PALL Pall Corporation

Ultipleat® SRT Filters

REVOLUTION not evolution

Filtration. Separation. Solution.SM

Ultipleat SRT Filters:

- Superior contamination control over the life of the filter
- Enhanced performance under cyclic flow and pressure conditions
- High flow capability
- Optimum service life and envelope size

The Ultimate in Filter Design

Pall's Ultipleat SRT hydraulic & lube filter elements combine an innovative pack design and stress-resistant media technology to provide the greatest overall performance and value.

Proprietary Laid-over Pleating

- Maximizes filter area
- Increases flow handling capability
- Reduces element size
- Creates uniform flow distribution through the element

Coreless/Cageless Construction

- Is incinerable
- Reduces disposal costs

Stress-Resistant Media

- Improves fluid cleanliness consistency
- Improves performance in "real world" conditions

Anti-Static Construction

- Minimizes static charge generation and electrostatic discharge
- Prevents damage to filter element, housing, or fluid due to static discharge

In-To-Out Flow Path

- Reduces the chance of cross contamination during element change

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Anti-Static Construction

Electrostatic charge can be generated by the flow of hydrocarbon fluids through porous media contained in a filter element. With low fluid electrical conductivity, this static charge can accumulate on the filter element and later discharge, causing noise and potential damage to the filter element, filter housing, or fluid.

Pall Ultipleat SRT elements *incorporate anti-static materials to reduce charge generation and eliminate static discharges.*

Great Things Come in Small Packages...

OEM Benefits:

- Smaller package size
- Increased machine reliability
- Reduced warranty costs
- Withstands system operating stresses

User Benefits:

- Increased system reliability
- Reduced operating costs
- Reduced filtration costs
- Reduced filter element size
- Environmentally friendly disposal

Media Substrate Support Layer (not shown): Provides support for the media and aids in drainage flow.

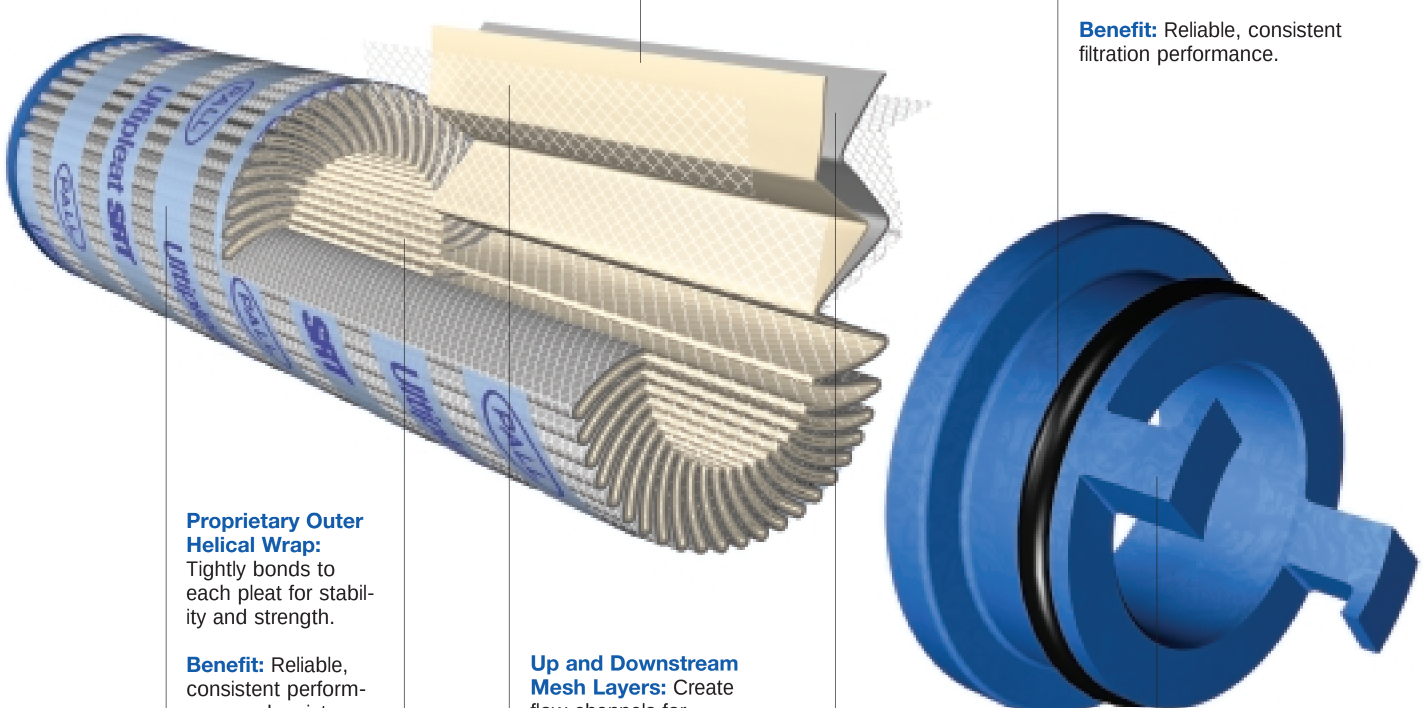
Benefit: Reliable, consistent performance

Proprietary Cushion Layer: Provides support for the media and protection from handling.

