

3M Purification Inc.

Betapure™ PK Series Filters



Innovative  
Filtration  
Solutions

Quality. Consistency. Performance.





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3M Purification Inc. (3M Purification) is a leader in advanced depth filter systems and membrane-based separations, offering a wide range of products for all stages of pharmaceutical processing and sterile filtration from bench-top to pilot-scale to manufacturing-scale operations.

Active Pharmaceutical Ingredients (API's) refer to the active chemicals used in the manufacture of drugs. API's are synthesized via a series of unit operations that include key filtration steps to produce the active ingredient of a drug product.

3M Purification's core filtration technologies address the most demanding applications in pharmaceutical processing for small molecule and API applications. Regulatory requirements demand the highest quality product standards along with documented evidence of manufacturing processes. 3M Purification products in the pharmaceutical industry meet the demands of regulatory agencies throughout the world and are used by the largest and most respected pharmaceutical manufacturers in the industry.

## Betapure™ PK Series Filters

### The Industry Standard for Oil & Gas Systems

Betapure™ PK series cartridges are easy to use filters manufactured from cellulose fibers, glass fibers, and a chemically resistant thermosetting resin to produce a durable, rigid filter structure. Standard Betapure PK series cartridges are grooved to significantly increase the surface area and extend service life in fluid filtration applications. Both grooved and smooth-surface Betapure PK series filters are available with absolute ratings from 10 to 60 microns. Cartridge configurations include standard industrial 2 5/8" OD, 336 style 3" OD, PG style 4 1/2" OD, and the PR internal o-ring style, in lengths from 9 3/4" to 72" with a wide range of end-treatments to ensure that Betapure PK series filter cartridges can easily retrofit installed filter housings. Standard diameter industrial Betapure PK series products include polyethylene foam gaskets for positive sealing in double open end housings. 3M Purification offers cartridges in the single open end style that employ integral polypropylene caps and springs to eliminate separate spring and seal assemblies.

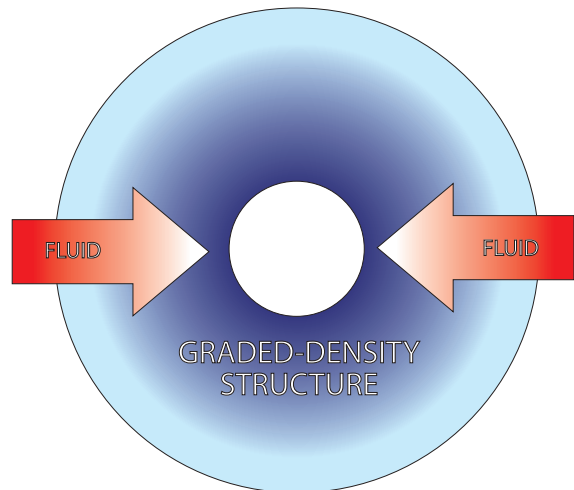
### Significant Life Advantage and Consistent Performance

The rigid graded porosity grooved structure of a Betapure PK series cartridge provides a significant life advantage over competitive products. Users of Betapure PK series in amine sweetening applications benefit from service life improvement 2 to 4 times greater than competitive products with amine clarity completely restored. Absolute rated Betapure PK series filters provide consistent performance at all times. Unlike many competitors, the rigid Betapure PK series structure does not unload or lose filtration efficiency throughout its usable life. (See Graph 1 on page 4).

An installation of Betapure PK series filters in an amine system at a major New Mexico gas processing plant demonstrated the filter's ability to provide over 3.5 times the life of a pleated media used previously. Betapure PK series filters provided over \$250K in total filtration cost savings during the first year of use. In another installation, a Texas NGL manufacturing facility substituted a 72" "PG series" Betapure PK series gas filter for a competitive "sock type" filter. The result was a service life increase from a maximum of three weeks with the "sock", to 12-14 weeks with Betapure PK series.

