PALL Life Sciences

Centrifugal Devices

Facilitate pure product with > 90% recoveries in just minutes

- **Accelerate sample processing** – Concentrate and purify samples with starting volumes of < 50 µL to 60 mL.
- **Maximize sample recovery** – Obtain high flow rates and low non-specific protein and nucleic acid binding.
- **Add versatility** – Available in various membrane types including low-binding Bio-Inert® (modified nylon), Supor® (polyethersulfone), and GHP (polypropylene) membranes, as well as Omega™ (modified polyethersulfone) ultrafiltration membrane in a variety of MWCOs.
- **Prevent solution bypass** – Membrane seals stop solution leakage, minimizing sample loss.
- **Easy visual identification** – Devices are color-coded for a wide variety of membranes, ranging from 1 kD to 0.45 µm.

Applications

Centrifugal devices can replace traditional separation techniques, such as column chromatography, preparative electrophoresis, alcohol or salt precipitation, dialysis, and gradient centrifugation, when performing the following:

- Protein or nucleic acid concentration
- Desalting
- Buffer exchange
- Deproteination of biological samples
- Fractionation of protein mixtures
- Separation of primers from PCR products
- Separation of labeled nucleic acids or proteins from unincorporated nucleotides
- Virus concentration or removal
- Clarification of cell lysates and tissue homogenates

Filtration. Separation. Solution.SM

How to Choose a Centrifugal Device

Pall's centrifugal devices simplify many common nucleic acid and protein handling procedures. These devices provide efficient concentration and salt removal from 50 µL to 60 mL samples. Choose from membranes that have been developed to assure low non-specific biomolecule binding and typically provide > 90% recovery of target biomolecules.

Ultrafiltration Method

Ultrafiltration is a membrane separation technique used to separate extremely small particles and dissolved molecules in fluids. The primary basis for separation is molecular size, although other factors such as molecular shape and charge can also play a role. Molecules larger than the membrane pores will be retained, but not bound, at the surface of the membrane (not in the polymer matrix as they are retained in microporous membranes) and concentrated during the ultrafiltration process.

Compared to non-membrane processes (chromatography, dialysis, solvent extraction, or centrifugation), ultrafiltration offers the following benefits:

- Is gentler to the molecules being processed.
- Does not require an organic extraction which may denature labile proteins.
- Maintains the ionic and pH conditions.
- Is fast and relatively inexpensive.
- Can be performed at low temperatures (for example, in the cold room).
- Is very efficient and can simultaneously concentrate and purify molecules.

The retention properties of ultrafiltration membranes are expressed as molecular weight cut-off (MWCO). This value refers to the approximate molecular weight of a dilute globular solute (i.e., a typical protein) which is 90% retained by the membrane. However, a molecule's shape can have a direct effect on its retention by a membrane. For example, linear molecules like DNA may find their way through pores that will retain a globular species of the same molecular weight.

There are three generic applications for ultrafiltration:

1. **Concentration** – Ultrafiltration is a very convenient method for the concentration of dilute protein or DNA/RNA samples. It is gentle (does not shear DNA as large as 100 Kb or cause loss of enzymatic activity in proteins) and very efficient (typically > 90% recovery).
2. **Desalting and buffer exchange (diafiltration)** – Ultrafiltration provides a convenient and efficient way to remove or exchange salts, remove detergents, separate free from bound molecules, remove low molecular weight materials, or rapidly change the ionic or pH environment.
3. **Fractionation** – Ultrafiltration will not accomplish a sharp separation of two molecules with similar molecular weights. The molecules to be separated should differ by at least one order of magnitude (10X) in size for effective separation. Fractionation using ultrafiltration is effective in applications, such as the preparation of protein-free filtrates, the separation of unbound or unincorporated label from DNA and protein samples, and the purification of PCR products from synthesis reactions.

Device Selection Based on Volume

Device	Sample Volume
Nanosep® device	< 0.5 mL
Microsep™ Advance device	0.5 - 5 mL
Macrosep® Advance device	5 - 20 mL
Jumbosep™ device	20 - 60 mL

Membrane Selection Based on Application

These membranes meet the challenges of a wide range of applications with superior performance and stability:

- **Omega** (modified polyethersulfone) ultrafiltration membrane for rapid concentrating and desalting.
- **Bio-Inert** (modified nylon), **Supor** (polyethersulfone), and **GHP** (hydrophilic polypropylene) microfiltration membranes for removing particulate (such as gel debris).

