3M Purification

Product Brochure

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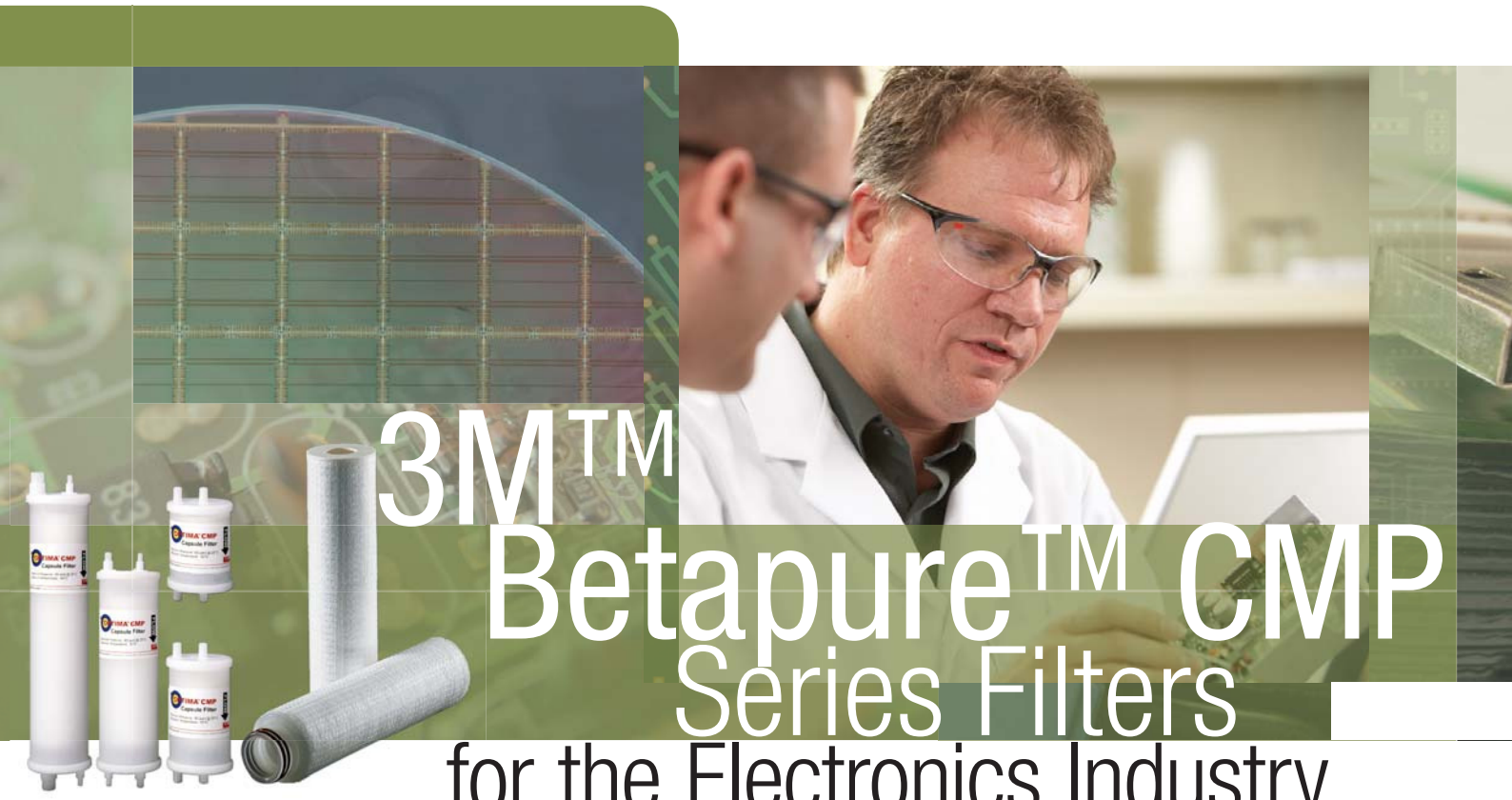


3M™ Betapure™ CMP Series Filters for the Electronics Industry

Features and benefits

Graded porosity design
- Superior removal of hard and soft gel contaminants, for reduced defectivity and improved yields
- High contaminant holding capacity reduces downtime and increases overall equipment effectiveness
- The filters are "matched" to the slurry providing the optimum level of performance needed to dramatically reduce defect causing particles
- Provides a low pressure drop reducing the potential for fluid shear of the slurry

