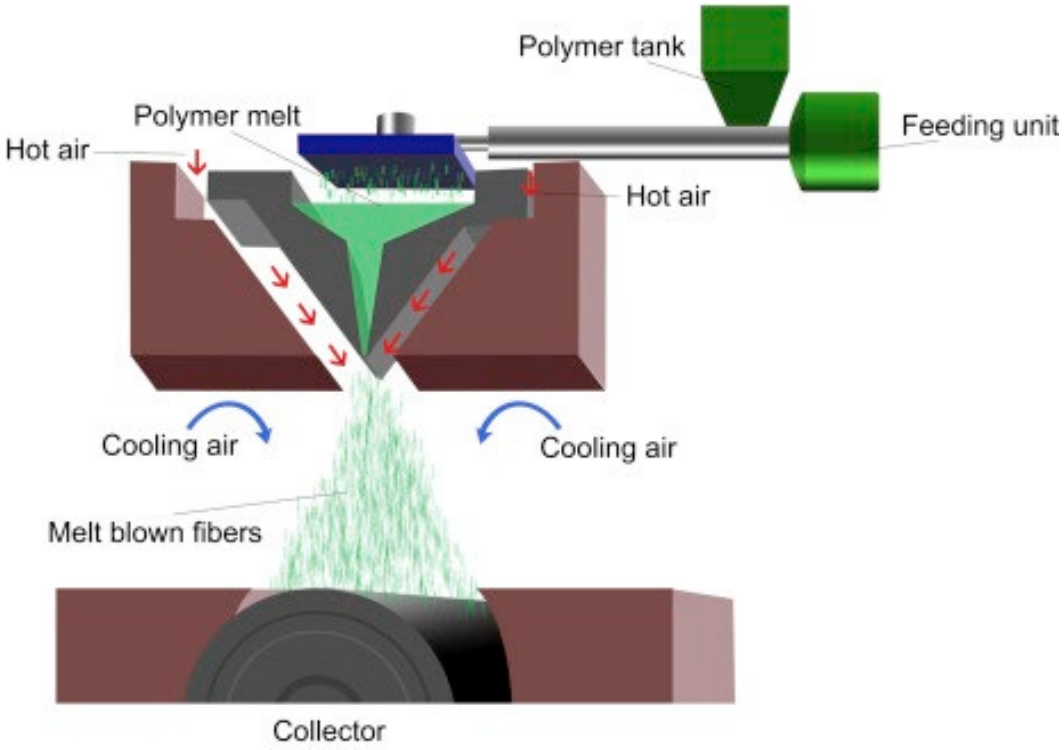
GRAVER TECHNOLOGIES

Product Line Overview

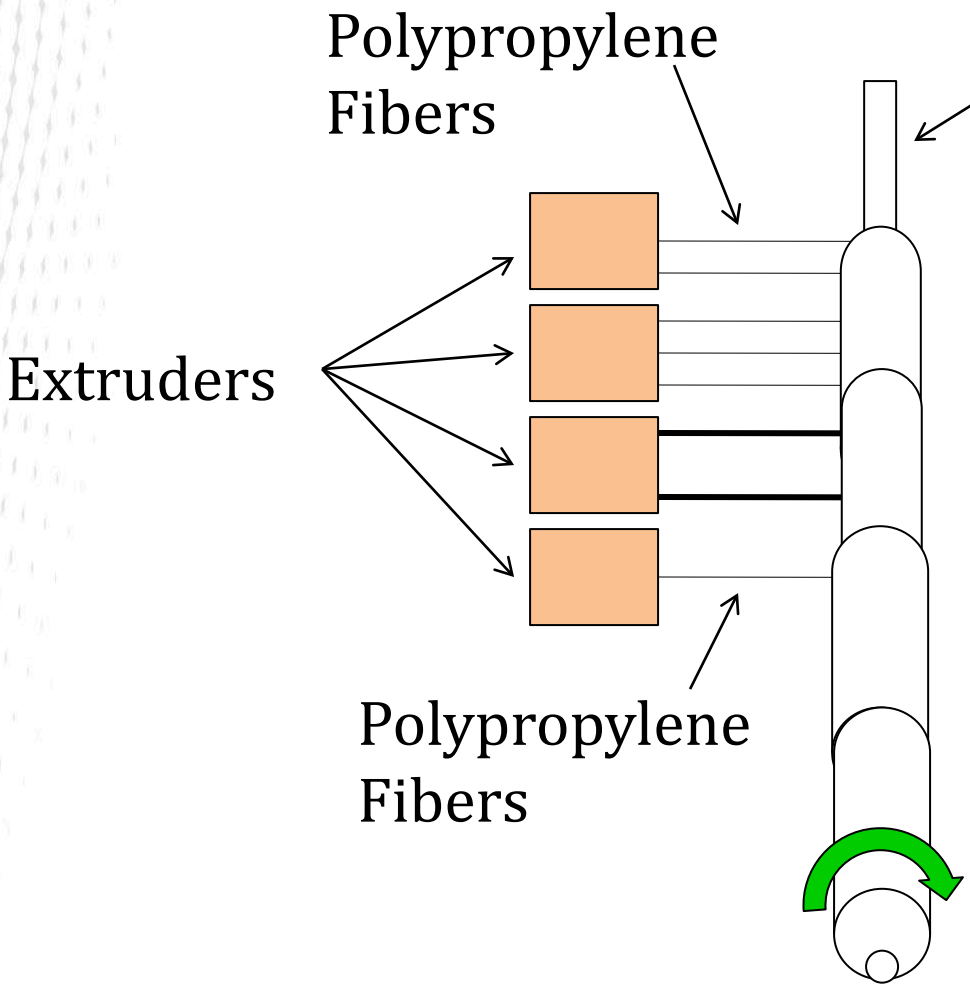
DEPTH FILTERS

DEPTH FILTERS: MELT BLOWING DEFINED

Fabrication method of microfibers where a melted polymer is extruded through small nozzles surrounded by high-speed blowing gas (air) to form randomly deposited fibers on a core.

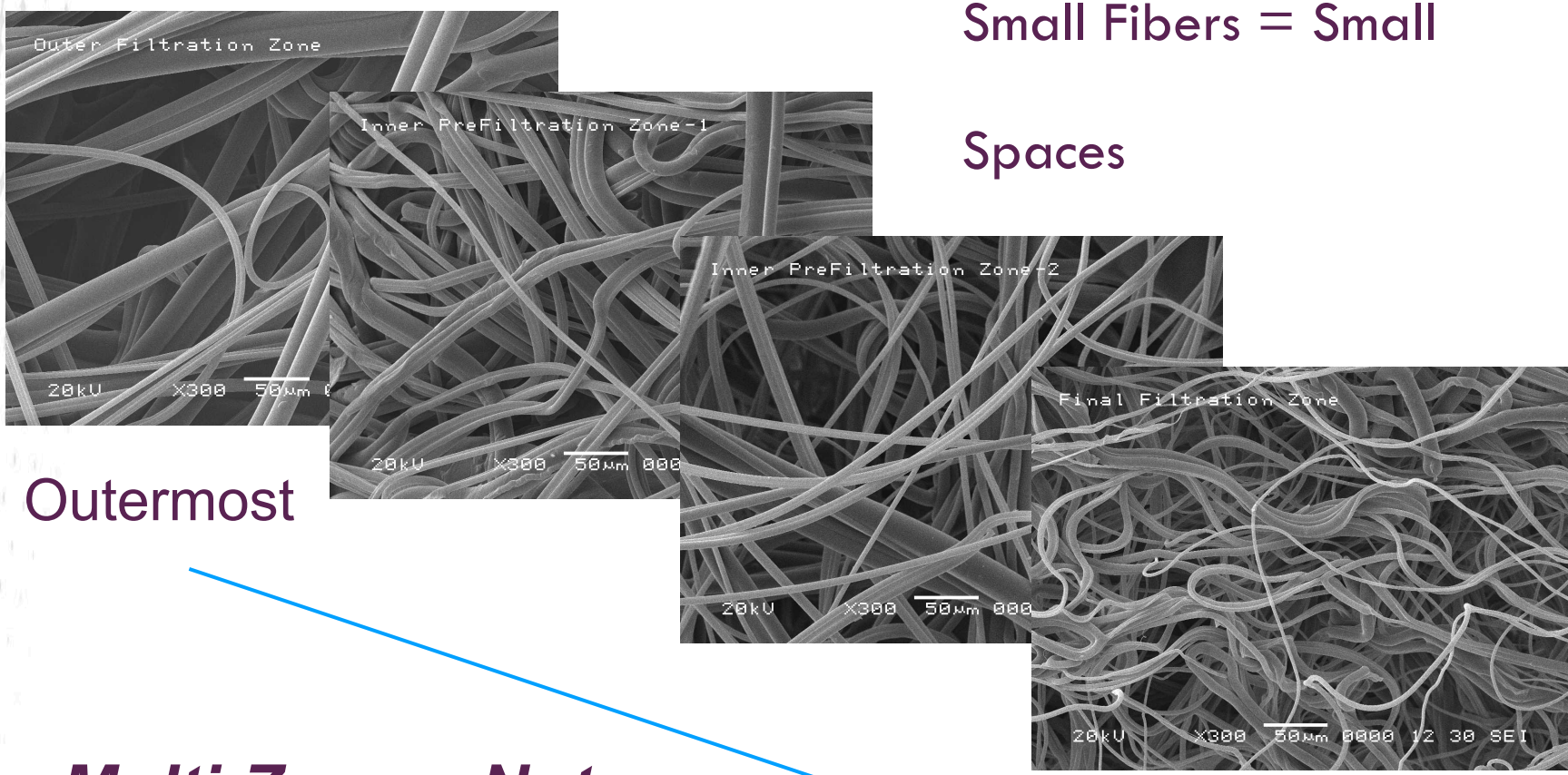


DEPTH FILTERS: GRAVER MULTI EXTRUDER



- Multi Extruder (4) process
- Microprocessor controlled recipes
- White room for contamination control
- Environmental controls for consistent temperature and humidity
- State-of-the-art Melt Blowing machinery

DEPTH FILTERS: GRADE PORE STRUCTURE



Small Fibers = Small Spaces

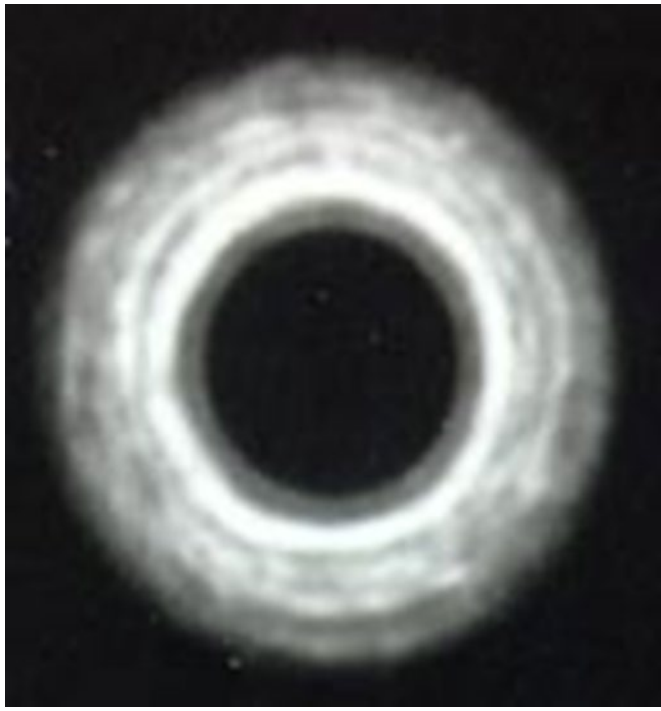
Outermost

Innermost

Multi-Zone – Not compressed to create gradient

TRUE GRADED PORE STRUCTURE

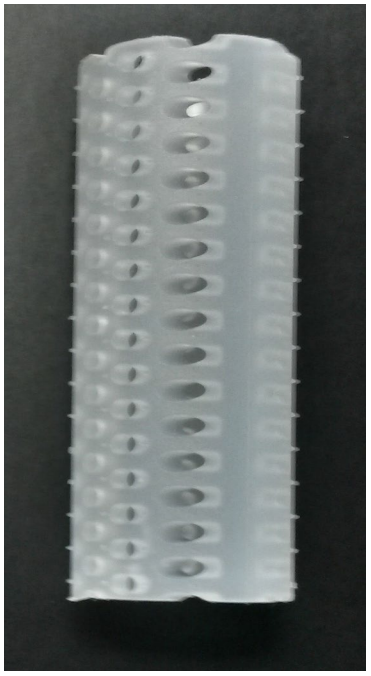
- Not Graded Density – Graded Pore Structure!
- 4 Filtration zones
- Fiber diameter differs by zone
- Smaller fibers create smaller pores
- Improved flow characteristics



DEPTH FILTERS: GRAVER TECHNOLOGY

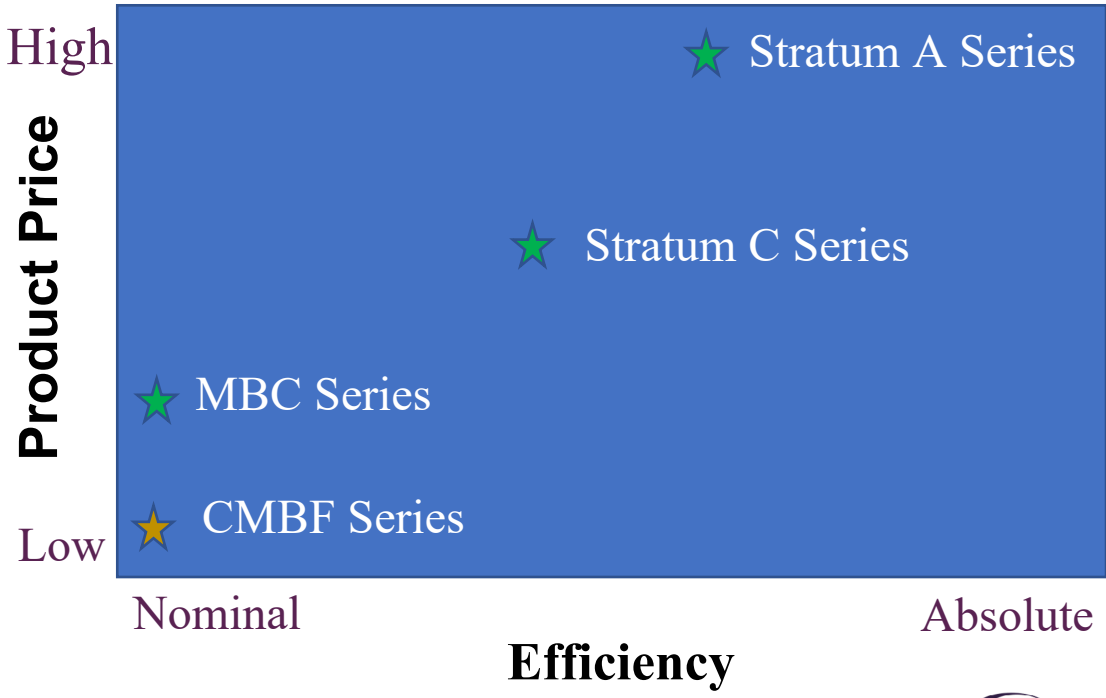
- "Crystal Core" - formed in Graver's facility from 100% pure polypropylene
- Eliminates the cost of an injection molded core
- High strength
- Excellent flow characteristics
- Design utilized for Crystal MBF