Choosing the Correct MWCO

Once sample volume is determined, the next step is to select the appropriate MWCO (for ultrafiltration) or pore size (for microfiltration). MWCOs are nominal ratings based on the ability to retain > 90% of a solute of a known molecular weight (in Kilodaltons). Table 2 provides retention characteristics of different MWCO membranes for some solutes. For proteins, it is recommended that an MWCO be selected that is three to six times smaller than the molecular weight of the solute being retained. If flow rate is a consideration, choose a membrane with an MWCO at the lower end of this range (3X); if the main concern is retention, choose a tighter membrane (6X).

It is important to recognize that retention of a molecule by an ultrafiltration membrane is determined by a variety of factors, among which its molecular weight serves only as a general indicator. Therefore, choosing the appropriate MWCO for a specific application requires the consideration of many factors including molecular shape, electrical charge, sample concentration, sample composition, and operating conditions.

Because different manufacturers use different molecules to define the MWCO of their membranes, it is important to perform pilot experiments to verify membrane performance in a particular application.

Common Variables That Increase Molecule Passage:

- Sample concentration less than 1 mg/mL.
- Linear versus globular molecules.
- High transmembrane pressure created by g-force in centrifugal concentrators. (This is especially important in the case of linear molecules, for example DNA fragments. Decreasing the g-force can increase retention of molecules by a membrane.)
- Buffer composition that favors breakup of molecules.
- pH and ionic conditions that change the molecule (for example, cause conformational changes or aggregation).

Common Variables That Decrease Molecule Passage:

- Sample concentration higher than 10 mg/mL.
- Buffer conditions that permit molecules to aggregate.
- Presence of other molecules that increase sample concentration.
- Lower transmembrane pressure (in the case of centrifugal concentrators, lower g-force).
- Adsorption to the membrane or device.
- Low temperature (4 °C versus 24 °C).

Table 1
MWCO Selection for Protein Applications

MWCO	Membrane Nominal Pore Size*	Biomolecule Size	Biomolecule Molecular Weight
3K	–	–	10K - 30K
10K	–	–	30K - 90K
30K	–	–	90K - 300K
100K	10 nm	30 - 90 nm	300K - 900K
300K	35 nm	90 - 200 nm	900K - 3,000K

MWCO Selection for Nucleic Acid Applications

MWCO	Base Pairs (DS)	Bases (SS)
3K	16 - 50 Bp	32 - 95 Bs
10K	50 - 145 Bp	95 - 285 Bs
30K	145 - 475 Bp	285 - 950 Bs
100K	475 - 1,450 Bp	950 - 2,900 Bs
300K	1,450 - 9,500 Bp	2,900 - 9,500 Bs

MWCO Selection for Virus Applications

MWCO	Membrane Nominal Pore Size*	Virus or Particle Diameter
100K	10 nm	30 - 90 nm
300K	35 nm	90 - 200 nm
1000K	100 nm	300 - 600 nm

**Nominal pore size as measured by electron microscopy (50K is an estimate).*

Color-Coding

Centrifugal devices from Pall Life Sciences are available in a range of MWCOs color-coded for easy identification.

MWCO/Pore Size	Color
3K	gray
10K	blue
30K	red
100K	clear
300K	orange
0.2 µm	aqua
0.45 µm	wildberry and clear

Nanosep and Nanosep MF Centrifugal Devices

Simple, reliable concentrating and desalting of 50 to 500 µL samples

- Ensures rapid processing of samples.
- Typical recoveries are > 90%. Available with low protein-binding Omega, Bio-Inert, and GHP membranes.
- A wide range of MWCOs, color-coded for easy identification.
- Constructed of low-binding polypropylene.
- Ultrasonically welded seals prevent bypass or seal failure.
- Fits standard centrifuge rotors that accept 1.5 mL tubes.

