

Spectra/Por®

**Standard Grade
Regenerated Cellulose
Dialysis Membrane
(Spectra/Por® 1 - 5, 6 & 7)**



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Introduction

The Spectra/Por® Standard Grade Regenerated Cellulose (RC) membrane has proven to be the most useful membrane available for laboratory dialysis. It carries no fixed charge and does not adsorb most solutes.

Unlike native cellulose which is highly crystalline and rigid, regenerated cellulose is largely amorphous and highly swollen by water. However, it still contains small regions of crystallinity, that lock (cross-link) the chains in place so that they maintain their integrity. Depending on the conditions of manufacture, these regions are more or less numerous. The areas between cross-links, swollen with water, act like pores permitting sufficiently small solute molecules to pass through the membrane.

Because of the amorphous gel-like nature of regenerated cellulose, mechanical strain will alter the porosity of the membrane.

Membrane Composition and Specifications

Spectra/Por 1, 2, 3, 4, 5, 6 and 7 dialysis membranes are manufactured from natural cellulose reconstituted from cotton linters. These RC membranes carry no fixed charge and do not adsorb most solutes. The standard RC dialysis membranes are used for general laboratory dialysis functions, ie. desalting, buffer exchange, or molecular separation.

Spectra/Por® 1-7 Regenerated Cellulose Membranes

These flexible, transparent membranes feature good chemical and pH resistance and high temperature tolerance without significant changes in the MWCO rating.

Spectra/Por 1 through 6 contain trace levels of heavy metals and sulfides. Spectra/Por 7 membranes have been chemically treated to minimize the heavy metal and sulfur content, eliminating the need for special cleaning treatments.

In the manufacturing process Spectra/Por 5 membrane is reinforced with a layer of porous paper to increase its wet strength for use in high shear or torque environments, resulting in a lower permeation rate compare to the other membranes.

Membrane Specifications

Specifications

Membrane Type:	Symmetric Regenerated Cellulose Tubing
Physical Properties:	Transparent, flexible (Spectra/Por® 5 reinforced with porous paper layer)
PH limits:	2-12
Suggested temperature:	60° C
Organic Solvent	
Tolerance:	Good

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Specifications

	Spectra/Por® 1-5	Spectra/Por® 6 & 7
Packaged:	Dry	Wet
Preservative:	Glycerin	0.05% sodium azide
Disc/Flat sheet:	Yes	No

Metal Content in Spectra/Por® 1-6 dialysis membranes

The following are approximate concentration of heavy metal and sulfur found in the Spectra/Por 1 through 6 membranes.

Element	Concentration	Element	Concentration
Cd	<1 ppm	Ni	1-2 ppm
Cr	<1 ppm	Pb	2-6 ppm
Cu	<1 ppm	Zn	5-10 ppm
Fe	20-60 ppm	S	0.1%
Mg	50-100 ppm		

Criteria for Selecting the Membrane for use

Membrane Selection of MWCO

Spectra/Por®	MWCO Daltons	Spectra/Por®	MWCO Daltons
1	6000-8000	6	1k, 2k, 3.5k, 8k, 10k, 15k, 25k, and 50k
2	12,000-14,000	7	1k, 2k, 3.5k, 8k, 10k, 15k, 25k, and 50k
3	3,500		
4	12,000-14,000		
5	12,000-14,000		

Membrane Permeability Characterization

The widely used method to characterize dialysis membranes is the molecular weight cut off (MWCO). Spectrum determines the MWCO of a membrane by conducting a 17 hour dialysis test with a set of solutes of known molecular weight. The MWCO of the membrane is then said to be the molecular weight of the smallest solute which is at least 90% retained during this test (the smallest solute for which the permeation is 10% or less).

Dialysis membrane may also be characterized by the rate at which a permeable species passes through the membrane. A rate test may be carried out by placing a solution of a permeable species on one side of a membrane and pure solvent on the other. If both the solution and the solvent are well stirred and the pure solvent is constantly changed (so that it never contains an appreciable concentration of solute), a first-order rate will be observed.