Benefit: Reliable, consistent performance

O-ring Seal: Prevents contaminant bypassing the filtration medium under normal operation.

Benefit: Reliable, consistent filtration performance.



Proprietary Outer Helical Wrap: Tightly bonds to each pleat for stability and strength.

Benefit: Reliable, consistent performance and resistance to severe operating conditions

Up and Downstream Mesh Layers: Create flow channels for uniform flow through the filter.

Benefit: Extended element life for lower operating costs.

SRT Media: Inert, inorganic fibers securely bonded in a fixed, tapered pore structure with increased resistance to system stresses such as cyclic flow and dirt loading.

Benefit: Improved performance over the life of the filter and more consistent fluid cleanliness.

Auto-Pull Element Removal Tabs: Corrosion-resistant endcaps feature exclusive Auto-Pull tabs for automatic element extraction upon opening the housing.

Benefit: Ease of element change-out.

Coreless/Cageless Design: Outer element cage is a permanent part of the filter housing

Benefit: Lighter, environmentally friendly element for reduced disposal costs and ease of element change-out.

The Shape of the Future

Key to the performance advantage in Ultipleat SRT filters is the laid-over pleat configuration of the medium pack. Laid-over pleating results in several important advantages:

- Allows more filter area to be packed into a given filter element envelope
- Creates uniform flow distribution through the element
- Protects against pleat collapse and bunching

Mathematically Optimized Filter Area

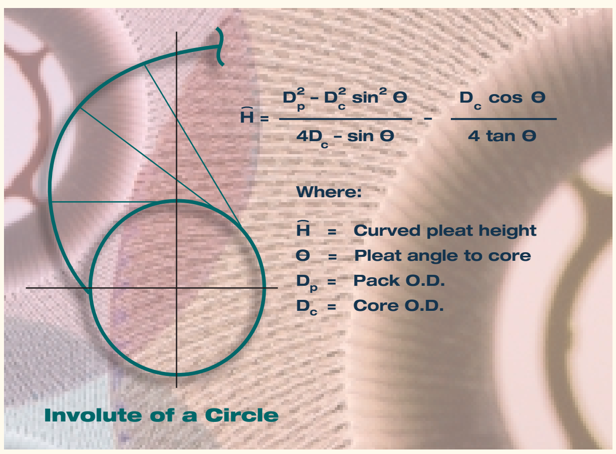


Figure 1

Figure 1 represents the geometric model used to determine the optimal pleat shape to maximize filter area. Pall has determined that an “involute” shape yields maximum pleat area. This laid-over configuration represents what we believe is the ultimate in pleat design, thus the name “Ultipleat”.

Avoid Unused Volume

As illustrated in figure 2, traditional straight or fan-pleated elements have their pleats radiate outward from the element core. As this occurs, spacing between the pleats increases, creating unused volume (spaces without filter media). With the laid-over pleating structure of Ultipleat SRT elements (figure 3), there is no unused spacing between the pleats, and therefore no unused volume. In fact, laid-over pleating maximizes filter area.