100% polypropylene construction
- Low capsule extractables, free of adhesives, binders and surfactants
- Excellent chemical compatibility with low and high pH slurries

Quality manufacturing
- ISO certified quality management system
- Manufactured and double-bagged in a clean environment to provide superior downstream cleanliness out of the package

Built to exacting specifications
- Provides a consistent quality of slurry enabling repeatability of the planarisation process

Fully disposable capsule
- Rapid installation
- Reduced downtime
- Reduced handling of hazardous chemicals

Superior reduction of large particle counts for improved yields

3M™ Betapure™ CMP filter cartridges and capsules, formerly known as CUNO Optima CMP, are high capacity depth filters optimised for oxide and metal slurries used in chemical mechanical planarisation (CMP) applications. Betapure CMP filters are composed of all-polypropylene components and features a multi-zone "graded-porosity" design for the optimum level of particle classification. This construction provides enhanced flow characteristics, including low pressure drop to minimise shearing of the slurry while providing superior service life.

The objective of a slurry filter is for the majority of particles to pass through it unchanged, while only removing the undesired or "oversized" particles. The oversized particle population is commonly referred to as large particle counts (LPC) and they typically form over time when the suspended particles in the slurry settle forming aggregates, agglomerates and gels. Large particles can also be the result of adverse shipping conditions, shearing, slurry drying and interaction with other distribution loop components such as fittings, tanks, piping, valves and pumps. These large particles can scratch metal and interlevel dielectrics potentially causing wafer defects.

3M Purification's Betapure CMP filters reduce large particle counts that can potentially reduce yields while maintaining the polishing characteristics of the slurry.

Particle size distribution

The filtration of CMP slurries is a challenging process as compared to the filtration of high purity chemicals used in electronics manufacturing. High purity chemical filtration is typically performed using 0.2 micron or tighter membrane filters that have a sharp particle removal cut-off at the rated pore size. The majority of CMP slurries contain a desired mean particle size that ranges from 0.03 to 0.2 microns. Consequently, the filter that was specifically designed for particle clarification of high purity chemicals would strip out the desired particles and adversely affect the polishing characteristics of the CMP slurry. Oversized particles in the slurry typically greater than 0.5 micron are undesired and represent the "tail" (figure 1) of the particle size distribution (PSD). Betapure CMP filters remove the PSD tail while allowing the majority of desired or "target" size particles to pass through it unchanged.

Applications

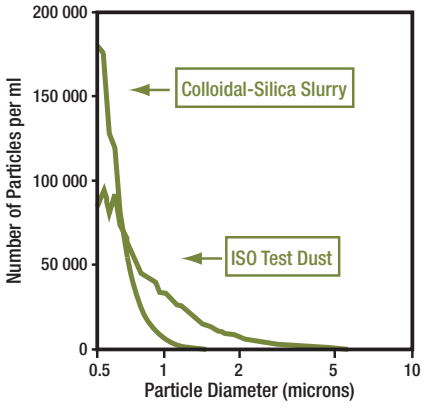
Semiconductor
- Oxide/low-k dielectrics
- Shallow Trench Isolation (STI)
- Interlevel Dielectric (ILD)
- Polysilicon
- Tungsten
- Copper

Data storage
- Magnetic heads
- Nickel and glass substrates

Data transmission
- Optical fibre

Compound semiconductor
- Light Emitting Diode (LED)

Figure 1
Particle Size Distribution > 0.5 micron
Colloidal-Silica Slurry & ISO Test Dust



Particle removal efficiency is the best measure of filter performance

Figure 1 compares the PSD of colloidal-silica slurry and a laboratory test dust which is typically used by filter suppliers to establish depth filter ratings. The data shows that test dust has a broader PSD above 0.5 micron proving that it is not a true representation of the types of particles in CMP slurry. A wide variation in performance also exists from one filter supplier to the next because there is no industry accepted standard for rating retention of depth filters. Furthermore, absolute and nominal filter ratings are both used to specify particle removal efficiency which only serves to confuse the situation while not providing the application specific information needed.

In figure 2, particle removal efficiency is compared for the same grade of CMP filters from 3M Purification. The filters were challenged using both a laboratory test dust and colloidal-silica slurry. There is a significant difference in particle removal efficiency, which is a direct result of the contaminant PSD distribution. The broad PSD of the test dust yields significantly higher particle removal efficiency than achieved when tested with slurry. Therefore, test dust is not representative of slurry and ratings based on test dust will likely be overstated and meaningless for CMP slurry applications.