- "Cactus Core" - Molded from 100% pure polypropylene
- Provided for high collapse strength even with viscous fluids and high differential high strength
- Stipples immobilize the media, to prevent shifting and unloading
- Design utilized for Stratum and MBC



DEPTH FILTERS: GRAVER TECHNOLOGY

- Premium – Stratum A Series, 99.9% Beta 1000 absolute rated on molded core
- Superior – Stratum C Series, 90%, Beta 10, highly consistent nominal rated on molded core
- General Purpose with Core – MBC Series, nominally rated with high collapse strength (molded core)
- General Purpose –Crystal MBF Series, nominally rated with formed core for ultimate economy

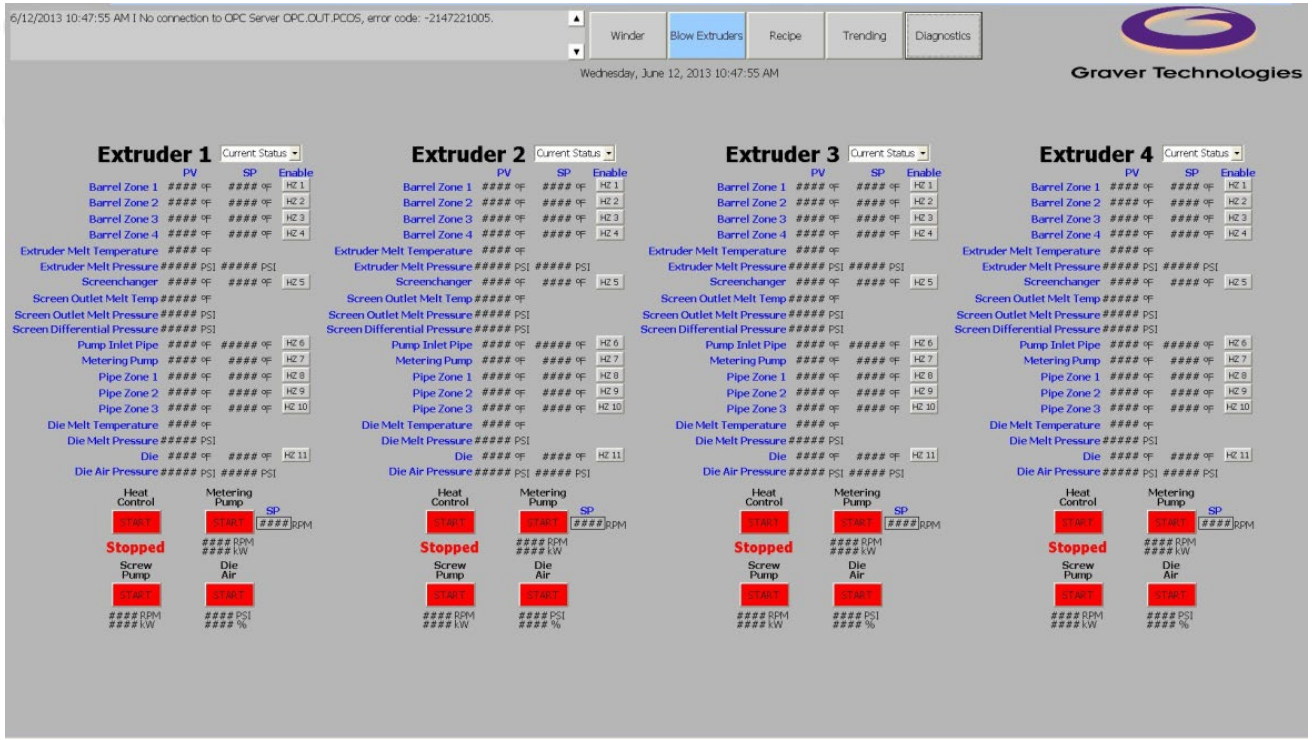


DEPTH FILTERS: GRAVER TECHNOLOGY

	Stratum A	Stratum C	MBC	CMBF
Efficiency	Absolute - 99.9%	Nominal - 90%	Nominal	Nominal
Core	Molded Cactus Core	Molded Cactus Core	Molded Cactus Core	Formed Crystal Core
Collapse Strength	Excellent	Excellent	Excellent	Moderate
Zones	4 Graded pore zones	4 Graded pore zones	4 Graded pore zones	4 Graded pore zones
List Price – 5 µm 10”	$20.39	$7.03	$4.07	$3.26
Applications	Critical clarifying applications Applications where absolute rated efficiency and high performance is required.	Clarifying applications where precise, repeatable performance is needed, but nominal efficiencies are accepted.	General purpose, economy depth filter with a molded center core for excellent pressure/temperature tolerance	All-purpose economy filter for a wide range of pre-filtration applications.

UNSURPASSED CONSISTENCY

- MICROPROCESSOR CONTROLLER STORES ALL RECIPES
- CONTROLS ALL CRITICAL PROCESS PARAMETERS
- DIAL IN SAME RECIPE EACH TIME RUN A GIVEN MICRON
- ASSURES HIGHEST DEGREE OF CONSISTENCY POSSIBLE



UNSURPASSED PURITY/CLEANLINESS

- 100% pure Virgin polypropylene construction
- FDA Listed Materials
- USP Class VI Compliant
- Binder, surfactant and adhesive free
- Quick rinse-up to 18 MΩ-cm
- Contained room for finishing/packaging
  - Hair nets and lab coats mandatory
  - Filtered compressed air removes cutting debris
  - Area cleaned daily
  - Operators responsible for cleanliness of area

NSF 61 CERTIFIED

- NSF International is an independent, not-for-profit organization.
- Conduct third-party conformity assessment services in the interest of protecting public health and safety
- NSF/ANSI Standard 61, specifically, addresses whether drinking water system components leach or migrate contaminants from the product/material into the drinking water at above acceptable levels
- Ideal for water system OEM's, municipal water treatment facilities, water bottlers

CRYSTAL MBF PRODUCT RANGE

- 1, 3, 5, 10, 20, 30, 50, 75 micron, nominal
- Continuous lengths from 9.75 to 40”
- End cap options: **NN** only
- Standard gasket and o-ring choices
  - Silicone
  - Buna N
  - EPDM
  - Viton A
- Sold in full case quantities only
  - 10” – 36 per case
  - 20” – 24 per case
  - 30” – 12 per case
  - 40” – 12 per case

CRYSTAL MBF OPPORTUNITY

- Take business from the Competition
  - GE (Hytrex & Purtrex), ROSave.Z, Muni.Z
  - Pall Claris
  - Cuno Micro-Klean RT, RW, RC, RP
  - String Wound Competitors
- Entry Point For Customers Interested In Melt Blown Cartridge Technology
- Eventually Up Sell to Higher Technologies - Stratum

CRYSTAL MBF

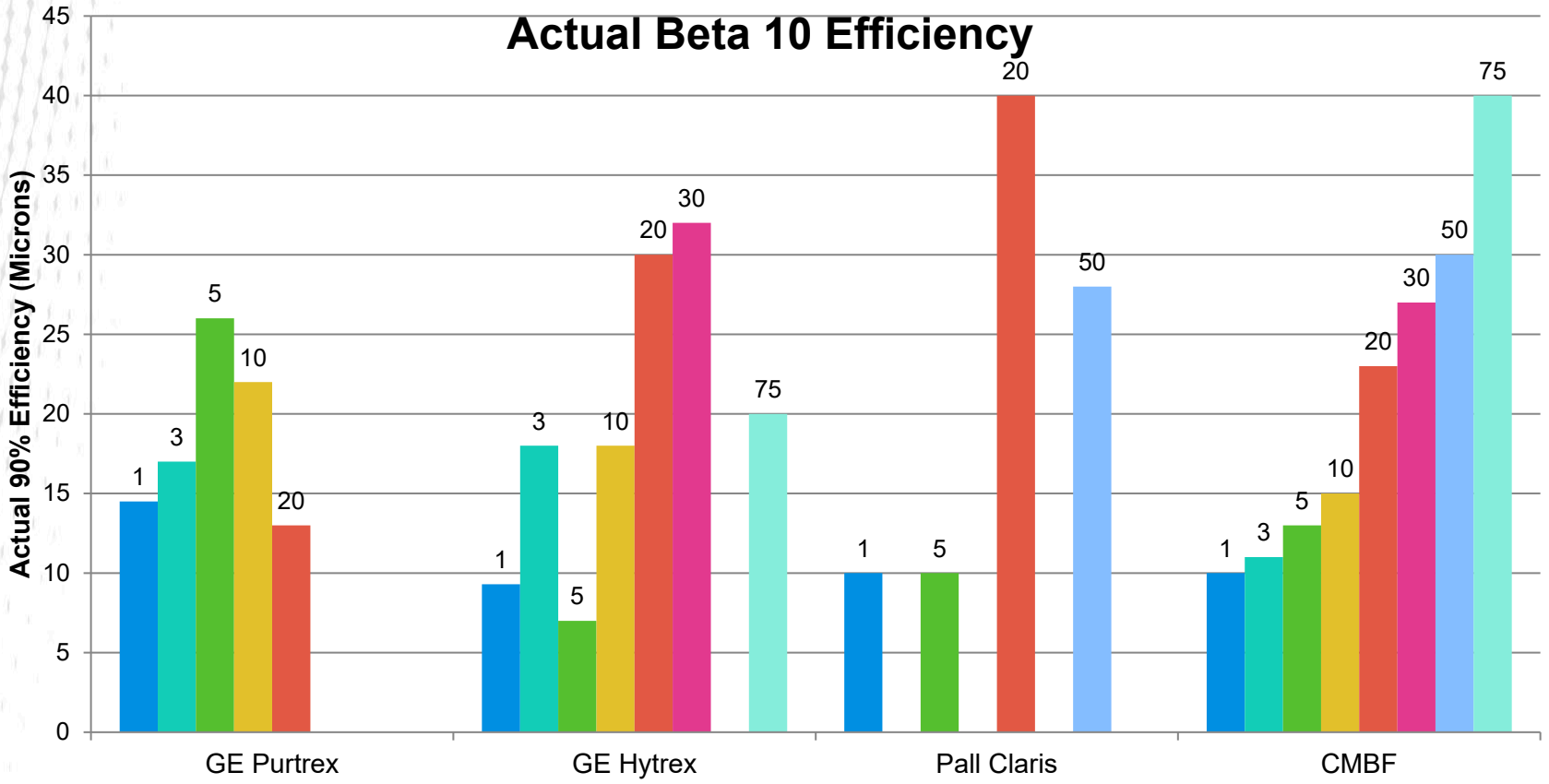
CRYSTAL MBF IS…..

- Intended for general purpose filtration
- NSF 61 certified
- Economically priced
- Low cost due to highly automated process
- Competitive on price and performance with Pall Claris and GE Hytrex & Z.Plex

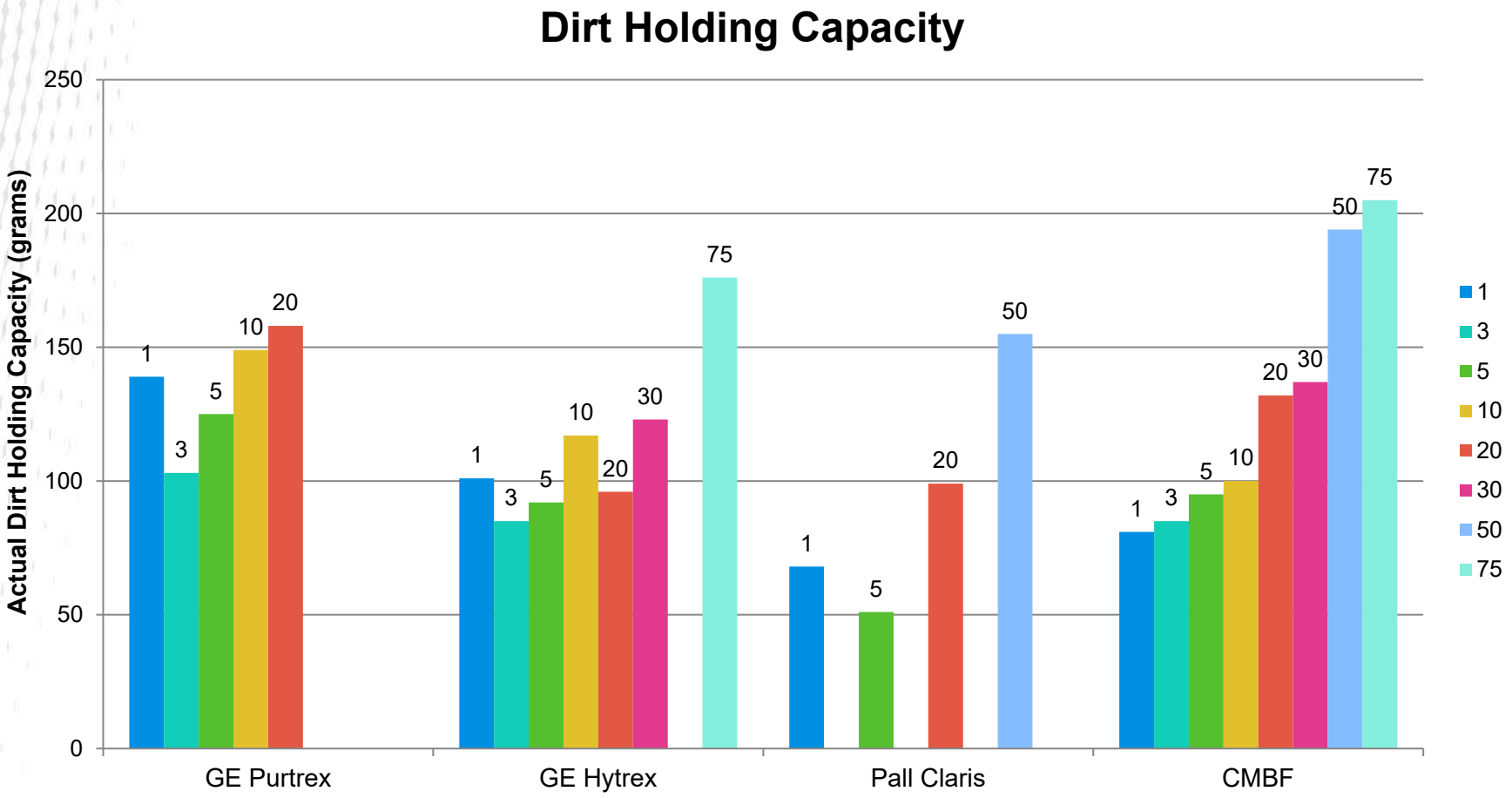
CRYSTAL MBF IS NOT…..

