set No. 2

Protein Set No. 1

For the personal use of the graduate student.

Builds a 40-peptide alpha-helix backbone, SP1 67-8262 Purine and SP1 67-8263 Pyrimidine units, SP1 67-8205 ATP, etc.

Order #	Product
SP1 67-6114	Protein Set No. 1

Protein Set No. 2

An intermediate set.

Builds 100-peptide alpha-helix backbone units with many side chains. Also builds nine SP1 67-8262 Purine rings or complete nucleotides.

Order #	Product
SP1 67-6122	Protein Set No. 2

Protein Set No. 3

For the laboratory where sizable segments of complete protein molecules are assembled.

Builds 200-peptide helix backbone units with many side chains or 12 nucleotides.

Order #	Product
SP1 67-6130	Protein Set No. 3

Harvard Apparatus offers thirty-two different sets for general chemistry and biochemical investigations. Each set is provided in one or more sturdy partitioned wooden box for convenient storage of the models.

- 2 Organic Sets
- Polymer Set
- 4 Steroid Sets
- 3 Carbohydrate Sets
- Surfactant Set
- 3 Vitamin Sets
- Enzyme Cofactor Set
- 3 Fatty Acids and Derivative Sets
- Organic Acid Set
- 3 Hydrocarbon Sets
- 3 Ring System Sets
- 3 Porphyrin Ring System Sets
- Alcohol, Aldehydes, Ketones and Ether Set
- TCA Cycle Intermediates Set
- Glycolysis Intermediate Set
- Bile Acid Set

Contact us for the contents and cost of each set.

Nucleic Acid and Protein Sets

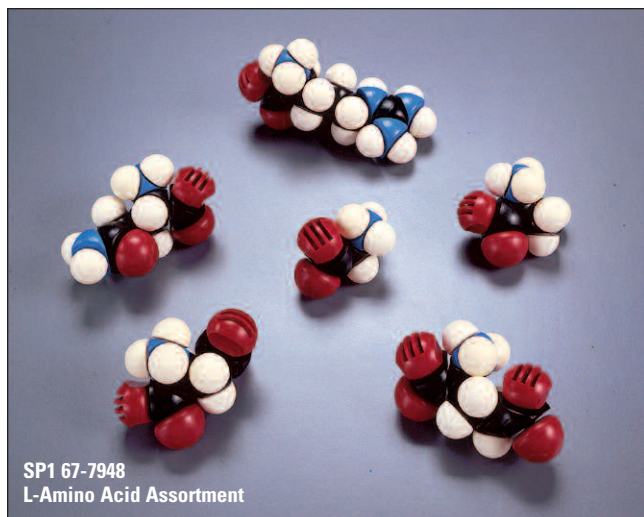
Harvard Apparatus offers two Nucleic Acid Sets and three Protein Sets with different numbers of individual atoms.

- The Nucleic Acid Sets can be used to build 30 or 100 assorted purine and pyrimidine base units with associated pentose sugar phosphate chains or several peptide chains.
- The Protein Sets can be used to build 40 to 200 peptide helix backbone units, Purine or Pyrimidine rings or nucleotides.
- Each set is supplied in a sturdy, partitioned wooden box.