Applications

- Concentrate, purify, and desalt oligonucleotides, DNA, RNA, and proteins.
- Clean up labeling and PCR reactions.
- Isolate DNA from agarose gel slices.
- Separate oligonucleotides and RNA from acrylamide gels.
- Concentrate PCR products regardless of size with 30K device if primer removal is required.
- Prepare protein sample for analytical techniques (e.g., HPLC, LC/MS).

Specifications

Materials of Construction

Nanosep Devices
Filter Media: Omega (modified polyethersulfone) ultrafiltration membrane
Sample Reservoir, Membrane Support Base, and Filtrate Receiver: Polypropylene

Nanosep MF Devices
Filter Media: Bio-Inert (modified nylon) and GH Polypro (GHP, hydrophilic polypropylene) membranes
Sample Reservoir, Membrane Support Base, and Filtrate Receiver: Polypropylene

Effective Filtration Area

0.3 cm^2

Dimensions

Overall Length (Fully Assembled With Cap): 4.5 cm (1.8 in.)

Capacities

Maximum Sample Volume: 500 µL
Final Concentrate Volume: 15 µL
Filtrate Receiver Volume: 500 µL
Hold-Up Volume (Membrane/Support): < 5 µL

Operating Temperature Range

0 - 40 °C (32 - 104 °F)

pH Range

Nanosep Devices: 1 - 14
Nanosep MF Devices: 3 - 14

Maximum Centrifugal Force

14,000 x g

Centrifuge

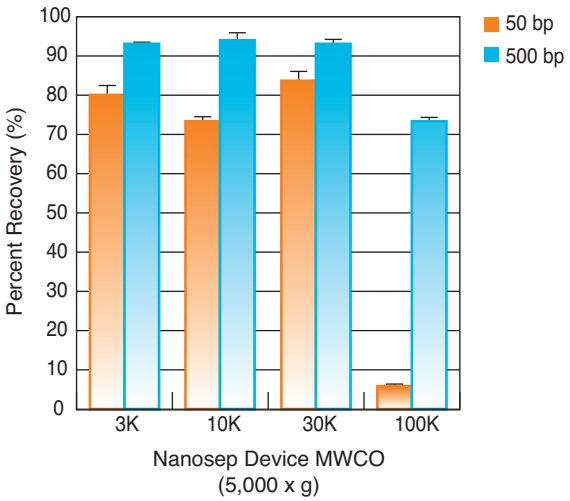
Fits rotors that accept 1.5 mL tubes

Sanitization

Provided non-sterile. May be sanitized by filtering 70% ethanol through the device prior to use.

Performance

DNA Recovery as a Function of Device MWCO



A 500 µL sample of a 100 µg/mL DNA fragment solution containing 50 and 500 bp double-stranded DNA fragments was centrifuged at 5,000 x g in Nanosep devices to a final volume of 50 µL. Recovered samples were quantified using absorbance at 260 nm. The 100K device was able to differentiate between the sizes of the DNA fragments.

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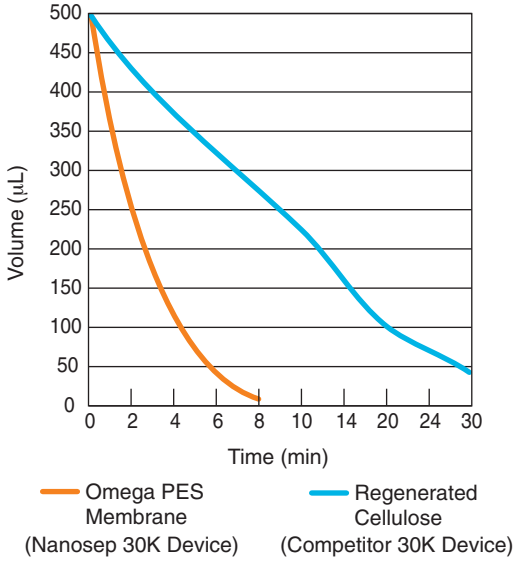
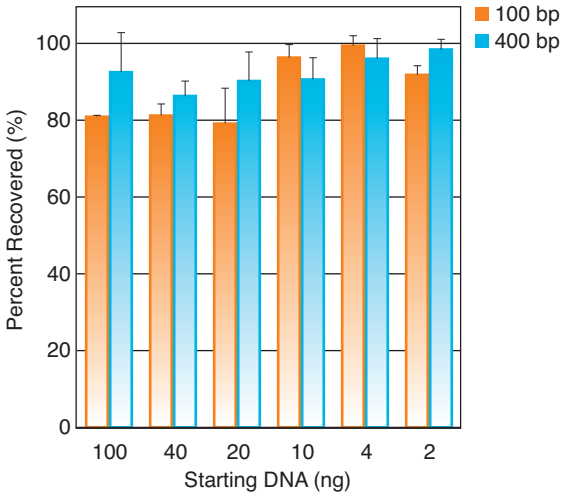
Centrifugal Device Spin Times