- For high value applications
- For critical processes
- A Stratum replacement
- Competitive with high value, high performance products – Nexis, profile, Selex

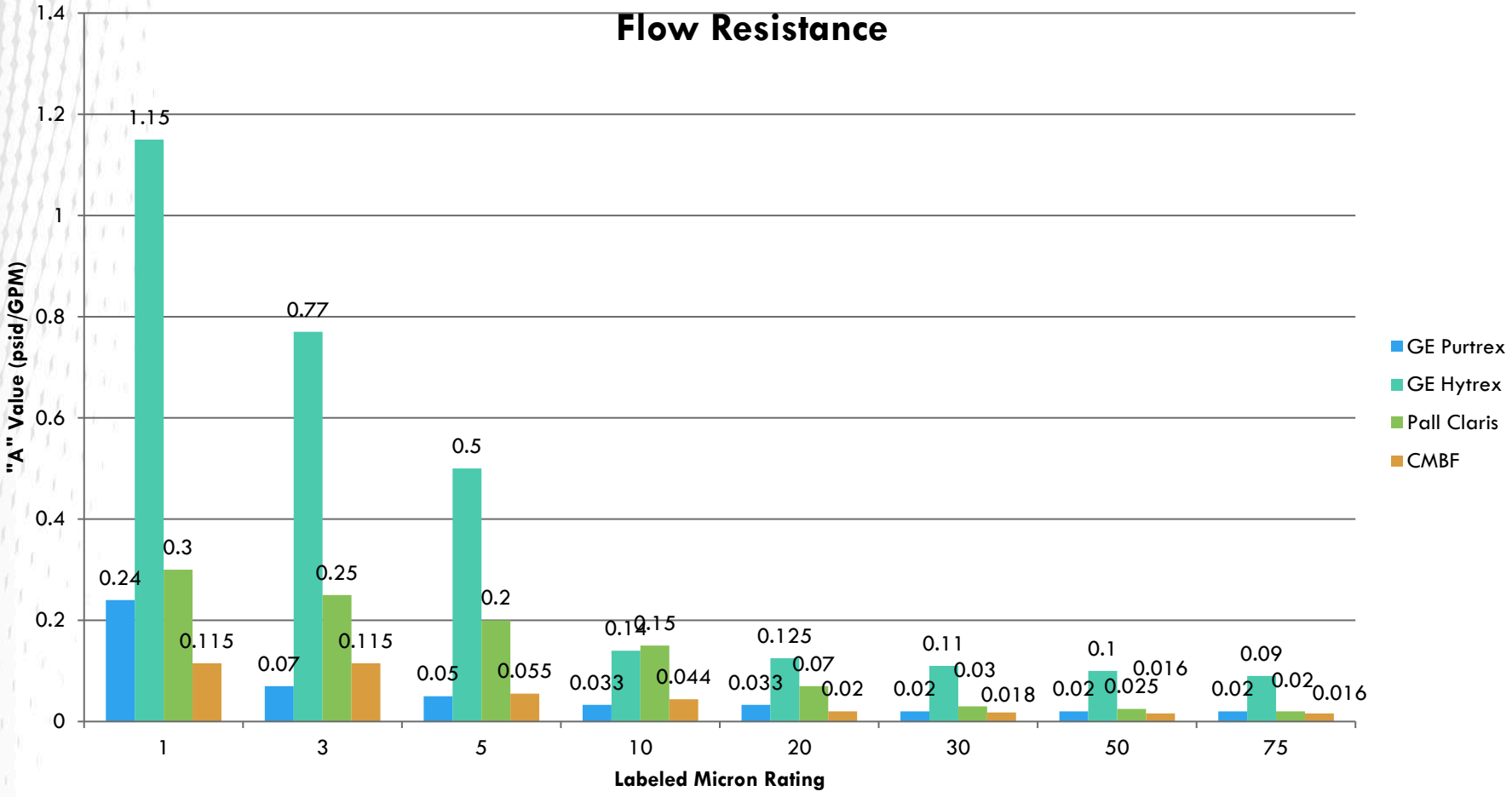
EFFICIENCY OVERVIEW



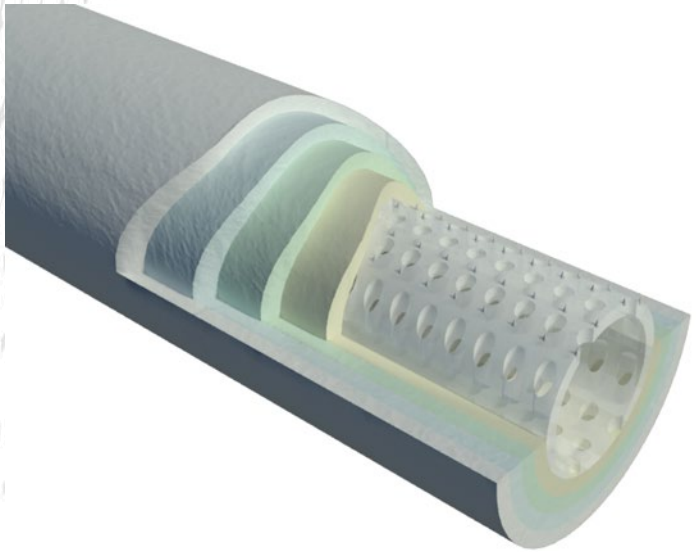
DIRT HOLDING CAPACITY OVERVIEW



SUPERIOR FLUID FLOW RATES!

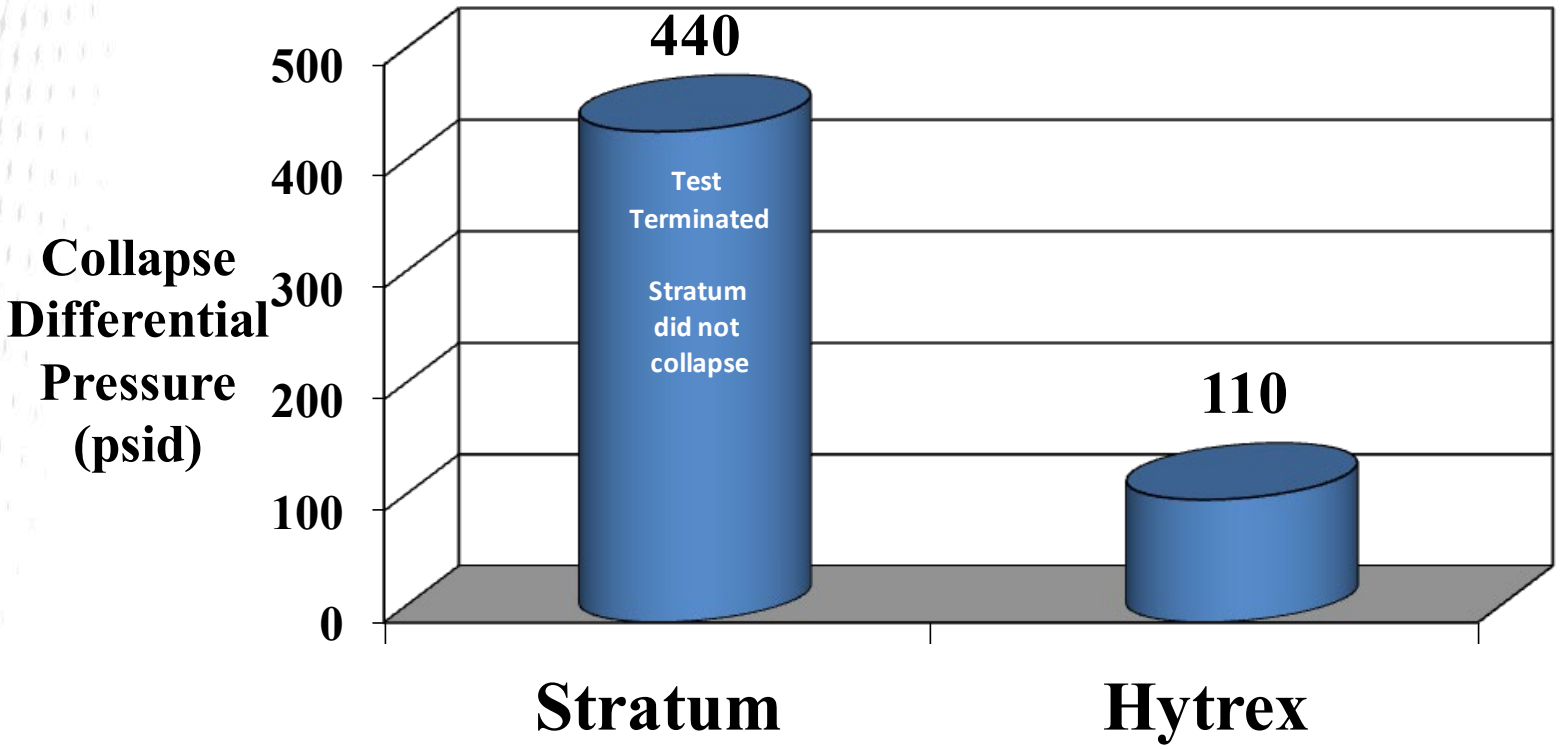


STRATUM SERIES MELT BLOWN FILTERS



- Advanced design with 4 distinct filtration zones for high performance
- Full micron range from 0.3 to 150µm
- Maximum dirt holding capacity
- Highly consistent performance
- Proprietary cactus core for high collapse strength
- Replaces Profile, Nexis, Betapure, Purocept, Selex