In figure 3, particle removal efficiency is compared for equivalent rated CMP filters from 3M Purification, Competitor A and Competitor B in colloidal-silica slurry. The data clearly shows that equivalent rated filters from different manufacturers does not deliver equivalent performance and reinforces the fact that the "rating" generated in a lab using test dust is not meaningful in predicting actual performance. Based on this information particle removal efficiency generated in slurry is the best measure of filter performance. Other important factors in selecting the appropriate slurry filter include particle classification, pressure drop and filter lifetime.

Superior particle retention through graded porosity design

Betapure CMP filter media was specifically engineered to provide a low porosity, downstream section with a sharp retention cut-off that closely aligns to the size distribution of undesired particles to be removed. This sharp removal cut-off will not alter percent solids (figure 4) or remove desired or "target" size particles thus preserving the polishing characteristics of the slurry. In contrast, competitive point-of-use filters (figure 4) that have a broad removal range can in fact retain particles smaller than the PSD. Removing these "target" size particles can alter the percent solids of the slurry which in turn reduces filter lifetime because more particles are being removed than required in the application.

The multiple higher porosity layers on the upstream section (figure 5) provide effective prefiltration of oversized particles resulting in higher contaminant removal capacity and increased filter lifetime. This graded porosity (figure 5) design also provides a tortuous downstream path and low pressure drop which is ideal for gel capture and reduced shear effect on the slurry.

Proper filtration provides for reduced defectivity

Large particles, greater than 0.5 micron, can scratch metal and interlevel dielectrics potentially causing wafer defects. Variations in particle size distribution and particle counts in the slurry can affect repeat ability of the planarisation process. In both cases, major reductions in large particle counts can be associated to proper filtration, resulting in reduced defectivity (figure 6) and an increase to yields. Proper filtration also provides a consistent quality of slurry which enables repeat ability of the planarisation process. The ideal slurry filter will have a retention curve that closely aligns to the PSD of "undesired" particles to be removed. By matching that characteristic, Betapure CMP filters are able to maintain the polishing characteristics of the slurry, maximise contaminant holding capacity and increase filter lifetime.

Figure 2: Particle removal efficiency colloidal-silica vs. ISO test dust

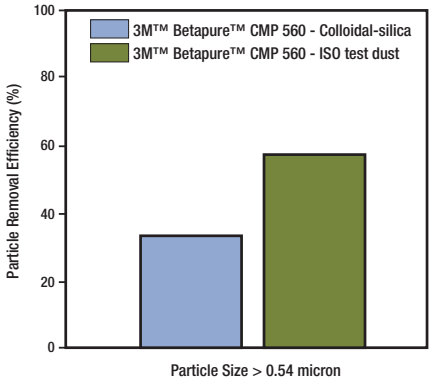


Figure 3: Comparative particle removal efficiency in colloidal-silica for equivalent rated filters

