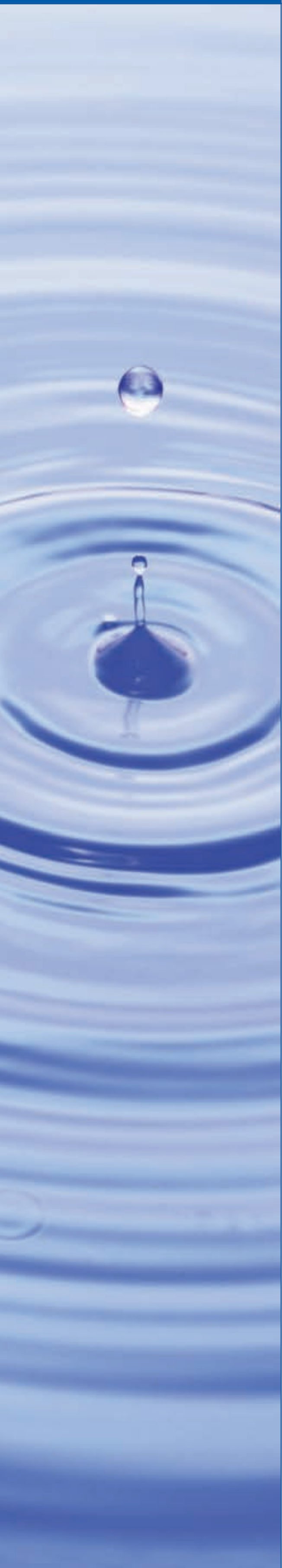
PALL

Power Generation

ENABLING A GREENER FUTURE℠



Pall is the global leader in providing filtration and separation products and services to the Power Generation industry

For decades Pall's Power Generation Group has served the international power generation market. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of your plant's equipment.

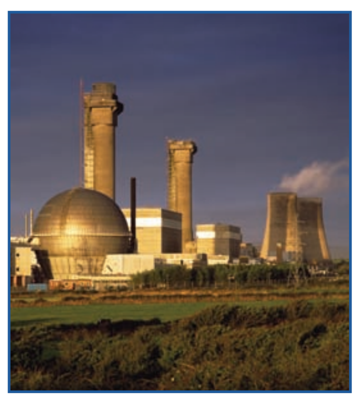
Pall's products are applied to the fluids found throughout a power plant to ensure cleaner, safer operations, which leads to more reliable power generation and higher profitability. Pall can solve your purification challenges – from small flows and simple installations to large flows and complex systems. We'll work with you to develop a solution that's right for you – whether that means applying a new element to your existing system or designing a new, fully-integrated turnkey system.

Visit us on the Web at www.pall.com or email us at PowerGen@pall.com.

To access our Products, Systems, and Applications literature, please click on a link below.

Lubrication, Hydraulics and Fuel

Industrial Water and Condensate



Nuclear

Filtration. Separation. Solution.℠

Lubrication, Hydraulics and Fuel

Case Studies and Articles

High Efficiency Coalescers Increase On-Line Sensor Reliability	Pall Oil Conditioning System - Case Study
High Performance Liquid/Gas Coalescers for Compressor	Ultipleat® SRT - Application Bulletin

Filter Elements

AquaSep® Plus L-L Coalescer Elements	Pall Power Gen Flagship Brochure
Claris® Series Filter Elements	PhaseSep® L-L Coalescers
Coreless Ultipor® III Filter Elements	PMM® Filter Elements
Dirt-Fuse® Filter Elements	PSS® Series Filter Elements
Pall Coreless Filter Elements - English version	Rigimesh® Filter Elements
Pall Coreless Filter Elements - French version	Schumatherm Filter Elements
Pall Coreless Filter Elements - German version	UFV Series Filters
Pall Coreless Filter Elements - Italian version	Ultipleat® SRT Filters Elements
Pall Coreless Filter Elements - Russian version	Ultipor® III Filter Elements
Pall Coreless Filter Elements - Spanish version	Ultipor® Max Filter Elements
Pall Dia-Schumalith® Filter Elements	Ultipor® Plus Filter Elements
Pall PFD Reservoir Vent Filter and Dryer	Ultipor® SRT Filter Elements

Housings

AquaSep® Plus - PhaseSep® Series Vertical Filter Housings	UR219 Series Filters - Ultipleat® SRT Return Line Filters
UH209 Series Filters - Ultipleat® SRT High Pressure Filters	UR319 Series Filters - Ultipleat® SRT Return Line Filters
UH219 Series Filters - Ultipleat® SRT High Pressure Filters	UR619 Series Filters - Ultipleat® SRT Return Line Filters
UH239 Series Filters - Ultipleat® SRT High Pressure Filters	UR629 Series Filters - Ultipleat® SRT Return Line Filters
UH319 Series Filters - Ultipleat® SRT High Pressure Filters	UR699 Series Filters - Ultipleat® SRT Return Line Filters
UH319 Series Filters - Ultipleat® SRT Side and Top Manifold Mounting	UT279 Series Filters - Ultipleat® SRT In-Tank Filters
UP319 Series Filters - Ultipleat® SRT High Pressure Filters	UT319 Series Filters - Ultipleat® SRT In-Tank Filters
UR209 Series Filters - Ultipleat® SRT Return Line Filters	

Purifiers and Water Removal

HLP6 Oil Purifier - Brazilian Portuguese version	HNP074 Series Oil Purifier
HLP6 Oil Purifier - English version	HRP020-HRM Purifier for Phosphate Ester Fluids
HLP6 Oil Purifier - French version	Pall HTP070 Dielectric Fluid Purifier
HLP6 Oil Purifier - Spanish version	Pall PB35 Reservoir Blower
HNP006 Series Fluid Conditioning Purifier	

Systems

Pall Varnish Control Solution - Brochure	Pall Varnish Control Solution - Datasheet

Testing and Monitoring

Differential Pressure Indicators and Switches	Water Sensor Calibration and Repair Services
Pall PCM200 Series Fluid Cleanliness Monitor	WS08 Series Water Sensor
Pall PCM400 Series Portable Cleanliness Monitor	WS09 Series Water Sensor
Pall PFC400W Series Portable Particle Counter	WS10 Series Water Sensor

Industrial Water and Condensate

Case Studies and Articles

Pall Aria™ System - Cost Saving Alternative to Clarifiers
Pall Aria™ System - Cost Saving Alternative to Demineralizers
Pall Aria™ System - Cost Saving Alternative to Lime Softening
Pall Case Study with Turbomachinery OEMs
Pall Condensate Newsletter
Pall Condensate Case Study at Indiana Power Plant
Pall Condensate Case Study at Midwestern Power Plant
Pall Condensate Case Study at Northeast Power Plant
Pall MF-RO Technical Paper on Boiler Feed Water
Pall Microfiltration Case Study at Burbank
Pall Microfiltration Case Study at EnCana
Pall Microfiltration Case Study at Texas Plant
Pall Microfiltration Case Study at Westar Plant
Pall Ultipleat® High Flow Case Study Filtering Feed Water

Filter Elements

Claris® Series Filter Elements
Hydro-Guard® CoLD-R Series Filter Elements
Hydro-Guard® PG Series Filter Elements
Hydro-Guard® PPB Series Backflushable Filter Elements
Hydro-Guard® PPT Series Pleated Filter Elements
Marksman™ High Capacity Filtration Systems
Nexis® A Series Filter Elements
Nexis® T Series Filter Elements
Pall Power Gen Flagship Brochure
PMM® Filter Elements
Profile® II Series Filter Elements
PSS® Series Filter Elements
Rigimesh® Filter Elements
Schumatherm Filter Elements
Ultipleat® High Flow 1 Micron Elements
Ultipleat® High Flow Filter Elements
Water-Fine™ Series Filter Elements

Housings

IDL Series Filter Housings
IDO Series Filter Housings
JD Series Filter Housings
Ultipleat® High Flow Filter Housings
LMO High Pressure Series Filter Housings
LMO Series Filter Housings
Marksman™ Series Filter Housings

Systems

Condensate Polishing Systems
Industrial Water Treatment
Pall Aria™ AP-Series Water Treatment Systems - Brochure
Pall Aria™ AP-Series Water Treatment Systems - Datasheet
Pall Aria™ Integrated MF/RO Systems
Pall Aria™ MF/RO System for Effluents
Pall Water Treatment Systems

Nuclear (NSSS)

Case Studies and Articles

Pall Fuel Pool Filtration Case Study

Pall Radwaste Case Study at South Texas Nuclear Plant

Filter Elements

Pall Nuclear Flagship Brochure - English version

Pall Nuclear Flagship Brochure - Russian version

Pall Power Gen Flagship Brochure

Ultipor® GF Plus Filter Elements

Ultipor® GF Plus Nuclear Grade Filters

Pall Corporation

CLARIS® Series Filter Cartridges

High Consistency Polypropylene Melt Blown Cartridge

- Graded Pore Structure Enhances Dirt Holding Capacity
- E-core, an Extruded Fibrous Core, Provides Excellent Strength
- Unique Proprietary Process
- Easy and Safe Cartridge Incineration and Disposal
- All Polypropylene Construction
- Free of Surfactants, Binders, and Adhesives
- NSF Certified
- Plastic and Metal Spring Assembly End Configurations Available

Performance Specifications

Filter Grades:
1, 3, 5, 10, 20, 30, 50, 75 µm

Maximum Differential Pressure:
50 psid (3.45 bar) @ ambient
25 psid (1.72 bar) @ 140˚F (60˚C)

Recommended Change Out Differential Pressure[1]:
35 psid (2.4 bar)

FDA Listed Materials:
Manufactured from materials, which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations. Product in compliance with EU Directive 2002/72/EC for plastic in food contact (in simulants A, B, C and D).

Toxicity:
All polypropylene components meet the specifications for biological safety as per the USP for Class VI-121˚C plastics (gaskets/O-rings excluded).

Purity:
Claris Series filter cartridges are free of surfactants, anti-static agents, binders, and adhesives.

Product Specifications

Materials of Construction:

Filter Media:	Polypropylene
End Caps[2]:	Polypropylene
Extended Core[2]:	Stainless Steel
Extruded Core:	Polypropylene
Gaskets/O-rings[2]:	Silicone Elastomer, Buna N, Viton[3] A, EPDM, Santoprene[4]

Dimensions (nominal):

Outside Diameter:	2 ½" (6.4 cm)
Inside Diameter:	1" (2.7 cm)
Lengths:	9 ¾" (24.8 cm), 9 ⅞" (25.1 cm), 10" (25.4 cm), 19 ½" (49.5 cm), 19 ⅘" (50.3 cm), 20" (50.8 cm), 29 ¼" (74.3 cm), 29 ½" (74.9 cm), 29 ¾" (75.6 cm), 30" (76.2 cm), 39" (99.1 cm), 40" (102 cm), 50" (127 cm)

NSF
COMPONENT

This Claris Series filter cartridge is tested and Certified by NSF International under ANSI/NSF Standard 42 for materials only.

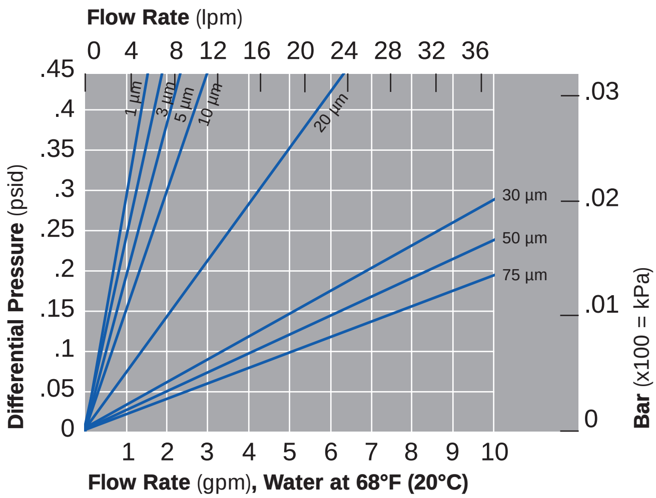
1 - Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

2 - These components are not NSF certified.

3 - Registered trademark of DuPont Dow.

4 - Registered trademark of Advanced Elastomer Systems.

Typical Flow vs. Differential Pressure for Application Sizing



Flow rate is per 10" (25.4 cm) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Part Numbers/Ordering Information

CLR ■ – ● ▼ ◆ (e.g. CLR 3–20DOES)

Code ■	Filter Grades[5]
1	1 µm
3	3 µm
5	5 µm
10	10 µm
20	20 µm
30	30 µm
50	50 µm
75	75 µm

Code ●	Cartridge Lengths (nominal)
9.75	9.75"
9.875	9.875"
10	10"
19.5	19.5"
19.8	19.8"
20	20"
29.25	29.25"
29.5	29.5"
29.75	29.75"
30	30"
39	39"
40	40"
50	50"

Code ▼	End Configurations
Blank	DOE industrial (no end caps)
DOE	DOE with elastomer gasket seals & end caps
H21	DOE, Santoprene gasket seal
1X	DOE industrial, 1" (2.54 cm) stainless steel extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[6]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[6]
M18	SOE flat closed end, external 222 O-ring
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
E	EPDM
V	Viton A

[5] - *Based on typical application usage.*

[6] - *For details, contact Pall Corporation.*

Pall Corporation

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Pall Corporation

WATER-FINE™ Series Filter Cartridges

DI and High Purity Water Filter

- Proprietary Highly Asymmetric Polysulfone Membrane Media
- Absolute Rated at >99.9% Efficiency with Retention Ratings from 0.05 to 1.2 µm
- Superior Flow Rates and Long Service Life
- High Purity Polypropylene Hardware
- End Configurations to Fit Most Housings

Performance Specifications

Filter Grades (>99.9% Retention Rating by Standard Latex Bead Challenge):
0.05, 0.1, 0.2, 0.45, 0.65, 0.8, 1.2 µm

Maximum Differential Pressure:
70 psid (4.8 bard) @ 120°F (49°C)
50 psid (3.4 bard) @ 180°F (82°C)

Recommended Change Out Differential Pressure[1]:
35 psid (2.4 bard)

FDA Listed Materials:
Manufactured from materials, which are FDA listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.

Sanitizing Agents:
Cartridge may be sanitized in place with common oxidizing agents. Consult factory for compatibility information.

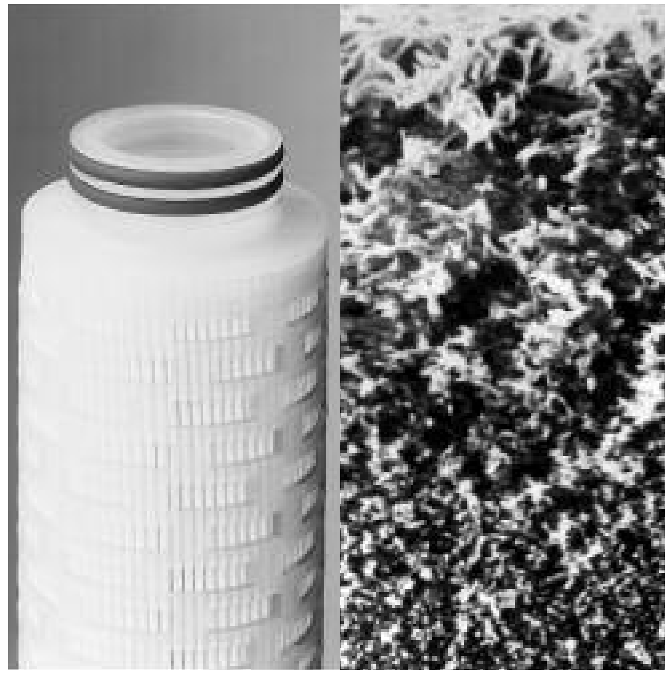
Rinse-Up:
Cartridges will rinse-up to 18 Megohm-cm with a minimum of throughput.

Pre-Rinsing:
A pre-rinse is available upon request. Specify code 314 at end of Water-Fine description.

Product Specifications

Materials of Construction:

Filter Media:	Highly Asymmetric Polysulfone Membrane
Support Material:	Polypropylene
Hardware:	Polypropylene
Surface Treatment:	Hydroxypropylcellulose
Sealing:	Thermal Bond
Gaskets/O-rings:	Silicone Elastomer, EPDM, Buna N, Viton[2] A, FEP Encapsulated Silicone



Dimensions (nominal):

Outside Diameter:	2 ⅝" (6.6 cm)
Lengths:	4" (10.2 cm), 9 ¾" (24.8 cm), 10" (25.4 cm), 19 ½" (49.5 cm), 20" (50.8 cm), 29 ¼" (74.3 cm), 30" (76.2 cm), 39" (99.1 cm), 40" (102 cm)
Surface Area:	6.1 ft^2 (0.57 m^2) per 10" (25.4 cm) equivalent

Product Applications

- Pre and Post Filter for DI Water
- Point-of-Use Filter for DI Water
- Filtration of Aqueous Chemical Solutions

[1] - *Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.*

[2] - *Registered trademark of DuPont Dow.*

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Liquid Flow Specifications

Filter Grade (µm)	DI Water Flow per 1 psid (gpm/10" (25.4 cm) equivalent)
0.05	1.0 (3.8 lpm)
0.1	1.7 (6.4 lpm)
0.2	3.0 (11.4 lpm)
0.45	5.5 (20.8 lpm)
0.65	6.0 (22.7 lpm)
0.8	7.0 (26.5 lpm)
1.2	8.0 (30.3 lpm)

Part Numbers/Ordering Information

WFN ■ – ● U ◆ – ▼ ▮ (e.g., WFN0.2–10US-M3 314)

Code ■	Filter Grades
0.05	0.05 µm
0.1	0.1 µm
0.2	0.2 µm
0.45	0.45 µm
0.65	0.65 µm
0.8	0.8 µm
1.2	1.2 µm

Code ●	Cartridge Lengths (nominal)
4	4"
9.75	9.75"
10	10"
19.5	19.5"
20	20"
29.25	29.25"
30	30"
39	39"
40	40"

Code ◆	Gasket/O-ring Materials
S	Silicone (standard O-rings)
E	EPDM
V	Viton A
N	Buna N (standard gaskets)
T	FEP Encapsulated Silicone
X	No O-ring required (M2 only)

Code ▼	End Configurations
Blank	DOE with elastomer gasket seals & end caps
1X	DOE, 1" (2.54 cm) extended core
M2	SOE flat closed end fits housing with 020 O-ring post
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[3]
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[3]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[3]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[3]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[3]
M10	DOE, internal O-rings (fits other manufacturers' housings)[3]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X-style)[3]
M20	SOE, internal O-ring (same as M10), closed end with deep recess

Code ▮	Pre-Rinse Option
Blank	No Pre-Rinse
314	Pre-Rinse

[3] - *For details, contact Pall Corporation.*

PALL® Pall Corporation

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Bulletin #E-2135-4C 1/05

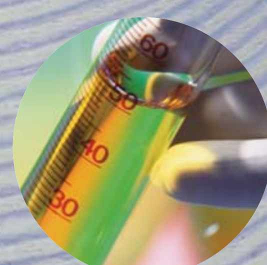
PALL

Pall Corporation

Ultipleat®

High Flow Filter Systems

Designed for Large Flow Applications



Filtration. Separation. Solution. SM

ULTIPLEAT

Ultipleat High Flow Filter Systems

...fewer elements
smaller housings
higher flow rates
and bigger cost savings

The Pall Ultipleat® High Flow filter system addresses your need for an economical and reliable filter system for high flow applications. You no longer have to rely on traditional bag or cartridge filter systems that do not meet all of your requirements.

Smaller, more economical filter systems

This proven filtration technology has advanced to the next level with even higher flow rates per filter cartridge. In fact, just one six-inch diameter Ultipleat High Flow filter element can handle up to 500 gpm (1900 lpm). The unique crescent-shaped pleat geometry, combined with its large diameter and proprietary range of available filter media, permits use of significantly fewer elements and smaller housings for high flow applications. Greater performance may now be achieved with a system that is two to four times smaller than conventional depth or pleated filter technologies. Smaller systems are also less costly to install and maintain (see Figure 1).

Lower waste disposal costs

Longer service life and coreless construction equate to minimized disposal volumes and costs. Use of Ultipleat High Flow elements result in up to four times less volume of spent cartridges than conventional depth filters (see Figure 2).

The inside-to-outside flow configuration and coreless construction of the Ultipleat High Flow element allows it to be tightly compacted to further minimize disposal costs. Also, since no metallic components are used in the element, incineration is a disposal option.

Waste disposal savings are even greater when the longer service life of Ultipleat High Flow filters is considered. Less frequent change outs provide even fewer elements for disposal.

Lower maintenance costs

Maintenance requirements and production downtime is dramatically reduced with 30 times fewer filters to change out versus conventional depth filters (see Figure 3). Removal of spent elements is neither difficult nor messy since all of the solid contamination is trapped inside of the filter.

Filter Comparison-500 GPM at 5 micron

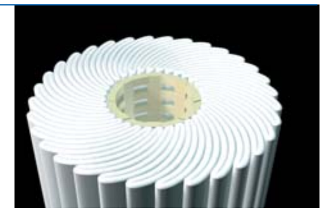


FIGURE 1. TYPICAL HOUSING DIAMETER

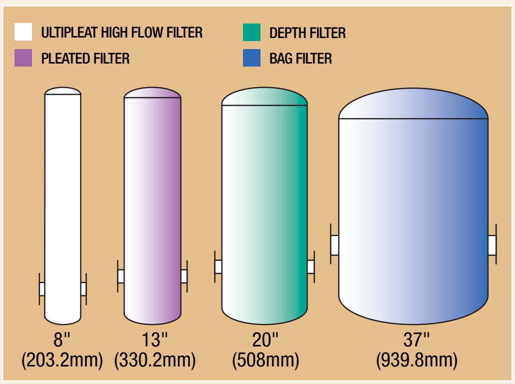


FIGURE 2. TYPICAL DISPOSAL VOLUME PER CHANGEOUT

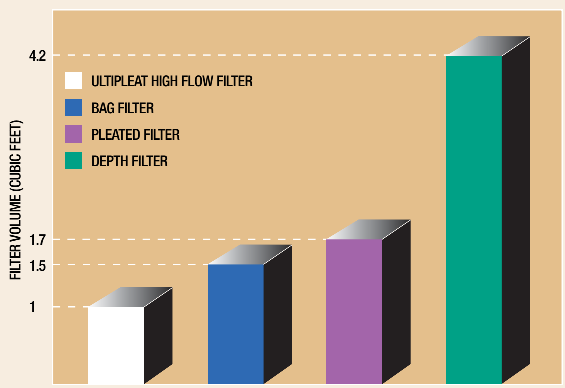
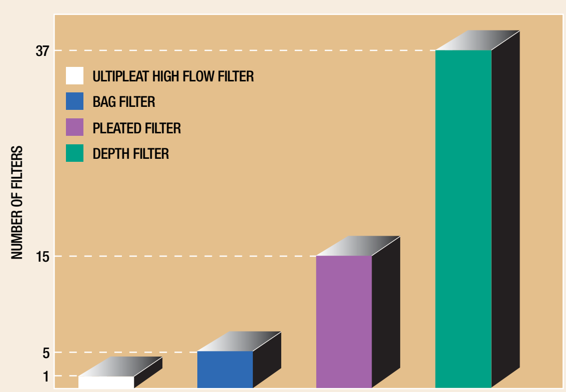
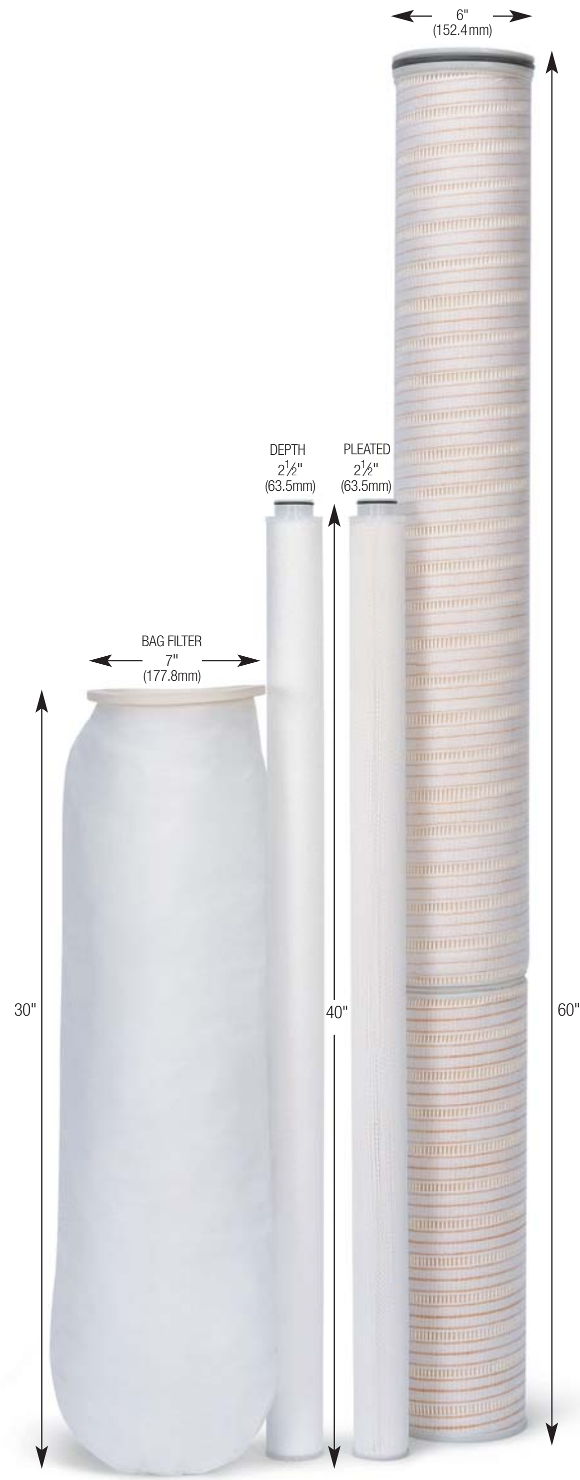


FIGURE 3. TYPICAL NUMBER OF FILTERS





Ultipleat High Flow Filter System Applications

Biopharmaceutical:

Pharmaceuticals, Cosmetics, Fragrances, Toiletries, Bioprocesses

Food & Beverage:

Beer, Wine, High Fructose Corn Syrup, Fats, Edible Oils, Soft Drinks, Dairy, Juice, Cyst and Oocyst Barrier, Bottled Water, Pre-RO, Utility Water

Fuels & Chemicals:

Chemical Plants, Refineries, Amines, Diesel Fuel, Specialty Chemicals, Petrochemicals, Polymer, Oil Recovery, Film, Fiber and Resins, High Performance Plastics

Machinery & Equipment:

Electrodeposited Primers, Paints & Coatings, Pulp and Paper, Automotive Manufacturing, Mobile Equipment, Primary Metals

Microelectronics:

Makeup Water, Semiconductors, Microlithography, Chemical Mechanical Polishing, Process Chemicals

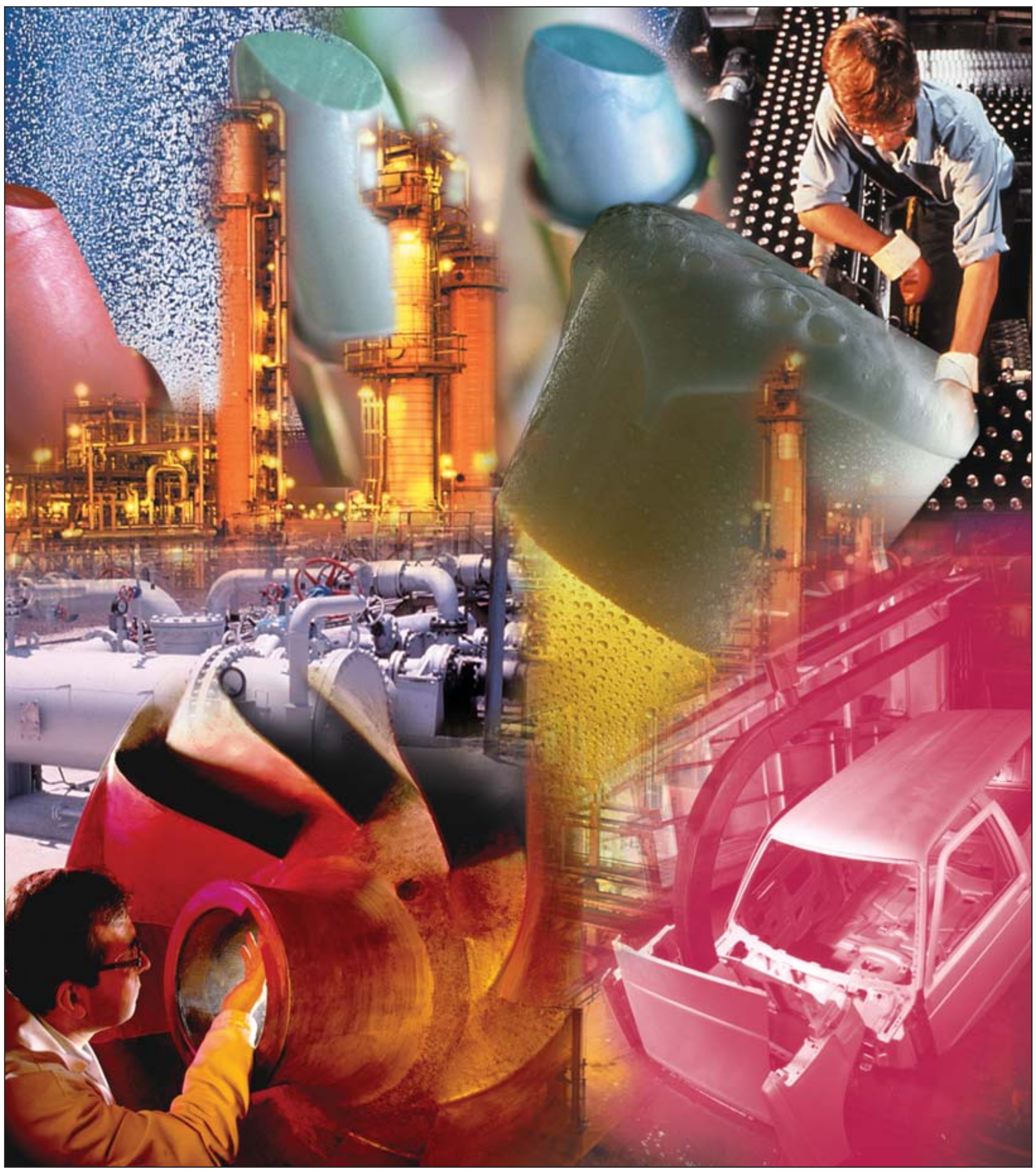
Power Generation:

Boiler Condensate, Nuclear and Fossil Power Plants, Cogeneration, Gas Turbines

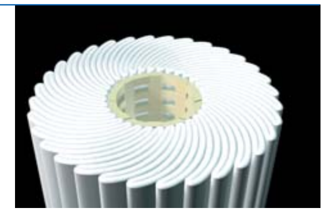
Water Processing:

Reverse Osmosis, Centralized Water Systems, Process Water, Municipalities, Desalination, Process Waste Water

Ultipleat High Flow filter systems are used in a wide variety of applications where high flow rates and long service life are primary requirements. These filter systems are used successfully in installations ranging up to 4,000 gpm (15,142 lpm).



Optimize filter life and lower operating costs with smaller Ultipleat High Flow filter systems

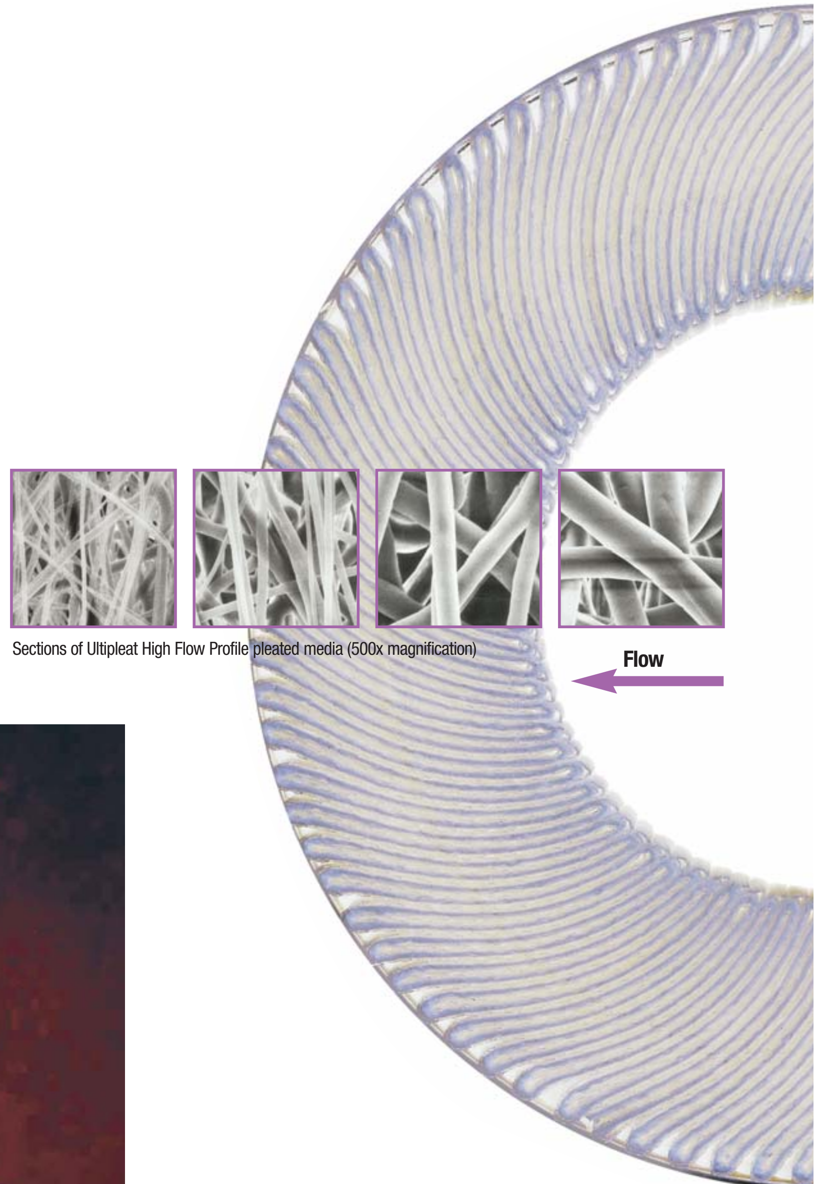


Long filter service life and low operating costs you require will not be compromised with the smaller Ultipleat High Flow filter systems due to innovative product features.

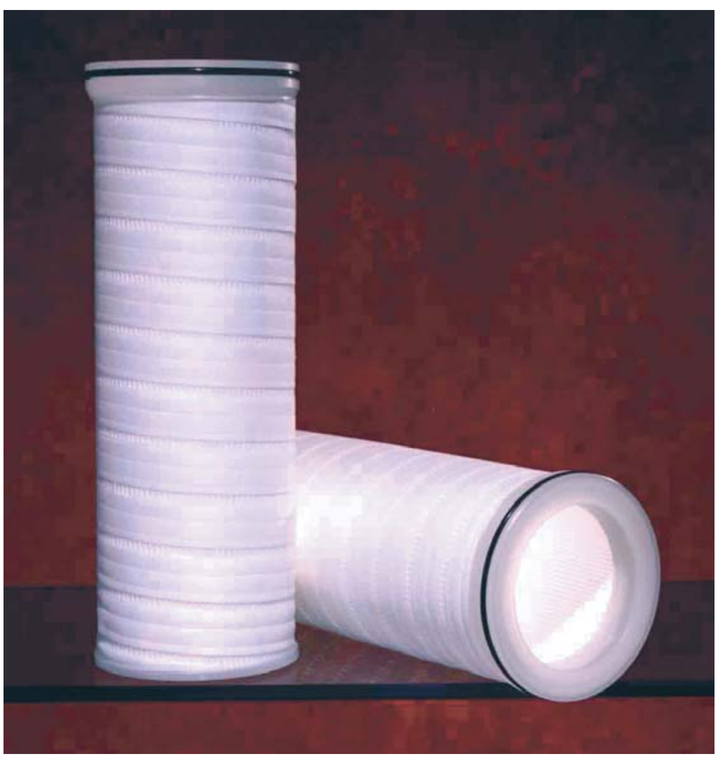
Innovation: High performance filter media

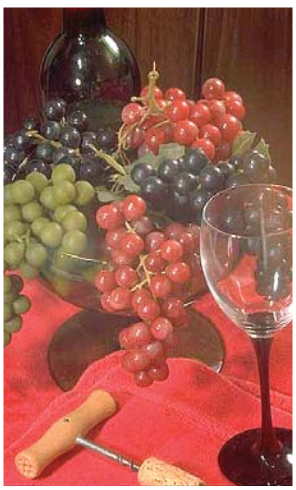
Many of the available filter media have a tapered pore structure made from fine fibers. This results in a range of filter media with excellent dirt holding capacity and low resistance to flow. In addition, the fixed pore media provide precise and reliable fluid quality.

Result: Economical and reproducible filtration



Sections of Ultipleat High Flow Profile pleated media (500x magnification)





Innovation: Ultipleat filter technology

The Ultipleat High Flow filter system is an extension of Pall's proprietary Ultipleat filter technology. The crescent-shaped pleat design of the Ultipleat High Flow filter allows for a large amount of filter area to be packed into one cartridge capable of handling up to 500 gpm (1900 lpm). Such a high flow rate combined with long filter service life in a small vessel, results in the lowest overall cost of ownership. No other filter can provide such performance. However, large filter area is only one aspect behind the superior performance of the Ultipleat High Flow filter.

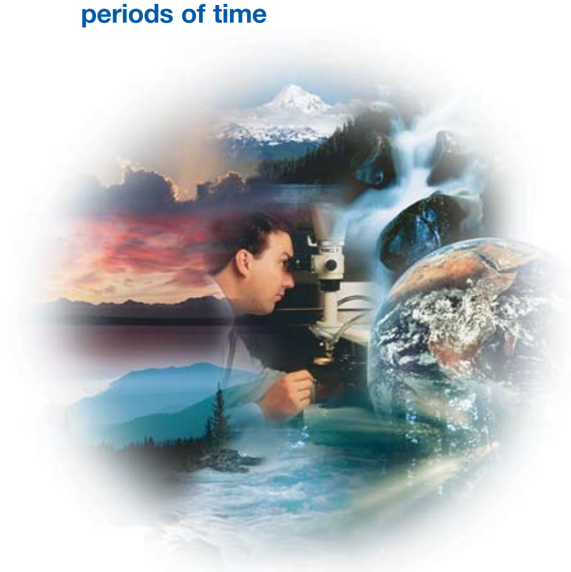
Uniform flow distribution over the filter's entire surface is the key.

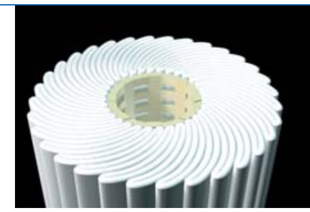
The fluid flow is completely uniform across the entire surface of the filter medium. The evenly distributed flow is maintained since the flow channel is the same width and length on both sides of the filter medium (see Figure 4). This uniform flow is maintained, even with high differential pressures across the element, due to the uniquely designed upstream support and downstream drainage layers. These layers, which sandwich the filter medium, hold the flow channels open. The pleats are then held in place and preserved by the proprietary external helical wrap that is bonded to each pleat tip along the outer diameter of the cartridge. Comparatively, the upstream flow channel of the medium in a conventional triangular shaped pleat structure is much more open than the downstream side (see Figure 5). Consequently, the flow is highest at the bottom of the pleat. This non-uniform flow distribution may result in areas of rapid plugging where the flow is the highest. Additionally, such a flow pattern through a conventional triangular shaped pleat structure may cause inconsistent particle removal.

The drainage and support materials used in conventional pleated filters are often thin and structurally weak. Consequently, pleats may become compacted thereby resulting in lower flow rates and, thus, limited on stream filter service life (see Figure 5).

Ultipleat High Flow filter's uniform flow yields:

- **Maximum filter service life**
- **Reliable particle removal**
- **Low resistance to flow for longer periods of time**





UNIFORM FLOW DISTRIBUTION
AMOUNT OF FLOW DEPICTED BY SIZE OF ARROW

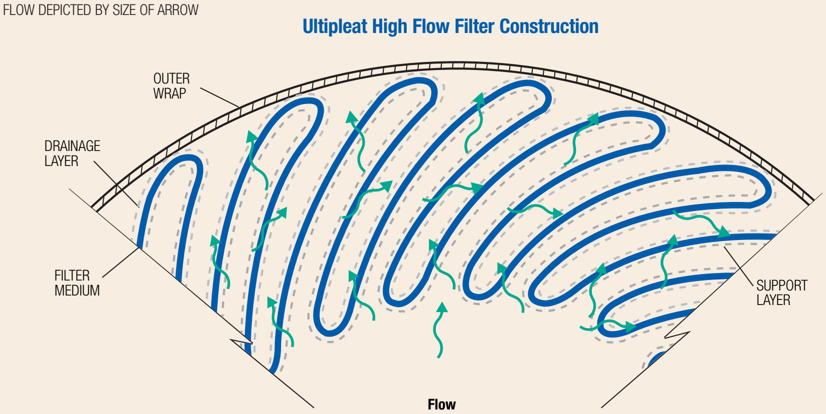
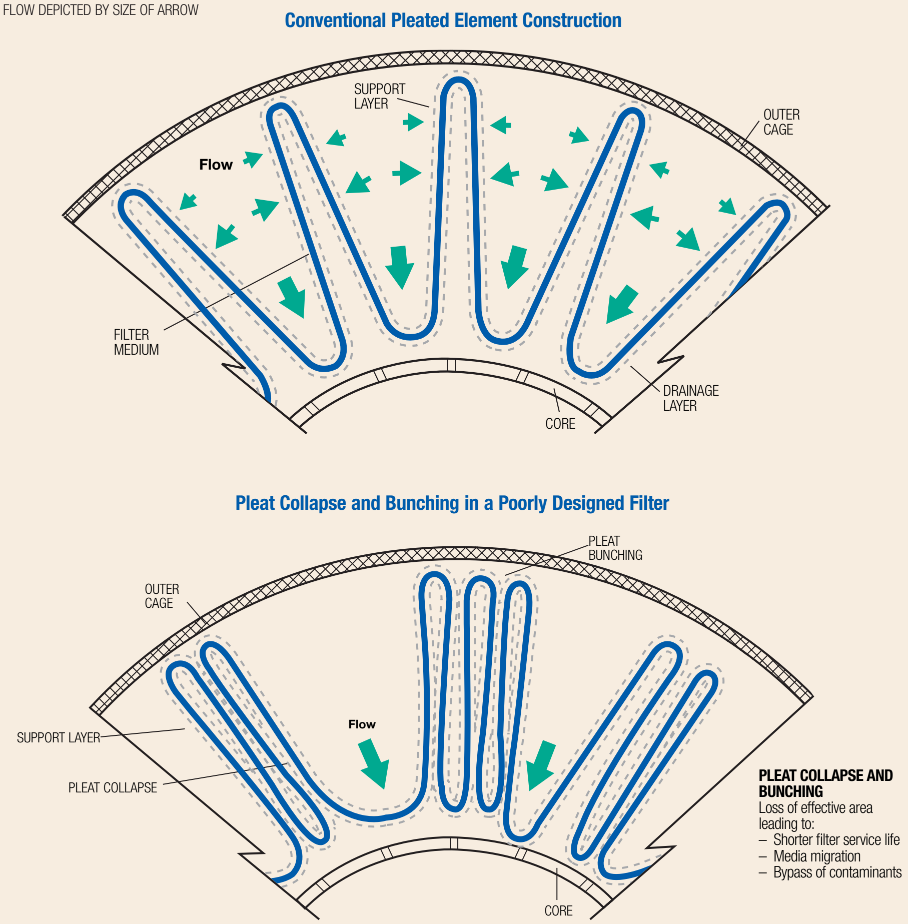


Figure 4.

NON-UNIFORM FLOW DISTRIBUTION
AMOUNT OF FLOW DEPICTED BY SIZE OF ARROW



PLEAT COLLAPSE AND BUNCHING
Loss of effective area leading to:
– Shorter filter service life
– Media migration
– Bypass of contaminants

Figure 5.

Filter Ordering Information

Part Numbers HFU

Select the appropriate part number from the tables below.

Medium Type	Code	Absolute Liquid Removal Rating at 99.98% Efficiency by Count[1] (um)	Maximum Allowable Pressure Drop at Temperature		Typical Element Aqueous Pressure Drop[2]					
					20" Length		40" Length		60" Length	
			(PSID/Bar)	Temp. (°F/°C)	(PSID/GPM)	(mBarD/M³/H)	(PSID/GPM)	(mBarD/M³/H)	(PSID/GPM)	(mBarD/M³/H)
HDC®-II Pleated Polypropylene[3]	J060	6	50/3.4	180/82	0.0016	0.48	0.0008	0.24	0.0005	0.15
	J100	10	50/3.4	180/82	0.0018	0.55	0.0006	0.18	0.0004	0.12
	J200	20	50/3.4	180/82	0.0011	0.30	0.0005	0.15	0.0003	0.09
Ultipleat Profile® Pleated Depth Polypropylene[3]	UY020[4]	2	50/3.4	180/82	0.0089	3.0	0.0054	1.6	0.0037	1.1
	UY045	4.5	50/3.4	180/82	0.0046	1.4	0.0023	0.70	0.0015	0.46
	UY060	6.2	50/3.4	180/82	0.0064	1.9	0.0032	1.0	0.0021	0.64
	UY100	10	50/3.4	180/82	0.0034	1.0	0.0017	0.52	0.0011	0.33
	UY200	20	50/3.4	180/82	0.0024	0.8	0.0012	0.36	0.0008	0.24
	UY400[5]	50	50/3.4	180/82	0.0018	0.55	0.0009	0.27	0.0006	0.18
	UY700[5]	70	50/3.4	180/82	0.004	0.11	0.0002	0.05	0.0001	0.04
	UY1000[5]	90	50/3.4	180/82	0.0008	0.26	0.0004	0.11	0.0003	0.08
Ultipor® Glass Fiber[6]	GF020	2	50/3.4	250/121	0.0022	0.67	0.0011	0.33	0.0007	0.21
	GF060	6	50/3.4	250/121	0.0039	1.2	0.0019	0.58	0.0013	0.40
	GF100	10	50/3.4	250/121	0.0016	0.49	0.0008	0.24	0.0005	0.15
	GF200	20	50/3.4	250/121	0.0012	0.36	0.0006	0.18	0.0004	0.12
Ultipor® GFK Medium	P100[7]	10	50/3.4	180/82	0.0016	0.49	0.0008	0.24	0.0005	0.15
	GFK100	10	50/3.4	250/121	0.0020	0.607	0.001	0.304	0.0007	0.213
Ultipor® K Medium	K200	20	50/3.4	200/93[8]	0.0031	0.941	0.0015	0.455	0.001	0.304
Ultipleat® Polyethersulfone Membrane[3]	CAS010	1	50/3.4	180/82	0.0128	3.9	0.0074	2.3	0.0049	1.5

Code	Filter Dimensions (in/mm)**
620	6/152.4 x 20/508
640	6/152.4 x 40/1016
660	6/152.4 x 60/1524

Footnotes:

1. The test procedure used is an adaption of ISO 4572, modified to determine the micron size above which particles are quantitatively removed.
2. Pressure drop in PSIG per GPM for the cartridge length shown. Multiply this value by the total system flow to determine the aqueous pressure drop. Next for fluids other than water, multiply this value by the fluid viscosity (in centipoise) at the operating temperature. Divide this calculated pressure drop by 3. This will determine the number of filters required to have a 3 psig/(0.2 bar) pressure drop across the filter elements at startup. This value is the pressure drop across the Ultipleat High Flow filter(s) only-it must be added to the pressure drop due to the Ultipleat High Flow housing to determine the total system pressure drop. Refer to the housing ordering information table to select a housing that can hold the number of filters you calculated.
3. Polypropylene medium and polyethersulfone membrane filters are made with FDA listed materials with the exception of the glass reinforced polypropylene end caps.
4. 99% efficiency.
5. Filters rated by Maximum Spherical Particle Passed test.
6. Maximum temperature in aqueous systems is 140°F/60°C.
7. Filter optimized for hydrogen peroxide working solution.
8. Rating in Aqueous Service
9. U-Cup Seal is standard for 1 micron CAS010 polyethersulfone filter.

40" FILTER CARTRIDGE

Code	O-ring Materials
H13 (Standard for glass fiber filters)	Buna N
J (Standard for polypropylene filters)	Ethylene Propylene
H4	Silicone
H	Fluorocarbon Elastomer
H1	FEP Encapsulated Fluorocarbon Elastomer
H13U	Buna N U-Cup Seal
JU	Ethylene Propylene U-Cup Seal
JUW[9] (FDA Listed Materials)	Ethylene Propylene U-Cup Seal*

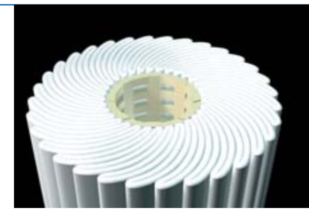
* Manufactured from Ethylene Propylene which is listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.

Sizes**

Filter Diameter (in/mm)	Filter Length (in/mm)	Suggested Maximum Flow of Water (GPM/LPM)
6/152.4	20/508	175/663
6/152.4	40/1016	350/1325
6/152.4	60/1524	500/1900

** All dimensions are nominal.

High Purity Ultipleat High Flow Filter Systems



Cyst and Oocyst Protection with Ultipleat High Flow Systems

The one-micron Ultipleat High Flow filter with our proprietary polyethersulfone membrane provides greater than 3 log reduction of *Giardia oocysts and Cryptosporidium cysts*. This unsurpassed removal of *Cryptosporidium and Giardia* from process water gives manufacturers the protection required to provide their customers with safe products.

Sanitization of Ultipleat High Flow 1-Micron Filters

Ultipleat High Flow 1-micron filters may be sanitized by any of the following methods:

- Hot water: 185°-194°F (85°-90°C)
- For information on other sanitization chemicals/methods, contact Pall.

High Purity Housings

Housing Design Features

Orientation	Horizontal or Vertical
Pressure/Temperature Rating	145psi (10.0 bar)@176°F (80.0°C)
Housing Seal	FDA-listed Ethylene Propylene
Material	316L Stainless Steel
Electropolish finish	32 µ-inch/0.8 µm Ra
Number of elements	1

Part Numbers ▲ ■ 1 ● G ◆ J

Code ▲	Housing Design
UHFS	Sanitary, electropolished
EWHF	Non-electropolished

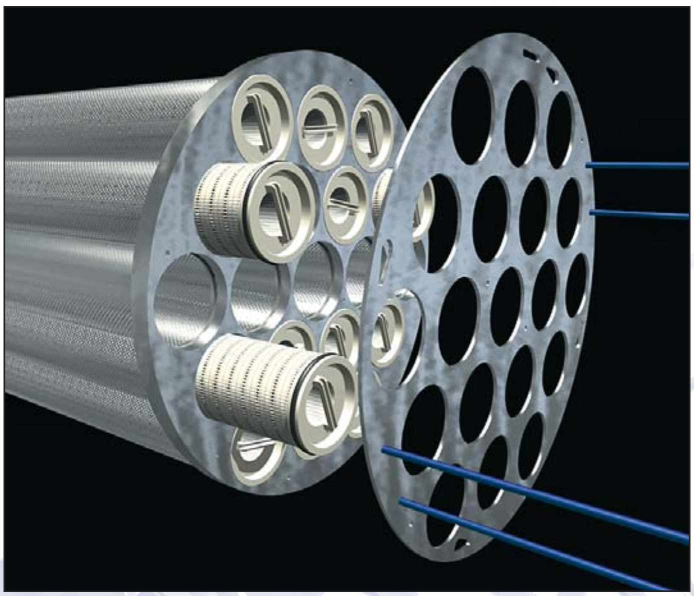
Code ■	Housing Configuration
H	Horizontal
V	Vertical

Code ●	Nominal Element Length (in/mm)
2	20/508
4	40/1016
6	60/1524

Code ◆	Inlet/Outlet Connection
31	2″ Tri-clamp
47	3″ Tri-clamp
NW80	80 mm DIN
NW100	100 mm DIN

Industrial Housing Designs

A series of housings are available in both horizontal and vertical configurations. The inline horizontal configuration minimizes pressure drop and is more easily accessible for filter changeout. Vertical configurations are an option, depending on your application and space limitations.



Unique filter element-to-tubesheet seal, is shown here with element hold down plate.

INDUSTRIAL HOUSING DESIGN FEATURES

Design	ASME, section VIII Division 1 code
Orientation	Horizontal or vertical
Maximum Differential Pressure Across Tubesheet	75 psid (5.2 bar) maximum
Standard Closure Gasket	Spiral wound 304 stainless/ mineral filler
Exterior Surfaces	Sandblasted and coated with an inorganic zinc primer
Vent and Drains	1″ (2.54 cm) FNPT

INDUSTRIAL HOUSING DESIGN RATINGS

Vessel Material	Pressure Rating at 180°F (82°C) (PSIG/Bar)	Pressure Rating at 275°F (135°C) (PSIG/Bar)
Carbon steel	265/18.3	237/16.3
304 stainless steel	243/16.8	212/14.6
304L stainless steel	202/13.9	180/12.4
316 stainless steel	247/17.0	220/15.2
316L stainless steel	202/13.9	180/12.4

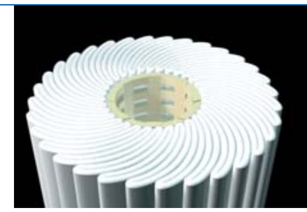
Innovation: Unique element sealing mechanism

In multi-cartridge housings, the elements are sealed into the tubesheet, independent of the housing closure, utilizing a unique sealing arrangement.

Result: Consistent fluid quality

These innovations make the Ultipleat High Flow filter system a compact, economical, environmentally sound and user-friendly product that will provide the highest performance and best overall value.

Industrial Housing Ordering Information



ASME Coded Pressure Vessels

Select the appropriate part number from the tables below.

Part Number	Number of Filters	Aqueous Rated Flow Per Housing (GPM/LPM[1])	Nominal Housing Outer Diameter (D) (in/mm)	Inlet/Outlet Flange Diameter (in/mm)	Housing Overall Length (L) (in/mm)	Horizontal Housing Height (H) (in/mm)	Housing Weight Empty (Lbs/KG)	Housing Weight Full of Water (Lbs/KG)
1HF ■ ● 0804F1 ▲ ◆	1	500/1893	8⅝/219.1	4/101.6	89/2261	32/817	471/214	621/282
2HF ■ ● 1606F1 ▲ ◆	2	1000/3785	16/406.4	6/152.4	100/2527	40/1023	1172/532	1771/803
3HF ■ ● 1808F1 ▲ ◆	3	1500/5680	18/457.2	8/203.2	104/2642	43/1093	1583/718	2384/1081
4HF ■ ● 2008F1 ▲ ◆	4	2000/7570	20/508	8/203.2	105/2654	46/1175	2087/947	3048/1382
7HF ■ ● 2412F1 ▲ ◆	7	3500/13248	24/609.6	12/304.8	112/2832	59/1487	3250/1474	4762/2160
12HF ■ ● 3016F1 ▲ ◆	12	6000/22710	30/762	16/406.4	121/3073	58/1480	4670/2118	7306/3314
19HF ■ ● 3620F1 ▲ ◆	19	9500/35958	36/914.4	20/508	129/3264	68/1718	7060/3202	11121/5045

1. The housing aqueous pressure drop at the maximum flow rating with the connection sizes noted will be approximately 5 psig (0.3 bar). To calculate the actual housing pressure drop, multiply this aqueous pressure drop by the fluid's specific gravity. This housing pressure drop must be added to the filter pressure drop calculated on page 9, above to determine the pressure drop of the Ultipleat High Flow Filter System.

Code ■	Housing Configuration
H	Horizontal
V	Vertical

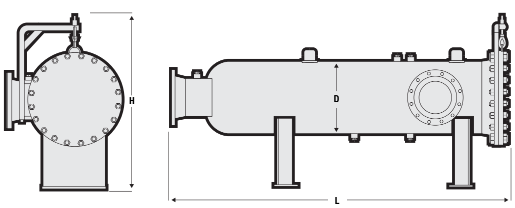
Code ●	Nominal Cartridge Length (in/mm)
2	20/508
4	40/1016
6	60/1524

Code ▲	Housing Metallurgy
285	Carbon steel vessel, 304 stainless steel tubesheet
S3	304L Stainless steel
S8	304 Stainless steel
L3	316L Stainless steel
L8	316 Stainless steel

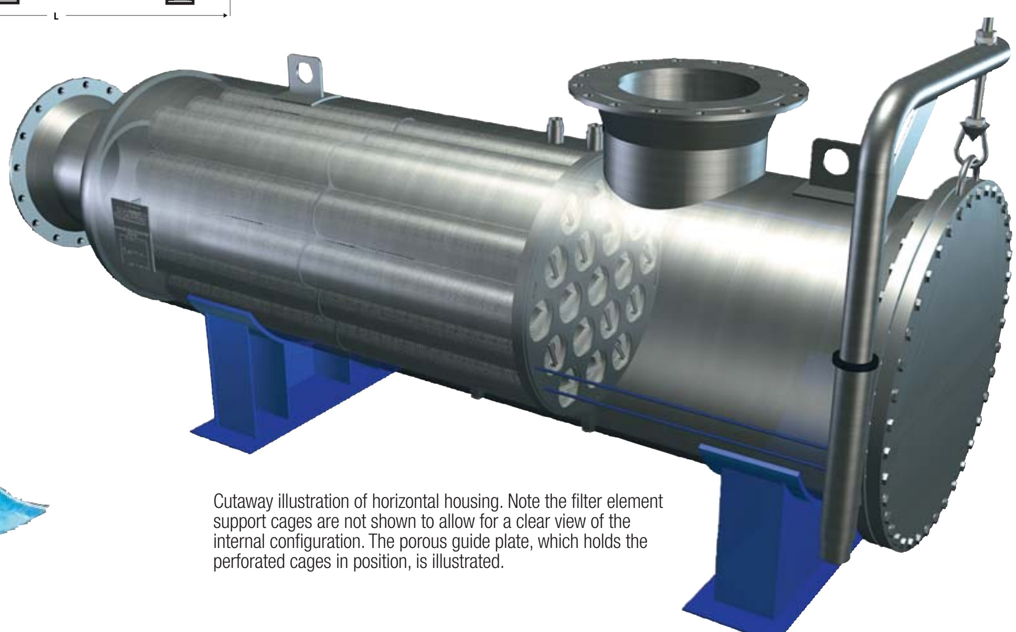
Code ◆	Optional Outlet style[1] Horizontal Housings
XU	Upper Outlet Location
XL	Lower Outlet Location

[1] If the housing is to be used as a prefilter to a horizontal liquid/liquid coalescer, then the vessel should be ordered using the XU or XL option for the outlet location. The orientation of the outlet should be the same as that of the sump on the coalescer. In this way no buildup of coalesced liquid will occur in the prefilter.

Horizontal Housings



For information on larger horizontal housings, Pall's family of vertical housings, or noncode housing designs for these filter cartridges, please contact Pall or your distributor.



Cutaway illustration of horizontal housing. Note the filter element support cages are not shown to allow for a clear view of the internal configuration. The porous guide plate, which holds the perforated cages in position, is illustrated.

