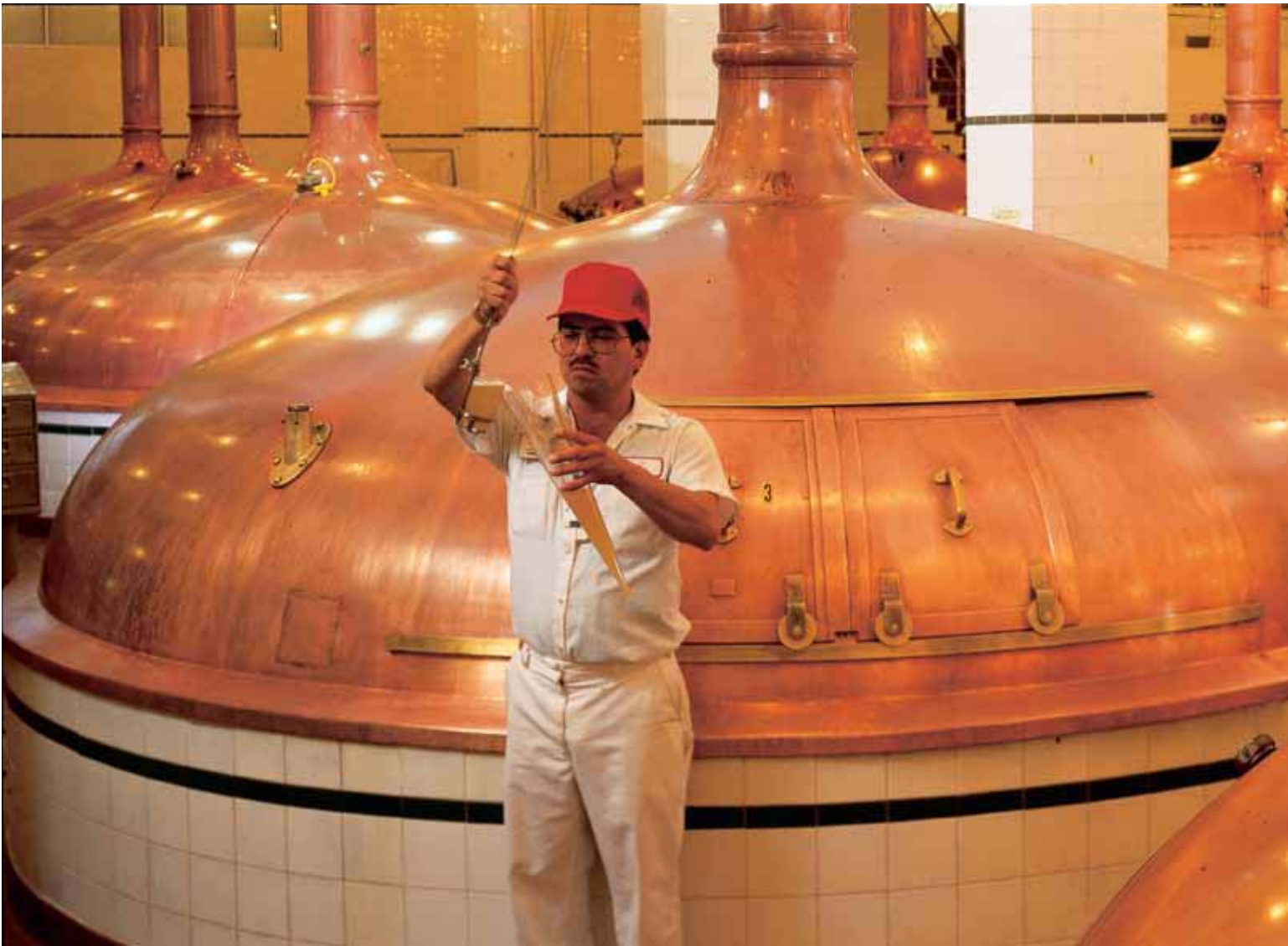


3M Purification Inc.

3M Purification Filter Systems for the Brewing Industry



Why do brewers around the world choose 3M Purification Filter Systems for their breweries?



Economy

3M Purification Filter Systems deliver **ECONOMICAL** answers to the filtration needs of brewers.

- Longer filter life and higher throughputs
- Low initial pressure drops
- Reduced labor time
- Exceptional contaminant holding capacity
- Filter cartridges designed for regeneration and backflushing

Convenience

3M Purification Filter Systems offer **CONVENIENCE** and ease-of-use.

- Easy filter installation and reduction for minimal downtime
- User friendly housing designs
- Wide range of products to match all process flow rates.

Quality

3M Purification Filter Systems deliver world wide **QUALITY** for consistent operation.

- ISO 9001:2000 quality systems
- Worldwide manufacturing and distribution
- Rigorous in-house testing and validation



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- Durable Generation 2 Cartridge Design
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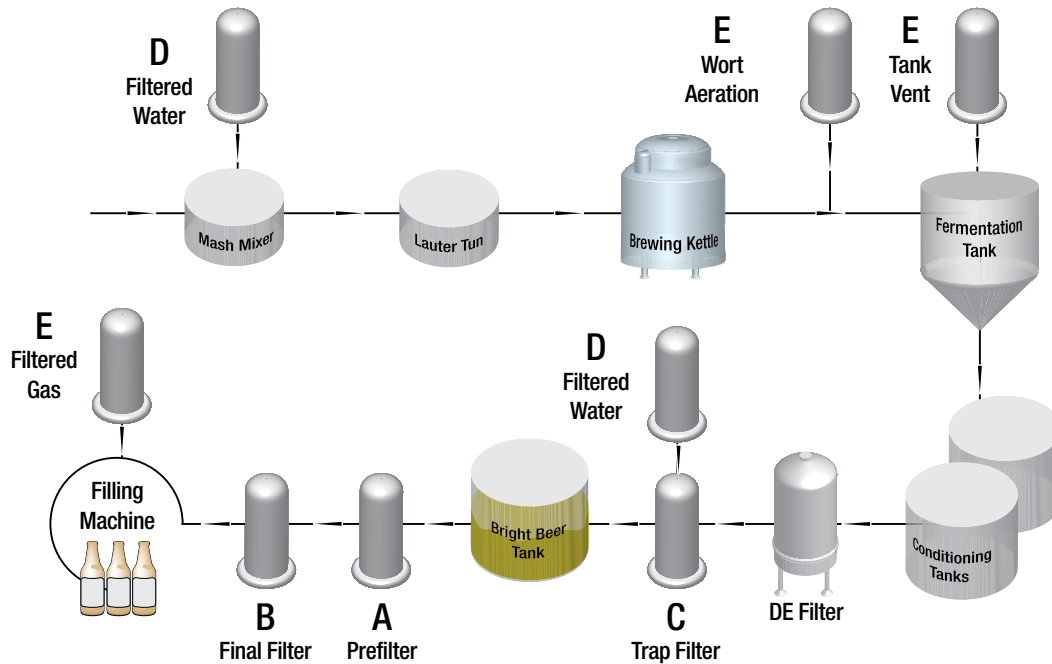


Figure 1

A. Zeta Plus™: The Flagship of Beer Filtration.

Convenient and cost effective clarification and bio-reduction filtration using the Zeta Plus cartridge concept.

B. Sterile Filtration: Zeta Plus™ & LifeASSURE BA™ Series Membrane Filtration Reduce Pasteurization.

By combining the economy of the premier depth filter, Zeta Plus, with the assurance of a bacteria retentive membrane filter, LifeASSURE BA series, 3M Purification provides brewers with the ultimate in sterile filtration options.

C. Trap Filtration: Reliable particle control with the innovative Betapure™ NT-T cartridge filter.

By employing a novel, multilayer construction with flow distribution layers and critically positioned flow channels, Betapure NT-T filters deliver consistent retention and long service life.

D. Water Filtration: Quality Water, the Building Block of a Quality Beer.

Since not all breweries are located near a sediment-free mountain spring, 3M Purification provides filters for brewing and blending water preparation, bottle and keg washing water, and sanitizing water.

E. Air & Gas Filtration: Why Risk Your Beer by Using Anything Else but LifeASSURE™ PFS Series Hydrophobic Membrane Filters for Sterile Air and Gas Filtration?

Airborne bacteria, molds and spores can quickly destroy a perfect batch. Hydrophobic PTFE LifeASSURE PFS series membrane filters are ideal for sterile filtration of wort aeration, tank venting and filtration of compressed gasses.

Clarification

Zeta Plus™: The Flagship of Beer Filtration

Brewers the world over rely on Zeta Plus™ depth filter cartridge systems for their filtration needs. The Zeta Plus technology provides both efficient clarification and significant reduction of spoilage yeast and bacteria. Zeta Plus systems offer the following major benefits to the brewer:

- Cost effective reduction of particulates, haze, and microorganisms to provide the highest quality bright beer.
- Zeta Plus systems are totally enclosed, which reduces beer loss due to leakage. The enclosed design also prevents the possibility of product contamination and oxidation from outside sources.
- Zeta Plus systems offer durable filter cartridges with state-of-the-art construction and high tensile strength filter media. The cartridges are capable of withstanding repeated heat sanitization and arduous processing conditions. This results in long, dependable service life and excellent process economies.
- Zeta Plus cartridges are fast and easy to install and remove, ensuring low labor costs and minimal system down time.
- Zeta Plus systems with polished stainless steel 3M™ ZPC and 3M™ ZPB filter housings are available in a wide range of sizes to grow with process needs as well as meet any flow rate requirements.