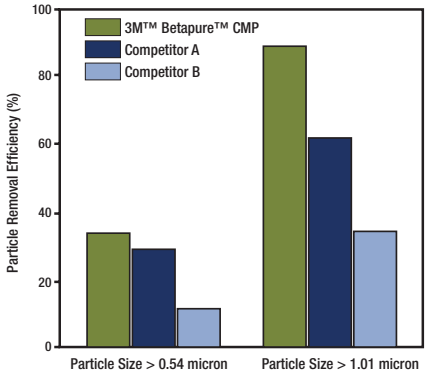


Figure 4: Percent Solids Comparison - Colloidal-Silica

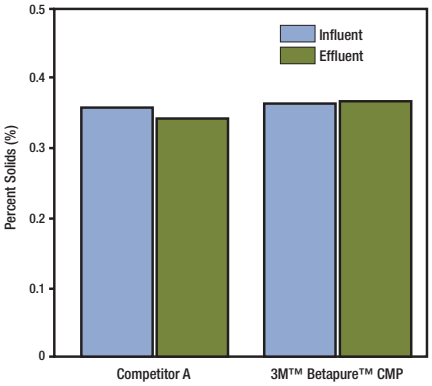


Figure 5: Graded Porosity Design

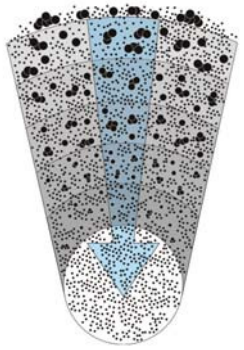


Figure 6: Benefits of proper filtration horizon capture of copper wafer surface

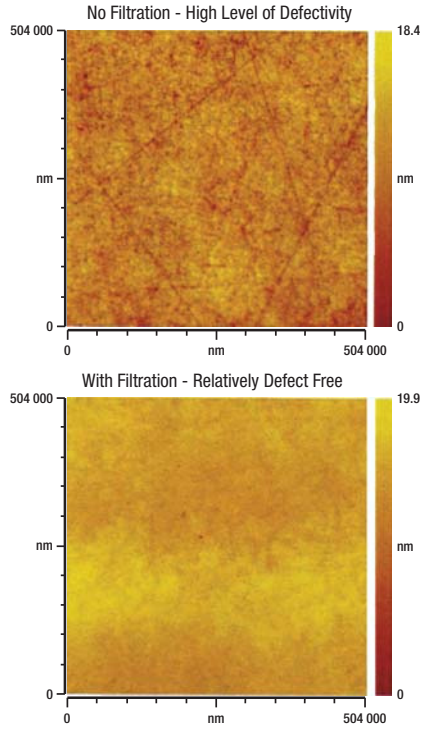


Figure 7: Betapure CMP particle removal efficiency

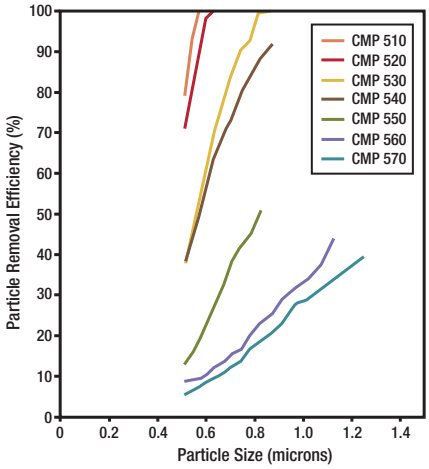
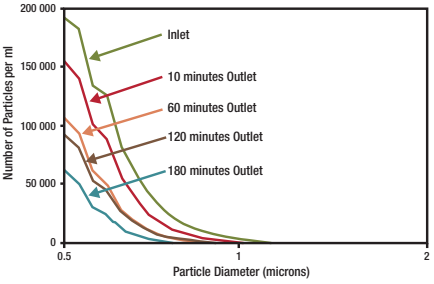


Figure 8: Particle removal efficiency over time



Filter Removal Efficiencies

Depending on the location in the slurry distribution system a filter with a sharp particle removal cut-off and a filter with a broad particle removal cut-off will be needed to reduce defectivity and increase yields. For example, in single pass applications at point-of-use the filter should have a sharp cut-off which is slightly larger than the desired PSD. Figure 7 shows that Betapure CMP 510, CMP 520, CMP 530 and CMP 540 contain that sharp cut-off making it ideal for particle classification at point-of-use.

However, in the distribution loop, the filter should have a broad removal range that closely aligns to the undesired PSD tail to be removed like that exhibited by Betapure CMP 550, CMP 560, CMP 570, CMP 580 and CMP590. Betapure CMP filters for distribution loop applications contain a higher porosity media as compared to Betapure CMP filters at point-of-use. The higher porosity media increases flow while reducing pressure drop and fluid shear on the slurry. Increasing flow while maintaining particle removal efficiency results in particle specifications being achieved in less time. Figure 8, shows the particle removal efficiency of a Betapure CMP 560 filter in re-circulation mode over specific time intervals.

"Matching" the slurry to the proper Betapure CMP filter provides the peak level of performance needed to dramatically reduce defect causing large particle counts. The porosity of the media layers can also be customised to meet the specific requirements of CMP slurry manufacturers.

Betapure CMP filter construction

Betapure CMP filters are constructed using all-polypropylene components (see table 1). Capsules are manufactured using the most advanced non-contact thermoplastic welding techniques - no adhesives, binders or surfactants are used in the process - and are double-bagged in a clean environment to ensure superior cleanliness out of the package. The Betapure CMP filter manufacturing site operates within an ISO certified quality management system.

Table 1: Product Specifications

Material of Construction	
Filter Media and Media Support Layer	polypropylene
Capsule Housing & Filter Core and End Caps	polypropylene
Filter O-rings/Gaskets	see ordering guide
Dimensions	
Length	see "Capsule Configurations" and "Cartridge Configurations"
Outside Diameter	Capsule: 9.8 cm Cartridge: 6.6 cm
Operating Conditions	
Maximum Operating Pressure	Capsule: 5.2 bar at 40 °C
Maximum Forward Differential Pressure	Capsule: 2.7 bar at 40 °C Cartridge: 4.1 bar at 30 °C and 2.0 bar at 60 °C
Maximum Operating Temperature	Capsule: 40 °C Cartridge: 60 °C

Betapure CMP Filters Flow Rates

Figure 9 depicts typical 10" cartridge flow rates for 1 cP fluids at 20 °C.