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UHF100 (version H)

Pall Corporation

Ultipleat® High Flow 1 Micron Element

Description

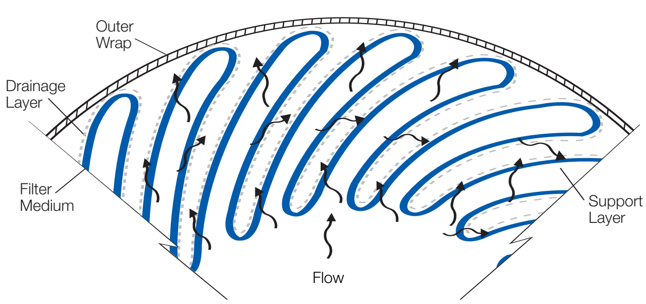
The 1 µm Ultipleat High Flow Element is a large diameter, coreless, single open ended, pleated cartridge with an inside to outside flow pattern. The filter's unique, crescent-shaped pleat geometry, combined with its large 6.3" (16 cm) diameter allows you to use fewer filters to remove fine particles and cysts in high flow applications.

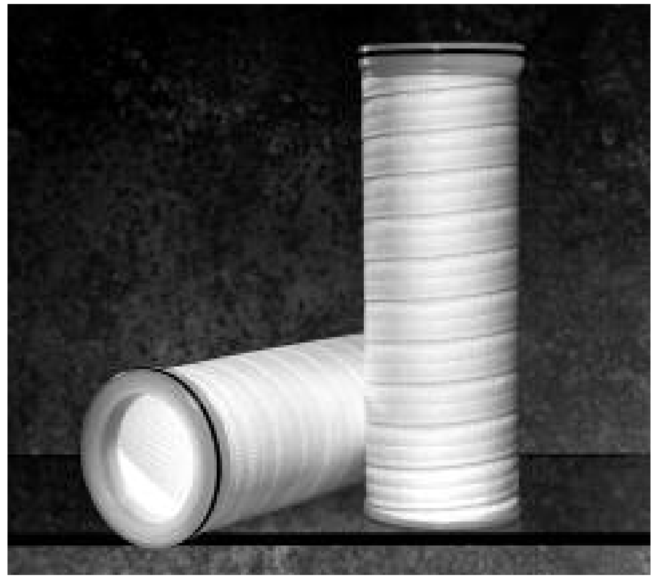
Benefits

- High flow rates per element
- Low cost of installation and filtration
- Fewer elements per change out
- 1 µm absolute[1] filtration
- Polyethersulfone media provides greater than 3 log reduction of *Giardia oocysts* and *Cryptosporidium*
- Inside to outside flow configuration retains all particulate matter inside the element
- Coreless, all plastic construction to minimize waste disposal
- U-cup element seal ensures high level removal efficiencies

[1] *Particle Removal Rating*

Crescent-Shaped Pleat Geometry with Inside to Outside Flow





Ultipleat High Flow Elements

Performance Specifications

- Water flow rate
  - 20" length – 68 gpm/psid (257 lpm/70 mbar)
  - 40" length – 135 gpm/psid (511 lpm/70 mbar)
  - 60" length – 204 gpm/psid (772 lpm/70 mbar)
- Maximum forward differential pressure
  - 50 psid @ 180°F (3.44 bar @ 82°C)
- Maximum operating temperature
  - 180°F (82°C)
- Sanitization
  - Can be sanitized with hot water (185°-194°F/85°-90°C) for a maximum of 100 cycles (1 cycle = 10 minutes) without compromising the removal efficiency of the filter.
  - Peracetic acid, chlorinated alkaline products and other sanitization chemicals may be used. Contact Pall for recommended procedures.

Applications

- Incoming water filtration
- Barrier to cysts and oocysts
- Prefilter for bottled water sterilizing filters
- Food and beverage processes

Product Specifications

Materials of Construction

Filter Media:	1 µm polyethersulfone
Outer Sleeve and End Caps:	Polypropylene
Drainage and Wrap:	Polypropylene
Wrap Adhesive:	Polyolefin hot melt
Filter Seal:	FDA compliant ethylene propylene

Dimensions

Diameter:	6.3" (16 cm)
Length:	20", 40", 60" (51 cm, 102 cm, 152 cm)

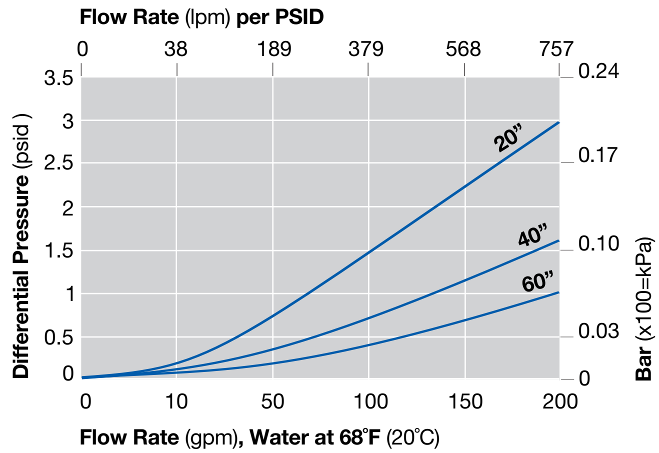
Other Ultipleat High Flow Elements

Ultipleat High Flow elements are available in other filter media with absolute ratings of 2, 4.5, 10, 20, 40 and 100 µm. Contact Pall for more information.

Housing Design

A single element, sanitary designed housing is available for use with the 1 µm Ultipleat High Flow element. Industrial style housings are also available. Contact Pall for more information.

1 µm Ultipleat High Flow



Ordering Information

Product Part Number: HFU6 ◆ CAS010JUW

Code ◆	Length
20	20" (51 cm)
40	40" (102 cm)
60	60" (152 cm)

Pall Corporation

Bad Kreuznach – Germany
0049 671 8822 0 telephone
0049 671 8822 200 fax

Portsmouth – United Kingdom
0044 23 92 30 33 03 telephone
0044 23 92 30 25 06 fax

New York – USA
001 516 484 5400 telephone
001 516 625 3610 fax

Melbourne – Australia
0061 395 8481 00 telephone
0061 395 8466 47 fax

Paris – France
0033 1 30 6138 00 telephone
0033 1 30 6157 08 fax

Milano – Italy
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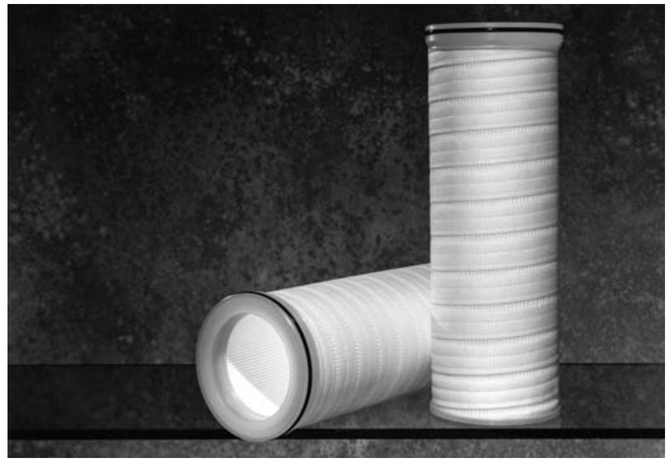
Bulletin #FB 102-D 11/065

Pall Corporation

Selection Guide
Ultipleat® High Flow Filter System

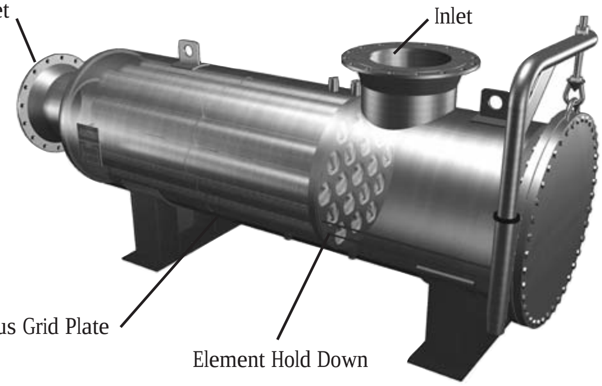
Description

The Ultipleat® High Flow filter is a large diameter, coreless, single open ended, pleated cartridge with an inside to outside flow pattern. The filter's unique crescent-shaped pleat geometry, combined with its large 6 inch (152.4 mm) diameter and proprietary range of available Pall filter media, allows you to use significantly fewer filters and smaller housings for high flow rate applications. Systems can handle up to 30,500 gpm (115,443 lpm).



Benefits

- Up to 50% smaller filter system possible
- Up to 40 times fewer elements to change out
- Higher flow rates per filter cartridge - up to 500 gpm (1900 lpm)
- Available in 20 inch (508 mm), 40 inch (1016 mm), 60 inch (1524 mm) and 80 inch (2032 mm) lengths
- Coreless, all plastic construction to minimize waste disposal
- Absolute rated filter medium for reproducible performance
- Inside to outside flow configuration - all debris stay within the filter



Materials of Construction

Filter Medium Type	Filter Medium	Support/Drainage Materials	End Caps	Wrap Materials
HDC® II Medium	High Area Polypropylene Structure	Polypropylene	Glass Filled Polypropylene	Polypropylene and Polyolefin Hotmelt
Profile® Medium in Ultipleat Format	Pleated Polypropylene Depth Structure	Polypropylene	Glass Filled Polypropylene	Polypropylene
Ultipor® GF Medium	Resin Bonded Glass Fiber / Polyester Support	Polyester / Nylon	Glass Filled Acetal	Polyester and Polyamide Hotmelt
Ultipleat CAS Medium	Pleated Polypropylene / Polyether Sulfone Membrane	Polypropylene	Glass Filled Polypropylene	Polypropylene

Operating Conditions

	Polypropylene Medium/ CAS Composite Medium	Glass Fiber Medium[2]
Maximum Differential Pressure[1] (normal inside to outside flow)	50 psid at 180˚F 3.4 bar at 82˚C	50 psid at 250˚F 3.4 bar at 121˚C

1) For fluids compatible with the filter element at the stated temperature.
2) Maximum temperature in aqueous systems is 140˚F / 60˚C

Ordering Information/Specifications

Filter Cartridge Part Number: HFU ▲ ● ◆

Code ▲	Filter Dimensions, nominal, diameter (in/mm) x length (in/mm)	Suggested Maximum Water Flow Per Cartridge (gpm/lpm/mgd)
620	6/152.4 x 20/508	175/663/0.25
640	6/152.4 x 40/1016	350/1325/0.5
660	6/152.4 x 60/1524	500/1900/0.7
680	6/152.4 x 80/2032	500/1900/0.7

Filter Cartridge Pressure Drop (typical) per Filter Length Shown[2]

Medium Type	Grade ●	Absolute Liquid Removal Rating (microns) at 99.98% by particle count[1]	20 inch length		40 inch length		60 inch length		80 inch length	
			psid/100gpm	mbar/M³/hr	psid/100gpm	mbar/M³/hr	psid/100gpm	mbar/M³/hr	psid/100gpm	mbar/M³/hr
HDC II Medium	J060	6	0.158	0.48	0.080	0.24	0.058	0.17	0.040	0.012
	J100	10	0.120	0.36	0.060	0.18	0.040	0.12	0.030	0.009
	J200	20	0.100	0.30	0.050	0.15	0.033	0.10	0.025	0.008
Profile Medium in Ultipleat Format	UY020[4]	2	1.091	3.31	0.540	1.64	0.362	1.10	0.270	0.082
	UY045	4.5	0.489	1.48	0.242	0.73	0.162	0.49	0.121	0.037
	UY060	6	0.395	1.20	0.196	0.59	0.131	0.40	0.098	0.030
	UY100	10	0.344	1.04	0.170	0.52	0.114	0.35	0.085	0.026
	UY200	20	0.243	0.74	0.120	0.36	0.080	0.24	0.060	0.018
	UY400[3]	40	0.182	0.55	0.090	0.27	0.060	0.18	0.045	0.014
	UY700[3]	70	0.040	0.12	0.020	0.06	0.013	0.04	0.010	0.003
	UY1000[3]	90	0.027	0.08	0.013	0.04	0.009	0.03	0.007	0.002
Ultipor GF Medium	GF020	2	0.219	0.66	0.110	0.33	0.073	0.22	0.055	0.017
	GF060	6	0.180	0.55	0.090	0.27	0.060	0.18	0.045	0.014
	GF100	10	0.159	0.48	0.080	0.24	0.053	0.16	0.040	0.012
	GF200	20	0.119	0.36	0.060	0.18	0.040	0.12	0.030	0.009
	GF400[3]	29	0.100	0.30	0.050	0.15	0.033	0.10	0.025	0.008
Ultipleat CAS Medium	CAS010	1	1.496	4.54	0.740	2.25	0.496	1.51	0.370	1.12

1) The test procedure used is an adaptation of ISO 4572, modified to determine the micron size above which particles are quantitatively removed.
2) Multiply this value by the total system flow to determine the aqueous pressure drop. For fluids other than water, multiply this value by the fluid's viscosity at the operating temperature in centipoise. This value is the pressure drop across the Ultipleat® High Flow filter(s) only; it must be added to the pressure drop contribution from the Ultipleat High Flow filter housing.
3) Precision evaluation of the 99.98% removal efficiency for these coarse grades is not possible with the ISO modified test procedure utilized. The removal efficiency was determined by the maximum spherical particle analysis.
4) 2 micron at 99% efficiency

Code-Filter O-Ring ◆		Material
H13	(Standard for glass fiber and aramid fiber filters)	Buna N
H13U[1]		Buna N U-Cup
J	(Standard for polypropylene filters)	Ethylene Propylene
JU[1]		Ethylene Propylene U-Cup
H4		Silicone
H		Fluoroelastomer

[1] U-Cup seal is standard for the 1 micron composite filter.

Housing Design

Three configurations are available: horizontal*, vertical and centerpipe design.

The in-line horizontal configuration eliminates the need for a platform, or ladder, to remove the filters from the housing.

Vertical vessels may be more appropriate when floor space is limited. However, a platform may be needed to easily remove the elements.

** Required for 80 inch lengths*

In both the standard horizontal and vertical configurations, the inlet pipe is located between the filter element tubesheet and housing lid. The larger the vessel diameter, the longer the distance to reach in and remove the elements from the vessel. In a centerpipe vessel the housing lid is closer to the filter tubesheet. When the lid is opened the filters are easily accessible for installation and removal. Centerpipe vessels are larger in diameter, and more costly.

- Designed to the ASME, section VIII, division 1 code
- Maximum differential pressure across tubesheet: 75 psid (5.17 bar) maximum
- Standard housing gasket: spiral wound 304 stainless steel mineral fiber
- Carbon steel exterior surfaces: sandblasted and coated with an inorganic zinc
- Vent and drains: 1 inch FNPT
- Corrosion allowance: 1/8 inch

Housing Ratings

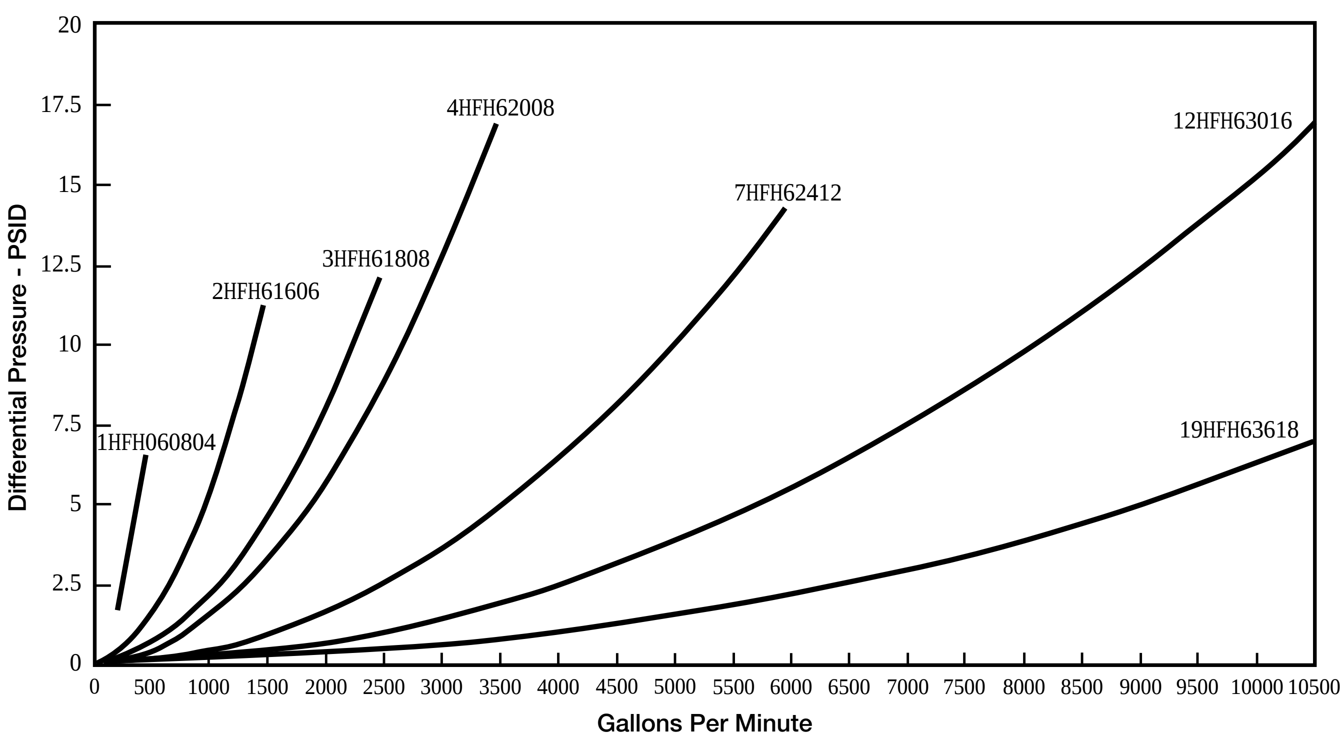
Vessel Material	Tubesheet and Hold Down Plate Material of Construction	Pressure Rating in Psig/Bar g at 140°F / 60°C
Carbon steel	304 stainless steel	275 psig (18.95 bar)
304 stainless steel	304 stainless steel	259 psig (17.85 bar)
304L stainless steel	304L stainless steel	216 psig (14.89 bar)
316 stainless steel	316 stainless steel	261 psig (17.99 bar)
316L stainless steel	316L stainless steel	216 psig (14.89 bar)

Filter Installation and Filter Seal Mechanism

To install a filter element, remove the element hold down plate by lifting it off the locating pins. Lubricate the O-ring on the open-end of the filter with a compatible fluid, and slide the closed end of the filter into the perforated cage, which is welded to the tubesheet. Seat the elements in place by pressing down on the open-end of the filter until the element is snug in the tubesheet. This provides a seal between the filter and housing via the filter O-ring. The open-end cap must be below the tubesheet surface. After installing all the filter cartridges, reinstall and secure the element hold down plate by guiding it over the locating pins on the tubesheet. The purpose of the hold down plate is to prevent the elements from becoming dislodged in the event of reverse flow.

A filter element tool is provided with each housing to aid with the installation and removal of the filter cartridges. This tool eliminates the need for an operator to reach within the filter vessel to either remove or install filters.

Figure 1: Ultipleat High Flow Horizontal Housings (Aqueous Housing Pressure Drop - PSID)



Ordering Information-Standard Horizontal and Vertical Housings

Part Number	No Of Filters	Rated Flow Per Housing- GPM/LPM 60″ Long Filter	Nominal Housing Diameter (in/mm) (D)	Inlet/Outlet Flange Diameter (in/mm)	Maximum* Horizontal Housing Overall Length (in/mm) (L)	Horizontal Housing Height (in/mm (H)	Distance Between Housing and Lid and Tubesheet (in/mm	Housing* Weight Empty (lbs/kg)	Housing* Weight Full Of Water (lbs/kg)	Housing Cover Swing Opening (in/mm)
1HF ■ ● 0804F1▲ ◆	1	500/1893	9/219.1	4/101.6	89/2261	32/817	14.5/368.3	471/214	621/282	9.0/228.6
2HF ■ ● 1606F1▲ ◆	2	1000/3785	16/406.4	6/152.4	100/2527	40/1023	22.7/576.3	1172/532	1771/803	25.8/654.6
3HF ■ ● 1808F1▲ ◆	3	1500/5680	18/457.2	8/203.2	104/2642	43/1093	26.2/665.2	1583/718	2384/1081	27.3/692.8
4HF ■ ● 2008F1▲ ◆	4	2000/7570	20/508.0	8/203.2	105/2654	46/1175	26.4/669.6	2087/947	3048/1382	29.8/756.3
7HF ■ ● 2412F1▲ ◆	7	3500/13248	24/609.6	12/304.8	112/2832	59/1487	31.9/809.6	3250/1474	4762/2160	34.3/870.6
12HF ■ ● 3016F1▲ ◆	12	6000/22710	30/762.0	16/406.4	121/3073	58/1480	38.7/982.7	4670/2118	7306/3314	38.0/964.9
19HF ■ ● 3620F1▲ ◆	19	9500/35958	36/914.4	20/508.0	129/3264	68/1718	43.4/1101.6	7060/3202	11121/5045	44.8/1138.8

** For 60 inch filter lengths*

Ordering Information - Horizontal Orientation, Centerpipe Designed Housings

Part Number	No. Of Filters	Rated Flow Per Housing- GPM/LPM 60 in Long Filter	Nominal Housing Diameter (in/mm) (D)	Inlet/Outlet Flange Diameter (in/mm)	Maximum* Horizontal Housing Overall Length (in/mm) (L)	Horizontal Housing Height (in/mm) (H)	Distance Between Housing and Lid and Tubesheet (in/mm)	Housing* Weight Empty (lbs/kg)	Housing* Weight Full Of Water (lbs/kg)	Housing Cover Swing Opening (in/mm)
7HF ■ C ● 2808F1▲ ◆	7	3500/13248	28/711	8/203.2	104.3/2648	57.0/1448	4.9/124	4056/1840	6229/2825	36/914
8HF ■ C ● 3012F1▲ ◆	8	4000/15140	30/762	12/304.0	117.6/2988	58.3/1480	6.1/154	4707/2135	7348/3333	40/1018

** For 60 inch filter lengths*

Code ■	Housing Configuration
H	Horizontal
V	Vertical

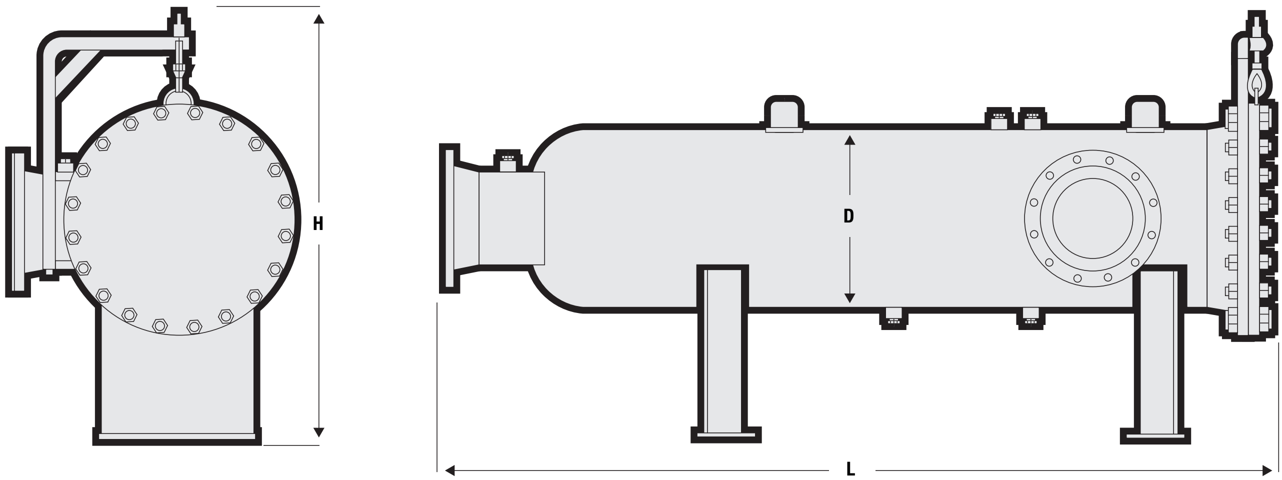
Code ▲	Housing Metallurgy
285	Carbon Steel Vessel, 304 Stainless Steel Tubesheet
S3	304L Stainless Steel
S8	304 Stainless Steel
L3	316L Stainless Steel
L8	316 Stainless Steel

Code ●	Nominal Cartridge Length (in/mm)
2	20/508
4	40/1016
6	60/1524
8	80/3032

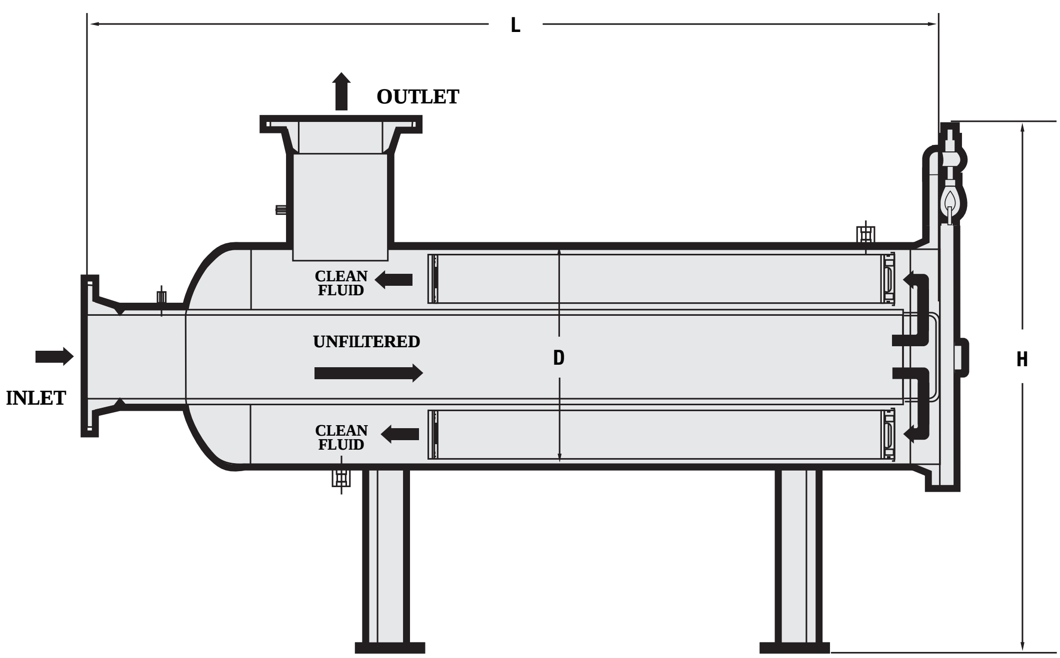
Code ◆	Optional Outlet Size[1] Horizontal Housings
XU	Upper Outlet Location
XL	Lower Outlet Location

[1] *If the housing is to be used as a prefiller to a horizontal liquid/liquid coalescer, then the vessel should be ordered using the XU or XL option for the outlet location. The orientation of the outlet should be the same as that of the sump on the coalescer. In this way no buildup of coalesced liquid will occur in the prefilter.*

Horizontal Housings



Horizontal Housings, Centerpipe Design



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GDS 131b

December 2009

Pall Corporation

SCHUMATHERM™
Products Information

Scanning Electron Micrograph

1. General Material Description

SCHUMATHERM filter elements are a high-quality porous fireclay ceramic. This material is distinguished by its good chemical and thermal resistance. Therefore cylinders or tiles made of SCHUMATHERM filter ceramic can be used for a large variety of applications as long as special process conditions do not require other process specific materials. One main application for SCHUMATHERM filter cylinders is the use as support material for precoat filtration. The surface structure and the high permeability of SCHUMATHERM builds an ideal support for the precoat.

2. Fields of Applications

SCHUMATHERM (ST)	Examples
Precoat filter for liquids	▪ Filtration of beer, water, glucose syrup; beer yeast recovery
Particle filter for gases	▪ Coarse filter for biogas
Diffuser	▪ Aeration of potable water (e.g. de-acidification)
Fluidization	▪ Hot fluidized bed processes; ash transportation; conveying of red. iron slurry

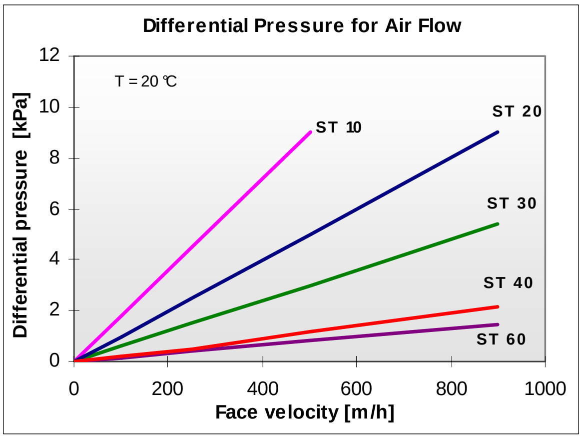
Further applications possible.

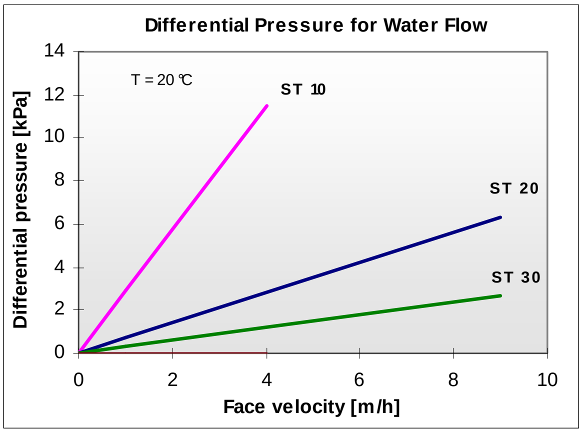
3. Physical Properties

SCHUMATHERM (ST)	Unit	10	20	30	40	60
Filtration fineness for liquids	µm	2.5	15	30	40	50
Filtration fineness for gases	µm	1.5	3	6	8	10
Porosity	%	40	40	35	35	35
Material density	g/cm^3	1.5	1.5	1.5	1.5	1.5
Specific permeability [1]	$10^{-13}m^2$	45	75	125	310	470
Bending strength [2]	MPa	> 12	> 10	> 9	> 9	> 8
Bursting pressure	bar	> 30	> 25	> 20	> 20	> 15
Max. temperature resistance [3]	°C	800	800	800	800	700
Thermal expansion coefficient (25 - 800°C)	$10^{-6}/K$	5.8	5.8	5.8	5.8	5.8
Dimensions Do / Di	mm	70 / 40	70 / 40	70 / 40	70 / 40	70 / 40

[1] = calculated from differential pressure AIR, [2] = O-ring strength, compression, [3] = depending on operating conditions

4. Differential Pressure Diagram





The physical data are valid for the dimensions listed in table „Physical Properties".

5. Chemical Resistance

SCHUMATHERM filter ceramic is resistant against acids, saline solutions and organic solvents, liquid or gaseous. It is not resist to hydrofluoric acid. SCHUMATHERM filter ceramic is resistant up to pH 10 in the alkaline range.

6. Standard Dimensions

	Type	Do / Di [mm]	Length [mm]	Area [m²]	Weight [kg]
Cylinder	10, 20, 40, 60	70 / 40	500	0.11	2.0
Cylinder	20, 30	120 / 70	500	0.19	5.6
Cylinder	10, 20, 40, 60	70 / 40	1000	0.22	4.0
Tile	20, 30	L x W: 500 x 500	H: 30	0.25	11.3

Special dimensions and special products on request.

7. General Information

- SCHUMATHERM filter ceramic can be utilised in the food and beverage industry in accordance with the German Foodstuffs and Consumer Goods Act and according to the European Directive 89/109/EEC – referring to directives 2002/72/EC and / or 84/500/EEC and their amendments, as appropriate.
- SCHUMATHERM filter ceramicis approved for the utilization in drinking water according to German regulations DVGW W270 and the KTW recommendation.
- SCHUMATHERM filter ceramic can be machined using hard metal tools.
- Ceramic elements are to be handled with care.
- Elements can be glued using commercial or special ceramic glues. Careful consideration should be taken regarding operating temperature and chemical resistance.

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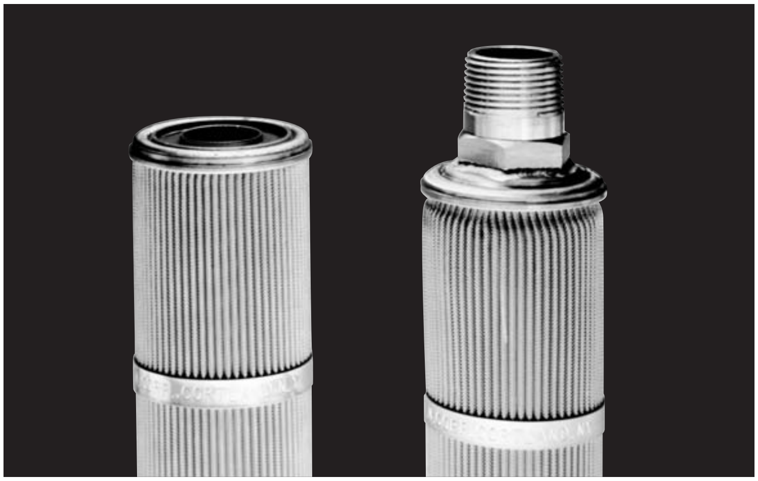
Rigimesh® Filter Elements



Description

Rigimesh® porous metal filter elements are extremely permeable and are constructed of high dirt capacity stainless steel (type 304 or 316L) woven wire mesh. Rigimesh media outperform other meshes because they are sintered woven wire meshes with higher void space. Pall sinters the wires at their points of contact, producing an extremely strong porous material whose wires will not shift under stress and whose pore size integrity is continually maintained. This patented Pall process permits use of finer diameter wires in manufacturing the filter medium. The net result is a filter with more pores per unit area, providing more dirt-holding capacity than that of an unsintered mesh made from coarser wires. Designs are available which are suitable for temperatures up to 600˚F/315°C.

Operating Characteristics

Standard cartridges are capable of withstanding a collapse differential of 125 psid in the forward flow (outside-in) direction and up to 600°F† and 10 psid in the reverse flow direction.

Sizes

The standard Rigimesh filters are cylindrical forms of pleated medium, 2 ½ inches in diameter in 10 inch multiple lengths, up to 30 inches. For AB style Rigimesh filters consult the factory.

Table I. Rigimesh Elements and Their Characteristics

Filter Grade	Removal Ratings				Clean Pressure Drop		Recommended Flow Density	
	Liquid Service[1] Rating In µm At % Efficiency		Gaseous Service[2]		Liquid Service Aqueous Pressure Drop[3] psi/gpm/ft^2	Gaseous Service Air Pressure Drop[4] psi/acfm/ft^2	Aqueous gpm/ft^2	Air acfm/ft^2
	98%	100%	Weight % Removal	100% Removal (µm)				
Z*	1.5	15	99.92	2	0.035	0.0038	1 – 5	10 – 40
K	5	18	99.45	13	0.0073	0.0008	2 – 8	20 – 60
J	10	25	99.20	18	0.0020	0.00025	3 – 10	25 – 80
M	17	45	98.65	25	0.0015	0.00019	4 – 15	30 – 100
R	40	70	–	55	0.0006	0.00008	5 – 20	35 – 150
S	70	105	–	85	0.0004	0.00006	6 – 25	40 – 200
T	145	225	–	175	0.0003	0.00005	7 – 30	45 – 240
A	300	450	–	350	Negligible	Negligible	8 – 40	50 – 300

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450˚F.

* Supramesh sintered powder metal and mesh composite medium.

(1) Liquid removal efficiency ratings are based on hard spherical particles.

(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings are calculated values.

(3) Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft^2) selected. See Table II for areas.

(4) Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities $\frac{\text{actual cp of gas}}{\text{0.018 (viscosity of air)}}$ all divided by total filtration area (ft^2) selected. See Table II for areas.

Part Numbers / Ordering Information

Table II. Standard Configurations of Rigimesh Elements

100% Removal Rating (µm)		Rigimesh Series Element Part Numbers	
Liquids	Gases	1000 Series	Threaded Element Series
15	2	MB ■ 100 ▼ RZ ●	◆ – 24 – ▲ – ■ – RZ
18	13	MB ■ 100 ▼ RK ●	◆ – 24 – ▲ – ■ – RK
25	18	MB ■ 100 ▼ RJ ●	◆ – 24 – ▲ – ■ – RJ
45	25	MB ■ 100 ▼ RM ●	◆ – 24 – ▲ – ■ – RM
70	55	MB ■ 100 ▼ RR ●	◆ – 24 – ▲ – ■ – RR
105	85	MB ■ 100 ▼ RS ●	◆ – 24 – ▲ – ■ – RS
275	175	MB ■ 100 ▼ RT ●	◆ – 24 – ▲ – ■ – RT
450	350	MB ■ 100 ▼ RA ●	◆ – 24 – ▲ – ■ – RA

Gasket Options	● Code
Viton*	H
Teflon*	H2
Silicone	H4
Buna-N (Std.)	H13
Ethylene Propylene	J
Butyl	J1
Neoprene	J2
Ethylene Propylene for Steam Service	J7

Nominal Length (in)	■ Code (Area (ft^2)) MB $\boxed{S}$ MB $\boxed{L}$	MB $\boxed{F}$ MB $\boxed{LF}$
10	1.0	2.0
20	2.0	4.0
30	3.0	6.0

Nominal Length (in)	▼ Code
10	1
20	2
30	3

Area (ft^2)	◆ Code P	F
1.0	1.0	–
2.0	2.0	4.0
3.0	3.0	–
4.0	–	4.0
6.0	–	6.0

Nominal Length (in)	▲ Code
10	10
20	20
30	30

Housing Information

A full selection of standard Pall industrial housings are available for Rigimesh elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) and chemical service. Custom designed housings for specific applications are also available.

Connection	■ Code
1″ NPT	4
1 $^1/_2$″ NPT	6

S= 304 hardware and 304 L medium.

L= 316 hardware and 316L medium.

* Trademark of E.I. du Pont de Nemours & Company.

Table III. Housings for Rigimesh Elements

Type of Element	Housing Available
MB ■ 100 Series	See Housing Data Sheets H1, H3-11, and H14-19.
Threaded Connector Series	See Housing Data Sheets H48, H49, and H50.

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Pall Corporation

PSS® Series Filter Elements

Description

The PSS® Series filter medium is composed of 316 low-carbon stainless steel powder sintered together in an inert environment. The resulting fixed pore structure medium provides quantitative particle removal efficiency without media migration or particle unloading. The inherently high void volume of this medium offers low resistance to flow and high dirt holding capacity. These filters offer broad temperature and chemical compatibility with the added economy of being repeatedly cleanable. PSS filters are used in many applications within the chemical process industry, in many aggressive environments, where critical filtration levels are required. Such applications include industrial gases (cryogenic and high temperature), steam, solvent, heat transfer fluids, polymers, chemical intermediates, food and beverages. PSS Series filter media have high chemical stability and do not impart taste, odor or extractables to the effluent. Designs are available for temperatures up to 1250°F with appropriate alloy selection.

Figure 1. Standard PSS Series Filter Elements

Operating Characteristics

Standard 316 stainless steel cartridges are capable of withstanding a minimum collapse differential pressure of 50 psid in the forward flow (outside-in) direction to 600°F † and 50 psid in the reverse flow direction.

† *Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F.*

Sizes

Standard PSS filters are available in three styles. Industrial (1000 style) cartridges are 2 ⅜-inch diameter double open-ended modules in incremental lengths of 10 inches; sanitary design (AB style) are closed on one end with an O-ring piston seal on the other end; and cylindrical elements, which are 1 ½-inches or 2 ⅜-inches in diameter, closed on one end with a threaded fitting connection on the other.

Table 1. PSS Elements And Their Characteristics

Filter Grade	Removal Ratings						Clean Pressure Drop		Recommended Flow Density	
	Liquid Service(1)				Gaseous Service(2)		Liquid Service	Gaseous Service		
	Rating in µm at % Efficiency				Weight % Removal	100% Removal µm	Aqueous Pressure Drop(3) psi/gpm/ft²	Air Pressure Drop(4) psi/acfm/ft²	Aqueous gpm/ft²	Air acfm/ft²
	50%*	90%	99%	100%						
PO5	0.5	2	3	5	99.99	0.4	0.85	0.091	0.5 - 2	5 - 10
PO9	2	4	7	9	99.98	0.8	0.27	0.030	0.75 - 3	10 - 30
H	5	7	9	13	99.97	1.3	0.23	0.024	1 - 4	15 - 40
F	8	12	15	20	99.94	2.8	0.052	0.0054	2 - 6	15 - 50
E	15	22	25	35	99.80	11.0	0.019	0.0013	2 - 7	20 - 60
D	20	28	40	55	99.50	20.0	0.0068	0.0007	3 - 10	25 - 80

* *These removal ratings should be used when comparing PSS to competitive grades.*

(1) *Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.*

(2) *Weight percent removal data based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.*

(3) *Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft²) selected. See Table 2 for area.*

(4) *Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities* $\frac{\text{Actual viscosity of gas (in cp)}}{\text{0.018 (viscosity of air)}}$ *all divided by total filtration area (ft²) selected. See Table 2 for area.*

Part Numbers/Ordering Information
Table 2. Standard Configuration of PSS Elements

100% Removal Rating	PSS Series Element Part Number: 100 Series	AB Series	Cylinder Series: 2 ⅜" Diameter Elements With 1" or 1 ½" NPT[5]	1 ½" Diameter Elements With ¼" NPT[5]
5	MBS100■PO5▲	AB■PO57▲	C-23-●◆PO5	C-14-★◆PO5
9	MBS100■PO9▲	AB■PO97▲	C-23-●◆PO9	C-14-★◆PO9
13	MBS100■PH▲	AB■PH7▲	C-23-●◆PH	C-14-★◆PH
20	MBS100■PF▲	AB■PF7▲	C-23-●◆PF	C-14-★◆PF
35	MBS100■PE▲	AB■PE7▲	C-23-●◆PE	C-14-★◆PE
55	MBS100■PD▲	AB■PD7▲	C-23-●◆PD	C-14-★◆PD

Code ▲	Gasket Option
H13	Nitrile (Std.)
H	Fluorocarbon Elastomer
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service

Code ■	Nominal Length (in)	Area (ft²)
1	10	0.5
2	20	1.0
3	30	1.5

Code ◆	Connection
1	¼" NPT
4	1" NPT
6	1 ½" NPT

Code ●	Nominal Length (in)	Area (ft²)
06	6	0.31
09	9	0.47
18	18	0.9
19	19[5]	0.98

Code ★	Nominal Length (in)	Area (ft²)
06	6	0.2
09	9	0.29
18	18	0.59

[5] C-23-19 has connection Code 6. Other C-23 part numbers have Code 4. All C-14 part numbers have Code 1.

Housing Information

A full selection of standard Pall industrial housings are available for use with PSS elements. Custom designed housings for specific applications are also available. Contact your Pall representative for more information.

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Profile® II Filters

Absolute Rated, Economical, High Efficiency Depth Filter Cartridges

Description -- Profile® II Filters

Each Profile® II element has...

An inner (downstream) section in which the pore diameter is constant. This section provides absolute rated filtration.

and...

An outer (upstream) section in which the pore diameter varies continuously from that of the absolute rated section up to 120 micrometers* (µm).

An absolute rating, which may only be assigned to a filter with a fixed pore structure, assures consistent, high quality filtration. The upstream section provides effective prefiltration for every particle with a diameter larger than the rated size. The continuity of the variable pore section, its wide range of pore sizes, and its depth, combine to provide extraordinarily long life in service.

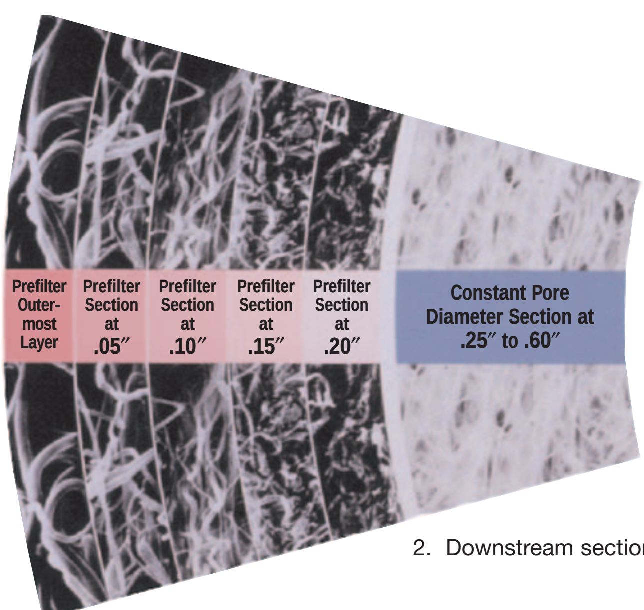
Pore size variation within the Profile II medium is achieved by varying the fiber diameter, while maintaining uniform density — and hence, uniform compressibility. Profile II elements contain effective pore sizes varying over a range as much as 40 to 1, a ratio many times higher than is achievable by simply varying density. Because uniform density and compressibility are maintained, Profile II elements can be made at lower density, and for this reason, have higher void volume — which means more pores and longer service life. No other competitive filter is made with this type of construction.

The thinner the fiber used to manufacture a fibrous structure, the greater the number of pores within the structure. A medium with more pores will provide greater service life. Also, the thinner the fibers, the smaller the pores within a medium. Profile II filter medium is constructed of ultra-thin fibers. As a result, the finest grade of the Profile II series of elements achieves an absolute rating of 0.3 µm. No commercially available competitive filter of similar appearance which we have tested provided absolute removal efficiency below about 5 µm.

Profile II cartridge filters are available in polypropylene, nylon, polyphenylene sulfide and positively charged polypropylene. The positively charged polypropylene Profile II-Plus™ cartridges provide enhanced removal of bacteria, viruses, bacterial endotoxins and particles which are negatively charged in suspension (most particles). The materials of construction for Profile II Plus filters differ from polypropylene Profile II cartridges only with respect to the modified acrylic-derived polymers which are permanently grafted to the continuous polypropylene fibers and which provide the positive zeta potential in aqueous service. The fibers in all Profile II filters may for all practical purposes be considered continuous. No surfactant or binder resin is used — the fibers are "bonded" by intertwining during the manufacturing process.

Profile II filters have a low level of extractables and due to the choice of available materials of construction they have wide temperature and chemical compatibility. Based on the widely accepted modified F-2 Filter Performance Test, when compared at equal efficiency, Profile II elements can be expected to yield longer service cycles, in some cases by factors of six or more, compared with existing products of similar physical appearance.

* One micrometer (µm) referenced as a micron, is 1/1000 of a millimeter or 1/25,400 of an inch. The smallest visible particle is about 30 to 50 µm in diameter.



2. Downstream section

1. Continuously graded upstream section

Profile II RF Style Filter

Shown above are sample sections of Profile II filter medium from a typical Profile II element at 300X. The photomicrographs illustrate the new principles of Profile II elements. 1. Continuously profiled pore size upstream section. 2. Absolute rated constant pore downstream section. Note the continuously decreasing fiber diameter in the profiled upstream section and the constant fiber diameter in the downstream section.

Applications

Acid Filtration

Wine and Beer Filtration

Automotive Paint Filtration

Coolant Water Filtration at a Nuclear Plant

Profile II cartridges and Profile II Plus cartridge filters may be utilized either upstream of finer Profile II filters or finer pleated filters — or alone as final filters. Representative applications include:

General Service: rinse water, reverse osmosis system prefiltration, water — prior to and/or after demineralization.

General Process Industries: printing inks, adhesives, liquid detergents, dyestuffs, fabric coatings, paper coatings, electroplating solutions, metal etching solutions, audio and video tape, automotive paints, can coatings, coil coatings, computer tape coatings, floppy and rigid disc coating, chemicals for photographic film development.

Electronic Industries: photoresists, acids, bases, solvents, etchant liquid mixtures, cryogenic gases, etchant gases, D.I. water prefiltration and post filtration, R.O. water prefiltration, prefiltration prior to absolute filtration.

Chemical/Petrochemical Industries: monoethanolamine and diethanolamine for gas scrubbing, monomers, polymers, glycols, herbicides and pesticides, catalysts, product polishing, photoresists, acids, bases, solvents, deep disposal well fluids.

Film and Fiber Industries: monomers, quench water, slurry additives, delusterants, slip agents, D.I. water, solvents, spin finishes, aqueous salt solutions.

Power Generation Industries: makeup water, laundry drain waste water, steam generator blowdown prefilters, filter demineralizer septa.

Pharmaceutical Industry: small and large volume parenterals, ophthalmics, oral medications.

Biological Industry: serum and serum fractions, tissue culture media, vaccine preparations, microbiological growth media, media makeup water, diagnostic sera.

Veterinary Industries: parenterals, therapeutic sera.

Fermentation Industries: liquid growth media, makeup water, intermediates, final liquid products, additives.

Food and Beverage Industries: bottled water, wine, beer, soft drinks, flavors, storage tank/reactor vents, corn syrup, edible oils, milk and distilled spirits.

Features and Benefits

Features	Advantages	Benefits
Absolute Rated Medium	• Consistent, verifiable filtration due to fixed pore structure.	• Reproducible production yields and absolute particle retention.
Constant Density Medium with Tapered Pores	• Longer service life — in some cases by factors of six times or greater.	• Lower filtration costs per year. • Lower waste disposal costs per year. • Quicker filling rates.
Small Diameter Fibers in Medium	• Longer service life. • Finer removal ratings than generally available.	• Lower yearly filtration costs. • Fewer filtration stages. - lower filtration costs - less downtime • Elimination or reduction of recirculation to achieve product clarity. • Improved product yields.
No Surfactants or Binders	• Low extractables.	• Consistent production yields and quality.
Polypropylene Medium	• Wide chemical compatibility. • Can remove trace quantities of oil.	• Multiple applications within one plant. • Reduced crater defects with paints.
Polypropylene Medium Available with a Positive Charge	• Enhanced removal of particles in aqueous fluids.	• Improved product yields. • Lower yearly filtration costs.
Continuous Fibers	• No media migration.	• Improved reliability. • Consistent production yields and quality.
Materials of Construction are FDA Listed	• Cartridge is appropriate for use in the pharmaceutical, biological, and food & beverage industries.	• Consistent, high quality filtration in stringent applications.
Available in a "P" Option for Pharmaceutical Applications	• Quality Control Procedures: 1. Manufacturing in controlled environment by specially trained personnel. 2. Statistical testing of filter effluent for: - particle and fiber counts - oxidizables by USP $KMnO_4$ consumption test - pH shift - pyrogens using LAL test • Cartridge can be *in-situ* steam sterilized.	• Performance tested.
Manufacturing Facilities in the U.S. and Europe	• Consistent product quality. • Continuous product availability.	• Consistent production yields.

Styles

Style: RF Style

Description: Double open-ended, 2-1/2" diameter element. The cartridge is constructed of either polypropylene, nylon, polyphenylene sulfide or positively charged polypropylene medium. Cartridge sealing is ensured by using a tie-rod seal nut in a Pall Profile II housing and by spring engaged knife edge sealing surfaces in competitive housings. The polypropylene cartridge is also available with elastomeric gaskets heat welded to each end. This cartridge may be used in competitive cartridge housings with blunt knife edge sealing surfaces, where cartridge to housing fluid bypass is suspected.

Service: General Industrial

Housing: See Table 7

RF Style Profile II filter cartridges available in 10", 20", 30" and 40" lengths.

Style: AB Style - Code 3, 7, 8

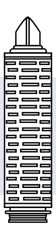
Description: Single open-ended, 2-3/4" diameter element with double external O-rings at one end. Available in polypropylene and positively charged polypropylene medium.

Service: Most commonly used in pharmaceutical, food & beverage and electronic applications. The cartridge may be hot water sanitized. Only P grade filters may be *in-situ* steam sterilized.

This style cartridge is also recommended for applications where the filters are heated for any reason above 122˚F (50˚C) and the temperature is then reduced by 36˚F (20˚C) or more prior to filtration.

Housing: See Table 7

AB Style Code 7 Profile II filter cartridges available in 10", 20", 30" and 40" lengths.



The distinctive fin at one end of the filter cartridge identifies it as a Pall product and is a trademark of Pall Corporation.

Ordering Information

Filter Selection Guidelines

For optimum efficiency and throughput, it is recommended that you select a filtration scheme based on flow and differential pressure requirements.

To select your filter simply:

A. Select desired level of filtration (refer to Table 8 for reference).

B. Select filter cartridge style and grade by referring to Tables 1, 2, 3, 4 and 5.

C. Confirm that the Profile II filter medium selected is compatible with the fluid and the operating temperature. See Table 9.

D. Determine the required number of 10 inch filter modules by dividing the system flow rate by the typical flow rate per 10 inch module given in Table 6. Calculate the clean pressure drop to verify that it is acceptable.

E. Refer to Table 7 for ordering information on housings. Determine stacking array (number of cartridges and length) of RF or AB series filter element(s) for selected housing.

F. Refer to Table 2 to complete ordering information for desired filter element(s).

For example: You require a filter cartridge for 40 µm removal in an RF style. Your flow rate is 100 gpm. Therefore, from Table 6 you require approximately 6-10, 10" filter modules (100 gpm divided by 15 gpm per 10" cartridge). From Table 7, you require a P04 housing which can accept four 20" or 30" filter cartridges. Four 20" filter cartridges (8, 10" filter modules) meet your requirements.

The part number for your filter cartridge would be:

R2F400

The part number stands for:
R: style-retrofit
2: 20" length
F400: 40 µm absolute rated, polypropylene Profile II medium

Table 1 – Maximum Operating Conditions

Cartridge[1]	Materials of Construction		Maximum Differential Pressure[2] (psid)	Temperature	
	Medium	Support Core		°F	°C
Polypropylene Profile II	Polypropylene	Polypropylene	15 30 50 60	180 158 122 86	82 70 50 30
Profile II Plus	Polypropylene with positive zeta potential	Polypropylene	15 30 50 60	180 158 122 86	82 70 50 30
Nylon Profile II	Nylon	Glass filled polypropylene	35 50 75	180 158 86	82 70 30
	Nylon	Glass filled nylon	50 70 80 90	300 212 158 86	150 100 70 30
Profile A/S	Polyphenylene Sulfide	316L Stainless Steel	30 40	400 200	205 93

[1] P grade AB Style elements can be heated to 125°C (257°F), for example during *in-situ* steam sterilization or in an autoclave, and subsequently cooled to ambient temperature prior to use. AB style elements may be constructed of either a polypropylene or a positively charged polypropylene medium.
[2] For higher differential ratings and for compatible fluids, Profile II cartridges are available with glass filled polypropylene cores on a special order basis. Please contact the Pall Sales Department or your local distributor.

Table 2 – Standard Configurations of Profile II Filter Cartridges

A. Polypropylene and Positively Charged Polypropylene Profile II Element Part Numbers

Removal Rating (µm)	RF and RMF Series	AB Series Code 3,7,8 -Hot water sanitization -In situ steam sterilization (P grade only)
0.3[1]	–	AB ▲ Y003 ● ▼ ✚ ★
0.5[1]	R ■ ▲ F 005 ➢	AB ▲ Y005 ● ▼ ✚ ★
0.7[1]	–	AB ▲ Y007 ● ▼ ✚ ★
1	R ■ ▲ F 010 ● ➢	AB ▲ Y010 ● ▼ ✚ ★
3	R ■ ▲ F 030 ● ➢	AB ▲ Y030 ● ▼ ✚ ★
5	R ■ ▲ F 050 ● ➢	AB ▲ Y050 ● ▼ ✚ ★
7	R ■ ▲ F 070 ➢	AB ▲ Y070 ▼ ✚ ★
10	R ■ ▲ F 100 ➢	
12	R ■ ▲ F 120 ➢	
15	R ■ ▲ F 150 ➢	
20	R ■ ▲ F 200 ➢	
30	R ■ ▲ F 300 ➢	
40	R ■ ▲ F 400 ➢	
70	R ■ ▲ F 700 ➢	
90[1]	R ■ ▲ F 900 ➢	
120[1]	R ■ ▲ F 1200 ➢	

[1] Extrapolated values.

B. Nylon Profile II Element Part Numbers

Removal Rating (µm)	RFN Element Part Number
5	R ✷ ✦ FN050
10	R ✷ ✦ FN100
20	R ✷ ✦ FN200
30	R ✷ ✦ FN300
40	R ✷ ✦ FN400
70	R ✷ ✦ FN700

C. Profile A/S Element Part Numbers

Removal Rating (µm)	RFN Element Part Number
5	RLS ✦ FPS050
10	RLS ✦ FPS100
20	RLS ✦ FPS200
40	RLS ✦ FPS400
70	RLS ✦ FPS700

O-Ring Option	Code ★
Silicone - standard	H4
Viton A	H
Ethylene Propylene	J

Nominal Length, (Inches)	Code ✦
10	1
20	2
30	3
40	4

Charge Option	Code ●
Positive Zeta Potential	Z

Application	Code ✚
Pharmaceutical	P
Other	Omit

Adaptor Materials	Adaptor Configuration	O-ring Size	Code ▼
Polypropylene	Flat top, double O-ring	222	3
Polypropylene	Finned end bayonet lock, double O-ring	226	7
Polypropylene	Finned end, double O-ring	222	8

Inner Core Material Construction	Code ✷
Glass Filled Polypropylene (Standard)	GY
Glass Filled Nylon (Option)	GN

Gasket Material	Code ➢
Alloy of Polypropylene and Ethylene Propylene Diene Monomer (EPDM)	H21

Nominal Length (Inches)	Code ▲
10	1
20	2
30	3
40	4

Gasket	Code ■
None	No Symbol
Elastometric Material*	M**

* Provides a positive sealing surface to eliminate potential fluid bypass in competitive housings with blunt knife edges.
** When the M symbol is selected the part number must end in H21 code.

Table 3 – Profile II Filter Cartridges Removal Ratings

Cartridge Grade	Liquid Service Removal Rating, µm 90%	99%	99.9%	99.98%	Gaseous Service DOP (0.3 µm) Removal Efficiency (%)[3]
003	<0.5[1]	<0.5[1]	<0.5[1]	<0.5[1]	>99.9999
005	<0.5[1]	<0.5[1]	<0.5[1]	<0.5[1]	>99.9999
010	<0.5[1]	<0.5[1]	<0.5[1]	1.0	>99.9999
030	<1.0[1]	1.8	2.5	3.0	>99.9999
050	2.0	3.0	4.0	5.0	>99.9999
070	3.5	5.0	6.0	7.0	>99.9999
100	6.5	7.5	9.0	10.0	99.2
120	7.0	9.0	11.0	12.0	96.5
150	8.0	10.0	13.0	15.0	88.0
200	10.0	14.0	18.0	20.0	84.8
300	14.0	18.0	26.0	30.0	67.0
400	20.0	30.0	35.0	40.0	48.3
700	32.0	50.0	70.0	–[2]	34.0
900	50.0	78.0[1]	90.0[1]	–[2]	25.0
1200	60.0	100.0[1]	120.0[1]	–[2]	10.0

[1] Extrapolated values.
[2] Precise evaluation of the 100% removal efficiency for these coarse grades is not possible with the test procedure utilized.
[3] The test containment, dioctyl phthalate (DOP) is a 0.3 µm suspension in air. Air flow used for these data was 20 CFM/10" cartridge, except grade 700 and coarser, which were run at 4 CFM.
For more information on Profile II filter cartridges see Element Data Sheet E1.