DNA Recovery



Nanosep 30K devices were used to filter dilute radioactive DNA fragments. In order to accurately quantitate DNA recovery from dilute samples, PCR products (100 and 400 bp) were dual labeled to low-specific activity with ^{32}P-labeled dCTP and ^{32}P-labeled dATP and prepared for filtration. After synthesis, unincorporated nucleotides, as well as termination products, were removed by ultrafiltration using a 30K Nanosep device. The resulting retentate was checked for size and quantitated using gel electrophoresis. Labeled DNA in quantities ranging from 100 ng all the way down to 2 ng per device was diluted to 500 µL using TE. The samples (in triplicate) were centrifuged at 5,000 x g for 10 minutes (spun to dryness) and recovered in two washes of 20 µL water. The resulting retentate was added to a counting vial containing scintillation solution and counted.

Ordering Information

Nanosep Centrifugal Devices with Omega Membrane

Part Number	Description	Pkg
OD003C33	3K, gray	24/pkg
OD003C34	3K, gray	100/pkg
OD003C35	3K, gray	500/pkg
OD010C33	10K, blue	24/pkg
OD010C34	10K, blue	100/pkg
OD010C35	10K, blue	500/pkg
OD030C33	30K, red	24/pkg
OD030C34	30K, red	100/pkg
OD030C35	30K, red	500/pkg
OD100C33	100K, clear	24/pkg
OD100C34	100K, clear	100/pkg
OD100C35	100K, clear	500/pkg
OD300C33	300K, orange	24/pkg
OD300C34	300K, orange	100/pkg
OD300C35	300K, orange	500/pkg

Nanosep MF Centrifugal Devices with Bio-Inert Membrane

Part Number	Description	Pkg
ODM02C33	0.2 µm, aqua	24/pkg
ODM02C34	0.2 µm, aqua	100/pkg
ODM02C35	0.2 µm, aqua	500/pkg
ODM45C33	0.45 µm, wildberry	24/pkg
ODM45C34	0.45 µm, wildberry	100/pkg
ODM45C35	0.45 µm, wildberry	500/pkg

Nanosep MF Centrifugal Devices with GHP Membrane

Part Number	Description	Pkg
ODGHPC34	0.45 µm, clear	100/pkg
ODGHPC35	0.45 µm, clear	500/pkg

Microsep Advance Centrifugal Devices

Precise, quick recovery of microliter volumes

- Achieve 50X concentration and > 90% recovery in just minutes.
- Deadstop feature prevents samples from spinning to dryness.
- Versatile Omega membrane is available in a variety of MWCOs.
- Color-coded and laser etched for easy identification.

Applications

Ultrafiltration

- Concentrate dilute protein samples prior to electrophoresis.
- Exchange buffer and remove salt in samples.
- Isolate low molecular weight compounds from fermentation broths for natural product screening.
- Recover biomolecules from cell culture supernatants or lysates.

Microfiltration

- Clarify samples with gross particulate.
- Remove particulate from samples for HPLC analysis of drugs, amino acids, and antibodies.

Specifications

Materials of Construction

Filter Media: Omega (modified polyethersulfone) and Supor (polyethersulfone) membranes
Sample Reservoir, Filtrate Receiver and Cap: Polypropylene
Paddle: Polyethylene

Effective Filtration Area

3.3 cm^2

Dimensions

Diameter: 17 mm (0.7 in.)
Length: 12.0 cm (4.9 in.)