Check List for Ordering Individual Components

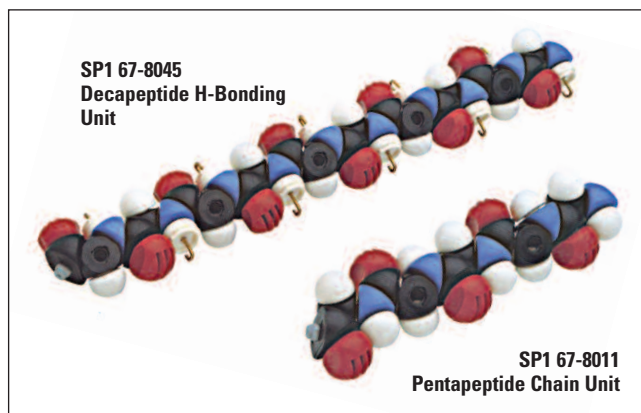
		Nucleic Acid Sets		Protein Sets		
		Set No. Order #	1 SP1 67-6213	2 SP1 67-6221	1 SP1 67-6114	2 SP1 67-6122
Order #	Product					
SP1 67-6577	C-Tetrahedral	155	525	75	150	200
SP1 67-6585	C-Ethylenic Double Bond	5	25	5	10	20
SP1 67-6593	C-Acetylenic Triple Bond	2	4	2	6	10
SP1 67-6569	C-Aromatic-6	90	300	25	120	300
SP1 67-6551	C-Aromatic-5	15	50	15	30	75
SP1 67-6619	C-Fused 6-6 Rings	2	4	2	4	6
SP1 67-6601	C-Fused 5-6 Rings	15	50	5	9	21
SP1 67-6536	C-Amide	15	45	40	100	200
SP1 67-6692	Hydrogen	450	1400	150	600	1500
SP1 67-6684	H-Bond, Bayonet Type	6	20	4	10	30
SP1 67-6726	H-Bond, Hook Type	60	200	40	100	300
SP1 67-6676	Fluoride	-	-	-	2	2
SP1 67-6650	Chloride	2	4	2	4	10
SP1 67-6510	Bromide	2	4	2	4	10
SP1 67-6734	Iodide	1	4	2	4	10
SP1 67-6841	N-Tetrahedral	15	45	8	20	25
SP1 67-6833	N-Aromatic-6	60	180	15	30	60
SP1 67-6825	N-Aromatic-5	30	100	10	20	40
SP1 67-6791	N-Amide	20	60	-	-	-
SP1 67-7112	Amine Cap	45	150	20	50	80
SP1 67-6874	O-Single Bond	155	525	25	50	75
SP1 67-6890	O-Double Bond	35	100	20	100	175
SP1 67-6916	O-Indented Double Bond	35	135	40	100	200
SP1 67-6924	Phosphorus, Tetrahedral	30	100	5	9	12
SP1 67-6957	Sulfur, Digonal	4	9	4	8	20
SP1 67-6973	Metal, Covalent	2	5	2	5	10
SP1 67-6981	Metal, Ionic	2	5	2	5	10
SP1 67-7005	Connector Link, Standard	700	1800	400	1000	1500
SP1 67-7021	Connector Link, Long	20	100	25	50	100
SP1 67-7013	Connector Link, Short	20	100	25	50	100
SP1 67-7047	Connector Link, Carbon	160	550	40	150	300
SP1 67-7039	Connector Link, Locking	50	200	100	200	500
SP1 67-7054	Connector Link, Gluing	50	100	50	100	500
SP1 67-7062	Connector Link, H-Bond	30	100	20	50	150
SP1 67-7096	H-Bond Spacer	90	300	60	150	450
SP1 67-7187	Screws For Amine Cap	Not supplied with sets				
SP1 67-7088	Socket	10	20	10	10	20
SP1 67-7138	Wrench, H-Bond	1	3	1	1	2
SP1 67-7120	Construction Tool	1	3	1	1	2
SP1 67-7146	Caliper	Not supplied with sets				
SP1 67-7179	Pamphlet: Molecules in 3-D	1	1	1	1	1

Assembled Amino Acid Models



- No assembly required
- 20 Models Included
- Naturally occurring L-configuration

Models for L-Amino Acids and L-Amino Acids Functional Groups are listed below.



L-Amino Acid Assortment

Order # Product

This Assortment contains one each of the 20 assembled amino acids listed below in their naturally occurring L-configuration.