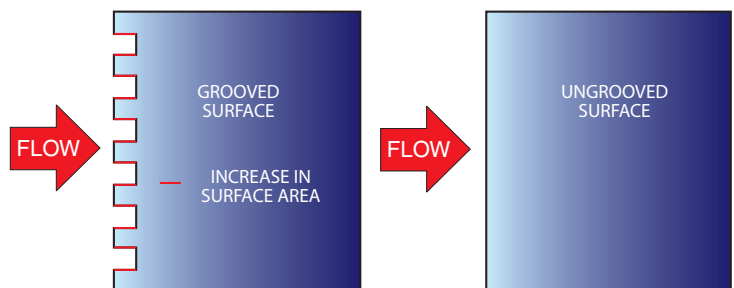
### Rigid Graded-Porosity Betapure™ PK series Structure

Betapure PK series filter cartridges are manufactured using an exclusive process to achieve a true graded-porosity structure. A 3M Purification manufacturing process results in a progressively more dense center core region creating a graded-porosity structure. Each fiber is locked in place by a thermosetting resin binder to create a rigid depth filter matrix that traps larger particles near the outer surface and smaller particles near the cartridge's inside diameter. The overall effect is to greatly improve cartridge service life by retaining particles and deformable contaminants in decreasing particle size ranges as the contaminant particles progress through the cartridge.



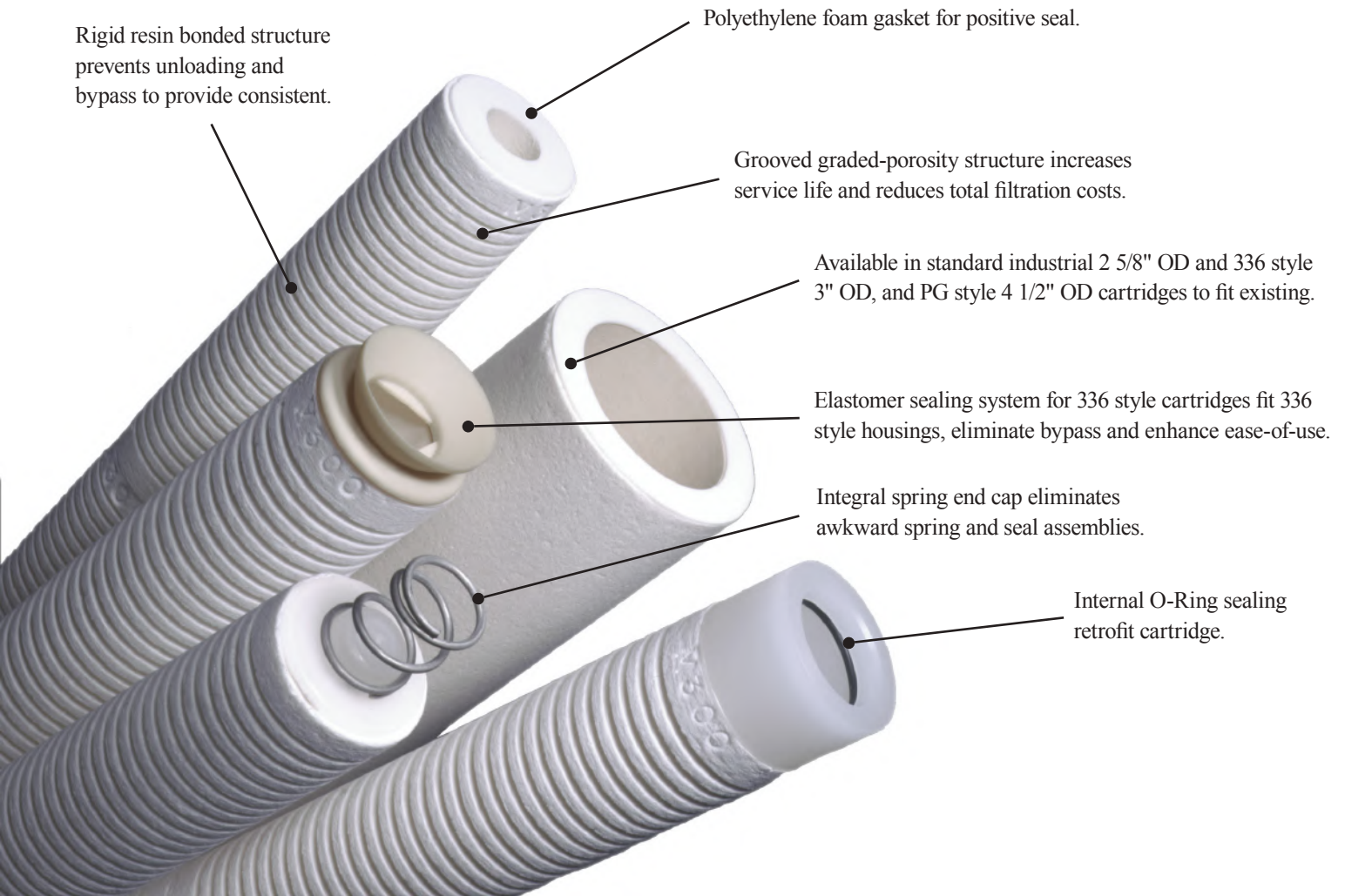
### Rigid Graded-Porosity Betapure™ PK series Structure