Table 4 – Profile II Plus Cartridge Filters Removal Ratings

Cartridge Grade	Removal Rating Independent of Zeta Potential (µm at % Efficiency) 90%	99.98%	Bacteria[2] Endotoxin Removal Capacity (Endotoxin Units/ 10″ Cartridge)
003Z	<0.5[1]	<0.5[1]	>1.6 x 10^8
005Z	<0.5[1]	0.5[1]	>1.6 x 10^8
007Z	<0.5[1]	0.7[1]	>1.6 x 10^8
010Z	<0.5[1]	1.0	>1.6 x 10^8
030Z	<1.0[1]	3.0	>1.6 x 10^8
050Z	2.0	5.0	>1.6 x 10^8

[1] Extrapolated values.
[2] One endotoxin unit is equal to 0.10 nanograms of *E. Coli* 055:B5 endotoxin. Cartridges were challenged with 1.6 x 10^8 Endotoxin Units (E.U.) without passing any detectable amount of endotoxin (<0.5 EU/ml).
For more information on Profile II Plus filter cartridges see Element Data Sheet E1Z.

Table 5 – Profile A/S Filter Cartridges Removal Ratings

Cartridge Grade	Liquid Service Removal Rating, µm 90%	99%	99.9%	99.98%
050	<1.0[1]	2.5	4.0	5.0
100	6.0	8.0	9.0	10.0
200	11.0	15.0	18.0	20.0
400	15.0	20.0	30.0	40.0
700	20.0	30.0	50.0	70.0[1]

[1] Extrapolated values.

Table 6 – Profile II and Profile II Plus Filter Cartridges Flow Characteristics

Profile II and Profile II Plus (Z) Cartridge Grades	Clean Pressure Drop				Typical Aqueous Flow GPM/10″ Cartridge
	Aqueous Service PSI/GPM Per 10″ Cartridge[1] Polypropylene and Nylon			Gas Service CFM of Air/PSI Per 10″ Cartridge[2]	
	Profile II Cartridges All Series	Profile II Plus Cartridges All Series	Profile A/S Cartridges	Profile II and Profile II Plus Cartridges All Series	
003(Z)	3.5	4.5	–	2.3	1 – 2.0
005(Z)	2.8	3.5	–	2.7	1 – 2.5
007(Z)	2.7	2.7	–	3.1	1 – 2.5
010(Z)	2.6	2.6	–	3.6	1 – 3.0
030(Z)	1.5	1.5	–	6.4	2 – 5
050(Z)	0.8	0.8	–	11.0	3 – 8
070	0.5	–	–	17.0	5 – 12
100	0.3	–	0.35	29.0	6 – 15
120	0.2	–	–	36.0	6 – 15
150	0.15	–	–	44.0	8 – 15
200	0.10	–	0.10	75.0	10 – 15
300	0.08	–	–	119.0	10 – 15
400	0.05	–	0.09	207.0	10 – 15
700	<0.05	–	0.03	415.0	10 – 15
900	<0.05	–	–	640.0	10 – 15
1200	<0.05	–	–	1000.0	10 – 15

[1] Pressure drop in PSI per GPM for a single 10" cartridge. For multiple elements, divide by the number of cartridges. For fluids other than water, multiply by the viscosity in centipoise.
[2] For longer cartridges, increase the flow rates in proportion. The flow rates listed do not take into account pressure losses due to flow in the internal diameter of the elements which become significant above about 40 to 60 CFM.

Profile II and Profile II Plus Filter Cartridges

Table 7 – Housing Selection

Element Style	Housing Series	Materials of Construction	Stacking Array	Flow Range (GPM)	Maximum Allowable Pressure/Temp. PSIG	˚F	Housing Data Sheets*
RF, RMF	PC401	Carbon Steel or 316 Stainless Steel	1 x 10″ 1 x 20″ 1 x 30″	to 15 to 30 to 38	400	300	H14
	PC04	Carbon Steel or 316 Stainless Steel	4 x 10″ 4 x 20″ 4 x 30″	to 120 to 120 to 120	230 215	300 300	H15
	PC07	Carbon Steel or 316 Stainless Steel	7 x 20″ 7 x 30″ 7 x 40″	to 210 to 368 to 420	230 215	300 300	H16
	PC15	Carbon Steel or 316 Stainless Steel	15 x 20″ 15 x 30″ 15 x 40″	to 340 to 480 to 675	230 215	300 300	H17
	P23	Carbon Steel or 316 Stainless Steel	23 x 30″ 23 x 40″	to 820 to 1240	205 215	300 300	H18
	P38	Carbon Steel or 316 Stainless Steel	38 x 30″ 38 x 40″	to 1630 to 1930	200 215	300 300	H19
AB Code 7	ALI in-line flow sanitary**	316L Stainless Steel	1 x 5″, 10″, 20″, 30″, 40″	to 20	150	284	–
	ALT "T" -flow sanitary**	316L Stainless Steel	1 x 10″, 20″, 30″, 40″	to 20	150	284	
	CLL4	316L Stainless Steel	1 x 10″, 20″, 30″	to 20	400	250	H26
	STL03 "T" -flow sanitary multistack	316L Stainless Steel	3 x 10″, 20″, 30″, 40″	to 100	125	200	–
	STL06 "T" -flow sanitary multistack	316L Stainless Steel	6 x 10″, 20″, 30″, 40″	to 200	125	200	–
	STL10 "T" -flow sanitary multistack	316L Stainless Steel	10 x 20″, 30″, 40″	to 200	125	200	–
	PCY	Polypropylene	1 x 10″, 20″	to 15	150	100	H39

*For more information on the housings listed see the appropriate Housing Data Sheet.

**Available with 50psig/3.4 bar at 300°F/149°C 316 SS jackets.

Removal Ratings – Bringing Order to Confusion!

There is no universally accepted system for determining removal ratings of cartridge filters in liquid service. As an example, a number of depth type filters rated at 1 micrometer (µm) were evaluated using a modified OSU F-2 test method (see below) and were found to have absolute ratings of 15 to 25 µm. All had virtually no removal at 1 µm. Rating methods used by the various manufacturers may be arbitrary and results obtained by different methods cannot be compared.

The OSU F-2 test method developed at Oklahoma State University in the 1970's has received wide acceptance for use on lubricating and hydraulic fluids. Pall Corporation uses this method for its oils extensively, and has adapted it for use with water in the range from 0.5 to 30 µm. A second modification uses oil and covers the range from 40 to 120 µm.

Profile II Replacement Filters

Some competitive elements deviate greatly from their assigned ratings. For example, one element rated at 0.5 µm nominal, had an efficiency of 90% at 8 µm and virtually zero efficiency at 0.5 µm in the modified F-2 test. A 1µm rated element of the same brand had a 90% efficiency at 6 µm! Both can be replaced by 10 µm rated Profile II elements which offer about equal removal and a probable two to four-fold increase in life.

Table 8 lists the nearest equivalent Profile II element to some of the more commonly used depth type filters. Therefore, in virtually all cases, when the contaminant added values were compared at *equal efficiency*, the Profile II element capacity was higher, often by a factor of two to three or more. Life in service may be different due to contaminant characteristics and process conditions. In general, longer life will be obtained when a Profile II element replaces a conventional depth filter with equal or similar OSU F-2 removal efficiency values.

Table 8 – Replacing Conventional Depth Filters with Profile II Elements

Manufacturer	Material	Part Number	Manufacturers Rating µm	Nearest Equivalent Profile II Element Rating µm
Cuno	Cotton String Wound	DCCFY	1	15
		DCCFA	3	15
		DCCFB	5	40
		DCCFC	10	40
		DCCFF	25	40
	Polypropylene String Wound	DPPFY	1	30
		DPPFA	3	40
		DPPFB	5	40
		DPPFC	10	40
		DPPFF	25	70
	Molded Fiber	G78A3	3	30
		G78B3	5	40
		G78C8	10	70
		G78F3	25	70
	Polyethylene Coated Polypropylene	AU9A11N	3	15
	Polyethylene Coated Polypropylene	AU9B11N	5	30
	Polyethylene Coated Polypropylene	AU9C11N	10	40
Commercial	Cotton String Wound	39R10	1	10
		27R10	3	15
		23R10	5	20
		19R10	10	30
		15R10	20	40
	Polypropylene	MBC10M10A	10	10
		MBC20M10A	20	20
		MBC40M10A	40	30
Hytrex	Polypropylene	GX01	1	30
		GX03	3	30
		GX05	5	70
		GX10	10	70
		GX20	20	70
Nippon Roki	Polypropylene	HT10	0.1	7
		HT20	0.2	5
		HT30	0.3	7
		HT40	0.4	7
		HT50	0.5	10
		HT55	0.5	15
		HT60	0.6	20
		HT60a	0.7	15
		HT80	0.8	20

Note: Many competitive depth cartridges are constructed of materials other than polypropylene. In many cases Profile II cartridges, constructed of polypropylene or nylon, may be suitable replacements provided that either of these materials has the required temperature and chemical compatibility. See Table 9.

Table 9 – Profile II Compatibility Data

Chemical Classification	Examples	Polypropylene	Nylon	Polyphenylene Sulfide
Inorganic Acids	Hydrochloric, Dilute Sulfuric, Dilute Nitric, Boric, Phosphoric	GR	T	NR GR
Organic Acids	Acetic	GR	T	GR
Bases (Alkalies)	Sodium Hydroxide, Potassium Hydroxide Amines, Quaternary Ammonium Hydroxide	GR	T	GR
Salt Solutions	Aluminum Chloride, Sodium Sulfate, Sodium Nitrate	GR	T	T
Brines	Sodium Chloride, Potassium Chloride, Sodium Bromide, Calcium Chloride	GR	T	GR
Oxidizers	Peroxides, Peracids	NR	NR	NR
Organic Solvents	Ethers, Esters, Amides, Ketones	GR	GR	GR
	Alcohols, Cellosolves, Glycols	GR	GR	GR
	Aromatics (Benzene, Toluenes, Xylenes)	NR	GR	T
	Petroleum Products (Gasoline, Kerosene)	NR	GR	GR
	Hydrocarbons (Hexane, Octane, Fats, Oils, Petroleum Ether)	T[1]	GR	GR
	Halogenated Hydrocarbons (Methylene Chloride, Perchloroethylene)	T[1]	T	T
Water				
(Ambient)		GR	GR	GR
(Hot – up to 180˚F without oxidants)		GR	NR	GR
(Hot – with oxidants)		NR	NR	T
Air				
(Ambient & Hot)		NR	NR	GR
Recommended temperature limits for most organic fluids unless evaluated on an individual basis		150˚F	200˚F	200˚F
Recommended temperature limits for most compatible organic fluids unless evaluated on an individual basis		180˚F	200˚F	200˚F
Maximum temperature limits for any fluid after evaluation on an individual basis		180˚F	300˚F	400˚F

Disclaimer:
- The compatibility data presented in this chart is for general guidance only. Because so many factors can affect the chemical resistance of a given product, you should pre-test under your own operating conditions observing applicable safety practices such as those given on the Material Safety Data Sheet for each chemical. If any doubt exists about specific applications, please contact Pall Corporation.

GR=Generally Recommended
NR=Not Recommended
T=Evaluate on An Individual Basis
[1] Recommended maximum temperature must not exceed 90˚F.

Scientific and Laboratory Services

Service for our customers, not only in product quality and delivery, but also in problem solving, system recommendations and sharing of scientific information, is the cornerstone of the Pall Corporation philosophy.

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SLS Facilities, World Headquarters, Port Washington, New York

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Pall Corporation is a world leader in fluid clarification. From its organization in 1946, Pall Corporation has developed products to meet the critical filtration needs of industry: protecting people, products, and systems through the capture and removal of contaminants in a variety of applications. Pall products serve three broad markets which include Fluid Processing, Aeropower and Health Care. The company is different from other filter companies for three important reasons:

- Pall is a highly integrated manufacturer and leader in the development and production of filter media which are made by a variety of proprietary methods which include metallurgy, papermaking, chemical deposition, plastic extrusion, and others.

- Pall is the leader in design and manufacture of sophisticated housings that encase the filter cartridges.

- Pall has vast technical resources. The unique human resource, the Scientific Laboratory Services (SLS) Department, is staffed with skilled engineers and scientists and equipped with the most sophisticated analytical instruments available to help solve the complex contamination problems associated with fluid clarification.

Pall products are readily available around the world. Regardless of the location of your plant or project, Pall has a manufacturing facility, regional office or distributor nearby, with a ready stock of many products. Pall products, from any Pall manufacturing plant, will be identical in performance.

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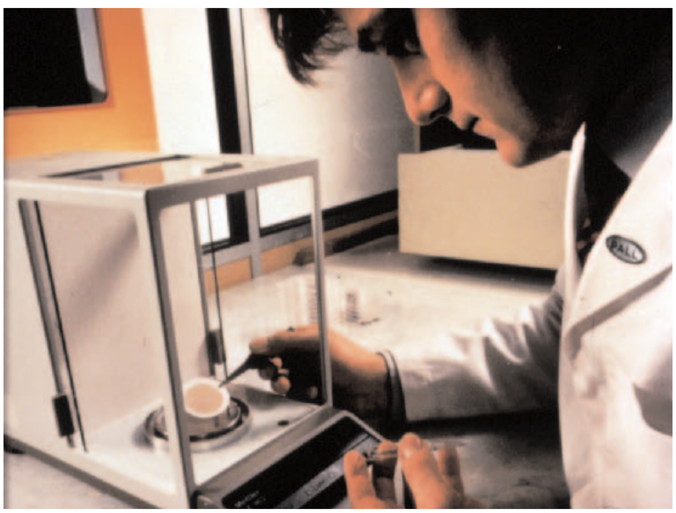
SLS Facilities, Pall Europe, Ltd., Portsmouth, England



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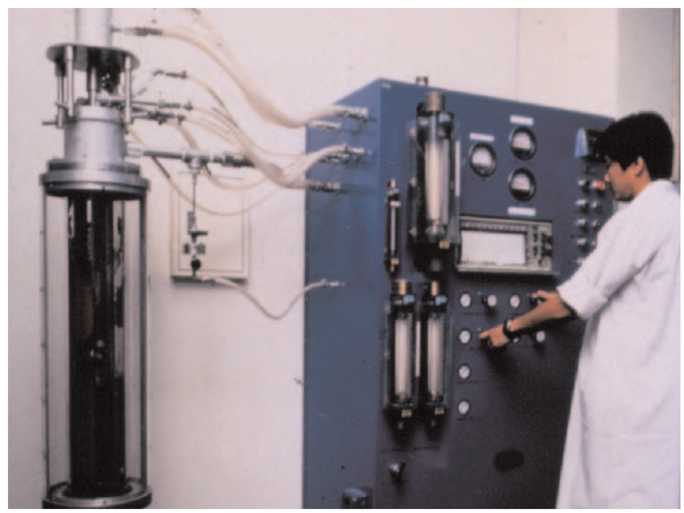

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PRO 400f

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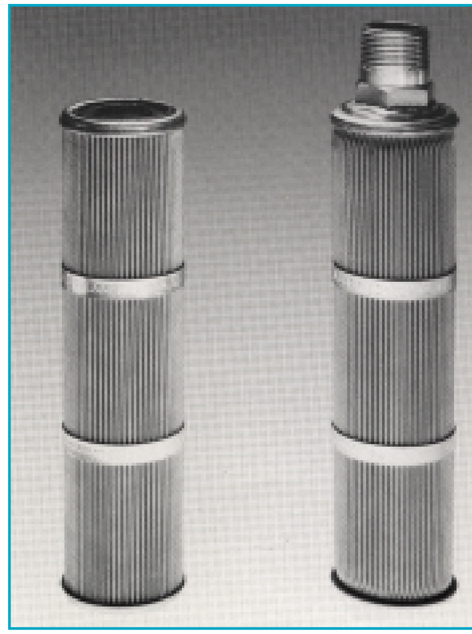
PMM® Filter Elements

Description

PMM® medium is a thin, sintered matrix of 316L stainless steel powder within the pore structure of stainless steel wire mesh. It combines the best qualities of Pall PSS® sintered powder medium and Pall Rigimesh® sintered woven wire mesh medium. The **PMM** filter is designed so that the sintered bonds are at the points of contact, producing an extremely strong porous material whose wires do not shift and whose pore size integrity is continuously maintained. Designs are available suitable for temperatures up to 1250°F (677°C).



Operating Characteristics

Standard cartridges are capable of withstanding a minimum collapse differential pressure of 125 psid (8.6 bard) in the forward flow (outside-in) direction at up to 600°F† (315°C) and 10 psid (.7 bard) in the reverse flow direction. Optional design available for 50 psid (3.4 bard) reverse flow.

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F (232°C).

Sizes

The standard **PMM** filters are cylindrical forms, 2-½" in diameter in 10" multiple lengths, up to 40". For AB style **PMM** filters consult the factory.

Technical Information

Table 1. PMM elements and their characteristics

Filter Grade	Removal Ratings						Clean Pressure Drop				Recommended Flow Density	
	Liquid Service[1]				Gaseous Service[2]		Liquid Service		Gaseous Service			
	Rating at % Efficiency (µm) 90%	99%	99.9%	100%	Weight % Removal	100% Removal (µm)	Aqueous[3] psi/gpm/ft^2	mbar/lpm/m^3	Air[4] psi/acfm/ft^2	mbar/m^3/hr/m^2	Aqueous gpm/ft^2	Air acfm/ft^2
M020	0.1	0.5	1	2	>99.99	0.4	0.87	1.47	0.093	.350	0.1-75	3-10
M050	0.6	2	4	5	99.99	0.6	0.49	.83	0.051	.192	0.1-75	3-10
M100	2	5	8	10	99.97	1.3	0.28	.47	0.030	.113	0.2-1	5-20
M150	5	9	12	15	99.96	2.5	0.17	.29	0.017	.064	0.5-3	7-25
M200	8	13	16	20	99.93	4.0	0.07	.12	0.007	.026	0.7-4	10-30
M250	10	16	21	25	99.90	9.0	0.02	.03	0.002	.008	1-5	15-40

(1) Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.

(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.

(3) Pressure drop obtained by multiplying value shown by actual flow desired, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area selected. See Table II for areas.

(4) Pressure drop in obtained by multiplying value shown by actual gaseous flow rate desired, ratio of viscosities, all divided by total filtration area selected. See Table II for areas.

Part Numbers/Ordering Information

Table II. Standard Configurations of PMM Elements

100% Removal Rating (µm)	PMM Series Element Part Numbers	
	1000 Series	Threaded Element 1000 Series
2	MBS 100 ■ M020 ▲	P24 ◆ ● M020 ▼
5	MBS 100 ■ M050 ▲	P24 ◆ ● M050 ▼
10	MBS 100 ■ M100 ▲	P24 ◆ ● M100 ▼
15	MBS 100 ■ M150 ▲	P24 ◆ ● M150 ▼
20	MBS 100 ■ M200 ▲	P24 ◆ ● M200 ▼
25	MBS 100 ■ M250 ▲	P24 ◆ ● M250 ▼

■ Code	◆ Code	Nominal Length (in.)	Area ft^2	m^2
1	**10**	10	1.5	.14
2	**20**	20	3.0	.28
3	**30**	30	4.5	.42
4	**40**	40	6.0	.26

▲ Code	Gasket Option
H13 (Std.)	Buna N (Nitrile)
H	Viton*
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service
RE	Reinforced for 50 psid (3.4 bard) reverse flow

*Trademark of E.I. du Pont de Nemours & Co.

● Code	Connection
4	1″ NPT
6	1¹/₂″ NPT

▼ Code	Other Options
RE	Reinforced for 50 psid (3.4 bard) reverse flow
C9	Cleaned for oxygen service

Housing Information

A full selection of standard Pall industrial housings are available for **PMM** elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) (426°C) and chemical service. Custom designed housings for specific applications are also available.

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Because of developments in technology these data or procedures may be subject to change. Consequently we advise users to review their continuing validity annually.

Pall Corporation has offices and plants throughout the world in locations including: Argentina, Australia, Austria, Belgium, Brazil, Canada, China, France, Germany, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Poland, Puerto Rico, Russia, Singapore, Spain, South Africa, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, the United States and Venezuela. Distributors are located in all major industrial areas of the world.

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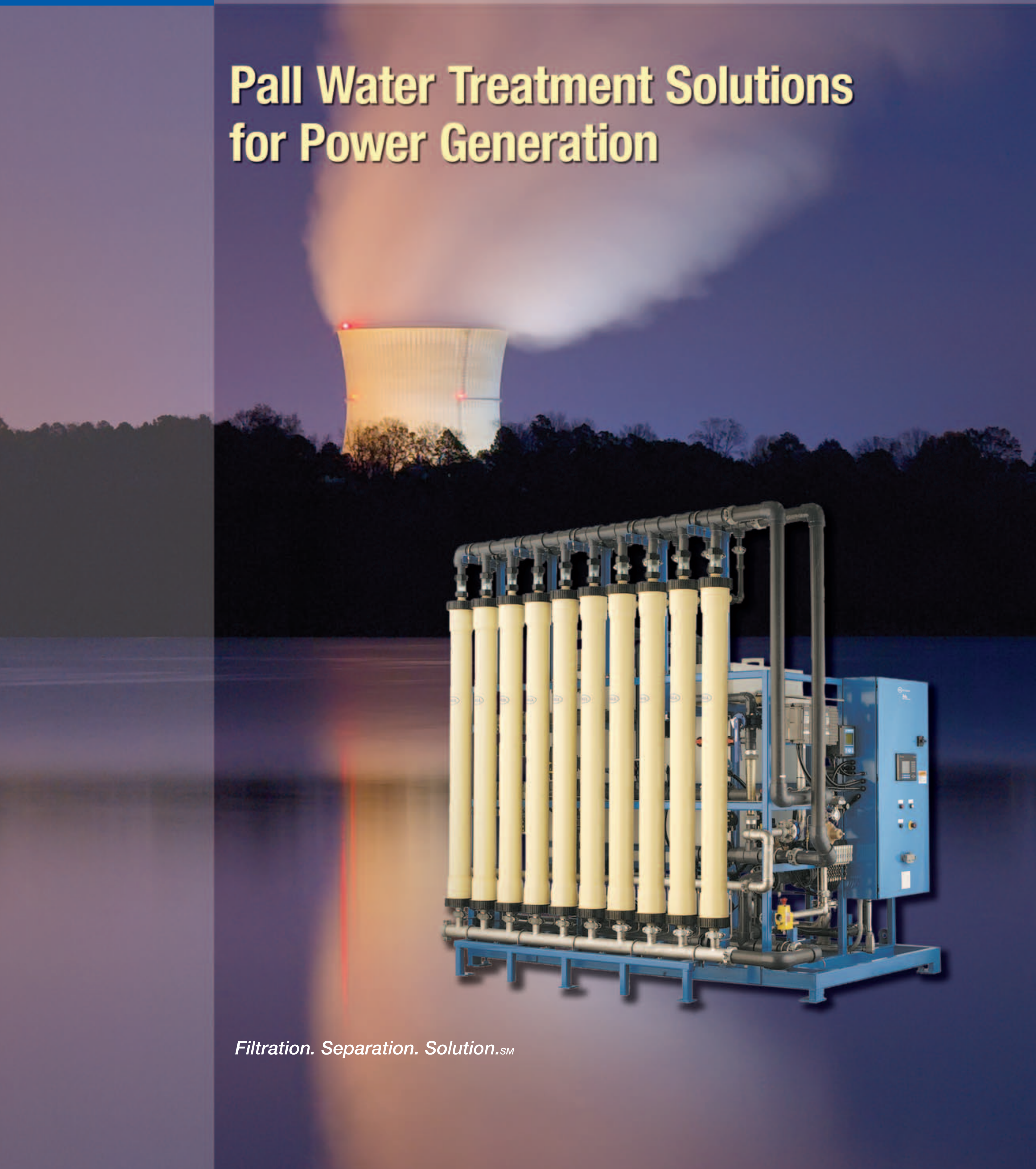
PALL Power Generation

Pall Water Treatment Solutions for Power Generation



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Pall Power Generation is a worldwide leader in fluid purification technologies for the power generation industry.

Pall advanced filtration and separation science and high quality manufacturing are applied on all fluids throughout the power plant to improve reliability and ensure clean, available, and profitable power.

With stringent water treatment regulations and a growing demand for safer water, treatment systems must ensure strict compliance with purity standards. Filtration is critical to the success of your water treatment system in meeting purity goals, and traditional filtration methods such as sand and granular mixed media are often inefficient, labor intensive, and costly.

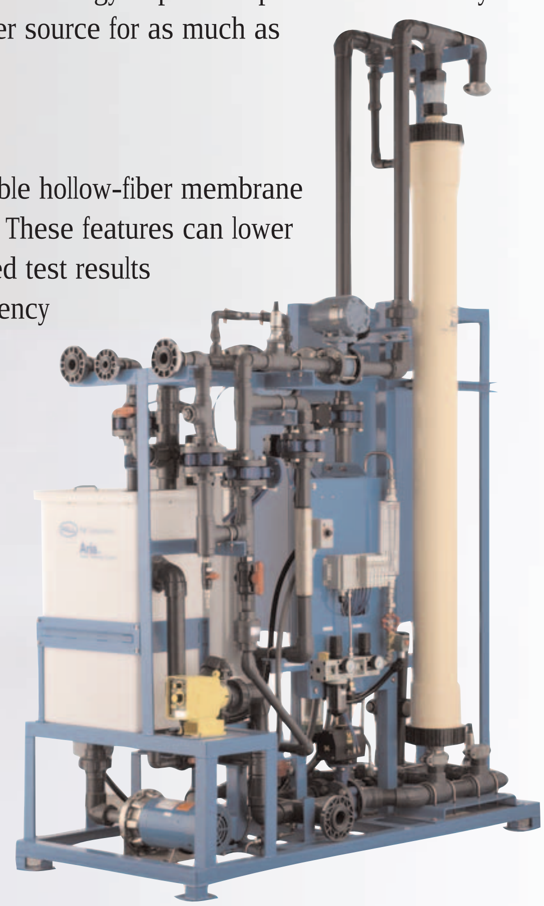
If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria™ Integrated MF/RO system. The Pall Aria line of water treatment systems uses hollow-fiber microfiltration or ultrafiltration membrane technology to produce pure water from any water source, delivering a consistent, high-quality water source for as much as 50% less than the cost of purchased water.

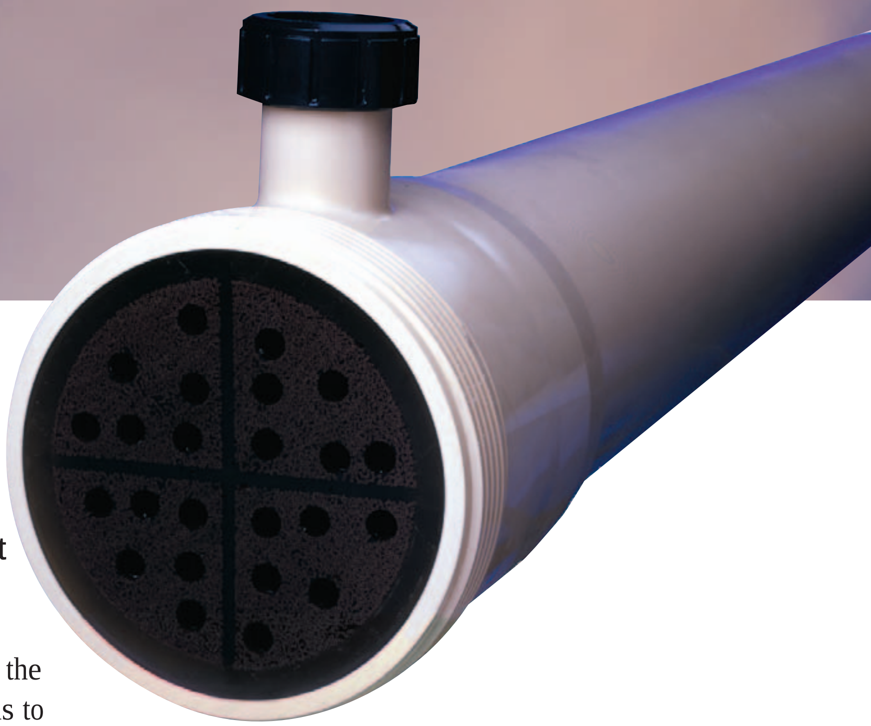
Cost-effective, efficient, and flexible

At the heart of the Pall Aria system is a highly permeable hollow-fiber membrane with high flow-per-unit area and a high recovery rate. These features can lower the cost of each gallon of water you treat. Documented test results and actual system performance demonstrate the efficiency of the membrane-based Pall Aria filtration system.

You can purchase the Pall Aria system for stand-alone use or for integration with your existing equipment. It's modular design offers flexibility and allows you to customize your system for your unique process application and integration requirements.

The Pall Aria system is offered as both a hollow-fiber MF system for pre-RO, or combined with Pall RO for a complete Pall Aria MF/RO package.





Pall Aria Water Treatment Systems for Plant Water Supply

Water – the most critical component for cost-effective power production

As water becomes increasingly scarce, the biggest issue facing power production is to secure high quality water supply in adequate quantity. New power technologies face an ever-increasing demand for ultra-pure water from alternative sources.

Conventional water treatment systems may not accommodate the strict quality requirements for peak operation of delicate RO membranes, nor are these systems flexible or scalable. Should water quality vary, conventional systems may take a long time to adjust. A pre-treatment system may look like the solution, but the majority of these systems require a lot of space and maintenance.

The Pall Aria System – Safe, reliable, economical, and efficient

The Pall Aria water treatment system is the best way to manage every aspect of water usage. Pall Aria systems are revolutionary turnkey systems designed to provide high-quality water exceeding even the most stringent requirements, from any water source, including: surface water, groundwater, reclaimed water, or secondary effluent.

The Pall Aria water treatment system purifies water for use in steam plant make-up water, gas turbine water supply, drinking water, and cooling tower blow-down. It has a small footprint and is so reliable it significantly reduces water supply costs.

Pall Aria water treatment systems are super-efficient, versatile, and tough:

- Influent Flexible – Pall Aria systems handle variations in water quality/flow rates without interruption
- Consistently provides maximum water quality with minimum intervention
- Reduces the need for chemical treatment prior to RO
- Reduces water supply costs through low chemical usage, low maintenance and small footprint
- Pall Aria systems can be monitored and controlled remotely

Designed to meet water management challenges in power generation, Pall Aria water treatment systems are an economical, flexible, and reliable solution for all your plant water needs.

Pall Aria for Make-Up Water

Pall Aria microfiltration (MF) systems provide consistent high purity water for plant make-up and feed to RO systems for a wide range of influent water sources and water quality. Used extensively around the world, Pall Aria Systems satisfy any and all water requirements including the ability to produce boiler quality feedwater as well as drinking water that meets today's stringent standards.

Pall Aria systems are influent flexible, meaning they can take influent of up to 500 NTUs and higher and consistently produce effluent of less than 0.05 NTUs in a single pass. Pall Aria systems use uniquely designed filtration modules in a hollow fiber configuration to remove fine particulates, bacteria, cysts and oocysts. Iron and manganese can be removed by pre-oxidation, and total organic carbon can be reduced by direct coagulation. The hollow fibers are highly permeable membranes resulting in high water flux rates.

Metals, biological contaminants and bacteria in RO feedwater can quickly escalate operating and maintenance costs. Designed for ease of operation, Pall Aria systems consistently provide a reliable quality feed to RO systems. The systems are complete turnkey solutions to treat water flows from 75 to 875 GPM. They can be easily installed and require little space and maintenance. When real estate is of concern, Pall Aria systems handle more than three times the flow of conventional systems per square foot of floor space. Additionally, the capitalized water treatment cost with a Pall Aria system is less than 50% per one thousand gallon basis of a typical clarifier.

Pall Aria Integrated MF/RO Systems

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system. Not only can the Pall Aria MF/RO system reduce your cost for purchased water, it can provide water that consistently meets critical water quality requirements while effectively protecting the environment.

Value

- Acquire a consistent, high-quality water source for as much as 50% less than the cost of purchased water.
- Decrease dependency on purchased water.
- Reduce wastewater discharge by as much as 80%.
- Reclaim a scarce water resource by using industrial clarified effluent.
- Increase operating profit by reusing an existing resource.
- Obtain a source of high-quality water for critical plant and utility use.

Is This an Opportunity for You?

- Do regulations require you to reuse water before your plant can undergo expansion?
- Do you have more than 100 gpm (23m^3/hr) of waste effluent that can be reclaimed?
- Do you need high-quality water for boilers and utility operations?
- Are you interested in significant operating cost savings?
- Is your present total water cost more than \$4.00 per 1000 gals (\$1.00/m^3)?
- Does your effluent have the following characteristics: TSS <100 mg/l, BOD <100 mg/l, FOG <20 mg/l, and TDS < 2,500 mg/l?

Why the Pall Aria Integrated MF/RO System?

- Assures consistent production of high quality water from a reclaimed source.
- Provides an integrity testable, positive barrier to TSS and microbial contaminants.
- Protects downstream processes such as electrodeionization (EDI).
- Delivers highly purified, low TDS water.

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

Pall Mobile Water Solutions

When facing source water problems, downtime from equipment malfunctions or emergencies, seasonal surges in consumption, or increased demand that exceeds system capacity, municipal and industrial water providers need a solution to rapidly increase production. If they're in the process of building a new facility, they might need a water treatment system to ensure a smooth transition while the old plant is being decommisissioned. Pall Corporation offers a solution that supplements or replaces your system on a permanent or temporary basis – "water treatment on wheels."

The Pall mobile water treatment system comprises a complete, automated, packaged Pall Aria micro-filtration membrane system mounted in a 48´ or 53´ box trailer. With appropriate site preparation and minimal labor, the system can be operational within hours. All that is required is to supply the source water, connect the effluent pipe, and add 460 VAC 3-phase power.

Using the same state-of-the-art hollow fiber membranes as hundreds of installed Pall Aria systems worldwide, the mobile system transforms ground water, surface water, or secondary effluent into water that is free from harmful bacteria, cysts, and particles. More than one million gallons of water a day can be filtered, to 0.1µm at 90-97% efficiency, for drinking or industrial use.

The Pall Aria system's redundant racks are mounted on skids inside the trailer. Up to 40 microfiltration membrane modules are contained in each rack. The system has a flexible configuration and can be engineered to operate in tandem with other water treatment technologies, such as Pall mobile RO systems.

In addition to housing the system components, the trailer holds equipment to monitor system operation and ensure that the water meets the required quality specifications. Safety features include two exits with platforms and stairs, an eyewash station, interior and emergency lighting, and a glow-in-the-dark walkway.

Membrane Filtration for Safe Drinking Water

Pall Aria water treatment systems are specifically designed to produce drinking water that meets today's stringent standards. The systems use uniquely designed filtration modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources.

- Suspended Solids/Turbidity
- Viruses
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Organics

The Microza* hollow fiber membranes are highly permeable resulting in high water production rates. Each hollow-fiber module provides high active surface area of up to 538 ft^2. Pall's dedication to a simplified process and control design has produced a family of systems that are characterized by:

- Tough, long-service hollow-fiber membranes
- Operator-friendly controls
- Simple surface water treatment without coagulation
- Easily integrity tested modules
- Unique air scrub and flush operation
- High efficiency, low waste
- Excellent compatibility with chlorine and common treatment chemicals
- Minimal cost of operation
- Easy installation using modular skids
- Compact system footprint
- Full system NSF 61 listing
- ISO 9001-certified manufacturing
- ETV-certified for surface water treatment rule

* Microza is a trademark of Asahi Kasei Corporation

Site testing has confirmed that Pall Aria systems meet or exceed EPA standards for safe drinking water. The system is also the first to receive “full system” certification in accordance with ANSI/NSF 61 specifications.

From 20 million gallons a day for the City of Pittsburgh to local drinking water systems at power plants, Microza MF hollow fibers and Pall Aria systems deliver a safe, automated, and flexible drinking water supply.

Pall Corporation offers a broad range of financing and rental programs. Please contact your Pall representative for details.

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Reorder Code. PGWTSENa

Power Generation

Case Study

Filtering Feed Water Reduces Boiler Tube Failures

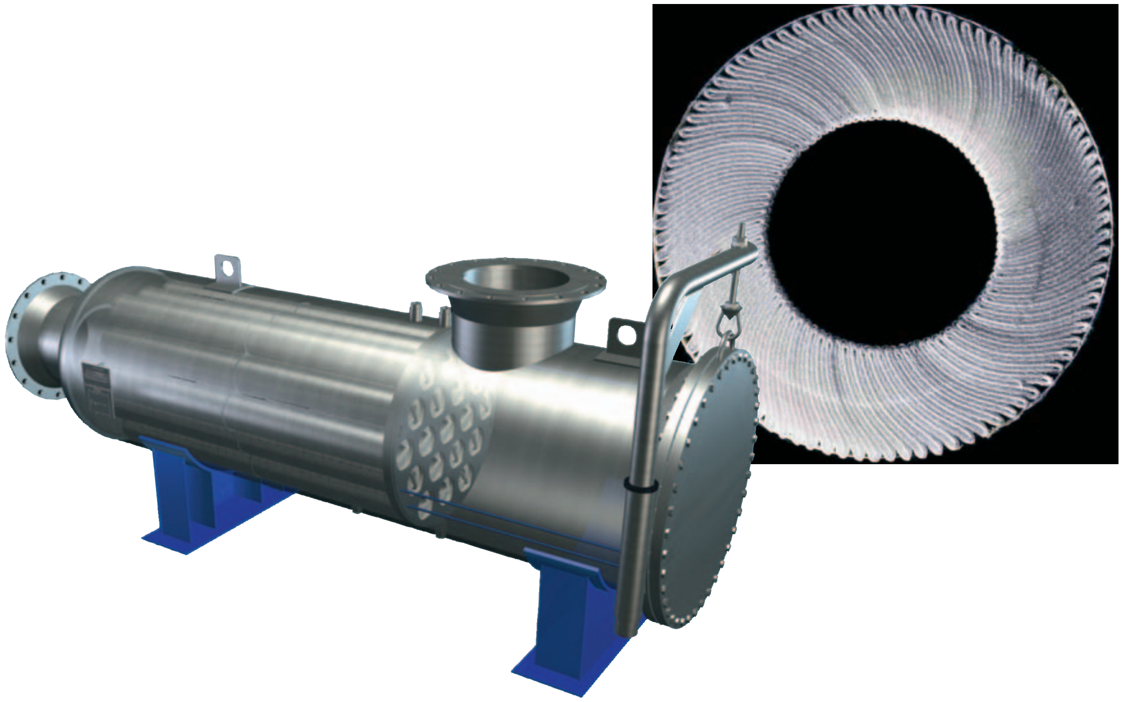
The Problem

During the 1990s, one unit of a two-unit drum type power plant in Colorado began suffering increased boiler water- wall tube failures due to hydrogen damage and under deposit corrosion from iron and copper components in the system. Under deposit corrosion is caused by concentrated contaminants building up on the boiler tube surface and eventually corroding and weakening the tube. This in turn results in large gouges, thinning of the tube, and eventual failure which can cause unplanned plant outages.

In 1996 the unit experienced ten tube failures. The ten unscheduled outages resulted in twenty days of lost generation revenue plus the expenses to repair the failed tubes. The station estimated total lost revenue of $3.5 million in 1996.

A systematic investigation of all parameters contributing to the tube failures was initiated. The results of the investigation identified condenser and economizer makeup to the boiler as the primary source of metallic contaminants contributing to under deposit corrosion.

The greatest amount of particulate metal oxide is transported to the boiler during unit startup. By reducing the metal transport to the boiler, the committee expected to reduce deposits, and subsequently reduce boiler related forced outages.



Pall Ultipleat® High Flow (UHF) filters control iron, silica, and copper in a small footprint designed for partial to full-flow filtration (up to 30,000 GPM).

Filtration. Separation. Solution.SM

The Solution

Pall Corporation supplied an Ultipleat High Flow filtration system to remove metals and other particulate from the water before they can be transported to the boiler during startup.

The solution was an assembly consisting of a 38″ diameter filter housing containing 19 Ultipleat High Flow filter cartridges. The system filters 100% of startup flow and provides β6=5,000 removal efficiency for particulates 6 microns and larger. High efficiency filtration is the key for the near total elimination of metal transport to the boiler.

Based on the success the plant had with the Pall Ultipleat High Flow installation, the plant installed an identical system in its other unit.

The Benefits

- No forced outages caused by boiler water wall tube failures since March of 2001
- Reduced boiler blow down
- Faster return to the grid after scheduled outages
- Increase in revenue generation for the plant
- Minimized copper deposition on turbine blades
- Reduced operating cost of makeup water system
- Reduced phosphate hideout, resulting in decreased chemical treatment costs

PALL® Power Generation

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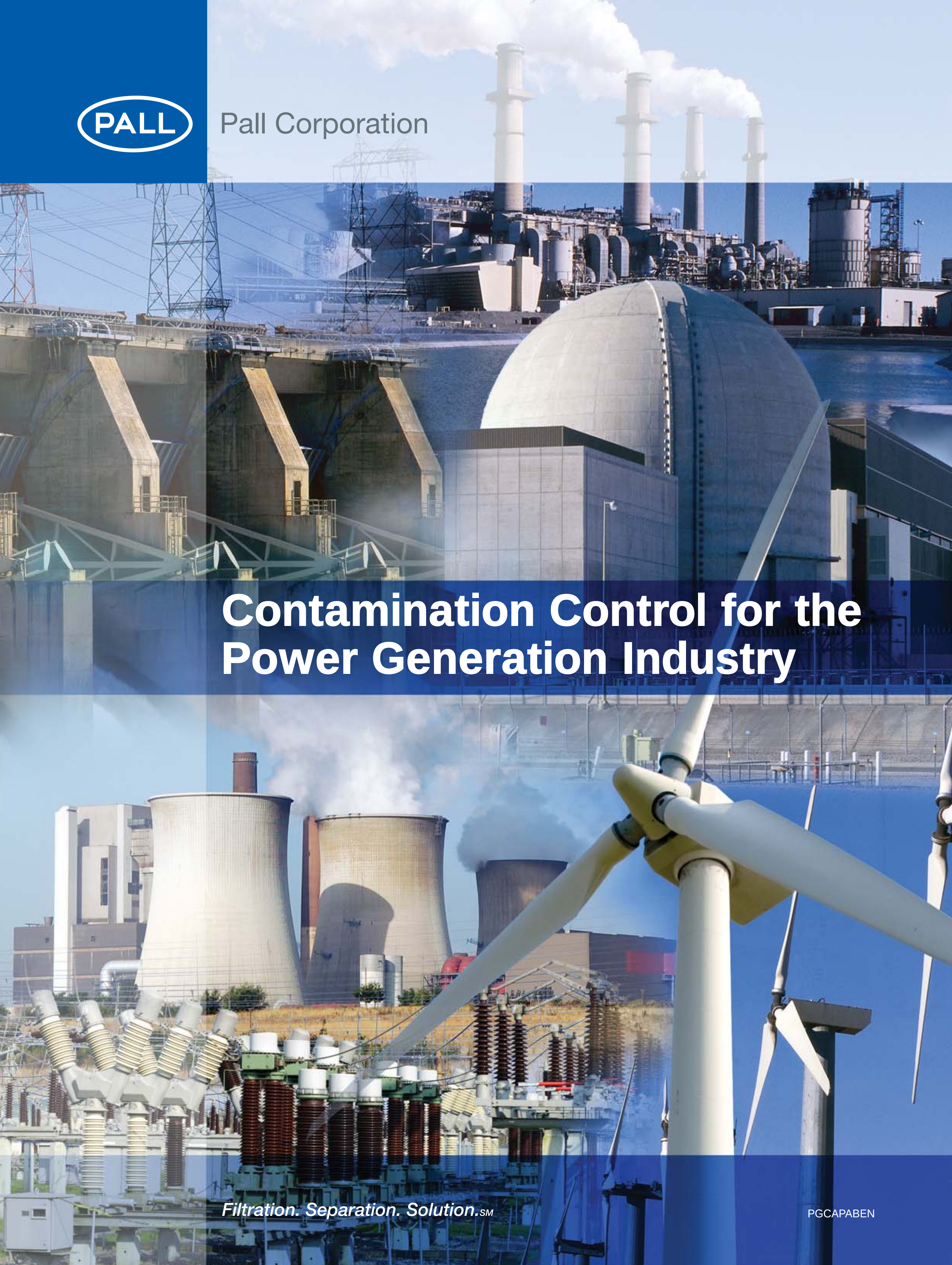
Pall Corporation



Contamination Control for the Power Generation Industry

*Filtration. Separation. Solution.*SM

PGCAPABEN

Introduction to Pall Power Generation

Pall - Your integrated partner in Power Generation

Pall Corporation is a global company solving complex contamination, separation and purification problems.

Pall's Power Generation Group is part of Pall Energy Division and as such serves the power generation market around the world. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment.

The power generation industry trusts Pall as a solution provider

Pall is a worldwide leader in fluid purification technologies for the power generation industry. Pall advanced separation science and high quality manufacturing are applied on all fluids throughout the power plant to ensure cleaner, safer, more reliable power with higher profitability.

Pall can solve your purification challenges in any size of application, from small flows and simple installations to large flows and complex systems, from the supply of filter elements to fully-integrated turnkey systems.

Benefit from Pall's expertize and customized services

Pall is much more than a filter company. Pall specializes in fluid management, leveraging our unmatched capabilities to make your operation more successful. Our expertize has enabled us to build a large library of proprietary core materials, which we can modify to separate, remove, or selectively capture the most elusive contaminants.

Total Fluid Management^{SM}

Pall has the ability to design, manufacture, and install economical, integrated systems as well as service them. Pall's Total Fluid Management (TFM) program for power generation plants help plant operators and engineers manage, control and monitor plant water, fuels and oil resources. This approach results in a reduction in total operating costs associated with fluids, operation and maintenance on critical components. Combining products with consulting services, commissioning and flushing assistance, Pall is the ideal partner for the power generation industry.

'Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment'

Contamination Control

Why is it so important to take care of fluid cleanliness?

Solid, liquid and dissolved contaminants present in liquids and gases will cause operating and maintenance problems on power production assets like boilers, turbines or transformers.

Left unchecked, these contaminants increase O&M costs, decrease thermal efficiency and output, and threaten environmental compliance of power plants.

Such issues can be solved by the use of highly effective, reliable and correctly applied filtration and separations technologies.

Applications:

Fossil Generation

Power plants around the world choose Pall to ensure the quality of their condensate water, the purity of their lubrication oil and the reliability of turbine control system operation. Pall products reduce downtime with unsurpassed flushing and oil treatment capabilities, technologies and on-site assistance. Pall water treatment systems also control and maintain make-up water and waste stream purity.

Nuclear Generation

Pall filtration systems help nuclear plants of all reactor types to maintain low levels of radioactive contamination throughout the water cycle. Pall filters reduce costs and maximize output by protecting the NSSS system, filtering the reactor pool and polishing condensate water:

- Less downtime
- Lower chemical usage
- Improved safety
- Optimal operating efficiency

Renewable Energy

Pall technology takes part in the development of renewable energy sources. From the filtration of hydroelectric turbine control and lubrication oil to the protection of windmill gearboxes or the purification of biomass gases, Pall employs state of the art technology to ensure that greener is always cleaner.

Transmission and Distribution

Energy availability also depends on a reliable and efficient grid. Pall products protect the critical purity of insulating oils. Pall online purifiers allow the online/onload treatment of transformer oil and insulation, dramatically reducing maintenance and downtime costs. By controlling water and fine particulate matter, Pall® Ultipor® WG filters protect LTC contacts, prevent OCB oil degradation and extend maintenance intervals.

'Let Pall help you optimize the performance of your generating equipment by improving fluids contamination control!'

Fossil Fuel Generation

Fuel Treatment Systems

With unmatched experience in the oil and gas industry worldwide, Pall brings complete solutions to the treatment of liquid and gas fuel for power plants. Combination of particulate filtration and high efficiency coalescence provide a fuel quality that meets the most stringent specifications of new generation combustion systems. The efficiency of Pall liquid/liquid and liquid/gas coalescers is only matched by their ease of use, low maintenance and long life.

Process Water Management

Water Supply Systems

Pall filters and membrane systems combine into a complete water treatment chain to ensure consistent, uninterrupted process water with minimal chemical usage, optimum quality and an unmatched ease of use and service. With microfiltration, ultrafiltration, reverse osmosis or filter cartridges, Pall offers the widest range of water filtration products.

Condensate Water

Boilers and turbines are protected by Pall condensate filtration systems, either in backwash or disposable configuration. For any system pressure of flowrate, Pall combines media science and system engineering expertize to offer the best protection against corrosion transport.

Pall HGCOld and HGPPB backwash systems offer:

- Engineering expertize to ensure long, economical operation, in demin-precoat or straight filtration mode
- Variety of media ranges and materials to adapt to any condensate flow conditions

Pall Ultipleat® High Flow disposable filters offer:

- Small footprint even for full flow installation
- Proprietary crescent shaped pleat geometry
- High efficiency, high flux filtration at ratings from 100 to 1 micron
- Simple element replacement

'high efficiency filtration, purer fuel, reduced pollutant emissions, low energy consumption, protection from erosive and corrosive wear, with minimal maintenance.'

Hot Gas Filtration

Pall has the full complement of fluid management products for hot gas filtration for the latest combustion technologies including ceramics for biomass and coal gasification, plus products that reduce pollutant emissions driving the movement towards efficient, clean and low cost energy.

Steam Turbines

Lubrication

Pall's full range of oil filtration and oil purification products combine to provide the best possible protection of the bearings and shaft against wear and corrosion. By efficiently and economically removing moisture, particles and gases from lubricating oils, Pall products ensure that critical machinery is protected and that the oil remains in pristine condition.

Hydrogen Seal Oil

The task of protecting seals from abrasive wear, and preventing water from ingressing into the generator falls on the turbine lubrication oil control system. The solid and moisture protection from the Pall TLC helps maintain hydrogen purity and minimize maintenance on the seals.

Control

The hydraulic systems controlling the steam valves are some of the most sensitive and critical components around the steam turbine. Pall products combine filtration, dehydration and ion exchange to protect and even reclaim hydraulic fluids, whether mineral or synthetic. With proper filtration and fluid treatment, critical valves are protected against stiction and erosive wear, and hydraulic fluids are protected against thermal degradation or acid formation.

Nuclear Power

'Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.'

State-of-the-art media design, application experience and unsurpassed removal efficiencies have made Pall the world standard in nuclear safety, control, radioactive waste treatment and fuel pool clean-up. Pall products shorten outages, increase operating efficiency and minimize exposure with the backing of expert customer support worldwide.

Fine Ratings Programs

For many years, Pall filtration systems have been used in the most sensitive nuclear applications of PWR coolant systems. Today, the cleanest plants use Pall nuclear grade filters to reduce the out of core radiation levels and reduce overall personnel exposure. The fine ratings program is a step by step reduction of filtration level down to 0.1 micron in order to decontaminate the coolant systems progressively, ensuring better operation, easier maintenance and reduced exposure.

Media

Pall provides innovative disposable and back-washable media in a wide range of micron removal ratings, developed, designed and manufactured under the strictest quality controls for exceptional performance, reliability, and consistency.

Elements

Pall's disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radioactive waste, fewer change outs and added protection for equipment and personnel.

CVCS and Coolant Pump Seals

Pall Ultipor GF Plus media is positively charged and rated down to 0.1 micron. These rapidly remove radioactive material and provide the highest level of safety in the primary loop.

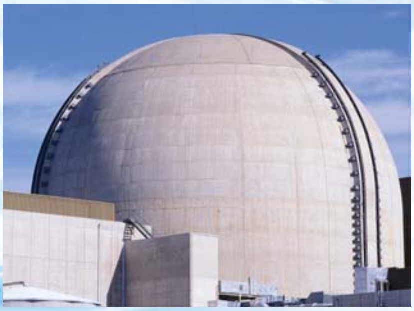
Pall Ultipor GF Plus elements filters the cooling water, protecting against seal wear and plant exposure with unsurpassed integrity, efficiency and durability. Pall filters provide the best way to reduce out of core radiation, personnel exposure and costs.

By removing minute solid particles, Pall Ultipor GF Plus filters are also used to protect the seals of the main coolant pumps. Reduction in abrasive wear of the seal, shown by a drastic reduction in leak rates, ensure longer life and lower seal replacement costs.

Nuclear Condensate Systems

Pall backwashable condensate filtration systems are an industry standard for BWR protection. In precoatable or straight filtration mode, Pall elements combine very high efficiency with strong integrity and durability. Backed by unmatched system design and operation expertize, Pall filters are the most effective way to maintain feed water purity, reduce ion resin consumption and protect the steam generators.

Pall traps and laterals protection feature an all-metallic porous media combining a very high void volume with high mechanical and thermal resistance up to 600F. With removal levels from 400 down to 18 micron, the Pall Rigimesh® line offers the best protection against resin leakage and fouling.



Renewable Energy

‘Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs.’

Hydroelectric Power

Clean hydroelectric generation depends greatly on the reliability, availability and response of the turbine control mechanisms and lubrication systems. By ensuring that the lubricating and hydraulic oils are maintained in pristine condition, Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs. Combined with Pall analysis capability and monitoring equipment, they form the ultimate protection against component related outages, high oil replacement costs and sluggish system response.

The combination of fine particle control and efficient moisture removal protects the oil films and the components. By consistently maintaining oil cleanliness lower than a ISO 16/14/12 life of roller or journal bearings can be drastically extended.

Filtration and Moisture Control - A Total Fluid Management solution

Pall Ultipleat SRT filters are especially designed to remove clearance size particles known to cause fatigue wear of the bearings, abrasive wear of the governor control valves and fluid degradation. With superior resistance to cyclic flows and no electrostatic discharge, the Pall Ultipleat SRT filter performs at its peak under the toughest of conditions.

When moisture is kept well under the saturation level of the oil, the process of oil oxidation can be stopped and with it, corrosion in the lube and control system. In hydroelectric plants, Pall purifiers and air dessicant breathers maintain moisture levels under 30%RH, and protect lubrication and hydraulic fluids against water ingression.

Wind Power

Gearbox Protection

When the gearbox faces variable loads, and operates in vibrating and extreme environments, it needs to be protected by a filtration system able to deliver specified cleanliness under stress conditions, at all times, consistently, and reliably. Pall wind turbine lube filtration systems combine design simplicity, ease of service, light weight with the performance of Ultipleat SRT technology.

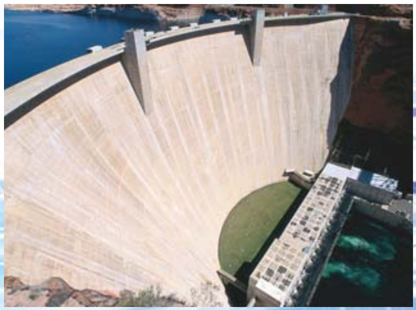
To ensure total cleanliness control, oil is protected against water or dirt ingression by Pall breathers, and its quality can be remotely monitored with Pall moisture and particle sensors.

Remote Monitoring of Oil Condition

The ability to detect oil quality problems early is a critical step in ensuring viability of remote windfarms. Oil contamination can be a strong indicator of component wear, its detection is the key for switching from reactive to predictive maintenance practices. With Pall capability for remote particle and moisture sensing equipment, wind turbines are never left alone, as far as they may be.

Biomass

Pall ceramics and metallic filter technologies are used to purify combustible gas in hot and chemically challenging environments such as in gasification processes and protect burners and turbines downstream. With advanced design capabilities for large blowback gas filter systems, Pall participates actively in the development of renewable combustible sources.



Pall Technology Services

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation technologies and services into a production process to yield the highest efficiency at the lowest cost. The Pall TFM program covers a wide range of filtration products, advanced technologies and services to improve system operation and increase productivity.

Our global team of scientists and engineers support TFM

Pall offers a variety of services to help you maximize productivity within your plant. We deliver TFM to you with the support of our global teams of Scientific and Laboratory Services (SLS). Located in more than 30 countries, our scientists and engineers provide these services locally, with broad-based assistance from Pall's worldwide technical support network. Our experts work directly with you to determine how Pall products and technologies can benefit your process.

Consultancy

Servicing

Flushing Services

Filtration Equipment Hire

Our customized system services include:

Commissioning and Flushing

Pall has the most extensive network of distributors and customer service centers in the world. Pall provides flushing, monitoring and consulting during plant overhaul, turbine start-up or system flushes worldwide. With Pall products, monitoring equipment and field expertize, our start-up assistance programs enable users to get back on-line faster, cheaper and more efficiently to maximize output, flexibility and operating profits.

Cleanliness Audit

A cleanliness audit can uncover contamination problems and their detrimental effects. Our laboratory staff and field engineers have at your disposal lab-scale and analytical equipment and field pilot-scale units. By sampling at various locations throughout the process, we collect, quantify and identify solid and liquid contaminants to determine their origin and provide you with recommendations for corrective action. Our recommendations are designed to help you optimize your processes and increase the reliability of your equipment at the lowest possible cost.

Process Audits / Consultancy

Pall offers troubleshooting, audit and consulting services to identify opportunities for process improvements that lead to increased productivity. Improvements are defined, for instance, as the reduction of operating costs or maintenance operations. An audit involves data collection and proposal review, followed by a technical report documenting the findings and suggestions for improvement.

Filtration Equipment Rental

When you need to rent filtration and purification equipment to conduct spot depollution of system fluids, to conduct large-scale pilot testing or to use while permanent equipment is being manufactured, contact Pall. Our rental services can provide equipment on the spot, so that you can handle upsets promptly.

Combustion Turbines and Combined Cycle

In all aspects of the operation of a combined cycle plant, Pall employs state-of-the-art technology to ensure a consistently high quality supply of water, fuels and lubricating oil to the machines. With gas treatment solutions to reduce emissions and environmental impact, Pall is the complete partner for CCPP operators looking to improve operation, save on fuel and water costs and improve system reliability and availability.

Fuels

Pall's expertize in liquid and gas fuel treatment ensures that combustion turbines are constantly protected from the mechanical and chemical attacks due to fuel impurities. Pall fuel treatment solution combines very efficient particulate filtration with coalescence to remove moisture or aerosols in the fuels. The result is a drastic reduction in the presence of solids, gels, water and salts in the fuels entering the combustion chamber.

Pall is also an expert in the treatment of alternative fuels and is an industry standard for coal and biomass gasification systems, with a range of ceramic and metallic filtration systems. With unmatched experience in materials and system designs, Pall hot gas filtration systems are at the core of some of the newest and most promising power generation designs.

Liquid / Liquid and Liquid / Gas Coalescers

Oil Mist Eliminator

Machine Protection

Whether industrial or aeroderivatives, combustion turbines are protected by Pall oil filters in the lubrication and control systems. By stopping the chain reaction of wear in rolling or journal bearings of the turbine, Pall filters protect the machine against downtime, repairs and bearing wear.

Pall oil mist eliminators reduce emissions of oil vapour to the atmosphere using Pall liquid / gas coalescers. Their efficiency and low resistance to flow means that the system reservoirs can breathe without restriction and with no detectable oil emissions into the plant.