SP1 67-7948 L-Amino Acid Assortment

Amino Acids

Individual L-Amino Acids

SP1 67-3772	Glycine
SP1 67-3707	L-Alanine
SP1 67-3897	L-Valine
SP1 67-3798	L-Isoleucine
SP1 67-3806	L-Leucine
SP1 67-3855	L-Serine
SP1 67-3863	L-Threonine
SP1 67-3723	L-Aspartic Acid
SP1 67-3731	L-Asparagine
SP1 67-3756	L-Glutamic Acid
SP1 67-3764	L-Glutamine
SP1 67-3830	L-Phenylalanine
SP1 67-3889	L-Tyrosine
SP1 67-3871	L-Tryptophan
SP1 67-3749	L-Cysteine
SP1 67-3822	L-Methionine
SP1 67-3848	L-Proline
SP1 67-3780	L-Histidine
SP1 67-3715	L-Arginine
SP1 67-3814	L-Lysine

Order # Product

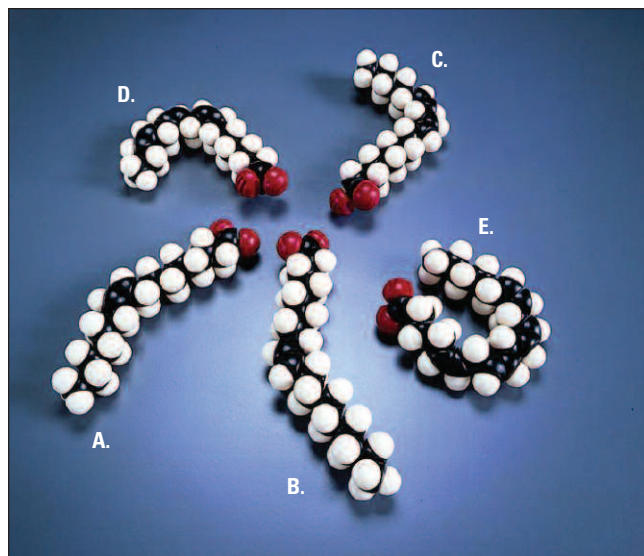
These L-Amino Acid functional groups complement the SP1 67-7948 L-Amino Acids Assortment. Further, the SP1 67-8011 Pentapeptide Chain Unit and the SP1 67-8045 Decapeptide H-Bonding Unit when used with the functional group, enable the assembly of polypeptide sequences.

Amino Acid Functional Groups

L-Amino Acid Functional Group

SP1 67-6692	Glycyl (Hydrogen)
SP1 67-8128	L-Alanyl
SP1 67-3898	L-Valyl
SP1 67-3799	L-Isoleucyl
SP1 67-3807	L-Leucyl
SP1 67-3856	L-Seryl
SP1 67-3864	L-Threonyl
SP1 67-3724	L-Aspartyl
SP1 67-3732	L-Asparaginy
SP1 67-3757	L-Glutamyl
SP1 67-3765	L-Glutaminyl
SP1 67-3831	L-Phenylalanyl
SP1 67-3890	L-Tyrosyl
SP1 67-8102	L-Tryptophanyl
SP1 67-3750	L-Cysteinyl
SP1 67-3823	L-Methionyl
SP1 67-8094	L-Prolyl
SP1 67-8086	L-Histidyl
SP1 67-3716	L-Arginyl
SP1 67-3815	L-Lysyl

Fully Assembled Molecular Models



Pre-assembled Unsaturated Fatty Acids

The most common unsaturated fatty acids of the naturally occurring Cis-conformation are shown at the left.

Monounsaturated

- A. **SP1 67-0045** Palmitoleic Acid
B. **SP1 67-0046** Oleic Acid

Diunsaturated

- C. **SP1 67-0047** Linoleic Acid

Triunsaturated

- D. **SP1 67-0048** α -Linolenic Acid

Tetraunsaturated

- E. **SP1 67-0049** Arachidonic Acid

Pre-assembled Fatty Acids

Order # Product

Saturated Fatty Acids

SP1 67-0040	n-Dodecanoic (Lauric) Acid
SP1 67-0041	n-Tetradecanoic (Myristic) Acid
SP1 67-0042	n-Hexadecanoic (Palmitic) Acid
SP1 67-0043	n-Octadecanoic (Stearic) Acid
SP1 67-0044	n-Eicosanoic (Arachidic) Acid