Figure 2 — Zeta Plus™ Systems are available in a wide range of sizes to meet any flow or batch size requirements

Zeta Plus™ Formulation

Zeta Plus is a family of depth filtration media composed of filter aids embedded in a cellulose fiber matrix. During the Zeta Plus manufacturing process, molecules carrying a positive charge are chemically bonded to the matrix components permanently forming an interconnected, rigid filter sheet with positively charged electrokinetic capture sites. The resulting porous filter structure is a tortuous network of charge-enhanced flow channels capable of reducing hazes and retaining bacteria, particulate, colloidal debris and submicronic contaminants to a level which mechanical screening alone cannot achieve¹ (see Figure 3). The graded porosity construction and the charge-enhanced internal absorptive capacity of Zeta Plus provide high-efficiency submicronic filtration to outperform pleated filters and competitive depth filters.

Durable ^{Generation} Cartridge Design

The innovative Zeta Plus cartridge is constructed with two sheets of filter media formed into an envelope-like cell which is then stacked with similar cells to make a cartridge. Cartridges are constructed with stiff cell separators for better flow and media utilization, hence longer life (see Figure 4). Competitive filters without stiff cell separators allow filter media to obstruct internal flow channels leading to higher differential pressures and shorter service life. Improved “tensioning” provides for the ultimate in cartridge integrity under arduous operating conditions including hot water sanitization cycles.

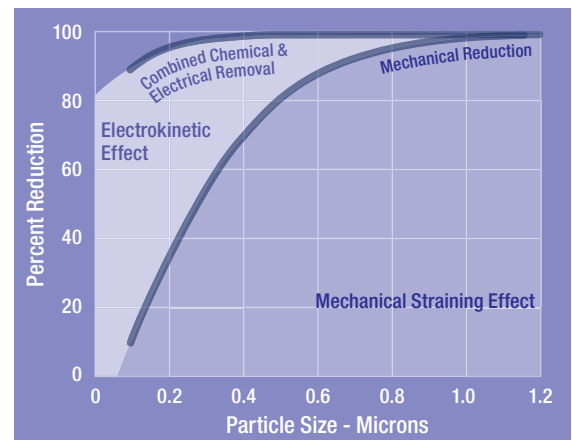


Figure 3

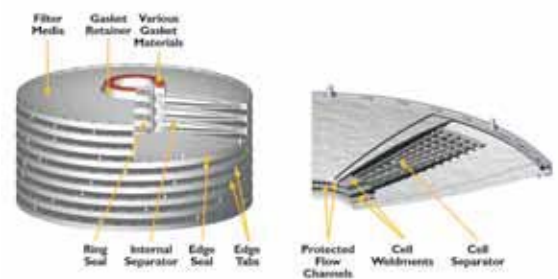


Figure 4

¹K. Hou, et al, Capture of Latex Beads, Bacteria, Endotoxin and Viruses by Charge-Modified Filters, Applied and Environmental Microbiology, 1980

Zeta Plus™ Cartridge System versus a Conventional Filter Press

Brewers have used conventional plate and frame filter presses for many years. However, filter presses have never been considered a particularly convenient or efficient method of filtration. 3M Purification developed the Zeta Plus™ cartridge system to reduce the disadvantages of filter presses and provide a convenient and cost effective alternative for beer filtration.

The Zeta Plus™ Cartridge System. . .

Benefits of the Zeta Plus Cartridge System

Saves on product loss

Zeta Plus cartridges are contained in a totally enclosed, sanitary filter housing to reduce any chance of leakage.

Saves on labor

A Zeta Plus cartridge system can be changed out in 15 minutes compared to much longer change-out times for a filter press (4 - 8 hours or longer for large presses).

Saves on media change-outs

Zeta Plus cartridges are used to complete blockage at 35 psid which results in fewer media change-outs when compared to sheet filters in a filter press. To avoid product contamination, sheet filters are changed every 3 - 5 days, regardless of used capacity, and typically cannot be stored in the press when not being used.

Saves on capital costs

For comparable flow rates, a typical Zeta Plus system housing costs less than one half of a stainless steel filter press.

Saves on maintenance

Zeta Plus systems have only one set of O-rings to maintain, resulting in easy upkeep. Filter presses have hundreds of O-rings to maintain and replace.

Saves on energy

Since Zeta Plus housings are totally enclosed, they are easier and quicker to sanitize with hot water than a filter press, leading to lower energy costs.

Saves on space

Zeta Plus systems are vertical in design and require only a fraction of the floor space needed for a comparable filter press.

Saves on disposal

Since Zeta Plus cartridges are used until they are plugged, disposal costs are reduced when compared to sheets in a filter press which are changed out every 3 - 5 days.

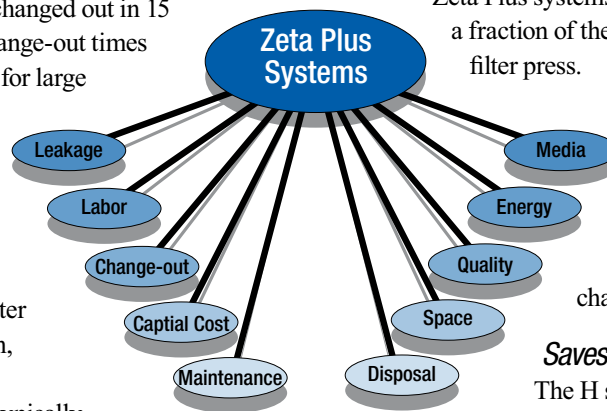
Saves on media

The H series filter media used in the Zeta Plus cartridge has tensile strength three times that of competitive filter media. The superior media strength results in longer life and throughput when compared to sheet filters.

Saves on quality

Zeta Plus media is made around the world in state-of-the-art, manufacturing facilities. Zeta Plus products undergo an extensive battery of Quality Control tests before release to ensure consistent, reliable filtration performance.

For more information, please ask for Customer Application Brief LITCABZPS2.



Zeta Plus™ Maximizer H Series

The Zeta Plus™ Maximizer H Series is an advanced, dual-zone depth filter designed to provide optimal clarification and prefiltration for difficult to filter beers. The construction consists of two distinct layers, or “zones” of durable H Series filter media, with the upstream zone more open than the downstream zone. This structure enhances the contaminant holding capacity of the filter by trapping larger particles, hazes, and microorganisms in the upstream layer, and smaller ones in the downstream layer. This distribution of plugging contaminants throughout the depth of the filter can greatly extend service life and reduce overall filter costs. The two filter zones can be independently selected and combined to optimize performance.

Beer Filtration

Table 1 highlights the significant economic advantage in capital and operating costs that the Zeta Plus™ system provides over conventional sheet filtration using a filter press. To complete this analysis, a typical bottling line running at 350 HL/hr was used with two stage Zeta Plus configuration compared to a standard plate and frame filter press. For calculating depreciation, a 10 year life period was assumed.

Table 1. – Plate and Frame versus Zeta Plus™ Cartridges

	Plate & Frame Filter Press (¢/HL)	Zeta Plus™ Cartridge (¢/HL)
Capital Cost	8.5	1.3
Media Cost	6.8	12.0
Labor Cost (media change-outs)	1.1	0.1
Product Losses (leakage)	1.3	-
Regeneration Sanitization	2.8	0.4
Spare Parts Maintenance	1.5	0.2
Total Cost/HL	22	14.0

Table 2 shows the typical throughputs and service life for a Zeta Plus system. Start up media operating costs of this system were 12.5¢/HL for the first stage and 6.5 ¢/HL for the second stage for a combined running cost of 19 ¢/HL. After system optimization, including fine tuning of the D.E. filter and instituting 3M Purification’s media regeneration protocol, media costs were reduced to between 10 ¢/HL and 14 ¢/HL.

Table 2

Media Life (Typical)	First Stage Zeta Plus™ 30H	Second Stage Zeta Plus™ 70H
Minimum Volume of Beer Filtered	24,000 HL	45,000 HL
Cartridge Life	68 Hours	128 Hours
Initial Replacement Costs	12.5 ¢/HL	6.5 ¢/HL
Optimized Replacement Costs	6 ¢ - 9 ¢/HL	4 ¢ - 5 ¢/HL

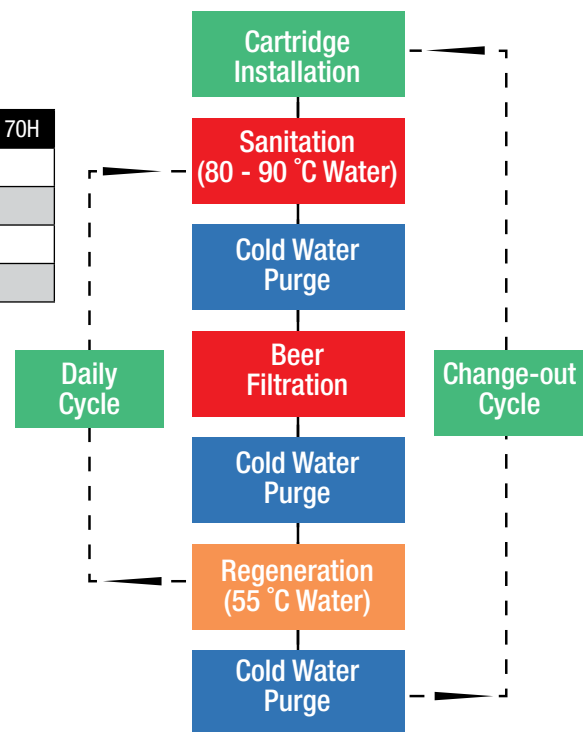


Figure 5

Media Regeneration

In order to extend the filter service life and provide the lowest possible operating cost to the brewer, 3M Purification has developed a media regeneration protocol. The protocol, seen in Figure 5, is designed to dissolve warm-water soluble compounds that, over time, can plug filter media. Typically performed prior to hot water sanitization at the end of the daily filtration cycle, this regeneration protocol results in a lower differential pressure at the next start-up, thereby extending the filter life and reducing overall filtration costs—sometimes as much as 25%.