Figures 10 through 13 depict typical flow rates of 1 cP fluids at 20 °C for 4", 10", 15" and 20" capsules with 3/8" Flaretek® fittings. Consult 3M Purification or your local 3M Purification distributor for flow rate information about capsules with other end connections.

Table 2: Betapure CMP Filter Recommendation Guide			
Slurry Type	Post Blending (1)	Filtration Location (see Figure 13) Distribution Loop (2)	POU Dispense (3)
Fumed Silica Oxide*	CMP560	CMP560, CMP570 or CMP580	CMP540, CMP550 or CMP560
Colloidal Silica Oxide	CMP560	CMP550, CMP560 or CMP570	CMP520, CMP530 or CMP540
Silica Based Metal	CMP560	CMP560 or CMP570	CMP520, CMP530 or CMP540
Non - Silica Based Metal < 2% Solids	CMP540 or CMP550	CMP540 or CMP550	CMP510 or CMP520
Non – Silica Based Metal > 2% Solids	CMP560	CMP560 or CMP570	CMP530 or CMP540
* Shear sensitive			

Figure 14
Betapure CMP Particle Removal Efficiency

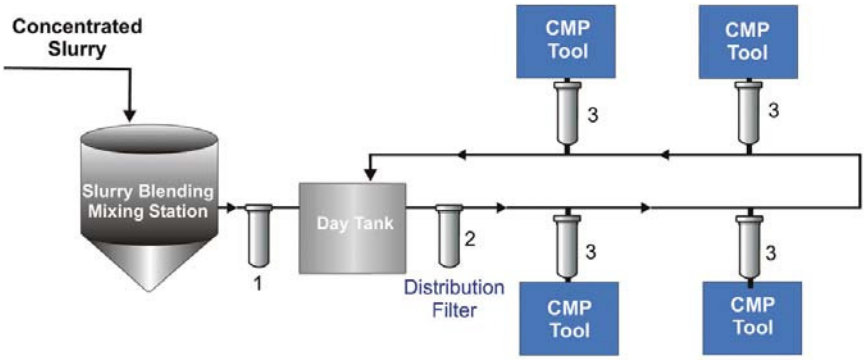


Table 3: Betapure CMP Filter to Pore Size Cross-Reference	
Betapure CMP Filter Grade	Typical Pore Size (Micron)
510	0.3
520	0.5
530	0.8
540	1
550	3
560	5
570	10
580	25
590	50

SASS

3M Purification performs in-house and on-site filtration studies worldwide through its Scientific Applications Support Services (SASS) group using the most advanced particle counting technologies to optimise the CMP process at the customer facility. In addition, 3M Purification works closely with the slurry manufacturers to characterise and customise filtration solutions that meet current and future requirements.