Figure 2. Conventional pleated filter element construction

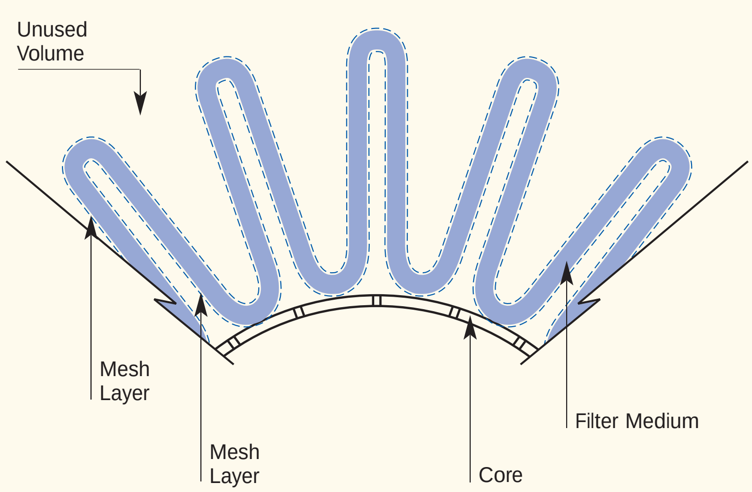
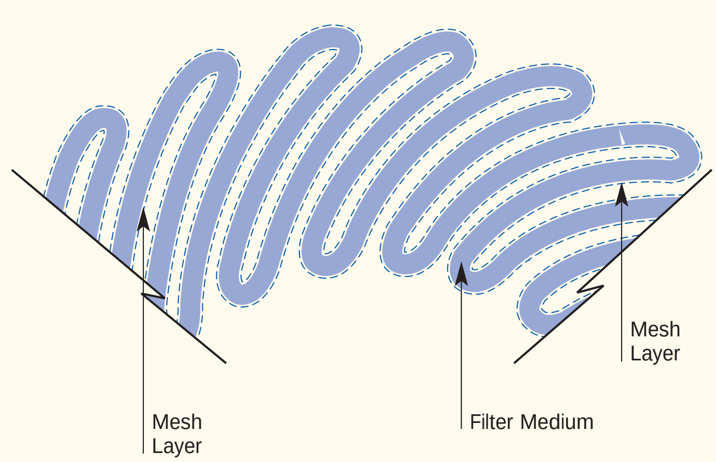


Figure 3. Ultipleat filter element construction



The Ultimate in Filter Design

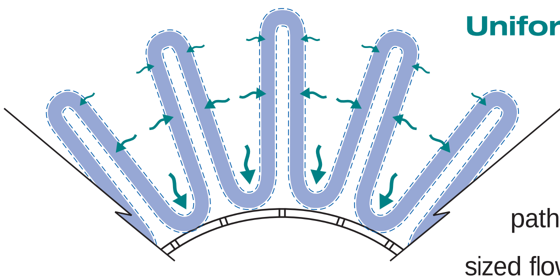


Figure 4. Non-uniform flow distribution in a traditional fan-pleat filter

Uniform Flow Distribution

Traditional fan pleated filters are structured such that fluid flow through the element is less restricted in some parts and more restricted in others (see figure 4). Fluid passing through the tips of the pleats must travel along a more restricted flow path than the flow passing through the root of the pleats. This is illustrated by the different sized flow arrows that show that most of the flow initially passes through the root of the pleats. This non-uniform flow distribution results in uneven dirt loading within the filter during operation. In comparison, the pleats of Ultipleat SRT elements (figure 5) are designed to support each other along the entire length of the pleat. The total flow resistance is the same, regardless of where along the pleat the flow passes through the medium. This creates a uniform flow velocity through the element and, therefore, uniform buildup of dirt within the filter. The result is greater dirt holding capacity and longer filter life.

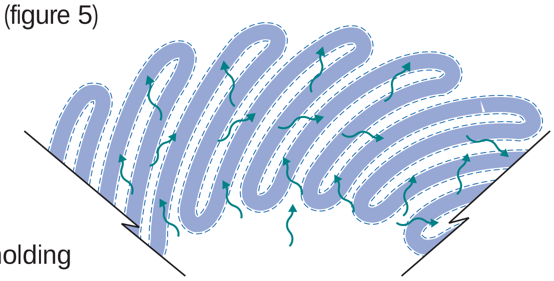


Figure 5. Uniform flow distribution in an Ultipleat SRT filter

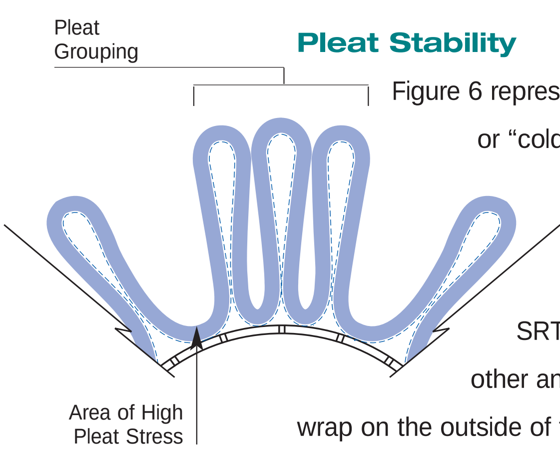


Figure 6. Pleat instability in a poorly supported filter element

Pleat Stability

Figure 6 represents a poorly supported fan-pleat filter element subjected to high differential pressure or "cold start" flow conditions. The pleats tend to be unstable and can move, thus increasing pressure on the flanks of the pleats. The result can be pleat collapse and the "bunching" together of pleats, which reduces useable filter area and filter life. In contrast, the pleats in Ultipleat SRT elements touch and support each other and are held in place via the helical wrap on the outside of the element. This results in long, consistent filter performance with uniform pleat spacing maintained.