Clarification with Zeta Plus™

The goal of most brewers is to produce a beer with excellent clarity and low turbidity. Haze and turbidity can lessen the value and quality of most beers.

Sometimes, however, this goal can be very elusive. Haze and turbidity may have simple origins such as chill haze or excess yeast in the beer. They can also be caused by more elaborate phenomenon such as complexes of proteins, tannins and beta-glucans.

In properly controlled and maintained systems, Zeta Plus cartridges containing 30H media or tighter have consistently exhibited 100% reduction of yeast (refer to Tables 3 and 4). Zeta Plus is formulated to reduce haze due to the charge modified feature of the media formulation. Haze complexes generally carry a net negative charge. As the beer is filtered through Zeta Plus, hazes are attracted by the positive charge sites in the matrix of the filter media. This results in beer with low turbidity and excellent clarity.

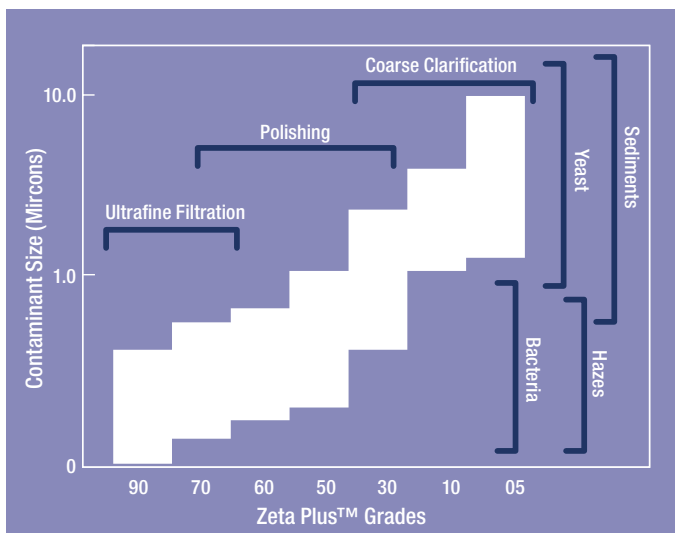


Figure 6. – Filter Grades

Table 3. – Bioburden Reduction with Zeta Plus™

Counts/100ml	Inlet	Ex 30H	Ex 70H
Yeast	3200	0	0
Lactic Bacteria*	600	0 - 300	0 - 1

*Pediococcus and Lactobacillus species

Bioburden Reduction with Zeta Plus™

The bioburden (yeast and spoilage bacteria) of beer must be greatly reduced or eliminated in order to provide a product that is microbiologically stable while maintaining an acceptable shelf life. Pasteurization is one method of producing microbiologic stability. However, pasteurization has a number of drawbacks including high operating costs (capital, energy, maintenance) and a negative flavor impact on the beer.

Brewers use Zeta Plus™, either in a single stage or in a series, to provide microbiologically stable beer without the need or expense of pasteurization. The combination of mechanical reduction and electrokinetic adsorption provided by Zeta Plus filter media results in superb microorganism reduction from beer. The process schematic Figure 7 and Table 3 depict typical reduction levels using a two stage Zeta Plus filter system with an open grade of media followed by a tighter grade. (Zeta Plus is available in eleven grades with various retention ratings providing filtration from rough clarification to ultrafine filtration, see Figure 6.)

Table 4 shows significant retention of indicator organisms that simulate beer contamination². In each test, the filter effluent was free of organisms. These challenge levels are much higher than what would be typically encountered in a brewery and represent a “worst case” scenario.

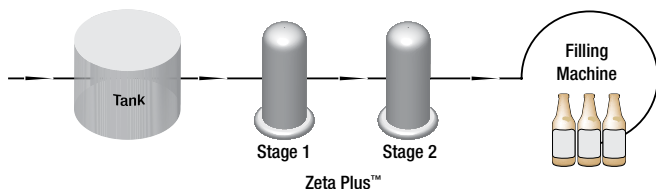


Figure 7

Table 4. – High Performance in Microbial Reduction

Zeta Plus™ H Grade	Challenge Organism	Reduction (CFU's/cm ² of Media)	Organisms in Effluent
30H	<i>Saccharomyces cerevisiae</i>	4.4 x 10 ⁸	0
50H		5.8 x 10 ⁸	0
60H		6.0 x 10 ⁸	0
60H	<i>Leuconostoc oenos</i>	5.5 x 10 ⁸	0
90H		7.2 x 10 ⁸	0
60H	<i>Pseudomonas diminuta</i>	9.7 x 10 ⁸	0
90H		1.3 x 10 ⁸	0

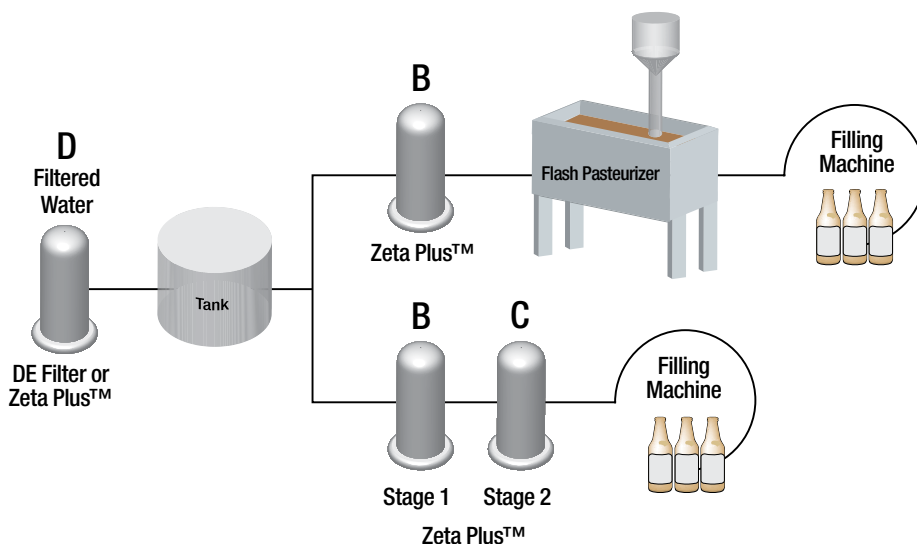


Figure 8

²Patel, Filtration Technologies and Beverage Processing, Filtration and Separation, 1993

Table 5. – Recommended 3M Purification Filters for Primary, Polishing and Bioreduction Filtration

Application	Recommended Filter	Filter Grade*	Nominal Reduction Rating	Purpose	For Sizing/Product Refer to Page:
A.	Coarse Clarification Zeta Plus™	05H	5 µm	Primary filtration	16/17
		10H	2 µm	Yeast & haze reduction	
B.	Polishing Filtration Zeta Plus™	30H	1 µm	Yeast reduction	16/17
		40H	0.9 µm	Bacteria & haze reduction	
		50H	0.8 µm		
C.	Ultrafine Filtration Zeta Plus™	60H	0.5 µm	Bacteria & haze reduction	16/17
		70H	0.3 µm		
		90H	0.2µm		

*Zeta Plus grade recommendations vary according to the nature and style of the beer, contaminant levels and the previous degree of filtration. On site testing by 3M Purification's SASS team or a member of our distribution organization can be performed to determine the optimum grade.

Sterile Filtration

Zeta Plus™ & LifeASSURE™ BA Series Membrane Filtration Reduce Pasteurization

3M Purification provides the most cost effective system to achieve microbiological stability. By combining the economy of a depth filter, Zeta Plus™, with the assurance of a membrane filter, LifeASSURE™ BA series, 3M Purification is able to provide brewers with the ultimate in sterile filtration.

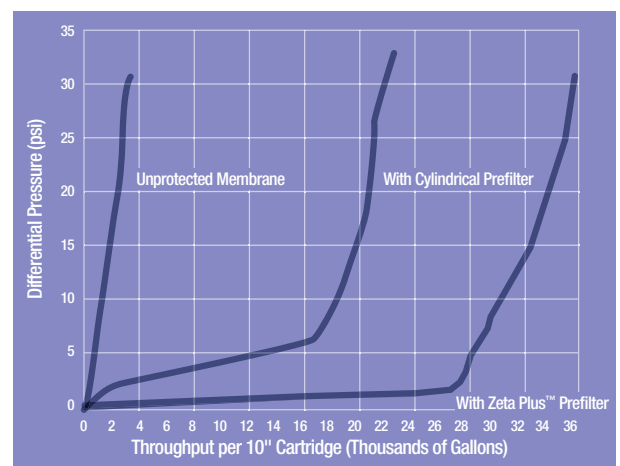
Many brewers, small and large, choose sterile filtration to avoid both the costs and negative flavor impact of pasteurization, while providing microbiologically stable beer with a long shelf life.

56% Longer Membrane Life with Zeta Plus™ Prefiltration

Studies show that Zeta Plus depth cartridge filters extend the life of downstream membranes by as much as 56%³ when compared to similarly rated cylindrical prefiltration (see Figure 9). Inadequate prefiltration leads directly to short membrane filter life and consequently, high membrane costs. Prefilters must provide a combination of high contaminant holding capacity and long service life to ensure cost effective membrane filtration. Zeta Plus provides efficient retention of membrane plugging particles, hazes and microorganisms as well as long service life for an economical aseptic packaging system.