Figure 9: 10” Cartridge flow rate vs. pressure drop for 1 cP fluids at 20 °C

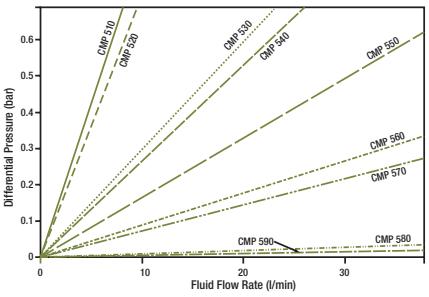


Figure 10: 4” Capsule* flow rate vs. pressure drop for 1 cP fluids at 20 °C

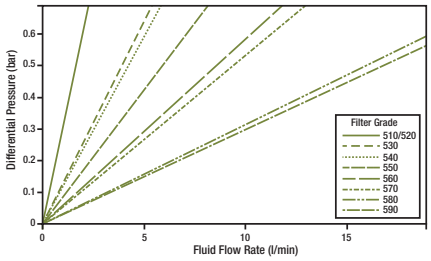


Figure 11: 10” Capsule* flow rate vs. pressure drop for 1 cP fluids at 20 °C

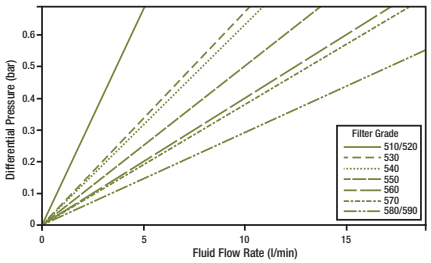


Figure 12: 15” Capsule* flow rate vs. pressure drop for 1cP fluids at 20 °C

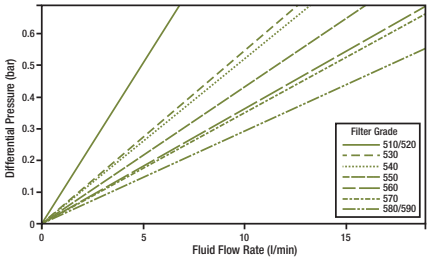
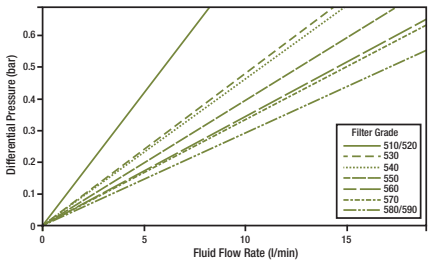


Figure 13: 20” Capsule* flow rate vs. pressure drop for 1 cP fluids at 20 °C

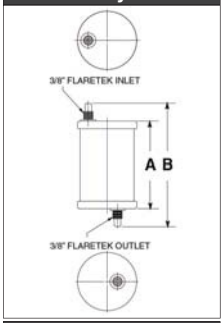


* with 3/8” Flaretek® fitting

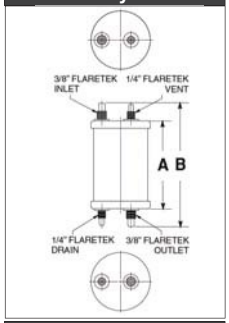
3M™ Betapure™ CMP Capsule Configurations

Capsule Style	Length Code	Dim. A (cm)	Dim. B (cm)
K	04	14.07	20.02
	10	29.31	35.26
	15	42.01	47.96
	20	54.71	60.66
L	04	14.07	20.02
	10	29.31	35.26
	15	42.01	47.96
	20	54.71	60.66
M	04	14.07	18.26
	10	29.31	33.50
	15	42.01	46.20
	20	54.71	58.90
P	04	14.07	18.26
	10	29.31	33.50
	15	42.01	46.20
	20	54.71	58.90
R	04	14.07	19.66
	10	29.31	34.90
	15	42.01	47.60
	20	54.71	60.30
S	04	14.07	20.47
	10	29.31	35.71
	15	42.01	48.41
	20	54.71	61.11

K Style



L Style



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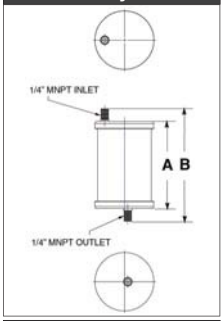

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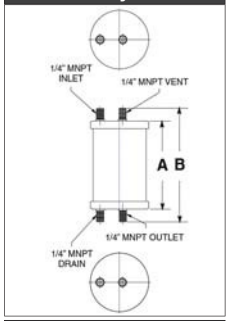

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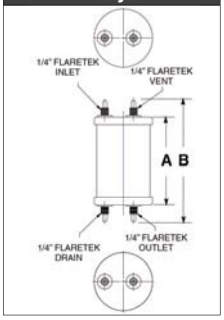

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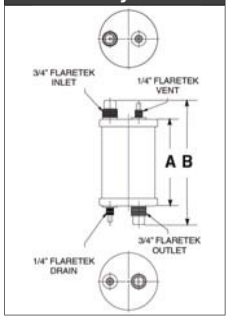
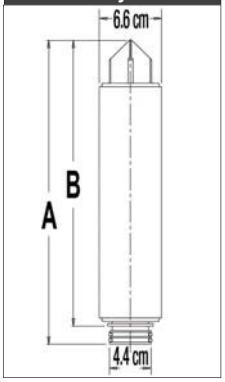


3M™ Betapure™ CMP Cartridge Configurations

Cartridge Style	Length Code	Dim. A (cm)	Dim. B (cm)
C	1 High	32.5	30.5
	2 High	57.2	55.4
	3 High	82.3	80.5
N	1 High	24.9	-
	2 High	49.8	-
	3 High	74.7	-
F	½ High	13.2	11.2
	1 High	27.9	25.9
	2 High	52.6	50.8
	3 High	77.7	75.7
U	1 high	26.4	24.4