Water Systems

In combined cycle plants, the availability and quality of water is critical for both the heat recovery boilers and the combustion turbine itself. Pall membrane systems ensure consistently pristine water meeting the most stringent purity requirements of new generation combustion turbines and high pressure boilers. With a wide range of ultra and microfiltration membranes, reverse osmosis, cartridge filtration and polishing systems, Pall brings the complete water management solution to combined cycle plants. The result is a cleaner combustion, better operation of Nox control systems, protection of the boiler against corrosion and FAC and reduced water usage overall.

Pall Aria System

Ultipleat High Flow Particulate Filters

Technologies For Contamination Control And Monitoring

Pall filtration and separation technology

Pall designs and supplies a wide range of media, filters, and systems to remove contaminants from liquids and gases.

These products, along with our service capabilities and technical expertize, enable us to fulfill diverse fluid purification requirements throughout all power generation processes.

Ultipleat High Flow/Coreless Filter Elements

Particulate Filtration for Liquids and Gases

Pall designs, manufactures and markets the widest range of solid contamination control products anywhere. Pall filters can remove minute solid particles from liquid or gas streams, across a wide range of temperature, pressure, and chemical conditions. These particulate filters can be made of glass fibres, polymers, metals or ceramics. With various shapes, sizes and micron ratings, they offer economic, efficient and durable contamination control in some of the most critical applications in power plants.

HNP006 Oil Purifier

Coalescence and Dehydration

Removal of moisture and aerosols from oils or fuels is paramount in order to protect machines like combustors or bearings. Moisture and aerosols carry chemical and solid contaminants responsible for deposits, chemical attacks or fluid degradation. Results can be devastating outages and high maintenance costs. Pall coalescers and oil purifiers have what it takes to remove unwanted contaminants from hydrocarbons, down to their solubility levels, and even beyond. Combustion chambers, injectors, bearings or seals all benefit from complete removal of moisture contaminants from fuels and oils.

Membrane Technologies

Membrane Technologies are by far the most effective methods for water processing applications. The Pall range of membrane systems includes microfiltration, ultrafiltration and reverse osmosis membrane technology. Pall Aria™ water treatment systems for example use hollow fiber microfiltration membranes to produce pure water from any water source. They remove bacteria, iron, manganese, arsenic, and other solid particulate to deliver water that consistently measures up to the toughest cleanliness and quality standards.

Pall membranes are used for production of make-up water, recycling of blowdowns and wastewater, as well as water fed protection for combustion turbines.

Contamination Monitoring

Solid Contamination Monitors

Obtaining accurate and reliable fluid cleanliness data quickly in order to detect abnormal contamination is a key factor in ensuring the efficiency of industrial processes and reducing downtime.

Reliable monitoring solutions ...whatever the conditions ...whatever the fluid

Pall have portable devices that resolve detection problems by giving plant operators the ability to measure the cleanliness of even the most troublesome fluids reliably, simply, and quickly, and prevent unnecessary and costly machinery downtime.

The Pall PCM400W Cleanliness Monitor can confirm cleanliness of almost every kind of system fluid.

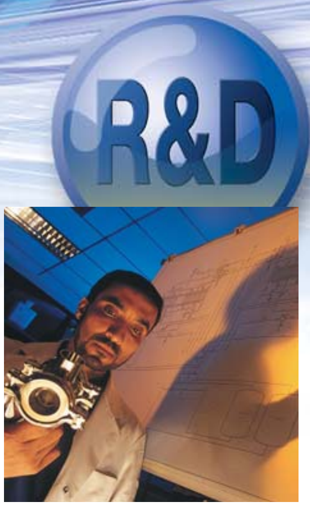
The Pall PCM400W uses multiple mesh blockage technology to address the common problem of inaccurate or unreliable results when monitoring fluids that are dark, cloudy, or contaminated by water or air. Additionally it can read fluid temperature and saturated water content (when appropriate).

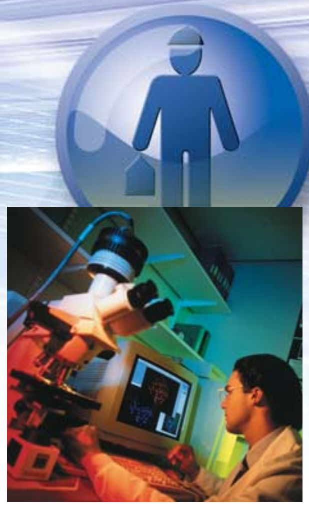
PCM400W

Pall Water Sensors

Wherever possible, oils should be operated without the presence of free or emulsified water.

Pall Water Sensors detect water in solution within the fluid, displayed as a percentage saturation or expressed as a parts per million (PPM) reading. Options include the handheld unit for a ‘point-in-time’ reading or the permanent unit which can provide continuous or timed monitoring.





Research and Development

Working with equipment and component manufacturers in these markets, Pall custom designs products and purification systems that are fully integrated into oil and gas industry applications.

These products extend component service life, enhance safety and improve the operating reliability of all processing systems.

Scientific and Laboratory Services

A principal element in Pall's customer support operations is our Scientific and Laboratory Services (SLS) Department. Filtration problems arising in the field can be assessed and simulated in the laboratory. Close monitoring by Pall scientists can determine the engineered solution to your contamination and separation problems and advise accordingly.

Sales and Support

The sales and support team comprises a group of experienced specialists located in Europe, the USA and across Asia with distributors and representatives worldwide. We offer a comprehensive sales and service support to all customers around the world.

Quality

The policy of Pall is to design and manufacture products to the highest and most current standards of quality, safety and reliability. To implement this policy, the organisational structure and the procedures by which Pall operates are fully defined in quality management systems, approved to ISO 9001:2000

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Power Generation

Case Study

Pall Generates Cost Savings for the 2007 Coal Plant of the Year

Westar Energy's Lawrence Plant Deploys Pall Aria™ Microfiltration System to Treat River Water

Overview

Westar Energy is the largest electric energy provider in Kansas, delivering reliable power to more than 675,000 customers.

Sitting on 600 acres in the northern edge of town, Westar's 69-year-old Lawrence, Kansas plant was recently named 2007 Coal Plant of the Year by the PRB Coal User's Group.

The Challenge: Reduce Water Expenses

Prior to 2007, the Lawrence Power Plant was relying on city water as its makeup water source. For the years 2004-2006, the plant spent almost $625,000 on water, about 87% of which was for city water.

The plant was relying on sand filters and clarifiers, but was not getting the results it needed.

The Solution: Pall Aria™ AP-4 Microfiltration System

The Lawrence plant had a five-year contract with a company to provide sand filtration, but the plant struggled to get the purity it needed. In fact, the plant was never able to realize consistent reliability. When the contract expired in late 2006, the plant installed a Pall Aria AP-4 microfiltration system.

Designed specifically to treat surface water like the water the plant was pulling from the Kansas River, the system performed very well. After incorporating a clean water flush before every shutdown, the plant has enjoyed excellent reliability. Currently, the Pall Aria system is providing high purity water with minimum intervention and greater degree of flexibility to the plant.

Westar Energy's Lawrence Plant

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"We run for five days and shut down for two days, and we flush the membranes with city water each time we shut down," says Vince Avila, Plant Engineer at Lawrence. "The system has handled all the seasonal changes in the water and has performed very well."

According to Avila, the plant saved more than $77,000 on water in 2007 – a savings he expects the plant to realize on an annual basis. "Expensive city water used to be a staple," he says. "Now we've gotten it where it should be – as an emergency measure."

Westar Lawrence Plant Water Costs

Pre Pall Aria System Implementation			
Year	**City**	**River**	**Total**
2004-2006	$180,788 (average per year)	$27,180 (average per year)	$207,968 (average per year)
Post Pall Aria System Implementation			
Year	**City**	**River**	**Total**
2007	$84,846	$45,492	$130,338

The Pall Aria system helped the Lawrence plant save more than $77,000 on water in 2007.

Pall Aria System Weathers the Storm

In May of 2007, the Pall Aria MF system was put to a test that neither the Lawrence plant nor Pall could have anticipated; heavy rain from an already deadly storm system caused severe flooding of the Kansas River.

The plant, which was now taking almost all of its water from the river, saw turbidity, normally in the 25-30 range, average 470 NTU for the entire month, with turbidity spikes reaching 2,200 NTU. The Pall Aria system proved to be up to the challenge; incredibly, the plant did not need to switch to city water one single time.

"Every piece of debris from the banks ended up in the river," says Vince Avila. "We wouldn't have been surprised if the system ground to a halt. But it stayed in operation the entire time."

"Every piece of debris from the banks ended up in the river. We wouldn't have been surprised if the Pall Aria system had ground to a halt. But it stayed in operation the entire time."

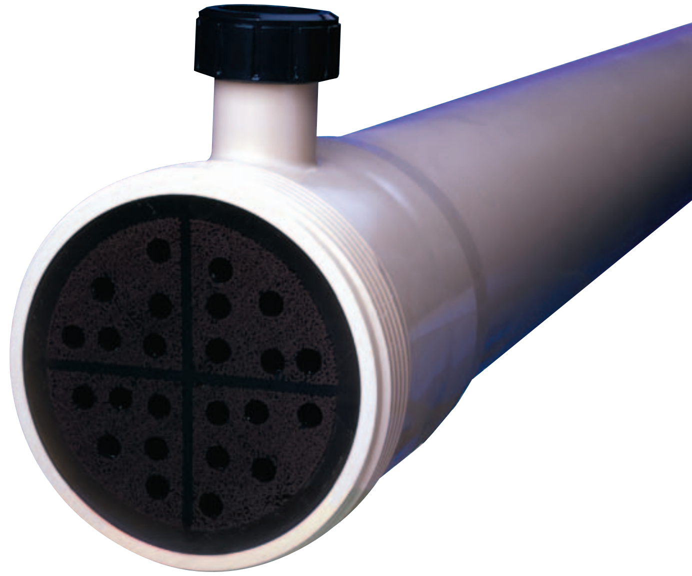
Vince Avila, Plant Engineer

In addition to its ruggedness, the plant is also impressed with the user-friendly nature of the Pall unit; since there are only two lab techs on staff for the entire plant, it was critical that the solution save man-hours.

"The system has performed very well for us," concludes Avila. "We take a set of readings in the morning, and if everything is OK, the system requires very little interaction."

Pall Power Generation

A Leader in Fluid Purification Technologies for the Power Generation Industry



Pall advanced filtration and separation science and high-quality manufacturing are applied on all fluids throughout the power plant to improve reliability and ensure available and profitable power.

With stringent treatment regulations and a growing demand for safer water, treatment systems must ensure strict compliance with purity standards. Filtration is critical to the success of your water treatment system in meeting purity goals, and traditional filtration methods such as sand and granular mixed media are often inefficient, labor-intensive, and costly.

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system. The Pall Aria line of water treatment systems uses hollow-fiber microfiltration or ultrafiltration membrane technology to produce pure water from any water source, delivering a consistent, high-quality water source for as much as 50% less than the cost of purchased water.

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Power Generation

Case Study

Texas Plant Revamps its RO Pre-treatment with Pall Aria™ Microfiltration System

Introduction

Until 2002, a supercritical plant in Texas equipped with three 750MW Westinghouse steam turbines and CE tangential supercritical boilers, was using a clarifier for pre-treatment of cellulose acetate RO membranes to provide condensate make-up.

The Problem

The large clarifier exhibited signs of corrosion due to the acidic treatment of the water in the process. In addition, the quality of the water was deteriorating, and conductivity increased due to ferric sulfate and caustic addition. The plant also reported difficulty in stabilizing water chemistry: an average of 2 or 3 days to stabilize the system after a change in demand or influent chemistry.

The plant was experiencing an increase in the cost of chemicals (up to $50,000/year) to try to catch up with a failing and deteriorating system. Initial estimate of repair and upgrade to the clarifier system was $300,000.

The Solution

A Pall Aria™ automated microfiltration (MF) system was used to replace the entire pre-treatment train. The system treats raw water from the 77,000 acre lake nearby for use in the plant RO system.

The Pall Aria solution comprises two AP-4 systems totaling 600gpm capacity. Both units are controlled from a single PLC and maintain consistent water effluent to the RO system, without chemical treatment. Water quality is maintained at 0.04 NTU.

Since installation in February 2002, the Aria system has been providing high purity water with minimum intervention and greater degree of flexibility to the plant.

Pall AP-4 Aria microfiltration system to treat 300 gpm (total output for 2 AP-4 is 600 gpm to the plant)

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The Benefits

- A consistent water quality of 0.04 NTU out of the Aria system, for a wide range of upstream water conditions
- At least 6 months operation between CIP (clean in place)
- The ability to change flow on demand from the PLC without major adjustment
- Reduction of the maintenance required for the pre-treatment process by a factor of 6
- Extension of the service life of the filter element upstream of RO, from 3 days to over 6 months.
- A great reduction in space needed for water treatment (by over 60%)
- 6-month Return on Investment
- Reduced man hours by 100,000 hours
- Chemical reduction of $50,000 per year
- Savings of $250,000 per year, previously spent on filter media for clarifier
- 3 years with 0 hours downtime
- Savings of $2000 per month, previously spent on Polymer addition
- First year savings of $500,000

PALL® Power Generation

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PGCS4

Case Study

PALL

Power Generation

EnCana Keeps the Water Flowing with Pall

Cavalier Power Plant Deploys Pall Aria™ Microfiltration System to Treat Cooling Tower Blowdown Water and Provide Feed Water to RO Units

Overview

Headquartered in Calgary, EnCana Corporation is one of the largest oil and gas companies in the world.

Formed in 2002, the company is involved in operations in Alberta, British Columbia, Saskatchewan, the Rocky Mountains, Texas, and Nova Scotia. EnCana has received numerous awards for its environmental initiatives and is recognized on the Dow Jones Sustainability Index.

The Challenge: Quality Feed Water

In 2006, the Cavalier Power Plant found itself unable to provide enough quality feed water to its RO units. The inlet water had very high levels of sub-1μm particles as well as an immeasurable high SDI. The multimedia filters that were in place at the time were simply not capable of producing water of sufficient quality or quantity. The multimedia filters also required the addition of costly chemical coagulants.

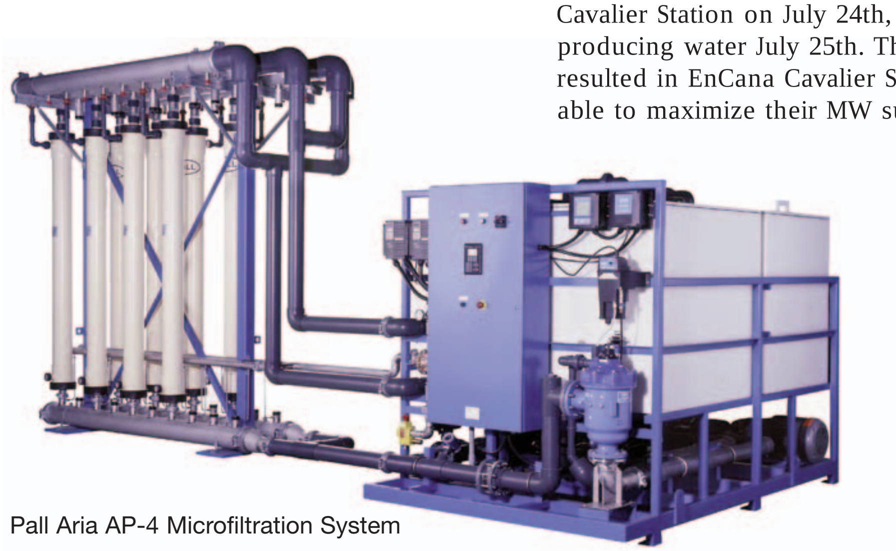
Experiencing rapid RO fouling and reduced water plant capacity, Cavalier was forced to resort to the expensive measure of trucking in DI water from another plant.

The Solution: Pall Aria™ AP-4 Microfiltration System

The level of small particles fouling the RO units, which could not be removed by the current filters, clearly indicated that a new technology was needed. After an extensive evaluation, Cavalier believed that MF/UF was the best solution, and reached out to Pall Corporation.

"Pall's MF has a reputation for being tough and reliable," says Brad Swainston, Water Treatment Plant Lead Operator, at EnCana's Cavalier Power Station. "Also, Pall was most willing to accommodate us with a trial."

Pall agreed to provide a Pall Aria AP-4 microfiltration system for a three-month trial period, guaranteeing < 3 SDI and < 1 NTU. If these parameters were not achieved, Pall agreed to refund all rental fees paid to that point, and to take back the AP-4. The unit was shipped from the Pall factory on July 14th, 2006, was commissioned at EnCana Cavalier Station on July 24th, and was producing water July 25th. This in turn, resulted in EnCana Cavalier Station being able to maximize their MW supply to the



Pall Aria AP-4 Microfiltration System

grid, only one day after receiving shipment of the Pall AP4.

It wasn't long before the Pall units proved their value. As a testament to that, EnCana was so satisfied with the results at the Cavalier plant that a second AP-4 was ordered in October, 2006

"We use our Pall AP-4 microfilters extensively in the CT blowdown recovery system at the Cavalier Power Station," says Swainston. "The overall filtration capacity of our redundant AP-4 unit exceeds the filtered water requirements at our RO inlet by roughly a factor of 2 times. This extra filtration capacity has been used to filter a portion of the raw water make up to the cooling tower and also part of the cooling water itself. This process reduces the suspended solids loading on the cooling tower and in turn increases the efficiency of our CW chemistry."

The most important benefit of this system was that it rendered the original cooling water side stream multimedia filters obsolete. These units used an excessively high volume of water for their backwash, creating a lot of waste. Also these filters were not capable of removing fine solids (sub 10 micron), so Cavalier's cooling water solids loading was weighted heavily with fine particulate. "In essence," adds Swainston, "the AP-4 units have reduced cooling tower waste water quantity and increased cooling water quality."

The cost of water treatment for the 12 months prior to installing the Pall Aria system was \$.99/megawatt hour. Of that, \$.25/megawatt hour was spent on multimedia filter coagulant.

"The addition of the microfilters allowed us to discontinue the use of coagulant, enabling a \$.25/megawatt hour savings," reports Swainston. "We were also hauling sludge from our blowdown pit at a cost of \$10,000 to \$15,000 a month for trucking and disposal. Now we're able to haul sludge once a year for an additional savings of \$.25/megawatt hour."

"Since implementing the Pall Aria AP-4 systems, Cavalier's water plant has proved extremely reliable," concludes Swainston. "This, in-turn, has increased over-all plant reliability and availability."

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2004 A Burbank: Link power, wastewater treatment to conserve potable water, reduce cost

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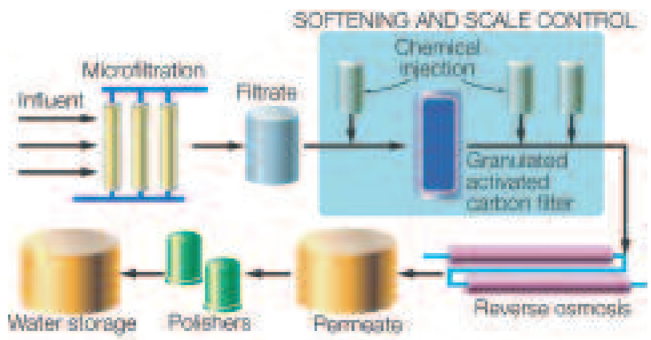

Microfiltration is first step in Burbank's water treatment system, followed by softening, reverse osmosis, polishing

To conserve potable water, California's Water Resources Control Board requires powerplant developers to use what it calls treated reclaim water for cooling-tower makeup or to install air-cooled condensers as an alternative to wet towers. While some developers might consider this restrictive, it's business as usual for Burbank Water & Power which first began using treated wastewater for cooling-tower makeup 35 years ago.

Innovation never stops at Burbank, however. In June 2002, the utility unveiled a treatment system that converts tertiary-treated municipal wastewater into high-quality demineralized water for power augmentation in its new LM6000 gas turbine (GE Power Systems, Atlanta, GA) and for makeup for two existing boilers. This system enables Burbank to operate its generating facilities without using any potable water from the city.

The new gas turbine was installed at the utility's Olive plant in spring 2002. It is equipped with the manufacturer's Sprint+ option which permits water injection to cool compression stages and thereby increase the machine's power output by about 9% at ISO conditions and by more than 20% when ambient temperature is above 90°F. The Mark 6 control system supplied with the LM6000 regulates water injection to maintain the optimum temperature for maximum compression.

Bear in mind that ultrapure water is critical for compression augmentation and for the unit's inlet fogging system. It must be free of all solid contaminants and of dissolved metallic and silica salts. Reason: Impurities will plate on turbine blades, causing efficiency loss, and contribute to erosion and corrosion of nozzles and blades, which can result in premature replacement. Water-quality specifications for gas-turbine applications often surpass those for steam-plant condensate systems. Power Supply Manager Dennis Moran says that injection of demineralized water into the compressor is the least-cost way of generating additional power at Olive, given the site's tight spacing and other considerations.

Executives at the nation's public utilities are particularly sensitive to the reliability and cost of energy services because their retail customers, in effect, own the company and they typically have little tolerance for price increases. So when Burbank began planning a water treatment system for the LM6000 it focused on an influent flexible system—one that could operate on reclaim as well as potable water without modification—and placed a high priority on cost containment.

The treatment system selected yields a product water that has 10 times the purity of makeup water the plant was buying for its steam units before the LM6000 was installed. Puretec Inc., Ventura, Calif, the primary contractor for the project, owns, operates, and maintains the treatment system for Burbank. *Con't*

Treatment begins with microfiltration. An Aria™ MF unit from Pall Corp, East Hills, NY, eliminates all solid contaminants above 0.1 micron in size. MF effluent is essentially free of solids, colloidal silica, and bacteria. It is piped to a temporary storage tank with sufficient volume to permit operation of the RO unit and polishing demineralizers at peak efficiency while the Pall filter undergoes periodic self-cleaning. Next step is chemical treatment for softening and to prevent scaling, and flow through a granulated activated carbon filter to remove residual chlorine. The resultant filtrate, with an average total dissolved solids (TDS) of 650 ppm, is piped to the suction inlet of Puretec's E-frame, dual-pass RO skid. It reduces the mineral and salt load in the influent by 99%, yielding a product effluent with 1.5 ppm TDS. Permeate is piped to a 120,000-gal tank for storage and degasification. On demand, the RO permeate is pumped from the storage tank through a set of mixed-bed polishing demineralizers to remove any remaining ionic material. CCJ

Pall's Aria Membrane Water Treatment System.

About Pall Aria™ Membrane Water Treatment System

Pall Aria microfiltration (MF) systems provide consistent high purity water for plant make-up and feed to RO systems for a wide range of influent water sources and water quality. Used extensively around the world, Pall Aria Systems satisfy any and all water requirements including the ability to produce boiler quality feedwater as well as drinking water that meets today's stringent standards. Pall Aria Systems are influent flexible, meaning they can take influent of up to 1000 NTUs and consistently produce effluent of less than 0.05 NTUs in a single pass.

Pall Aria Systems use uniquely designed filtration modules in a hollow fiber configuration to remove fine particulates, bacteria, cysts and oocysts. Iron and magnesium can be removed by pre-oxidation, and total organic carbon can be reduced by direct coagulation. The hollow fibers are highly permeable membranes resulting in high water flux rates.

Metals, biological contaminants and bacteria in RO feedwater can quickly escalate operating and maintenance costs. Designed for ease of operation, Pall Aria Systems consistently provide a reliable quality feed to RO systems. Pall Aria Systems are complete turnkey solutions to treat water flows from 75 to 875 GPM. They can be easily installed and require little space and maintenance. When real estate is of concern, Pall Aria Systems handle more than three times the flow of conventional systems per square foot of floor space. Additionally, the capitalized water treatment cost with a Pall Aria System is less than 50% per one thousand gallon basis of a typical clarifier.

Pall Aria Systems are fully automated to offer the technology, consistency, and ease of operation needed in today's pursuit for efficient, clean and reliable power production. Utilities worldwide look to Pall to provide an unsurpassed level of safety, quality, purity, and economic value.

Pall Corporation

Technical Paper Presented at Southwest Chemistry Workshop, Farmington, NM, June 23-24, 2009

Pall Integrated Membrane System Enhances Boiler Feed Water Make-Up Quality and Lowers Operating Costs

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Abstract

A major North American utility station deploys conventional lime softening and demineralizers to produce high-quality water for boiler make-up. The conventional system uses coagulant, lime, acid, and caustic in large quantities to produce demineralized water. Pall Corporation and plant personnel worked together to develop an integrated membrane-based system to produce high-quality permeate water to maximize ion exchange run times. This paper focuses on the conventional approach and the new membrane approach in treating the lake water to produce demineralized water, as well as the challenges faced, and direct and indirect benefits gained with the new system.

Introduction

The utility is a large coal-fired power plant that operates three coal-fired units. The units are about 600 MW each and were originally designed to handle high sulfur bituminous coal. This paper shows the results obtained from the conventional water treatment scheme established at the plant to make boiler feed water for the high-pressure boilers. The paper has a detailed description of the integrated membrane-based system that Pall recently installed at the site, and documents the improvements in performance that were realized.

Microfiltration/Reverse Osmosis Technology

Conventional clarifier/multimedia filters for the treatment of incoming fresh water into plants suffer from several drawbacks. The primary one is the inability of these systems to cope with sudden upset conditions that could result in increases in total suspended solids in the feed water. This is also reflected in an increase in Silt Density Index (SDI), or in turbidity (NTU values) in the feed water to the unit, as well as in the permeate (filtrate).

Technological improvements since the 1990's have resulted in processes such as Microfiltration (MF), Ultrafiltration (UF), and Reverse Osmosis (RO) becoming economical and popular. In a typical application with MF, the incoming water passes through several thousand spaghetti-like hollow-fiber polymeric membranes, which remove suspended solids and bacteria such as Giardia and Cryptosporidium. The range for MF is 0.05-5 micron, and for UF technology, the range is 0.005-0.1 micron.

For removal of dissolved solids, the treated water from the MF/UF unit passes through the RO membranes. This technology is employed before the demineralizers. The pores in the RO membrane are only a few angstroms in size and can remove a majority of the dissolved salts. The RO membranes (normally spiral-wound design) are easily susceptible to fouling and extra care is needed to limit the amount of suspended solids entering the RO. This means that the unit upstream of the RO membrane (MF, sand filters, etc.) must limit turbidity to less than 1 NTU and have an SDI less than 3.

Modes of Operation

The MF and UF filtration systems can be operated in the dead-end mode (outside-in flow) or in crossflow mode. The RO units operate in the crossflow mode.

The MF unit described in this paper uses a hollow fiber PVDF membrane operated in the conventional dead-end filtration mode under pressure, where the feed water flows in from the outside to the inside of the hollow fiber and the suspended particles and bacteria are captured within the filter .The permeate is sent to the RO unit. The MF unit requires continuous air and chemical cleaning, which is described in a later section. The RO unit operates in the crossflow mode, in which the feed water flows parallel to the membrane surface. The water that is filtered through the fine pores (permeate) is mostly devoid of dissolved salts and is sent to the demineralizers for the polishing step before being used as boiler feed water. The portion known as the "retentate" or "reject" flows along the surface and is independently collected.

Background Information

Raw surface water from an adjoining lake is the fresh water source for the power plant. In the original treatment scheme, about 1500 gpm of this water was being treated with a conventional clarification and cold lime softening process followed by sand/gravel bed filtration. Demineralization units were subsequently used to produce the required water quality for the HP boilers. These units consisted of a conventional cation bed using sulfuric acid for resin bed regeneration, and weak and strong base anion beds as well as a mixed-bed demineralizer using caustic soda for resin regeneration. Downstream of the demineralized units, the condensate water for the boilers was sent to storage tanks. A Graver Powdex® pre-coat filtration system was used for polishing condensate before the low-pressure heaters.

The driving force to consider alternate treatment schemes in lieu of the conventional clarifier/sand bed was as follows:

A. Chemical costs required to regenerate the demineralizer beds were extremely high since regeneration of the resin was carried out once a day or even more frequently. The ion exchange run time needed to be improved significantly.

B. Operational simplicity: Frequent upset in the clarifiers would result in frequent regeneration.

C. Although the plant was designed with a three-bed demineralizer followed by mixed-bed polishers to meet boiler feed water quality, silica breakthrough in the strong base bed was frequent and beds were regenerated more often. This is reflected in the chemical consumption shown in Table 1 (page 5).

D. The condensate polishing system had to be precoated frequently due to the poor quality of the condensate water. An improvement in the frequency of precoating the resin would provide an indirect benefit to the plant.

Quality of Incoming Water:

According to information provided by the plant, the following was the quality of the incoming lake water for which the MF and RO units were designed.

TDS	540 ppm
Turbidity	<10 NTU
Iron	0.62 ppm

RO Feed Water Quality

Feed Stream Composition (mg/l)

TDS	<540 ppm
Barium	0.01
Calcium	51.00
Potassium	3.18
Magnesium	20.90
Sodium	20.41
Chloride	22.35
Fluoride	1.30
Bicarbonate	238.00
Nitrate	0.50
Sulfate	29.00
Silica	16.00
Carbonate	0.67
Carbon Dioxide	7.59

Pall water treatment experts performed a detailed analysis of the plant conditions and decided to recommend an integrated membrane (MF/RO) system (IMS) to replace the cold lime softening clarifiers and sand/gravel filter beds. Since the power plant was online, an additional challenge was to install the systems without shutting down the demineralizer trains or negatively impacting the amount of treated water while the new IMS plant was brought on line. Pall recommended installing the IMS in parallel with the clarifiers and sand/gravel filters and reusing the existing filtered water tanks. One filtered water tank was used as an MF/RO break (filtrate tank), and the other as an RO permeate water storage tank (the new demineralizer train feed tank).

After commissioning the IMS, the plant personnel bypassed the clarifier/sand bed system and fed the incoming water from the feed system directly into the MF system.

The MF and RO product water quality that the units were designed for is shown below:

MF Product Water Quality

Feed Water Element	Treated Water Quality
Giardia and Cryptosporidium	Undetectable
Suspended Solids	Undetectable
Turbidity	< 0.1 NTU

RO Product Water Quality

TDS: < 25 ppm
pH: 5-7

Integrated System Details:

Pall's integrated system was commissioned in February 2008, which means there is more than one year of performance data to report. The installed MF system consisted of a Pall Aria™ Microfiltration system using Microza* microfiltration modules. The system consists of two independent treatment trains of 42 modules each. This system is 2 x 100% capacity (770 gpm maximum each) and allows for an average production of 1400 gpm (input of 1540 gpm with 95% recovery) with both trains in service.

Since the IMS system was installed along with the existing system, the space available for the RO skid was limited. Therefore the RO skid had to be custom designed to fit in the available space.

To accomplish this, the RO system consisted of three stages (single train), arranged in a 16:8:4 array with five membrane elements each. The inlet flow to the RO system was 625 gpm. The system was designed for a total permeate production of 500 gpm, the average capacity of the boiler.

* Microza is a registered trademark of Asahi Kasei Corporation

Process scheme and sizing

The RO system capacity was designed to meet an average demineralized water demand of 500 GPM. However, during boiler chemical cleans or tube leaks, the demineralized water demand could be as high as 900 GPM. During high demand conditions, the RO permeate will be blended with the MF filtrate. The demineralizer feed pump has the capability to draw from both MF filtrate and the RO permeate, thus blending the two streams before being fed to the demineralizer trains.

The question that arises in the RO system design is “How frequent can the system start/stop?”, particularly when the demineralized water demand is below average capacity (500 GPM). Pall’s Water Team decided to tie the overflow line from the RO permeate water tank to filtrate water tank, thus achieving two goals:

1. Keeping the RO in service all the time and avoiding frequent starting and stopping
2. Improving the water quality to the demineralizer train. Since the RO permeate tank is full, the overflow would fill the filtrate tank. This will back off the MF filtrate, thus providing partial double RO product quality.

With the above process improvement, the RO system had to self-regulate in terms of flow and pressure. Therefore the RO booster pump was equipped with a VFD and the reject valve is of the modulating type. The PLC would control the flow and pressure to maintain the constant product water flow and system recovery.

The average MF filtrate required for the RO is 625 GPM and during the peak demand, the MF filtrate required would be 1,025 GPM to make the blended feed of 900 GPM to the demineralizer system.

Flux Maintenance (FM) is being performed to lower Trans Membrane Pressure (TMP) across the MF membrane. There are three FM methods used in this system.

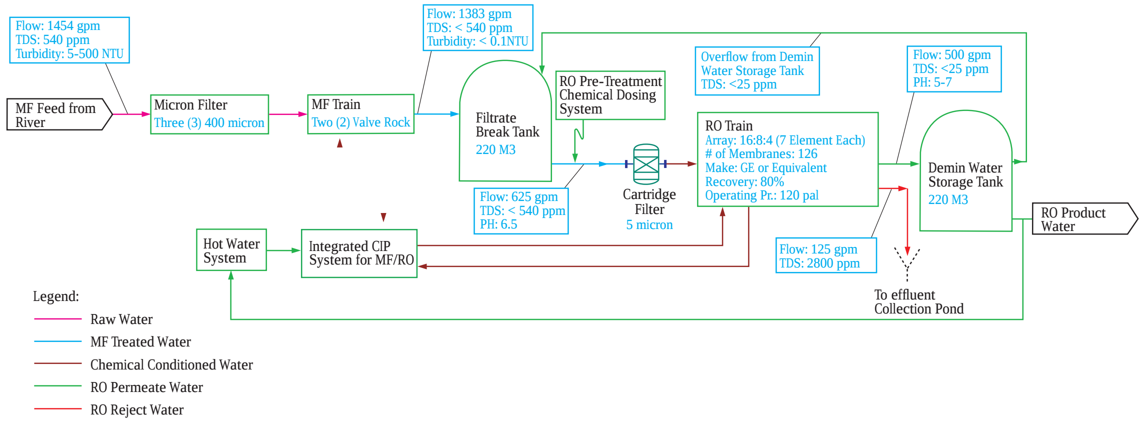
The first FM method is air scrub/reverse filtration (AS/RF), which involves injection of air at low pressure into the feed side of the module approximately every 20 minutes. Clean filtrate is also pumped in a reverse direction through the hollow fibers to dislodge foulants and deposits. After the AS/RF, the MF unit will ramp up to the instantaneous peak flow to compensate for the loss in filtered water, thus maintaining the constant average filtrate output.

The second FM method is Enhanced Flux Maintenance (EFM), which is being performed based on an increase in the TMP. This fluctuates between once per day and once per week to remove microbial fouling, thus lowering TMP values. During EFM, a hot caustic chlorine solution or a hot chlorine solution is circulated through the feed side of the membrane. During the EFM the MF unit will be off line for 30 – 60 minutes.

Normally, as TMP approaches 25-30 psig, a chemical clean-in-place (CIP) is performed -- the third FM method. This is a two-step protocol, first using hot caustic/chlorine, and then an acidic solution to return the modules to “nearly new” conditions. This is carried out hundreds of times over the lifetime of the modules. A CIP can also be performed at periodic intervals (once every 60 days, for example) as a precautionary step to protect the membrane even if TMP does not rise significantly during that interval.

Considering the FM requirements for the MF system, two MF units were selected. Since the average demineralizer feed rate is 500 GPM (RO feed 625 GPM), each MF unit was sized for 700 GPM average filtrate production. See Figure 1 (page 5) for the overall mass balance for the project.

Figure 1:
Overall Water Mass Balance Diagram



Result and Discussion

Table 1 compares the existing costs for chemical addition and power requirements with the clarifier/sand-gravel bed operation prior to the plant switching over to the MF/RO system. The sludge treatment/disposal costs and some other costs have not been quantified. The chemical costs were considerable, exceeding $3500/day.

Table 1:
Chemical/Power Costs with Conventional Treatment

Component	Daily Consumption, lbs	Unit Cost in USD	Total Cost in USD
Sulfuric Acid—93% (lb)	8054	0.05	402.70
Caustic Soda—50% (lb)	16000	0.18	2880,00
Sodium Aluminate—40% (lb)	1000	0.20	200.00
Lime—100% (lb)	750	0.06	45.00
Power –KWH	1630	0.05	81.50
Total Daily Cost			$3609
Total Yearly Cost			**$1,317,358**

The costs for caustic soda and sulfuric acid are extremely high, owing to the fact that the demineralizer train was regenerated at least once a day. Sodium aluminate/lime was used for the lime softening operation.

Table 2 shown below lists the chemical addition and power costs in the plant after Pall's integrated system was operational. There was a dramatic lowering of the chemical costs.

Table 2.
Chemical/Power Costs with Pall Integrated System

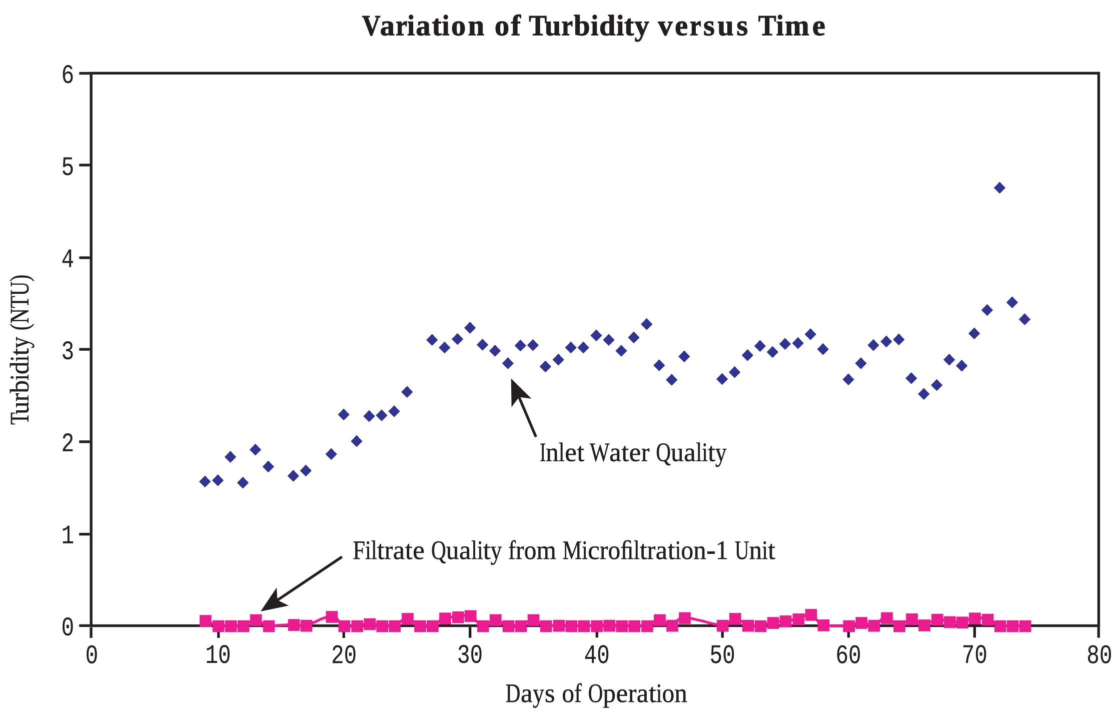
Component	Daily Consumption, lbs	Unit Cost in USD	Total Cost in USD
Sod. Hypochlorite-12%(lb)	26	0.13	3.4
Citric Acid—50% (lb)	21.4	0.54	11.6
Caustic Soda—50% (lb)	181	0.18	32.6
Sod. Bisulfite—38% (gal)	58	0.43	24.9
Antiscalant—100% (gal)	2.2	35.00	77.0
Sulfuric Acid—93% (gal)	0	0.05	0
Power—KWH	2800	0.05	140.0
Total Daily Cost			$289.5
Total Yearly Cost			**$105,650**

The principal benefit of the Pall system is the significant improvement in the regeneration of the ion exchange units. The regeneration cycle in the demineralizers improved from daily to once every 5-6 days. This led to a steep decrease in the use of caustic soda and sulfuric acid used in the resin bed regeneration. The use of sodium aluminate and lime was eliminated by bypassing the clarifier operation. The chemicals used to clean the MF/RO system during EFM and CIP (sodium hypochlorite, caustic soda and citric acid) are commodity chemicals and usage quantities are negligible compared to the conventional system. Antiscalant was used to prevent LSI scaling in the RO unit, while sodium bisulfite was used for dechlorination (described later). All of these chemicals resulted in a daily cost of approximately $150.

As indicated in Tables 1 and 2, the resulting daily savings in chemical/power costs is $3310 per day ($3600 - $290), or about $1.2 million per year.

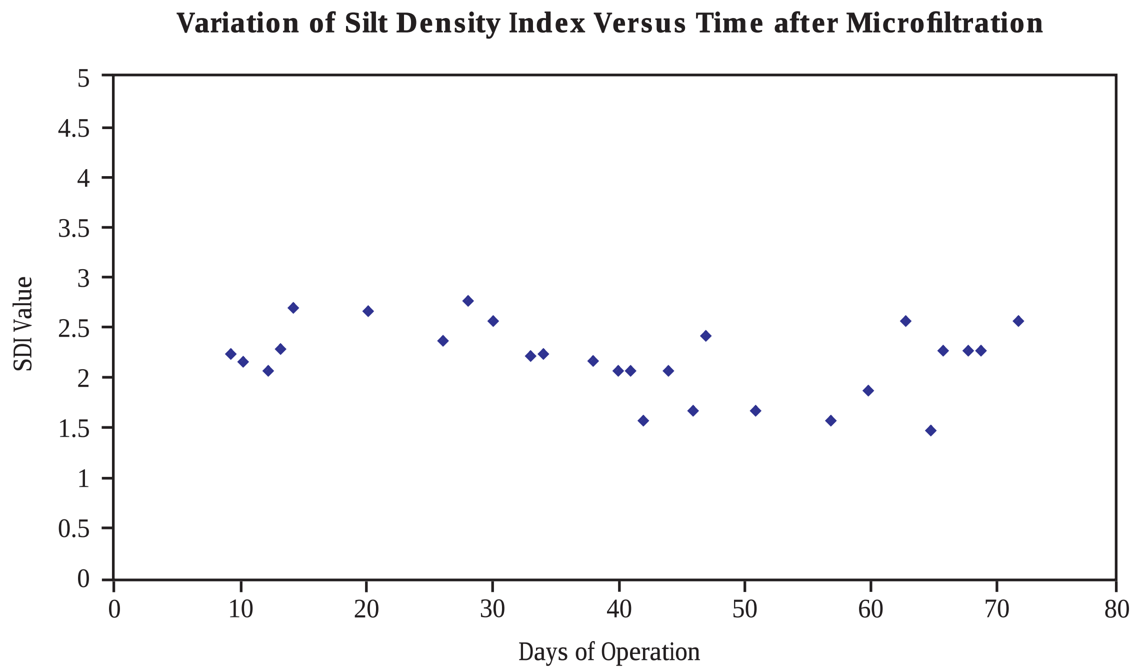
Figure 2 shows the variation of the turbidity of the incoming surface water and the turbidity of the filtered water from the MF unit with time over a period of several months. The incoming water varies in the range of 1.5 - 4 NTU, with occasional higher values. MF filtrate always exhibited turbidities below 0.05 NTU, with a majority of the readings less than 0.02 NTU.

Figure 2: Turbidity of incoming water and permeate from the MF Unit



The classic Silt Density Index (SDI) method was used to determine the fouling potential of the RO membrane. SDI is measured manually before the RO "guard" filter. Figure 3 demonstrates the variation of SDI. All the readings were in the range of 1-3, with a majority of the SDI values being below 2.0. This again demonstrates consistent MF performance and fouling protection for the RO.

Figure 3:
Variation of Silt Density Index after Microfiltration



The flow rates to both the MF Units vary in a wide range, depending on the demand. Trans Membrane Pressure (TMP) readings across MF Unit 1 have been plotted in Figure 4 below. Since the variation in flow rates is wide, the normalized TMP values are shown. It is important to note that the normalized TMP values appear to increase marginally with time but do not show a steep increase, which normally indicates that a chemical CIP is required. We commented earlier that Enhanced Flux Maintenance (EFM) is being carried out once a day to control the rise in TMP values. Nevertheless, a CIP procedure is carried out every 60 days on both MF units as a precautionary step to optimize MF performance.

Figure 4:
Trans Membrane Pressure Normalized for Flow Rate variation versus time

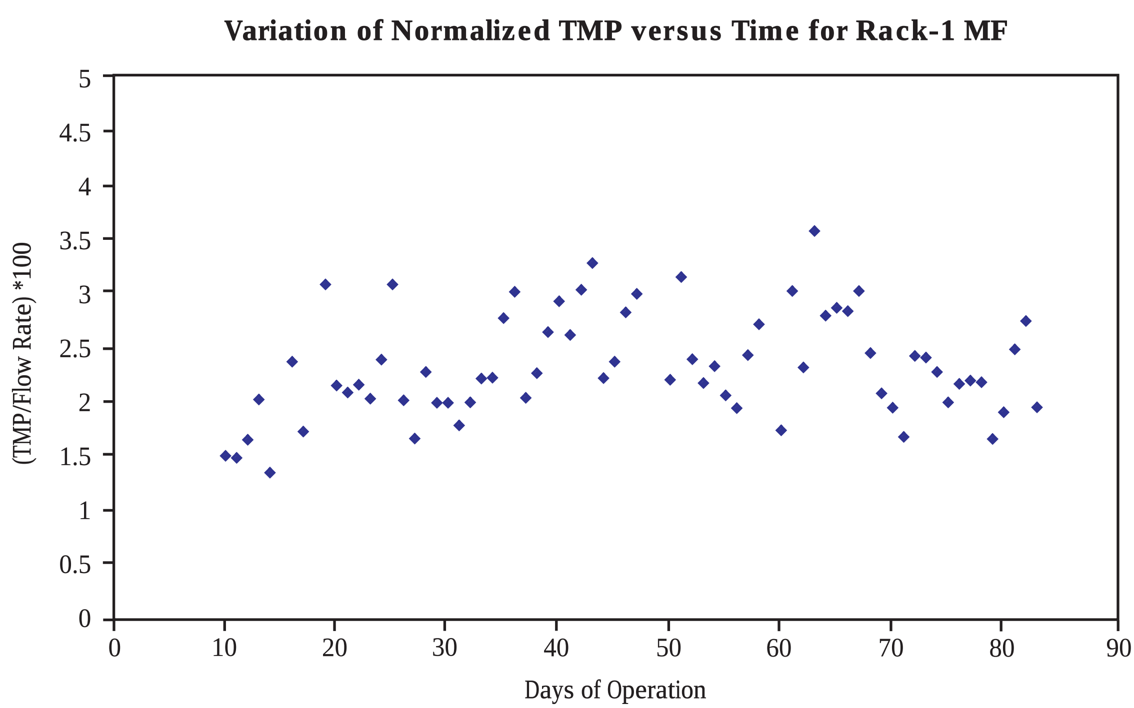


Figure 5 shows the operation of Stage 1 of the RO unit. The outlet pressure over several months is steady and actually declines slightly. The figure also demonstrates the pressure drop across the elements in Stage 1 and it shows no increase. This demonstrates the excellent RO performance of Stage 1, and is characteristic of a very low fouling tendency. Although not shown here, similar results were obtained for Stages 2 and 3 of the RO unit.

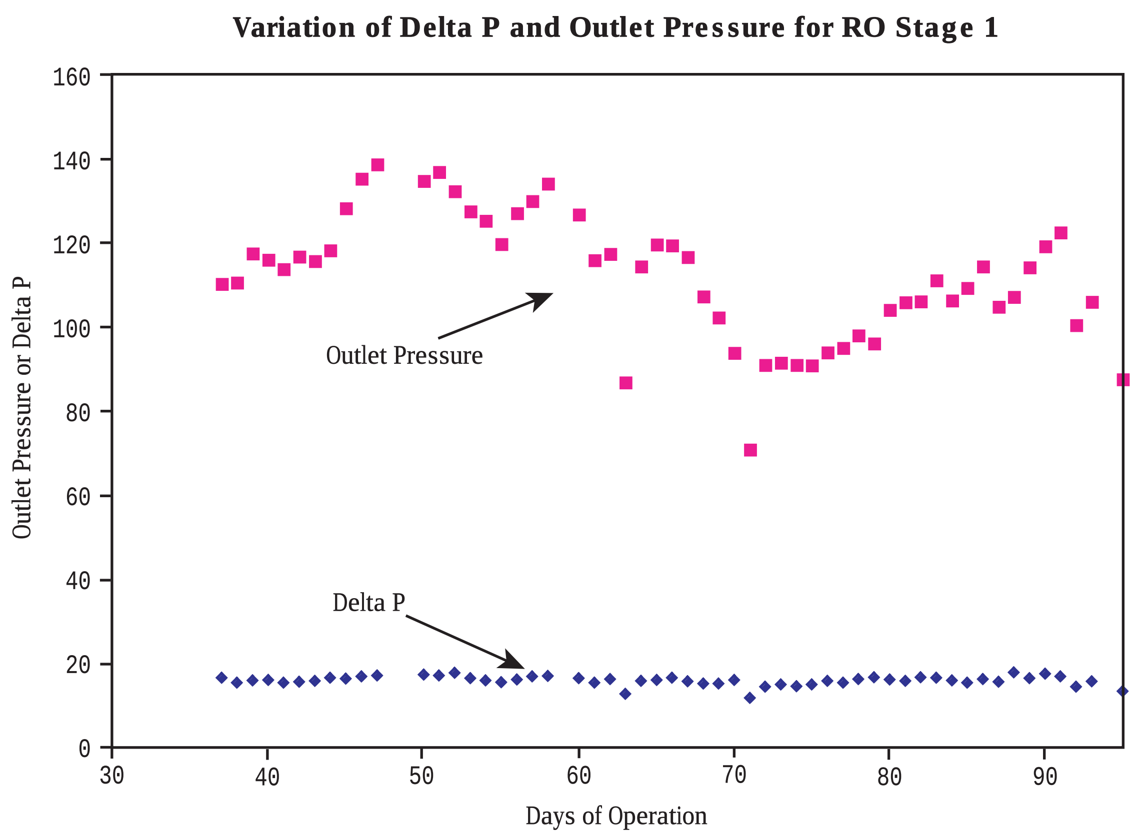


Figure 5: Variation of outlet pressure and differential pressure across RO Stage 1

Operational Challenges

Although the utility has achieved satisfactory performance in more than 15 months of continuous operation with the MF/RO unit, some technical challenges had to be met:

1. Filtered water tanks were old and unpainted. Therefore, even though the MF filtrate was of very high quality, the SDI at the RO inlet was consistently high (> 5). Due to these high suspended solids, the RO "guard" (cartridge) filter would not last more than a week. Upon investigation, we found that the filtered water tank had all the lime sludge and the iron crud as the tank was never painted. A high-density polyethylene (HDPE) tank was brought on site to replace the existing filtered water tank, which was then cleaned. With the HDPE tank online, the SDI at the RO inlet was consistently below 3.0.

2. During the early summer, the "guard" (cartridge) to the RO unit, a two-micron Ultipleat® High Flow cartridge filter needed replacement every two or three days. This time it was not the SDI that was fouling the cartridge filter as the SDI was below 3. However, the fouling was from the microbial growth due to algae blooms in the lake. The microbial growth had to be stopped in order to increase the life of the cartridge filters. It was recommended that sodium hypochlorite be added in front of the MF units to maintain free chlorine residue in the filtrate tank. Further, we wanted to utilize the residual chlorine in the cartridge filter to prevent the microbial growth. Therefore it was decided to move the sodium bisulfite dosing downstream of the cartridge filter. In other words, the system-engineered design was changed. These changes resulted in the run length of the cartridge filter increasing from one week to five months. These steps helped to mitigate the problems associated with algae formation on the cartridge filter.

Indirect Savings

The utility power plant deploys a Powdex condensate polishing system (three vessels per unit) for handling the condensate. These systems are installed to meet stringent boiler feed water requirements, to improve the reliability of production, and to increase the efficiency of the power plant. Prior to installation of Pall's integrated system, the conductivity from the condensate system to the boilers was elevated, possibly due to high total organic carbon content. These precoatable filters were precoated at a very high frequency – once a day. Since it costs approximately $850/pre-coat, the plant was spending $1100/day for pre-coating work for the two polishing units during operating times and start-ups.

Since the operation of the integrated system commenced, the frequency of the pre-coating has decreased from once a day to once a week. The double-membrane (MF/RO) IMS system was effective in reducing total organic carbon content to very low levels in the condensate, and this had an immediate positive impact on the performance of the condensate polishing system. The total precoat cost decreased, contributing to substantial savings of approximately $250,000/yr. These savings were in addition to the $1.2 million/yr saved in chemical costs, as described earlier.

Return on Investment

The cost of the Pall Integrated System was approximately $1.2 million.

Savings from chemical costs from installation of system: $1.2 million/yr.

Savings from improved performance of polishing system: $250,000/yr.

Hence, total savings to the plant: $1.2 +$0.25 = **$1.45 million/yr.**

The return on investment was achieved in less than 10 months of operation.

Conclusions

1. Pall's integrated system resulted in considerable direct savings on chemical costs and improved ion exchange unit run times.

2. Considerable indirect savings were achieved by reducing the frequency of pre-coat operation in the condensate polishing system. Also included in these costs was the average lifespan of the precoatable elements. Changing elements every two years may extend to five years.

3. Challenges associated with the plugging of the RO pre-filters in summer were overcome with an innovative technical solution.

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PGMFROSTR June 2009

Power Generation

Pall: A world of expertise to meet your condensate challenges

Reliability, efficiency, fuel consumption, power output…all the major critical performance indicators of steam power plants are affected by the quality of the boiler feedwater. From boiler tube corrosion to lower heat transfer and high blowdown rates, the consequences of poor condensate quality are widespread, costly, and sometimes irreversible.

When it comes to condensate polishing, Pall Power Generation functions with a set of principles that serve as the backbone of our entire organization, from fundamental R&D to our service organization.

Performance
The core of our filtration systems is our high-performance filter elements. Much more than one component of the system, Pall elements enable the performance and reliability our clients demand.

Productivity
A tremendous range of technology platforms and dedicated market expertise guarantees that the right product is chosen to meet your unique need. Our team leverages years of experience to ensure the highest level of productivity.

Partnership
As a partner committed to innovation and the science of filtration, Pall can solve even the toughest contamination challenges. We work with you to identify your needs, and develop the best possible solution to keep your business running smoothly.

Performance: Condensate polishing as a filter media science

The primary and overarching goal of optimum fluid cleanliness takes precedence over other considerations. In short, Pall filter systems are developed so that the filter elements can perform the role for which they were designed. In the filtration world, very few applications are as demanding as the protection of high pressure steam generators. Large water flow rates, stringent contamination and chemical specifications, and the requirement for quasi-continuous operation over a number of years all make this market quite challenging. Pall has extensive experience in this application, and has excelled in meeting customers' unique needs for years.

*Filtration. Separation. Solution.*SM

Pall Melt-Blown Elements: Blowing away the competition

Pall HGCoLD-R melt-blown elements are applied when pre-coat backwash operation and consistent element performance are required. These elements combine a modified pore structure with added structural strength to allow both efficient coating and efficient backwash. In that sense, all melt-blown elements are not created equal.

In its most basic form, a melt-blown element is difficult to backwash. However, Pall has designed a special pre-coatable element specifically for condensate polishing. This element, the Pall HGCold-R, leverages advanced depth structure and surface filtration capabilities.

The pore distribution was modified so that the element acts as a surface filter in which the pores on the upstream side (the outside layers) are the tightest. This enables no penetration inside the element. Instead, the deeper pore structure acts as a structural backing in operation, and as a flow channel during backwash. Pall's design allows the depth element to act as a surface filter, supported by a thick hydro-dynamically optimized support structure.

Maintaining a proper precoat layer on the element is key for filtration and demineralization efficiencies. The upstream layers of Pall's HGCoLD-R element stand apart. The added strength of co-located large fibers inside the element increase resistance to compression stresses, protecting the resin coat. The "roughness" of the element's surface also helps stabilize the resin coat onto the outer surface.

The Pall HGCoLD-R systems currently in operation around the world stand as proof that a melt-blown element can be much more than just a low-cost alternative.

Improving element performance doesn't mean sacrificing backwash operation

Much has been said of the influence of increasing filter surface area on the operation of the backwash cycle. The basic rule of thumb is that if you increase surface area, you reduce flux. In the case of reverse backwash flow, this flux reduction results in lower drag force on the particles and improper cleaning of the elements.

However, one of the biggest advantages of Pall HGPPB pleated elements is that they offer an increase in filtration surface area without sacrificing backwash ability. Not only has it proven to provide the highest removal efficiency without precoat, it consistently exhibits long runs and very long life, showing an excellent ability to be backwashed with minimal system flow upgrade.

Materials and media science means that even at lower fluxes, the element can be made to capture particles efficiently in the forward direction, while offering the least resistance in the backwash direction. For Pall, reducing the force needed to dislodge particles from the filter meant the following:

Optimizing filter media

The proper membrane structure must be "asymmetrical" regarding pressure drop. One way to accomplish this is to avoid fiber displacement in operation. If fibers are allowed to move, particles can "wedge themselves" into a pore, and drag forces will need to be higher to dislodge them. Pall filters are designed to minimize pore distortion, in order to minimize drag forces necessary for backwash.

Pall HGPPB elements combine excellent iron filtration capabilities with long life from advancements in its media and structure.

Pall Ultipleat High Flow® filters are the newest generation of disposable filtration for small condensate treatment. The revolutionary pleat configuration makes it possible to filter full condensate flows with very few elements, without sacrificing element life or removal efficiency.

Expert flow dynamics

More than just structural strength and durability, the special support layer provides the HGPPB element its excellent flow dynamics as well. It is designed to “channel” the water at optimum velocity into the filter media layer, which is itself designed to offer low resistance to drag forces in the backwash direction.

Lower flux applies in the forward direction. Our experience across wide industries shows that lower fluxes prevent deep penetration of contamination and level off its distribution in the media. Forward forces embedding particles into the filter membrane are lower, contamination is more evenly distributed, and element pressure drop stays lower longer.

System performance is key

At Pall, element science and separations performance is paramount. This requires that our system designs and upgrades allow the elements to perform consistently, as specified, with a long operational life.

This philosophy affects how we size the vessels, how we design and improve the backwash dynamics, how we design element change-out tools and procedures, and how we upgrade tube sheet designs for efficiency, reliability, and ease-of-use. To take full advantage of the possibilities regarding filter elements, each Pall system integrates features learned and adapted from some of the most challenging backwash applications in the industry -- from slurry oil to heavily contaminated coolant fluids.

An example of this is Pall’s backwash design. Born out of the need to process and backwash viscous and contaminated fluids in the petrochemical industry, this vessel concept matches Pall condensate filter elements performance and makes for a durable, efficient, and cost-effective installation.

Another example is our top tube sheet design, which has been a Pall standard for years because it offers excellent backwash characteristics, provides easier evacuation of waste, and is easier to service.

Productivity: Leveraging an unmatched knowledge base

Nothing has a greater impact on the productivity of a power producing asset than the purity of the fluids running through it. This is the fundamental idea behind Pall’s Total Fluid Management practices, and is certainly true for condensate polishing. Productivity is our goal – the productivity of assets, the productivity of people, and the productivity of Pall’s own scientific and engineering force.

Learning, customer relationships, innovation, and evolution are the tools with which Pall maintains its productivity and leadership. Pall’s ability to combine the dedicated, customer-centric knowledge of our SLS[1] structure with a remarkable filtration and separation technology portfolio ensures that only the best products are brought to market. Our customers choose our products because they are best adapted to the application. The result is a higher level of productivity, both for us and for our customers.