Betapure PK series cartridges also feature an optimized groove pattern to increase the surface area by over 65% when compared to ungrooved cylindrical cartridges. The grooved surface prevents premature blinding of the outer surface by large particles and allows full utilization of the depth structure. Maximum surface area with a true graded-porosity structure means that Betapure PK series can provide significantly greater service life than competitive filter cartridges.



## The Betapure™ PK Series Advantage!

Feature	Advantage	Benefit
Absolute-rated cartridge filters from 10 - 60 microns	Distinct particle size cutoff at the specified removal rating	Reproducible effluent quality throughout the filter's life
Beta 1000 rated throughout the cartridge life	No bypass or unloading at high differential pressure	Consistent product quality throughout the filter's life
Grooved surface with true graded-porosity structure	Significantly longer life	Dramatic cost savings with optimized yields
"336" cartridge elastomer sealing system	User-friendly, maintains integrity at high differential pressure	Fast filter change-out and consistent product quality
No metal or plastic cores	Easy disposal, suitable for incineration or shredding	Reduced disposal costs
Available in 2 5/8" OD, 3" OD, and 4 1/2" OD and lengths to 72"	Broad range of configurations for custom sizing	Retrofit existing housings and current applications





## Filtration Applications

### Betapure™ PK series for Natural Gas Processing

Betapure™ PK series provides excellent filtration performance in many natural gas processing applications including:

- Amine Sweetening
- Glycol Dehydration
- Compressor lube oil systems
- Fuel Gas

### Betapure™ PK series for Refining

Betapure PK series provides excellent filtration performance in many refinery applications including:

- Amine plant systems
- Hydrotreating
- Catalytic reforming
- Sour water stripping

Oil & Gas Processors have long recognized the benefits that absolute filtration systems provide including:

- Clean, high quality fluids for increased process efficiency
- Consistent protection of equipment to eliminate fouling of heat exchangers, reboilers, and pumps

Betapure PK series absolute filtration systems provide:

- Long on-stream service life to reduce downtime and maintenance
- Consistent filtration efficiency (Beta Rated Performance) throughout the entire operation
- Reduced total filtration costs

### Betapure™ PK Series for Waterflood

Distinct particle size cutoff and reproducible effluent quality make absolute-rated Betapure PK series ideally suited for waterflood applications. Betapure PK series consistently provides clean fluids to maximize well production. The efficient removal of suspended solids minimizes formation damage and plugging, and reduces the need for injection well workovers.

### Betapure™ PK Series for Enhanced Oil Recovery

In chemical processes, steam flood applications, and gas injection projects, absolute filtration is critical for removal of solid particles and contaminants that plug formations and foul equipment. Betapure PK series' rigid structure provides clean fluids and gases to optimize enhanced oil recovery (EOR) process efficiency and to protect equipment, reducing maintenance and repair costs.

### Betapure™ PK Series for Lube Oil Applications

Reproducible performance by Betapure PK series is essential for many lube oil applications in gas plants, gas transmission facilities and refineries. Betapure PK series' consistent absolute retention of particles provides specific benefits over compressible structures - sock type, string-wound, or melt-blown filter elements - that typically unload or lose filtration efficiency as differential pressure increases.