C Style



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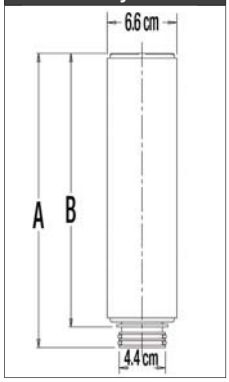

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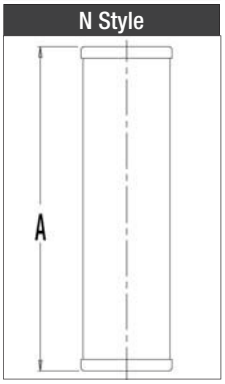

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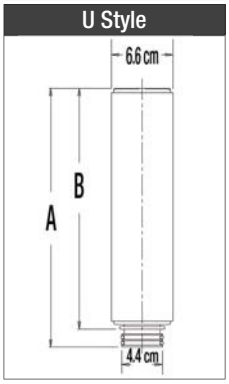

3M™ Betapure™ CMP filter cartridge range - Ordering guide

Cartridge	Filter Grade	Media Construction	Length (Inches)	End Modification (see illustration on previous page)	Gasket / O-ring Material
CMP	510 520 530 540 550 560 570 580 590	**P** = polypropylene cartridge	**04** = 4 * **10** = 10 **20** = 20 **30** = 30	**C** = 222 O-ring & spear **F** = 222 O-ring & flat cap **U** = 222 O-ring & flap cap **	**C** = EPR
			09 = 9 **19** = 19 **29** = 29	**N** = D.O.E. (double open end)	**G** = polyethylene

* F only
** Replaces Mykrolis Code 0, 10" length only (see U style on previous page)

3M™ Betapure™ CMP disposable filter capsules range - Ordering guide

Capsule	Filter Grade	Media Construction	Length (Inches)	End Connection (see illustration on previous page)	Internal O-ring Material	Packaging
CMP	510 520 530 540 550 560 570 580 590	**C** = Capsule	**04** = 4 **10** = 10 **15** = 15 **20** = 20	**K** = 3/8" Flaretek® **L** = 3/8" Flaretek® with 1/4" Flaretek Vent and Drain **M** = 1/4" MNPT **P** = 1/4" MNPT with 1/4" MNPT Vent and Drain **R** = 1/4" Flaretek® with 1/4" Flaretek Vent and Drain **S** = 3/4" Flaretek® with 1/4" Flaretek Vent and Drain	**C** = EPR	**01** = single **06** = 6-pack

NOTE: 3M™ Betapure™ CMP is new name for CUNO Optima CMP.

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 BE RESPONSIBLE FOR DAMAGES OF ANY NATURE WHATSOEVER RESULTING FROM THE USE OF OR RELIANCE UPON INFORMATION.

It is your responsibility to determine if additional testing or information is required and if this product is fit for a particular purpose and suitable in your specific application.

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3M

For more contact addresses visit our website www.3M.eu/purification.

Data may be subject to change without further notice.