Pall’s Ultipleat® High Flow filters for condensate filtration were developed from this rich cross-fertilization. Ultipleat High Flow filters offer a compact, cost-effective, and highly efficient solution to solid metal transport in smaller condensate systems. Its innovative pleat design was first introduced to solve some of the most challenging hydrocarbon contamination issues in the oil

[1] *SLS : Scientific & Laboratory Services : Pall’s unique structure of scientists and technicians around the world whose sole mission is to act at the customer level, with focused application and technology expertise, to provide consulting, analysis and process improvement services.*

industry. The unique structure and flow path of the element makes for the perfect combination of high flux capability and high removal efficiency.

For condensate systems, it opens a new realm of possibility for utility and industrial steam generators looking for better boiler productivity without the large capital or running costs of backwash systems or traditional disposable filter systems, respectively.

Continuous Improvement

We continuously improve our technology through the challenges and hurdles we encounter, and with the partnerships we form with our customers. When Pall filters purify the primary coolant of nuclear reactors, we learn to capture particles so small they are almost not considered particles at all; when Pall filters are used on aircraft hydraulic systems, we learn to manufacture our products to the toughest quality standards; when Pall filters purify water to wash microelectronic wafers, we master the art of making very low-extractable filter elements; when Pall filters purify drinking water for entire cities, we ensure large flows with uncompromising reliability. All these examples and more increase our scope and expand the possibilities.

Our manufacturing facilities benefit from the same sharing of knowledge. While some have to find a way around calendaring machines for fear of hot spots, Pall manufacturing engineers, technicians and operators tackle the challenge, fine-tune the process, and use their years of experience across industries to prevent excessive heat transfer through the fiber layers.

Partnerships: Improving together

Innovation, separations science, media expertise, engineering and manufacturing adaptation all require in-depth knowledge and constant monitoring of the markets we serve. Being a technology leader means not only understanding any process and its current requirements, but to also ask what can be done better. This is the fundamental idea behind the partnerships Pall has with customers, large research institutions, Universities and private research centers. Pall's SLS group is continuously on the pulse of our customers' requirements and expectations so that we can deliver the best available separations technology for a given process.

Total Condensate Leader

Pall's condensate product evolution is always deeply rooted in the relationships we have with our customers. Pall Power Generation's leadership is rooted not only in our products, but also in our unwavering commitment to cleanliness through media science, the productivity gains we enable for the users of our products, and the partnerships we form with our customers to always move forward.

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Case Study

Power Generation

Major Northeast Power Plant Realizes Significant Cost Reductions in Condensate Water Treatment with Pall Hydro-Guard® Filters

Premature plugging of resin pre-coated, backwashable condensate filter elements with resin fines and contaminants is a common and wasteful occurrence at power plants. Premature plugging results in short runs, especially during start-ups when the contamination loading is at its highest. In addition to short runs, filter bypass, end-cap failures, and system trips due to high filter differential pressure are also common in condensate water backwash systems using typical, nominal rated commodity filtration.

The Challenge

A 775 MW combined cycle plant in the northeastern United States was experiencing premature plugging of resin pre-coated, backwashable condensate filter cartridges with resin fines and contaminants. This occurred especially during start-ups, when the contamination loading is at its highest. In addition to short runs, the plant also experienced filter bypass, end-cap failures, and system trips due to high filter differential pressure. The plant has a 275 MW steam turbine generator that uses an air-cooled condenser. The condensate polishing system consists of two Pall Septra™ backwash vessels in parallel, with one in operation and one on standby. Each vessel contains 420 filter cartridges, 2.50″ diameter by 80″ long.

The automated backwash cycle at the station consists of a sequence of operations that utilizes about 8,000 gallons of clean water, generating an equal amount of wastewater for each backwash event. The amount of resin and filter aid used for the pre-coat of the filters after each backwash is 100 cubic feet. The cost of the resin and the filter aid for each pre-coat is roughly $2,500 US.

The plant had been using string-wound filter cartridges since its inception, but was experiencing a number of issues with performance and integrity. The biggest issue was short runs or low condensate throughput, especially during start-ups. The fouling of the string-wound filter media with particulate contaminant and the fine powder resin resulted in high differential pressure, resulting in by-pass of untreated condensate. In addition, there were instances of filter cartridge end-cap detachment, string ‘unwinding’ due to repeated back flush and water hammer effects, and galling of the metal threads over time. Each such occurrence would require corrective action resulting in lost time and revenue.

The Solution

In light of the problems with the string-wound filters that the plant was experiencing, Pall recommended its Hydro-Guard® filter

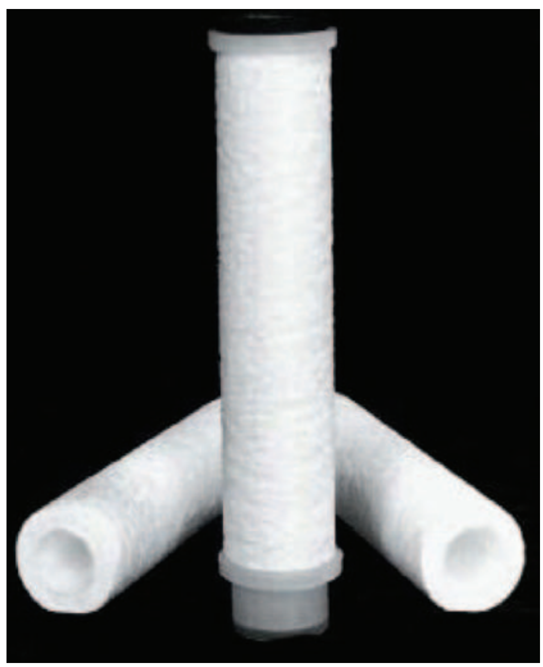

Figure 1 – Cutaway view of HydroGuard® filter element

Figure 2 – End-cap and connector of Hydro-Guard filter element (top) and the string-wound filters

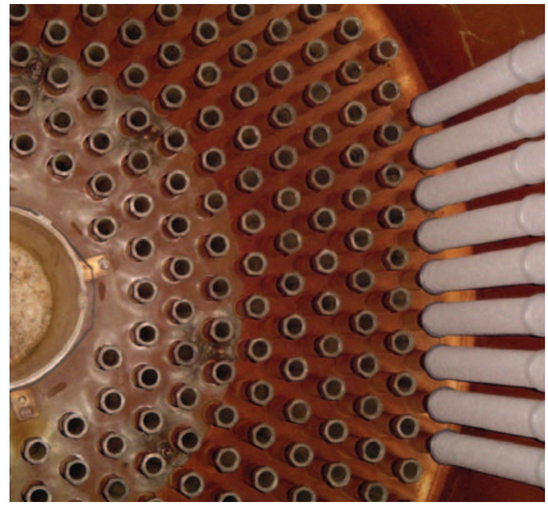

Figure 3 – Hydro-Guard filter element being installed

cartridges made with proprietary CoLD Melt™ technology. This technology creates a filtration matrix with small, micro-thin fibers for particle removal efficiency and Co-located Large Diameter (CoLD) fibers for the rigid structure and strength that is critical under the dynamic operating conditions encountered in this application. The filter cartridge offers reverse depth gradient pore structure that effectively captures particles on the finer porosity, tighter outer surface. At the inner depths of the filter exists a more open fiber matrix that facilitates a forceful and efficient backwash, which is critical to the performance and longevity of the filters.

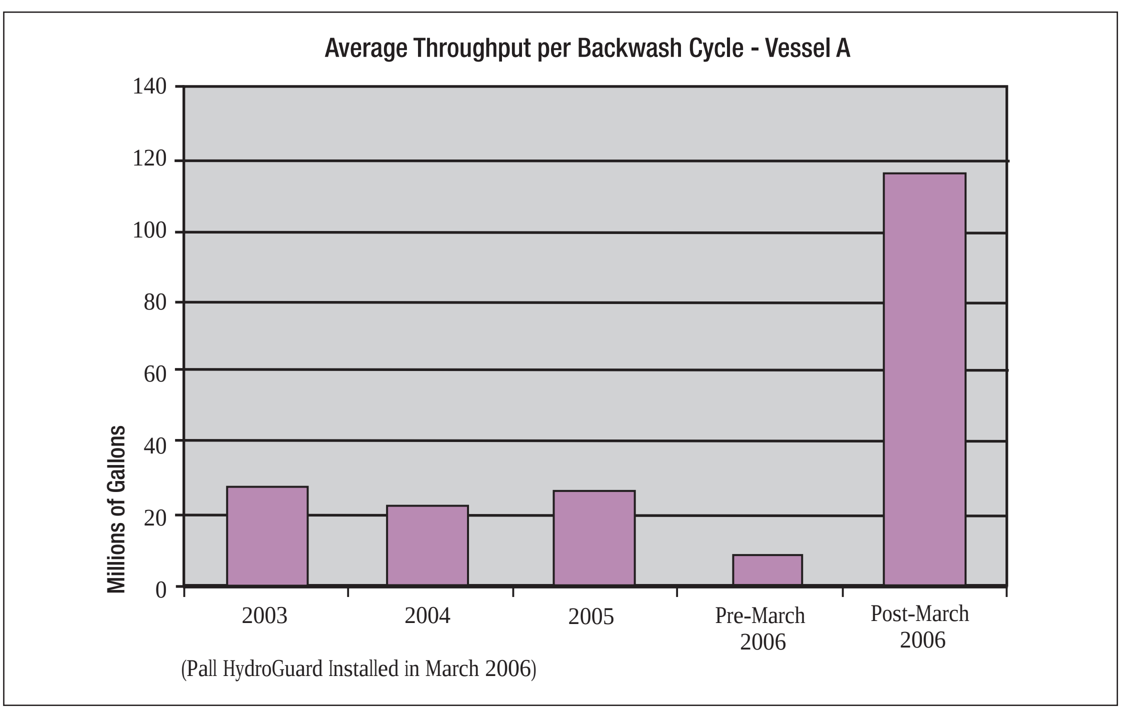

Figure 4 – Average Throughput Data

The filter cartridges are made with 100% polypropylene, inert melt-blown fibers, containing no surfactants, wetting agents, or other extractables that are associated with string-wound construction, thus eliminating the issue of these materials contaminating the system. The absence of the extractable materials in melt-blown media saves time and water – both the clean water and the wastewater required to rinse off the extractable materials. A total of 420 Pall Hydro-Guard filter cartridges, 2.5″ diameter by 80″ long, were installed in the bottom tube-sheet vessel, without any modifications to the vessel.

Plant records show that of the 69 total backwash cycles that the system underwent between 2003 and 2006, prior to the installation of the Pall cartridges, five were caused by high conductivity and two were caused by resin trap problems; the rest were due to high differential pressure (DP). Since the installation of the Pall filter cartridges, the system has undergone 10 backwash cycles, all of which were due to water conductivity.

The power plant has reported an average throughput of 94.25 million gallons, which is about 4.4 times the throughput obtained with the string-wound filters between the backwash cycles. The longer runs have lessened the need for pre-coat resins, resulting in more than $60,000 in savings over a period of eight months. Based on the positive experience with the first vessel, the plant has retrofitted the second vessel. Since then, the plant has reported total cost savings of more than $140,000 over a period of 18 months, realized through higher efficiency, improved productivity, and lower resin and chemical treatment costs.

Benefits:

- Melt-blown technology is inherently resistant to the 'unwinding' associated with the string-wound design
- Thermal bonding of the media pack with the polypropylene end caps eliminates media pack separation from end caps eliminating iron and resin bypass
- Elimination of thread galling common to metal-to-metal connections
- Contains no surfactants, wetting agents, or other extractables associated with string-wound construction, thus eliminating the issue of these materials contaminating the system

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Case Study

Pall Filters Help Recover Lost Megawatts and Lost Revenue

The Problem

A major Midwestern power plant continuously experienced losses in power generation capacity, typically 27,000 MWh per year, due to the deposition of copper onto the turbine blades. Near the end of a twelve month fuel cycle, the station was derated by 30 MW, resulting in an average of $30,000 per day of lost generation revenue. The station was forced to decrease turbine rotation speed due to copper deposition, and imbalance of the turbine blades.

As MW output decreases due to copper deposition, the plant must increase heat rate (fuel consumption) to maintain a consistent energy output at a lower efficiency. The plant then loses revenue as costs rise per MW generated.

The copper plating that occurs on the turbine is typically removed either by mechanical or chemical cleaning. Mechanical cleaning requires complete turbine disassembly, rotor removal, grit blasting of the parts with deposits, and re-assembly. This can take up to six weeks and cost more than $350,000 for a 400 MW steam turbine. Chemical cleaning has the potential of contaminating the intermediate pressure and low-pressure turbines, heaters, and the condenser. Neither method addresses the action of minimizing or eliminating the deposition process in the first place.

Industry standards require specific hold points for Copper, Iron, and Silica. Attaining these guidelines is usually the determining factor for startup duration in plants that adhere to EPRI or similar criteria.

Pall Ultipleat® High Flow is a full-flow condensate filtration system that provides a cost-effective, long-lasting platform to minimize metallic, silica, and all particulate transport in the condensate flow.

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The Solution

The station investigated upgrading their existing condensate polisher to reduce copper carry-over. Pall Corporation provided a more economical solution with the Ultipleat High Flow startup filtration system.

After conducting several pilot tests to determine optimum equipment selection, Pall proposed an assembly consisting of a 38″ diameter filter housing containing 19 Ultipleat High Flow filter cartridges.

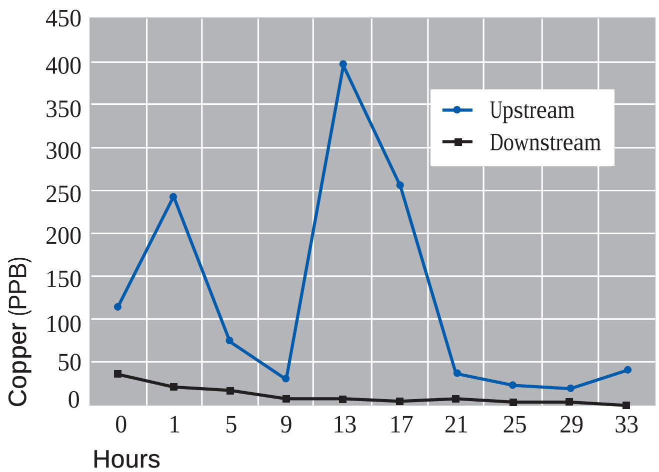
Since the installation, the condensate system has undergone 5 startups. The unit has consistently achieved the EPRI startup guidelines for Copper, Iron, and Silica in 15-20 hours compared with the >35 hours prior to the installation.

Since installation there have been no power derates due to copper deposition on the turbine blades.

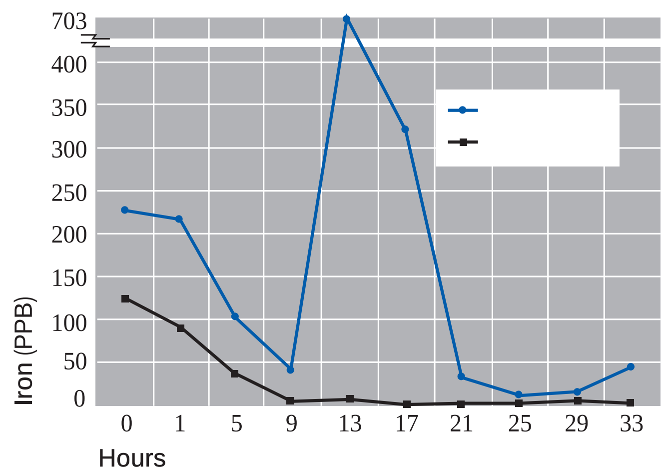
The Benefits

- Reduced chemical holds
- Reduced chemical feed
- Reduced boiler blow down
- Faster return to the grid
- Increase in revenue generation for the plant
- The cleaner condensate effluent from the filter has helped minimize the resulting problem of copper deposits on turbine blades and under deposit corrosion of boiler tubes due to iron
- Reduced risk of boiler tube water wall failures due to under deposit corrosion
- Increased efficiency of existing condensate polisher due to better removal of particulate copper and iron prior to the demineralizer bed

Concentration of Copper Up and Down-Stream of Pall UHF Filters During Condensate Start-Up



Concentration of Iron Up and Down-Stream of Pall UHF Filters During Condensate Start-Up



PALL® Power Generation

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PGCS1

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Power Generation

Case Study

Upgrade to Condensate Filter Elements Saves Power Plant $110,000/Year

Overview

At a four-unit power plant in southern Indiana, units 2 and 3 are supercritical boilers with original-equipment two vessel condensate filter demineralizer systems. Unit 4 is a supercritical boiler with a powdered resin precoat condensate filter demineralizer system.

Units 2 and 3 have traditionally been operated using string wound filter elements with powered resin precoat and cellulose fiber overlay which acts as a filtration aid and protects the string wound elements from prematurely fouling. Unit 4 uses the same precoat material with stainless steel spiral wound elements.

Hydro-Guard CoLD R filters are specifically designed for the use of backflushable, resin precoated power plant applications. The powdered resin removes dissolved and suspended copper, silica, and sulfate contaminants.

The Problem

The Station was precoating every 30 days. The cost for one precoat on Unit 2 is approximately $1900 per vessel (resin acquisition cost only). The station's goal was to reduce resin costs while maintaining required condensate chemistry.

The station precoated monthly because the string-wound elements being used tended to foul with particulate contamination and embedded powdered resin due to the filters' depth filtration characteristics. In addition, the strings would loosen and stretch as a result of forward and backflush flows.

The plant needed to find a way to optimize their condensate demineralizer system in order to reduce system operating costs.

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The Solution

In October 2002, the station upgraded the Unit 2 polisher with the installation of Pall Corporation's meltblown HydroGuard CoLDR elements. The new HGCOLDR elements are comprised of 100% polypropylene meltblown reverse depth graded pore structure filter media, with a 2.25″ outside diameter (OD), compared with 2″ OD on the old string elements. This slight increase in OD provided a 14% increase in precoatable surface area, which lowered the vessel flux rates significantly. These features improved operating performance due to better backflush ability, more uniform precoat application, absolute filtration matrix, and precise element permeability.

The Station has replaced the Unit 3 string-wound elements with Pall Corporation's HGCOLDR elements in March 2004, and is currently experiencing similar cost savings. The station has recently initiated a project to upgrade the old vessels with HGColdR elements.

The Benefits

- The station is now precoating every 60 days, versus every 30 days, cutting precoat costs in half.
- By reducing precoat frequency from 12 precoats per year to 6 precoats per year, the station has saved $50,000 per year on Units 2 and 3 resin costs alone.
- The system needs less oversight and requires less manpower, allowing staff to concentrate efforts on other key plant issues.

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PGCS5

Case Study

Power Generation

Turbomachinery OEMs Power Up With Pall

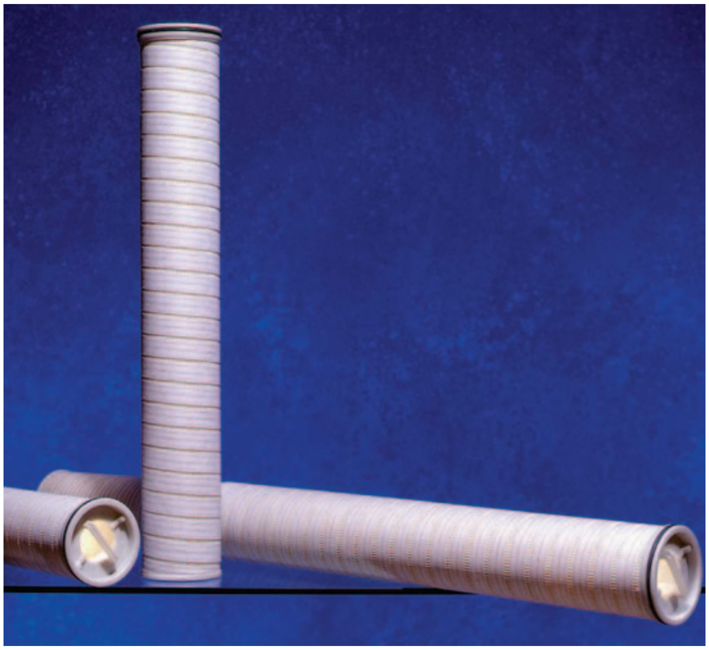
Pall Ultipleat® High Flow Filters the Choice for Water Injection NOx and SOx Emission Control

Problem Overview

Wear-related component failures are major occurrences that often lead to significant turbine downtime, costly repairs, or complete engine rebuilding. For years, leading turbine manufacturers have trusted Pall Corporation to protect their most critical components, realizing optimum efficiency, availability and reliability, while reducing waste.

Turbomachinery OEMs rely on Pall's Ultipleat High Flow filters for filtration on water injection systems for NOx and SOx emission control. Pall's industry-recognized technology is a critical component in helping prevent nozzle fouling. This technology also protects against turbine blade erosion by removing the hard particulate found in the source water. Filtration of high pressure demineralized water before injection into the turbine helps control NOx and SOx emissions in turbine exhaust - a major environmental issue raised by concerns over global warming.

Water controls and NOx and SOx filtration also ensure the system functions properly, maintaining spray patterns and delivery volume.



Pall's Ultipleat High Flow system is a proprietary, large diameter, disposable filter system, and features long filter life and easy filter change-outs.

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The Solution

Pall's simplex and duplex Ultipleat High Flow filter packages are compact, cost effective, and meet or exceed the original equipment manufacturer's filtration requirements. Ultipleat High Flow filter elements are available in lengths of 20″, 40″, and 60″ for use in single- or multi-element housings to handle a wide range of flow rates from 40 gpm to 1,000 gpm. Ultipleat High Flow filter cartridges are available in a broad array of absolute removal ratings from 2 micron to 40 micron in both glass fiber and polypropylene construction.

Typical Ultipleat High Flow duplex filter systems employ a six-way transfer valve between the two filter vessels. The vessels utilize a reusable, stainless steel internal basket and inside to outside flow configuration to retain all captured dirt. The vessel design, in combination with the external piston seal construction of the element, virtually eliminates bypass of contaminants while allowing for rapid element change-out. The removed element is disposal-friendly, owing to its non-metallic components. Filter cartridges can be incinerated, shredded, or crushed.

Clients have also found Ultipleat High Flow filters to be a cost-effective solution for fogging systems, wet compression systems, ammonia injection systems, and post filtration of demineralized water treatment systems.

Let the Pall Power Generation Group show you why turbomachinery OEMs around the world trust their most critical fluid components to Pall Corporation.

The Benefits

- Smaller, more economical filters: just one six-inch diameter Ultipleat High Flow filter element can handle up to 500 gpm/1,900 lpm
- Lower waste disposal costs: up to 4 times less volume of spent Ultipleat High Flow filters to dispose of versus conventional depth filters
- Lower maintenance costs: more than 30 times fewer filters in smaller filter housings to change out versus conventional depth elements

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PGCS6

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CLARIS® Series Filter Cartridges

High Consistency Polypropylene Melt Blown Cartridge

- Graded Pore Structure Enhances Dirt Holding Capacity
- E-core, an Extruded Fibrous Core, Provides Excellent Strength
- Unique Proprietary Process
- Easy and Safe Cartridge Incineration and Disposal
- All Polypropylene Construction
- Free of Surfactants, Binders, and Adhesives
- NSF Certified
- Plastic and Metal Spring Assembly End Configurations Available

Performance Specifications

Filter Grades:
1, 3, 5, 10, 20, 30, 50, 75 µm

Maximum Differential Pressure:
50 psid (3.45 bar) @ ambient
25 psid (1.72 bar) @ 140˚F (60˚C)

Recommended Change Out Differential Pressure[1]:
35 psid (2.4 bar)

FDA Listed Materials:
Manufactured from materials, which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations. Product in compliance with EU Directive 2002/72/EC for plastic in food contact (in simulants A, B, C and D).

Toxicity:
All polypropylene components meet the specifications for biological safety as per the USP for Class VI-121˚C plastics (gaskets/O-rings excluded).

Purity:
Claris Series filter cartridges are free of surfactants, anti-static agents, binders, and adhesives.

Product Specifications

Materials of Construction:

Filter Media:	Polypropylene
End Caps[2]:	Polypropylene
Extended Core[2]:	Stainless Steel
Extruded Core:	Polypropylene
Gaskets/O-rings[2]:	Silicone Elastomer, Buna N, Viton[3] A, EPDM, Santoprene[4]

Dimensions (nominal):

Outside Diameter:	2 ½" (6.4 cm)
Inside Diameter:	1" (2.7 cm)
Lengths:	9 ¾" (24.8 cm), 9 ⅞" (25.1 cm), 10" (25.4 cm), 19 ½" (49.5 cm), 19 ⅘" (50.3 cm), 20" (50.8 cm), 29 ¼" (74.3 cm), 29 ½" (74.9 cm), 29 ¾" (75.6 cm), 30" (76.2 cm), 39" (99.1 cm), 40" (102 cm), 50" (127 cm)

NSF
COMPONENT

This Claris Series filter cartridge is tested and Certified by NSF International under ANSI/NSF Standard 42 for materials only.

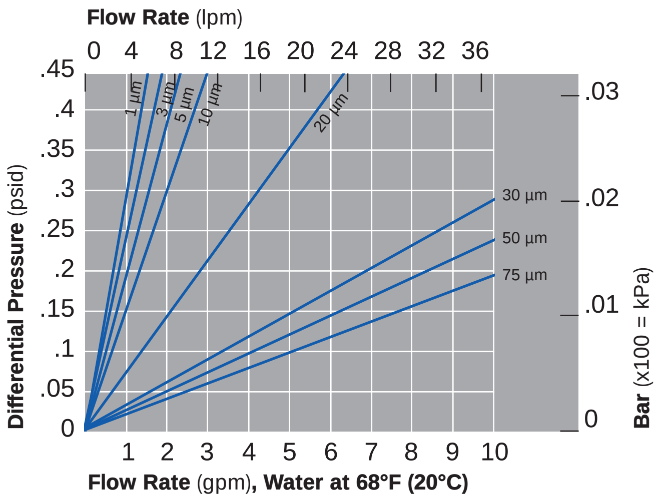
[1] - Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

[2] - These components are not NSF certified.

[3] - Registered trademark of DuPont Dow.

[4] - Registered trademark of Advanced Elastomer Systems.

Typical Flow vs. Differential Pressure for Application Sizing



Flow rate is per 10" (25.4 cm) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Part Numbers/Ordering Information

CLR ■ – ● ▼ ◆ (e.g. CLR 3–20DOES)

Code ■	Filter Grades[5]
1	1 µm
3	3 µm
5	5 µm
10	10 µm
20	20 µm
30	30 µm
50	50 µm
75	75 µm

Code ●	Cartridge Lengths (nominal)
9.75	9.75"
9.875	9.875"
10	10"
19.5	19.5"
19.8	19.8"
20	20"
29.25	29.25"
29.5	29.5"
29.75	29.75"
30	30"
39	39"
40	40"
50	50"

Code ▼	End Configurations
Blank	DOE industrial (no end caps)
DOE	DOE with elastomer gasket seals & end caps
H21	DOE, Santoprene gasket seal
1X	DOE industrial, 1" (2.54 cm) stainless steel extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[6]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[6]
M18	SOE flat closed end, external 222 O-ring
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
E	EPDM
V	Viton A

[5] - *Based on typical application usage.*

[6] - *For details, contact Pall Corporation.*

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PALL Power Generation

Power Generation Condensate Polishing Systems

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Pall Condensate Polishing Systems for Power Plants

MOST RELIABLE, COST EFFECTIVE CONDENSATE FILTRATION SOLUTION

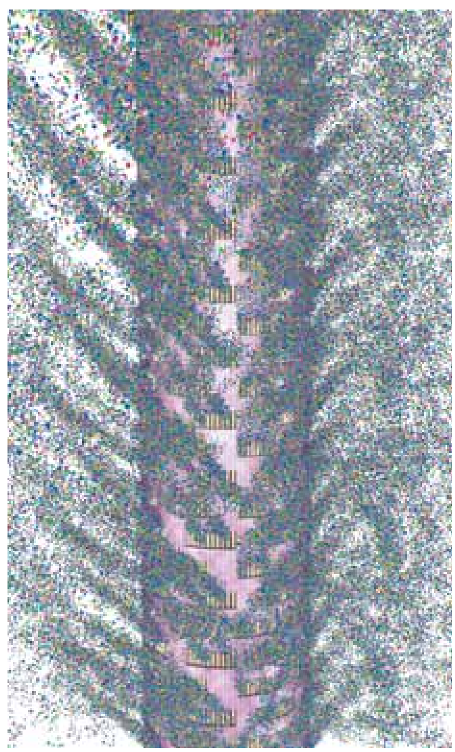
The power industry is installing hundreds of new condensate polishing systems as a result of increasingly stringent boiler feed water requirements, the need for greater power production reliability, and the demand for higher efficiency power plants. Pall Power Generation is the industry leader in providing filtration systems for power plant condensate.

Our combination of cutting edge filtration products and a wide range of system components, backed by extensive experience and expertise, enables Pall to offer you the optimum condensate polishing system.

If you need to retrofit an existing system, implementing one of our advanced solutions can result in significant process improvements.

The following pages guide you on selecting the ideal system for your application. Each of Pall's four condensate polishing systems is engineered to address specific application requirements in a particular type of power plant.

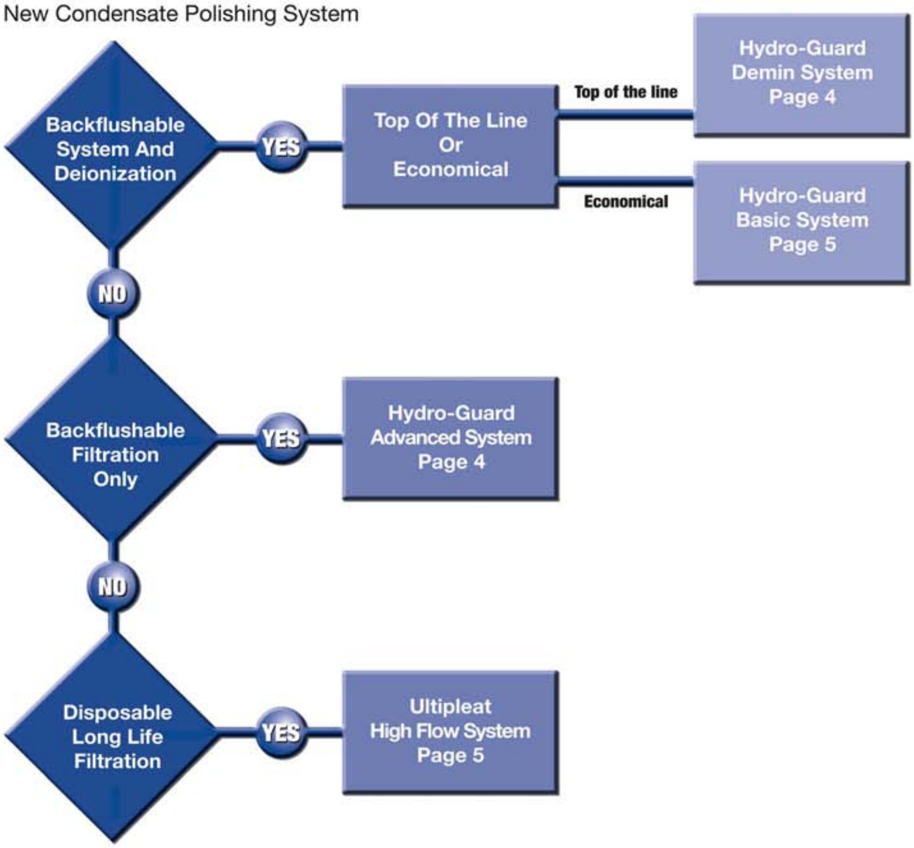
Pall Power Generation Field Engineers, in conjunction with Pall's Design Engineers, outline the system advantages and recommend the most performance appropriate, cost effective, condensate polishing system.



High energy backflush blasts contaminant from the surface of the filter.

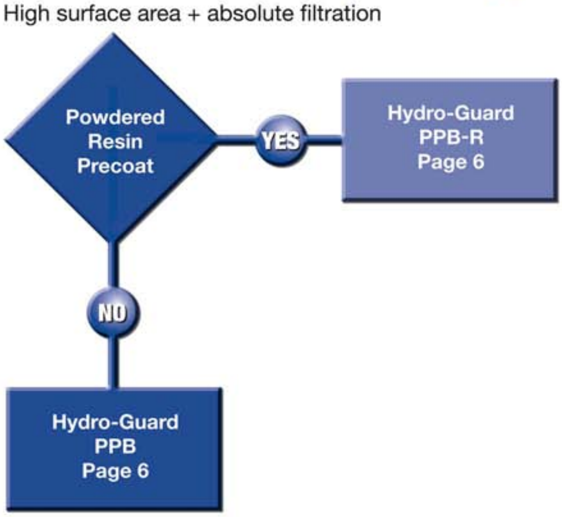
Pall System Selection

New Condensate Polishing System

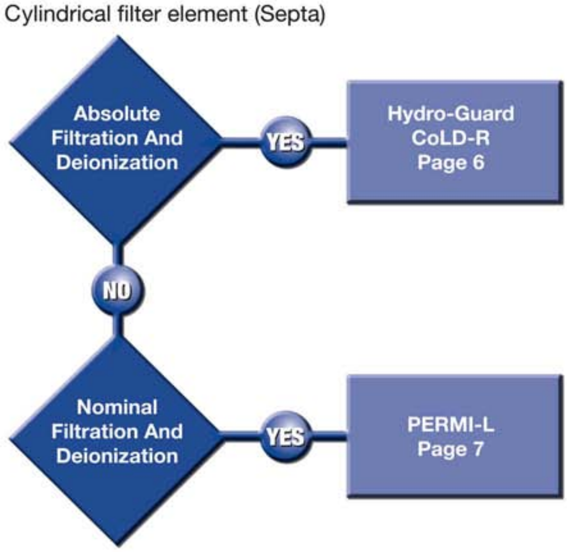


Filter Element Selection (new or existing systems)

High surface area + absolute filtration



Cylindrical filter element (Septa)



Pall Offers a Complete Line of Full Systems

PALL HYDRO-GUARD® DEMIN SYSTEM

Description

The Pall Hydro-Guard Demin System is the highest quality backflushable filtration and deionization system using absolute, high surface area Hydro-Guard PPB-R filters.

Performance

- Delivers excellent condensate deionization combined with absolute iron oxide filtration.
- Solves dissolved and suspended copper, silica and sulfate concerns.
- Cleans resin and captured suspended contaminants from the filters for long filter service life and uniform precoating by using Pall's proprietary backflush protocol effectively.

Features and benefits

- High energy backflush
- Simple operation
- High quality valves
- Uniform precoating
- Operator friendly controls and components
- Easy installation

Filter recommendations

- Hydro-Guard PPB-R filter element
- Hydro-Guard CoLD R or Permi-L filter elements

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers

PALL HYDRO-GUARD ADVANCED (NON-PRECOAT) SYSTEM

Description

Advanced backflushing protocol, absolute filtration, and the highest quality components make the Hydro-Guard Advanced System the first choice for critical condensate applications.

Performance

- Designed for absolute removal of suspended iron oxide, copper, and other particulate without powdered resin precoating or other filter aids.
- Particle removal efficiencies in excess of 98% can be expected.
- Effectively removes captured particulate from the filter surface thus insuring long filter service life, high condensate throughput between backflushes and low-pressure drops.

Features and benefits

- No expensive and labor-intensive powdered resin precoating
- No hazardous waste disposal
- Reduced power plant start-up time
- Reduced or eliminated copper deposition on turbine blades
- Reduced down stream deep bed cleanings and regenerations

Filter recommendations

- Hydro-Guard PPB filter element

Applications

- Excellent for both fossil and nuclear applications.
- Full flow recommended for once-through super critical boilers.
- Partial flow or start-up only usage may be adequate for drum boiler power plants.

PALL ULTIPLEAT® HIGH FLOW SYSTEM

Description

This proprietary, large diameter, disposable filter system features long filter life and easy filter change outs.

Performance

- Delivers excellent condensate filtration combined with absolute iron oxide removal.
- Captures suspended copper, silica, and sulfate contaminants effectively.
- Captures suspended contaminants inside the filter cylinder for clean and simple filter element removal and disposal via Pall's unique filter construction that uses an inside-out flow design.

Features and benefits

- Patented "Laid Over Pleat Design" permits high flow rates within a given filter envelope.
- Up to 50% smaller filter systems possible.
- Dramatic reduction in number of filter elements to handle.
- All plastic, coreless construction minimizes waste disposal.
- Standard vessels capable of flow rates from 250 to 5000GPM.

Filter recommendations

- Ultipleat High Flow filter cartridge

Applications

- Condensate filtration during plant start-up
- Combined cycle condensate
- Small coal fired plants

PALL HYDRO-GUARD BASIC (BACKFLUSHABLE) SYSTEM

Description

This deionization and backflushable filtration system features a capital cost conserving alternative to the Hydro-Guard Demin System.

Performance

The Hydro-Guard Basic System is an economical system for applications that do not require the critical performance offered by the Hydro-Guard Demin System. This is the basic workhorse of condensate particulate filtration and is ideal for start-up use or full flow use on a tight budget.

Features and benefits

- Effective backflushing saves filter replacement costs
- Absolute iron oxide retention
- Effective deionization
- Basic, reliable valves, controls, and piping designs

Filter recommendations

- Hydro-Guard CoLD R filter element

Applications

- Predominantly used in drum boiler and combined cycle power plants for start-up, partial flow, or full flow condensate polishing.

PALL SYSTEM RETROFITS

Performance

Outdated components on older systems could be hurting your facility's productivity. You can replace outdated control panels, tube sheet assemblies, filter sealing hardware, valves, pumps, precoating systems and filter vessels with quality Pall retrofits. Also, upgrade obsolete string wound filters in existing vessels with high performance elements such as the HGCoLD R Melt Blown backflushable filter.

Features and benefits

- Ensure fewer system breakdowns and repairs with new valves, pumps and filter sealing hardware.
- Achieve longer runs between backflushes, better filtration efficiency, and more productive use of powdered resin precoats with Pall's advanced filter technologies.
- Replace unreliable, irreparable analog systems at reasonable cost with state of the art digital control systems.

Applications

- All 15-year or older powdered resin precoat systems
- Any system using string wound filters
- Any existing backflushable system with analog controls
- Systems using springs to seal filter cartridges

Pall's Advanced Filtration Technology Completes the Sy

PALL HYDRO-GUARD PPB AND PPB-R BACKFLUSHABLE FILTER CARTRIDGES

Performance

- Absolute iron oxide and insoluble copper retention plus long life and robust construction are reasons that the Hydro-Guard PPB is the most extensively used backflushable pleated filter in power plant condensate worldwide.
- HGPPB filter cartridges are designed for filtration use without powdered resins.
- HGPPB-R filter cartridges, with reduced pleat height, are designed for use with powdered deionization resin for filtration and deionization in one step.

Features and benefits

- Backflushable filter element
- Highly efficient particle removal
- All polypropylene construction
- Low pressure drop
- High surface area
- No fillers, talcs, TiO_2, or surfactants

Applications

- HGPPB Series filter cartridges perform best when used with the Hydro-Guard Advanced Backflush System.
- HGPPB-R Series filter cartridges are included with the Hydro-Guard Demin Backflush System.

PALL HYDRO-GUARD COLD R FILTER ELEMENTS

Performance

- Hydro-Guard CoLD R filters are specifically designed for use in backflushable, resin precoated power plant applications. The powdered resin removes dissolved and suspended copper, silica, and sulfate contaminants.
- The HGCoLD R filter provides a rigid, low-pressure drop surface to hold the resin in a consistently even layer from top to bottom.

Features and benefits

- CoLD fiber construction resists media compression common to conventional string wound filters.
- Melt bonded connections prevent bypass, common to string wound filters.
- No surfactants, binders, or adhesives that can be extracted into the process.
- Proprietary construction traps resin at the filter medium surface.

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers

PALL PERMI-L FILTER ELEMENTS

Performance

Replacement of conventional string or metal filters in existing vessels with high performance PERMI-L filter elements results in improved filtration, resin life, and dissolved contaminant removal efficiency.

Features and benefits

- Used with conventional backflush systems.
- Retrofits into existing hardware or can be custom designed for the application.
- Made with continuous filament yarn for added durability. No fiber deterioration or migration.
- Uniquely designed and processed filament minimizes extractables and eliminates start-up rinse.

Applications

- Used in both Fossil and Nuclear applications.
- Is currently used in many conventional systems.
- Designed for removal of ionic contaminants and iron oxides.
- Can also be supplied for high temperature (300ºF/150ºC) use.

PALL FILTER SEALING HARDWARE

Performance

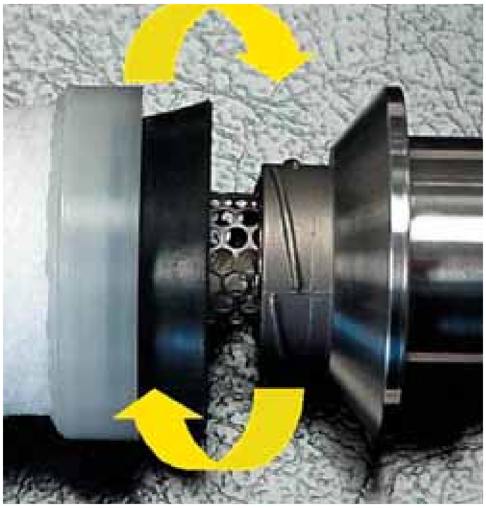
For installations using spring type sealing devices, consider upgrading to a higher integrity sealing system. The Power Seal Pak is cutting edge technology and is ideal for retrofitting bottom tube sheet condensate filter demineralizers or for new vessel construction. The new Power Seal Pak stainless steel hardware attaches directly to the standing tubes on the bottom tube sheet after removal of the ‘old’ hardware.

Features and benefits

- One-piece construction
- Reusable full flow center core
- Patented pressure energized sealing from gasket to core
- Manufactured according to ISO standards
- Operator friendly installation
- Use with any Hydro-Guard filter

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers, drum boilers, BWR condensate, and PWR condensate



PALL SCIENTIFIC LABORATORIES & QUALITY CONTROL

Pall's Manufacturing Expertise

Highly trained manufacturing personnel melt blow polymeric filter media and assemble condensate filters in a clean, controlled environment. Modern techniques and cutting edge equipment, applied according to ISO9001-2000 standards, result in the highest quality filters for the customer. Condensate customers rely on Pall manufacturing's consistency, dependability and on-time delivery.

Proprietary manufacturing equipment, patented filter products, and rigorous quality control measures make Pall's condensate filter offering unique and highly desired around the world.

Efficiency testing lab

Extractables testing lab

Pleated manufacturing area

Melt blown area

Pall's Scientific and Laboratory Services

Pall's Scientific and Laboratory Services (SLS) team consists of hundreds of scientists and engineers, most with advanced degrees working in 41 labs around the world. These filtration experts can apply their years of experience investigating and solving the often complex problems surrounding fluid clarification and membrane-based separation processes to provide you with the best solution for your particular application.

Working jointly with customers, SLS team members evaluate filters, employing post-use, state-of-the art particle counting and other advanced techniques in order to establish optimum filter life. Should a standard product not meet your needs, custom solutions can also be developed. SLS support and service are available to all Pall customers, worldwide.

Whether pushing the envelope to develop cutting edge solutions or assisting with routine, day-to-day operations, Pall customers can count on SLS for a proactive response that is fast and particularly tuned in to the unique filtration requirements in their specific applications.

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Reorder Code: PG2000-B

PALL Power Generation

HYDRO-GUARD® PPB Series Backflushable Filter Cartridges

The Most Extensively Used Backflushable Pleated Filter in Power Plant Condensate

- Backflushable Pleated Filter Designed Specifically for Use in Power Plants
- The Hydro-Guard PPB is Used in Condensate With or Without Resin Precoat
- Constructed With the Highest Purity Materials (no fillers, talcs, TiO_2 or surfactants) for Minimal Rinse-up Time
- Surface Area Exceeds That of Conventional Condensate Filters by a 20:1 ratio for Lower Pressure Drops, Increased Filter Life and Longer Backflush Cycles
- Eliminates Costs Associated with Use and Disposal of Powdered Resins
- Iron Oxide and Suspended Copper are Typically Reduced by 98%[+]
- Absolute Construction and Surface Retention for Efficient Backflushing and Particle Removal

Performance Specifications

Maximum Operating Temperature:
180°F (82.2°C)

Maximum Differential Pressure:
40 psid (2.8 bar) @ 150°F (65°C)

Product Feature	Product Benefit	Customer Benefit
Backflushable filter element	Longer on stream life Reduced number of filter changeouts	Lower disposal costs Reduced personnel exposure to radiation during filter changeouts
High surface area	Longer run times Higher dirt holding capacity	Lower operating costs Fewer backflushes for reduced disposal costs
All Polypropylene	Virtually no extractables Incinerable Radiation Resistant No rinse-up required	Concerns eliminated with regard to chemistry changes Reduced startup costs (i.e. downtime rinse-up water, etc.)
Modular design	High structural integrity	Easy retrofit into existing pressure vessels
Absolute Construction	Highly efficient particle removal	Less damage from iron and copper in boiler and turbine Quicker plant startups Fewer boiler cleanings

Product Specifications

Materials of Construction

Filter Media:	Polypropylene
Support Material:	Polypropylene
Hardware:	Polypropylene
Sealing:	Thermal Bond
Gasket/O-ring Materials:	EPDM (standard), Others available

HGPPB also offered in tubesheet and cage designs.

Pressure Drop/Flow Data

Model	Delta Pressure ΔP = (k) (Flow Rate)
HGPPB1	Δ = (0.50) Flow Rate
HGPPB2	Δ = (0.40) Flow Rate
HGPPB4	Δ = (0.05) Flow Rate
HGPPB10	Δ = (0.03) Flow Rate
HGPPB18	Δ = (0.01) Flow Rate
HGPPB42	Δ = (0.01) Flow Rate

This information is with water at ambient temperatures. Differential pressures are in PSID based on flow in GPM through a 10" (25.4 cm) element.

Part Numbers/Ordering Information

HGPPB – ■ – ● – P – ◆ – ▼ (e.g. HGPPB–2–70–P–E–DOE)

Code ■	Filter Grades*
1	1 µm
2	2 µm
4	4 µm
10	10 µm
18	18 µm
42	42 µm

** Based on typical application usage.*

*** For details, contact Pall Corporation.*

1 - Registered trademark of DuPont Dow.

Code ●	Cartridge Lengths (nominal)
10	10" (25.4 cm)
20	20" (50.8 cm)
30	30" (76.2 cm)
40	40" (102 cm)
50	50" (127 cm)
60	60" (152.4 cm)
70	70" (178 cm)
80	80" (203.2 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
V	Viton[1] A
E	EPDM

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and endcaps
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
COOP	Fine thread direct screw in
TVO	Extended neck for better sealing
PAK	Easy installation and removal; double seals for high integrity
PEA	Retrofit for 2" (5.1 cm) seat cups
AERO	Connects directly to tube sheet without additional hardware

PALL Power Generation

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Filtration. Separation. Solution.SM

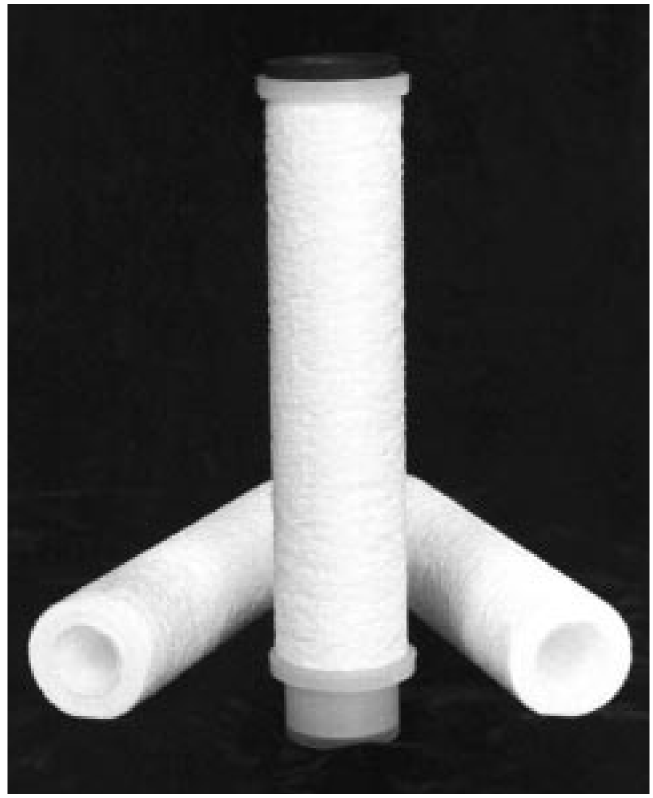
PALL Power Generation

HYDRO-GUARD® COLD R Series Filter Cartridges

Advanced Resin Retaining Backflushable Technology

- Melt Blown Filter Element for use in Backflushable, Resin Precoated Power Plant Applications
- Reduced Precoat Resin Application
- Proprietary Air Backwash Protocol
- Reduced Extractables
- Free of Adhesives, Binders and Silicones
- Rigid Pore Structure Results in more Consistent, Reliable, and Reproducible Filtration
- Resists Collapse or Compression Under Increasing Differential Pressure
- Resin Precoat Remains Uniform on Surface for Reduced Possibility of Bleed Through

The Hydro-Guard CoLD R filter element is manufactured by a unique, proprietary process called CoLD MELT. This technology creates a filtration matrix with small, micro-thin fibers to remove particles and Co-located Large Diameter fibers to for added strength. The CoLD Melt process permits the creation of multiple filtration zones within a single filter cartridge. The multi-zone design produces a gradient pore structure, which effectively captures particles on the outer surface of the cartridge. The interior sections have a more open pore structure to efficiently remove resin and contaminants from the cartridge during the backwash process.



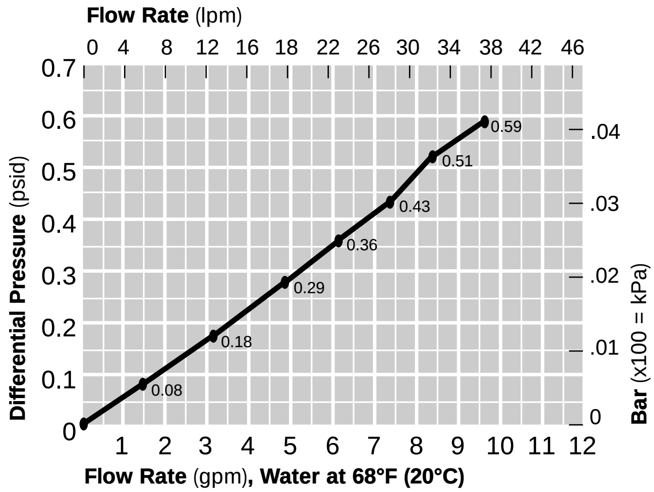
Product Feature	Product Benefit	Customer Benefit
Reduced Resin Application	Reduced Powdered Resin Precoat Consumption	Lower Resin and Resin Disposal Costs
Backflushable Filter Element	Longer Element Service Life Reduced Number of Filter Changeouts	Filter Disposal Costs Reduced Minimizes Exposure in Radioactive Applications
Proprietary CoLD Fiber Technology	Consistent Filtration Under Dynamic Operating Conditions Rigid Structure Multiple Filtration Zones	High Performance Filtration No Cartridge Collapse or Resin Bleed Through Contaminants Remain on Surface for Efficient Backflush
All Polypropylene	Virtually No Extractables Incinerable Limited or No Rinse-up Required on Condensate	Wide Range of Chemical Compatibility Reduced Startup Costs
Various Sealing Configurations	Flexibility in Design and Manufacturing	Retrofits into Existing Pressure Vessels
Backflush with Pressurized Air	More Efficient than Water only Assisted Backflush	Reduced Operating Costs

Performance Specifications

Maximum Operating Temperature:
150°F (65°C)

Maximum Differential Pressure:
30 psid (2.07 bar) @ 150°F (65°C)

Typical Flow vs. Differential Pressure for Application Sizing



Product Specifications

Materials of Construction

Filter Media:	Polypropylene
Hardware:	Polypropylene
Sealing:	Thermal Bond
Gasket/O-ring Materials:	EPDM (standard), Silicone, Buna N, Viton[1] A

Part Numbers/Ordering Information

HGCoLDR – ● – P – ◆ – ▼ (e.g. HGCoLDR–70–P–PSF–DOE)

Code ●	Cartridge Lengths
50	50" (127 cm)
60	60" (152.4 cm)
70	70" (178 cm)
80	80" (203.2 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
V	Viton A
E	EPDM

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and end caps
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
PEA	Retrofit for 2" (5.1 cm) seat cups
SOE	Other

[1] - Registered trademark of DuPont Dow.

*** For details, contact Pall Corporation.*

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PALL Power Generation

HYDRO-GUARD® PG Series Filter Cartridges

Pleated Glass Media Filter Cartridges for Use in Power Plants

- Sub-micron Glass Filaments Ensure Mechanical Sieving of Iron Oxides and Other Particles
- Polyester Support Material to Prevent Media Migration
- Bubble Point Tested for Excellent Consistency
- Absolute Construction For >99.9% Efficiency (by ASTM F-795 Test)
- Efficiency Tested Under Power Plant Operating Conditions
- Optimized Surface Area for Highest Iron Oxide Loading

Product Description

The Hydro-Guard PG excels in power plant applications requiring high performance at a lower cost. Documented cost savings can be expected with the use of the Hydro-Guard PG pleated filter.

Constructed for long life in applications such as rad-waste and make-up water, the Hydro-Guard PG typically lasts five to six times longer than some depth type filters. Mechanical sieving prevents contaminant unloading during fluctuating power plant system conditions.

The cartridge assembly consists of proprietary pleated microfiberglass media with polyester support layers upstream and downstream. Surface retention design avoids iron oxide pore plugging.

The Hydro-Guard PG is tested under conditions that simulate power plant operating environments, not those of other industries. Performance has been proven reliable and cost effective in numerous North American and international power plants.

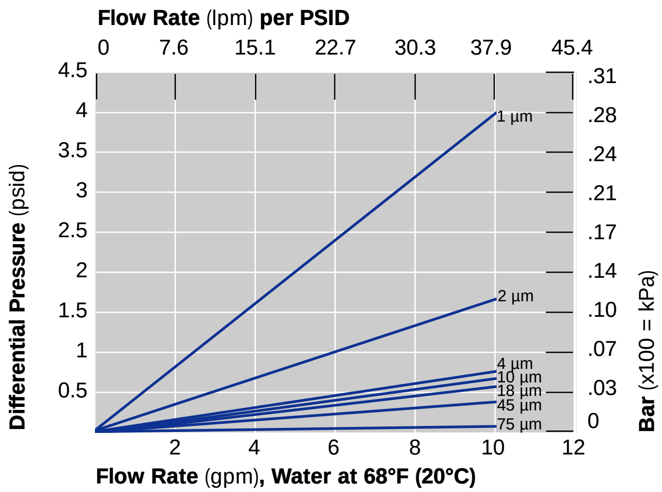
Materials of Construction

Filter Media:	Borosilicate microfiberglass with acrylic binder
Gaskets/O-rings:	Siliconer, Buna N, Viton[1] A, EPDM, FEP
Support Material:	Spun-bonded polyester
Hardware:	Polypropylene
Sealing:	Thermal Bond

[1] - Registered trademark of DuPont Dow.

Product Feature	Product Benefit	Customer Benefit
Fixed pore structure prevents particle unloading	>99.9% Efficiency	Complete protection of downstream equipment and system
Tight surface pores assist in the formation of filter cakes	Extended filter life	Fewer cartridge changeouts
Fits standard filter housings	Easy retrofit into existing housings	No hardware changes
Manufactured under ISO 9001 guidelines	Excellent performance in rad waste and make-up water applications	Improved system productivity
Tested specifically for power plant environments	Long history of reliable performance in power plant applications	Meets or exceeds filtration requirements

Typical Flow vs. Differential Pressure for Application Sizing



Flow rate is per 10" (25.4 cm) cartridge. For liquids other than water, multiply the differential pressure by the fluid viscosity in centipoise.

Part Numbers/Ordering Information

HGPGT ■ – ● P – ◆ – ▼– ▮ (e.g. HGPGT 4 – 30P – N – M8 – B)

Code ■	Filter Grades*
1	1 µm
2	2 µm
4	4 µm
7	7 µm
10	10 µm
18	18 µm
45	45 µm
75	75 µm

Code ●	Cartridge Lengths (nominal)
4	4" (10.2 cm)
10	10" (25.4 cm)
20	20" (50.8 cm)
30	30" (76.2 cm)
40	40" (102 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
E	EPDM
V	Viton A
T	FEP

** Based on typical application usage.*

*** For details, contact Pall Corporation.*

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and endcaps
1X	DOE industrial, 1" extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M5	Double open end, internal O-rings (retrofits other manufacturers' O-ring)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
M19	119 O-ring

Code ▮	Bubble Point
Blank	10% Bubble Point
B	100% Bubble Point

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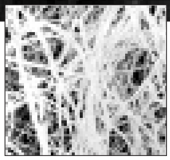
Bulletin #PG-900-3C 4/03

POWER GENERATION
HYDRO-GUARD™ PPT SERIES PLEATED POLYPROPYLENE FILTER CARTRIDGES

Fixed Pore Structure Filter Cartridges for Use in Power Plants

- Increased Surface Area
- Proprietary Melt Blown Filter Medium with Ultrafine Filaments
- Efficiency Tested Under Power Plant Conditions
- Absolute Rated at 99.98%
- Meets NQA-2-1989 (N45.2.1-N45.2.23) (Updated NQA-1-10-1979)



Outer Pre-filtration Layer

Product Description

The Hydro-Guard PPT is a pleated filter cartridge designed specifically for use in power plants. Filter features such as increased surface area, reduced extractables and absolute retention make this product better suited to the demands of power plant filtration applications than many products currently in use. The Hydro-Guard PPT is a next generation filter constructed of 100% polypropylene made by a patented* melt blowing technique.

In liquid applications where corrosion products are the predominant contaminant, the Hydro-Guard PPT increases filtration productivity by providing longer filter life and reduced extractables.

The Hydro-Guard PPT is tested using conditions that model power plant environments, not those of the chemical processing industry. Performance has been proven reliable and cost effective in numerous North American and international power plants. Customer references are available upon request.