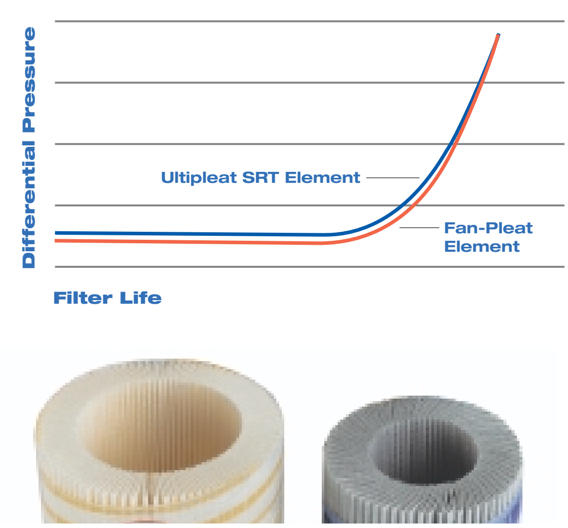


Figure 7. Filter life curve illustrating how a smaller Ultipleat SRT element can achieve equivalent service life compared to a larger fan-pleat filter

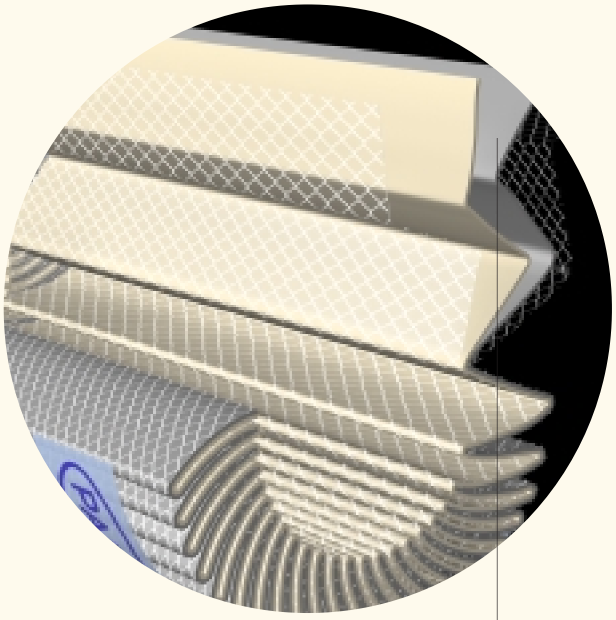
Less is More (Smaller Element, Long Life)

The combination of maximized filter area, optimized pleat geometry, and uniform flow distribution in a stable, laid-over pleat structure provides the benefit of significant filtration area compared to a traditional fan-pleat element of the same envelope size.

Of equal importance, these design features allow users to choose a smaller filter for an application and still obtain comparable element service life.

Figure 7 illustrates how a smaller Ultipleat SRT filter can be used in place of a larger fan-pleat element. In the figure, the smaller Ultipleat SRT element has a slightly higher clean pressure drop, but the overall life of the 2 different size filters is equivalent.

Stress-Resistant Technology (SRT) Media:
The Heart of Ultipleat SRT Filters



Stress-Resistant Technology (SRT) Filter Medium

SRT Filter Medium Technology

Designing filter media has traditionally been a question of balance. Make a medium finer and more efficient and clean pressure drop and/or service life is sacrificed. To get lower clean pressure drop, removal efficiency is sacrificed. With SRT filter media Pall has improved the filter's ability to maintain fluid cleanliness, while at the same time increasing flow capacity (reducing pressure drop). The result: better, more consistent system protection.

- High flow capacity in a small envelope size
- Optimum performance at all stages of filter life for consistently cleaner fluid
- Optimum performance under cyclic flow and pressure conditions for consistently cleaner fluid

SRT Media Construction

- Specially blended layers of fibers optimized for low pressure drop and stress resistance
- Proprietary anti-static design
- Uniform pore size control layer
- Tapered pore construction
- Epoxy resin bonded fiber structure

SRT Media Features & Benefits

Feature	Advantage	Benefit
Stress-Resistant construction	• Increased stability under cyclic or dirt loading conditions	• Cleaner fluid under cyclic conditions • Consistent performance throughout the filter's service life
Anti-Static design	• Minimized static charge generation and no electrostatic discharges	• No damage to filter element or housing from static discharge
Uniform pore size control layer	• Maintains particle removal efficiency	• Cleaner fluid • Increased system protection
Tapered pore structure	• Dirt captured throughout the media depth	• Long filter service life
Epoxy bonded fiber matrix with small fiber size	• High particle removal efficiency • Consistent performance	• Cleaner fluid • Increased system protection