COLLAPSE STRENGTH- CACTUS CORED PRODUCT



STRATUM SERIES MELT BLOWN FILTERS

THERMALLY BONDED FIBERS

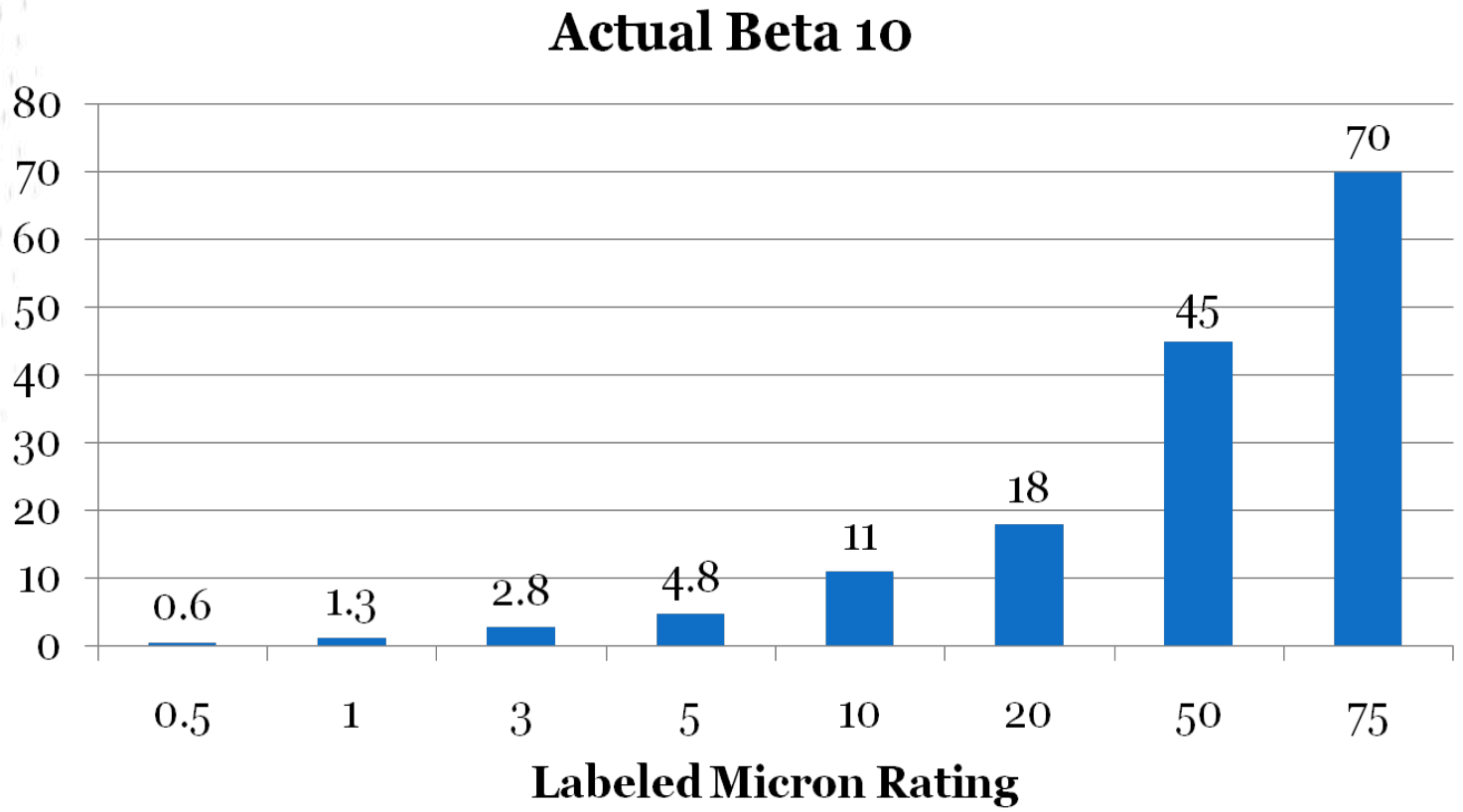
PREVENT CONTAMINANT UNLOADING

MAINTAIN PORE STRUCTURE

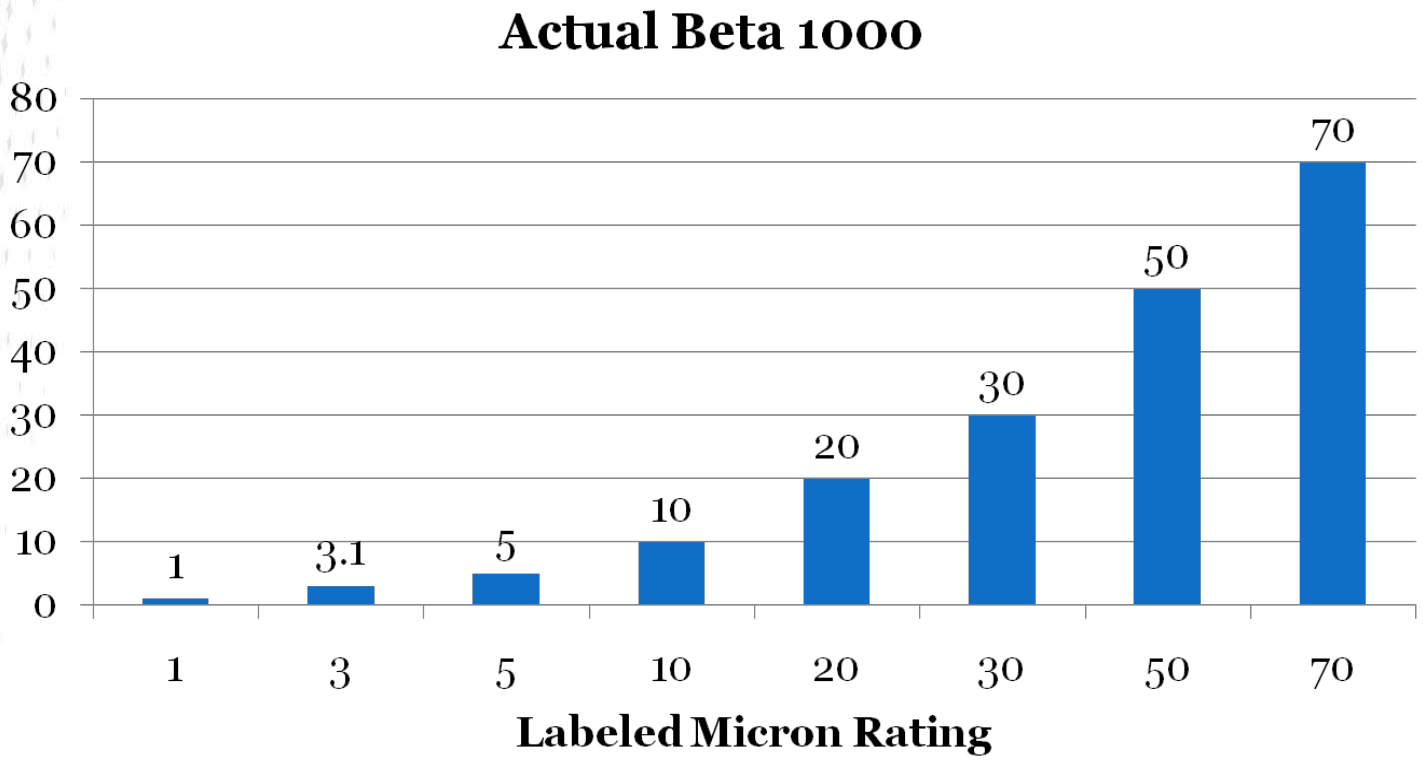
STRATUM SERIES MELT BLOWN FILTERS

ENHANCED MECHANICAL STRENGTH

STRATUM A SERIES



STRATUM C SERIES



MBC SERIES

- Similar Nominal Efficiencies as the Crystal MBF
- Targeted at price competitive installations
- Use MBC when need higher collapse strength – based on Stratum construction with the Cactus core.
- Offer when an end-capped economical melt blown is required - End cap options P, PX, P6, DBG, P3, P8, P2, P7

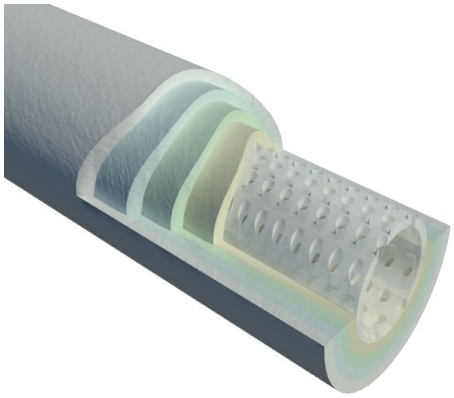
DIFFERENTIATION

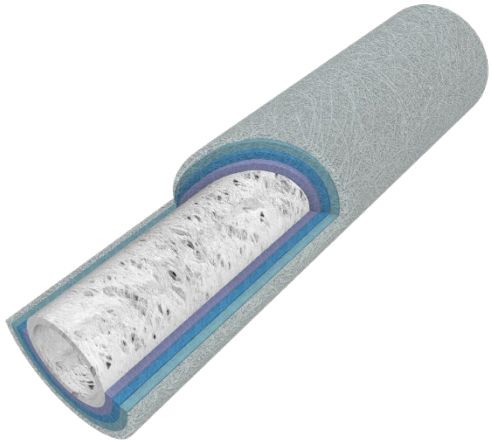
- Always Lead With:
  - Stratum A
  - Stratum C
- Crystal MBF is an economical alternative for customers who do not have a critical application
- If price competitive, but need higher collapse strength, sell MBC.
- Always be prepared to up-sell on future calls

DIFFERENTIATION

OPERATING CONDITIONS

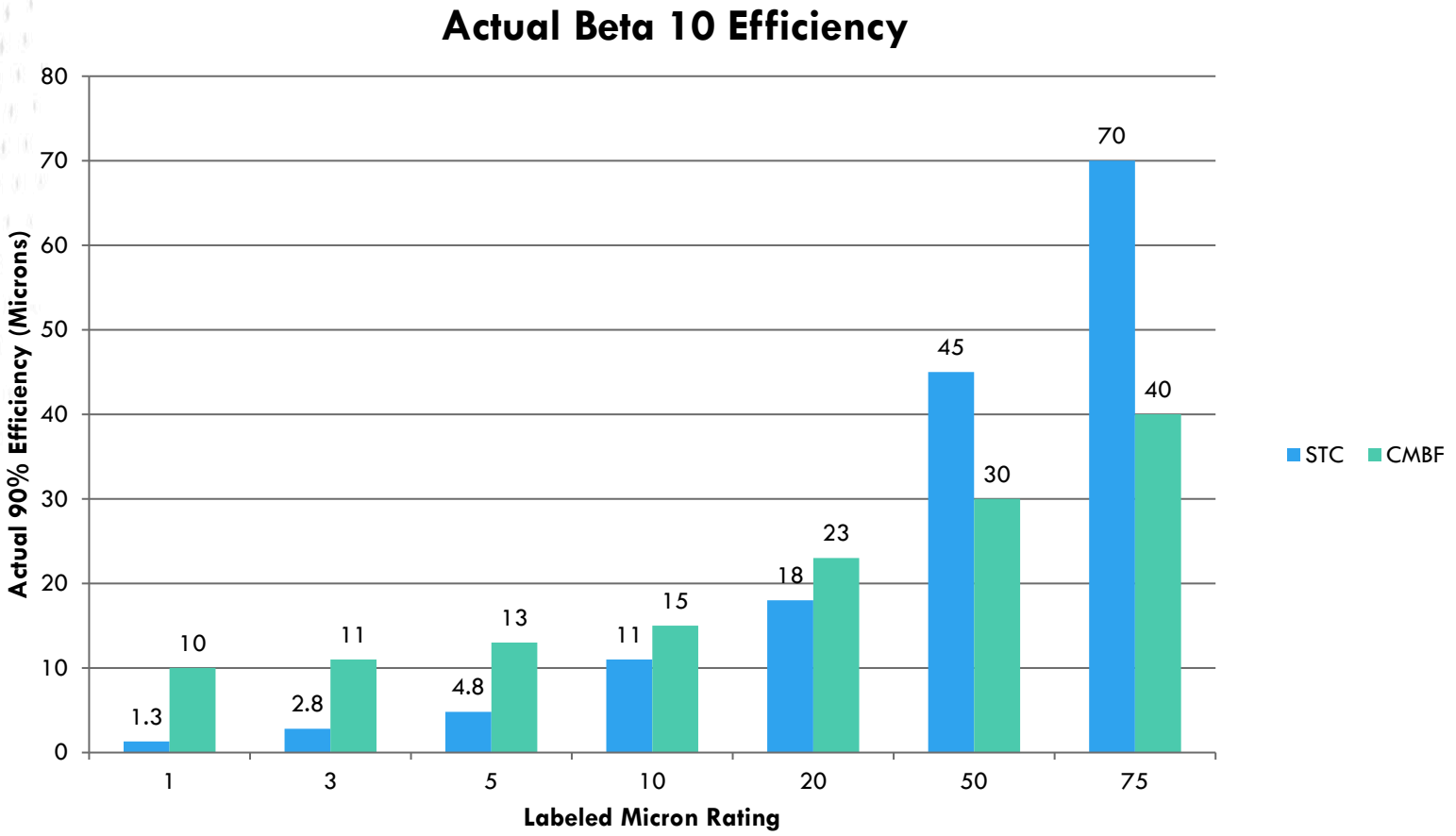
- Max Delta P at Ambient Temperature
  - CMBF = 65 psid/4.5 bar
  - Stratum = 150 psid/10.3 bar
- Maximum allowable temperature
  - CMBF = 170 ^{o}F/77 ^{o}C
  - Stratum = 176 ^{o}F/80 ^{o}C





DIFFERENTIATION

EFFICIENCY CRYSTAL MBF VS STRATUM C



STRATUM A TARGETED APPLICATIONS

- Ink Jet inks
- CMP Slurries
- Aqueous solutions
- Cosmetics
- Chemicals
- Beverage
- Amine
- Flavors & Fragrances
- Automotive Paints

STRATUM C SERIES TARGETED APPLICATIONS

- Pre RO filtration
- Glycol recovery
- Aqueous solutions
- DE Trap
- Chemicals
- Coatings
- Acids
- Pressure sensitive adhesive

MBC TARGETED APPLICATIONS

- Plating Solutions
- Aqueous solutions
- Parts Washing
- Machine Coolants
- Process Water
- Trap filters
- Higher pressure
- Higher temperature

CRYSTAL MBF TARGETED APPLICATIONS

- Pre RO filtration
- Desalination plants
- Aqueous solutions
- Wastewater
- Chemicals
- Rad Waste
- Cooling towers

DEPTH FILTERS: SUPPORT MATERIALS

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

Crystal MBF Series Filter Cartridges

Melt Blown Filters

Product Specifications

Media: Polypropylene

End caps/Center Core: Polypropylene

Micron rating:
1, 3, 5, 10, 20, 30, 50, 75 µm

Dimensions

Nominal lengths:
5", 9.75", 10", 19.5", 20", 29.25", 30", 39", 40"
(12.7, 24.8, 25.4, 49.5, 50.8, 74.3, 76.2, 99.1, 101.6 cm)
(Other lengths available)

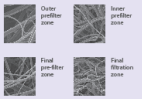
Outside diameter: 2.5" (6.35 cm), 2.63" (6.7 cm) End capped

Inside diameter: 1.1" (2.79 cm)

Operating Parameters

Maximum differential pressure:
65 psid @ 68°F (4.5 bar @ 20°C)
50 psid @ 100°F (3.4 bar @ 38°C)
25 psid @ 170°F (1.7 bar @ 77°C)

Recommended change-out pressure:
35 psid (2.4 bar)



An economical, melt blown filter element that can be used in a wide range of applications. The Crystal MBF depth filter is constructed of 100% polypropylene media for chemical compatibility with a variety of process fluids. The unique Crystal Core prevents collapse even at elevated temperatures.

FEATURES & BENEFITS

- Available in nominal ratings from 1 to 75 microns
- Formed Crystal Core for excellent collapse strength
- Graded pore construction for long on-stream life
- Melt blown media resists dirt unloading as differential pressure increases
- Non-shedding
- High dirt holding capacity
- Economical depth filtration
- Free of binders, adhesives and surfactants
- Highly consistent performance

CERTIFICATIONS

- USP Class VI: Meets USP Class VI Biological Test for Plastics
- FDA Listed Materials: All materials comply with FDA Title 21 of the Code of Federal Regulations Sections 174.5, and 177.1520, as applicable for food and beverage contact.
- NSF 61: Certified to NSF/ANSI STD 61 for materials requirements only — Component
- European Directive for Direct Food Contact: European Regulation No. 1935/2004 and European Regulation 10/2011: Tested for migration behavior and is suitable for contact with all kinds of foodstuffs with minimal rinse-up. Data available upon request.

TYPICAL APPLICATIONS

- RO Prefilters
- Wastewater
- Food and beverages
- Chemicals
- Blowdown post filter
- Radwaste
- Aqueous solutions
- Inks

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

MBC™ Series Filter Cartridges

Melt Blown Filters

Product Specifications

Media: Polypropylene

End caps/Center Core: Polypropylene

Gaskets/O-Rings:
Buna-N, EPDM, Santoprene, Silicone, Teflon Encapsulated Viton (O-Rings only), Viton

Micron rating:
1, 3, 5, 10, 20, 30, 50, 75 µm

Dimensions

Nominal lengths:
5", 9.75", 10", 19.5", 20", 29.25", 30", 39", 40"
(12.7, 24.8, 25.4, 49.5, 50.8, 74.3, 76.2, 99.1, 101.6 cm)
(Other lengths available)

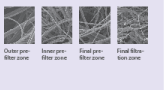
Outside diameter: 2.5" (6.35 cm), 2.63" (6.7 cm) End capped

Inside diameter: 1.0" (2.54 cm)

Operating Parameters

Maximum differential pressure:
150 psid @ 68°F (10.3 bar @ 20°C)
90 psid @ 150°F (6.2 bar @ 66°C)
35 psid @ 176°F (2.4 bar @ 80°C)

Recommended change-out pressure:
35 psid (2.4 bar)



An economical, melt blown filter element that can be used in a wide range of applications. The MBC depth filter is constructed of 100% polypropylene media for chemical compatibility with a variety of process fluids. The molded core prevents collapse even at elevated temperatures.