# Absolute Betapure™ PK Series

Absolute removal ratings for Betapure™ PK series are determined using a filter performance test developed by 3M Purification to comply with the general procedures outlined in ASTM 975 3M Purification defines absolute rating as the particle size (x) providing an initial Beta Ratio (Bx) = 1000. At this Beta ratio the removal efficiency is equal to 99.9%. Beta Ratio (Bx) is defined by the following equation:

$$B_x = \frac{\text{Cumulative Number of Particles Larger than } x \text{ in the Influent Challenge}}{\text{Cumulative Number of Particles Larger than } x \text{ in the Effluent}}$$

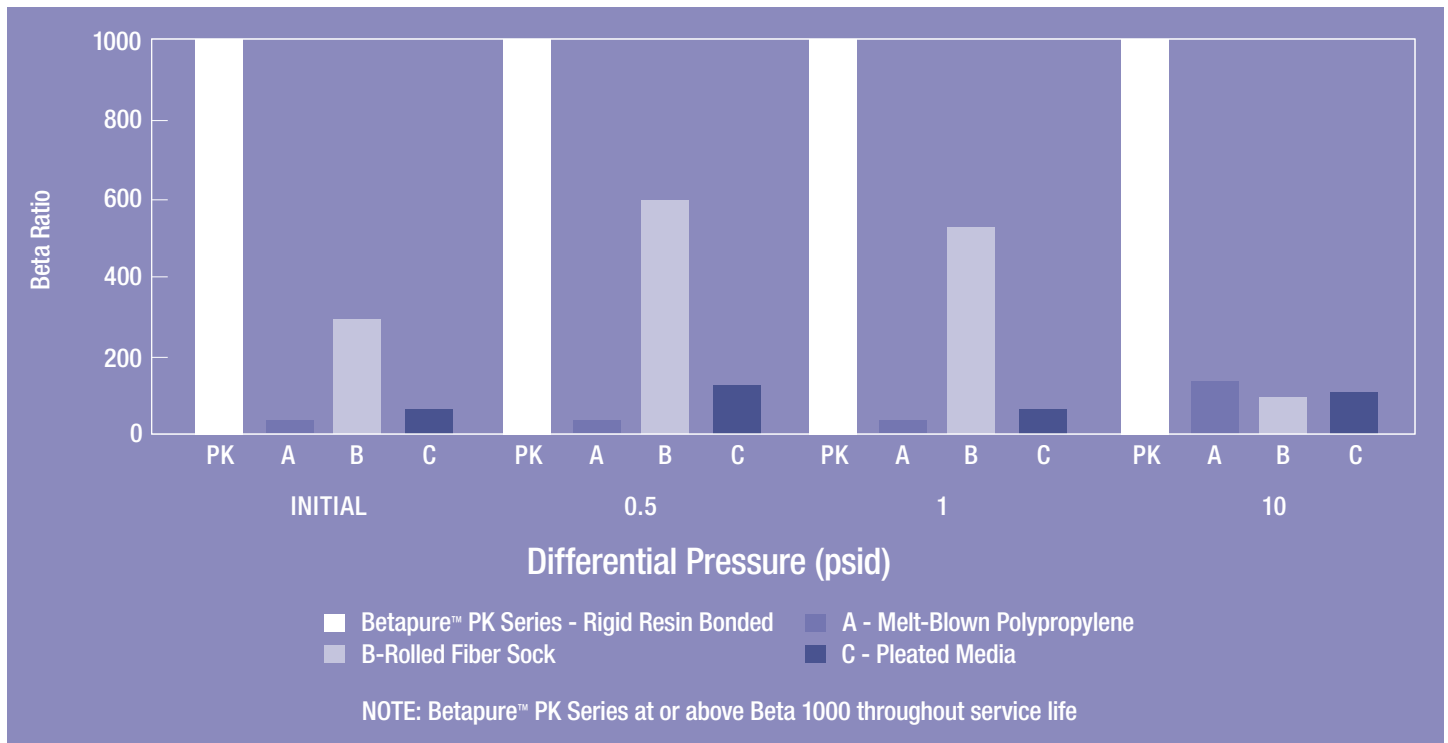
Betapure PK series filters achieve a minimum Beta (Bx) value of 1000 at the ratings specified in Table 1.