A very important variable in the rate of dialysis is the molecular weight of the solute. As the molecular weight of a permeable solute increases, the rate of dialysis decreases. At molecular weights far from the MWCO, the rate decrease is caused by the decrease of the diffusion rate with the increasing molecular weight. As the solute's molecular weight nears the MWCO, the rate will slow dramatically with further increases in molecular weight until finally, the molecules become too large to pass through the membrane.

MWCO Selection

The effective size of many solute molecules will be affected by the pH and ionic strength of the solution in which they are dissolved.

Therefore, the listed MWCO values should be used merely as typical and not absolute values. To establish the optimal MWCO for any application, it may be necessary to test several membranes. To maximize the rate of dialysis, the membrane with the largest MWCO which will not cause excess loss of the desired species should be used.

The selecting of MWCO is based on the Molecular Weight (MW) of the macro molecules that are going to be retained inside the membrane and the MW of the micromolecule contaminants to be removed. For reasonably efficient separation by means of dialysis with Spectra/Por membranes, the ratio of the molecular weights of the two compounds to be separated should be at least 25. A rule of thumb is to choose a MWCO by selecting an MWCO value about half of the MW of the macromolecules to be retained in order to achieve a minimum 90% retention.

Chemical Compatibility

Spectra/Por® RC membranes have a good chemical resistance. Variables in temperature, concentrations, durations of exposure and other factors may affect the use of the membrane. You may wish to test under your conditions first. These membranes are resistant to the following groups: halogenated hydrocarbons, alcohols, ketones,

esters, oxides and solvents containing nitrogen. They are not recommended for use with >25% hydrochloric, nitric and perchloric acids; 96% sulfuric acid; 1N potassium hydroxide and 10% phenol. Please see chemical compatibility table on **page 20**.

Membrane Tubing “Flat Width” Selection

The selection of the flat width membrane tubing depends on the size of the sample volume and the dialysis reservoir. The smaller tubing (which has a higher surface area to volume ratio) will dialyze more quickly and larger tubing will dialyze more slowly due to the longer diffusion distances involved. For easy handling of the membrane tubing, the suggested total length including closures and head space should be approximately 10 to 15 cm. The “Volume/Length” ratio (ml/cm) is provided in the catalog and packaging label.

Closure Selection

It is recommended to select a closure width of 4 to 10 mm longer than the flat width of the membrane tubing. This will allow the closure to seal the tubing securely when the sample solution is being filled inside.

Closures are available in two types of material: polypropylene (Spectra/Por) or nylon (Universal).

Polypropylene closures (Spectra/Por®)

These closures are autoclavable and commonly used for

RC membranes. There are 3 types of polypropylene closure:

- **Standard Closures:** float on their own. The standard closures seal at the top of the membrane tubing.
- **Weighted Closures:** contain a stainless steel bar which is embedded in the standard closures. The weighted closures are applied at the bottom of the membrane tubing to keep a vertical floating position.
- **Magnetic Weighted Closures:** contain a magnetic stir bar. There is no need for a magnetic stir bar when the magnetic weighted closure is used at the bottom of the membrane tubing.

Nylon Closures (Universal)

Nylon closures can be used for all types of membrane tubing. These Universal closures sink on their own and allow the membrane tubing to float vertically with a head space. They are not autoclavable.

Membrane Preparation

Spectra/Por® 1-6

For most applications, the membrane can be soaked in distilled water at room temperature for 30 minutes to remove the preservative (glycerine or sodium azide). Then, rinse the membrane thoroughly in distilled water.

If the presence of heavy metals and sulfides is anticipated

to cause interferences, the membranes can be treated with Spectrum Sulfide Removal solutions and Spectrum Heavy Metals Cleaning Solution. The Sulfide Removal kit contains two separate wash solutions and instructions for their use. This cleaning process takes less than 10 minutes to complete. The Heavy Metals Cleaning solution is a chelating rinse which strips the heavy metals from the membrane.

Spectra/Por® 7

Spectra/Por 7 membrane has been chemically treated to minimize the content of heavy metals and sulfide contaminants; therefore, it is only necessary to soak the membrane in a large volume of deionized or distilled water for 30 minutes to remove the sodium azide preservative agent. Then, rinse thoroughly with running deionized or distilled water.