Table 1

Ultipleat SRT Filtration Products

Ultipleat SRT Filter Elements

Series	Flows to:	Available lengths*
UE219/UE299	285 lpm (75 gpm)	4″, 8″, 13″, 20″
UE319	760 lpm (200 gpm)	8″, 13″, 20″, 40″
UE619	1135 lpm (300 gpm)	20″, 40″

* nominal length

Ultipleat SRT Filter Housings

Series	Flows to:	Pressures to:
UH219	285 lpm (75 gpm)	420 bar (6000 psi)
UH319	760 lpm (200 gpm)	420 bar (6000 psi)
UP319	760 lpm (200 gpm)	350 bar (5100 psi)
UR219	285 lpm (75 gpm)	41 bar (600 psi)
UR319	760 lpm (200 gpm)	41 bar (600 psi)
UR619	1135 lpm (300 gpm)	28 bar (400 psi)
UT299	285 lpm (75 gpm)	10 bar (150 psi)
UT319	760 lpm (200 gpm)	10 bar (150 psi)

Auto-Pull Element Removal Mechanism

Ultipleat SRT filter assemblies feature Pall's unique Auto-Pull element removal mechanism, allowing easy element removal from the filter housing.

When the cover or tube (depending on assembly design) is unscrewed from the housing, tabs on the filter element endcaps fit into hooks in the housing. Thus, as the cover or tube is unscrewed, the element is automatically pulled from the tube. This eliminates the need to reach into the tube to grab an endcap or handle and manually pull out the element.

The Cyclic Stabilization Test:
A Realistic Measurement of Filter Performance

Figure 8. Typical cleanup when a filter is added to the system

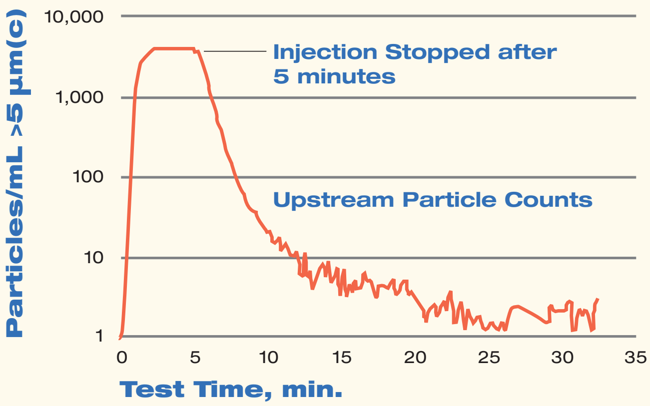


Figure 9. Impact of cyclic flow and dirt loading on a filter's ability to clean up the system

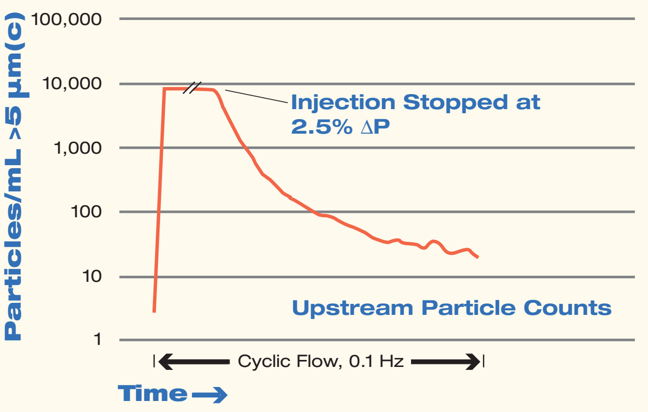
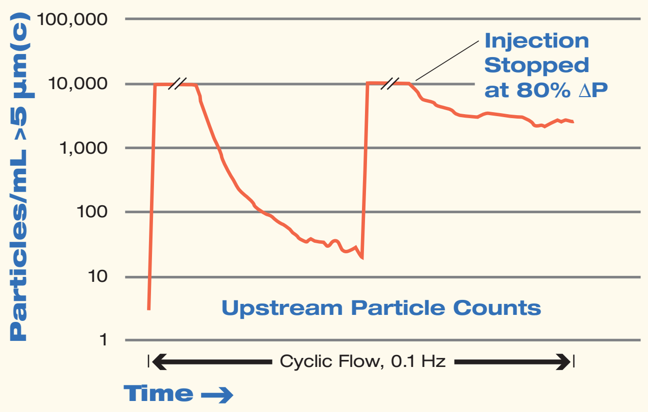


Figure 10. Impact of cyclic flow and continued dirt loading on a filter's ability to clean up the system



The Cyclic Stabilization Test

The data from an ISO multi-pass test is often used as the only performance based factor in the process of selecting filters. However, it is not indicative of filter performance under actual operating conditions.