Grade Designation	Absolute Rating ( m )
M100	10
M200	20
M300	30
M400	40
M600	60

Table 1 Betapure™ PK Series Absolute Ratings

## Betapure™ PK Series - Consistent Performance

The initial Beta Ratio for all grades of Betapure PK series filter cartridges is equal or greater than 1000, and Betapure PK series cartridges perform at or above this initial value throughout the usable (all the way to plugging) life. This defines the Betapure PK series absolute filtration performance. The Beta Ratio vs. Differential Pressure in Graph 1 illustrates how competitive filters do not achieve the consistent performance of Betapure PK series. Filters that show a decrease in Beta Ratio as the differential pressure increases are exhibiting either unloading of previously held contaminants or a loss of filtration efficiency.



As illustrated in Graph 1, the performance of the Rolled Fiber Sock cartridges (Competitor B) exhibits contaminant unloading and a loss of filtration efficiency as differential pressure increases from 1 to 10 psid. The Melt-Blown (Competitor A) and the Pleated Cellulose/Polyolefin (Competitor C) filters exhibit minimal contaminant retention through the test duration.

## Betapure™ PK Series Product Specifications

### Betapure™ PK Series Chemical Compatibility

Betapure PK series is well suited for organic solvents including amines and glycols. Table 4 contains specific recommendations.

Rating & Materials Of Construction			
Absolute Rating (µm)	Grade	Fiber	Resin
10	M100	Cellulose / Glass	Melamine
20	M200		
30	M300	Cellulose	
40	M400		
60	M600		

Operating Parameters			
Maximum Operating Temperature	Standard (Media Only)*	250°F (121°C)	
	With Polyester End Fittings		
	With Polyethylene Foam Gasket	200°F (93°C)	
	With Elastomer Seal or	180°F (82°C)	
Maximum Differential Pressure	Polypropylene End Fittings 70 psid (4.8 bar) @ 68°F (20°C)		
Recommended Change-out Differential Pressure	35 psid (2.4 bar)		

Dimensions				
	PG Style	PR Style	336 Style	Standard Industrial Style
ID	3 1/8" (79.4 mm)	1 15/32" (37.3 mm)	1 15/32" (37.3 mm)	1 1/16" (27 mm)
OD	4 1/2" (114.3 mm)	2 25/32" (70.6 mm)	2 25/32" (70.6 mm)	2 19/32" (65.9mm)
Length	24" to 72" (610 - 1829 mm)	39" (990.6 mm)	36" (914 mm)	9 3/4" to 40" (248 - 1016 mm)

Table 2. - Betapure™ BK Series Product Specification

Standard Industrial Cartridges		
Grade	Absolute Rating	Specific p/10" Element * (psi/gpm)
M100	10	0.35
M200	20	0.19
M300	30	0.11
M400	40	0.10
M600	60	0.09
336 Style Cartridges		
Grade	Absolute Rating	Specific p/36" Element * (psi/gpm)
M100	10	0.06
M200	20	0.04
M300	30	0.03
M400	40	0.02
M600	60	0.015
PG Style Cartridges (4 1/2" OD)		
Grade	Absolute Rating	Specific p/12" Element * (psi/gpm)
M100	10	0.12
M200	20	0.06
M300	30	0.03
M400	40	0.02
M600	60	0.01
PR Style Cartridges (Internal O-Ring)		
Grade	Absolute Rating	Specific p/39" Element * (psi/gpm)
M100	10	0.06
M200	20	0.04
M300	30	0.03
M400	40	M400
M600	60	0.015

\*Specific aqueous pressure drop ( p) for a 10" equivalent length cartridge. For multiple length cartridges, divide total flow by the number of 10" equivalents.

\*\* Specific aqueous pressure drop ( p) for a 12" equivalent length cartridge. For multiple length cartridges, divide total flow by the number of 10" equivalents.