FEATURES & BENEFITS

- Available in nominal ratings from 1 to 75 microns
- Molded core for excellent collapse strength
- Graded pore construction for long on-stream life
- Melt blown media resists dirt unloading as differential pressure increases
- Non-shedding
- High dirt holding capacity
- Economical depth filtration
- Thermal bonded endcaps optional
- Free of binders, adhesives and surfactants

CERTIFICATIONS

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TYPICAL APPLICATIONS

- RO Prefilters
- Wastewater
- Chemicals
- Blowdown post filter
- Radwaste
- Aqueous solutions
- Inks

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

Stratum® C Series Filter Cartridges

High Performance Filters

Product Specifications

Media: Polypropylene

End caps/Center Core: Polypropylene

Gaskets/O-Rings:
Buna-N, EPDM, Santoprene, Silicone, Teflon Encapsulated Viton (O-Rings only), Viton

Micron rating:
0.5, 1, 3, 5, 10, 20, 50, 75, 100 µm

Dimensions

Nominal lengths:
5", 9.75", 10", 19.5", 20", 29.25", 30", 39", 40"
(12.7, 24.8, 25.4, 49.5, 50.8, 74.3, 76.2, 99.1, 101.6 cm)

Outside diameter: 2.5" (6.35 cm), 2.63" (6.7 cm) End capped

Inside diameter: 1.0" (2.54 cm)

Operating Parameters

Maximum differential pressure:
150 psid @ 68°F (10.3 bar @ 20°C)
90 psid @ 150°F (6.2 bar @ 66°C)
35 psid @ 176°F (2.4 bar @ 80°C)

Recommended change-out pressure:
35 psid (2.4 bar)

Steam Sterilization:
Stratum single open end style filters may be autoclaved under no end load conditions for 30 minutes at 121°C. Filters should be cooled to normal operating temperatures prior to use.

For critical customer applications requiring precise and repeatable depth filtration, the Graver Stratum C series melt blown filters deliver exceptional performance. With a multi- zoned construction, true clarifying filtration is achieved with no unloading of captured contaminant.

FEATURES & BENEFITS

- Multi-zone melt blown depth filter with a true graded pore structure
- Thermally bonded fibers for high void volume and long on-stream life
- Available in precise 90% removal efficiencies from 0.5 to 100 microns
- 100% pure virgin polypropylene
- Molded center core for higher temperature and pressure capability
- Free of surfactants, binders and adhesives

CERTIFICATIONS

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- FDA Listed Materials: All materials comply with FDA Title 21 of the Code of Federal Regulations Sections 174.5, and 177.1520, as applicable for food and beverage contact.
- NSF 61: Certified to NSF/ANSI STD 61 for materials requirements only — Component
- European Directive for Direct Food Contact: European Regulation No. 1935/2004 and European Regulation 10/2011: Tested for migration behavior and is suitable for contact with all kinds of foodstuffs with minimal rinse-up. Data available upon request.

TYPICAL APPLICATIONS

- Chemicals
- Pharmaceuticals
- Paint/Inks
- Food and beverages
- Water
- Microelectronics
- Plating
- Cosmetics

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

Stratum® A Series Filter Cartridges

Absolute Rated Melt Blown Filters

Product Specifications

Media: Polypropylene

End caps/Center Core: Polypropylene

Gaskets/O-Rings:
Buna-N, EPDM, Santoprene, Silicone, Teflon Encapsulated Viton (O-Rings only), Viton

Micron rating:
0.3, 0.5 1, 3, 5, 10, 20, 30, 50, 70, 100 µm

Dimensions

Nominal lengths:
5", 9.75", 10", 19.5", 20", 29.25", 30", 39", 40"
(12.7, 24.8, 25.4, 49.5, 50.8, 74.3, 76.2, 99.1, 101.6 cm)

Outside diameter: 2.5" (6.35 cm)

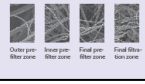
Inside diameter: 1.0" (2.54 cm)

Operating Parameters

Maximum differential pressure:
150 psid @ 68°F (10.3 bar @ 20°C)
90 psid @ 150°F (6.2 bar @ 66°C)
35 psid @ 176°F (2.4 bar @ 80°C)

Recommended change-out pressure:
35 psid (2.4 bar)

Steam Sterilization:
Stratum single open end style filters may be autoclaved under no end load conditions for 30 minutes at 121°C. Filters should be cooled to normal operating temperatures prior to use.



Stratum A Series melt blown depth filters deliver 99.9% efficiency at the stated micron for the most demanding applications. By utilizing ultra fine fibers and controlled thermal bonding, the Stratum A series retains captured contaminant even at higher differential pressures.

FEATURES & BENEFITS

- Absolute retention ratings from 0.3 to 100 microns
- Multi-zone melt blown depth filter with a graded pore structure for maximum dirt holding capacity
- Thermally bonded fibers for high void volume and long on-stream life
- Lot traceable filters come with certificate of conformance
- 100% pure virgin polypropylene
- Molded center core for higher temperature and pressure capability
- Free of surfactants, binders and adhesives

CERTIFICATIONS

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- FDA Listed Materials: All materials comply with FDA Title 21 of the Code of Federal Regulations Sections 174.5, and 177.1520, as applicable for food and beverage contact.
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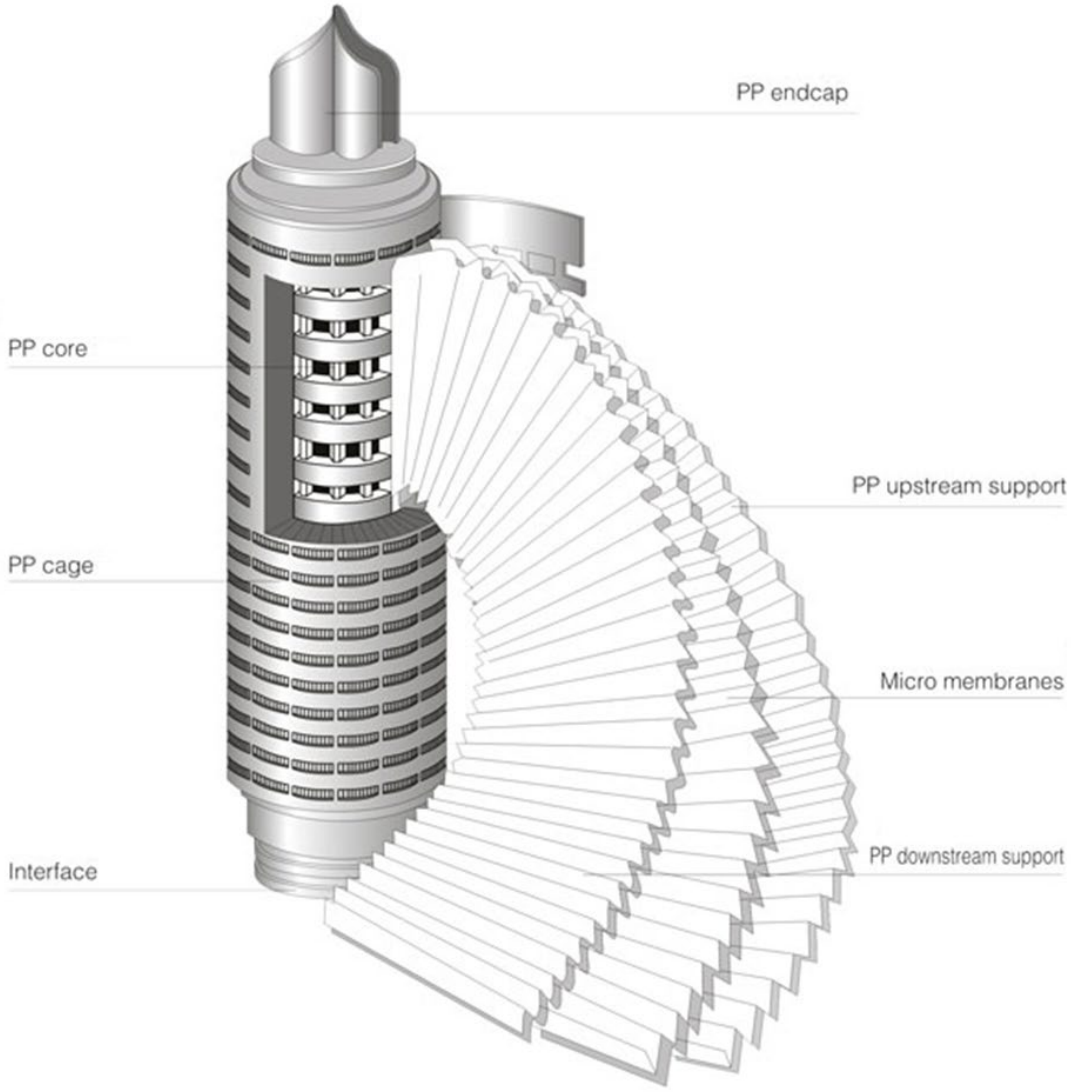
TYPICAL APPLICATIONS

- Chemicals
- Pharmaceuticals
- Paint/Inks
- Food and beverages
- Water
- Microelectronics
- Plating
- Cosmetics
- CMP Slurry

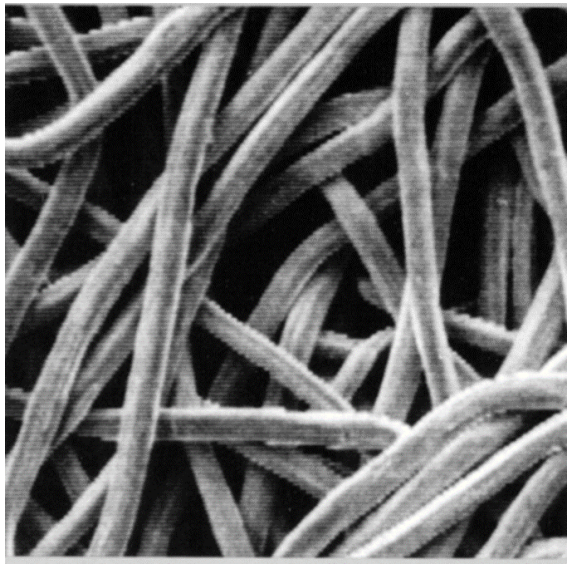
PLEATED FILTERS

PLEATED FILTERS: GRAVER TECHNOLOGIES



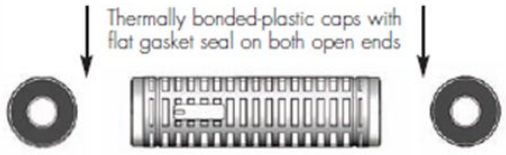
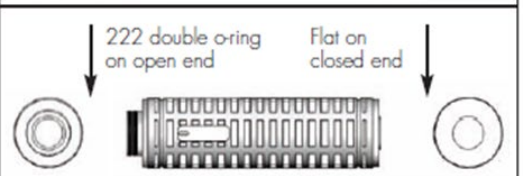
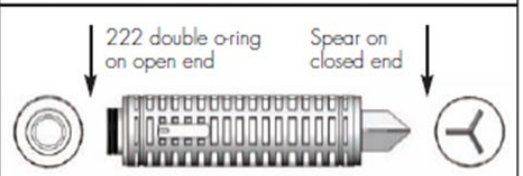
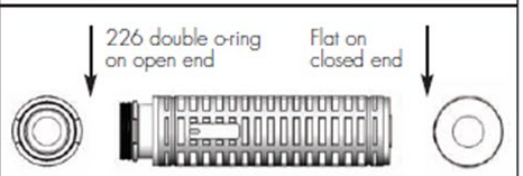
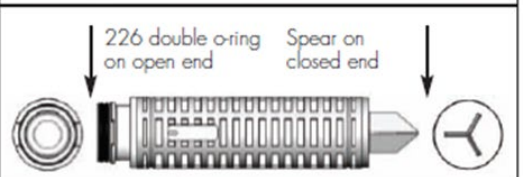
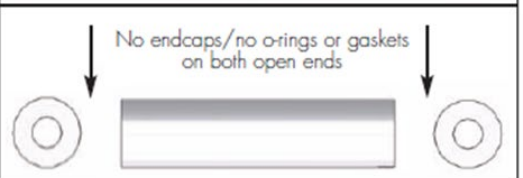
PLEATED FILTERS: GRAVER TECHNOLOGIES

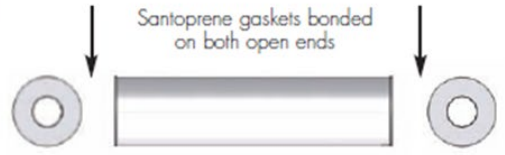
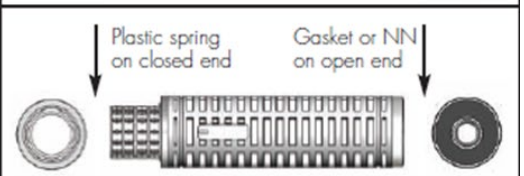
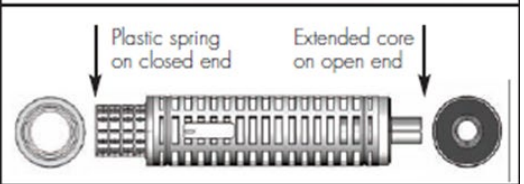
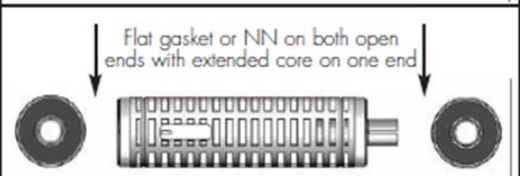
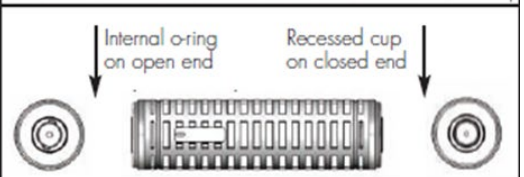
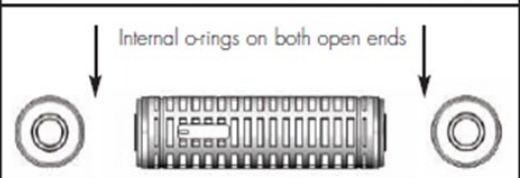
- Typically supported by a Core and Outer Sleeve (cage).
- Flow pattern typically outside – in.
- Microfiber
  - Pleated for High Surface Area
  - Filters by Direct Interception and Sieving
  - Effective from 0.2µm to 100µm
- Multiple Media Materials
  - Glass
  - Polypropylene