The LifeASSURE BA series 0.45 µm membrane filter, combined with 3M Purification's Zeta Plus filter cartridge, is the ideal combination to achieve the goal of high contaminant holding capacity and long service life. The system's benefits include:

- The Zeta Plus/LifeASSURE BA series combination of filters is the most economical method to achieve a microbiologically stable beer using depth and membrane filtration. The high contaminant holding capacity and excellent membrane protection of Zeta Plus make it the most economical solution on the market today.
- LifeASSURE BA series membrane filter cartridges are 100% integrity tested in manufacturing and are integrity testable before and after filtration runs to assure microbial retention.
- LifeASSURE BA series membrane filter cartridges are constructed with double layer Nylon 6,6 microporous membrane designed to withstand multiple hot-water sanitization cycles. In addition, all 21 CFR listed components are designed to have virtually no extractables or organoleptic impact on the beer.



Prefiltration with Zeta Plus™ leads to significantly longer final membrane life when compared to cylindrical prefiltration.

- LifeASSURE™ BA series membrane filter cartridges are available in a variety of end configurations and lengths which are adaptable to any flow requirements, small or large.
- A filtration system using Zeta Plus™ and LifeASSURE BA series filter cartridges requires substantially less capital investment and costs less to operate than a system using pasteurization.

The System

Zeta Plus, the industry standard for easy-to-use, economical depth filtration, acts as a prefilter to the LifeASSURE BA series membrane by reducing yeast and greatly reducing spoilage bacteria such as *Pediococcus* and *Lactobacillus* organisms. Zeta Plus also significantly reduces the colloidal components like tannin-protein-beta glucan colloids, that lead to premature membrane plugging⁴. Without adequate prefiltration, membrane filters would be plugged prematurely, resulting in higher operating costs. The LifeASSURE BA series membrane filter cartridge acts as the final barrier against spoilage bacteria. In properly prefiltered beer, LifeASSURE BA series membrane filters are an insurance policy, retaining any stray organisms that may find their way past the prefilter (see Figure 11). In worst case scenarios, LifeASSURE BA series membranes have shown 100% retention of bacteria at concentration levels as high as 1 x 10⁶ organisms per cm² of membrane surface⁵ — much higher than would ordinarily be seen in a brewery.

Together, Zeta Plus and LifeASSURE BA series are the premium method to provide microbiologically stable beer without pasteurization (see Table 6).

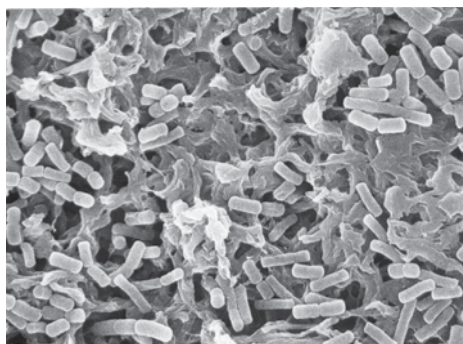


Figure 10. — SEM of common beer spoilage organisms, *Lactobacillus brevis* trapped on the surface of LifeASSURE™ BA series membrane.

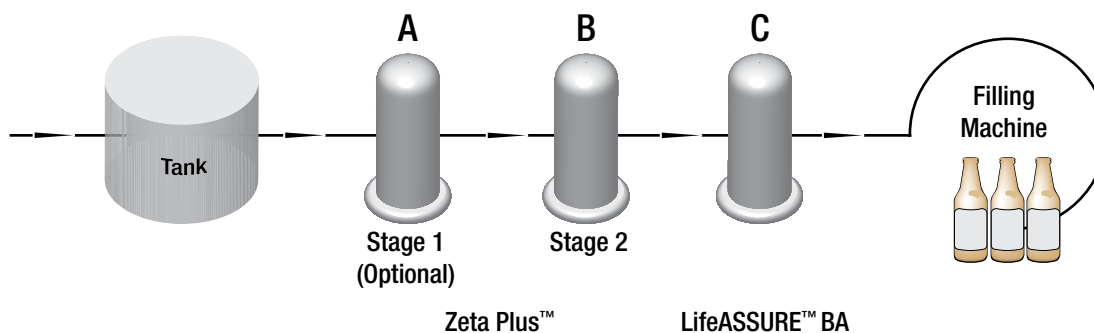


Figure 11

Table 6. — Recommended 3M Purification Filters for Sterile Filtration

Application	Recommended Filter	Filter Grade*	Reduction Rating	Purpose	For Sizing/Product Refer to Page:
A.	Zeta Plus™	30H	1 µm	Reduce bioburden and extend Stage 2 Life	16/17
		40H	0.9 µm		
B.	Zeta Plus™	60H	0.5 µm	Reduce bioburden and extend membrane life	16/17
		70H	0.3 µm		
C	LifeASSURE™ BA	BA045	0.45 µm	Microbiological stability	16/17

*Zeta Plus grade recommendations vary according to the nature and style of the beer, contaminant levels and the previous degree of filtration. On site testing by 3M Purification's SASS team or a member of our distribution organization can be performed to determine the optimum grade.

⁴Meier, et al, Investigation of Plugging Colloids on Microporous Membrane Filters, MBAA Technical Quarterly, 1995
⁵3M Purification Scientific Applications Support Services Report, A03069

Trap Filtration

Reliable and Robust Particle Control

Trap filters serve two important functions. First, they reduce extraneous diatomaceous earth (D.E.) fines and yeast that randomly pass from the D.E. filter during normal filter operation. Second, trap filters act as an “insurance policy”. In the event that the diatomaceous earth filter malfunctions (startups, screen rupture, over dosing or bypass) the trap filter averts disaster. It prevents the contaminating yeast and D.E. from not only ruining the current batch of beer, but future ones as well. Once D.E. fines contaminate downstream equipment and piping, they are difficult to flush out completely.

Betapure™ NT-T trap filter cartridges:

- Provide excellent retention of diatomaceous earth fines, protecting beer quality and downstream filters.
- Offer consistent, reliable performance from batch to batch, lot to lot.
- Are composed of CFR 21 listed materials for easy brewery integration.
- Are extremely durable and are capable of withstanding multiple hot water sanitization cycles and backwashing.



Betapure NT-T filters provide the consistency of absolute rated filtration, as well as the high DE fine holding capacity needed in the brewery. For most brewery operations, the Betapure NT-T 10 µm absolute rated filter is recommended, although a brewery may choose to employ either a “tighter” filter (5 µm rated) or a more “open” filter (20 µm rated), depending on local process conditions and specifications.

Betapure NT-T filter construction combines a polypropylene filter media with fluid distribution netting to form multiple layers. Critically positioned media flow channels allow greater movement of fluid from layer to layer (Figure 12). Three distinct media sections, made from multiple media/netting layers, are combined to form a filter cartridge. The outer and middle sections contain multiple layers of interleaved filter media and fluid distribution netting. Within each media layer, a portion of the fluid travels through the media while the balance of fluid is delivered directly to the next distribution layer through the flow channels. The fluid distribution netting provides longitudinal and latitudinal flow paths to evenly distribute fluid flow across the surface of each successive filter media layer.

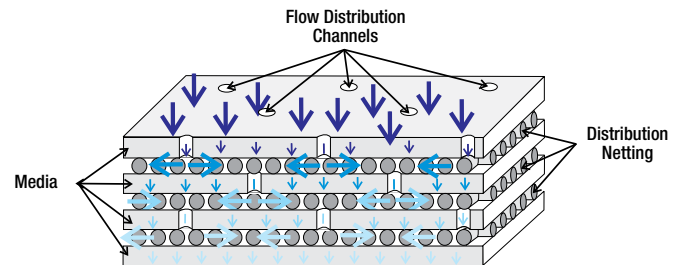


Figure 12

For more information on trap filtration, please refer to Application Brief LITCABPN1.

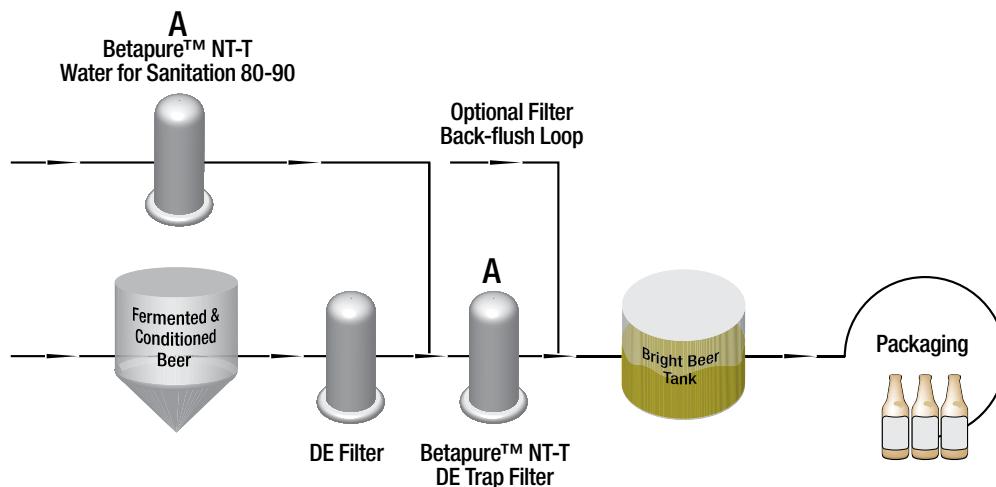


Figure 13

Table 7. – Recommended 3M Purification Filters for D.E. Trap Filters

Application	Recommended Filter	Filter Grade	Reduction Rating	Purpose	For Sizing/Product Refer to Page:
A.	Trap Filter	T100	10 µm (absolute)	D.E. Control	16/19

Water Filtration



Quality Water, the Building Block of a Quality Beer

Water, a key ingredient in beer, must be carefully monitored and controlled. Since many breweries are not located next to a sediment free mountain spring, proper filtration is a vital aspect in brewing and blending water preparation, bottle/keg washing water, and sanitizing water. 3M Purification filter products, with a long history of providing quality water filtration to bottled water, pharmaceutical and food & beverage companies around the world, can accommodate virtually any design system in order to meet all process requirements. System benefits include:

- 3M Purification’s Activated Carbon filter provides efficient reduction of chlorine and organics.
- Micro-Klean™ RB series filters offer exceptionally high dirt holding capacity for excellent particle reduction and crystal clear water.
- Betapure™ NT-T series filters complete a premium water filtration train combining the high capacity and flow rates of its design with the assurance of absolute retention ratings.
- With a wide range of filter housing choices, 3M Purification provides the necessary system for all process flow requirements.