Table 3. - Betapure™ PK Series Flow Rates

Fluid		Rating
Category	Example	
Organic Solvents	Amines (DEA, MDEA, MEA) 20% - 50% up to 160°F (71°C)	R
	Glycols	R
	MEK	R
	Benzene	R
	Xylene	R
	Alcohols	R
	Dimethyl Formamide (DMF)	R
Petroleum	Gasoline	R
	Kerosene	R
	Diesel Fuel	R
	Lube Oil	R
	Fuel Oil	R
	Waxes	R
Water	Process (212 F/100°C)	R
	Produced (212 F/100°C)	R
	Boiler Feed (212 F/100°C)	R
	Demineralizer Feed (212 F/100°C)	R
Organic Acids	Acetic (100%)	N
	Tannic 10%	N
Inorganic Acids	Hydrochloric (Muriatic) Acid 5%	N
	Sulfuric 50%	N
	Sulfurous 5-10%	N
	Nitric	N
Brines and Aqueous Salt Solutions	Sodium Chloride	R
	Sodium Sulfate	R
	Sodium Nitrate	R
Weak Alkalis	Aluminum Hydroxide	N
	Ferric Hydroxide	N
	Magnesium Hydroxide	N
Fatty Acids - Oils	Detergents	R
	Mineral Oil	R
	Silicone Oils	R
R = Generally Recommended up to 250°F (121°C) unless otherwise noted.		
N = Not Recommended		

Table 4. - Chemical Compatibility

For liquids other than water, use the following formula in conjunction with the values from column 3 of Table 3. The specific pressure drop values may be effectively used when three of the four variables (Viscosity, Flow, Differential Pressure, and Cartridge Grade) are set.

$$\frac{\text{psid}}{\text{clean}} = \frac{(\text{Total system gpm}) (\text{Viscosity in Cp}) (\text{Value from table})}{\left( \text{Number of Equivalent Single Length Cartridges in housing} \right)}$$

The recommendations in Table 3 are for general guidance only. Testing under specific application conditions is recommended. For various end modifications and multi-length cartridges, consult your local distributor or 3M Purification. Refer to 3M Purification publication GF.G02.788 for additional information.

### Betapure™ PK series Waste Management

Betapure PK series filter cartridges contain no metal or plastic cores. They can be incinerated, shredded, or crushed after use to reduce overall disposal costs. For more information about Betapure PK series disposal, refer to 3M Purification literature CF.TD2.

### 3M™ Filter Housings

The 3M™ ES series cartridge filter housings are designed and certified to ASME Code, Section VIII, Div. I to provide a broad range of high quality stainless and carbon steel vessels for the oil and gas processing industries. Available in 150 and 300 psi ASME Code, this premium 304L, 316L stainless, or carbon steel filter housing can be constructed to fit specific system requirements including inlet/outlet location, connection size and type, and corrosion allowance. For more information ask your local 3M Purification Distributor for literature number LITCHSES1.



### 3M™ ES Series Filter Housing Advantages

- Durable construction for long service life
- Easy access, swing bolts and cover lifting device, for filter removal
- Flexible housing design accepts a wide range of industrial style filters
- Easy maintenance and clean-up
- ASME Code design meets plant safety requirements



# Betapure™ PK Series Filters

Housing Model	Housing Diameter (inches)	Number of Cartridges	Cartridge Style	Construction Material	Pressure Rating	Gasket Materials	Outlet Location
<b>For Standard Industrial Cartridges (2.625" Maximum OD)</b>							
ES	8	6	Double Open End	Carbon Steel, 304L Stainless Steel, or 316L Stainless Steel	150 psi or 300 psi	Nitrile, EPR, fluorocarbon, or PTFE encapsulated fluorocarbon	Bottom, Side 90°, Side 180° Side 270°
	12	12					
	14	18					
	16	24					
	20	36					
	24	52					
	30	85					
	36	120					
<b>For 336 Style Cartridges (36" long by 3" Maximum OD)</b>							
ES	8	3	Betapure™ PK series 336	Carbon Steel, 304L Stainless Steel, or 316L Stainless Steel	150 psi or 300 psi	Nitrile, EPR, fluorocarbon, or PTFE encapsulated fluorocarbon	Bottom, Side 90°, Side 180° Side 270°
	12	9					
	14	12					
	16	17					
	20	27					
	24	39					
	30	63					
	36	91					



## Scientific Applications Support Services (SASS)

The cornerstone of 3M Purification's philosophy is service to customers, not only in product quality and prompt delivery, but also in problem solving, application support, and in the sharing of scientific information. 3M Purification's Scientific Applications Support Services (SASS) group is a market-focused group of scientists and engineers who work closely with customers in the oil & gas processing industry to provide solutions to challenging filtration applications and aid in the selection of the most efficient and economical filter systems. SASS provides a vital link between 3M Purification and users of 3M Purification filter systems. SASS specialists are skilled in performing on-site testing (pilot or lab bench scale) and are able to relate field test results to full manufacturing scale operations. SASS projects can also be performed in 3M Purification's extensive in-house laboratory facilities. 3M Purification's vast experience with gas processing operations worldwide provides the knowledge and insight to resolve problems promptly and efficiently in a cost-effective, confidential manner.