Membrane Handling and Use

The following dialysis procedure is a general protocol for basic dialysis. There are many variables that should be taken into consideration before starting the dialysis of your sample. Some of the variables that will affect the rate of dialysis are sample solvent, membrane compatibility, membrane MWCO, dialysate solvent, dialysate volume, temperature, etc. Therefore, some application specific changes to the following dialysis procedure may be necessary.

1. Fill a Spectra/Por Dialysis Reservoir with a large volume of appropriate dialysate (buffer). The dialysate volume

should be equal 100X of sample volume. (Example: dialyze 10 ml of sample in a Liter of dialysate.)

2. Cut dialysis tubing into appropriate lengths. Allow extra tubing length (about 10% of total sample volume) for a small head space. This insures that the sack will float and not be damaged by the rotating stir bar. Prepare the tubing according to the directions for use. **(see page 7-8)**
3. Open the Closure by releasing the security lock. Insert dialysis tubing into the opened Closure and reclamp with approximately 3 to 5 mm of tubing extending from the Closure.
4. Load the sample into dialysis tubing through the open end. Adjust the length for a head space and clamp the tubing closed.
5. Place the Dialysis sample in appropriate dialysis buffer.
6. Drop a clean magnetic stir bar into the dialysis reservoir. Make sure that the stir bar is large enough to stir the entire dialysate volume but not too large that it can not freely rotate. Place the dialysis reservoir on a stirrer. Adjust the control for the maximum speed that does not pull down the sample by the vortex.

Sample Recovery

Grasp the tubing extending from Closure and unclamp Closure. Decant the dialyzed sample or remove it with a Pasteur Pipette or syringe. Very small samples may also

Spectra/Por® 1-7 Regenerated Cellulose Membranes

be recovered by carefully puncturing the tubing and drawing the sample into a syringe using a 24-gauge hypodermic needle.

Typically, dialysis is allowed to run overnight. During the duration of dialysis, the entire dialysate volume can be changed for fresh dialysate solution. Dialysis should be allowed to continue for at least 2 to 4 hours after the last dialysate change. Note: For highly concentrated contaminants, sample may need to dialyze for a longer duration with more frequent changes of dialysate solution.

Membrane Storage and Shelf Life

Store dry membrane at room temperature or at 4° C in a polyethylene bag. Store unopened wet membrane at 4° C. Once wet, membranes should be immersed in a solution of one of the following: 0.05% sodium azide, 1% sodium benzoate or 1% formaldehyde.

Note: Once wet, do not allow membrane to dry. Drying causes unrecoverable collapse of the pore structure.

Shelf life is two years depending on storage conditions. For maximum shelf life of wet membranes, the preservative solution should be changed periodically.

Membrane Sterilization

The common method of membrane sterilization is exposure to ethylene oxide (EtO) gas. Alternative sterilization methods are either gamma irradiation or steam autoclaving.

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Spectrum does not recommend boiling or steam autoclaving Regenerated Cellulose membranes. Temperatures greater than 60° C will change the structure of membrane by decreasing the permeability after sterilization. It is essential that steam autoclaved RC membranes should be recharactized to compensate for any change in permeation characteristics or MWCO. Membranes may be autoclaved at 121° C for no more than 15 minutes (cycle should be kept as short as possible) immersed in distilled water.

Ordering Information

Spectra/Por® 1-5 Dialysis Membranes

- Packaged dry with glycerine
- Rolls of 15 or 30 meters
- Trial size of 5 meters for select tubings

Spectra/Por® 1 6,000-8,000 Dalton MWCO

Product No.	Flat Width (mm)	Diameter (mm)	Vol/Length (ml/cm)	Length (m/ft)
132645	10	6.4	0.32	15/50
132650	23	14.6	1.7	30/100
132655	32	20.4	3.3	30/100
132655T	32	20.4	3.3	5/16
132660	40	25.5	5.1	30/100
132665	50	32	8.0	30/100
132665T	50	32	8.0	5/16
132670	100	64	32	15/50
132675	120	76	46	15/50