Capacities

Maximum Sample Volume: 5.0 mL
Final Concentrate Volume:
65 µL (swinging bucket)
80 µL (45° angle rotor)
100 µL (34° angle rotor)
Filtrate Receiver Volume: 6.5 mL
Hold-Up Volume: 40 µL (membrane and paddle)

Operating Temperature Range

0 - 40 °C (32 - 104 °F)

pH Range

1 - 14

Maximum Centrifugal Force

7,500 x g (ultrafiltration)
14,000 x g (microfiltration)

Centrifuge

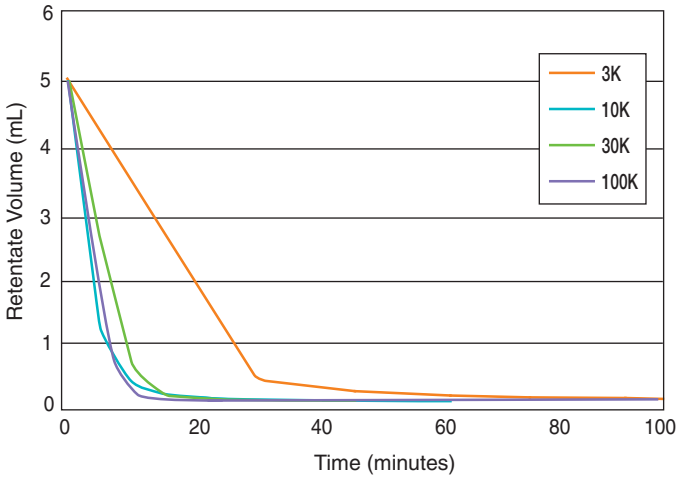
A fixed angle rotor or swinging bucket that accepts standard 17 x 100 mm tubes and is capable of 3,000 to 14,000 x g

Sanitization

Provided non-sterile. May be sanitized by filtering 70% ethanol through the device prior to use.

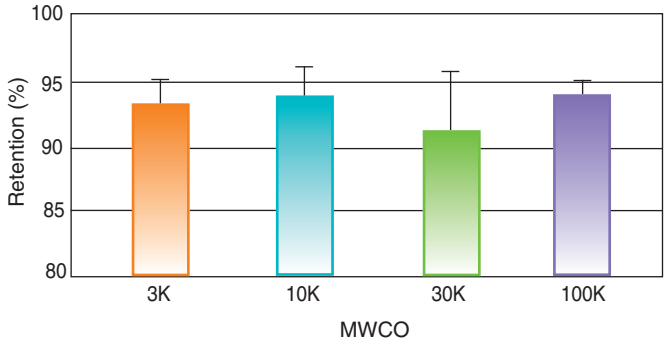
Performance

Microsep Advance Centrifugal Devices: Reduced Spin Time



Protein solutions were processed in each of the Microsep Advance devices. Average time (minutes) is plotted against mL of remaining product to be filtered using a 34° fixed angle rotor at 5,000 g. Solutions are 3K: Cytochrome C, 250 µg/mL; 10K: BSA, 1 mg/mL; 30K: IgG, 1 mg/mL; and 100K: Thyroglobulin, 1 mg/mL.

Microsep Advance Centrifugal Devices: Retention Efficiency



Protein solutions were processed in each of the Microsep Advance devices. Average percent retention using 34° fixed angle rotor at 5,000 g is displayed for each MWCO. Solutions were 3K: Cytochrome C, 250 µg/mL; 10K: BSA, 1 mg/mL; 30K: IgG, 1 mg/mL; and 100K: thyroglobulin, 1 mg/mL.

Ordering Information

Microsep Advance Centrifugal Devices with Omega Membrane

Part Number	Description	Pkg
MCP003C41	3K, gray	24/pkg
MCP003C46	3K, gray	100/pkg
MCP010C41	10K, blue	24/pkg
MCP010C46	10K, blue	100/pkg
MCP030C41	30K, red	24/pkg
MCP030C46	30K, red	100/pkg
MCP100C41	100K, clear	24/pkg
MCP100C46	100K, clear	100/pkg

Microsep Advance Centrifugal Devices with Supor Membrane

Part Number	Description	Pkg
MCPM02C67	0.2 µm, aqua	24/pkg
MCPM02C68	0.2 µm, aqua	100/pkg
MCPM45C67	0.45 µm, wildberry	24/pkg
MCPM45C68	0.45 µm, wildberry	100/pkg

Macrosep Advance Centrifugal Devices

Quickly concentrates up to 20 mL of biological sample

- Rapidly concentrates 20 mL sample volumes to 0.5 mL.
- Provides high recoveries, typically > 90%.
- Low protein-binding Omega membrane and polypropylene housing minimize losses due to non-specific binding.
- Versatile Omega membrane is available in a variety of MWCOs.
- Built-in deadstop prevents spinning to dryness.
- Color-coded for easy identification.