Product Features	Benefits	Customer Benefits
High surface area	Lower pressure drops Increased filter life	Fewer element changes Less customer exposure to chemistry
100% polypropylene	Virtually no extractables Easy disposal Radiation resistant	Concerns eliminated with regard to chemistry changes Reduced start-up costs
Tighter pore distribution on media surface	Reduces pore plugging Dynamic cake filtration Absolute retention	Fewer cartridge change-outs Meets critical filtration requirements
Fits standard filter housings	Easy retrofit into existing housings	No hardware changes
Lower extractables and better radiation stability	Avoid filter caused chemistry problems	Quicker start-up No rinse-up required
Tested for power plant environments	Reliable performance in power plant applications	Successful experience provides for effective solutions

*U.S. Patent Nos.: 5,829,708 5,955,012

Pall Corporation

Bulletin #PG-500-1C

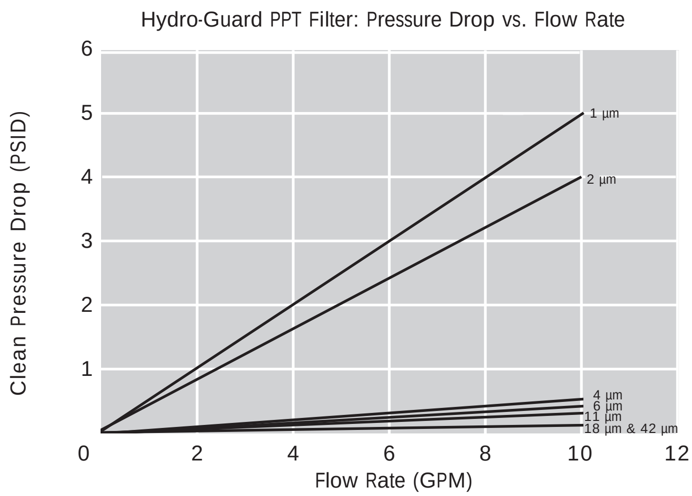
POWER GENERATION

HYDRO-GUARD PPT SERIES PLEATED POLYPROPYLENE FILTER CARTRIDGES

Materials of Construction

Filter Media: Melt Blown Polypropylene
Hardware: Polypropylene
Sealing: Thermal Bond
Support Material: Polypropylene
Gaskets: Buna N, EPDM, Silicone, Viton A
O-rings: Silicone, EPDM, Buna N, Viton A

Performance Parameters



Differential Pressures are in PSID based on flow in GPM through a 10-inch cartridge.

Ordering Information

HG PP T 4 -30 -P -E -M8 -B

Hydro-Guard (HG)

Pleated Polypropylene (PP)

T = Thermal Bond

Retention Ratings (absolute):
1, 2, 4, 6, 11, 18, 42 µm

Cartridge Lengths (nominal):
10”, 20”, 30”, 40”

Center Core:
P = Polypropylene

Gasket/O-ring Materials:
S - Silicone
V - Viton A
N - Buna N (Standard Gaskets)
E - EPDM
D - EPR Blue Dot

Bubble Point Options:
No Symbol = 10% Bubble Point
B = 100% Bubble Point

End Configurations:
DOE– Double open end with elastomer gasket seal
1X – Double open end industrial. 1” extended core
M3 – SOE flat closed end, external 222 O-rings (replaces MILLIPORE® code 0)
M6 – SOE flat closed end, external 226 O-rings (replaces Millipore code 6)
M7 – SOE fin end, external 226 O-rings (replaces Millipore code 7)
M8 – SOE fin end, external 222 O-rings (replaces Millipore code 5)
M19- 119 O-ring

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Filtration. Separation. Solution. SM

Pall Corporation

IDL Series Filter Housings

- Single Cartridge Housings Accept Double Open End, RF and 1001 Style Filters
- All Stainless Steel Materials of Construction
- Accepts 1 in (2.54 cm), 4 in (10.2 cm), 10 in (25.4 cm), 20 in (50.8 cm), and 30 in (76.2 cm) Lengths
- V-Band Clamp Features a Quick Opening T-Handle
- Variety of Inlet/Outlet Sizes and O-ring Seal Options Offered
- Optional Mounting Brackets Available

Housing Specifications

Design Ratings[1]:

V-band Clamp Design: 260 psig (17.9 bar) @ 100°F (40°C)
200 psig (13.8 bar) @ 300°F (150°C)
114 psig (7.9 bar) @ 347°F (175°C)[2]

NOTE: Above ratings apply to housing only. Cartridge and housing O-ring selection may impose different and narrower limitations.

Materials of Construction:

Head:	316L Stainless Steel
Bowl:	316 Stainless Steel

Connections:

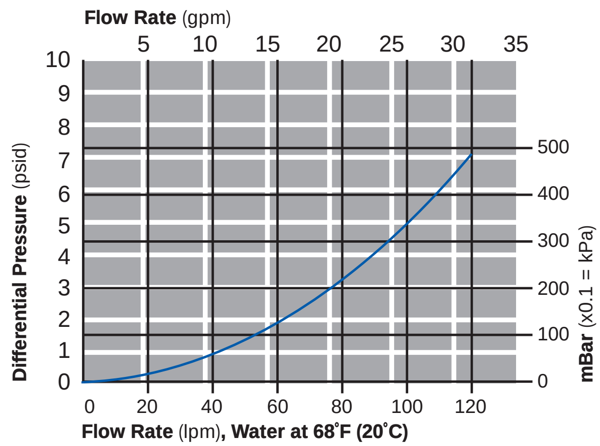
Inlet/Outlet:	¾" NPT, 1" NPT, ¾" BSPT, 1" BSPT, 1" BSPP
Flange Option:	150 lb. ANSI raised face flanges or BS4504 flanges available for 1" IDL Housings
Vent/Drain:	¼" NPT, BSPT or BSPP (refer to ordering information for complete details)

Shell O-rings: FEP Encapsulated Fluorocarbon Elastomer, Silicone Elastomer, Fluorocarbon Elastomer, Nitrile, Ethylene Propylene, Ethylene Propylene for Steam Service

Bracket Option: Stainless steel brackets are available as a standard option.

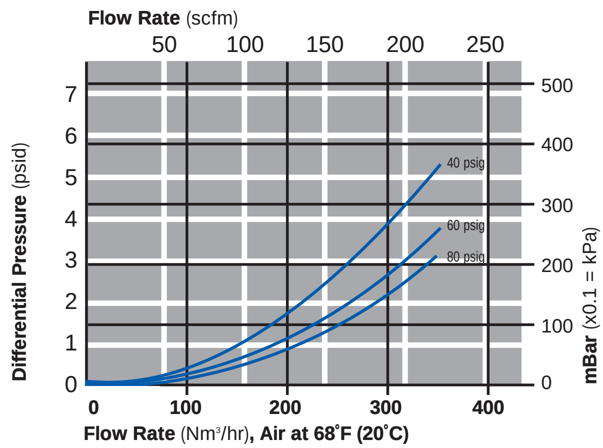
1 - Fully vacuum rated.
2 - For continuous steam service.

Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Housing Differential Pressure vs. Air Flow Rate



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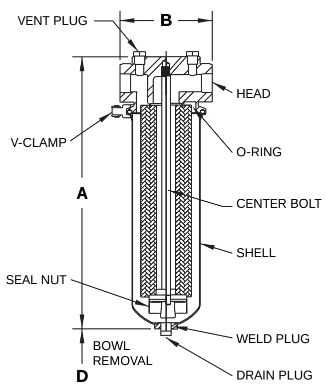
Dimensional Data

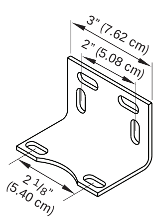
Model	Flow[3] Rate (gpm/lpm)	Dimensions A in/mm	B in/mm	C in/mm	D in/mm	Volume Gal/L	Weight Empty Threaded Nozzle lbs/Kg	Flanged Nozzle lbs/Kg
IDLD01	1/3.78	5.81/147.57	4.81/122	9.81/250	3.75/95.25	0.41/.15	4.5/2.0	———
IDLD04	4/15	8/203	4.81/122	9.81/250	6/153	0.11/0.4	5.1/2.3	11.9/5.4
IDLD1	10/38	14.25/362	4.81/122	9.81/250	12.63/321	0.34/1.3	5.7/2.6	12.5/5.7
IDLD2	20/76	24.25/516	4.81/122	9.81/250	22.5/572	0.74/2.8	6.7/3	13.5/6.1
IDLD3	30/114	34.25/870	4.81/122	9.81/250	32.38/822	1.14/4.3	7.7/3.5	14.5/6.6
IDL101	1/3.78	5.81/147.57	4.81/122	9.81/250	3.75/95.25	0.41/.15	4.5/2.0	———
IDL104	4/15	8/203	4.81/122	9.81/250	6/153	0.11/0.4	5.1/2.3	11.9/5.4
IDL11	10/38	14.25/362	4.81/122	9.81/250	12.63/321	0.34/1.3	5.7/2.6	12.5/5.7
IDL12	20/76	24.25/516	4.81/122	9.81/250	22.5/572	0.74/2.8	6.7/3	13.5/6.1
IDL13	30/114	34.25/870	4.81/122	9.81/250	32.38/822	1.14/4.3	7.7/3.5	14.5/6.6

[3] - Dependent on inlet/outlet selection.

Side View



Optional Mounting Bracket



Part #T10567035

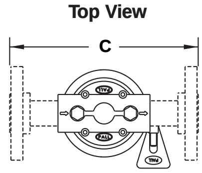
Part Numbers/Ordering Information

IDL ■ ● G ◆ ▼ ▮ (e.g., IDL D 04 G N12 C2 H13)

Code ■	Cartridge Style
D	DOE/RF V-band
1	1001 V-band

Code ●	Bowl Length
01	1" (available in N16 and B16 option only)
04	4"
1	10"
2	20"
3	30"

Top View



Code ◆	Inlet/Outlet And Vent/Drain Size
N12	¾" NPT/¼" NPT
N16	1" NPT/¼" NPT
B12	¾" BSPT/¼" BSPT
B16	1" BSPT/¼" BSPT
B17	1" ANSI Flange/¼" BSPT
N17	1" ANSI Flange/¼" NPT
P17	1" ANSI Flange/¼" BSPP
P19	1" BSPP/¼" BSPP
B35	1" BS4504 Flange/¼" BSPT
P35	1" BS4504 Flange/¼" BSPP

Code ▼	Housing Options
Blank	Blank
C2	Passivated
C9	Cleaned For Oxygen Service

Code ▮	Seal Materials
H	Fluorocarbon Elastomer
H1	FEP Encapsulated Fluorocarbon Elastomer
H4	Silicone
H13	Nitrile
J	Ethylene Propylene
J7	Ethylene Propylene for Continuous Steam Service

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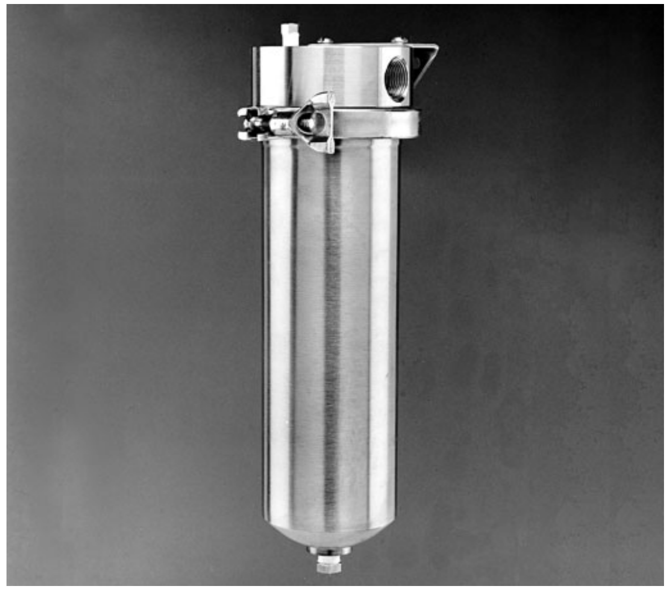
Bulletin #1703-5C

November 2009

Pall Corporation

IDO Series Filter Housings



175 PSIG, Accepts Pall M3 (Code 3) Style 222 O-ring Single Open End Cartridges

- Positive Cartridge Sealing Minimizes Fluid Bypass
- Accepts 4″ (10.2 cm), 10″ (25.4 cm), 20″ (30.8 cm) or 30″ (76.2 cm) M3 (Code 3) Style Cartridges
- Unique Housing Design Has No Internal Parts
- Tri-Clamp Sealing Requires No Special Tools to Open or Close Housing
- Design Permits Visual Inspection of Cartridge Seal Prior to Closing Housing
- Optional Tri-Clamp Bracket Allows Easy Cartridge Replacement

Housing Specifications

Maximum Operating Pressure:
175 psig (12.1 bar) @ 150°F (66°C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:

Head:	316L Stainless Steel
Shell:	316 Stainless Steel
Tri-Clamp:	304 Stainless Steel
Vent Plug:	316 Stainless Steel
Drain Plug:	316 Stainless Steel

Connections:

Inlet/Outlet:	¾″ NPT
Vent:	⅛″ NPT
Drain:	¼″ NPT

Shell O-rings:	EPDM (standard) Neoprene, FEP, Silicone Elastomer, Buna N, Viton[1] A

Bracket Options:

Universal:	Nickel Plated Steel
Tri-Clamp:	316 Stainless Steel

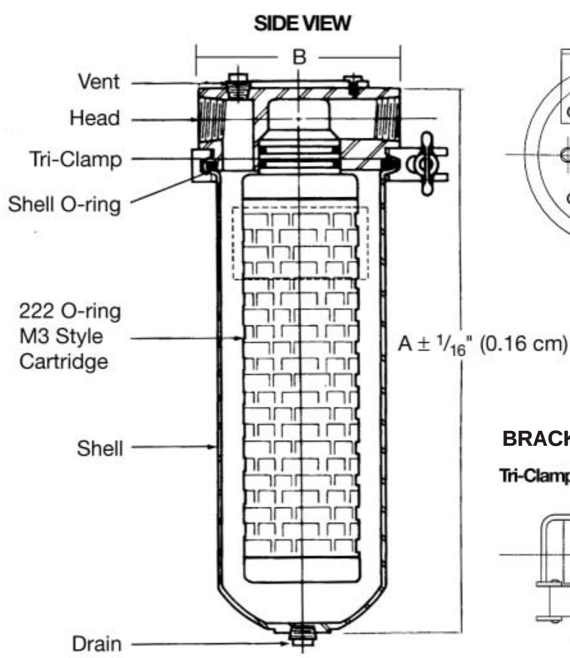
Interior Finish:	#4 Final Finish

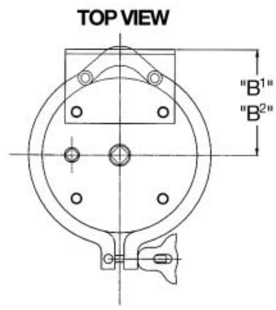
[1] *Registered trademark of DuPont Dow.*

Dimensional Data (nominal)

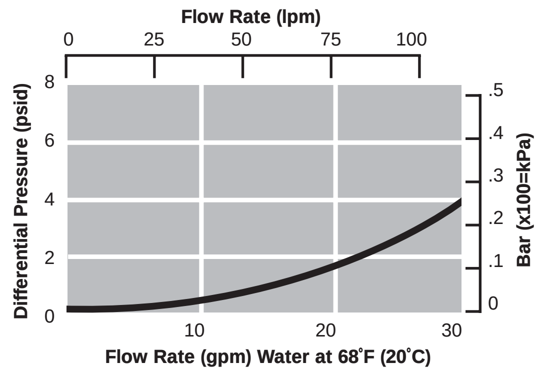
Model	Liquid[2] Flow Rate (gpm)	Dimensions (inches) A	B	Dry Weight (pounds)
IDO4S-¾	to 4 (15.1 lpm)	8 ½ (21.6 cm)	4 ⅛ (10.5 cm)	8 (3.6 kg)
IDO10S-¾	to 10 (37.9 lpm)	14 ¾ (37.5 cm)	4 ⅛ (10.5 cm)	9 (4.1 kg)
IDO20S-¾	to 20 (75.7 lpm)	24 ¾ (62.9 cm)	4 ⅛ (10.5 cm)	10 (4.5 kg)
IDO30S-¾	to 30 (113.7 lpm)	34 ¾ (88.3 cm)	4 ⅛ (10.5 cm)	13 (5.8 kg)

[2] *Dependent on cartridge selection, fluid viscosity, and allowable pressure drop. See graph above for housing pressure drop at various low rates. Refer to specific cartridge nomograph to determine initial pressure drop due to the filter cartridge.*





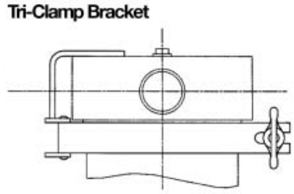
Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

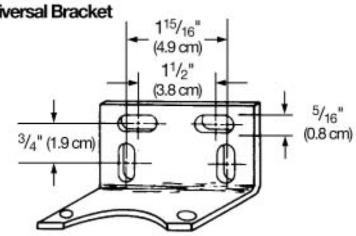
BRACKET OPTIONS

Tri-Clamp Bracket



Part #T10876032
$B^1 = 2\,^3/_4$" (7.0 cm)

Universal Bracket



Part #T10567035
$B^2 = 2\,^1/_2$" (6.4 cm)

Part Numbers/Ordering Information

IDO ● S – 3/4 ✷ (e.g., IDO10S–3/4CB)

Code ●	Cartridge Lengths
4	4"
10	10"
20	20"
30	30"

Code ✷	Mounting Brackets
Blank	Universal
CB	Tri-Clamp

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Pall Corporation

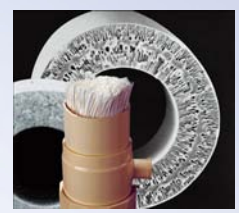
Industrial Water Treatment Programs

Pall Corporation is the global leader in the rapidly growing field of filtration, separation and purification. Pall is also recognized as being one of the largest water treatment companies in the world. Pall's broad capabilities and technologies for industrial water customers include:

- Total treated water capacity greater than 800 MGD and growing
- More than 25 installations specifically designed for wastewater reuse for utility water makeup and boiler feedwater
- Experts in water reuse engineering and water balance evaluations

Pall is recognized for its expertise in Industrial processes. For decades Pall has applied its separation and filtration knowledge and technologies to solve a variety of complex and critical applications.
We understand the origin of your process waters and their characteristics. <u>Our understanding of your process places Pall in the best position to define solutions for water treatment and reuse</u>. We have experience in treating or developing solutions for some of the most difficult and troublesome process waters. Our technologies are applied to remove mercury, selenium, hydrocarbons, and other troublesome contaminants.

Our integrated systems include coupled MF/UF/NF/RO designs that offer:



- Reduced system footprint
- Dramatic extension of RO membrane life
- Elimination of inter-stage pumping which simplifies operation and reduces operating costs
- Integrated ion exchange designs to provide turnkey solutions
- Conversion of raw water, C/T blowdown, or process water into high-quality boiler feedwater. Over 80 installations.

Our core technologies include a unique hollow fiber MF/UF membrane that can be configured in either an inside-out cross flow or an outside-in dead-end configuration. This allows Pall to optimize designs for the widely variable waters that your plant may generate or need to process.

- PVDF membrane is highly resistant to chemical attack
  - Unparalleled integrity
  - 0.00031% failure rate documented in a 5-year study. That equates to 6 fiber failures out of a population of 1,905,000 fibers in a 5-year period!
- Hydrophilic membrane types (PAN and certain ceramics) provide more resistance to oil fouling

Pall ceramic systems and technologies offer superior resistance to thermal and chemical degradation when facing water with extremes in pH and temperature. Pall manufactures ceramic membranes and modules that are utilized in systems optimized for specific characteristics. Pall ceramic technologies and systems are based on a variety of membrane configurations. Porous alumina structures are lined with asymmetric membrane layers made of alpha-alumina, zirconia, and titania which offer a range of ultrafiltration efficiencies.

We invite you to learn more about Pall and our Industrial water capabilities. Visit us on the web or contact your local Pall representative.

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Pall Corporation

JD Series Filter Housings

All Natural Polypropylene 20″ Single Cartridge Housing

- Constructed from all natural polypropylene components with no fillers, colorants, plasticizers or lubricants
- Economical alternative to fluoropolymer, stainless steel or other high purity vessels
- Housing designed to accept SOE filter cartridges with 222 o-ring sealing
- Excellent chemical compatibility for use with semiconductor grade chemicals, CMP slurry, magnetic coatings, electronic etching solutions, DI and reagent grade water
- Accommodates standard 20″ (50.8 cm) Pall M3 (Code 3) style filter cartridges

Housing Specifications

Maximum Operating Pressure:
100 psig (6.9 bar) @ 100˚F (38˚C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Material of Construction:
All natural polypropylene – no fillers, colorants, plasticizers or lubricants

Connections:

Inlet/Outlet:	3/4″ FNPT
Vent/Gauge:	1/4″ FNPT
Drain:	1/4″ FNPT

Shell O-rings: Fluoroelastomer (standard), Nitrile, Silicone Elastomer

Replacement Cap Plug Kit:
For vents/drains – includes 1 plug and 1 O-ring (Part # T11039030)

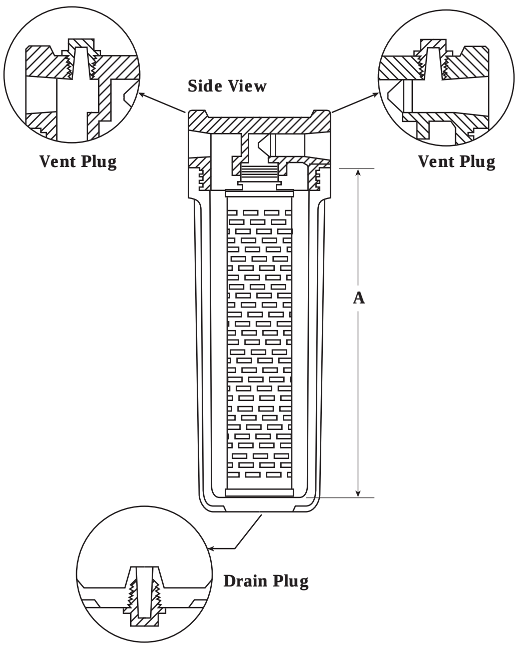
Use of this product in a manner other than in accordance with Pall's current recommendations may lead to injury or loss. Pall cannot accept liability for such injury or loss.

JD SERIES FILTER ASSEMBLIES SHOULD NOT BE USED WITH FLUIDS INCOMPATIBLE WITH THE MATERIALS OF CONSTRUCTION, INCLUDING CLEANING AGENTS. INCOMPATIBLE MATERIALS ARE THOSE, WHICH CHEMICALLY ATTACK, SOFTEN, STRESS CRACK OR ADVERSELY AFFECT THE MATERIALS OF CONSTRUCTION IN ANY WAY. USERS SHOULD CHECK THE COMPATIBILITY OF PROCESS FLUIDS BEFORE USE.

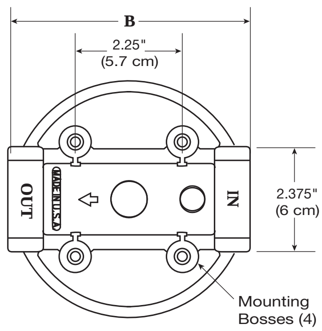
Dimensional Data (nominal)

Model	**Liquid Flow Rate**[1] (gpm)	**Dimensions** (inches)		**Weight** (pounds)
		A	B	
JD20	to 20 (75.7 lpm)	$19^{15}/_{16}$ (50.6 cm)	$5^{1}/_{8}$ (13 cm)	4.25 (1.9 kg)

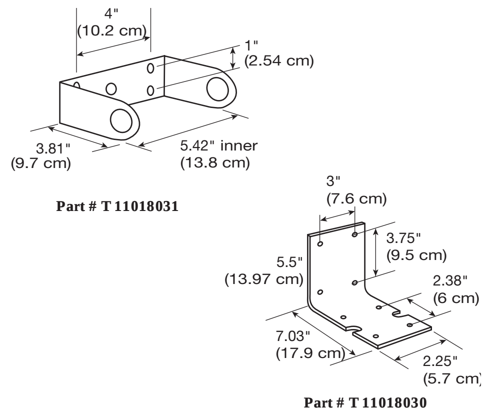
[1] *Dependent upon cartridge selection, fluid viscosity, and allowable pressure drop.*



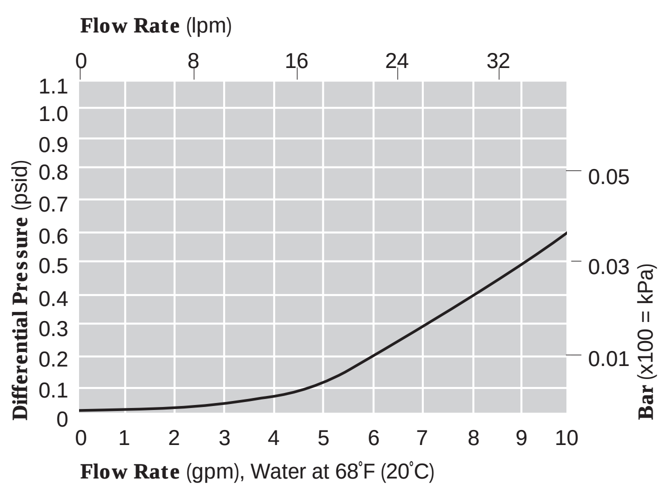
Top View



Optional Mounting Brackets



Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by the specific gravity of the fluid.

Part Numbers/Ordering Information

JD20 – 3/4 ◆ (e.g., JD20 – 3/4 N)

Code ◆	**O-ring Materials**
Blank	Fluoroelastomer
N	Nitrile
S	Silicone

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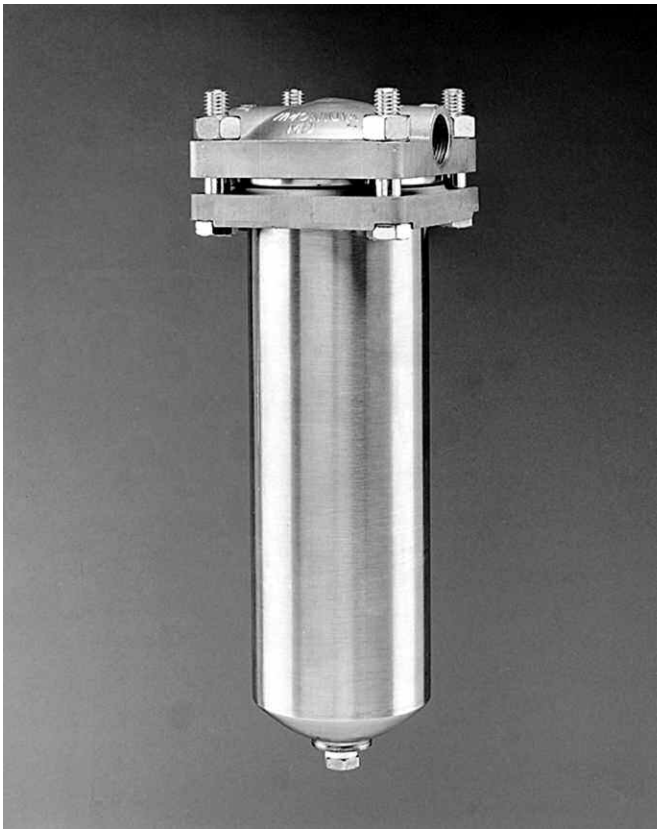
Pall Corporation

LMO High Pressure Series Filter Housings



Accepts 10 in (25.4 cm) or 20 in (50.8 cm) Double Open End Filter Cartridges

- Designed and constructed specifically for high pressure applications (750 or 1000 PSIG)
- Standard multi-bolt closure design provides safe, trouble-free sealing
- In-line inlet and outlet connections ensure easy installation
- Eye nut and flange options available
- Not for use with non-compressible filter cartridges such as pleated, carbon, metallic, and membrane.
  For non-compressible cartridges use the LMOVS-HP/VHP Series housings.

Housing Specifications

Maximum Operating Pressure:

HP: 750 psig (51.7 bar) @ 250°F (121°C)
VHP: 1000 psig (69 bar) @ 250°F (121°C)

Material of Construction:

316 Stainless Steel

Connections:

Inlet/Outlet: ¾" NPT
Drain: ¼" NPT

Shell O-rings: Ethylene Propylene (standard), Nitrile, FEP, Fluorocarbon Elastomer, Neoprene, Silicone Elastomer

Eye Nut Option:

Zinc plated steel eye nuts are available. Four eye nuts (Part #T10640030) are required. Standard units are supplied with hex nuts.

Flange Option:

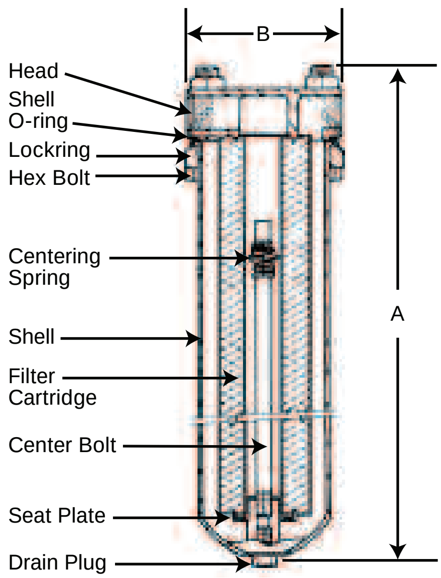
LMOHP housings are available with ¾" welded flanges.

Dimensional Data (nominal)

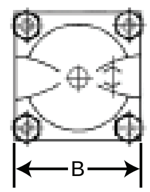
Model	Flow Rate[1] gpm	Dimensions (inches) A	Dimensions (inches) B	Weight (pounds)
LMO10S – ¾ HP	to 10 (37.9 lpm)	13 (33 cm)	4 ⅜ (11.1 cm)	10 (4.5 kg)
LMO20S – ¾ HP	to 20 (75.7 lpm)	23 (58.4 cm)	4 ⅜ (11.1 cm)	13 (5.9 kg)
LMO10S – ¾ VHP	to 10 (37.9 lpm)	13 (33 cm)	4 ⅜ (11.1 cm)	10 (4.5 kg)
LMO20S – ¾ VHP	to 20 (75.7 lpm)	23 (58.4 cm)	4 ⅜ (11.1 cm)	13 (5.9 kg)

[1] *Dependent upon cartridge selection, fluid viscosity, and allowable pressure drop.*

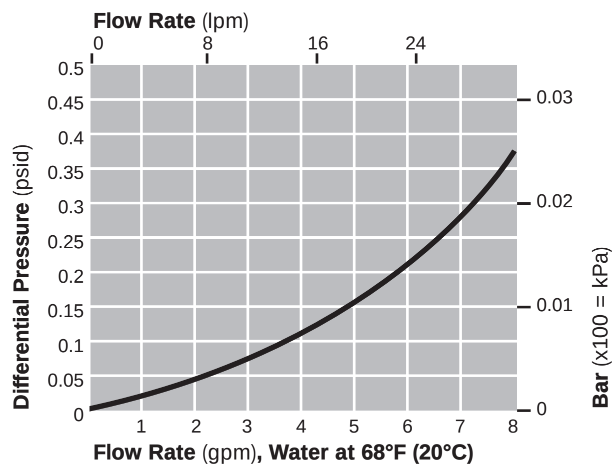
SIDE VIEW



TOP VIEW



Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Part Numbers/Ordering Information

LMO ● S – ¾ ▼ ✪ (e.g., LMO10S–¾FHP)

Code ●	Cartridge Lengths
10	10"
20	20"

Code ▼	Connection Styles
Blank	NPT
F	Flange

Code ✪	Pressure Rating
HP	750 psig @250˚F
VHP	1000 psig @250˚F

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1732-12C October 2009

Pall Corporation

LMO Series Filter Housings

Accepts 4 in (10.2 cm), 10 in (25.4 cm), 20 in (50.8 cm), or 30 in (76.2 cm) Double Open End Filter Cartridges[1]

- Operating pressure to 175 psig (12.1 bar) @ 200°F (93°C) permits use in a wide range of applications
- Cast iron, brass, or 316 stainless steel materials of construction
- In-line inlet and outlet connections for easy installation
- Optional T-handle permits replacement of filter cartridge without tools

Housing Specifications

Maximum Operating Pressure:
175 psig (12.1 bar) @ 200˚F (93˚C)

__NOTE:__ Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:	**Head**	**Shell**
LMO:	Cast Iron[2]	316 Stainless Steel
LMOB:	Cast Brass	316 Stainless Steel
LMOS:	Cast 316 Stainless Steel	316 Stainless Steel

Connections:

Inlet/Outlet: $^3/_8$", $^1/_2$", $^3/_4$", or 1" NPT

Drain: LMO: Drain Plug, 316 Stainless Steel, $^1/_4$" NPT

LMOB: Petcock, Brass, $^1/_4$" NPT

LMOS: Drain Plug, 316 Stainless Steel, $^1/_4$" NPT

Shell O-rings: Ethylene Propylene (standard), Nitrile, FEP, Fluorocarbon Elastomer, Neoprene, Silicone Elastomer

Cover Nut O-ring: FEP (standard)

Bracket Option:
Nickel plated steel brackets are available as standard option.

T-Handle Option:
T-handle cover nuts are available in carbon steel or 316 stainless steel. Standard units are supplied with hex nuts.

Flange Option:
150 lb. ANSI raised face flanges are available for $^1/_2$", $^3/_4$" and 1" LMOS stainless units only.

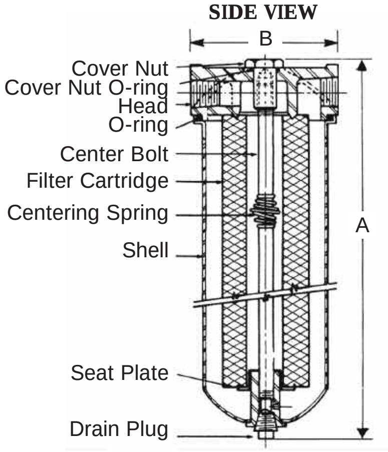
__NOTE:__ Non-compressible filters such as pleated, carbon, and membrane cartridges are not recommended for use with this housing. LMO Spring Seal and LMO Vari-Seal™ housings are designed to accommodate non-compressible filter cartridges. For metallic filter cartridges use the LMO Vari-Seal housings only.

[1] When fitting with 4 in (10.2 cm) DOE membrane filters, please order filters under Code 550 to assure proper fit.
[2] Painted exterior.

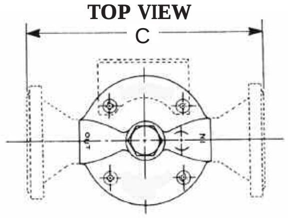
Dimensional Data (nominal)

Model	Flow Rate[3] gpm (lpm)	Dimensions inches (cm) A	B	C	Weight lb (kg)
LMO4 - ⅜	to 4 (15.1)	7 ¼ (18.4)	4 ¾ (12.1)	-	2 ¾ (1.3)
LMO10 - ⅜	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 (2.7)
LMO10 - ½	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10 - ¾	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10 - 1	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¾ (3.1)
LM020 - ¾	to 20 (75.7)	23 ⅜ (59.4)	4 ¾ (12.1)	-	8 ½ (3.9)
LMO20 - 1	to 20 (75.7)	23 ⅜ (59.4)	4 ¾ (12.1)	-	9 (4.1)
LMO4B - ⅜	to 4 (15.1)	7 ⅞ (20)	4 ¾ (12.1)	-	2 ¾ (1.3)
LMO10B - ⅜	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 (2.7)
LMO10B - ½	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10B - ¾	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10B - 1	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¾ (3.1)
LMO20B - ¾	to 20 (75.7)	24 ⅛ (61.3)	4 ¾ (12.1)	-	8 ½ (3.9)
LMO20B - 1	to 20 (75.7)	24 ⅛ (61.3)	4 ¾ (12.1)	-	9 (4.1)
LMO30B - ¾	to 30 (113.6)	34 (86.4)	4 ¾ (12.1)	-	10 (4.5)
LMO30B - 1	to 30 (113.6)	34 (86.4)	4 ¾ (12.1)	-	10 ½ (4.8)
LMO4S - ½	to 4 (15.1)	7 ¼ (18.4)	4 ¾ (12.1)	-	4 (1.8)
LMO10S - ½	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10S - ¾	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	8 ⅞ (22.5)	6 ¼ (2.8)
LMO10S - 1	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	9 ⅛ (23.2)	6 ¾ (3.1)
LMO20S - ¾	to 20 (75.7)	23 ½ (59.7)	4 ¾ (12.1)	8 ⅞ (22.5)	8 ½ (3.9)
LMO20S - 1	to 20 (75.7)	23 ½ (59.7)	4 ¾ (12.1)	9 ⅛ (23.2)	9 (4.1)
LMO30S - ¾	to 30 (113.6)	33 ½ (85.1)	4 ¾ (12.1)	8 ⅞ (22.5)	10 (4.5)

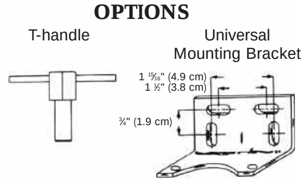
SIDE VIEW



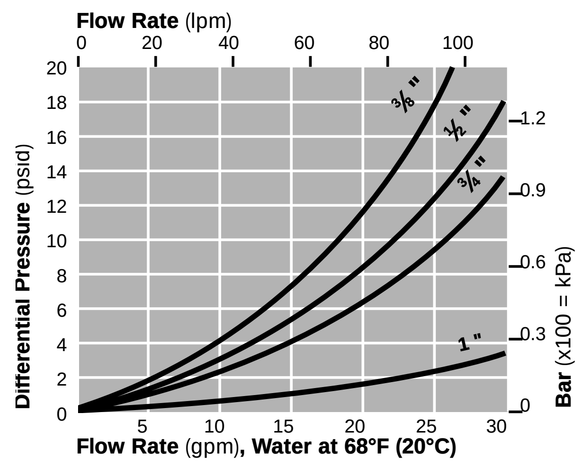
TOP VIEW



OPTIONS



Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Part Numbers/Ordering Information

LMO ● ◗ – ◆ ▼ (e.g., LMO100S–¾ F)

Code ●	Cartridge Lengths
4[1]	4"
10	10"
20	20"
30[4]	30"

Code ◗	Materials of Construction
Blank	Cast Iron and 316 Stainless Steel
B	Cast Brass and 316 Stainless Steel
S	316 Stainless Steel

Code ◆	Connection Sizes
⅜	⅜"
½	½"
¾	¾"
1	1"

Code ▼	Connection Styles
Blank	NPT
F	Flange

[3] *Dependent upon cartridge selection, fluid viscosity and allowable pressure drop at various flow rates. Refer to cartridge nomograph to determine initial pressure drop of filter cartridge.*

[4] *NOT AVAILABLE with cast iron head and carbon shell.*

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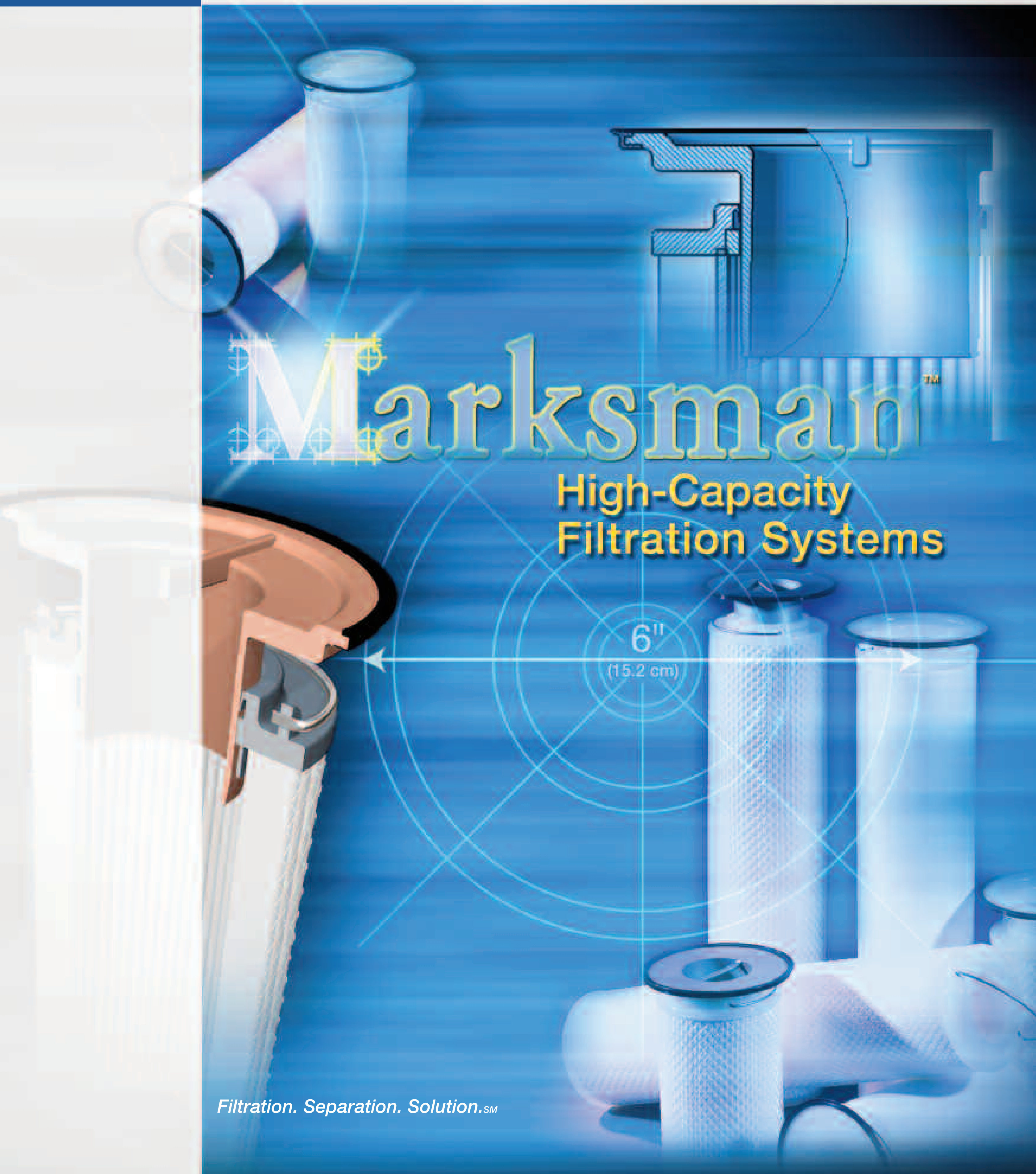
Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid.

Pall Corporation



Marksman™

High-Capacity Filtration Systems

*Filtration. Separation. Solution.*SM

Expanding the Filtration Horizon

High-Performance Filtration

Pall, a world leader in filtration and separations technology, has developed a range of filters that combines the performance advantages of cartridge filters with the ease-of-use of bag filter systems. The resulting Marksman™ Series filters offer a unique combination of benefits and economics. Filtration customers now have a smart, cost-effective alternative to bag filters.

At the heart of the Marksman Series of filters is Pall's proprietary filter media. Pall's range of advanced filter media provides higher removal efficiencies and longer service life than most other filters of equal efficiency. The unique configuration of the Marksman filters offers significantly higher surface area than conventional filters or bag technologies and exceptional dirt-holding capacity.

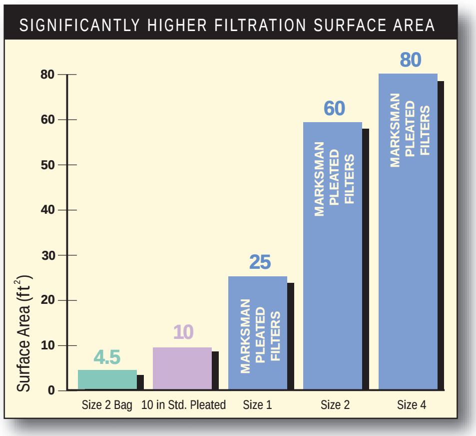
Exceptional Flexibility

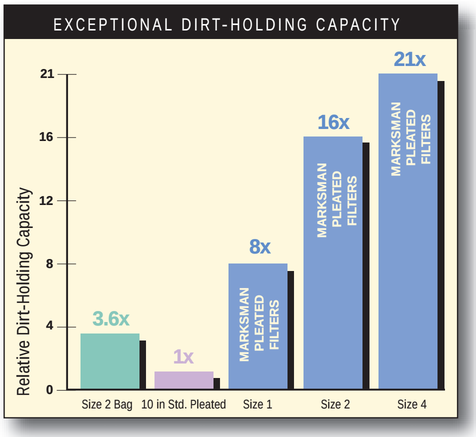
Ease of Use

The large 6 in (15.2 cm) diameter Marksman Series filters easily retrofit into existing Size 1 and Size 2 bag housings. In addition, these high-capacity filters also fit into the new Size 4 (40 in / 101.6 cm) Marksman housing. One Size 2 Marksman Series filter replaces up to 16 standard 10 in (25.4 cm) filters, making change-outs quick and easy.

The user-friendly design of the Marksman Series filters eliminates the hardware commonly associated with cartridge filtration systems. Also, there are no tube guides, springs, or compression plates to maintain. This results in faster cartridge change-outs and reduces system downtime.

In addition, the inside-to-outside fluid flow ensures that the unwanted particles are trapped within the element. This significantly reduces the possibility of contaminating the clean, downstream side of the filter housing during element change-out.





The graphs above compare high-efficiency bags and 10 in (25.4 cm) standard pleated filters with Marksman PFT filters. The comparison is typical for most filter grades.

Adaptability

No longer will filtration performance be limited by the original selection of system hardware. As filtration requirements change, Marksman Series filters can easily retrofit into existing bag systems, with little or no additional hardware investment.

For example, Marksman Series filters can be used during normal process conditions, where bag filters may be used for short periods of time during upset conditions. Similarly, Marksman filters can be used for critical batches, while bag filters may be used for less critical production runs. Marksman Series filters can also be used as a complementary technology to existing bag filters.

Lower Operating Costs

Marksman Series filters deliver lower operating costs than most conventional filters for critical applications. The high surface area and resulting long service life translates into fewer cartridge change-outs and lower disposal costs. The large diameter configuration is more economical than the equivalent number of standard 10 in (25.4 cm) filters, thus delivering additional savings on filter purchases.

Unique Design

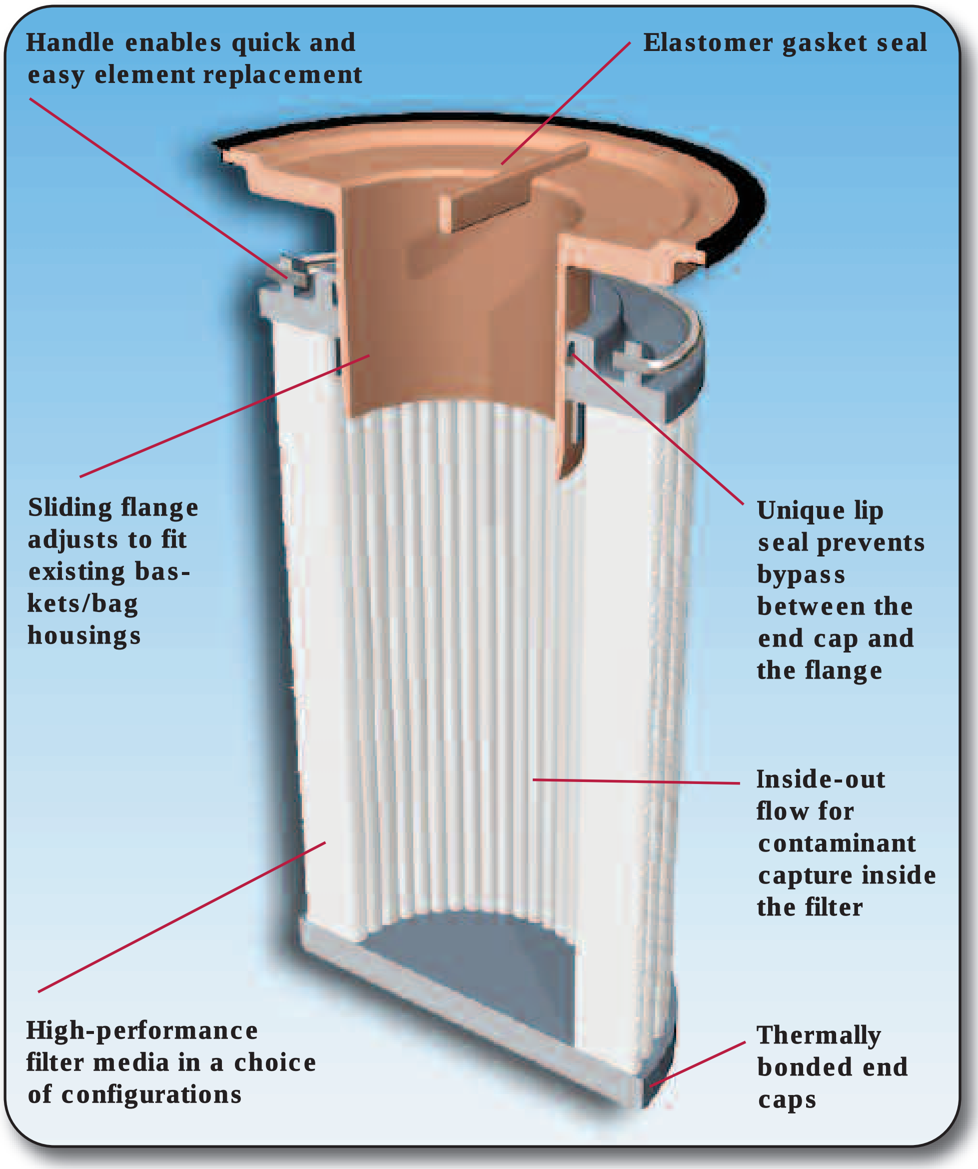
Innovative Technology

Marksman Series filters are manufactured in Pall's state-of-the-art facilities and contain the most advanced melt-blown and pleated media in the industry. Pall's proprietary melt-blowing technology produces media for the sole purpose of filtration. Our attention to detail throughout the entire manufacturing process ensures a high-quality product with unmatched performance.

Other technology benefits include:

- Unsurpassed consistency
- Consistent[1] removal efficiencies
- High-porosity for maximum dirt-holding capacity
- Wide range of product offerings (polypropylene and glass media)
- Customized products for specific applications

[1] *Removal efficiencies based upon a modified ASTM F795 Dynamic Single Pass Efficiency Test.*



Marksman Series Filter Elements	Construction	Filter Grades
Marskman DFN filters	Pleated surface glass filter	1.5 to 40 microns
Marksman NXA filters	Melt-blown polypropylene depth filter with proprietary CoLD Melt™ technology	5 to 70 microns
Marksman PFT filters	Pleated surface melt-blown polypropylene filter	1 to 150 microns
Marksman XLD filters	Pleated depth melt-blown polypropylene filter	1.5 to 70 microns

Features and Benefits

Product Feature	Product Benefit	Customer Benefit
Large 6 in (15.2 cm) diameter element	• High-flow capacity • High surface area	• Lower filtration costs due to fewer filter elements • Lower labor costs due to fewer cartridge change-outs • Lower energy costs as a result of lower initial differential pressures • Quick and easy filter change-outs • Lower disposal costs
High-performance, proprietary media	• Precise filtration performance • Highly consistent performance • Wide range of removal ratings	• High-performance filtration in critical applications • Consistent and reproducible filtration results over time • Less rework due to inconsistent filtration
Inside-to-outside flow	• Contaminant captured inside the filter • Eliminates contaminant falling into the downstream (clean) section of the housing during element change-outs	• Faster element change-outs • Faster system start-ups • Improved product quality
Unique adjustable flange design	• Retrofits most existing Size 1 and Size 2 bag filter housings and baskets • Size 4 (40 in/101.6 cm) fits a standard 40 in Marksman housing • Flexibility to use bag filters or cartridges	• No need to purchase new hardware • Uses existing bag filter systems • Lower capital costs • Easy to switch from bag filtration to cartridge technology
All polypropylene construction	• Wide chemical compatibility	• Compatible with a wide range of fluids • Ease of disposal
No center core	• Less flow resistance • Lower initial pressure drops	• Improved flow rates • Lower energy costs
Re-usable stainless steel flange (option)	• Reduces element volume • Lower cost to replace elements • Can be used in higher temperature applications	• Lower disposal volumes • Reduced filtration costs • Extends usability in elevated temperature applications

Product Line

Marksman filters are available in four configurations ...

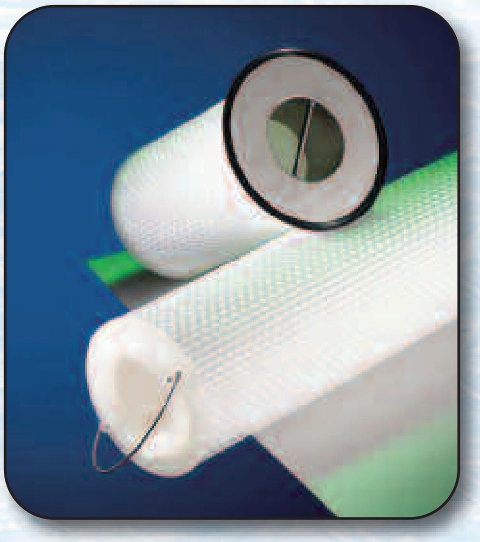
Marksman PFT Series Filters

Marksman PFT filters are constructed of ultra-thin, proprietary melt-blown Poly-Fine® filter media. These high surface area, pleated, polypropylene filters deliver extremely long service life and are ideal for classifying filtration and for capturing non-deformable particulate.

Marksman XLD Series Filters

Marksman XLD (eXtended Life Depth) Series filters have a unique pleated depth configuration. They feature a thicker, multi-layered pleat pack that combines the best of pleated and depth technologies into a single cartridge.

The proprietary Poly-Fine media incorporated into the Marksman XLD Series filter makes these filters ideal for applications where the long life of a pleated filter is desired, and the presence of deformable particles requires the use of depth media.



Product Line

Marksman DFN Series Filters

Marksman DFN filters are constructed of micro fiberglass Duo-Fine® media. These 6 in (15.2 cm) diameter filters have a wide chemical compatibility and offer long service life. They are available in a variety of filter grades for specific applications.

Marksman NXA Series Filters

Marksman NXA filters deliver the same performance advantages of Pall's Nexis® Series filters, by utilizing the same proprietary CoLD Melt technology. The unique Co-located Large Diameter fiber construction produces a fiber matrix with excellent structural integrity to assure that the media does not shift, compress, or unload captured contaminant.

The proprietary manufacturing process produces a melt-blown depth filter with precise removal efficiencies, excellent consistency, and exceptional void volume for high contaminant-holding capacity.

An additional benefit of the inside-out flow configuration is that the finest filtration zone is on the outside of the filter, where the greatest surface area resides.

Product Line

Marksman Series Housings

Pall offers a complete range of Marksman Series filter housings for use with Marksman Series filters. Pall's ISO 9001 manufacturing facility operates under a world-class manufacturing philosophy with a never-ending focus on continuous improvement.

The 316L stainless steel Marksman housings are available in Size 1, Size 2, and Size 4 to accommodate a wide range of filters and bags. Single- and multi-cartridge housings, code and non-code designs are offered. Custom-engineered housings are also available. Contact a Pall representative for more information about custom designs.

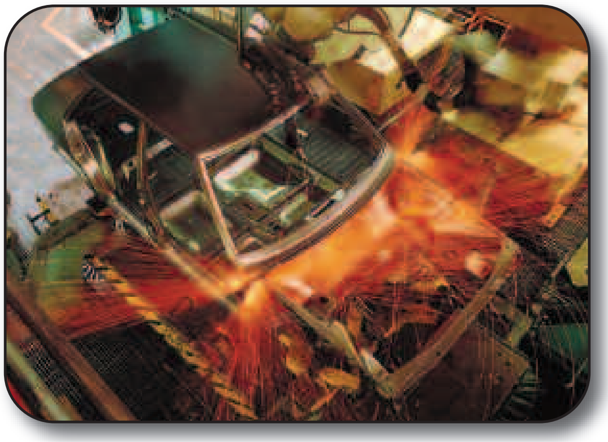
Size 1 and Size 2 Marksman housings are equipped with standard bag housing baskets and allow the flexibility to switch between Marksman filters and traditional bags. The Size 4 housing is designed to hold only a 40 in (101.6 cm) length filter. All Marksman housings are sized to optimize the dirt-holding capacity of the element.

Marksman Filter Applications

Industry Applications

Automotive/ Industrial In-plant:	Parts washing, machine tool coolant, make-up water, pre-and post-RO, E-coat filtration, auto coatings, water and oil-based metal working fluids, wash rinses and baths
Chemicals:	Intermediates and fine chemicals
Electronics:	Pre-RO, process cooling water, wastewater, reclaim water, inks, CD/DVD, magnetic media, slurries
Food & Beverage:[2]	Edible oils, corn syrup and sweeteners, food grade ethanol
Mining:	Make-up water for water/glycol fluids, long wall applications (raw water and emulsion return, emulsion top up)
Oil & Gas:	Amine, glycol
Power Generation:	Condensate, make-up water, water injection, cooling water
Primary Metals:	Make-up water, pre-and post-RO, process fluids, coatings, wire drawing
Pulp and Paper:	Trim squirts, shower water, seal protection
Refineries:	Amine, sour water

[2] ***Food and Water Contact Use:*** *Please contact Pall Corporation for product applicability to specific National Legislation and/or Regional Regulatory requirements for food and water contact use.*



Total Fluid Management℠

Pall is much more than a filter company. We are fluid management specialists who strive to make our customers' operations more successful. Our Total Fluid Management (TFM) program consists of a wide range of filtration products and services designed to help maintain a specified level of fluid cleanliness, leading to improved operations and reliability of the systems involved. To this end, we have developed a comprehensive program that leverages our strengths and provides true value to our customers.

We offer a variety of customized productivity and system services as part of our TFM program. A partial list of these services includes:

- Cleanliness / process audits
- Laboratory and pilot testing
- Customized product development
- Commissioning
- Equipment rental
- Remote monitoring
- Training seminars
- Reliability engineering
- Troubleshooting and system support
- System maintenance / service contracts

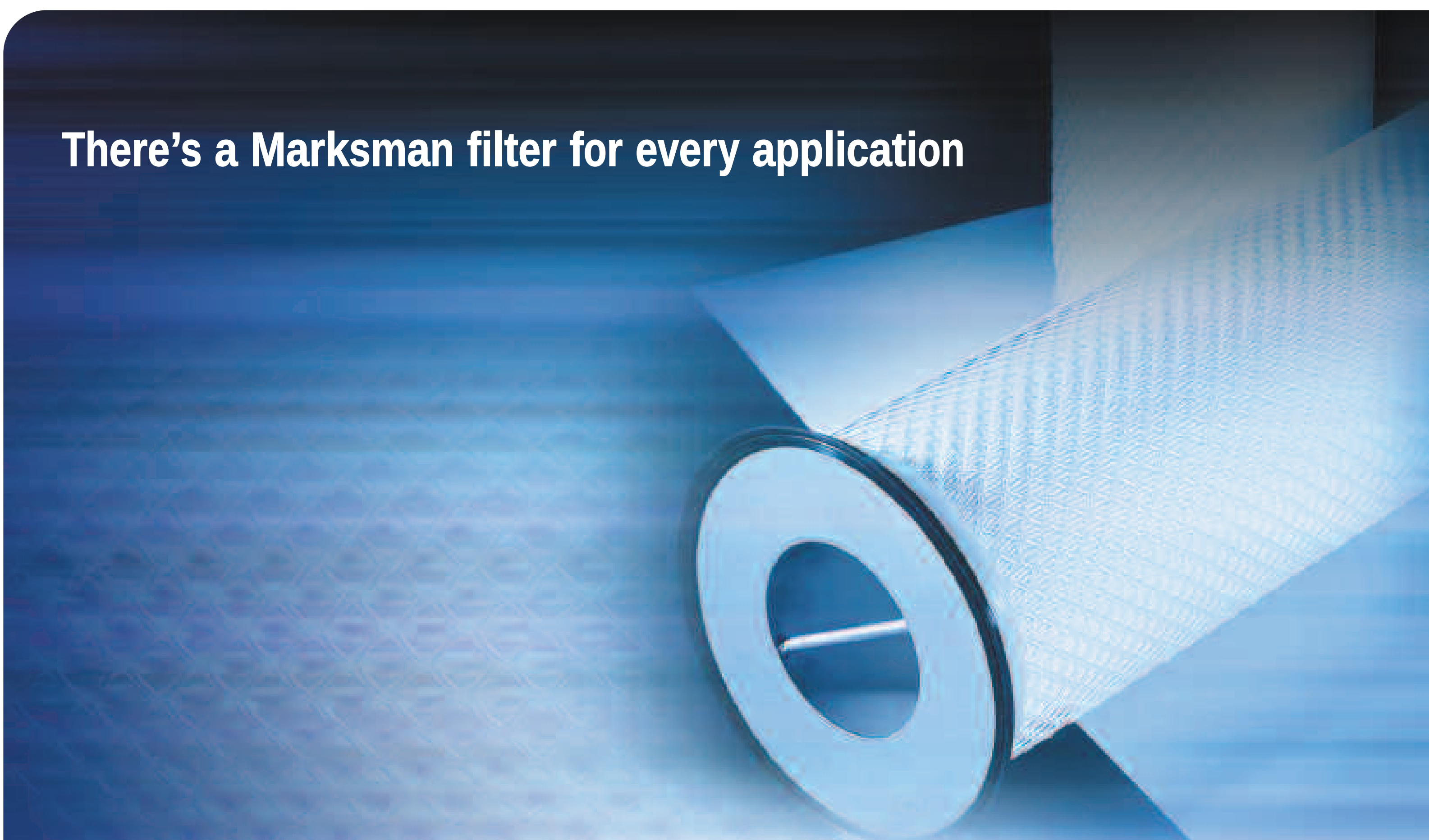
Pall Corporation – A Leader in Filtration Technologies

For more than 60 years, Pall Corporation has been solving complex contamination, separations and purification problems for diverse customers around the globe. With revenues of more than $2 billion, Pall is the largest and most diverse filtration, separations, and purifications company in the world. Our products and services allow customers to meet regulatory requirements and increase output while reducing total cost of ownership. Our enabling technologies help make customers' products better, safer, and even possible.