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Spectra/Por® 2 12,000-14,000 Dalton MWCO

Product No.	Flat Width (mm)	Diameter (mm)	Vol/Length (ml/cm)	Length (m/ft)
132676	10	6.4	0.32	15/50
132678	25	16.0	2.0	15/50
132678T	25	16.0	2.0	5/16
132680	45	29.0	6.4	15/50
132680T	45	29.0	6.4	5/16
132682	105	67.0	34.0	15/50
132684	120	76.0	46.0	15/50

Spectra/Por® 3 3,500 Dalton MWCO

Product No.	Flat Width (mm)	Diameter (mm)	Vol/Length (ml/cm)	Length (m/ft)
132720	18	11.5	1.0	15/50
132720T	18	11.5	1.0	5/16
132724	45	29	6.4	15/50
132725	54	34	9.3	15/50
132725T	54	34	9.3	5/16

Spectra/Por® 4 12,000-14,000 Dalton MWCO

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)	Length (m/ft)
132697	10	6.4	0.32	30/100
132700	25	16	2.0	30/100
132703	32	20.4	3.3	30/100
132706	45	29	6.4	30/100
132709	75	48	18	15/50

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Spectra/Por® 5 High Wet Strength 12,000-14,000 Dalton MWCO

Spectra/Por 5 is reinforced with a layer of porous paper to increase its wet strength for use in high shear or torque environments. Spectra/Por 5 has a relatively low permeation rate for solutes compared to other membranes.

Product No.	Flat Width (mm)	Diameter (mm)	Vol/Length (ml/cm)	Length (m/ft)
132754	75	48	18	15/50
132757	140	89	62	15/50

Spectra/Por® 6

- Regenerated Cellulose membrane tubing
- Supplied wet in 0.05% sodium azide preservative solution
- Chemical pretreatment may be required for removing traces of heavy metal contaminants.
- Package of 10 meter/33 feet length

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 1,000			
132636	18	11.5	1.0
132638	38	24	4.6
132640	45	29	6.4

Spectra/Por® 6 (cont.)

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 2,000			
132620	18	11.5	1.0
132625	38	24	4.6
132633	45	29	6.4
MWCO 3,500			
132590	18	11.5	1.0
132592	45	29	6.4
132594	54	34	9.3
MWCO 8,000			
128056	8	5.1	0.20
132579	12	7.5	0.45
128058	18	11.5	1.0
132580	24	15	1.8
132582	32	20.4	3.3
132584	40	25.5	5.1
132586	50	32	8.0
MWCO 10,000			
128106	8	5.1	0.20
132570	12	7.5	0.45
128118	18	11.5	1.0
132572	24	15	1.8
132574	32	20.4	3.3
132576	45	29	6.4
MWCO 15,000			
128156	8	5.1	0.20
132560	12	7.5	0.45
128158	18	11.5	1.0
132562	24	15	1.8

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 15,000 (cont.)			
132564	32	20.4	3.3
132566	45	29	6.4
MWCO 25,000			
128206	8	5.1	0.20
132550	12	7.5	0.45
128218	18	11.5	1.0
128224	24	15	1.8
132552	28	18	2.5
132554	34	22	3.7
MWCO 50,000			
132539	10	6.4	0.3
132540	12	7.5	0.45
132542	28	18	2.5
132544	34	22	3.7

Spectra/Por® 7

- Regenerated Cellulose Membrane Tubing
- Minimum sulfur and heavy metal contamination
- Supplied wet in 0.05% sodium azide
- Package of 5 meter/16 feet length

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 1,000			
132103	18	11.5	1.0
132104	38	24	4.6
132105	45	29	6.4

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Spectra/Por® 7 (cont.)