Brewing and Blending Water

3M Purification provides the filtration components necessary to turn the most challenging water sources into quality brewing and blending water. The combination of 3M Purification’s Activated Carbon filter, Micro-Klean RB series and Betapure NT-T filter cartridge provides unsurpassed chlorine, organics, and particulate reduction.

Bottle and Keg Washing Water

Bottle and keg washing water filtration are frequently overlooked applications. Wash water can contain particles and organics that affect the final product. Proper filtration of wash water is especially important when the container (bottle or keg) will not be pasteurized. Microorganisms from poorly filtered water can recontaminate non-pasteurized beer, easily causing spoilage. In this case, wash water should be filtered at least as well as the beer itself. The combination of Zeta Plus™ depth filtration followed by LifeASSURE™ BA series 0.45 µm membrane filtration provides the optimal, economical solution for keg and bottle washing for non-pasteurized beer.

Sanitizing Water

Sanitizing water (> 80 °C) is used to reduce the bioburden and to clean systems, including the filters. Filtering sanitizing water is important so that the system is not contaminated with particulate in the sanitizing water between beer production runs. Additionally, the sanitizing water should be filtered to at least the same level as the process filters it will be sanitizing. To use a lesser degree of filtration would expend the capacity of the process filters by filtering the sanitizing water, leading to poor filter life. Durable Betapure NT-T depth filter cartridges are ideal for final filtration of sanitizing water. The large surface area of the filter media and the media formulation provide exceptional contamination capacity and protection of process filters.

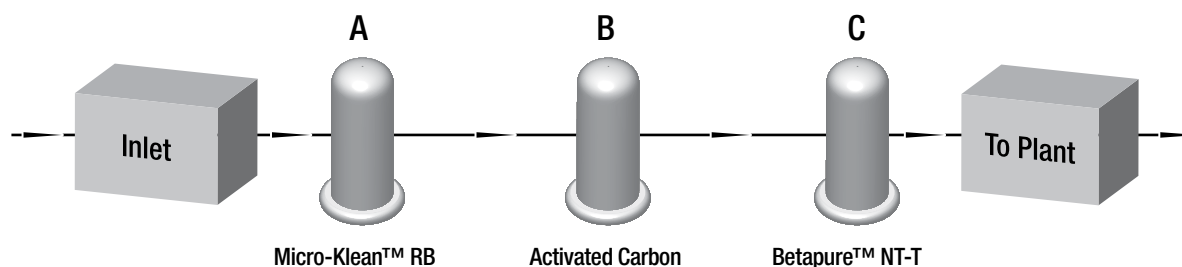


Figure 14

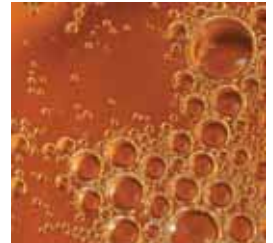
Table 8. – Recommended 3M Purification Filters for D.E. Water Filtration

Application	Recommended Filter	Filter Grade	Reduction Rating	Purpose	For Sizing/Product Refer to Page:
A.	Micro-Klean™ RB	B2	5 µm	Particle reduction	16/21
B.	Activated Carbon	46332	5 µm	Chlorine & organic reduction	16/21
C.	Betapure™ NT-T	T100	10 µm	Final Filtration	16/21

Air and Gas Filtration

Why Risk Your Beer by Using Anything But LifeASSURE™ PFS Series Hydrophobic Membrane Filters for Sterile Air and Gas Filtration?

Sterile filtered air and gas are imperative in preventing contamination of the yeast culture and the beer. Airborne bacteria and molds can quickly destroy a perfect batch. For either injected gasses or for sterile vent filtration of the tanks, LifeASSURE™ PFS series hydrophobic membrane filter cartridges are the ideal final filter. The hydrophobic nature of the membrane won't wet out and block as hydrophilic filters do. LifeASSURE PFS series filters provide the following benefits:



- LifeASSURE PFS series filters with flow enhanced construction allow use of smaller, more economical air filter assemblies compared to competitive air filters.
- LifeASSURE PFS series filters provide absolute retention based on liquid bacteria challenge and aerosol bacteriophage challenge
- LifeASSURE PFS series filters are available in a wide range of cartridge and capsule configurations to provide the most economical solution to air, gas and aggressive liquid filtration applications.

One cause of poor or sporadic beer quality is infection of the wort with undesirable microorganisms. A leading source of contamination is improperly filtered aeration of the wort. Aeration requires a clean, well filtered, sterile air source for successful beer production. When present in the aeration source, particles, oils and water from the plant and the compressor, organic debris, as well as airborne microorganisms can combine to ruin the beer. A 3M Purification filter train, composed of the elements in Figure 16, is specifically designed to provide the brewer with the quality air source necessary for the task.

A second source for airborne contamination exists in improperly filtered vents on tanks. Safeguarding the beer from airborne contaminants is also accomplished by using sterile membrane filters on tank vents. LifeASSURE PFS series is particularly well suited to the application by virtue of its durable design and high air flow rates for easy, worry-free operation.

In many breweries, the final step prior to capping, crowning or seaming is the introduction of a high pressure jet of CO₂ displacing oxygen in the bottle head-space. LifeASSURE PFS series sterile air filters ensure that this gas is free of spoilage microorganisms and the beer is protected prior to closure.

LifeASSURE PFS series cartridges are composed of a PTFE membrane reinforced with polypropylene support layers. The media pack is completed with upstream and downstream support and flow distribution layers resulting in a durable, high flow air and gas filter (see photo at right)..

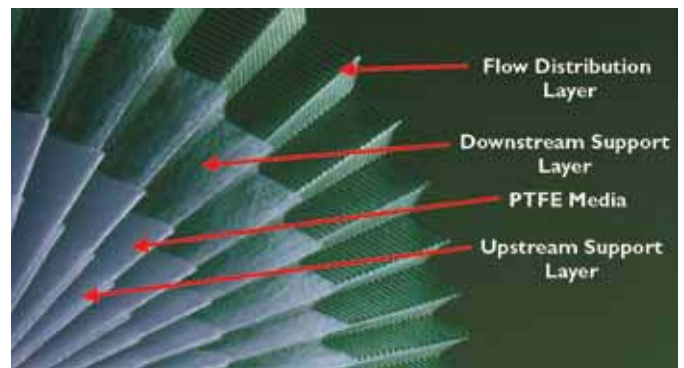


Figure 15

Superior Flow Rate Performance

LifeASSURE™ PFS series filter cartridges and capsules offer outstanding flow rate performance at low differential pressures. Whether used for tank venting, jetting/fobbing, keg blowdowns or wort air sterilization, filter flow rate is a critical parameter. Using the design enhancements described, LifeASSURE PFS series filters provide maximum flow performance. Figure 15 presents the comparison of LifeASSURE PFS series cartridge filter performance to competitive air filters.

Figure 15. – LifeASSURE™ PFS Series Filter Cartridges versus Competitive Filter Cartridges

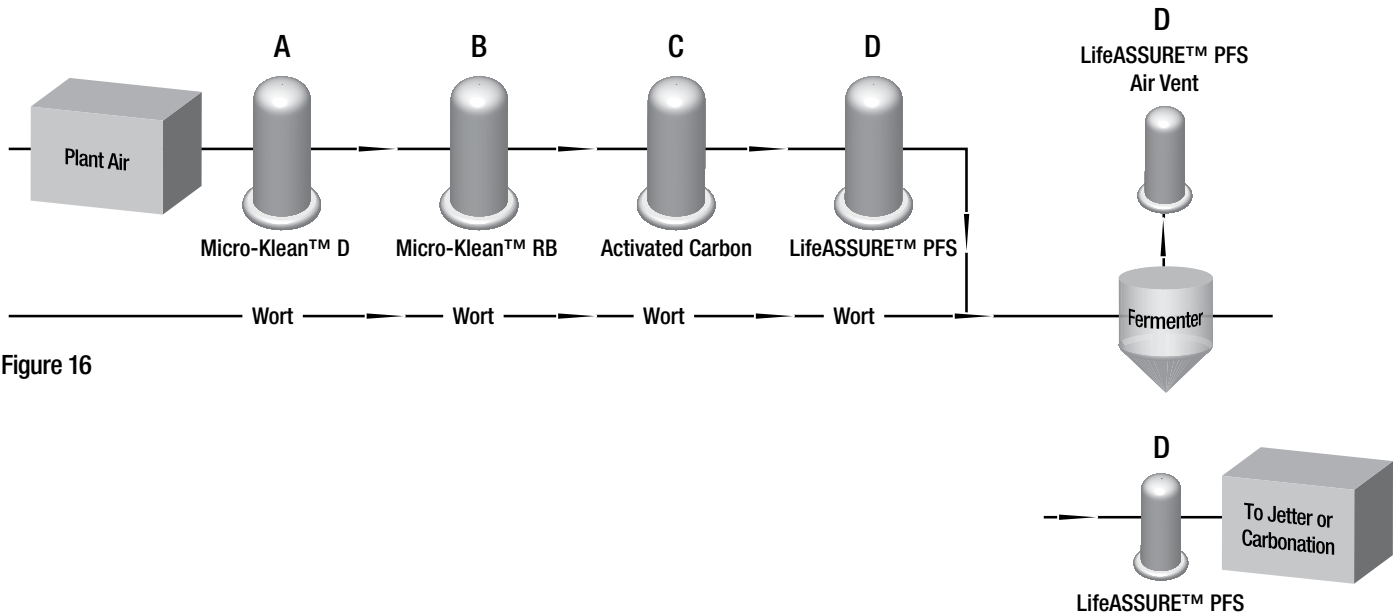
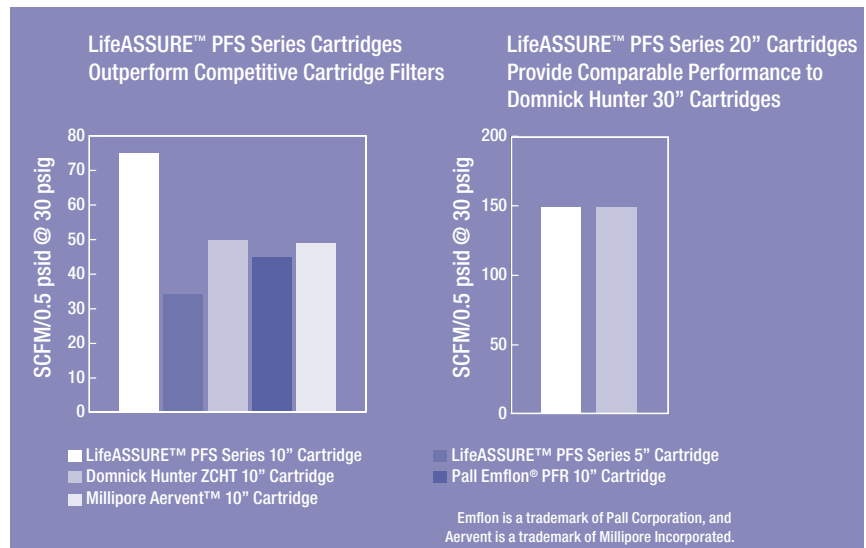