The Cyclic Stabilization Test examines the effects of cyclic flow conditions and contaminant loading (typical real-world conditions) on the capture and retention characteristics of a filter element.

Figure 8 shows the typical system cleanup provided by a new, generic filter after dirt is injected into a system under steady flow and then the injection is stopped. As shown, over the approximate 30 minute test period the filter reduces the number of particles >5µm(c) to nearly zero.

This is typical of what occurs in a "real world" system, except here the filter is not subjected to any of the typical stresses experienced during normal system operation

The Cyclic Stabilization Test measures the same cleanup curve as in figure 8, but under cyclic flow conditions (25% to 100% of rated flow at a frequency of 0.1 Hz) at two points in the filter's service life represented by an increase above clean pressure drop by:

- 2.5% of net* pressure drop (~50% into the filter's life)
- 80% of net pressure drop (~90% into the filter's life)

Figure 9 shows the cleanup curve at ~50% into the filter's life. As you can see, cleanup occurs, but the filter's ability to reduce contamination levels is not as good as with a clean filter under steady flow conditions (figure 8).

Figure 10 shows the cleanup curves at both ~50% and ~90% into the filter's life. The cleanup curve at ~90% into the filter's life shows a marked reduction of the filter's ability to clean up the fluid. This clearly illustrates the impact of cyclic flow and dirt loading on the filter's ability to control fluid contaminants.

With this in mind, Pall developed SRT filter media to resist degradation in performance when the filter is subjected to typical system operating stresses.

For more details on the Cyclic Stabilization Test, see publication PM&E SRT-tech-A.

* net pressure drop equals terminal pressure drop minus clean pressure drop.

Figure 11. Cyclic Stabilization Test downstream stabilized particle counts

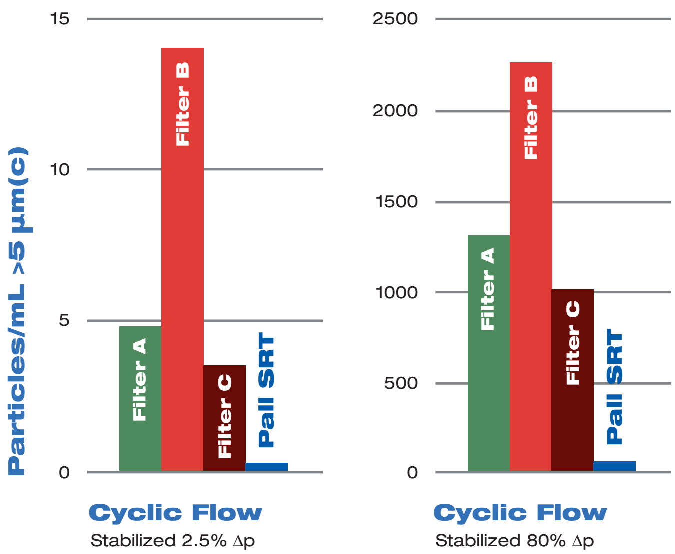


Figure 11 charts the stabilized contamination level achieved with Pall filters containing SRT media compared to three other manufacturers' conventional filters with similar Beta ratings. At both the 2.5% and 80% pressure drop points the elements with SRT filter medium exhibit significantly better capability to control fluid contamination.

In order to best characterize filter performance throughout its service life, it is essential to report how the filter will perform at the worst operating condition. The stabilized cleanliness achieved at the 80% pressure drop point in the Cyclic Stabilization Test provides an excellent representation of this "worst operating condition" and should be used as the reference to evaluate filter performance.

Reporting Filter Performance as an ISO Code

Stabilized cleanliness levels resulting from the Cyclic Stabilization Test can be reported as an ISO 4406 Cleanliness Code. Since the ISO Cleanliness Code is an industry-recognized and understood measure of system fluid cleanliness, Pall Corporation has chosen to rate Ultipleat SRT filter elements by the stabilized ISO Cleanliness Code achieved at the 80% net pressure drop point (the worst operating condition).