Applications

Ultrafiltration

- Concentrate and desalt proteins.
- Exchange buffer or remove salt of chromatography eluates and gradient fractions.
- Recover proteins or other molecules from cell culture supernatants.

Microfiltration

- Remove particulate from aqueous solutions and clinical samples.

Specifications

Materials of Construction

Filter Media: Omega (modified polyethersulfone) and Supor (polyethersulfone) membranes
Sample Reservoir, Filtrate Receiver, and Cap: Polypropylene
Paddle: Polyethylene

Effective Filtration Area

7.2 cm^2

Dimensions

Diameter: 29 mm (1.2 in.)
Length: 12.0 cm (4.7 in.)

Capacities

Maximum Sample Volume: 20 mL
Final Concentrate Volume:
450 µL (swinging bucket)
1.2 - 1.5 mL (45° angle rotor)
1.5 mL (34° angle rotor)
Filtrate Receiver Volume: 22 mL
Hold-Up Volume: 80 µL (membrane and paddle)

Operating Temperature Range

0 - 40 °C (32 - 104 °F)

pH Range

1 - 14

Maximum Centrifugal Force

5,000 x g (ultrafiltration)
14,000 x g (microfiltration)

Centrifuge

Fits centrifuges that accept standard 50 mL conical end tubes

Sanitization

Provided non-sterile. May be sanitized by filtering 70% ethanol through the device prior to use.

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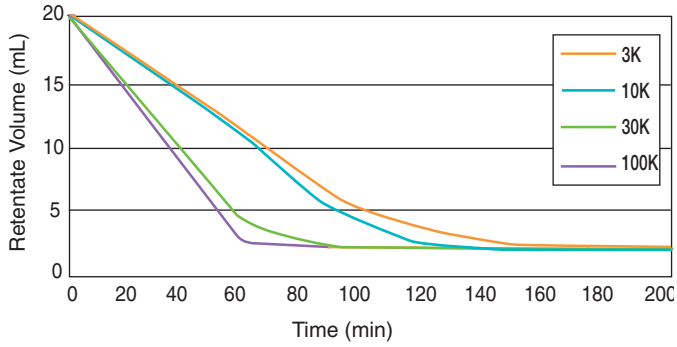
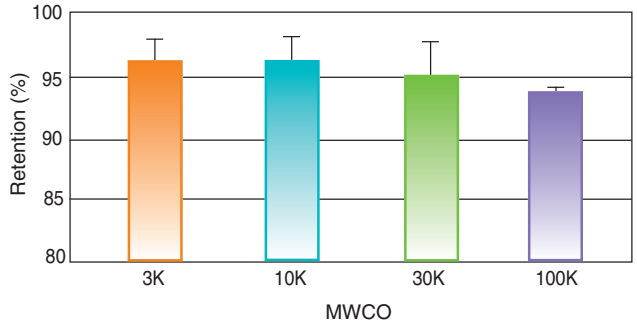
Performance

Macrosep Advance Centrifugal Devices: Reduced Spin Time



Protein solutions were processed in each of the Macrosep Advance devices. Average time (minutes) is plotted against mL of remaining product to be filtered using a swinging bucket rotor at 5,000 x g. Solutions are 3K: Protamine Sulfate, 0.1% in 1X PBS; 10K: Cytochrome C, 0.025% in 1X PBS; 30K: IgG, 0.1% in 1X PBS; and 100K: Apoferritin, 0.1% in 1X PBS.

Macrosep Advance Centrifugal Devices: Retention Efficiency



Protein solutions were processed in each of the Macrosep Advance devices. Average percent retention using a swinging bucket rotor at 5,000 x g is displayed for each MWCO. Solutions were 3K: Protamine Sulfate, 0.1% 1X PBS; 10K: Cytochrome C, 0.025% in 1X PBS; 30K: IgG, 0.1% in 1X PBS; and 100K: Apoferritin, 0.1% in 1X PBS.