Figure 16

Table 9. – Recommended 3M Purification Filters for Air and Gas Filtration

Application	Recommended Filter	Filter Grade	Reduction Rating	Purpose	For Sizing/Product Refer to Page:
A. Wort Aeration Prefiltration	Micro-Klean™ D	DCCSC	10 µm (nominal)	Reduction of large particles	19/24
B. Wort Aeration Coalescer	Micro-Klean™ RB	U78B2	5 µm (nominal)	Coalesce oil and water from air	19/24
C. Wort Aeration Organic Reduction	Activated Carbon	46332	5 µm (nominal)	Reduction of organics	19/24
D. Wort Aeration Sterile Air	LifeASSURE™ PFS	PFS020	0.2 µm (absolute)	Microbial control	19/22
D. Tank Vent, Jetter, Or Carbonation	LifeASSURE™ PFS	PFS020	0.2 µm (absolute)	Microbial controls	19/22

3M™ Filter Housings and Systems

3M Purification offers an extensive range of versatile cartridge filter housings designed to meet any process flow requirement and handle even the most critical applications found in breweries.

Process Flow Rates from 1 GPM to 2000 GPM (2 HL/hr to 4500 HL/hr)

3M™ filter housings can meet virtually any process flow requirements found in breweries. From the lab to pilot plant to full production, 3M filter housing are available to grow with the needs of the brewer.

Wide Variety of Materials and Ratings

3M filter housings are manufactured of high impact plastic; 316L stainless steel and other high alloy steels, offering the brewer a number of options. A variety of internal and external surface finishes are available. These finish options include selected polymer coatings, mechanical finishes from 35 Ra (average roughness) to mirror polish and electropolishing that limit microbial adhesion. Additionally, 3M filter housings can be manufactured in accordance with the ASME Code, “CE” marked and various other requirements of countries around the world. For more information about 3M filter housing options, please contact your local 3M Purification distributor.

User Friendly Designs

3M filter housings are specifically designed with the end user in mind to make installing and removing filter cartridges quick and easy. Fast action swing bolts, quick release clamps and convenient cartridge hold-down devices allow for rapid filter change-outs, low labor requirements and reduced down-time.

Skid-Mounted Systems

For increased flexibility and enhanced mobility, 3M Purification manufactures fixed skid-mounted or cart-mounted mobile filtration systems custom designed to meet the needs of the brewer. Skids include all the equipment necessary to perform any brewing operation from D.E. pre-coating of body feed Zeta Plus™ cartridges for small scale primary filtration, to aseptic filtration filter trains with prefilters, final filters, pumps, gauges, and sampling ports.

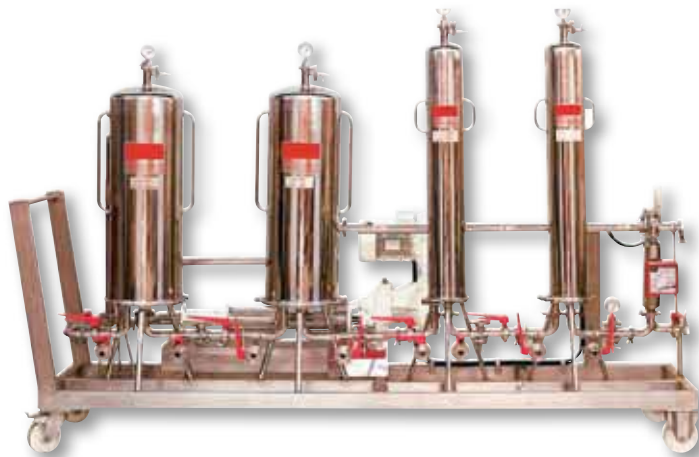


Figure 20 – A self-contained mobile filtration system is shown above. This system consists of stages of Zeta Plus™ and LifeASSURE™ PFS series filter housings as well as pumps, valves, flow meters and gauges for easy incorporation into a brewery.



Figure 17. – This 12ZP48 housing contains 48 Zeta Plus™ cartridges and is capable of service flow rates up to 240 GPM (480 HL/hr).



Figure 18 – Like all Zeta Plus™ housings, this 12ZP9 utilizes an easy to operate, spring loaded sealing system (seen at the top of each filter stack) to ensure reliable cartridge to housing sealing. The housing contains 9 Zeta Plus cartridges and is capable of service flow rates up to 45 GPM (90 HL/hr).



Figure 19 – 3M Purification manufactures a wide range of sanitary design, pre and final filter housings. The ZMS/ZVS models (shown above) accommodate a single 10"-40" filter cartridge while the ZWC/ZWB models (not shown) accommodate up to 21 10"-40" cartridges.

Housing Ordering Guide

3M™ filter systems can provide a wide array of filter housings designed to meet all process requirements found in breweries. Standard housings are available to meet flow rates from 1 GPM to 2000 GPM.

3M filter housings are engineered specifically for easy cartridge installation and removal and are simple to clean and maintain. Surface finishes of all microfiltration housings are polished 316L stainless steel providing a high quality, low adhesion surface for easy sanitization.

Zeta Plus™ ZPC and ZPB filter housings come standard with an integral downstream check valve for system protection. They also include the spring loaded sealing system designed for effective cartridge sealing for the entire life of the filter.

Zeta Plus™ Filter Housings

Zeta Plus filters are contained in totally enclosed, 316L stainless steel filter housings that set the standard for quality, performance and ease of use. Benefits of the housing system include:

- A totally enclosed system that reduces edge leakage, external contamination, and oxidation of beer.
- An advanced sanitary design constructed of polished 316L stainless steel that provides maximum corrosion resistance and limits microbial and particulate adhesion of wetted surfaces.
- A full range of housing sizes to provide easy scale-up from bench-top to pilot scale to full production as your brewery grows.
- A positive spring-loaded cartridge to housing sealing system that provides proper sealing compression to prevent filter bypass even under the most arduous process conditions.
- Housings seal with fast action swing bolts or clamps, permitting rapid assembly and cartridge change-outs, minimizing downtime and ensuring operator safety.
- Available as complete sanitary systems including piping, valves, pressure gauges, and skid-mounted mobile systems for single source system solutions.

Table 10 - Zeta Plus™ Series

These housings are ideal for trap, polishing and sterile filtration applications using Zeta Plus™ Filter Cartridges

Model	Filter Cartridge Diameter	Number of Cartridges	Maximum Flow Rate*	Maximum Allowed Pressure/Temp.	Literature Reference
ZPC 316L, T-type, clamp closure	8" - 12" or 16"	1 to 4	up to 86 GPM/(324 LPM)	75 psi / 200 °F (5 bar / 90 °C)	LITHSZPBC
ZPB ¹ 316L, T-type, swing bolt closure	8" - 12" or 16"	1 to 4	up to 86 GPM/(325 LPM)	150 psi / 200 °F (10 bar / 90 °C)	LITHSZPBC
ZPIP 316L, in-line, clamp closure	8" - 12"	1	up to 46 GPM/(174 LPM)	125 psi / 200 °F (8.6 bar / 90 °C)	LITZPH1P2

¹ Special sanitary style Zeta Plus™ housings are available for processes with greater flow rates. Please contact your local 3M Purification distributor or 3M Purification directly.

* Flow rates listed are for housings only. Do not use this value to size an application. Actual process flow rates are determined by the recommended flow rates of the installed cartridges and other process conditions. Please consult 3M Purification for actual filter system sizing.