Random Fiber Matrix

PLEATED FILTERS: CONFIGURATIONS

Style	DOE or SOE	
P	DOE	
P3	SOE	
P8	SOE	
P2	SOE	
P7	SOE	
NN	DOE	

Style	DOE or SOE	
DBG	DOE	
P6	SOE	
P9	SOE	
PX	DOE	
AM	SOE	
NPC	DOE	

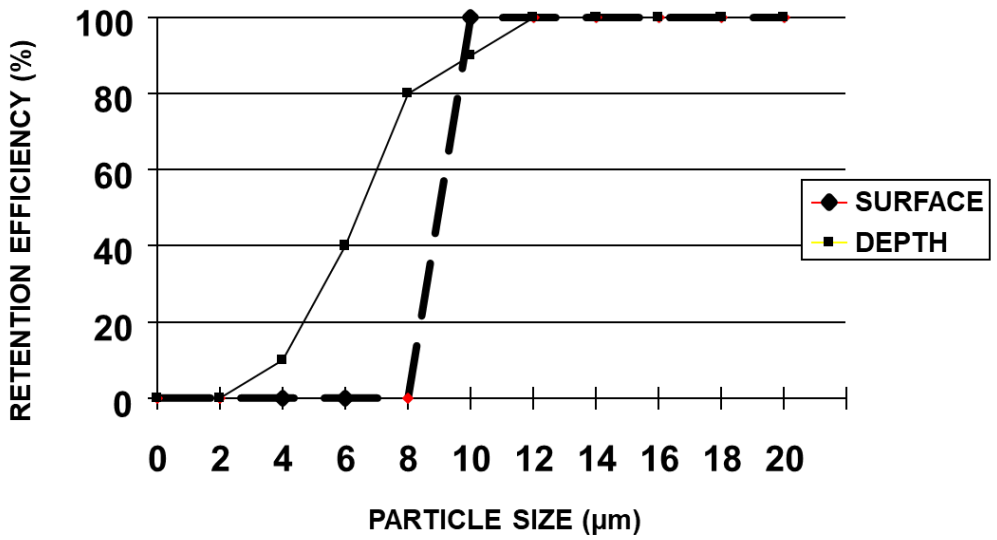
PLEATED FILTERS: DIFFERENTIATION

Advantages

- Very high dirt capacities
- 10-15 X surface area of Depth
- Absolute & Nominal rated @ higher pressure (35 psi)
- High flows
- Low Media Migration

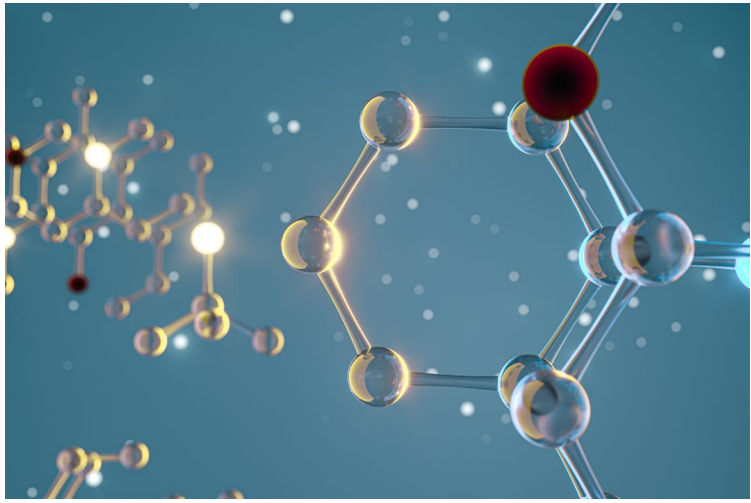
Disadvantages

- “Expensive” when compared to depth
- Narrower particle size retention vs. depth
- Not effective for gels and deformable particles



PLEATED FILTERS: TYPICAL APPLICATIONS

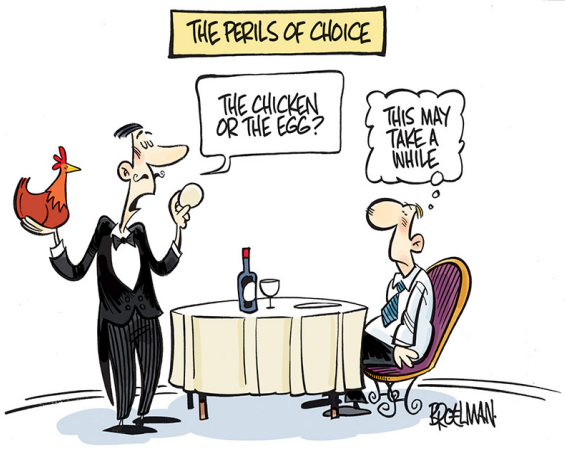
- Inks, Coatings, CMP slurries
- Bottled Water, Wine & Beer prefilters
- Pharmaceutical clarifying and classifying filters
- Prefilters to Membranes
- Chemicals final and prefilters
- Process and drinking water



PLEATED FILTERS: GRAVER TECHNOLOGY

Microfiber

- Pleated for High Surface Area
- 2.55” and 2.7” OD (4.5” also in market)
- Effective from 0.2µm to 100µm
- Available as Absolute or Nominal
- Multiple Media Materials
  - Glass
  - Polypropylene



- Pleated Filters
  - QMA
  - QMC
  - PMA
  - PMC
  - PME
  - QXL
  - QCR
  - QSL
  - GFC
  - GFP
  - GSS
  - High Flow
  - High Flow GF
  - High Flow RF

PLEATED FILTERS: ABSOLUTE RATED

QMA™

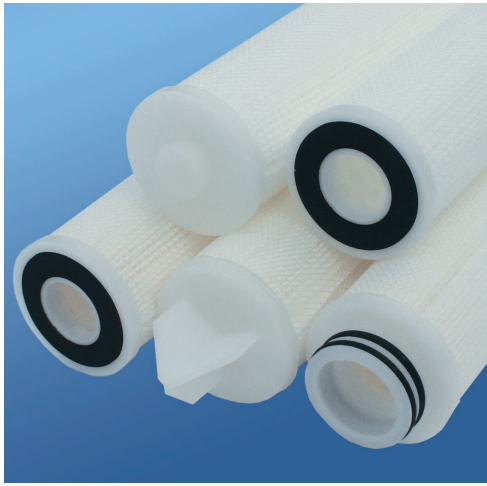
- *Absolute* ratings with 99.98% efficiencies
- 7.7 square feet of media
- Highest performance offering

PMA™

- *Absolute* ratings with 99.98% efficiencies
- Reduced surface area of 5.4 square feet
- Offers economy with high performance

PME™

- *Absolute* ratings with 99.98% efficiencies
- Reduced surface area of 4.3 square feet
- Economy – lowest price offering
- 2.55” OD – retrofits melt blown and some industrial vessels.



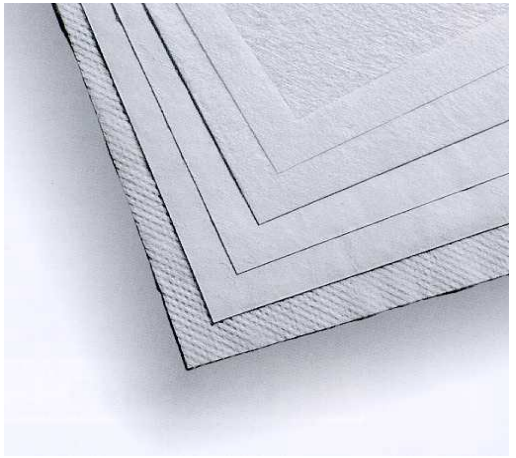
PLEATED FILTERS: ABSOLUTE RATED

	QMA	PMA	PME
Multi or Single layer	Single	Single	Single
Nominal or Absolute	Absolute Beta 5000	Absolute Beta 5000	Absolute Beta 5000
Surface Area	7.0 ft^2	5.4 ft^2	4.3 ft^2
List Price – 5 µm 10”	$78.76	$64.50	$25.00
Ideal Application Parameters	Used where on-stream life is essential. Production of high value products - healthcare	For batch operations or where a value priced filter is necessary for competitive reasons	Value driven application competing against low cost competition. Retrofit for melt blown.

PLEATED FILTERS: NOMINAL RATED

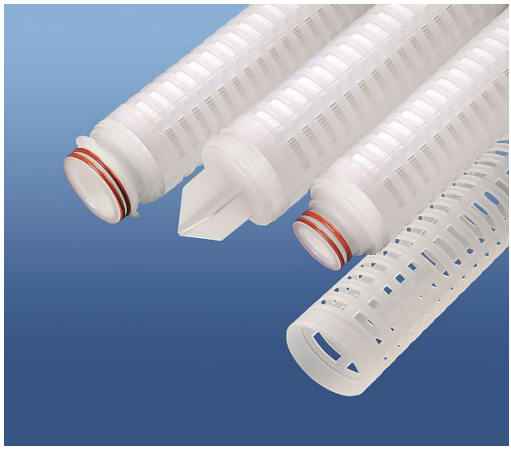
QMC™

- *Nominal* ratings with 95% efficiencies
- Multi-layered gradient density media provides high dirt holding capacity
  - Successive layers get tighter
  - Thicker media pack results in to 4.4 square feet of effective filter area (EFA)



PMC™

- *Nominal* ratings with 90% efficiencies
- Surface area of 5.4 square feet
- Offers economy with high performance



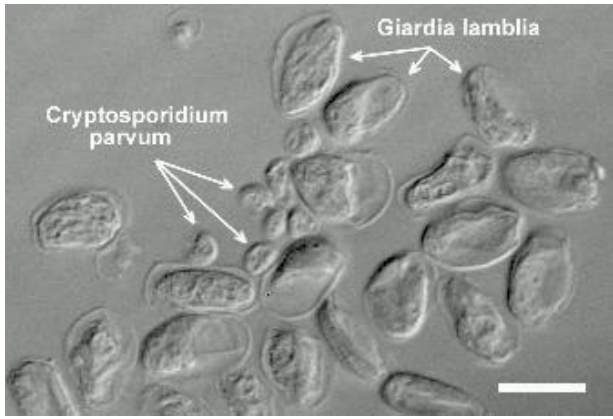
PLEATED FILTERS: NOMINAL RATED

	QMC	PMC
Multi or Single layer	Multi	Single
Nominal or Absolute	Nominal Beta 10	Nominal Beta 10
Surface Area	4.4 ft^2	5.4 ft^2
List Price – 5 µm 10”	$62.12	$40.61
Ideal Application Parameters	Used in complex fluids where added depth is advantageous, ie wine/beer bottling prefilter	For batch operations or where a value priced filter is necessary for competitive reasons

PLEATED FILTERS: SPECIALTY PLEATED

QCR™

- Designed specifically for cryptosporidium and giardia cyst reduction
- Meets Long Term 2 Enhanced Surface Water Treatment Rule
- Two ratings:
  - 1 µm meets LT2 Standard with >3 LRV.
  - 0.8 µm exceeds LT2 Standard with >3 LRV for 1 µm particles



QXL™

- *Absolute* ratings with 99.9% efficiencies
- Hybrid pleated/depth multi-layer design to capture deformable particles.

QSL™

- *Absolute* rating at 0.2 & 0.5 micron with 99.98% efficiency
- ***Serial layer*** utilizing polypropylene pre-layer with membrane – *two filters in one.*

PLEATED FILTERS: SPECIALTY PLEATED

	QCR	QXL	QSL
Multi or Single layer	Single/Multi	Multi	Multi
Nominal or Absolute	Absolute Beta 2000 (99.95%)	Absolute Beta 1000	Absolute Beta 5000
Surface Area	7.0 ft^2	2.2 – 2.4 ft^2	6.8 ft^2
List Price – 5 µm 10”	$69.25/$76.04	$49.97	$99.78/$73.30
Ideal Application Parameters	Intended for surface water treatment of Cysts to meet EPA standard	Targeted to applications with deformable particles – inks, plant extracts.	Primarily intended as a prefilter to membrane filters in F&B & healthcare applications.

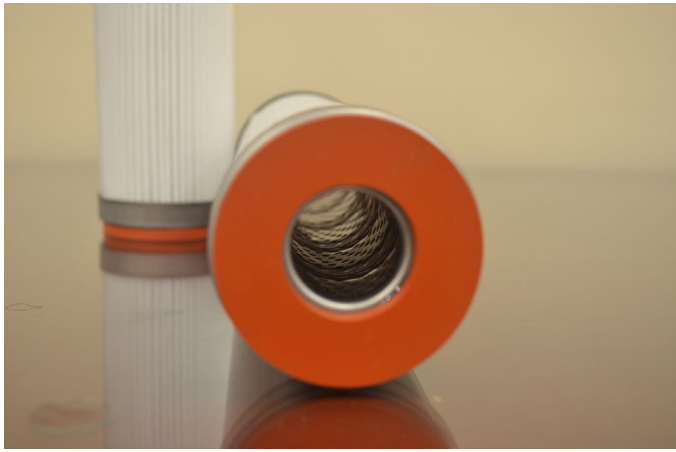
PLEATED FILTERS: MICROFIBERGLASS

GFC™

- *Nominal* ratings with 90% efficiencies.
- Micro-fiberglass media with PP hardware

GFP™

- *Nominal* ratings with 90% efficiencies.
- All polyester hardware for higher temperature resistance up to 230° F (110° C)



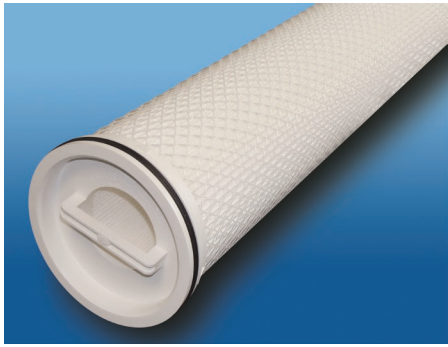
GSS™

- *Nominal* ratings with 90% efficiencies.
- Utilizes 304 Stainless steel structural components with 2.55” OD.
- High temperature resistance up to 250° F (121° C)

PLEATED FILTERS: GRAVER TECHNOLOGY

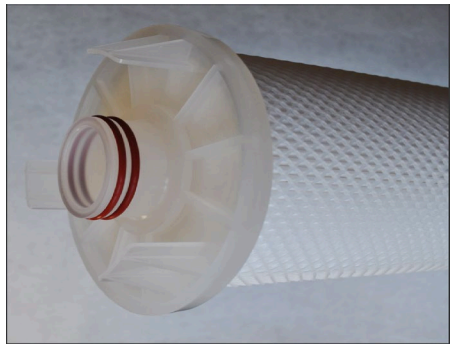
	GFC	GFP	GSS
Multi or Single layer	Single	Single	Single
Nominal or Absolute	Nominal Beta 10	Nominal Beta 10	Nominal Beta 10
Surface Area	5.4 ft^2	5.4 ft^2	4.3 ft^2
List Price – 1 µm 10”	$49.60	$75.45	$67.75
Ideal Application Parameters	Inherent positive charge makes it great in biological solutions and for haze removal.	Industrial applications requiring temperature tolerance above 80C (up to 110C)	Intended for high temperature applications where polymeric structures cannot be used.