With offices in more than 30 countries, we are well-positioned to provide assistance to customers on the local level, as well as offer broad-based, worldwide support when needed. At the core of our support network is our Scientific and Laboratory Services (SLS) department, an extensive global network of scientists and engineers who are experts in their field.

We invite you to learn more about Pall's wide array of products and services. For more information, contact your Pall representative or visit us on the web at: www.pall.com.

There’s a Marksman filter for every application



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*Filtration. Separation. Solution.*SM

PIMARKSMANEN   Printed in the USA.   June 2009

Pall Corporation

Marksman™ Series Filter Housings

For Use With Marksman Series Filter Elements

- One, Four, Seven and Nine Around Models Available
- Other Sizes Available Upon Request
- ASME U and UM Stamps Available For All Sizes
- Housings Constructed of 316L Stainless Steel For Corrosion Resistance
- Baskets Included
- Swing Bolt Closure Design Ensures Secure Sealing and Easy Change Out
- Adjustable Length Legs And Side In/Out Flow Design On Single Element Housing Button
- Side In/Side Out Flow Design On Multi-Around Housing Allows For Easy Piping Layout

Housing Specifications

Maximum Operating Pressure:

Stainless Steel:	150 psig (10.3 bar) @ 200˚F (93˚C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:

Non-Code:	Available for all sizes
Code:	ASME U or UM stamp available for all sizes

Connections:

Inlet/Outlet:	2" – 8" Flange
Option:	2" NPT for 1-Around, Size #1 Model
Drain[1]:	1 $^{1}/_{2}$" NPT
Vent:	1" NPT ($^{1}/_{4}$" NPT on single housing)
Gauge[1]:	$^{1}/_{4}$" NPT (Upstream/Downstream)

Shell O-rings:	Nitrile (standard), Silicone Elastomer, Neoprene, Ethylene Propylene, Fluorocarbon Elastomer,

Filter Element Specifications

Marksman housings are designed to accept the entire family of Marksman filter elements, including Marksman Duo-Fine® filters, Marksman NEXIS® A Filters, Marksman Poly-Fine® II Filters, Marksman Poly-Fine XLD Filters. Size 1, Size 2, and 40" (102 cm) cartridges are available with our proprietary sliding flange. Refer to individual data sheets for detailed information on Marksman Series filter elements.

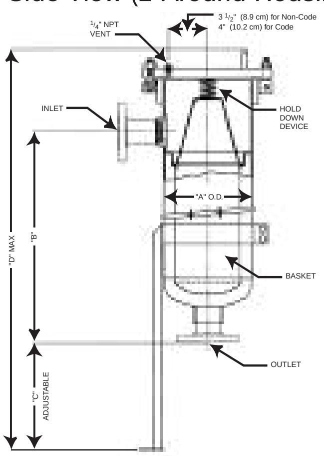
[1] - Applies to multi-around housing only.

Dimensional Data (nominal)[3]

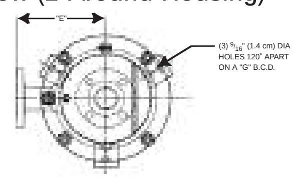
Model	Number of Cartridges	Size (nominal)	Code	Liquid Flow Rate[4] (gpm)	Dimensions (inches) A (shell OD)	B	C	D (height)	E	F	G	Inlet/ Outlet	Dry Weight (pounds)[5]
1MAR1	1	1	N	60 (227 lpm)	8 1/2 (21.6 cm)	21 1/2 (54.6 cm)	12 1/2 (31.8 cm)	43 (109 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	2 (5.1 cm)	77 (35 kg)
1MAR2	1	2	N	120 (454 lpm)	8 1/2 (21.6 cm)	35 (89 cm)	12 1/2 (31.8 cm)	57 (145 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	3 (7.6 cm)	110 (50 kg)
1MAR1	1	1	Y	60 (227 lpm)	8 1/2 (21.6 cm)	21 1/2 (54.6 cm)	11 (28 cm)	43 (109 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	2 (5.1 cm)	123 (55.8 kg)
1MAR2	1	2	Y	120 (454 lpm)	8 1/2 (21.6 cm)	35 (89 cm)	11 (28 cm)	57 (145 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	3 (7.6 cm)	138 (62.6 kg)
4MAR2	4	2	Y	480 (1817 lpm)	20 (50.8 cm)	25 (63.5 cm)	20 (50.8 cm)	79 (200 cm)	16 (40.6 cm)	32 (81.3 cm)	20 1/4 (51.4 cm)	6 (15.2 cm)	570 (258.5 kg)
7MAR2	7	2	Y	840 (3179 lpm)	24 (61 cm)	25 (63.5 cm)	20 (50.8 cm)	79 (200 cm)	18 (45.7 cm)	36 (91.4 cm)	24 1/4 (61.6 cm)	6 (15.2 cm)	740 (335.6 kg)
9MAR2	9	2	Y	1080 (4088 lpm)	30 (76.2 cm)	21 (53.3 cm)	24 (61 cm)	84 (213 cm)	21 (53.3 cm)	42 (107 cm)	30 7/8 (78.4 cm)	8 (15.2 cm)	1220 (553.3 kg)

3 - *40" (102 cm) housing specifications are available upon request.*
4 - *Flow rates listed are for depth cartridges. Consult factory for more specific information.*
5 - *Weights listed are for vessels with flange connections.*

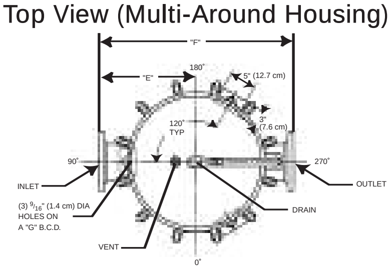
Side View (1-Around Housing)



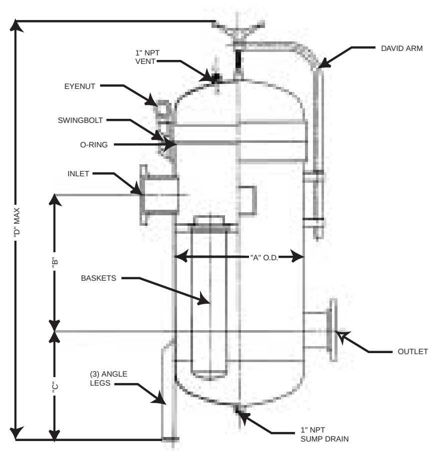
Top View (1-Around Housing)



Top View (Multi-Around Housing)



Side View (Multi-Around Housing)



Part Numbers/Ordering Information

■ MAR ● -316L – ◆ ▼ – ▮ 150 ◗ (e.g. 1MAR1–316L–2–C150UM)

Code ■	No. of Marksman Elements
1	1
4	4
7	7
9	9

Code ●	Cartridge Lengths (nominal)
1	Size 1 Bag
2	Size 2 Bag
4	40" Length

Code ▼	Connection Styles
Blank	NPT
F	Flange

Code ◆	Inlet/Outlet Connection Sizes
2	2"
3	3"
6	6"
8	8"

Code ▮	Code Construction
C	Code Construction
Blank	Non Code Construction

Code ◗	ASME Stamp Designation
UM	UM Stamp
U	U Stamp

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Filtration. Separation. Solution.SM

Pall Corporation

Nexis® A Series Filter Cartridges

Description

- Rated at >99.9% efficiency[1] with retention ratings from 0.5 to 120 µm
- Proprietary CoLD Melt™ fiber technology
- Resists contaminant unloading even at high differential pressures
- Micro-denier melt blown filtration fibers
- Media manufactured with a continuous gradient pore structure
- All-polypropylene construction
- Free of adhesives, binders, resins, and silicone
- Proprietary center core for added strength (0.5 - 20 µm)
- Fast rinse-up to 18 Megohm-cm
- Certification of conformance including lot identification

Performance Specifications

Filter grades

0.5, 1, 3, 5, 10, 20, 30, 40, 50, 70, 90, 120 µm

Maximum differential pressure

0.5-20 µm:	1.03 bard @ 82°C (15 psid @ 180°F)
	1.72 bard @ 66°C (25 psid @ 150°F)
	4.14 bard @ 30°C (60 psid @ 86°F)
30-120 µm:	1.72 bard @ 60°C (25 psid @ 140°F)
	3.45 bard @ ambient (50 psid @ ambient)

Recommended change-out differential pressure[2]

2.4 bard (35 psid)

Food and water contact use

Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Purity

Nexis A series filter cartridges are free of adhesives, binders, resins, and silicone.

Rinse-up

Rinse-up to 18 Megohm-cm with a minimum of throughput.

Autoclaving

Single-open-end Nexis A series filter cartridges can be autoclaved for 30 minutes at 121°C (250°F) under no end load conditions. However, filter cartridges should be allowed to cool to normal system operating temperatures prior to use.

Steam sterilization

Not recommended.

[1] >99.9% retention rating by ASTM F-795 test.

[2] Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

Filtration. Separation. Solution.℠

Product Specifications

Materials of construction

Filter media:	Polypropylene
Hardware:	Polypropylene
Gaskets/O-rings:	Silicone elastomer, EPDM, nitrile, fluorocarbon elastomer, Santoprene[3] (DOE only), FEP, FEP encapsulated silicone, FEP encapsulated fluorocarbon elastomer

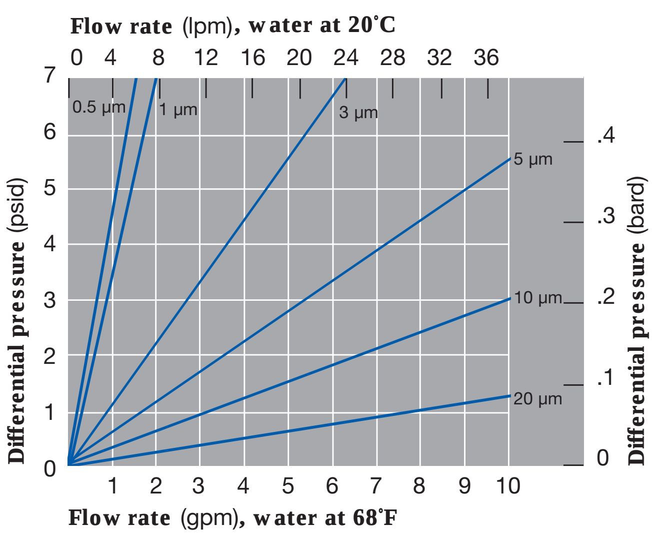
Dimensions (nominal)

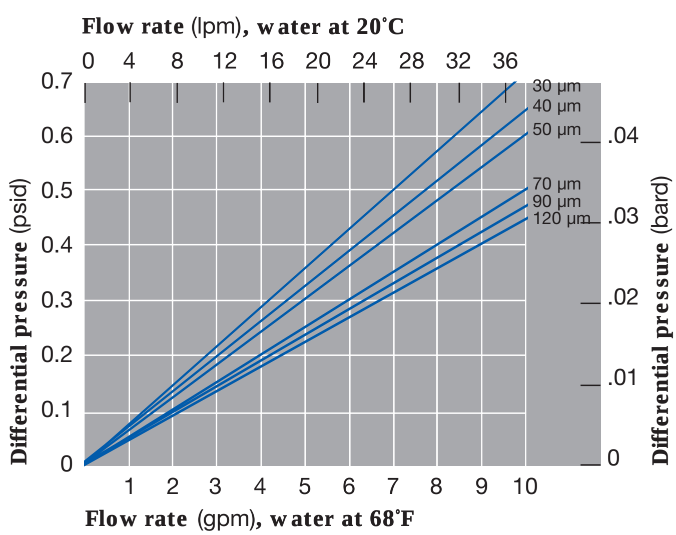
Outside diameter:	6.4 cm (2.5 in)
Lengths:	10.2 cm (4 in), 12.7 cm (5 in), 24.8 cm (9.75 in), 25.1 cm (9.875 in), 25.4 cm (10 in), 49.5 cm (19.5 in), 50.8 cm (20 in), 74.3 cm (29.25 in), 76.2 cm (30 in), 99.1 cm (39 in), 100.3 cm (39.5 in), 102 cm (40 in)

Particle Removal Ratings[4] (µm)

Cartridge Designation	99.9% Efficiency	90% Efficiency
NXA 0.5	0.5	<0.5
NXA 1	0.95	0.65
NXA 3	2.8	1.5
NXA 5	4.1	3.4
NXA 10	9.5	4.7
NXA 20	18.5	13
NXA 30	27	18
NXA 40	36	20
NXA 50	46	27
NXA 70	65	42
NXA 90	85	55
NXA 120	105	65

Typical Flow vs. Differential Pressure for Application Sizing[5]





Unit conversion: 1 bar = 100 kPa

[3] Registered trademark of Advanced Elastomer Systems.

[4] >90% and 99.9% retention ratings by ASTM F-795 test.

[5] Flow rate is for a 25.4 cm (10 in) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Ordering Information

Pall Part Number = NXA 1 **–** 2 **U –** 3 4

Table 1

Code	Filter grades (µm)
0.5	0.5
1	1
3	3
5	5
10	10
20	20
30	30
40	40
50	50
70	70
90	90
120	120

Table 2

Code	Cartridge lengths (cm/in) nominal
4	10.2 / 4
5	12.7 / 5
9.75	24.8 / 9.75
9.875	25.1 / 9.875
10	25.4 / 10
19.5	49.5 / 19.5
20	50.8 / 20
29.25	74.3 / 29.25
30	76.2 / 30
39	99.1 / 39
39.5	100.3 / 39.5
40	102 / 40

Table 3

Code	End configurations
Blank	DOE industrial (no end caps)
1X	DOE, 2.54 cm (1 in) extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[6]
M3H	SOE large diameter closed end, external 222 O-rings
M4	SOE fin end, external 222 O-rings with locking tabs (silicone and EPDM O-rings only)
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[6]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[6]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[6]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[6]
M10	DOE, internal O-rings (fits other manufacturers' housings)[6]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X style)[6]
M18	SOE flat closed end, external 222 O-ring
M20	SOE with internal O-rings (same as M10), closed end with deep recess
DOE	DOE with elastomer gasket seals and end caps
H21	DOE, Santoprene gasket seal
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

[6] For details, contact Pall Corporation.

Table 4

Code	Gasket/O-ring materials
S	Silicone
N	Nitrile
E	EPDM
V	Fluorocarbon elastomer
T	Expanded PTFE (gaskets) FEP encapsulated silicone (O-rings)
F	FEP encapsulated fluorocarbon elastomer (O-rings)
Y	Santoprene

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Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 0 830 191; US 5,591,335; US 5,653,833; US 5,681,469; US 5,690,782; US 5,730,820; US 5,733,581; US 5,741,395; US 5,783,011.

Filtration. Separation. Solution.SM

1668-9C Produced in the USA June 2010

PALL Pall Corporation

Nexis® T Series Filter Cartridges

Description

- Proprietary CoLD Melt™ fiber technology
- Continuous gradient pore structure media provides both prefiltration and final filtration
- Proprietary center core for greater mechanical strength and chemical resistance (0.5 - 10 µm)
- Resists contaminant unloading even at high differential pressures
- Computer controlled CoLD Melt manufacturing process increases product consistency
- Polypropylene media construction
- Thermally bonded structure - not employing adhesives
- Plastic and metal spring assembly end configurations are available

Performance Specifications

Filter grades[1]

0.5, 1, 3, 5, 7, 10, 15, 20, 25, 30, 40, 50, 75, 100, 120, 150, 200 µm

Maximum differential pressure

0.5-10 µm:	1.03 bard @ 82°C (15 psid @ 180°F)
	1.72 bard @ 66°C (25 psid @ 150°F)
	4.14 bard @ 30°C (60 psid @ 86°F)
15-120 µm:	1.72 bard @ 60°C (25 psid @ 140°F)
	3.45 bard @ ambient (50 psid @ ambient)

Recommended change-out differential pressure[2]

2.4 bard (35 psid)

Food and water contact use

Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Rinse-up

Rinse-up to 18 Megohm-cm with a minimum of throughput.

Autoclaving

Single-open-end Nexis T series filter cartridges can be autoclaved for 30 minutes at 121°C (250˚F) under no end load conditions. However, filter cartridges should be allowed to cool to normal system operating temperatures prior to use.

Steam sterilization

Not recommended.

[1] >90% retention rating by ASTM F-795 test. Nexis T series filter cartridge retention ratings are based on Pall's Dynamic Efficiency test protocol. This single pass, destructive challenge test is based on ASTM F-795 test procedures for determining the performance of a filter medium. Fine test dust is used as the test contaminant for filters in the 0.5 to 20 micron range. Coarse test dust is used for micron ratings above 20 micron. Additional information can be obtained by contacting Pall Corporation.

[2] Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

Product Specifications

Materials of construction

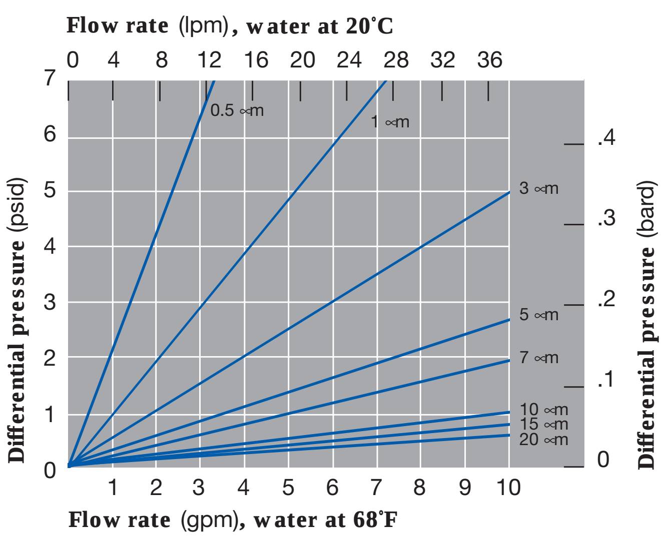
Filter media:	Polypropylene
Hardware:	Polypropylene
Gaskets/O-rings:	Silicone elastomer, EPDM, nitrile, fluorocarbon elastomer, FEP, thermoplastic elastomer (DOE only), FEP encapsulated silicone elastomer, FEP encapsulated fluorocarbon elastomer

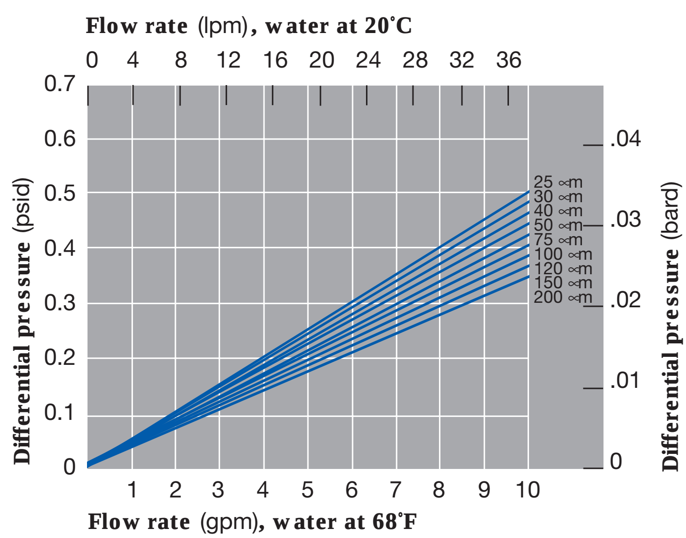
Dimensions (nominal)

Outside diameter:	6.4 cm (2.5 in)
Lengths:	10.2 cm (4 in), 12.7 cm (5 in), 24.8 cm (9.75 in), 25.1 cm (9.875 in), 25.4 cm (10 in), 49.5 cm (19.5 in), 50.8 cm (20 in), 74.3 cm (29.25 in), 76.2 cm (30 in), 99.1 cm (39 in), 100.3 cm (39.5 in), 102 cm (40 in)

Pall's proprietary CoLD Melt fiber media technology is designed to assure efficient use of the entire gradient depth of the filter. The CoLD Melt process produces a mixture of micro-thin fibers intermingled and thermally bonded with large diameter CoLD Melt fibers to provide an integral support and fluid transport network. The large internal void area created by the CoLD Melt process enables Nexis T filter cartridges to capture more contaminant than conventional cartridges while the rigid support fibers hold the filtration fibers firmly in place. The result is less potential random unloading of contaminant and more efficient filtration under a variety of operating conditions.

Typical Flow vs. Differential Pressure for Application Sizing[3]





Unit conversion: 1 bar = 100 kPa

[3] Due to the very low flow resistance of the media in the more open grades, pressure drop is primarily related to turbulent loss through the center core. Flow rate is for a 25.4 cm (10 in) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Ordering Information

Pall Part Number = NXT 1 **–** 2 **U –** 3 4

Table 1

Code	Filter grades (µm)
0.5	0.5
1	1
3	3
5	5
7	7
10	10
15	15
20	20
25	25
30	30
40	40
50	50
75	75
100	100
120	120
150	150
200	200

Table 2

Code	Cartridge lengths (cm/in) nominal
4	10.2 / 4
5	12.7 / 5
9.75	24.8 / 9.75
9.875	25.1 / 9.875
10	25.4 / 10
19.5	49.5 / 19.5
20	50.8 / 20
29.25	74.3 / 29.25
30	76.2 / 30
39	99.1 / 39
39.5	100.3 / 39.5
40	102 / 40

Table 3

Code	End configurations
Blank	DOE industrial (no end caps)
1X	DOE, 2.54 cm (1 in) extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[4]
M3H	SOE large diameter closed end, external 222 O-rings
M4	SOE fin end, external 222 O-rings with locking tabs (silicone and EPDM O-rings only)
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[4]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[4]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[4]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[4]
M10	DOE, internal O-rings (fits other manufacturers' housings)[4]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X style)[4]
M18	SOE flat closed end, external 222 O-ring
M20	SOE with internal O-rings (same as M10), closed end with deep recess
DOE	DOE with elastomer gasket seals and end caps
H21	DOE, Santoprene gasket seal
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

[4] For details, contact Pall Corporation.

Table 4

Code	Gasket/O-ring materials
S	Silicone
N	Nitrile
E	EPDM
V	Fluorocarbon elastomer
T	Expanded PTFE (gaskets) - DOE option FEP encapsulated silicone (O-rings) - SOE option
F	FEP encapsulated fluorocarbon elastomer (O-rings)
Y	Santoprene

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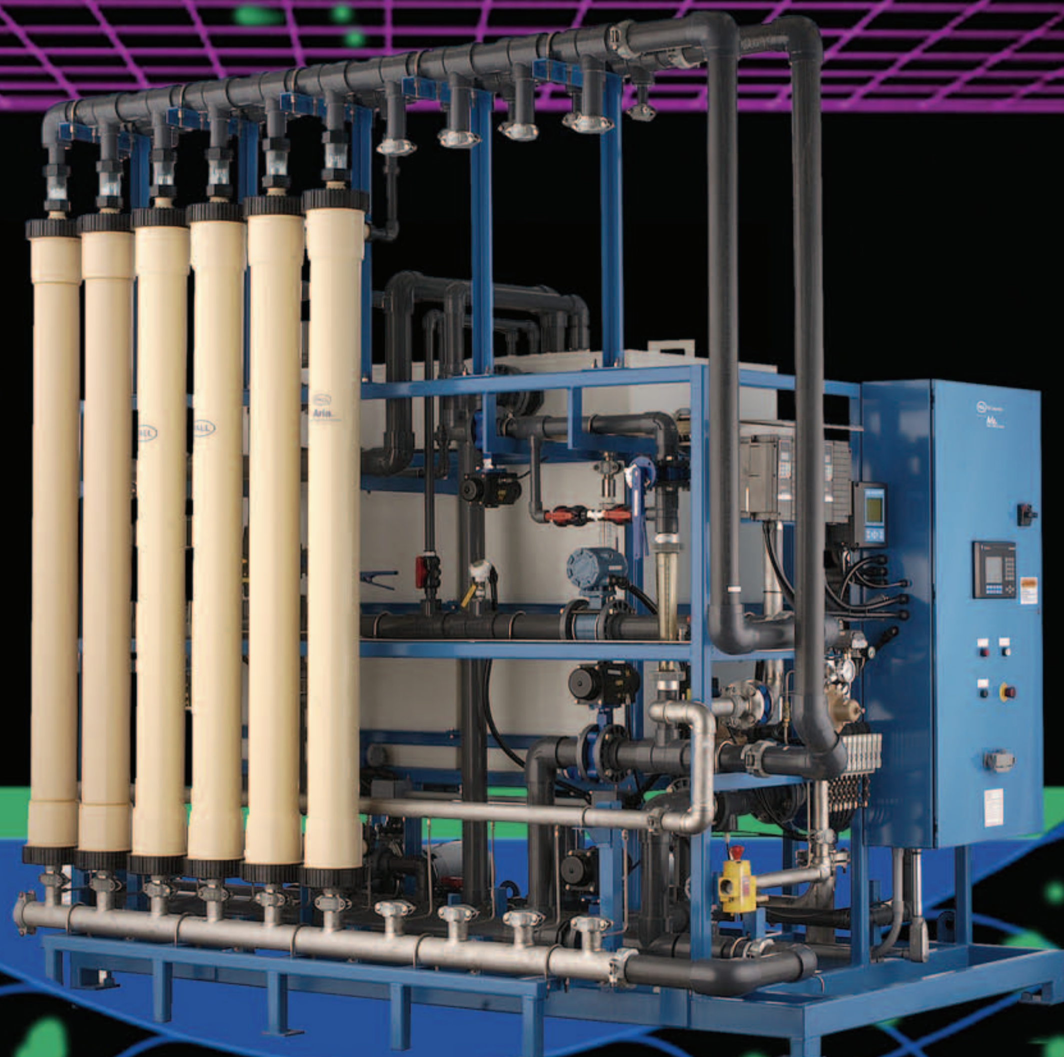
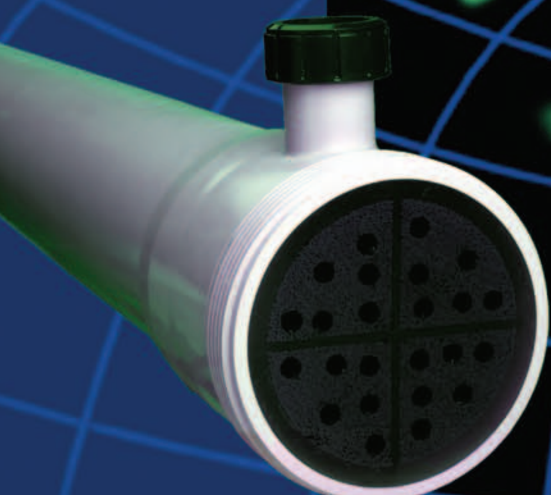
Pall Corporation

Pall Aria™ AP-Series Packaged Water Treatment Systems





Filtration. Separation. Solution. SM

Pall Aria™ AP-Series Packaged Water Treatment Systems

Installations

Point Hope, AK

Wainwright, AK

Nuiqsut, AK

Point Lay, AK

Atqasuk, AK

Anchorage, AK

Kaktuvik, AK

Kernville, CA

Burbank, CA

Membrane Filtration for Safe Drinking Water

Pall Aria™ water treatment systems are specifically designed to produce drinking water that meets today's stringent standards. The systems use uniquely designed filtration modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources.

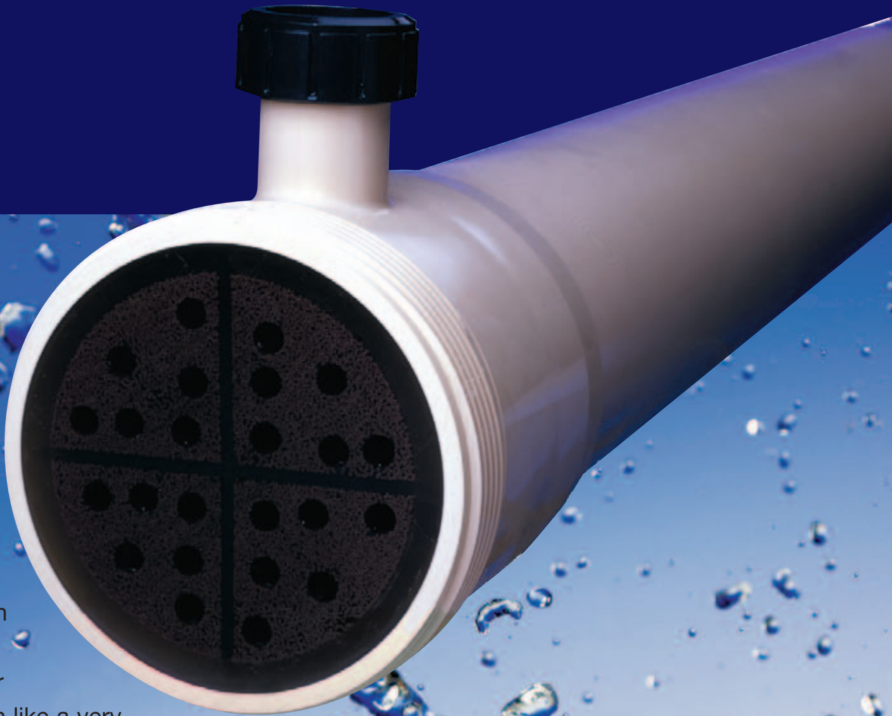
- Suspended Solids/Turbidity
- Viruses
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Arsenic
- Organics

The Microza[1] hollow fiber membranes are highly permeable resulting in high water production rates. Each hollow fiber module provides high active surface area of up to 538 ft^2. Pall's dedication to a simplified process and control design has produced a family of systems that are characterized by:

- Tough, long-service hollow fiber membranes
- Operator friendly controls
- Simple surface water treatment without coagulation
- Unique air scrub and flush operation
- High efficiency, low waste
- Excellent compatibility with chlorine and common treatment chemicals
- Minimal cost of operation
- Easy installation using modular skids
- Compact system footprint
- Full system NSF 61 listing
- ISO 9001 certified manufacturing
- ETV certified for surface water treatment rule

Site testing confirmed Pall Aria Systems meet or exceed EPA standards for safe drinking water. The system is also the first to receive 'full system' certification in accordance with ANSI/NSF 61 Specifications.

[1] Microza is a registered trademark of Asahi Kasei Corp., Ltd. Pall Aria is a trademark of Pall Corporation.



Membrane filtration is a pressure driven process that uses a semi-permeable (porous) membrane to separate particulate matter from soluble components in the carrier fluid, such as water. In Pall Aria systems, microfiltration or ultrafiltration membranes act much like a very fine sieve to retain particulate matter, while water and its soluble components pass through the membrane as filtrate, or filtered water. The retained solids are concentrated in a waste stream that is discharged from the membrane system. The pore size of the membrane and the integrity of the sealing mechanism controls the fraction of the particulate matter that is removed. Microza membranes, with their fine pore size and absolute seal, remove virtually all of the fine matter, such as silica, bacteria, and parasite cysts.

Pall Aria Systems - Overview

Installations

Forestville, CA

Avon, CO

Pinellas Park, FL

Hobart, NY

Youngs River, OR

Beverly Beach Park, OR

Bullards Beach, OR

Astoria, OR

Hite Marina, UT

Transforming Water from Any Source to Match Your Requirements

Pall Aria water treatment systems are used to filter ground and surface waters for drinking water supply and industrial uses, and secondary wastewater effluent for reuse.

Ground Water

- Lowers turbidity and removes microbial pathogens from ground water under the influence of surface water.
- Removes iron and manganese with oxidation.
- Removes arsenic with coagulation.

Surface Water

- Lowers turbidity and removes microbial pathogens from raw water drawn from rivers, streams, lakes, and reservoirs.
- Removes organics with coagulation to improve disinfection by-products rule compliance, taste and odor.

Secondary Wastewater Effluent

- Removes suspended solids and reduces SDI prior to RO treatment for reuse.
- Removes bacteria and other pathogens, and suspended solids to produce water suitable for landscape irrigation and similar reuse applications.

Pall Membrane Microbial and Particulate Removal

Contaminants	Typical Removal [2]	
	Microfiltration (MF)	Ultrafiltration (UF)
Giardia	>6 (log)	>6 (log)
Cryptosporidium	>6 (log)	>6 (log)
MS2 Coliphage or Bacteriophage	0.5 – 2.5 log[3]	4.5 – 6 log[3]
Turbidity	<0.1 ntu	<0.1 ntu

[2] Based on third party testing.
[3] Virus removal varies depending on coagulation process upstream of system.

Application Guidance

Design Parameter	Ground Water (GW)		Surface Water		Secondary Wastewater
	Under the Influence of Surface Water	High Iron & Manganese	Low TOC or Turbidity	High TOC or Turbidity	
Contaminants	Turbidity & Microbial Pathogens	Iron & Manganese	Turbidity & Microbial Pathogens	Turbidity & Microbial Pathogens	Suspended Solids & Pathogens
Pretreatment	None	Oxidation & Precipitation	Strainer	Strainer, Oxidation, or Coagulation	Disinfection & Strainer
Filtered Water Quality	Turbidity <0.05 ntu No Detectable Giardia & Crypto	Turbidity < 0.05 ntu Iron & Manganese < 0.05 mg/L	Turbidity <0.05 ntu No Detectable Giardia & Crypto	Turbidity <0.05 ntu up to 60% TOC Removal	SDI ≤3 Turbidity <0.05 ntu

Pall Aria Systems - Specifications

Packaged for Fast, Easy Installation

Pall Aria water treatment systems are highly flexible, production scale, membrane filtration packages, designed to filter a wide range of feed streams. Standard systems are available in the following skid-mounted configurations.

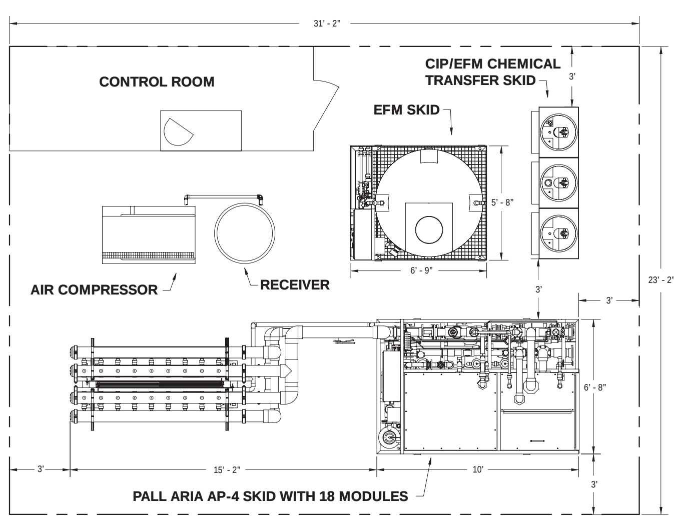
Standard System Specifications

Model Number	Maximum Number of Modules	Filtered Water Capacity (gpm [m³/hr])	Dimensions (L x W x H : ft [m]) Shipped[4]	Dimensions (L x W x H : ft [m]) Installed
AP-1	2	3-25 [0.7-5.7]	6.1 x 2.8 x 6.5 [1.9 x 0.9 x 2.0]	6 x 2.8 x 9.8[7]
AP-2	8	10-50 [2.3-11.4]	8.1 x 2.8 x 6.5 [2.5 x 0.9 x 2.0]	8 x 4.1 x 9.9[7]
AP-3	10	25-200 [5.7-45.4]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3]	9.5 x 6.9 x 10.3[7]
AP-3x	20	25-200 [5.7-45.4]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3][5, 6]	8.8 x 18.6 x 10.8[5]
AP-4	36	50-350 [11.4-79.5]	10 x 6.8 x 7.7 [3 x 2.1 x 2.3][5, 6]	10.8 x 20.8 x 10.8[5]
AP-6	60	200-700 [45.4-159]	10 x 6 x 6.8 [3 x 1.8 x 2.1][5, 6, 8]	19.1 x 17 x 10.8[5, 8]

4 Crating add 0.5 ft. [0.15m] to each dimension.
5 Module rack is off the skid.
6 Module rack shipped as crated parts kit.
7 Control skid w/attached module rack.
8 Two freestanding tanks 5′6″ wide x 7′6″ high, shipped separately for each skid.

Optional and Auxiliary Equipment

- Modem for Remote Access
- Auto Dialer for Alarms
- PC for Operator Interface Terminal and Data Acquisition
- Feed or Filtrate Turbidimeters
- Oxidant Dosing Systems
- Air Compressor Systems
- EFM Systems to Reduce System Costs
- Disinfectant Dosing Systems
- Coagulant and CIP Chemical Storage/Dosing Systems
- Filtrate Particle Counter



Typical treatment plant layout for 500,000 gallons per day.

Auxiliary equipment to improve treatment capabilities is available on separate skids, which are equipped with distributed controls that can be integrated into a master control system to provide optimal, automatic integrated system operation.

Standard Components

A standard Pall Aria AP Package consists of 1 to 60 membrane modules, one feed/CIP tank and pump, one reverse filtration tank and pump, manual and automatic valves, flow meter, pressure and temperature sensors, PLC control, control panel, and a painted carbon steel frame. Other items can be added on request. Separate auxiliary skids are available for compressed air and chemical feed/pre-oxidation.

- Painted Carbon Steel Frame
- 316 SST Pumps W/TEFC Motors and VFDs
- PVC and Stainless Steel Piping
- Butterfly Valves (Manual and Air Operated)
- PE Tanks with Level Control
- PLC Controls and Software
- Instrumentation (Digital and 4-20 ma Analog Signal)
- NEMA-4 Electrical Enclosures

Operating Conditions

- Maximum Inlet Pressure: 44 psi (3 bar)
- Maximum Operating Temperature: 104˚F (40˚C)
- Minimum Operating Temperature: 33˚F (1˚C)

Utility Requirements

Electrical Connection:

AP 1:	1 ph	230v	50 A
AP 2:	1 ph	230v	30 A or
	3 ph	230v	25 A or
	3 ph	460v	15 A
AP 3/3x:	3 ph	230v	40 A or
	3 ph	460v	25 A
AP 4:	3 ph	460v	40 A
AP 6:	3 ph	460v	70 A

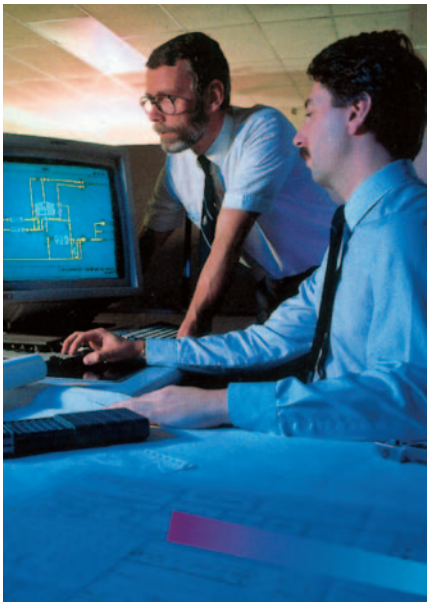
Other voltage can be accommodated, if required. Water Supply for CIP: 75-95˚F (25-35˚C)

Module cutaway showing hollow fibers.

Microza Hollow Fiber Microfiltration Module[9]

- Membrane Material: PVDF
- Pore Rating: 0.1 micron (µm)
- Fiber OD / ID: 1.3 mm/0.7 mm
- Active Filter Area: 538 ft^2
- Module Size: 6" diameter x 79" long
- Housing: PVC or ABS
- Gasket: EPDM
- Potting Material: Silicone Epoxy or Urethane

[9] Ultrafilters also available



Pall R&D Team Members

NSF System Listing

Pall's family of hollow fiber membrane systems were the first "full systems" to be listed in accordance with ANSI/NSF 61 specifications. The Pall Aria system is manufactured from NSF approved materials and meets all requirements for potable water service.

ISO 9000 Certification

Pall's North American manufacturing, engineering, sales and marketing operations have received ISO 9001 registration from Lloyd's Register of Quality Assurance Limited. ISO 9001, which also covers design and development functions, represents the highest, most comprehensive level of ISO 9000 Certification. The quality system and procedures are regularly audited to assure compliance and proper record keeping before the certification is renewed.

Clean Water, Clean System

Filtration (Normal Production)

Feed water enters the bottom of the module and is distributed uniformly to the outside of the fibers. Since it is under pressure, the water passes through the hollow fiber membranes and filtered water exits from the top of the module. Under normal conditions, all of the feed water flows through the membranes and exits as filtered water. Depending on feed quality, a small amount of the feed water may be circulated past the outside of the hollow fibers. This flow prevents the accumulation of foulants and debris on the surface of the membrane and helps evenly distribute flow though the membrane fibers.

Air Scrub

As water is filtered, rejected particulate accumulates in the module or on the membrane fiber's surface. The effect is a flow restriction in the module, resulting in an increase in trans-membrane pressure (TMP). Air Scrubbing (AS) is a mechanical process to remove the debris from the module and decrease the rate of overall increase in trans-membrane pressure.

AS is usually initiated at a preset interval of water throughput. As a secondary trigger, AS is initiated if the rate of TMP increase exceeds a specified maximum. The air injection valve opens and air is injected at low pressure into the feed side of the module. At the same time, filtrate that has been collected in the Reverse Filtration (RF) tank is pumped in the reverse direction through the module and out through the main system drain. Air and RF flow are then stopped. At this point, most if not all of the accumulated debris in the module have been swept to drain.

To complete the cycle, a forward flush (FL) is implemented, circulating feed water from the feed tank on the outside (feed side) of the membrane fibers at high velocity. This fast flow of liquid is directed through the excess recirculation port of the module to drain. This further dislodges and removes from the module debris that was captured by the membrane fibers.

This fully automated cycle is included in every Pall Aria System and occurs every 20-120 minutes, and stops forward filtrate flow for about 1.5-2 minutes.

Enhanced Flux Maintenance (EFM)

To assure maximum efficiency and lowest total cost of ownership, Pall has developed techniques to keep the membranes free of fouling materials. EFM is a patent pending, fully automated process that uses warm water with mild chemical solutions tailored to specific foulants that may be present in the application on a daily basis. EFM is used to reduce the times when a partially fouled membrane results in a system operating at less than peak efficiency.

The benefits to using EFM are a smaller system footprint, which reduces floor space and facility heating and cooling costs, and a lower average trans-membrane pressure, which reduces pumping energy.

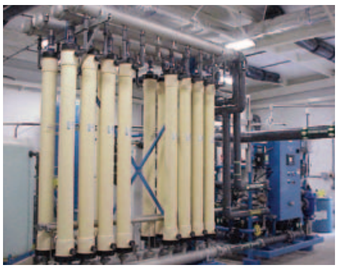
The durable, strong and chemical resistant hollow fiber which is incorporated into every Pall Aria System makes this possible. Best of all, it can be subjected to thousands of EFM cycles with no reduction in service life.

In addition, the flexible, control system on-board the Pall Aria System allows EFM to be enabled only when warranted by feedwater conditions.

EFM capability is included on the Pall Aria AP-1 System and can be included via an auxiliary skid mounted EFM system on the larger Pall Aria AP-Series systems.

Chemical Clean In Place (CIP)

Backwash and EFM are designed to remove particulate matter and foulants. In most applications, it will occasionally be necessary to perform a complete CIP process. The CIP process is a 2-step protocol using an acidic solution and a caustic solution with chlorine. This process will return the modules to "nearly new" condition and can be performed hundreds of times over the life of the modules.



Due to the low frequency of CIP operation, the process is designed as a semi-automated process. The rinse cycles are programmed for manual initiation. This process requires minimal operator intervention to “setup” the system for CIP and can be achieved by turning 5 manual valves.

Pictured on the left is a Pall Aria System installed at Stoney Creek, VA.

Pretreatment Requirements

Pall Aria water treatment systems provide reliable, low maintenance performance. A 400-µm strainer is included on the feed water line to prevent debris from clogging small passages in the system.

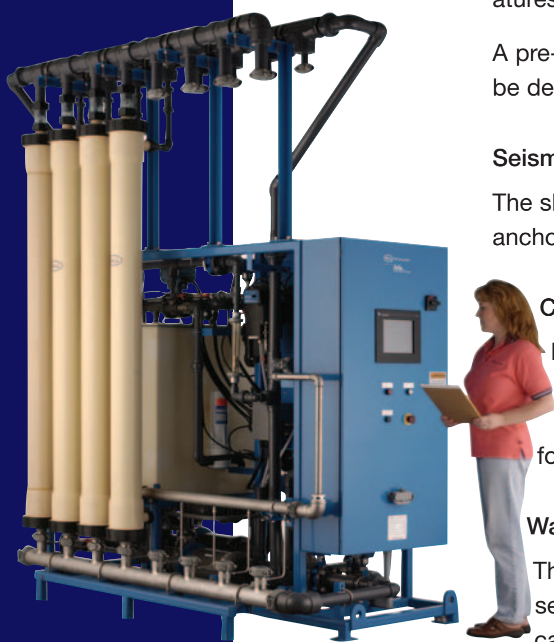
Enclosures

A heated structure is required where freezing temperatures are expected. A roof may be required in other areas to prevent damage from sunlight and high temperatures.

A pre-engineered metal, concrete, or wood frame building is acceptable and can be designed to meet many aesthetic concerns.

Seismic Design

The skid can be modified for use in Seismic Zone 4 areas (highest hazard). An anchoring plan will be furnished upon request.



CIP Conditions

Pall recommends that all chemicals for treatment and CIP be purchased in solution form. Water for CIP should be heated to 90-100°F (31-38°C). Contact Pall to obtain the recommended CIP procedures and specifications for chemicals.

Wastewater Disposal

The RF and AS wastewater and CIP wastes can be discharged to a sanitary sewer if available. In areas without sanitary sewers, the RF and AS wastewater can be discharged to a settling pond to remove suspended solids. The clarified supernatant may be discharged to a local receiving stream or recycled to the plant feed water. Pilot testing may be required before recycling the supernatant. If sanitary sewers are unavailable, CIP wastes should be combined and neutralized prior to collection and disposal by a waste hauler. These wastes, can be disposed of like septic system sludge. The customer is responsible for contacting the local regulatory agencies and obtaining the appropriate permits and approvals before initiating any discharge of process wastewater.

Contact Us for Support or Information

Remote online monitoring of system performance by Pall water specialists and membrane maintenance contracts are available from Pall. Contact your local Pall representative or Pall Corporation to obtain more information.


PALL Water Processing

Pall Corporation

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Reorder Code. WP-300 (Version C) 8/06 3M BRD

PALL Water Processing

Pall Aria℠ AP-Series Water Treatment Systems

Pall Aria Water Treatment System with control panel and modules.

Pall Aria AP-Series Water Treatment Systems

Pall Aria℠ AP-Series Water Treatment Systems are specifically designed to meet the drinking water treatment requirements of small communities. Aria systems use uniquely designed Pall Microza* membrane modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources:

- Turbidity
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Arsenic

Each 0.1µm hollow fiber module provides high active surface area (538ft² - 50m²). The hollow fiber modules in the Aria system are highly permeable resulting in high water production rates.

Pall's dedication to simplified process design and control logic has produced a family of systems that are characterized by:

- Full System NSF 61 Certification
- Long Service Life Hollow Fiber Membranes
- Operator Friendly Control Interface
- Simple Clean-In-Place Operation
- High Recovery
- Low Cost of Operation
- Easily Installed Modular Skids
- Compact System Footprint
- ISO 9000 Certified Manufacturing
- Optional Auxiliary Equipment

View of Hollow Fiber Membrane Module Cut-away.

Aria AP-Series System Performance

Pall Microza membrane systems have been approved for potable water supply. The Aria hollow fiber membrane system was the first to receive a "full system" certification in accordance with ANSI / NSF 61 Specifications.

Extensive testing has been done across the USA including:

- University of New Hampshire
- Croton Reservoir, NY
- Highland Reservoir, PA
- Meeteetse Reservoir, WY
- Oregon Parks Department
- North Slope Borough WTP, AK
- Youngs River, OR
- Stoney Creek, VA
- Westover, PA
- Caney, KS
- Kernville, CA
- Basalt, UT
- Crested Butte, CO
- Hobart, NY

Site testing confirmed Pall Aria Water Treatment Systems meet or exceed EPA standards for safe drinking water, such as the requirement of the Surface Water Treatment Rule (as amended December 16, 1998).

* *Microza is a trademark of Asahi Kasei Corporation.*

Table 1: Pall Membrane Microbial and Particulate Removal

Contaminants	Typical Removal*
Giardia	> 6 log
Cryptosporidium	> 6 log
MS2 coliphage or bacteriophage	0.5 - 3 log
Turbidity	< 0.1 NTU

*Based on third party testing

Aria AP-Series System Specifications

Aria AP-Series System Components
Standard system components consist of 1 to 60 membrane modules, a feed tank, one feed pump, one reverse filtration pump, manual on/off and automatic valving, filtrate flow meter, pressure and temperature sensors, and PLC control.

Aria AP-Series System Operation
Maximum Inlet Pressure to Module: 45 psi (3 bar)
Maximum Operating Temperature: 104˚F (40˚C)

Aria AP-Series System Specifications

Module Housing: PVC, ABS or other
Gasket: EPDM
Potting Material: Silicone and Epoxy or Urethane
Panel: NEMA 4
Tanks: Polyethylene
Piping: Lower Manifold and Air: Stainless Steel
(other piping: PVC)
Hollow Fiber Membrane: PVDF
Pumps: Horizontal Stainless Steel Centrifugal

System Service

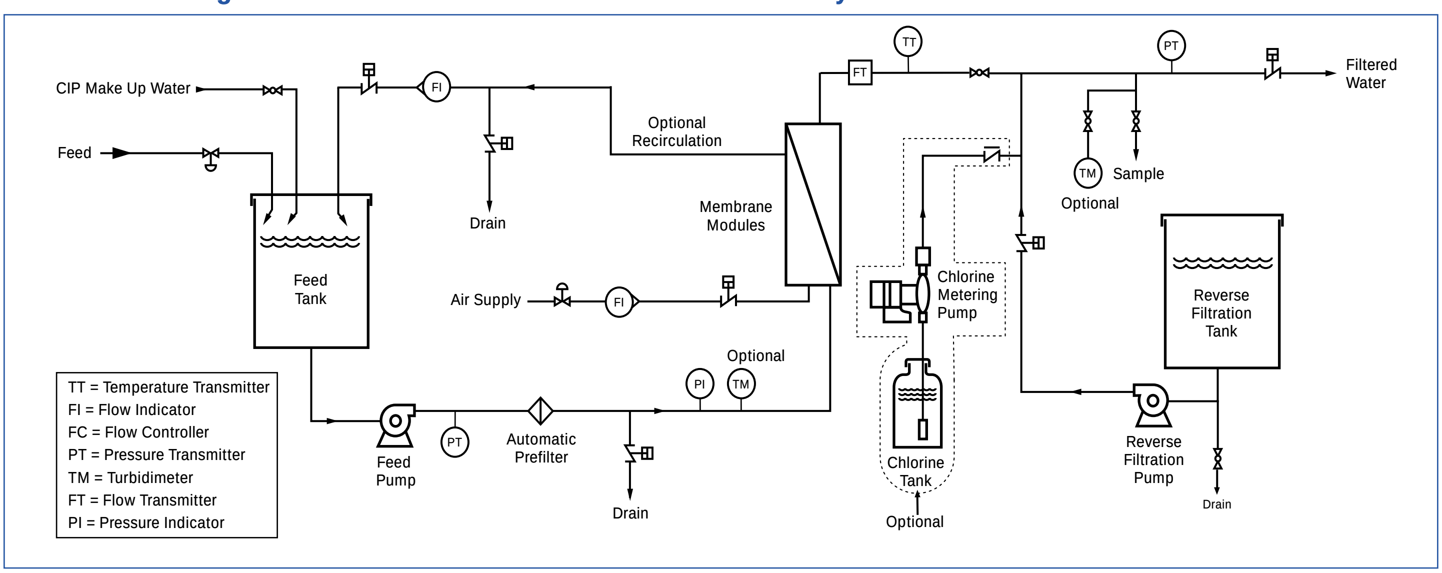
Remote monitoring of system performance available as an online service. On-site service and maintenance contract also available.

Table 2: Standard Filtration Skid Specifications

Model Number	Maximum Number of Modules	Maximum Flow Rate (gpm [m³/hr])	Footprint (L x W x H) (Feet) Installed
AP-1	2	3-25 [1-7]	6 x 2.8 x 9.7
AP-2	8	10-50 [2.3-12]	8 x 4.1 x 9.9
AP-3	10	25-175 [6-40]	10 x 6.9 x 10.3
AP-3x	20	25-175 [6-40]	(1) 22.9 x 5.7 x 10.8
AP-4	36	50-350 [15-80]	(1) 24 x 6.8 x 10.8
AP-6	60	200-700 [45-150]	(1) 27 x 17 x 10.8

(1) Module Rack is off the skid. Other configurations allow variation in footprint.

Process Flow Diagram for the Pall Aria AP-Series Water Treatment System



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Pall Corporation

Purification and Reuse of Industrial Clarified Effluents

The Pall Aria™ Integrated MF/RO System

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system.

By using best-in-class treatment chemicals with a combination of hollow-fiber microfiltration (MF) and reverse osmosis (RO), we can provide you with a highly efficient system for reclaiming effluent water. Not only can the Pall Aria MF/RO system reduce your cost for purchased water, it can provide water that consistently meets critical water quality requirements while effectively protecting the environment.

Value

- Acquire a consistent, high-quality water source for as much as 50% less than the cost of purchased water.
- Decrease dependency on purchased water.
- Reduce wastewater discharge by as much as 80%.
- Reclaim a scarce water resource.
- Increase operating profit by reusing an existing resource.
- Obtain a source of high-quality water for critical plant and utility use.

Is This an Opportunity for You?

- Do regulations require you to reuse water before your plant can undergo expansion?
- Do you have more than 100 gpm ($23 m^3$/hr) of waste effluent that can be reclaimed?
- Do you need high-quality water for boilers and utility operations?
- Are you interested in significant operating cost savings?
- Is your present total water cost more than $4.00 per 1000 gals ($1.00/m^3)?
- Does your effluent have the following characteristics: TSS <100 mg/l, BOD <100 mg/l, FOG <20 mg/l, and TDS < 2,500 mg/l?

Why the Pall Aria Integrated MF/RO System?

- Assures consistent production of high-quality water from a reclaimed source.
- Provides an integrity testable, positive barrier to TSS and microbial contaminants.
- Protects downstream processes such as electrodeionization (EDI).
- Delivers highly purified, low TDS water.

Key Industries

- Chemical processing
- Food and beverage
- Hydrocarbon processing
- Metal working
- Mining
- Pharmaceuticals
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

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PASRO4

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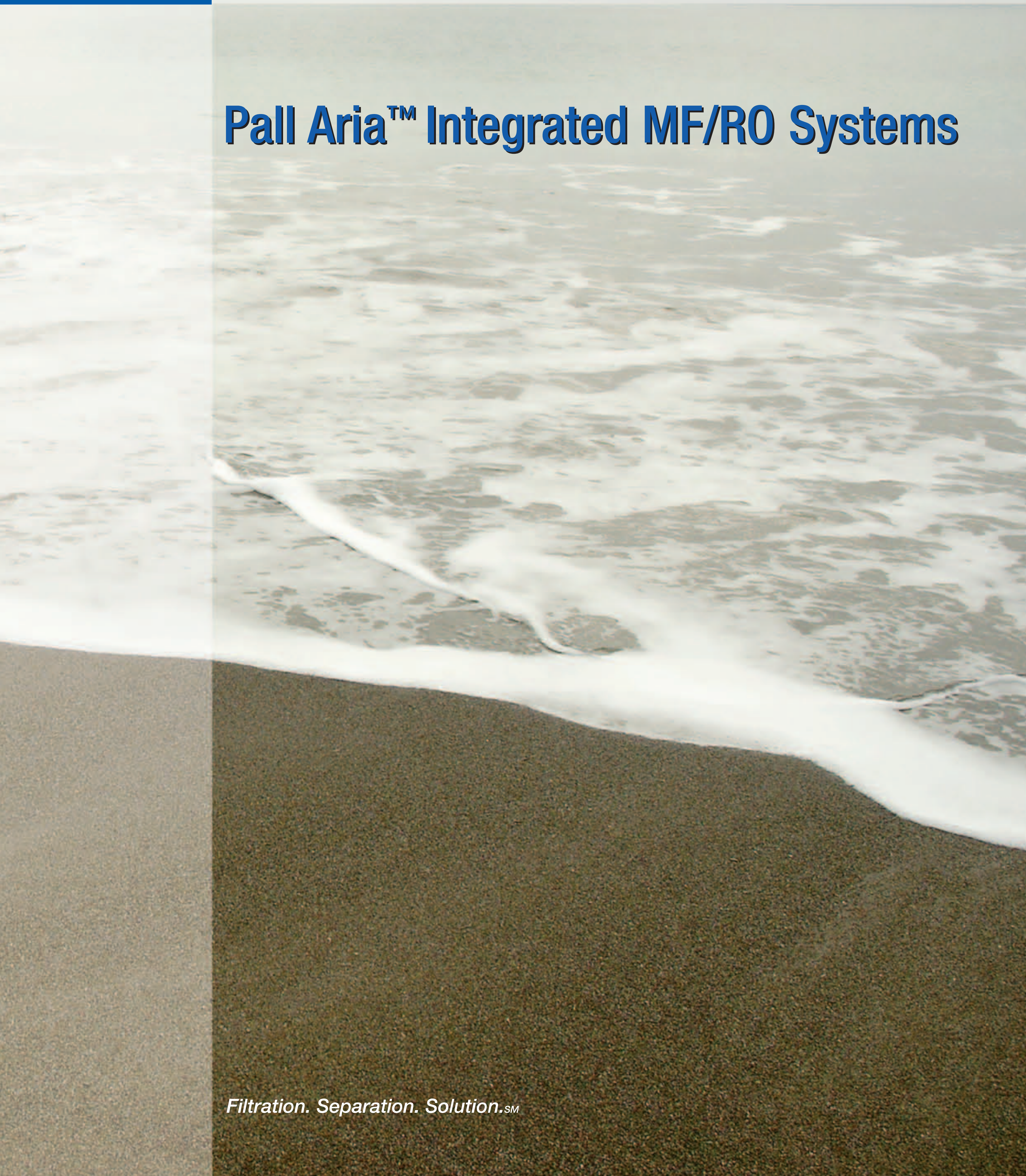
Pall Aria™ Integrated MF/RO Systems



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Pall Aria™ Integrated MF/RO Systems for Cost-Effective Treatment of Plant Make-Up Water

Water scarcity resulting from man-made and natural influences such as growing populations, expanding industrial usage, climate change and drought, is a challenge faced by water producers and users worldwide. High-pressure reverse osmosis (RO) and nanofiltration membrane systems have been used for many years to remove dissolved substances from water, with mixed success. The pretreatment typically used with these processes—conventional (sand) filters with coagulation, followed by cartridge filters—has proven to be ineffective and expensive in the long-term. On the other hand, when microfiltration is used to pre-treat the water, spiral-wound RO membrane systems are a reliable and cost-effective alternative that has become the technology of choice for many plant make-up water applications.