Ordering Information

Macrosep Advance Centrifugal Devices with Omega Membrane

Part Number	Description	Pkg
MAP003C36	3K, gray	6/pkg
MAP003C37	3K, gray	24/pkg
MAP003C38	3K, gray	100/pkg
MAP010C36	10K, blue	6/pkg
MAP010C37	10K, blue	24/pkg
MAP010C38	10K, blue	100/pkg
MAP030C36	30K, red	6/pkg
MAP030C37	30K, red	24/pkg
MAP030C38	30K, red	100/pkg
MAP100C36	100K, clear	6/pkg
MAP100C37	100K, clear	24/pkg
MAP100C38	100K, clear	100/pkg

Macrosep Advance Centrifugal Devices with Supor Membrane

Part Number	Description	Pkg
MAPM02C67	0.2 µm, aqua	24/pkg
MAPM02C68	0.2 µm, aqua	100/pkg
MAPM45C67	0.45 µm, wildberry	24/pkg
MAPM45C68	0.45 µm, wildberry	100/pkg

Jumbosep Centrifugal Devices

Convenient and reliable concentration, purification, and diafiltration of 20 to 60 mL biological samples

- Typically concentrates 60 mL sample volumes to 5 mL in 30 minutes.
- Provides high recoveries, typically > 90%.
- Low protein-binding Omega membrane and polysulfone housing minimize losses due to non-specific binding.
- Versatile Omega membrane is available in a variety of MWCOs, color-coded for easy identification.
- Built-in deadstop prevents spinning to dryness.
- Unique sealing mechanism prevents retentate leakage and filtrate contamination.
- Economical. Sample reservoir and filtrate receiver can be sanitized or autoclaved, and reused.

Applications

Replaces dialysis, chemical precipitation, and lyophilization in the following applications:

- Concentrating and desalting proteins.
- Exchanging buffer or removing salt from chromatography eluates and gradient fractions.
- Separating biomolecules from cell culture supernatants.
- Concentrating or removing viruses.
- Performing crude fractionation of dilute protein mixtures.
- Removing debris and particulates from cell lysates.

Specifications

Materials of Construction

Filter Media: Omega (modified polyethersulfone) membrane
Sample Reservoir and Filtrate Receiver: Polysulfone
Sample Reservoir Cap: Polyethylene
Insert Without Membrane: High density polyethylene
Filtrate Receiver Cap and Insert Release: Polypropylene

Effective Filtration Area

15.2 cm^2

Dimensions

Outside Diameter (Maximum): 6 cm (2.4 in.)
Overall Height (Fully Assembled With Cap): 11.3 cm (4.5 in.)

Capacities

Maximum Sample Volume: 60 mL
Final Concentrate Volume: 3.5 - 4 mL
Maximum Filtrate Receiver Volume: 60 mL
Hold-Up Volume (Membrane/Support): 0.2 mL

Operating Temperature Range

0 - 40 °C (32 - 104 °F)

pH Range

1 - 14

Centrifuge

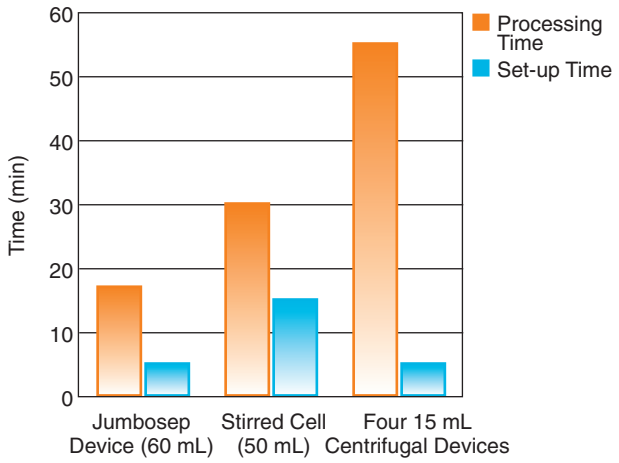
Swinging bucket rotor is required that accepts flat-bottomed 250 mL bottles and is capable of spinning at up to 3,000 x g

Sanitization

Provided non-sterile. May be sanitized by filtering 70% ethanol through it prior to use. The sample reservoir and the filtrate receiver can be autoclaved. Do not autoclave the filter media.