PLEATED FILTERS: LARGE GEOMETRY



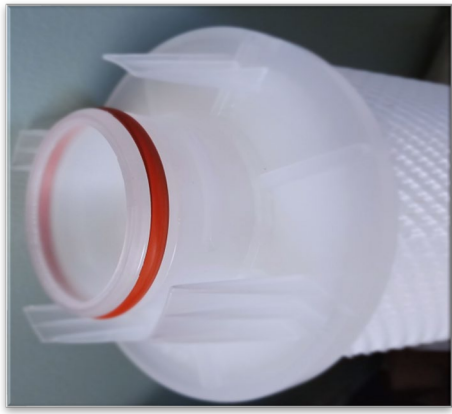
High Flow™

- *6” Diameter filter in 20”, 40” and 60” lengths*
- *Handles flows up to 500 GPM (60” element)*
- *Inside to out flow contains captured contaminant.*



High Flow™ GF

- *Microfiberglass media*
- *Choice of PP or acetal/polyester hardware*
- *Acetal components available to allow for higher temperatures – 230˚ F (110 ˚ C)*

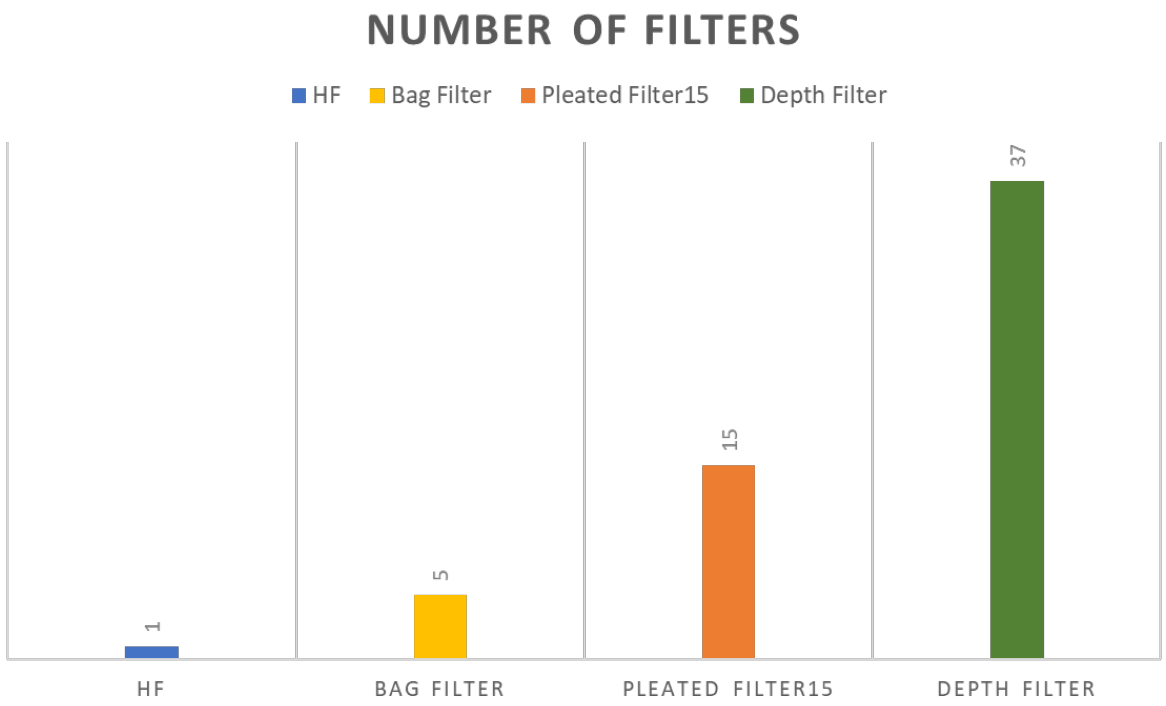


High Flow™ RF

- 43 ft2 of surface area.
- Traditional outside-inside flow.
- Two formats
  - Double 226 O-ring seal (3M 740 retrofit) Up to 80 GPM flow
  - 338 o-ring (3M High Flow retrofit) – Up to 500 (375) GPM

LARGE GEOMETRY: THE SCIENCE

- ***One 60" High Flow handles up to 350 GPM***
  - That would be 37 depth filters (40")
  - That would be 23 pleated filters (40")
  - That would be 5 bag filters (30")
- ~75 Square feet of media in each 60" filter
  - 20" length handles 125 GPM & 40" length handles 250 GPM
- Absolute rated (99.9%) pleated depth media



LARGE GEOMETRY: TYPICAL APPLICATIONS

- Reverse Osmosis
- Centralized Water Systems
- Process Water
- Deep Well Injection
- Municipalities
- Desalination
- Process Wastewater
- Boiler Condensate

PLEATED FILTERS: LARGE GEOMETRY

	HF	HFGF	HFRF
Multi or Single layer	Multi	Single	Multi
Nominal or Absolute	Absolute Beta 1000	Absolute Beta 1000	Absolute Beta 1000
Surface Area	24/48/72 ft^2	32/64/96 ft^2	43/65 ft^2
List Price – 5 µm	$325.68/ $465.27/$628.13	$307.10/ $438.72/$592.30	$327.99/ $442.93
Ideal Application Parameters	Large flow applications – Pre RO, Injection wells. Single cartridge can replace multiple pleated or depth filters	Large flow industrial application where glass may be beneficial or where temperature is an issue	Large flow applications. Targeted to replacing 3M High Flow designs.

PLEATED FILTERS: SUPPORT MATERIALS

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

High Flow Series Filter Cartridges

Large Geometry Pleated Filters for High Flow

Graver High Flow Series filters feature a larger geometry to handle higher flows with fewer filter elements. The result is much faster, easier filter changeouts. In addition, the inside to outside flow allows for excellent dirt holding capacity, extending the time between filter changeouts. Filter housings are also available and because of the filter's high flow and dirt holding capacity, smaller systems are possible, reducing upfront capital costs.

Product Specifications

Media/Support/Cage: Polypropylene
End Caps: Polypropylene
Gaskets/O-Rings: Buna-N, EPDM, Silicone, Viton
Micron rating: 1, 3, 5, 10, 20, 40, 60, 75, 100 µm

Dimensions

Nominal lengths:
20" 40" 60"
50.8 101.6 152.4 cm
Outside diameter: 6.0" (15.2 cm)
Surface Area:
24 ft² (2.2 m²) per 20" element
49 ft² (4.6 m²) per 40" element
73 ft² (6.8 m²) per 60" element

Operating Parameters

Maximum operating temperature: 176°F (80°C)
Maximum differential pressure:
75 psid @ 70°F (5.2 bar @ 21°C)
30 psid @ 176°F (2.0 bar @ 80°C)
Maximum reverse pressure:
40 psid @ 70°F (2.8 bar @ 21°C)
Recommended change-out pressure: 35 psid (2.4 bar)
Maximum flow rates*:
60" element up to 500 GPM (1892 lpm)
40" element up to 350 GPM (1325 lpm)
20" element up to 175 GPM (662 lpm)
*Consult factory for sizing assistance based on particle loads.

FEATURES & BENEFITS

- 6" diameter, large geometry for high flow rates
- Absolute retention ratings from 1 to 100 microns
- Capable of flow rates up to 500 GPM in a single 60" element
- Inside-out flow retains contaminant even during changeout
- Multi layer pleated construction with optimized surface area
- Outer cage prevents media extrusion problem experienced with some competitive offerings
- Unique Quad Seal gasket provides maximum seal integrity
- Retrofits competitive high flow filter housings
- Thermally bonded construction

CERTIFICATIONS

- FDA Listed Materials: All materials comply with FDA Title 21 of the Code of Federal Regulations Sections 174.5, and 177.1520, as applicable for food and beverage contact.
- European Directive for Direct Food Contact: European Regulation No. 1935/2004 and European Regulation 10/2011: Tested for migration behavior and is suitable for contact with all kinds of foodstuffs with minimal rinse-up. Data available upon request.
- NSF 61: Certified to NSF/ANSI STD 61 for materials requirements only — Component.

TYPICAL APPLICATIONS

- Water Systems
- Chemicals
- Food and Beverage
- Pre RO

Graver Technologies

GLOBAL LEADERSHIP
IN BEVERAGE FILTRATION

Graver Technologies

FILTRATION | SEPARATION | PURIFICATION

GSS™ Series Filter Cartridges

High Temperature Glass Fiber Cartridges

This high efficiency, economical filter element is constructed of pleated Borosilicate Microfiberglass media to combine excellent flow rates with exceptional service life. The 304 stainless steel core and end caps of the GSS filter cartridge provide excellent thermal tolerance for for higher temperature applications. The 90% nominally-rated borosilicate microfiber depth matrix has a natural positive charge that aids in the retention of negatively charged particles, and combined with the depth characteristics of glass media, works well in the removal of both deformable and non-deformable particles. The GSS filter cartridge is an economical solution for both liquids and gases in a wide variety of filtration applications.

Product Specifications

Media: Borosilicate Microfiberglass with Acrylic Binder
Core/Cage: 304 SS
Support Layers: Polyester
End Caps: 304 SS with epoxy bond
Gaskets/O-Rings: Buna-N, EPDM, Silicone, Teflon, Viton
Micron rating: 0.2, 0.45, 1, 10, 30 µm

Dimensions

Nominal lengths:
9.75" 10" 20" 30" 40"
24.8 25.4 50.8 76.2 101.6 cm
Outside diameter: 2.55" (6.86 cm)
Inside diameter: 1.0" (2.54 cm)

Operating Parameters

Maximum operating temperature: 250°F (121°C)
Maximum differential pressure: 75 psid @ 250°F (5.2 bar @ 121°C)
Maximum reverse pressure: 30 psid @ 70°F (2.0 bar @ 21°C)
Recommended change-out pressure: 35 psid (2.4 bar)

FEATURES & BENEFITS

- 304 stainless steel center core and end caps — allows for high temperature applications
- Micron ratings from 0.2 to 30 µm — Broad application range
- Uniform pore size — High removal efficiency
- High surface area — High flow capability and dirt holding capacity
- Long service life — Minimizes maintenance costs
- Small diameter fibers — High flow rates at low pressure drops

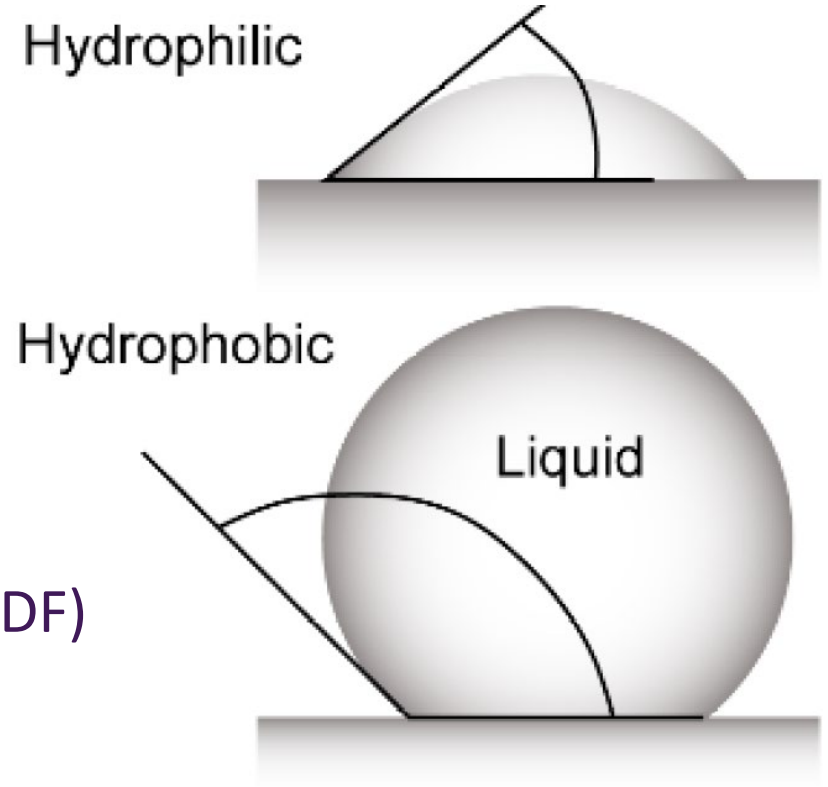
TYPICAL APPLICATIONS

- Petrochemicals
- Injection Wells
- Discharge Water
- Boiler Water
- Oil & Gas
- Lube Oil

MEMBRANE FILTERS

MEMBRANE FILTERS: MEMBRANE TECHNOLOGY

- Hydrophilic
  - Cellulosic
  - Nylon
  - Polyester
  - Polyethersulfone
  - Polysulfone
  - Polyvinylidene fluoride (PVDF)
- Hydrophobic
  - Polypropylene (PP)
  - Polytetrafluoroethylene (PTFE)
  - Polyvinylidene fluoride (PVDF)