Unsaturated Fatty Acids

SP1 67-0045	Palmitoleic Acid
SP1 67-0046	Oleic Acid
SP1 67-0047	Linoleic Acid
SP1 67-0048	α -Linolenic Acid
SP1 67-0049	Arachidonic Acid

Order # Product

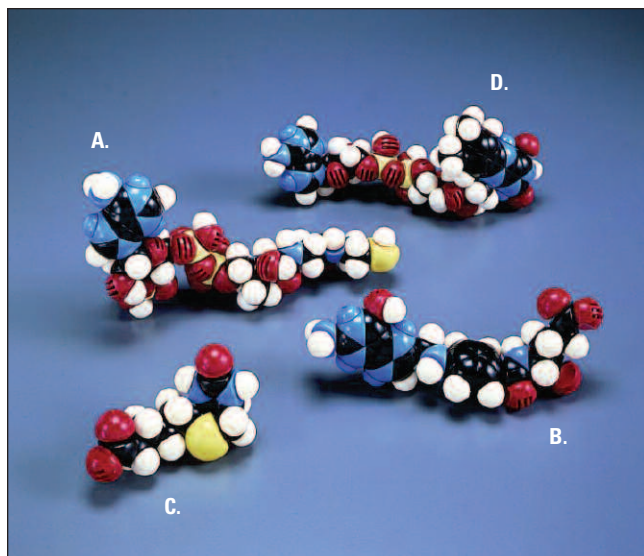
Saturated Fatty Ester

SP1 67-0050	Tripalmitin
--------------------	-------------

Phosphoglycerides

SP1 67-0051	Phosphatidic Acid
SP1 67-0052	Phosphatidylethanolamine (Cephalin)
SP1 67-0053	Phosphatidylcholine (Lecithin)
SP1 67-0054	Phosphatidylserine
SP1 67-0055	Phosphatidylinositol
SP1 67-0056	Phosphatidylglycerol
SP1 67-0057	Cardiolipin
SP1 67-0058	Sphingomyelin

Fully Assembled Molecular Models (continued)



Pre-assembled Enzyme Cofactors

Some of the most notable enzyme cofactors, high-energy compounds and vitamin derivatives are shown at the left.

- A. SP1 67-0020 Coenzyme A (CoA)
- B. SP1 67-0021 Folic Acid
- C. SP1 67-0022 Biotin
- D. SP1 67-0023 FAD: Flavin Adenine Dinucleotide

These cofactors are valuable in any biochemical investigation of enzyme kinetics.
The Purine and Pyrimidine nucleotide triphosphates are also the highest energy state enzyme cofactors.

Pre-assembled Models

Order # Product

Enzyme Cofactors

SP1 67-0020	Coenzyme A (CoA)
SP1 67-0021	Folic Acid
SP1 67-0022	Biotin
SP1 67-0023	FAD: Flavin Adenine Dinucleotide
SP1 67-0024	FMN: Flavin Mononucleotide
SP1 67-0025	NAD: Nicotinamide Adenine Dinucleotide
SP1 67-0026	NADP: Nicotinamide Adenine Dinucleotide Phosphate
SP1 67-0027	Pantothenic Acid
SP1 67-0028	PEP: Phosphoenolpyruvate
SP1 67-0029	TPP: Thiamine Pyrophosphate
SP1 67-0030	Dihydrofolic Acid
SP1 67-0031	Tetrahydrofolic Acid

Order # Product

Purine Nucleotide Triphosphates

SP1 67-8205	ATP: Adenosine-5'-Triphosphate
SP1 67-8208	GTP: Guanosine-5'-Triphosphate
SP1 67-8211	ITP: Inosine-5'-Triphosphate

Pyrimidine Nucleotide Triphosphates

SP1 67-8229	UTP: Uridine-5'-Triphosphate
SP1 67-8223	TTP: Thymidine-5'-Triphosphate
SP1 67-8226	CTP: Cytidine-5'-Triphosphate

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