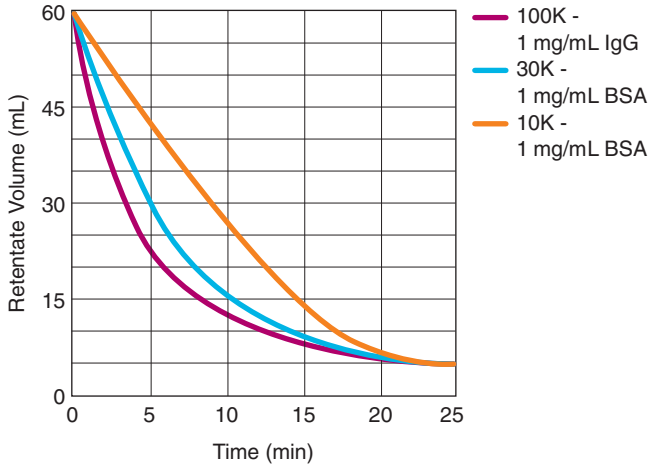
Performance

Jumbosep Device Reduces Processing Time Over Other Devices



1 mg/mL BSA solution was processed in each of the above devices until a 15-fold concentration was achieved.

Concentration Time



Concentrate dilute protein samples in less than 30 minutes with 10, 30, and 100K Jumbosep devices.

Ordering Information

The generic starter kit includes four holders, cups, and caps. Membrane inserts sold separately. The starter kits include four holders, cups, caps, and membrane inserts.

Jumbosep Centrifugal Device Starter Kits

Part Number	Description	Pkg
FD000K65	Generic starter kit, (no membrane inserts)	4/pkg
FD003K65	3K starter kit, gray	4/pkg
FD010K65	10K starter kit, blue	4/pkg
FD030K65	30K starter kit, red	4/pkg
FD100K65	100K starter kit, clear	4/pkg
FD300K65	300K starter kit, orange	4/pkg

Jumbosep Centrifugal Device Membrane Inserts

Part Number	Description	Pkg
OD003C65	3K membrane insert, gray	12/pkg
OD010C65	10K membrane insert, blue	12/pkg
OD030C65	30K membrane insert, red	12/pkg
OD100C65	100K membrane insert, clear	12/pkg
OD300C65	300K membrane insert, orange	12/pkg

Accessories and Replacement Parts

Part Number	Description	Pkg
FD001X65	Filtrate receiver and cap	12/pkg
FD002X65	Sample reservoir and cap	12/pkg
FD003X65	Insert release	24/pkg

Related Literature

- Protocol Guide, Nanosep Centrifugal Devices, www.pall.com/lab
- Technical Report, Purification and Handling of DNA Fragments, www.pall.com/lab
- Technical Report, Nanosep Centrifugal Ultrafiltration Devices and PCR: Before and After, www.pall.com/lab
- Technical Report, Single-Tube DNA Purification and Cloning Using Ultrafiltration Devices, www.pall.com/lab
- Technical Report, Fast and Efficient Elution of Proteins From Polyacrylamide Gels Using Nanosep Centrifugal Devices, www.pall.com/lab
- Product Data, Minimate™ Tangential Flow Filtration System and Capsule, PN 33366
- Application Manual, Protein Sample Preparation and Analysis, PN 33465

Related Products Available from Pall

- **AcroPrep™ Advance 96- and 384-well Filter Plates** are an excellent platform for a wide variety of molecular biology, analytical, and high throughput sample preparation and detection applications.
- **AcroWell™ 96 Filter Plates** are ideal for a wide variety of molecular biology detection applications.
- **BioTrace™ and Biodyne® Transfer Membranes** offer precise performance and compatibility with nearly every detection system available.
- **Minimate Tangential Flow Filtration Capsule** offers fast and efficient concentration and diafiltration (desalting) of biomolecules on the same system.
- **Omega Ultrafiltration Membrane Discs** are highly porous, providing fast flow rates and high recoveries.

PALL Life Sciences

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