# Betapure™ PK Series Ordering Guide

## Standard Dimension Industrial Cartridges (2 5/8" OD)

Cartridge Type	Cartridge Length	Grade Description		Surface Type	Packing Option	End Modification	Gasket Material
		Grade	Absolute Rating (µm)				
PT (2 5/8" OD)	09 - 9 3/4"	M100	10	G - Grooved	2 - Bulk	C - 222 O-ring & Spear	A - Silicone
	10 - 10"	M200	20	U - Ungrooved		F - 222 O-ring & Flat Cap	B - Fluorocarbon
	19 - 19 1/2"	M300	30			N - None	C - EPR
	20 - 20"	M400	40			P - Polypropylene Core Extender	D - Nitrile
	29 - 29 1/4"	M600	60			R - Closed Cap with Stainless Spring	N - None*
	30 - 30"					S - Stainless Steel Core Extender	G - PE Foam*
	39 - 39"					Q - Same as "R" without Spring	
	40 - 40"					Y - Single O-ring (40" length only)	

### 336 Style Cartridges (3" OD)

Cartridge Type	Cartridge Length	Grade Description		Surface Type	Packing Option	End Modification	Gasket Material
		Grade	Absolute Rating (µm)				
PK (3" OD)	35 - 35 1/2"	M100	10	G - Grooved	2 - Bulk	V - Elastomer Compression Seal (Double Open End)	S - Elastomer Compression Seal
	36 - 36"	M200	20	U - Ungrooved		W - Elastomer Compression Seal 72 - 72" * M400 40 (Single Open End)	
	37 - 36 1/2"	M300	30			R - Closed Cap with Spring	G - PE Foam
	72 - 72"	M400	40				
		M600	60				

### PG Style Cartridges (4 1/2" OD)

Cartridge Type	Cartridge Length	Grade Description		Surface Type	Packing Option	End Modification	Gasket Material
		Grade	Absolute Rating (µm)				
PG (4 1/2" OD)	24 - 24"	M100	10	U - Ungrooved	2 - Bulk	N - None	G - PE Foam
	36 - 36"	M200	20				
	71 - 71"	M300	30				
	72 - 72"	M400	40				
		M600	60				

### PG Style Cartridges (4 1/2" OD)

Cartridge Type	Cartridge Length	Grade Description		Surface Type	Packing Option	End Modification	End Fitting	O-Ring Material
		Grade	Absolute Rating (µm)					
PR	39 - 39"	M100	10	G - Grooved	2 - Bulk	S - Standard, Polypropylene	1 - 1.9" ID O-ring	B - Fluorocarbon
		M200	20	U - Ungrooved		H - High Temperature, Polyester		2 - 2.2" ID O-ring
		M300	30					D - Nitrile
		M400	40					
		M600	60					





#### Important Notice

The information described in this literature is accurate to the best of our knowledge. A variety of factors, however, can affect the performance of the Product(s) in a particular application, some of which are uniquely within your knowledge and control. **INFORMATION IS SUPPLIED UPON THE CONDITION THAT THE PERSONS RECEIVING THE SAME WILL MAKE THEIR OWN DETERMINATION AS TO ITS SUITABILITY FOR THEIR USE. IN NO EVENT WILL 3M PURIFICATION INC. BE RESPONSIBLE FOR DAMAGES OF ANY NATURE WHATSOEVER RESULTING FROM THE USE OF OR RELIANCE UPON INFORMATION.**

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Your Local Distributor:



**3M Purification Inc.**  
400 Research Parkway  
Meriden, CT 06450, U.S.A.  
Tel (800) 243-6894  
(203) 237-5541  
Fax (203) 630-4530  
[www.3Mpurification.com](http://www.3Mpurification.com)

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