Table 2. Comparison of filter performance from the Cyclic Stabilization Test

Ultipleat SRT Filter Grade	Stabilized Particle Count per mL			ISO Code Rating (80% ΔP)
	>4 µm(c)	>6 µm(c)	>14 µm(c)	
AZ	1.4	0.15	0.01	08/04/01
AP	25.1	0.83	0.02	12/07/02
AN	267.2	13.89	0.11	15/11/04
AS	386.2	42.08	0.14	16/13/04
AT	694.0	198.30	1.57	17/15/08

Ultipleat SRT Filter Specifications

Filter Ratings

Cyclic Stabilization Test (80% ∆p) ISO Cleanliness Code Rating, Table 3

Ultipleat SRT	ISO Cleanliness Code Rating (ISO 4406) per Cyclic Stabilization Test (80% ∆p)*
AZ	08/04/01
AP	12/07/02
AN	15/11/04
AS	16/13/04
AT	17/15/08

* based on 4 bar (60 psid) terminal pressure drop

Table 3. CST filter performance ratings

Multi-pass Filter Rating (ISO 16889), Figure 12

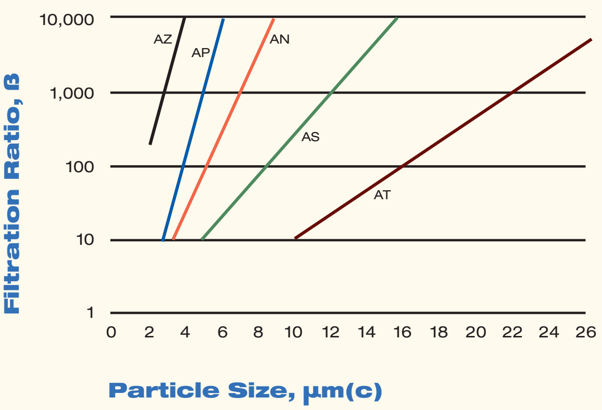


Figure 12. Multi-pass filter ratings (per ISO 16889)

Element Collapse/Burst Rating (ISO 2941)

10 bar (150 psid)

Flow vs. Pressure Drop (ISO 3968)

See appropriate Ultipleat SRT housing data sheet.

Fluid Compatibility (ISO 2943)

Compatible with petroleum oils, water glycols, water-oil emulsions, and high water containing fluids. Fluorocarbon seals are available for industrial phosphate esters, diesters, and specified synthetics.

Flow Fatigue (ISO 3724)

Contact factory; element pleats are fully supported, both upstream and downstream to achieve excellent fatigue cycle life.

Fabrication Integrity (ISO 2942)

Fabrication integrity is validated and assured during the manufacturing process by numerous evaluations and inspections including Bubble Point testing.

Temperature Range

Nitrile seals: -43˚C (-45˚F) to +107˚C (+225˚F)

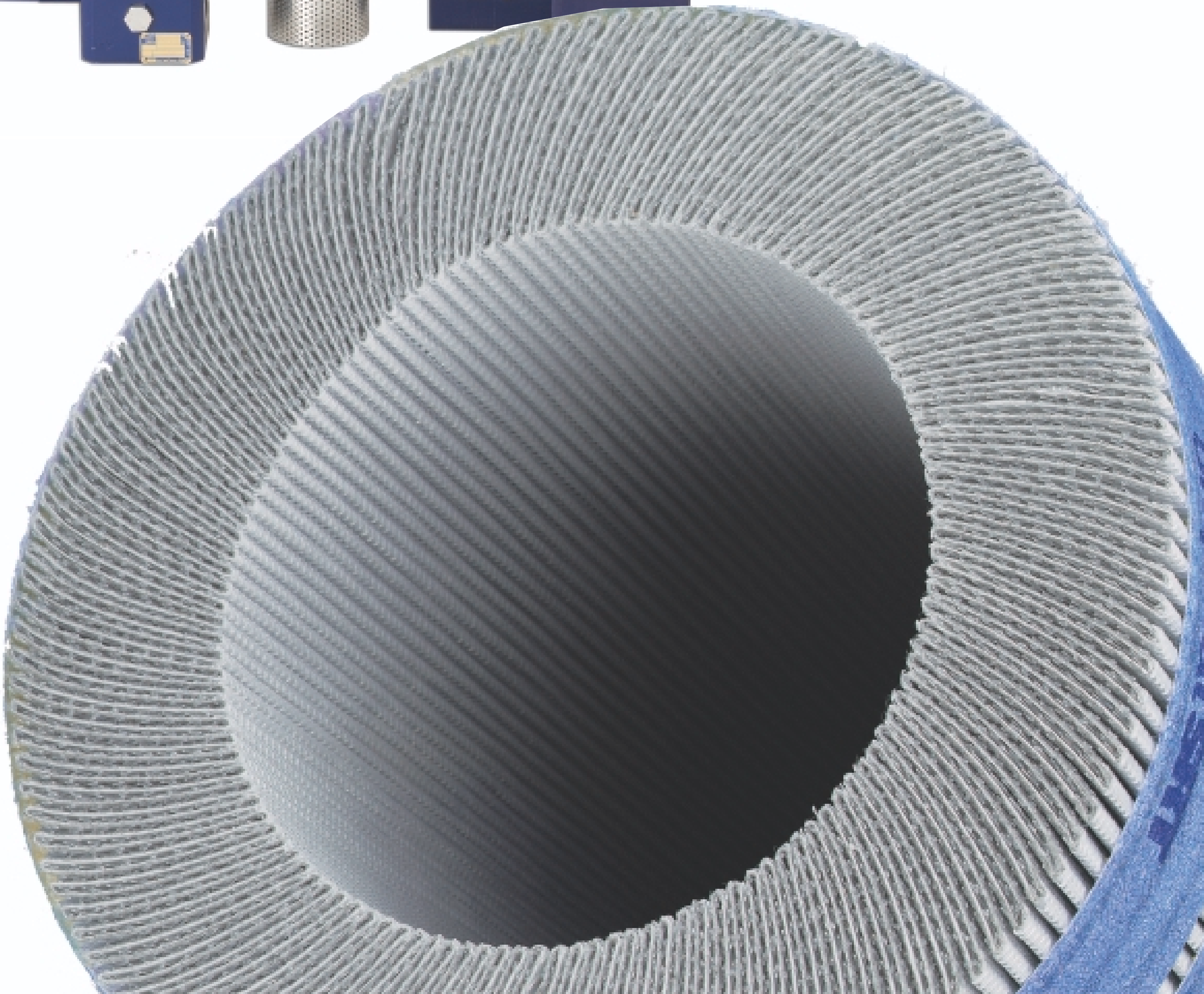
Fluorocarbon seals: -29˚C (-20˚F) to +120˚C (+250˚F)