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 2,000			
132107	18	11.5	1.0
132108	38	24	4.6
132109	45	29	6.4
MWCO 3,500			
132110	18	11.5	1.0
132111	45	29	6.4
132112	54	34	9.3
MWCO 8,000			
128356	8	5.1	0.20
132113	12	7.5	0.45
128358	18	11.5	1.0
132114	24	15	1.8
132115	32	20.4	3.3
132116	40	25.5	5.1
132131	50	32	8.0
MWCO 10,000			
128406	8	5.1	0.20
132117	12	7.5	0.45
128418	18	11.5	1.0
132118	24	15	1.8
132119	32	20.4	3.3
132120	45	29	6.4
MWCO 15,000			
128456	8	5.1	0.20
132121	12	7.5	0.45

Spectra/Por® 1-7 Regenerated Cellulose Membranes

Product No.	Flat Width (mm)	Dia (mm)	Vol/Length (ml/cm)
MWCO 15,000 (cont.)			
128458	18	11.5	1.0
132122	24	15	1.8
132123	32	20.4	3.3
132124	45	29	6.4
MWCO 25,000			
128506	8	5.1	0.20
132125	12	7.5	0.45
128518	18	11.5	1.0
128524	24	15	1.8
132126	28	18	2.5
132127	34	22	3.7
MWCO 50,000			
132128	12	7.5	0.45
132129	28	18	2.5
132130	34	22	3.7

Spectra/Por® RC Membrane Discs and Flat Sheet

- Precut membrane discs are packaged 50 per pack
- Flat sheet membranes are packaged 25 per pack
- Membrane supplied dry with glycerol as a humectant

Spectra/Por®	MWCO (Daltons)	Product No. for Dia. Discs		
		33 mm	47 mm	100 mm
Spectra/Por® 1	6,000-8,000	132478	132476	132474
Spectra/Por® 2	12,000-14,000	132482	132480	132477
Spectra/Por® 3	3,500	132488	132486	132484
Spectra/Por® 4	12,000-14,000	132498	132496	132494

Spectra/Por® RC Membrane Flat Sheet (cont)

Spectra/Por®	MWCO (D)	Sheets (mm)	Product No.
Spectra/Por® 1	6,000-8,000	240 x 240	132677
Spectra/Por® 2	12,000-14,000	200 x 200	132686
Spectra/Por® 3	3,500	108 x 108	132723
Spectra/Por® 4	12,000-14,000	150 x 150	132712
Spectra/Por® 5	12,000-14,000	275 x 275	132759

Spectra/Por® Ready-to-Use Dialysis Sacks

Spectra/Por Ready-to-Use Dialysis Sacks feature regenerated cellulose tubing sealed at one end with a closure and open at the other. These sacks have a funnel attached to the top for easy sample filling. Supplied in a 0.05% sodium azide preservative, sacks should be rinsed prior to use. Each Dialysis Sack is 60 cm in length for volumes of 1 to 40 ml or 50 to 400 ml. Supplied 10/package in three MWCO choices.

Product No.	Description	MWCO (Daltons)	Flat Width (mm)
1 to 40 ml			
132651	Spectra/Por® 1	6,000-8,000	23
132679	Spectra/Por® 2	12,000-14,000	25
132721	Spectra/Por® 3	3,500	18
132701	Spectra/Por® 4	12,000-14,000	25
50 to 400 ml			
132666	Spectra/Por® 1	6,000-8,000	50
132681	Spectra/Por® 2	12,000-14,000	45
132726	Spectra/Por® 3	3,500	54
132707	Spectra/Por® 4	12,000-14,000	45

Heavy Metals Cleaning Solution

Spectra/Por 1, 2, 3, 4, 5, and 6 membranes contain traces of heavy metals. For ultracritical work, chelate wash the membranes with Heavy Metals Cleaning solution before use.

Product No.	Description
132908	Heavy Metals Cleaning Kit, 8 oz.

Spectra/Por® Openers

Solve the problem of opening dry dialysis tubing with Spectra/Por Openers. They have a strong adhesive that grips dry tubing for easy membrane separation for filling with sample solution.

Product No.	Description	Qty
132730	Spectra/Por® Openers	100

Membrane Compatibility Table

This chemical resistance chart is intended for use as a guide, not as a guarantee of chemical compatibility. Variables in temperature, concentrations, durations of exposure and other factors may affect the use of the product. It is recommended to test under your own conditions.