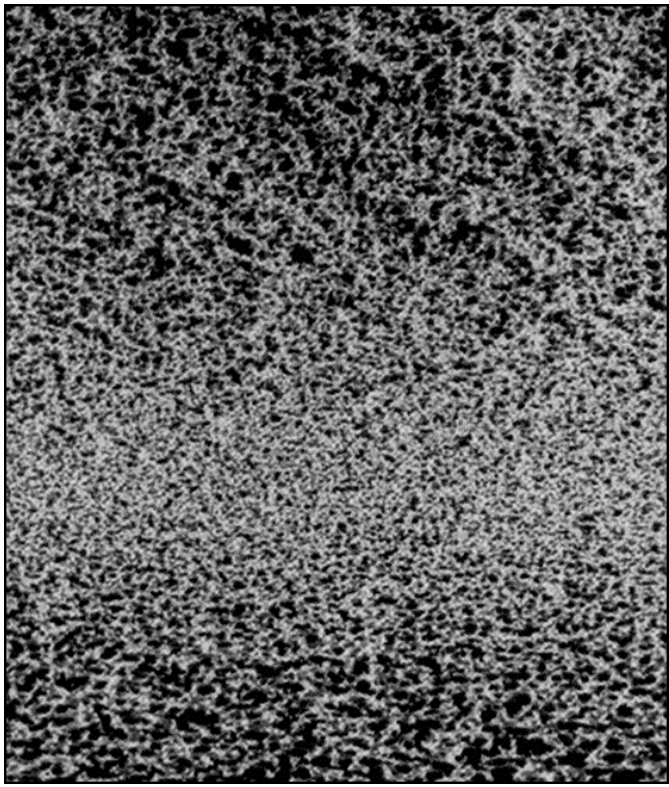


MEMBRANE FILTERS: TYPICAL APPLICATIONS

- Heathcare
  - Bioburden control
  - Sterility
- Medical (Dialysis)
- Microelectronics
  - Water Systems
  - FAB
  - Etchs
  - Buffers
  - Acids
- Beverage
  - Final filtration of Beer, Wine, Bottled Water
- Fine Chemicals
  - Pharmaceutical
  - Semiconductor Grade

MEMBRANE FILTERS: GRAVER TECHNOLOGY

- Hydrophilic PES Membrane Filters
  - ZTEC-G
  - ZTEC WB
  - ZTEC B
  - ZTEC E
  - ZTEC P
  - WaterTec
- High Performance Membrane
  - High flow rates
  - High dirt-holding capacity
  - Good mechanical strength
  - Good resistance to acids, bases, and oxidizers other than ozone
  - Limited solvent resistance



MEMBRANE FILTERS: PRODUCT DIFFERENTIATION

Within a membrane product families (there are variations of the product that are intended to meet certain application requirements. Grade designation such as:

- *"E" – Electronics*
- *"B" – Bioburden reduction*
- *"P" - Pharmaceutical*
- *"WB" - Food and Beverage*

- *APPLICATION DRIVEN - In most cases, the same materials and construction parameters are utilized but the manufacturing processes and/or claims are modified to meet the demands of the application.*

- *Recommending the correct grade is critical to meeting end user expectation and process requirements.*

- *Refer to the Qualification/Performance/Validation Guides*

MEMBRANE FILTERS: HYDROPHILIC PES

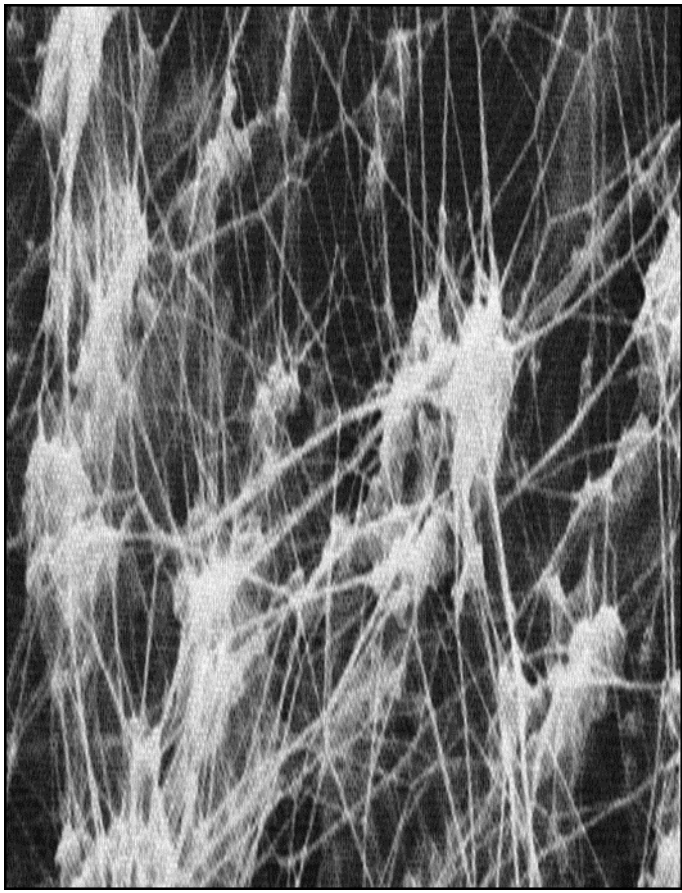
- Microbial – “B”, “WB” & “P” retention
  - P= Sterility = 0.2 micron membrane filter passes no microbes when challenged according to ASTM 838-05.
  - B/WB =Bioburden Reduction – identifies the number of logs of microbes that are removed in the standard ASTM838-05 challenge. Difference is market = test organisms
- Cleanliness – “E”
  - Total Organic Carbon (TOC) Rinse–Up Time/Volume required to reduce organic contaminant/manufacturing debris down to baseline level.
  - Resistivity Rinse-Up - Time/volume required to bring system effluent to baseline resistivity level (18 megohm-cm)
  - Extractables - FTIR (Fourier Transform Spectroscopy) Analysis – used to determine organic contaminants of flush solution
  - Leachables - analysis for metal extractables in water
- General Use = “G”
  - No specific claims.
    - Utilize same membrane material but may have broader specification range
    - Reduced validated processing – Integrity test, flushing

MEMBRANE FILTERS: HYDROPHILIC PES

	ZTEC G	ZTEC WB	ZTEC B	ZTEC E	ZTEC P	WaterTEC
Surface Area	7.0 ft^2	7.6 ft^2	7.6 ft^2	7.6 ft^2	6.8 ft^2	6.0 ft^2
Retention Range	0.1 – 0.65 µm	0.2-0.65 µm	0.2 – 0.65 µm	0.03 – 0.45 µm	0.2 µm	0.05 – 0.65 µm
Clean room mfg.	Yes	Yes	Yes	Yes	Yes	No
Integrity Tested	Diffusive Flow	Diffusive Flow	Diffusive Flow	Diffusive Flow	Diffusive Flow	None
List Price – 0.2 µm 10"	$130.96	$137.76	$137.78	$159.44	$268.81	$77.03
Target Applications	• Ultrapure water • Acids/Bases • Food/ Beverage • Chemicals • Ink • Cosmetics	• Bottled water • Beer • Wines • Sparkling wines • Spirits • Soft drinks	•Opthalmic solutions •Culture media •LVPs •Reagent chemicals •Buffers •Juices	• Ultrapure DI water	•Opthalmic solutions •Culture media •LVPs •Buffers •Vaccines	• General water filtration • DI pre-filter • DI post-filter • Aqueous-based chemicals

MEMBRANE FILTERS: HYDROPHOBIC PTFE

- e-PTFE Hydrophobic Membrane Filters
  - TefTEC
  - TefTEC V
  - TefTEC P
  - Citadel
- Expanded (stretched) microstructure
- Most hydrophobic of commercial membranes
- Almost universal chemical compatibility
- Excels as air, gas, and vent filter

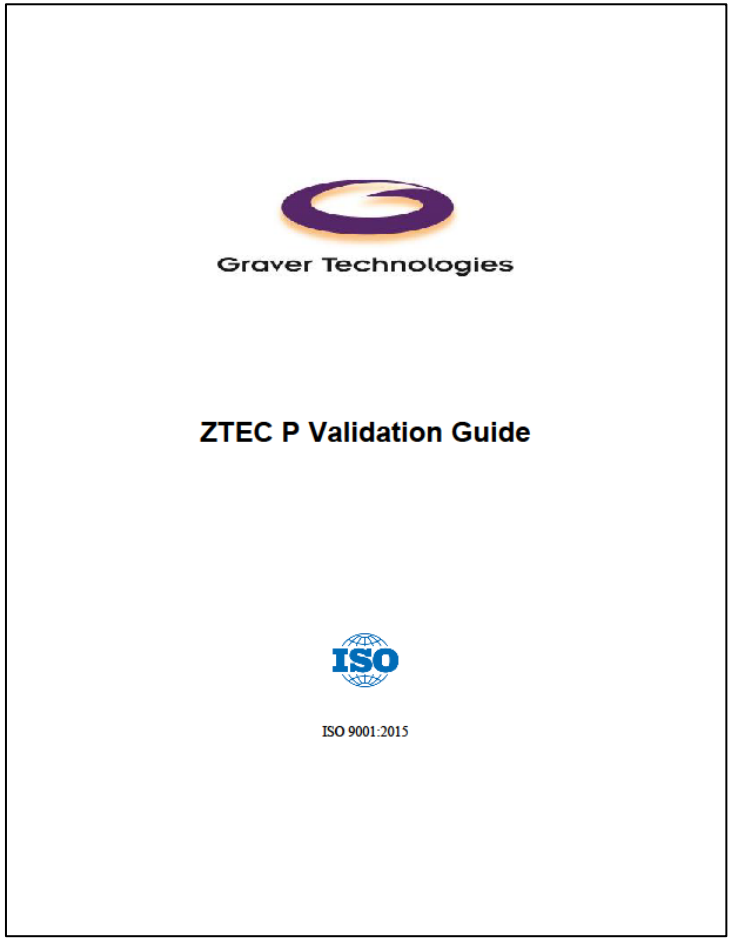


MEMBRANE FILTERS: HYDROPHOBIC PTFE

	TefTEC	TefTEC V	TefTEC P	Citadel
Surface Area	8.5 ft^2	7.6 ft^2	8.5 ft^2	
Retention Range	0.05 – 1 µm	0.2 5 µm	0.2 µm	0.05 – 1 µm
Clean room mfg.	Yes	Yes	Yes	Yes
Integrity Tested	Diffusive Flow	Diffusive Flow	Diffusive Flow	Diffusive Flow
List Price – 0.2 µm 10”	$288.38	$134.25	$355.95	$1377.70
Target Applications	General purpose applications in microelectronics and chemical markets requiring chemical compatibility of PTFE membrane	Food , beverage and non-critical healthcare applications requiring aerosol bacterial retention claims	Critical venting or feed air healthcare application requiring complete bacterial retention claims	Microelectronics applications requiring the highest level of compatibility due to temperature and/or chemical compatibility

MEMBRANE FILTERS: SUPPORT MATERIALS

- Case Studies
- Technical Briefs
- Data Sheets
- Qualification/Performance/Validation Guides
  - Cartridge Integrity Test
  - Flow Rate Testing
  - Core Collapse (Differential Pressure Stress) Testing
  - Sanitization and Sterilization Testing
  - Bacteria Challenge Test
  - Endotoxin Test
  - Bio-safety Testing



SPECIALTY PRODUCTS

SPECIALTY PRODUCT: FILTERS

TPE Porous Metal Filters

- Titanium or stainless-steel powder sintered to form a rugged fixed-pore elements
- Appropriate for backwash applications or where temperature or pressure conditions eliminate use of polymeric filters

- Corrosive liquids and gases
- High viscosity solutions
- High temp liquids and gases
- Cryogenic fluids
- Process steam
- Catalyst recovery

RTEC G Resin Bonded

- Microfiberglass and phenolic resin with tin plated steel core
- Economical technology suitable for industrial applications with elevate temperatures and viscosities

- Paints, Inks, Lacquers, Varnishes
- Adhesives, sealants
- Oils and grease
- Machine coolants
- Silicones
- Antifreeze

SPECIALTY PRODUCT: HOUSINGS

GSC Housings

- Economy single element housing.
- Clamp closure
- Constructed of 316 SS.
- Available for 222, 226 and DOE configuration

GLP Housings

- General purpose, non-Code, industrial housing for liquid service
- 316 stainless steel for excellent corrosion resistance
- Universal seat cups accept DOE or 222 style filters; 226 cups optional
- Choice of V-band clamp or swing bolts closure

GHP Housings

- Meets 3A sanitary standards for healthcare applications.
- Intended for Healthcare and Food and beverage applications

SPECIALTY PRODUCT: HOUSINGS

GSC Housings

- Constructed of 316 SS.
- Economy single element housing.
- Clamp closure
- Tapered housing bottom permits complete drainage
- Available for 222, 226 and DOE configuration
- Center rod to accommodate cartridges of varying lengths.

SPECIALTY PRODUCT: HOUSINGS

GLP Housings

- General purpose, non-Code, industrial housing for liquid service
- 316 stainless steel for excellent corrosion resistance
- Universal seat cups accept DOE or 222 style filters; 226 cups optional
- Choice of V-band clamp or swing bolts closure
- Sizes from 3 to 36 around
- Accepts 10”, 20”, 30”and 40” cartridges
- Suitable for flow rates from 21 to 588 GPM
- Accommodates up to 2.75” OD cartridges
- Equipped with ¼” vent and ½” drain

SPECIALTY PRODUCT: HOUSINGS

GHP Housings

- Constructed of 316L SS.
- Both V-Band clamp and swing bolt closure available
- Rugged, high-purity, “T” style design from 1 round to 36 round.
- Mechanically polished with acid washed interior
- Meets 3A sanitary standards for healthcare applications.
- Intended for Healthcare and Food and beverage applications

SPECIALTY PRODUCT: HOUSINGS

Product Description:

- Designed to accept High Flow Series Filters
- Industrial housing for liquid service
- Carbon steel, 304L or 316L stainless steel
- ASME U code available
- Vertical, horizontal and tipped horizontal configurations offered
- 150 psig designs
- 1, 3, 4 or 7 filters for flows to 3500 GPM

QUESTIONS?

"I hear and I forget. I see and I remember. I do and I understand."

Confucius

Fairbanks Center for Chinese Study – Harvard University