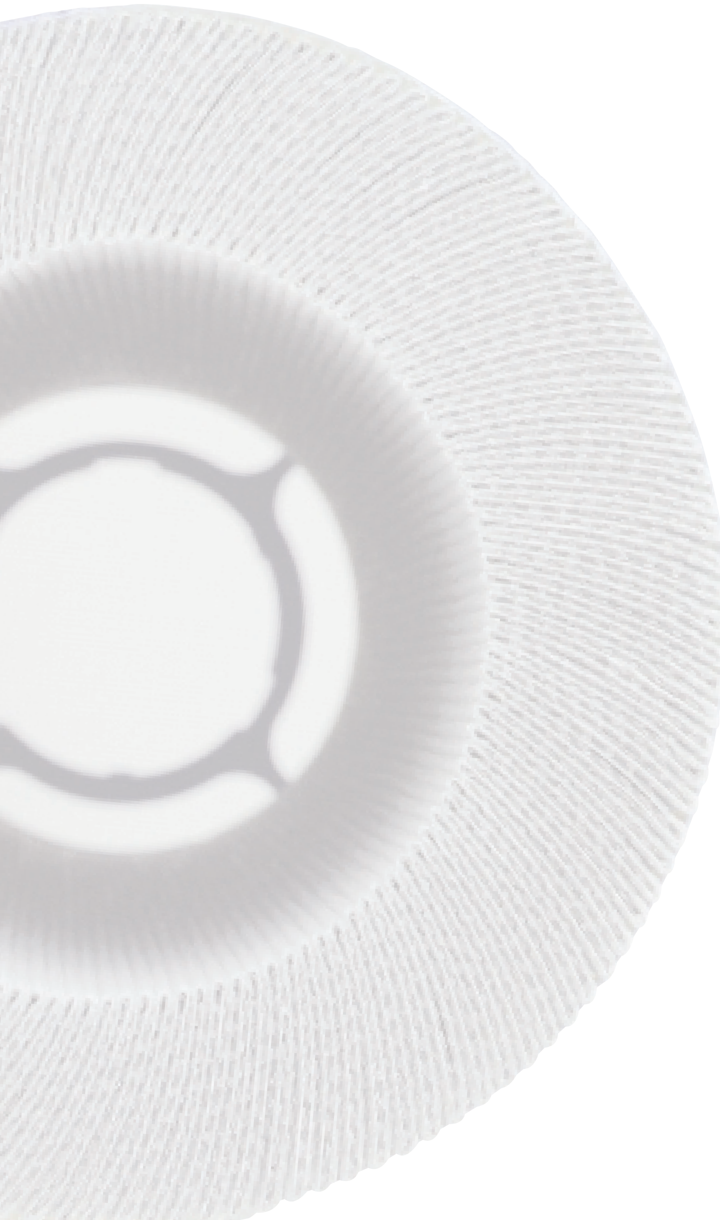
Note: Maximum 60˚C (140˚F) in water based fluids

Quality Control

All elements are manufactured by Pall to exacting procedures and strict quality controls. Elements are checked against rigorous ongoing validation test protocols within Pall Corporation. Pall is accredited to ISO 9001 and QS 9000.

Ultipleat SRT
Filter Housings





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