v.2 - DOC10105
LITCTBPCMP1.EU - 1211

CMP 510 p 04 C	CMP 510 p 09 N	CMP 510 C 04 K
CMP 510 p 04 F	CMP 510 p 19 N	CMP 510 C 04 L
CMP 510 p 04 U	CMP 510 p 29 N	CMP 510 C 04 M
CMP 510 p 10 C	CMP 520 p 09 N	CMP 520 C 04 P
CMP 510 p 10 F	CMP 520 p 19 N	CMP 520 C 04 R
CMP 510 p 10 U	CMP 520 p 29 N	CMP 520 C 04 S
CMP 510 p 20 C	CMP 530 p 09 N	CMP 520 C 10 K
CMP 510 p 20 F	CMP 530 p 19 N	CMP 520 C 10 L
CMP 510 p 20 U	CMP 530 p 29 N	CMP 520 C 10 M
CMP 510 p 30 C	CMP 540 p 09 N	CMP 530 C 10 P
CMP 510 p 30 F	CMP 540 p 19 N	CMP 530 C 10 R
CMP 510 p 30 U	CMP 540 p 29 N	CMP 530 C 10 S
CMP 520 p 04 C	CMP 550 p 09 N	CMP 530 C 15 K
CMP 520 p 04 F	CMP 550 p 19 N	CMP 530 C 15 L
CMP 520 p 04 U	CMP 550 p 29 N	CMP 530 C 15 M
CMP 520 p 10 C	CMP 560 p 09 N	CMP 540 C 15 P
CMP 520 p 10 F	CMP 560 p 19 N	CMP 540 C 15 R
CMP 520 p 10 U	CMP 560 p 29 N	CMP 540 C 15 S
CMP 520 p 20 C	CMP 570 p 09 N	CMP 540 C 20 K
CMP 520 p 20 F	CMP 570 p 19 N	CMP 540 C 20 L
CMP 520 p 20 U	CMP 570 p 29 N	CMP 540 C 20 M
CMP 520 p 30 C	CMP 580 p 09 N	CMP 540 C 20 P
CMP 520 p 30 F	CMP 580 p 19 N	CMP 540 C 20 R
CMP 520 p 30 U	CMP 580 p 29 N	CMP 540 C 20 S
CMP 530 p 04 C	CMP 590 p 04 N	CMP 550 C 20 K
CMP 530 p 04 F	CMP 590 p 10 N	CMP 550 C 20 L
CMP 530 p 04 U	CMP 590 p 10 N	CMP 550 C 20 M
CMP 530 p 10 C	CMP 570 p 04 C	CMP 550 C 20 P
CMP 530 p 10 F	CMP 570 p 10 F	CMP 550 C 20 R
CMP 530 p 10 U	CMP 570 p 10 u	CMP 550 C 20 S
CMP 530 p 20 C	CMP 580 p 10 C	CMP 560 C 20 K
CMP 530 p 20 F	CMP 580 p 10 F	CMP 560 C 20 L
CMP 530 p 20 U	CMP 580 p 10 U	CMP 560 C 20 M
CMP 530 p 30 C	CMP 580 p 20 C	CMP 560 C 20 P
CMP 530 p 30 F	CMP 580 p 20 F	CMP 560 C 20 R
CMP 530 p 30 U	CMP 580 p 20 U	CMP 560 C 20 S
CMP 540 p 04 C	CMP 580 p 30 C	CMP 570 C 20 K
CMP 540 p 04 F	CMP 580 p 30 F	CMP 570 C 20 L
CMP 540 p 04 U	CMP 580 p 30 U	CMP 570 C 20 M
CMP 540 p 10 C	CMP 580 p 04 C	CMP 570 C 20 P
CMP 540 p 10 F	CMP 580 p 04 C	CMP 570 C 20 R
CMP 540 p 10 U	CMP 580 p 10 F	CMP 570 C 20 S
CMP 540 p 20 C	CMP 580 p 10 u	CMP 580 C 20 K
CMP 540 p 20 F	CMP 590 p 10 C	CMP 580 C 20 L
CMP 540 p 20 U	CMP 590 p 10 F	CMP 580 C 20 M
CMP 540 p 30 C	CMP 590 p 10 U	CMP 580 C 20 P
CMP 540 p 30 F	CMP 590 p 20 C	CMP 580 C 20 R
CMP 540 p 30 U	CMP 590 p 20 F	CMP 580 C 20 S
CMP 550 p 04 C	CMP 590 p 20 U	CMP 590 C 20 K

CMP 550 p 04 F
CMP 550 p 04 U
CMP 550 p 10 C
CMP 550 p 10 F
CMP 550 p 10 U
CMP 550 p 20 C
CMP 550 p 20 F
CMP 550 p 20 U
CMP 550 p 30 C
CMP 550 p 30 F
CMP 550 p 30 U
CMP 560 p 10 C
CMP 560 p 10 F
CMP 560 p 10 U
CMP 560 p 20 C
CMP 560 p 20 F
CMP 560 p 20 U
CMP 560 p 30 C
CMP 570 p 30 U
CMP 570 p 04 C

CMP 590 p 30 C
CMP 590 p 30 F
CMP 590 p 30 U
CMP 590 p 04 C
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CMP 590 p 10 F
CMP 590 p 10 u
CMP 560 p 30 F
CMP 560 p 30 U
CMP 560 p 04 C
CMP 560 p 04 C
CMP 560 p 10 F
CMP 560 p 10 u
CMP 570 p 10 C
CMP 570 p 10 F
CMP 570 p 10 U
CMP 570 p 20 C
CMP 570 p 20 F
CMP 570 p 20 U
CMP 570 p 30 C
CMP 570 p 30 F

CMP 590 C 20 L
CMP 590 C 20 M
CMP 590 C 20 P
CMP 590 C 20 R
CMP 590 C 20 S