Table 11 - Sanitary Series

These housings are ideal for trap, polishing and sterile filtration applications

Model	Filter Cartridge Style	Number of Filter Cartridges	Length of Filter Cartridges	Maximum Flow Rate*	Maximum Allowed Pressure/Temp.	Literature Reference
ZWC 316L, T-type clamp closure	SOE 226 O-rings	4, 8, 11, 21	10" to 40"	360 GPM (1360 LPM)	75 psi / 200 °F (5 bar / 90 °C)	LITZRH106
ZWB 316L, T-type, swing bolt closure		4, 8, 11, 21		360 GPM (1360 LPM)	150 psi / 200 °F (10 bar / 90 °C)	LITZRH106
ZMS 316L, T-type, clamp closure		1		18 GPM (68 LPM)	150 psi / 300 °F (10 bar / 149 °C)	LITZRH104
ZVS 316, in-line, clamp closure		1		46 GPM (174 LPM)	150 psi / 300 °F (10 bar / 149 °C)	LITZRH104

*Flow rates listed are for housings only. Do not use this value to size an application. Actual process flow rates are determined by the recommended flow rates of the installed cartridges and other process conditions.

SOE - Single Open End. DOE - Double Open End.

Table 12 - Industrial Series

These housings are ideal for plant water and general plant utility applications

Model	Filter Cartridge Style	Number of Filter Cartridges	Length of Filter Cartridges	Maximum Flow Rate*	Maximum Allowed Pressure/Temp.	Literature Reference
SD 316L, side inlet/outlet quick-release clamp	DOE or SOE 222 O-rings	5, 12, or 22	10" to 40"	up to 400 GPM (1514 LPM)	150 psi / 250 °F (10 bar / 121 °C)	LITHSSD1
DC 316L, side inlet/outlet quick-release clamp	DOE	4, 5, 12, or 22	10" to 40"	up to 400 GPM (1514 LPM)	150 psi / 250 °F (10 bar / 121 °C)	LITHSDC1
ZMO 316, top inlet/outlet, threaded closure	SOE 222 O-rings	1	10" to 40"	up to 26 GPM (98 LPM)	150 psi / 200 °F (10 bar / 90 °C)	LITZRH101
CT brass 304/316, threaded closure	DOE	1	9¾" to 29¼"	up to 26 GPM (98 LPM)	300 psi / 200 °F (20 bar / 90 °C)	LITHSCT3
ES ASME code, swing bolt closure, carbon steel, 304L or 316L stainless steel	DOE, SOE 222 and 226 O-rings, and Zeta Plus™	6, 12, 18, 24, 36, 52, 85, or 120	10" to 40"	up to 2000 GPM (7570 LPM)	300 psi / 450 °F (20 bar / 232 °C)	LITHSESI
IM plastic, top inlet/outlet	DOE	1	9¾" & 19½"	up to 16 GPM (60 LPM)	125 psi / 100 °F (8 bar / 38 °C)	LITHS1M1

*Flow rates listed are for housings only. Do not use this value to size an application. Actual process flow rates are determined by the recommended flow rates of the installed cartridges and other process conditions. Please consult 3M Purification for actual filter system sizing.

SOE - Single Open End. DOE - Double Open End.

Filter Ordering Guide

The following pages contain charts designed to help you select the style and number of filters needed for your application.

1. From the application sections: determine the filter cartridge needed for your application.
2. From the filter ordering guide charts: select the style, grade and number of 10" cartridge elements required for your process based on the recommended flow rate and pressure drop per filter element. (Divide your process flow rate by the recommended flow rate per 10" cartridge element to find how many cartridge elements are needed.)
3. From the housing section: select the appropriate housing to accommodate the number of cartridges needed for the application.

Example:

You wish to sterile filter your new line of beer and want to use Betapure™ NT-T cartridges as your D.E. trap filter with Zeta Plus™ and LifeASSURE™ BA series as your final filter train. Your process flow rate is 18 GPM.

1. From the Betapure NT-T filter ordering guide: you determine that you will need 5 Betapure NT-T 5 µm 10" cartridge elements. From the housing ordering guide, a 5SD1 will contain 5, 10" filter cartridges.
2. From the Zeta Plus filter ordering guide: you determine that you will need 4, 45245-01D-50H style 12" diameter Zeta Plus cartridges. From the housing ordering guide, a 12ZPC4 will contain these cartridges.
3. From the LifeASSURE BA series filter ordering guide: you determine that you will need 12, LifeASSURE BA045 grade 10" cartridge elements. From the housing ordering guide, a 4ZWC3 will contain these cartridges.

Caution: Care must be exercised in applying equivalent cartridges to competitive housings. While every effort has been made to assure compatibility, exceptions may exist. A dimensional check of competitive products in the field is recommended

Zeta Plus™



Known as the flagship of beer filtration, Zeta Plus filters are used the world over for providing effective haze reduction and clarification, substantial bioburden reduction and excellent membrane prefiltration.

Available in either the conventional sheet form, or the innovative, convenient totally-enclosed cartridge system, Zeta Plus filters deliver the performance, ease-of-use, and economy unmatched by any competitive product. 3M Purification's pioneering work in charge-enhanced depth filtration has led to numerous engineering innovations that provide benefits to the user. These innovations include: advanced media formulations and retention ratings tailored to provide consistent and reliable beer filtration; a computer designed "stiff-cell" separator between each sheet of media that results in increased utilization and low filtration costs; and a spring-loaded cartridge- to-housing sealing system that takes the worry out of installing cartridges. Zeta Plus Generation 2 cartridge and housing systems are available to meet a wide range of needs, from the smallest microbrewery to the largest, full scale brewery.

For more information, please ask for 3M Purification literature number LITZPH1

Ordering Guide

Catalog Number	Recommended Flow Rate	Gasket	Media Grade	Media Formulation
45109 (8" - 8 Cell) - 2.8 ft ² 45167 (8" - 7 Cell Plug-in) - 2.5 ft ²	1 GPM	11 - Nitrile 22 - Silicone 01 - Nitrile 04 - Silicone	05, 10, 30, 40, 50, 60, 70, 90 10, 30, 40, 50, 60, 70, 90	H

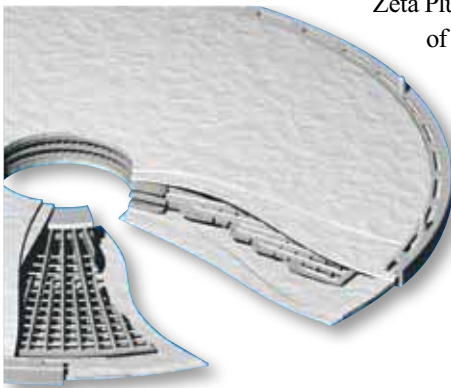
Ordering Guide

Catalog Number	Recommended Flow Rate	Geometric Variation	Gasket	Media Grade	Media Formulation
45237 (12" - 12 Cell) - 12.3 ft ² 45245 (12" - 16 Cell) - 16.4 ft ²	3.5 GPM 5 GPM	01 - Standard Polypropylene 02 - Talc Filled Polypropylene	A - Silicone D - Nitrile C - EPR	05, 10, 30, 40, 50, 60, 70, 90	H

Ordering Guide

Catalog Number	Recommended Flow Rate	Gasket	Media Grade	Media Formulation
Z16P (16" - 14 Cell) - 34.7 ft ² Z16H* (16" - 16/17 Cell) - 39.7/42.2 ft ²	10 GPM	A - Silicone D - Nitrile	05, 10, 30, 40, 50, 60, 70, 90	H

Zeta Plus™ Maximizer



Zeta Plus™ Maximizer H series was designed to handle difficult to filter beers. The design consists of two discrete layers of Zeta Plus filter media, with the upstream layer being more open than the downstream layer. This structure enhances the contaminant holding capacity of the filter by trapping larger particles, hazes, and microorganisms in the upstream layer, and smaller ones in the downstream layer. Available in BioCap capsules and 8", 12" and 16" diameter cartridges, the Maximizer H series depth filter can meet challenges from small single lot beers to large-scale production.

For more information, please ask for 3M Purification literature number LITZPMH.

Ordering Guide

Catalog Number	Recommended Flow Rate	Gasket	Media Grade
45109 (8" - 8 Cell) - 2.8 ft ² 45167 (8" - 7 Cell Plug-in) - 2.5 ft ²	1 GPM	11 - Nitrile 22 - Silicone 01 - Nitrile 04 - Silicone	10MH01, 10MH02, 30MH02, 30MH03, 60MH03, 60MH05, 70MH05, 90MH05, 90MH08

Ordering Guide

Catalog Number	Recommended Flow Rate	Geometric Variation	Gasket	Media Grade
45237 (12" - 12 Cell) - 12.3 ft ² 45245 (12" - 16 Cell) - 16.4 ft ²	3.5 GPM 5 GPM	01 - Standard Polypropylene 02 - Talc Filled Polypropylene	A - Silicone D - Nitrile	10MH01, 10MH02, 30MH02, 30MH03, 60MH03, 60MH05, 70MH05, 90MH05, 90MH08

Ordering Guide

Catalog Number	Recommended Flow Rate	Geometric Variation	Gasket	Media Grade
Z16P (16" - 14 Cell) - 34.7 ft ² Z16H** (16" - 16/17 Cell) - 39.7/42.2 ft ²	10 GPM	01 - Standard Polypropylene 02 - Talc Filled Polypropylene	A - Silicone D - Nitrile	10MH01, 10MH02, 30MH02, 30MH03, 60MH03, 60MH05, 70MH05, 90MH05, 90MH08

**Z16H contains 17 cells for 60MH05, 70MH05, 90MH05, 90MH08 and 16 cells for 30MH02, 30MH03, 60MH03

LifeASSURE™ BA



How can a brewer achieve microbiological stability without the use of costly pasteurization? The LifeASSURE™ BA series membrane filter is the solution.