The following codes are used to rate chemical resistance:

R	Recommended
L	Limited Exposure
NR	Not Recommended
U	Unknown

Regenerated Cellulose (RC)	Regenerated Cellulose (RC)	Regenerated Cellulose (RC)	
Acetic acid (diluted-5%)	R	Chloroacetic acid	R
Acetic acid (med conc-25%)	R	Chloroform	R
Acetic acid (glacial)	R	Chromic acid	NR
Acetone	R	Cresol	R
Acetonitrile	R	Cyclohexane	R
Ammonium hydroxide (diluted)	R	Cyclohexanone	R
Ammonium hydroxide (med conc)	L	Diacetone alcohol	R
Amyl acetate	R	Dichloromethane	R
Amyl alcohol	R	Dimethyl formamide	L
Aniline	R	Dimethylsulfoxide	R
Benzene	R	1,4 Dioxane	L
Benzyl alcohol	R	Ethers	R
Boric acid	R	Ethyl acetate	R
Brine	R	Ethyl Alcohol	R
Bromoform	R	Ethyl alcohol (15%)	R
Butyl acetate	R	Ethyl alcohol (95%)	R
Butyl alcohol	R	Ethylene dichloride	R
Butyl cellosolve	L	Ethylene glycol	R
Butylaldehyde	R	Ethylene oxide	L
Carbon tetrachloride	R	Formaldehyde (2%)	R
Cellosolve	L	Formaldehyde (30%)	R

Regenerated Cellulose (RC)	Regenerated Cellulose (RC)	Regenerated Cellulose (RC)	Regenerated Cellulose (RC)
Formic acid (25%)	R	Nitrobenzene	L
Formic Acid (50%)	R	Nitropropane	L
Freon®	R	Oils, mineral	R
Gasoline	R	Pentane	R
Glycerine	R	Perchloric acid (25%)	L
Glycerol	R	Perchloroethylene	R
Hexane	R	Petroleum based oils	R
Hexanol	R	Petroleum ether	R
Hydrochloric acid (diluted-5%)	R	Phenol (0.5%)	R
Hydrochloric acid (med conc-25%)	NR	Phenol (10%)	R
Hydrochloric acid (con-37%)	NR	Phosphoric acid (25%)	L
Hydrofluoric acid (25%)	L	Potassium hydroxide (1N)	L
Hydrogen peroxide (30%)	NR	Potassium hydroxide (25%)	R
Iodine solutions	NR	Potassium hydroxide (50%)	NR
Isobutyl alcohol	R	Propanol	R
Isopropanol	R	Pyridine	R
Isopropyl acetate	R	Silicone oil	R
Isopropyl alcohol	R	Sodium hydroxide (0.1N)	R
Isopropyl ether	R	Sodium hydroxide (diluted-5%)	L
Jet Fuel 640A	R	Sodium hydroxide (25%)	L
Kerosene	R	Sodium hydroxide (conc-50%)	NR
Lactic acid	R	Sodium Hydroxide (Concentrated)	NR
Methyl acetate	R	Sodium Hypochlorite	R
Methyl alcohol	R	Sulfuric acid (diluted-5%)	R
Methyl alcohol (98%)	R	Sulfuric acid (med conc-25%)	L
Methyl cellosolve	L	Sulfuric acid (6N)	L
Methyl Chloride	R	Sulfuric Acid (concentrated)	NR
Methyl ethyl ketone	R	Tetrahydrofuran	R
Methyl formate	R	Toluene	R
Methyl isobutyl ketone	L	Trichloroacetic acid (25%)	NR
Methylene chloride	R	Trichlorobenzene	R
N-Methyl-2-Pyrrolidone	R	Trichloroethane	R
Mineral spirits	R	Trichloroethylene	R
Monochlorobenzene	R	Triethylamine	R
Nitric acid (diluted-5%)	R	Turpentine	R
Nitric acid (med conc-25%)	NR	Urea	R
Nitric acid (6N)	NR	Urea (6N)	R
Nitric acid (conc-70%)	NR	Water	R
Nitric acid (concentrated)	NR	Xylene	R

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