Made with durable, microporous Nylon 6,6 membrane, LifeASSURE BA series filters were created to provide superior retention of beer spoilage organisms resulting in long shelf life without the cost or adverse effects on beer quality that pasteurization presents. Combined with Zeta Plus™ prefiltration, the LifeASSURE BA series filter is specifically designed to meet the rigors of beer processing including multiple hot water sanitization cycles. Made with inert Nylon 6,6 and without the use of adhesives, binders or surfactants, the LifeASSURE BA series filter has virtually zero extractables and does not effect the organoleptic qualities of beer. Available in retention ratings of 0.45 μm and 0.65 μm, and in lengths from 10" to 40" with a wide variety of end fittings, LifeASSURE BA series filters can accommodate any process

requirements. For filter sizing purposes, a minimum flow rate of 1 GPM per 10" cartridge element can be used, although faster flow rates are achievable. Refer to the Flow Rate versus Differential Pressure chart in the LifeASSURE BA series literature for more information on faster flow rates.

For more information, please ask for 3M Purification literature number LITZRBA2.

Ordering Guide

Catalog Number	Grade	Configuration	Length	End Modification	O-ring/Gasket
BA	045 - 0.45 µm 065 - 0.65 µm	A - Cartridge	01 - 10" 02 - 20" 03 - 30" 04 - 40"	B - 226 Bayonet Locking C - 222 O-ring & Spear, D - DOE, Flat Gasket (10") E - DOE, Flat Gasket (9¾") F - 222 O-ring & Flat Cap J - 226 O-ring & Flat Cap	A - Silicone B - Fluorocarbon C - EPR D - Nitrile

LifeASSURE™ PFS

Brewers around the world rely on LifeASSURE™ PFS020 series membrane filters, to ensure absolute sterility of the wort aeration, injected air or gas, tank vents and air used at the filler.

LifeASSURE PFS series filter cartridges are durable, biologically safe and effective filters designed for critical filtration applications. LifeASSURE PFS series filter cartridges have passed the most comprehensive validation program in the industry, including bacterial retention in liquids according to the demanding ASTM procedure. The LifeASSURE PFS series cartridge is composed of a durable, hydrophilic, PTFE membrane. Polypropylene cage, core and cartridge components ensure both membrane rigidity and compatibility required for severe operating conditions including repetitive steam cycles. All cartridges are 100% integrity tested after manufacture and are integrity testable by the end-user for dependable, documented air and gas filtration.

For more information, please ask for 3M Purification literature number LITCMR2.



Ordering Guide

Basic Cartridge Guide	Recommended Flow Rate	Height	End Modification	O-ring Material
PFS020	A	01 - 10 02 - 20 03 - 30 04 - 40 50 - 5	B - 226 O-ring & Spear C - 222 O-ring & Spear F - 222 O-ring & Flat Cap J - 226 O-ring & Flat Cap	A - Silicone B - Fluorocarbon C - EPR D - Nitrile K - PTFE Encapsulated Fluorocarbon

Betapure™ NT-T



3M Purification designed the Betapure™ NT-T cartridge to provide significantly superior service life while maintaining consistent filtration efficiency. Betapure NT-T filters achieve this through an innovative cartridge design that allows uniform distribution of fluid flow and contaminant throughout the entire depth of the cartridge.

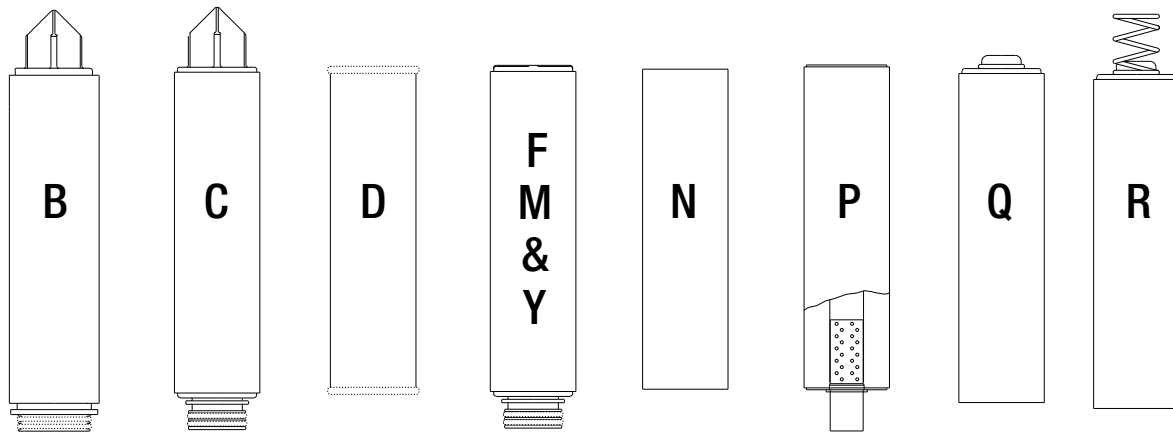
Betapure NT-T filter construction combines a polypropylene media with fluid distribution netting to form multiple layers. Critically positioned media flow channels allow greater movement of fluid from layer to layer. Three distinct media sections, made from multiple media/netting layers, are combined to form the filter cartridge. The outer and middle sections contain multiple layers of interleaved filter media and fluid distribution netting. Within each media layer a portion of the fluid travels through the media while the balance of the fluid is delivered directly to the next distribution layer through the flow channels. The fluid distribution netting provides longitudinal and latitudinal flow paths to evenly distribute fluid flow across the surface of each successive media layer.

For more information, please ask for 3M Purification literature number LITCPN1.

Ordering Guide

Cartridge Type	Length*	Grade-Micron Absolute	Packaging Option	Support Ring	End Modification (See Illustrations below)	Gasket/O-ring	
NT - Betapure™	09 - 9¾"	T005 - 0.5	S - Individual Poly Bag 1 High: 30/carton 2 - 4 High: 15/carton	For End Modifications D, N, P, Q & R: 0 - None	B - 226 O-ring & Spear C - 222 O-ring & Spear D - DOE with Polypropylene End Caps F - 222 O-ring & Flat cap M - 222 O-ring & Flat cap N - None P - Polypropylene Core Extender Q - End Cap without Spring R - End cap with Spring Y - Single O-ring (40" only)	For End Modifications B, C, & F: A - Silicone B - Fluorocarbon C - EPR D - Nitrile	
	10 - 10"	T010 - 1		For End Modifications B, C, F, M, & Y: 0 - None 1 - Polysulfone 2 - Stainless Steel			For End Modifications N, P, Q, R: G - Polyethylene
	19 - 19½"	T020 - 2					
	20 - 20"	T030 - 3					
	29 - 29¼"	T050 - 5					
	30 - 30"	T100 - 10					
	39 - 39"	T200 - 20					
	40 - 40"	T300 - 30					
		T400 - 40					
		T500 - 50					
		T700 - 70					

* Lengths are multiples of 9 3/4" or 10" depending on an end modification.



Micro-Klean™ RB



Known the world over as the standard for water filtration, the exclusive manufacturing process of the Micro-Klean™ RB series produces a rigid, resin bonded, graded-porosity structure that reduces by-pass and the unloading characteristics of soft, easily deformable competitive filters.

The design of Micro-Klean RB series provides a family of filter cartridges that offer a number of distinct benefits. The filter's graded porosity design provides a low pressure drop resulting in long life and consistent performance. The rigid, resin bonded structure prevents by-pass and unloading common with soft filters as the system pressure increases or surges. The Micro-Klean RB series filter contains no metal or plastic cores which allows for easy disposal. Micro-Klean RB is available in retention ratings from 5 to 25 µm, in a variety of lengths and end fittings designed to fit seamlessly into any application.

For more information, please ask for 3M Purification literature number LITZCMK.001.

Table 13

Grade	Typical Flow Rate (GPM)	Pressure Drop per 10" Cartridge PSID/GPM
B	3	0.23
F	4	0.18

Ordering Guide

Surface Type	Cartridge Length	Designation Grade – Rating	Formulations Available	Cartridge Lengths	Options
G - Grooved U - Ungrooved	78 - 9¾" 80 - 10"	Y - 1 µm A - 3 µm B - 5 µm C - 10 µm F - 25 µm L - 50 µm	2	1 2 3 4	N - None G - Polyethylene Gasket X - 316 SS Core Extender P - Polypropylene Core Extender S - Shrink Warp T - Tissue Wrap

Activated Carbon Cartridge



Activated Carbon cartridges reduce chlorine, color, and odors caused by dissolved organics, and turbidity from water. All components are constructed of FDA CFR 21 listed materials for food contact. The easy-to-change disposable cartridge contains approximately 33 cubic inches of premium grade granular activated carbon. The activated carbon adsorbs dissolved organics and reduces chlorine. An integral 5 µm prefilter reduces particulates to reduce premature plugging of the carbon bed, while a 5 µm postfilter reduces carbon fines that may shed from the bed.

Table 14

Grade	Typical Flow Rate (GPM)	Pressure Drop per 10" Cartridge PSID/GPM
46332-01	2	0.65
46285-01	2	0.65

Ordering Guide

Basic Catalog Number	Maximum Temperature	Outside Diameter (Inches)
46332-01 46285-01	100 °F (38 °C)	2¾" Industrial 3"

3M Purification. . . A World Leader in Fluid Purification

3M Purification Inc's leadership in fluid purification has expanded by continually providing superior products and services. 3M Purification filtration systems are designed and manufactured to the most stringent industry standards. This assures the reliability of 3M Purification systems which brewers around the world have come to expect.

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 validation, application support and in the sharing of scientific information.

3M Purification's Scientific Applications Support Services works closely with customers to solve difficult filtration challenges and to recommend the most efficient, economical filter systems. SASS specialists can perform on-site testing and utilize filtration applications expertise to partner with customers.

3M Purification resolves filtration problems promptly and efficiently in a cost-effective, confidential manner with a commercial support group consisting of 3M Purification's in-house customer service staff, application specialists, and engineering services. 3M Purification's broad distributor base and sales offices provide worldwide customer service, local inventory, and field support in virtually every major center of manufacturing.

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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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