In addition to choosing the most effective technology, industrial high-purity water users are concerned with maximizing production volume by ensuring ongoing operation of the make-up water system. If the system comprises components from several vendors, the troubleshooting process can take much longer. **When the components of the make-up system are sourced through a single vendor, the responsibility is clear, and service and support are optimized.**

An Integrated Make-Up Solution from Pall, the Global Leader in Filtration and Separations

To meet the need to produce pure water for make-up, Pall Corporation offers complete, packaged, spiral-wound RO and nanofiltration systems, fully integrated with our proven microfiltration membrane technology for pretreatment. As the global leader in filtration solutions, Pall has been a trusted supplier to municipalities, industries and government for over 60 years. Pall's water processing team applies its expertise in process design, membrane science, system engineering, and manufacturing to deliver truly optimized make-up water systems.

Major MF and RO Components

Two major components comprise the Pall Aria™ MF/RO integrated system: the Pall Aria microfiltration membrane system for pretreatment, and an RO membrane system. Ion exchange may also be used if necessary. Both systems are constructed from standard "building blocks"—prefabricated skids of valve and module racks.

- **The Pall Aria microfiltration membrane system—** removes suspended solids from source water during the pretreatment process. Pall Aria microfiltration membranes are the most robust in the industry, with the longest warranty. In fact, a Pall customer in California with more than 700 modules experienced fiber breakage of only 1 in 3,073,400 over a 40-month period.* More than 300 filtration systems using the membrane technology incorporated in Pall's systems have been sold worldwide.

- **A Pall reverse osmosis membrane RO system—** captures dissolved salts and other impurities from pretreated water with spiral-wound RO technology, the industry standard for RO systems. Spiral-wound RO modules capitalize on an extremely high ratio of filter area to hold-up volume. With feedwater that is optimally pre-treated, these modules allow the greatest output of treated water with the lowest energy use.

Recover Energy From Your Process

After analyzing the energy requirements and costs for your specific process, Pall will recommend and implement a state-of-the-art device to recover energy from the pressured brine stream. By recycling this energy to power the pumps on the RO system, your cost of water production will be reduced.

* Based on the CalWater, Bakersfield, CA installation.

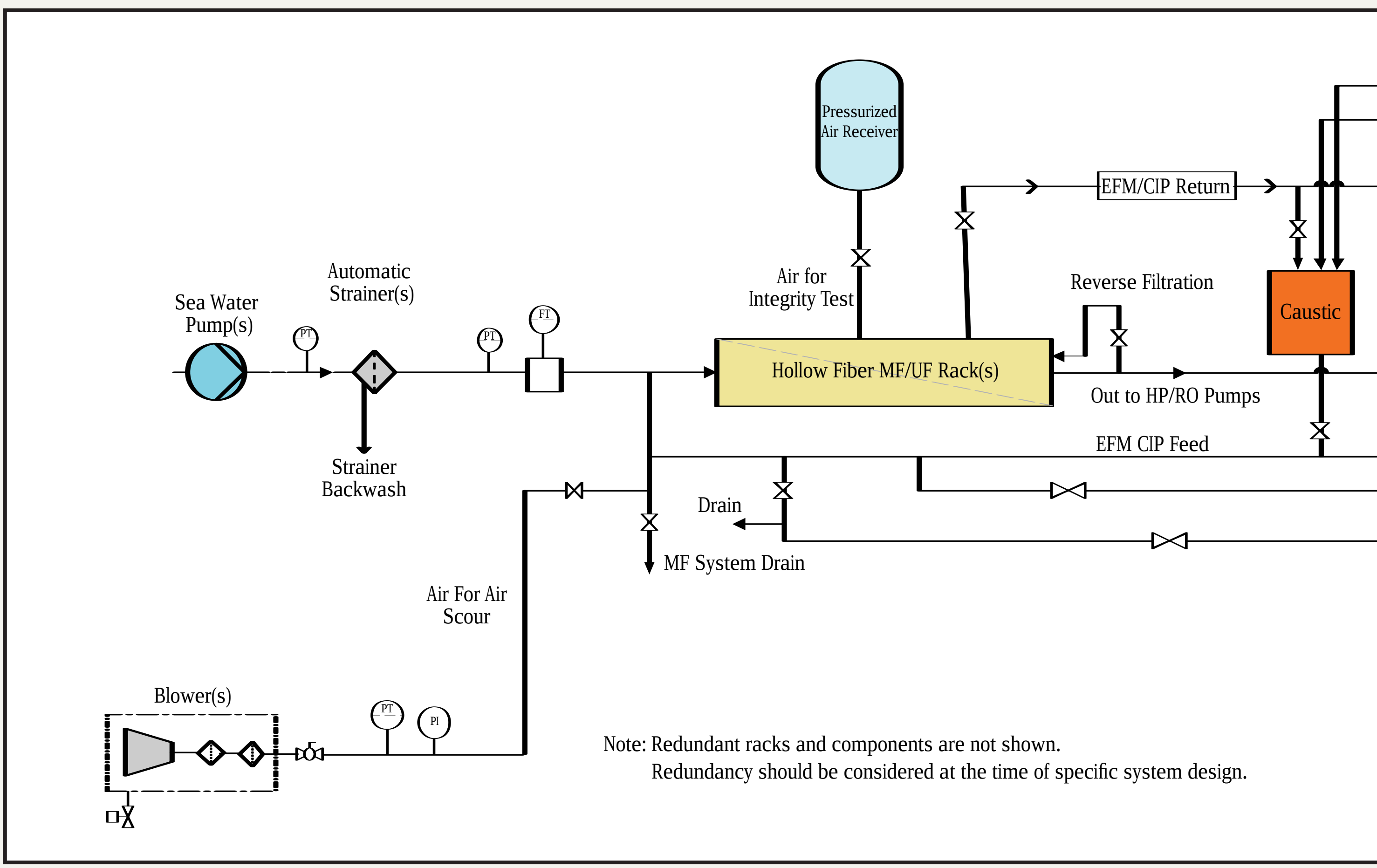
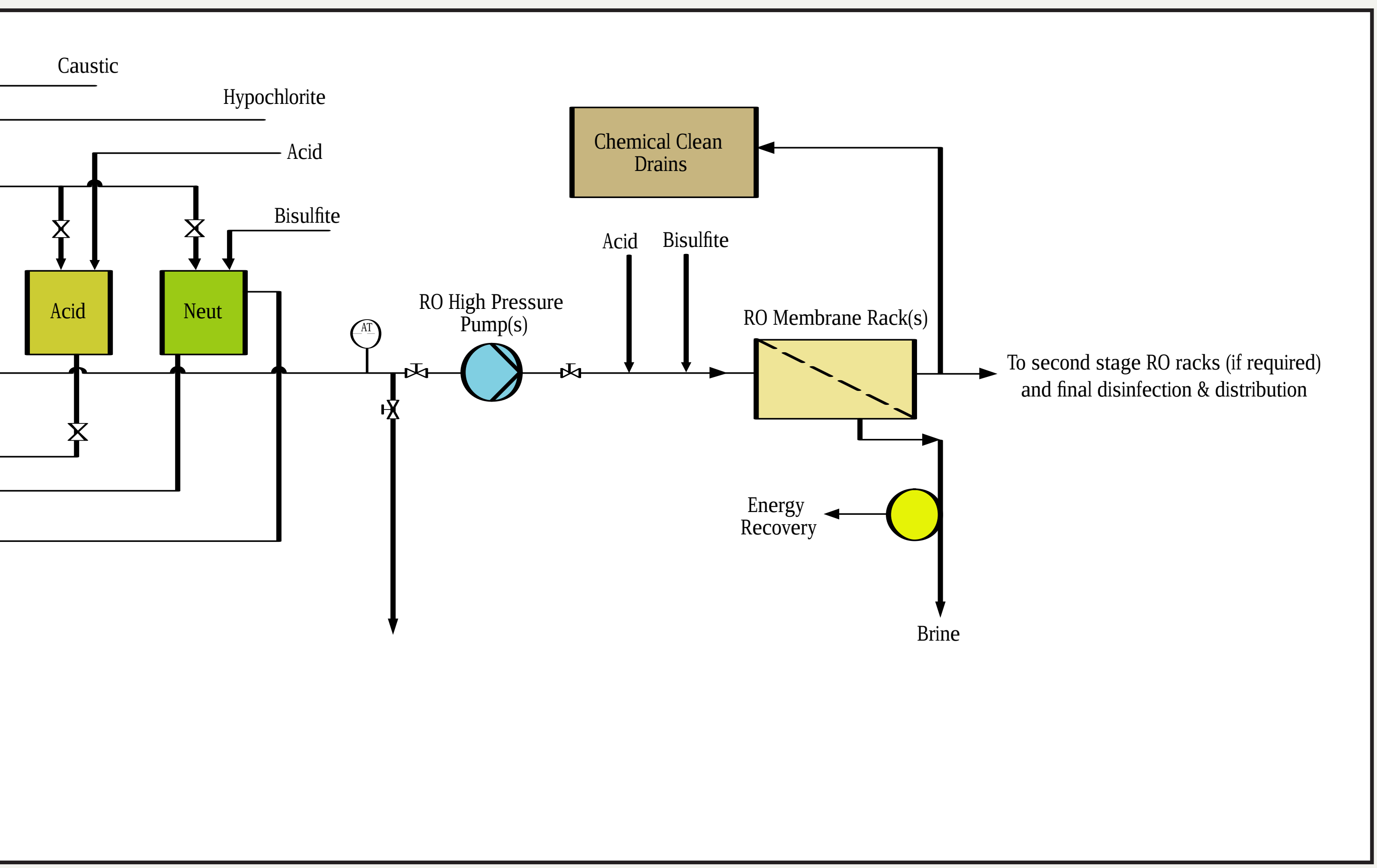


Figure 1—Simplified process flow diagram: Pall Aria™ Integrated MF/RO System

Reduce Your Risk and Long-Term Costs

In addition to the energy conservation benefits of our MF/RO solution, Pall provides you with the following cost-saving, efficiency, and risk-reduction advantages.

- **Smaller footprint**—Membrane systems have a smaller footprint and lower long-term costs than conventional filtration technologies. The pre-engineered design and assembly of the integrated MF/RO system enables you to reduce space requirements, thereby reducing facility costs.
- **Lower overall cost of water production**—Pall sales and process engineers are available to provide estimates for capital and operating costs to enable you to derive and evaluate the overall cost of water using a Pall integrated MF/RO system. We're convinced that our system will realize cost savings over systems supplied by others who are not filtration experts. Our experienced engineers design and package systems that optimize operations and maintenance.
- **Longer lifespan of the RO membranes**—By pretreating raw make-up water with microfiltration membranes, Pall's integrated system exposes the RO membranes to a lower volume of particulate matter. This protective capability reduces the number of membrane cleanings, increases efficiency, and prolongs the life and value of the RO system.
- **Redundant components maximize uptime**—The MF and RO system modules are redundant, enabling the integrated system to maximize uptime for critical water delivery applications.
- **Lower chemical use**—There are no pre-treatment chemicals to mix, feed, and adjust when feedwater conditions change.
- **Long-term reliable operation**—By developing a make-up process that is tailored to your feed water characteristics and treatment needs, Pall will ensure the long-term, reliable operation of your MF/RO system. Further, your system can be matched with a customized service plan.
- **Single point of responsibility**—With a single supplier for your entire make-up system, potential problems will be addressed more rapidly, thereby reducing the potential risk of downtime and reduced production.



Technical and Support Services for Long-Term Reliability

To help ensure trouble-free operation of your system, Pall offers a comprehensive portfolio of technical support services. These services can help you:

- Gain technical expertise without adding head-count
- Realize optimized system performance and product quality
- Increase system reliability
- Enjoy cost-effective operation and maintenance

Your Pall representative will help you choose one or more of the following services to support your MF/RO integrated system:

- 24/7 Service Support
- CIP (Clean-In-Place)
- Commissioning and Start-up
- Emergency Service
- Inspection and Maintenance
- Membrane Cleaning Study
- Operation And Maintenance (O&M)
- Process Audit
- Process Consulting
- Process Monitoring Systems
- Remote Monitoring
- Spare Parts Inventory Management
- System Optimization
- Technical Support
- Training
- Water Analysis

How to Get Started

Pall's integrated MF/RO system combines the strengths of Pall's membrane microfiltration technologies, engineering and technical expertise, and comprehensive support for high-yield production of pure water for plant make-up. Please contact your local Pall representative for more information and a free analysis of your feedwater and treatment requirements.

Power Generation

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PGMFROENa

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Cost-Saving Alternative to Clarifier and Multimedia Filtration Operations

The Pall Aria™ Integrated MF/RO System

If you are dependent on clarifiers and multimedia filters to treat surface water and influent water for boiler and utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/RO system.

The Pall Aria MF/RO system leverages advanced dual-membrane technology for process water treatment. This hollow-fiber microfiltration (MF) and reverse osmosis (RO) system has been proven to reduce overall operational costs by 15-20%. It can also achieve consistent and high-quality product water, with a significantly smaller footprint, less waste, and no need for sludge dewatering, hauling, and disposal.

Value

- Reduce operational costs by as much as 20%.
- Improve water quality.
- Eliminate water variability to downstream unit operations.

Is This an Opportunity for You?

- Do seasonal or frequent operational conditions cause variability in your makeup water?
- Does poor water quality and variability stress your downstream unit operations (such as demineralizer, softener, or boiler and utility operations)?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/RO System?

- Eliminates source water variability caused by fluctuations in seasonal and operational conditions.
- Reduces TDS and ensures high-quality water to downstream unit operations.
- Provides the consistency and high quality required for critical applications.

Key Industries

- Chemical processing
- Electronics
- Food and beverage
- Hydrocarbon processing
- Mining
- Power
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

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PASRO2

Pall Corporation

Cost-Saving Alternative to DI Operation

The Pall Aria™ Integrated MF/RO System

If you use demineralizers to treat your surface water influent for boiler and utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/RO system.

Utilizing this hollow fiber microfiltration and reverse osmosis system can result in more efficient, lower-cost makeup water and demineralizer operations. The Pall Aria MF/RO system eliminates conductivity spikes and reduces silica, thereby improving the performance of your demineralizer system. It also extends resin life by increasing the interval between regenerations and reducing acid and caustic consumption.

Value

- Maximize control over your water treatment operation.
- Improve water quality.
- Minimize waste and disposal costs.
- Reduce operating expenses by as much as 50%.

Is This an Opportunity for You?

- Does your demineralizer system require frequent regeneration?
- Does fouling or attrition from particulate abrasion result in a resin life of less than 10 years?
- Does silica cause you problems with downstream boiler operation?
- Does your operation suffer from conductivity spikes?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/RO System?

- Reduces particulate and microbiological fouling attrition.
- Significantly reduces backwash requirements.
- Reduces regeneration chemical usage and waste.

Key Industries

- Automotive
- Chemical processing
- Electronics
- Food and beverage
- Hydrocarbon processing
- Power
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
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Why Pall?

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PASRO3

Pall Corporation

Cost-Saving Alternative to Lime Softening

The Pall Aria™ Integrated MF/NF System

If you are dependent on lime softening to pretreat surface water and influent water for general utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/NF system.

The Pall Aria MF/NF system leverages advanced dual-membrane technology for process water treatment. This hollow-fiber microfiltration (MF) and nanofiltration (NF) system has been proven to reduce overall operational costs by 15-20%. It can also achieve consistent and high-quality product water, with a significantly smaller footprint, less waste, and no need for sludge dewatering, hauling, and disposal.

Value

- Ensure consistent, high-quality water.
- Maximize control over your water treatment operation.
- Minimize footprint, waste, and disposal costs.
- Reduce operating expenses by as much as 20%.

Is This an Opportunity for You?

- Does your water quality vary or periodically fail to meet specifications?
- Is consistent water quality important to you?
- Do you typically use more than 100 gpm (23 m^3/hr) of water for boilers and utility operations?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/NF System?

- Produces consistent quality water without upsets from a lime softening operation.
- Eliminates sludge dewatering and disposal costs.
- Improves the removal of hardness and alkalinity in treated water.
- Reduces chemical costs and usage.
- Improves ion exchange water treatment.

Key Industries

- Automotive
- Chemical processing
- Food and beverage
- Hydrocarbon processing
- Mining
- Power
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

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PASNF1

Case Study

Power Generation

Turbomachinery OEMs Power Up With Pall

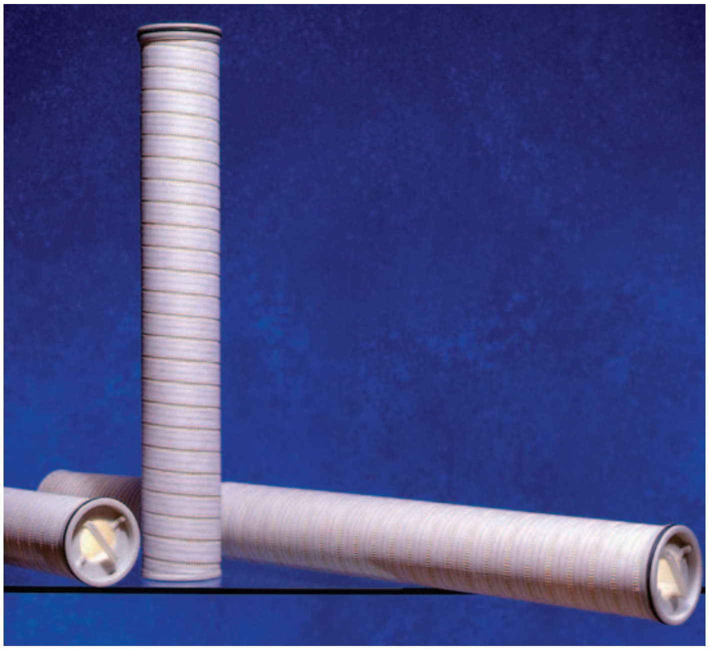
Pall Ultipleat® High Flow Filters the Choice for Water Injection NOx and SOx Emission Control

Problem Overview

Wear-related component failures are major occurrences that often lead to significant turbine downtime, costly repairs, or complete engine rebuilding. For years, leading turbine manufacturers have trusted Pall Corporation to protect their most critical components, realizing optimum efficiency, availability and reliability, while reducing waste.

Turbomachinery OEMs rely on Pall's Ultipleat High Flow filters for filtration on water injection systems for NOx and SOx emission control. Pall's industry-recognized technology is a critical component in helping prevent nozzle fouling. This technology also protects against turbine blade erosion by removing the hard particulate found in the source water. Filtration of high pressure demineralized water before injection into the turbine helps control NOx and SOx emissions in turbine exhaust - a major environmental issue raised by concerns over global warming.

Water controls and NOx and SOx filtration also ensure the system functions properly, maintaining spray patterns and delivery volume.



Pall's Ultipleat High Flow system is a proprietary, large diameter, disposable filter system, and features long filter life and easy filter change-outs.

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The Solution

Pall's simplex and duplex Ultipleat High Flow filter packages are compact, cost effective, and meet or exceed the original equipment manufacturer's filtration requirements. Ultipleat High Flow filter elements are available in lengths of 20″, 40″, and 60″ for use in single- or multi-element housings to handle a wide range of flow rates from 40 gpm to 1,000 gpm. Ultipleat High Flow filter cartridges are available in a broad array of absolute removal ratings from 2 micron to 40 micron in both glass fiber and polypropylene construction.

Typical Ultipleat High Flow duplex filter systems employ a six-way transfer valve between the two filter vessels. The vessels utilize a reusable, stainless steel internal basket and inside to outside flow configuration to retain all captured dirt. The vessel design, in combination with the external piston seal construction of the element, virtually eliminates bypass of contaminants while allowing for rapid element change-out. The removed element is disposal-friendly, owing to its non-metallic components. Filter cartridges can be incinerated, shredded, or crushed.

Clients have also found Ultipleat High Flow filters to be a cost-effective solution for fogging systems, wet compression systems, ammonia injection systems, and post filtration of demineralized water treatment systems.

Let the Pall Power Generation Group show you why turbomachinery OEMs around the world trust their most critical fluid components to Pall Corporation.

The Benefits

- Smaller, more economical filters: just one six-inch diameter Ultipleat High Flow filter element can handle up to 500 gpm/1,900 lpm
- Lower waste disposal costs: up to 4 times less volume of spent Ultipleat High Flow filters to dispose of versus conventional depth filters
- Lower maintenance costs: more than 30 times fewer filters in smaller filter housings to change out versus conventional depth elements

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PGCS6

PALL

Power Generation

Case Study

Upgrade to Condensate Filter Elements Saves Power Plant $110,000/Year

Overview

At a four-unit power plant in southern Indiana, units 2 and 3 are supercritical boilers with original-equipment two vessel condensate filter demineralizer systems. Unit 4 is a supercritical boiler with a powdered resin precoat condensate filter demineralizer system.

Units 2 and 3 have traditionally been operated using string wound filter elements with powered resin precoat and cellulose fiber overlay which acts as a filtration aid and protects the string wound elements from prematurely fouling. Unit 4 uses the same precoat material with stainless steel spiral wound elements.

The Problem

The Station was precoating every 30 days. The cost for one precoat on Unit 2 is approximately $1900 per vessel (resin acquisition cost only). The station's goal was to reduce resin costs while maintaining required condensate chemistry.

The station precoated monthly because the string-wound elements being used tended to foul with particulate contamination and embedded powdered resin due to the filters' depth filtration characteristics. In addition, the strings would loosen and stretch as a result of forward and backflush flows.

The plant needed to find a way to optimize their condensate demineralizer system in order to reduce system operating costs.

Hydro-Guard CoLD R filters are specifically designed for the use of backflushable, resin precoated power plant applications. The powdered resin removes dissolved and suspended copper, silica, and sulfate contaminants.

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The Solution

In October 2002, the station upgraded the Unit 2 polisher with the installation of Pall Corporation's meltblown HydroGuard CoLDR elements. The new HGCOLDR elements are comprised of 100% polypropylene meltblown reverse depth graded pore structure filter media, with a 2.25″ outside diameter (OD), compared with 2″ OD on the old string elements. This slight increase in OD provided a 14% increase in precoatable surface area, which lowered the vessel flux rates significantly. These features improved operating performance due to better backflush ability, more uniform precoat application, absolute filtration matrix, and precise element permeability.

The Station has replaced the Unit 3 string-wound elements with Pall Corporation's HGCOLDR elements in March 2004, and is currently experiencing similar cost savings. The station has recently initiated a project to upgrade the old vessels with HGColdR elements.

The Benefits

- The station is now precoating every 60 days, versus every 30 days, cutting precoat costs in half.
- By reducing precoat frequency from 12 precoats per year to 6 precoats per year, the station has saved $50,000 per year on Units 2 and 3 resin costs alone.
- The system needs less oversight and requires less manpower, allowing staff to concentrate efforts on other key plant issues.

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PGCS5

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Power Generation

Case Study

Pall Filters Help Recover Lost Megawatts and Lost Revenue

The Problem

A major Midwestern power plant continuously experienced losses in power generation capacity, typically 27,000 MWh per year, due to the deposition of copper onto the turbine blades. Near the end of a twelve month fuel cycle, the station was derated by 30 MW, resulting in an average of $30,000 per day of lost generation revenue. The station was forced to decrease turbine rotation speed due to copper deposition, and imbalance of the turbine blades.

As MW output decreases due to copper deposition, the plant must increase heat rate (fuel consumption) to maintain a consistent energy output at a lower efficiency. The plant then loses revenue as costs rise per MW generated.

The copper plating that occurs on the turbine is typically removed either by mechanical or chemical cleaning. Mechanical cleaning requires complete turbine disassembly, rotor removal, grit blasting of the parts with deposits, and re-assembly. This can take up to six weeks and cost more than $350,000 for a 400 MW steam turbine. Chemical cleaning has the potential of contaminating the intermediate pressure and low-pressure turbines, heaters, and the condenser. Neither method addresses the action of minimizing or eliminating the deposition process in the first place.

Industry standards require specific hold points for Copper, Iron, and Silica. Attaining these guidelines is usually the determining factor for startup duration in plants that adhere to EPRI or similar criteria.

Pall Ultipleat® High Flow is a full-flow condensate filtration system that provides a cost-effective, long-lasting platform to minimize metallic, silica, and all particulate transport in the condensate flow.

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The Solution

The station investigated upgrading their existing condensate polisher to reduce copper carry-over. Pall Corporation provided a more economical solution with the Ultipleat High Flow startup filtration system.

After conducting several pilot tests to determine optimum equipment selection, Pall proposed an assembly consisting of a 38″ diameter filter housing containing 19 Ultipleat High Flow filter cartridges.

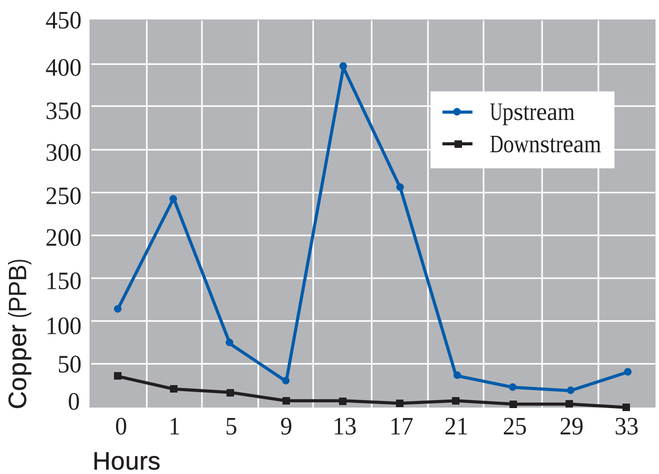
Since the installation, the condensate system has undergone 5 startups. The unit has consistently achieved the EPRI startup guidelines for Copper, Iron, and Silica in 15-20 hours compared with the >35 hours prior to the installation.

Since installation there have been no power derates due to copper deposition on the turbine blades.

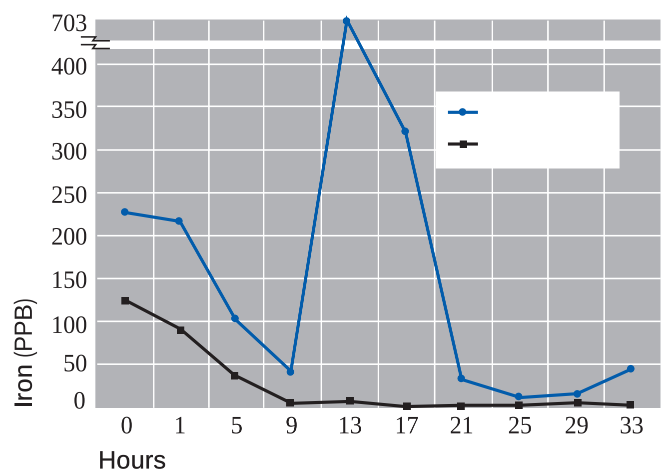
The Benefits

- Reduced chemical holds
- Reduced chemical feed
- Reduced boiler blow down
- Faster return to the grid
- Increase in revenue generation for the plant
- The cleaner condensate effluent from the filter has helped minimize the resulting problem of copper deposits on turbine blades and under deposit corrosion of boiler tubes due to iron
- Reduced risk of boiler tube water wall failures due to under deposit corrosion
- Increased efficiency of existing condensate polisher due to better removal of particulate copper and iron prior to the demineralizer bed

Concentration of Copper Up and Down-Stream of Pall UHF Filters During Condensate Start-Up



Concentration of Iron Up and Down-Stream of Pall UHF Filters During Condensate Start-Up



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PGCS1

Power Generation

Case Study

Major Northeast Power Plant Realizes Significant Cost Reductions in Condensate Water Treatment with Pall Hydro-Guard® Filters

Premature plugging of resin pre-coated, backwashable condensate filter elements with resin fines and contaminants is a common and wasteful occurrence at power plants. Premature plugging results in short runs, especially during start-ups when the contamination loading is at its highest. In addition to short runs, filter bypass, end-cap failures, and system trips due to high filter differential pressure are also common in condensate water backwash systems using typical, nominal rated commodity filtration.

The Challenge

A 775 MW combined cycle plant in the northeastern United States was experiencing premature plugging of resin pre-coated, backwashable condensate filter cartridges with resin fines and contaminants. This occurred especially during start-ups, when the contamination loading is at its highest. In addition to short runs, the plant also experienced filter bypass, end-cap failures, and system trips due to high filter differential pressure. The plant has a 275 MW steam turbine generator that uses an air-cooled condenser. The condensate polishing system consists of two Pall Septra™ backwash vessels in parallel, with one in operation and one on standby. Each vessel contains 420 filter cartridges, 2.50″ diameter by 80″ long.

The automated backwash cycle at the station consists of a sequence of operations that utilizes about 8,000 gallons of clean water, generating an equal amount of wastewater for each backwash event. The amount of resin and filter aid used for the pre-coat of the filters after each backwash is 100 cubic feet. The cost of the resin and the filter aid for each pre-coat is roughly $2,500 US.

The plant had been using string-wound filter cartridges since its inception, but was experiencing a number of issues with performance and integrity. The biggest issue was short runs or low condensate throughput, especially during start-ups. The fouling of the string-wound filter media with particulate contaminant and the fine powder resin resulted in high differential pressure, resulting in by-pass of untreated condensate. In addition, there were instances of filter cartridge end-cap detachment, string ‘unwinding’ due to repeated back flush and water hammer effects, and galling of the metal threads over time. Each such occurrence would require corrective action resulting in lost time and revenue.

The Solution

In light of the problems with the string-wound filters that the plant was experiencing, Pall recommended its Hydro-Guard® filter

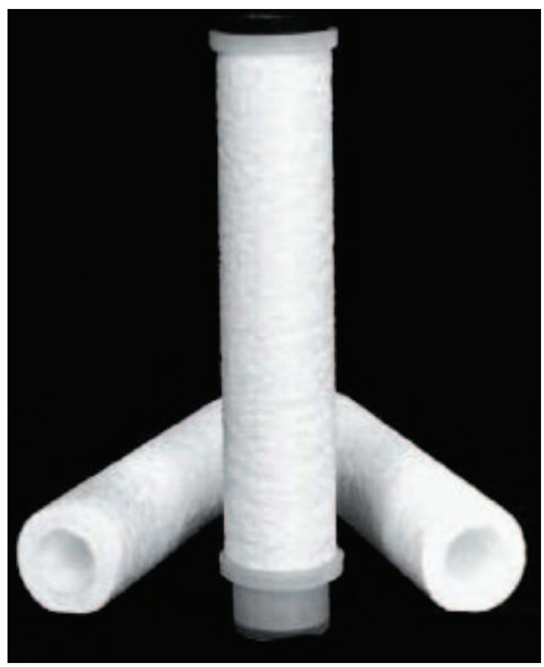

Figure 1 – Cutaway view of HydroGuard® filter element

Figure 2 – End-cap and connector of Hydro-Guard filter element (top) and the string-wound filters

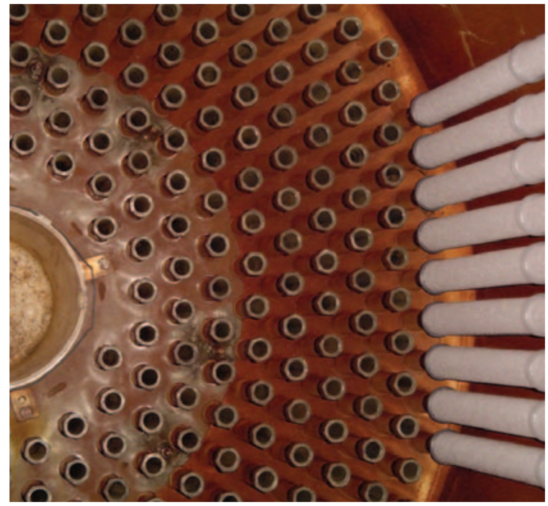

Figure 3 – Hydro-Guard filter element being installed

cartridges made with proprietary CoLD Melt™ technology. This technology creates a filtration matrix with small, micro-thin fibers for particle removal efficiency and Co-located Large Diameter (CoLD) fibers for the rigid structure and strength that is critical under the dynamic operating conditions encountered in this application. The filter cartridge offers reverse depth gradient pore structure that effectively captures particles on the finer porosity, tighter outer surface. At the inner depths of the filter exists a more open fiber matrix that facilitates a forceful and efficient backwash, which is critical to the performance and longevity of the filters.

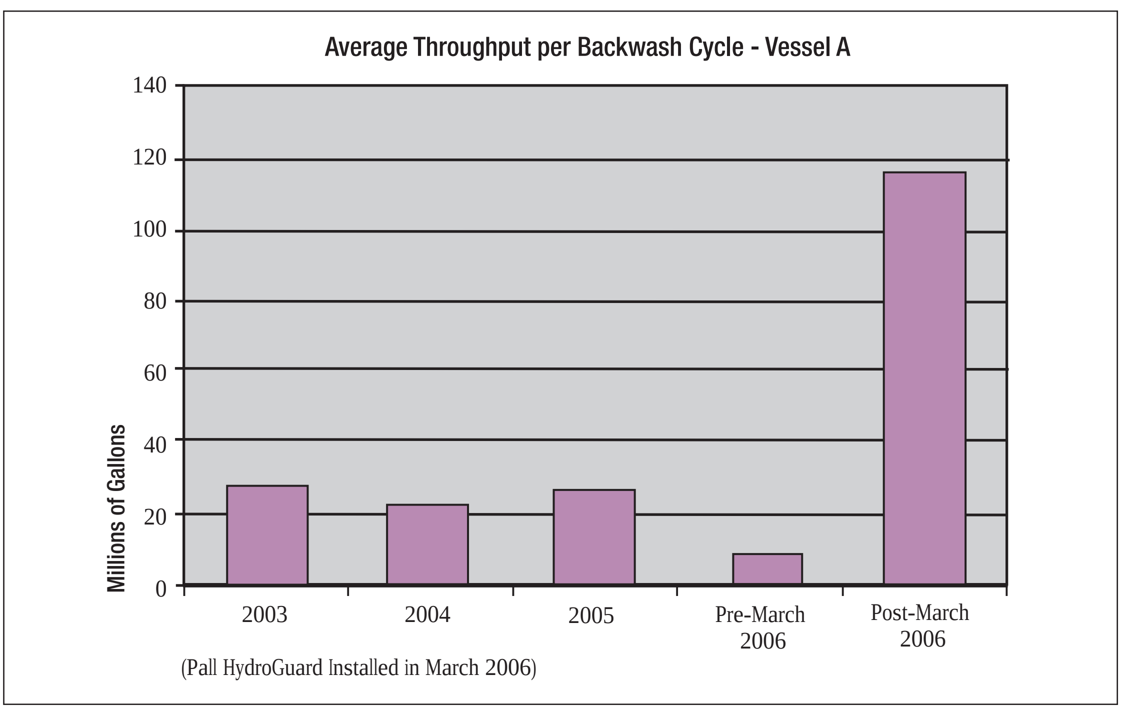

Figure 4 – Average Throughput Data

The filter cartridges are made with 100% polypropylene, inert melt-blown fibers, containing no surfactants, wetting agents, or other extractables that are associated with string-wound construction, thus eliminating the issue of these materials contaminating the system. The absence of the extractable materials in melt-blown media saves time and water – both the clean water and the wastewater required to rinse off the extractable materials. A total of 420 Pall Hydro-Guard filter cartridges, 2.5˝ diameter by 80˝ long, were installed in the bottom tube-sheet vessel, without any modifications to the vessel.

Plant records show that of the 69 total backwash cycles that the system underwent between 2003 and 2006, prior to the installation of the Pall cartridges, five were caused by high conductivity and two were caused by resin trap problems; the rest were due to high differential pressure (DP). Since the installation of the Pall filter cartridges, the system has undergone 10 backwash cycles, all of which were due to water conductivity.

The power plant has reported an average throughput of 94.25 million gallons, which is about 4.4 times the throughput obtained with the string-wound filters between the backwash cycles. The longer runs have lessened the need for pre-coat resins, resulting in more than $60,000 in savings over a period of eight months. Based on the positive experience with the first vessel, the plant has retrofitted the second vessel. Since then, the plant has reported total cost savings of more than $140,000 over a period of 18 months, realized through higher efficiency, improved productivity, and lower resin and chemical treatment costs.

Benefits:

- Melt-blown technology is inherently resistant to the 'unwinding' associated with the string-wound design
- Thermal bonding of the media pack with the polypropylene end caps eliminates media pack separation from end caps eliminating iron and resin bypass
- Elimination of thread galling common to metal-to-metal connections
- Contains no surfactants, wetting agents, or other extractables associated with string-wound construction, thus eliminating the issue of these materials contaminating the system

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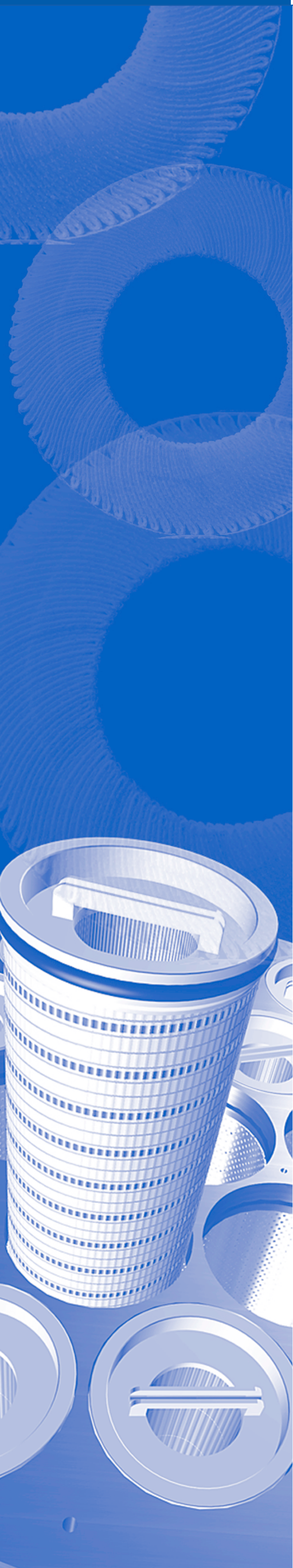

Pall: A world of expertise to meet your condensate challenges

Reliability, efficiency, fuel consumption, power output…all the major critical performance indicators of steam power plants are affected by the quality of the boiler feedwater. From boiler tube corrosion to lower heat transfer and high blowdown rates, the consequences of poor condensate quality are widespread, costly, and sometimes irreversible.

When it comes to condensate polishing, Pall Power Generation functions with a set of principles that serve as the backbone of our entire organization, from fundamental R&D to our service organization.

Performance

The core of our filtration systems is our high-performance filter elements. Much more than one component of the system, Pall elements enable the performance and reliability our clients demand.

Productivity

A tremendous range of technology platforms and dedicated market expertise guarantees that the right product is chosen to meet your unique need. Our team leverages years of experience to ensure the highest level of productivity.

Partnership

As a partner committed to innovation and the science of filtration, Pall can solve even the toughest contamination challenges. We work with you to identify your needs, and develop the best possible solution to keep your business running smoothly.

Performance: Condensate polishing as a filter media science

The primary and overarching goal of optimum fluid cleanliness takes precedence over other considerations. In short, Pall filter systems are developed so that the filter elements can perform the role for which they were designed. In the filtration world, very few applications are as demanding as the protection of high pressure steam generators. Large water flow rates, stringent contamination and chemical specifications, and the requirement for quasi-continuous operation over a number of years all make this market quite challenging. Pall has extensive experience in this application, and has excelled in meeting customers' unique needs for years.

Pall Melt-Blown Elements: Blowing away the competition

Pall HGCoLD-R melt-blown elements are applied when pre-coat backwash operation and consistent element performance are required. These elements combine a modified pore structure with added structural strength to allow both efficient coating and efficient backwash. In that sense, all melt-blown elements are not created equal.

In its most basic form, a melt-blown element is difficult to backwash. However, Pall has designed a special pre-coatable element specifically for condensate polishing. This element, the Pall HGCold-R, leverages advanced depth structure and surface filtration capabilities.

The pore distribution was modified so that the element acts as a surface filter in which the pores on the upstream side (the outside layers) are the tightest. This enables no penetration inside the element. Instead, the deeper pore structure acts as a structural backing in operation, and as a flow channel during backwash. Pall's design allows the depth element to act as a surface filter, supported by a thick hydro-dynamically optimized support structure.

Maintaining a proper precoat layer on the element is key for filtration and demineralization efficiencies. The upstream layers of Pall's HGCoLD-R element stand apart. The added strength of co-located large fibers inside the element increase resistance to compression stresses, protecting the resin coat. The "roughness" of the element's surface also helps stabilize the resin coat onto the outer surface.

The Pall HGCoLD-R systems currently in operation around the world stand as proof that a melt-blown element can be much more than just a low-cost alternative.

Improving element performance doesn't mean sacrificing backwash operation

Much has been said of the influence of increasing filter surface area on the operation of the backwash cycle. The basic rule of thumb is that if you increase surface area, you reduce flux. In the case of reverse backwash flow, this flux reduction results in lower drag force on the particles and improper cleaning of the elements.

However, one of the biggest advantages of Pall HGPPB pleated elements is that they offer an increase in filtration surface area without sacrificing backwash ability. Not only has it proven to provide the highest removal efficiency without precoat, it consistently exhibits long runs and very long life, showing an excellent ability to be backwashed with minimal system flow upgrade.

Materials and media science means that even at lower fluxes, the element can be made to capture particles efficiently in the forward direction, while offering the least resistance in the backwash direction. For Pall, reducing the force needed to dislodge particles from the filter meant the following:

Optimizing filter media

The proper membrane structure must be "asymmetrical" regarding pressure drop. One way to accomplish this is to avoid fiber displacement in operation. If fibers are allowed to move, particles can "wedge themselves" into a pore, and drag forces will need to be higher to dislodge them. Pall filters are designed to minimize pore distortion, in order to minimize drag forces necessary for backwash.

Pall HGPPB elements combine excellent iron filtration capabilities with long life from advancements in its media and structure.

Expert flow dynamics

More than just structural strength and durability, the special support layer provides the HGPPB element its excellent flow dynamics as well. It is designed to “channel” the water at optimum velocity into the filter media layer, which is itself designed to offer low resistance to drag forces in the backwash direction.

Lower flux applies in the forward direction. Our experience across wide industries shows that lower fluxes prevent deep penetration of contamination and level off its distribution in the media. Forward forces embedding particles into the filter membrane are lower, contamination is more evenly distributed, and element pressure drop stays lower longer.

Pall Ultipleat High Flow® filters are the newest generation of disposable filtration for small condensate treatment. The revolutionary pleat configuration makes it possible to filter full condensate flows with very few elements, without sacrificing element life or removal efficiency.

System performance is key

At Pall, element science and separations performance is paramount. This requires that our system designs and upgrades allow the elements to perform consistently, as specified, with a long operational life.

This philosophy affects how we size the vessels, how we design and improve the backwash dynamics, how we design element change-out tools and procedures, and how we upgrade tube sheet designs for efficiency, reliability, and ease-of-use. To take full advantage of the possibilities regarding filter elements, each Pall system integrates features learned and adapted from some of the most challenging backwash applications in the industry -- from slurry oil to heavily contaminated coolant fluids.

An example of this is Pall’s backwash design. Born out of the need to process and backwash viscous and contaminated fluids in the petrochemical industry, this vessel concept matches Pall condensate filter elements performance and makes for a durable, efficient, and cost-effective installation.

Another example is our top tube sheet design, which has been a Pall standard for years because it offers excellent backwash characteristics, provides easier evacuation of waste, and is easier to service.

Productivity: Leveraging an unmatched knowledge base

Nothing has a greater impact on the productivity of a power producing asset than the purity of the fluids running through it. This is the fundamental idea behind Pall’s Total Fluid Management practices, and is certainly true for condensate polishing. Productivity is our goal – the productivity of assets, the productivity of people, and the productivity of Pall’s own scientific and engineering force.

Learning, customer relationships, innovation, and evolution are the tools with which Pall maintains its productivity and leadership. Pall’s ability to combine the dedicated, customer-centric knowledge of our SLS[1] structure with a remarkable filtration and separation technology portfolio ensures that only the best products are brought to market. Our customers choose our products because they are best adapted to the application. The result is a higher level of productivity, both for us and for our customers.

Pall’s Ultipleat® High Flow filters for condensate filtration were developed from this rich cross-fertilization. Ultipleat High Flow filters offer a compact, cost-effective, and highly efficient solution to solid metal transport in smaller condensate systems. Its innovative pleat design was first introduced to solve some of the most challenging hydrocarbon contamination issues in the oil

1 *SLS : Scientific & Laboratory Services : Pall’s unique structure of scientists and technicians around the world whose sole mission is to act at the customer level, with focused application and technology expertise, to provide consulting, analysis and process improvement services.*

industry. The unique structure and flow path of the element makes for the perfect combination of high flux capability and high removal efficiency.

For condensate systems, it opens a new realm of possibility for utility and industrial steam generators looking for better boiler productivity without the large capital or running costs of backwash systems or traditional disposable filter systems, respectively.

Continuous Improvement

We continuously improve our technology through the challenges and hurdles we encounter, and with the partnerships we form with our customers. When Pall filters purify the primary coolant of nuclear reactors, we learn to capture particles so small they are almost not considered particles at all; when Pall filters are used on aircraft hydraulic systems, we learn to manufacture our products to the toughest quality standards; when Pall filters purify water to wash microelectronic wafers, we master the art of making very low-extractable filter elements; when Pall filters purify drinking water for entire cities, we ensure large flows with uncompromising reliability. All these examples and more increase our scope and expand the possibilities.

Our manufacturing facilities benefit from the same sharing of knowledge. While some have to find a way around calendaring machines for fear of hot spots, Pall manufacturing engineers, technicians and operators tackle the challenge, fine-tune the process, and use their years of experience across industries to prevent excessive heat transfer through the fiber layers.

Partnerships: Improving together

Innovation, separations science, media expertise, engineering and manufacturing adaptation all require in-depth knowledge and constant monitoring of the markets we serve. Being a technology leader means not only understanding any process and its current requirements, but to also ask what can be done better. This is the fundamental idea behind the partnerships Pall has with customers, large research institutions, Universities and private research centers. Pall's SLS group is continuously on the pulse of our customers' requirements and expectations so that we can deliver the best available separations technology for a given process.

Total Condensate Leader

Pall's condensate product evolution is always deeply rooted in the relationships we have with our customers. Pall Power Generation's leadership is rooted not only in our products, but also in our unwavering commitment to cleanliness through media science, the productivity gains we enable for the users of our products, and the partnerships we form with our customers to always move forward.

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Technical Paper Presented at Southwest Chemistry Workshop, Farmington, NM, June 23-24, 2009

Pall Integrated Membrane System Enhances Boiler Feed Water Make-Up Quality and Lowers Operating Costs

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Spence Wise, General Sales Manager, Power Generation, Pall Corporation
Ramraj Venkatadri, Sr. Marketing Manager, Fuels & Chemicals, Pall Corporation

Abstract

A major North American utility station deploys conventional lime softening and demineralizers to produce high-quality water for boiler make-up. The conventional system uses coagulant, lime, acid, and caustic in large quantities to produce demineralized water. Pall Corporation and plant personnel worked together to develop an integrated membrane-based system to produce high-quality permeate water to maximize ion exchange run times. This paper focuses on the conventional approach and the new membrane approach in treating the lake water to produce demineralized water, as well as the challenges faced, and direct and indirect benefits gained with the new system.

Introduction

The utility is a large coal-fired power plant that operates three coal-fired units. The units are about 600 MW each and were originally designed to handle high sulfur bituminous coal. This paper shows the results obtained from the conventional water treatment scheme established at the plant to make boiler feed water for the high-pressure boilers. The paper has a detailed description of the integrated membrane-based system that Pall recently installed at the site, and documents the improvements in performance that were realized.

Microfiltration/Reverse Osmosis Technology

Conventional clarifier/multimedia filters for the treatment of incoming fresh water into plants suffer from several drawbacks. The primary one is the inability of these systems to cope with sudden upset conditions that could result in increases in total suspended solids in the feed water. This is also reflected in an increase in Silt Density Index (SDI), or in turbidity (NTU values) in the feed water to the unit, as well as in the permeate (filtrate).

Technological improvements since the 1990's have resulted in processes such as Microfiltration (MF), Ultrafiltration (UF), and Reverse Osmosis (RO) becoming economical and popular. In a typical application with MF, the incoming water passes through several thousand spaghetti-like hollow-fiber polymeric membranes, which remove suspended solids and bacteria such as Giardia and Cryptosporidium. The range for MF is 0.05-5 micron, and for UF technology, the range is 0.005-0.1 micron.

For removal of dissolved solids, the treated water from the MF/UF unit passes through the RO membranes. This technology is employed before the demineralizers. The pores in the RO membrane are only a few angstroms in size and can remove a majority of the dissolved salts. The RO membranes (normally spiral-wound design) are easily susceptible to fouling and extra care is needed to limit the amount of suspended solids entering the RO. This means that the unit upstream of the RO membrane (MF, sand filters, etc.) must limit turbidity to less than 1 NTU and have an SDI less than 3.

Modes of Operation

The MF and UF filtration systems can be operated in the dead-end mode (outside-in flow) or in crossflow mode. The RO units operate in the crossflow mode.

The MF unit described in this paper uses a hollow fiber PVDF membrane operated in the conventional dead-end filtration mode under pressure, where the feed water flows in from the outside to the inside of the hollow fiber and the suspended particles and bacteria are captured within the filter .The permeate is sent to the RO unit. The MF unit requires continuous air and chemical cleaning, which is described in a later section. The RO unit operates in the crossflow mode, in which the feed water flows parallel to the membrane surface. The water that is filtered through the fine pores (permeate) is mostly devoid of dissolved salts and is sent to the demineralizers for the polishing step before being used as boiler feed water. The portion known as the “retentate” or “reject” flows along the surface and is independently collected.

Background Information

Raw surface water from an adjoining lake is the fresh water source for the power plant. In the original treatment scheme, about 1500 gpm of this water was being treated with a conventional clarification and cold lime softening process followed by sand/gravel bed filtration. Demineralization units were subsequently used to produce the required water quality for the HP boilers. These units consisted of a conventional cation bed using sulfuric acid for resin bed regeneration, and weak and strong base anion beds as well as a mixed-bed demineralizer using caustic soda for resin regeneration. Downstream of the demineralized units, the condensate water for the boilers was sent to storage tanks. A Graver Powdex® pre-coat filtration system was used for polishing condensate before the low-pressure heaters.

The driving force to consider alternate treatment schemes in lieu of the conventional clarifier/sand bed was as follows:

A. Chemical costs required to regenerate the demineralizer beds were extremely high since regeneration of the resin was carried out once a day or even more frequently. The ion exchange run time needed to be improved significantly.

B. Operational simplicity: Frequent upset in the clarifiers would result in frequent regeneration.

C. Although the plant was designed with a three-bed demineralizer followed by mixed-bed polishers to meet boiler feed water quality, silica breakthrough in the strong base bed was frequent and beds were regenerated more often. This is reflected in the chemical consumption shown in Table 1 (page 5).

D. The condensate polishing system had to be precoated frequently due to the poor quality of the condensate water. An improvement in the frequency of precoating the resin would provide an indirect benefit to the plant.

Quality of Incoming Water:

According to information provided by the plant, the following was the quality of the incoming lake water for which the MF and RO units were designed.

TDS	540 ppm
Turbidity	<10 NTU
Iron	0.62 ppm

RO Feed Water Quality

Feed Stream Composition (mg/l)

TDS	<540 ppm
Barium	0.01
Calcium	51.00
Potassium	3.18
Magnesium	20.90
Sodium	20.41
Chloride	22.35
Fluoride	1.30
Bicarbonate	238.00
Nitrate	0.50
Sulfate	29.00
Silica	16.00
Carbonate	0.67
Carbon Dioxide	7.59

Pall water treatment experts performed a detailed analysis of the plant conditions and decided to recommend an integrated membrane (MF/RO) system (IMS) to replace the cold lime softening clarifiers and sand/gravel filter beds. Since the power plant was online, an additional challenge was to install the systems without shutting down the demineralizer trains or negatively impacting the amount of treated water while the new IMS plant was brought on line. Pall recommended installing the IMS in parallel with the clarifiers and sand/gravel filters and reusing the existing filtered water tanks. One filtered water tank was used as an MF/RO break (filtrate tank), and the other as an RO permeate water storage tank (the new demineralizer train feed tank).

After commissioning the IMS, the plant personnel bypassed the clarifier/sand bed system and fed the incoming water from the feed system directly into the MF system.

The MF and RO product water quality that the units were designed for is shown below:

MF Product Water Quality

Feed Water Element	Treated Water Quality
Giardia and Cryptosporidium	Undetectable
Suspended Solids	Undetectable
Turbidity	< 0.1 NTU

RO Product Water Quality

TDS: < 25 ppm
pH: 5-7

Integrated System Details:

Pall's integrated system was commissioned in February 2008, which means there is more than one year of performance data to report. The installed MF system consisted of a Pall Aria™ Microfiltration system using Microza* microfiltration modules. The system consists of two independent treatment trains of 42 modules each. This system is 2 x 100% capacity (770 gpm maximum each) and allows for an average production of 1400 gpm (input of 1540 gpm with 95% recovery) with both trains in service.

Since the IMS system was installed along with the existing system, the space available for the RO skid was limited. Therefore the RO skid had to be custom designed to fit in the available space.

To accomplish this, the RO system consisted of three stages (single train), arranged in a 16:8:4 array with five membrane elements each. The inlet flow to the RO system was 625 gpm. The system was designed for a total permeate production of 500 gpm, the average capacity of the boiler.

* Microza is a registered trademark of Asahi Kasei Corporation

Process scheme and sizing

The RO system capacity was designed to meet an average demineralized water demand of 500 GPM. However, during boiler chemical cleans or tube leaks, the demineralized water demand could be as high as 900 GPM. During high demand conditions, the RO permeate will be blended with the MF filtrate. The demineralizer feed pump has the capability to draw from both MF filtrate and the RO permeate, thus blending the two streams before being fed to the demineralizer trains.

The question that arises in the RO system design is "How frequent can the system start/stop?", particularly when the demineralized water demand is below average capacity (500 GPM). Pall's Water Team decided to tie the overflow line from the RO permeate water tank to filtrate water tank, thus achieving two goals:

1. Keeping the RO in service all the time and avoiding frequent starting and stopping
2. Improving the water quality to the demineralizer train. Since the RO permeate tank is full, the overflow would fill the filtrate tank. This will back off the MF filtrate, thus providing partial double RO product quality.

With the above process improvement, the RO system had to self-regulate in terms of flow and pressure. Therefore the RO booster pump was equipped with a VFD and the reject valve is of the modulating type. The PLC would control the flow and pressure to maintain the constant product water flow and system recovery.

The average MF filtrate required for the RO is 625 GPM and during the peak demand, the MF filtrate required would be 1,025 GPM to make the blended feed of 900 GPM to the demineralizer system.

Flux Maintenance (FM) is being performed to lower Trans Membrane Pressure (TMP) across the MF membrane. There are three FM methods used in this system.

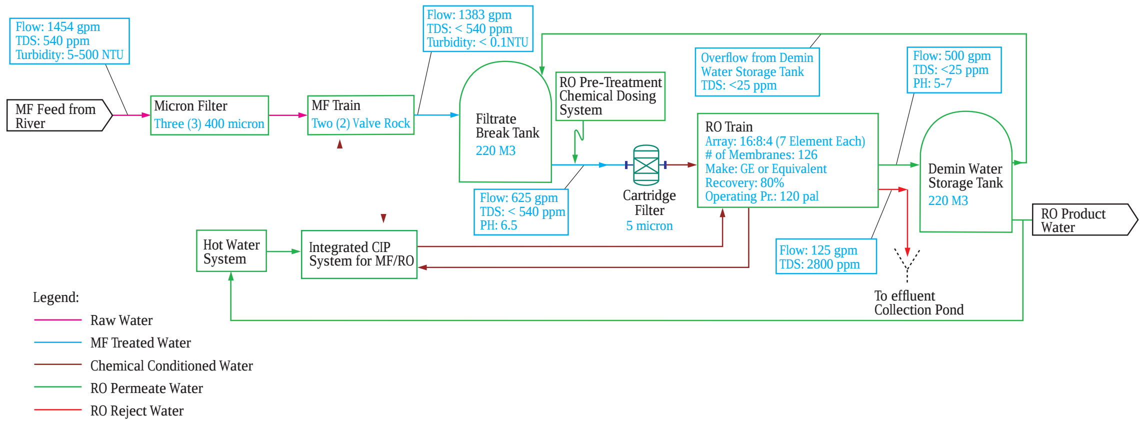
The first FM method is air scrub/reverse filtration (AS/RF), which involves injection of air at low pressure into the feed side of the module approximately every 20 minutes. Clean filtrate is also pumped in a reverse direction through the hollow fibers to dislodge foulants and deposits. After the AS/RF, the MF unit will ramp up to the instantaneous peak flow to compensate for the loss in filtered water, thus maintaining the constant average filtrate output.

The second FM method is Enhanced Flux Maintenance (EFM), which is being performed based on an increase in the TMP. This fluctuates between once per day and once per week to remove microbial fouling, thus lowering TMP values. During EFM, a hot caustic chlorine solution or a hot chlorine solution is circulated through the feed side of the membrane. During the EFM the MF unit will be off line for 30 – 60 minutes.

Normally, as TMP approaches 25-30 psig, a chemical clean-in-place (CIP) is performed -- the third FM method. This is a two-step protocol, first using hot caustic/chlorine, and then an acidic solution to return the modules to "nearly new" conditions. This is carried out hundreds of times over the lifetime of the modules. A CIP can also be performed at periodic intervals (once every 60 days, for example) as a precautionary step to protect the membrane even if TMP does not rise significantly during that interval.

Considering the FM requirements for the MF system, two MF units were selected. Since the average demineralizer feed rate is 500 GPM (RO feed 625 GPM), each MF unit was sized for 700 GPM average filtrate production. See Figure 1 (page 5) for the overall mass balance for the project.

Figure 1:
Overall Water Mass Balance Diagram



Result and Discussion

Table 1 compares the existing costs for chemical addition and power requirements with the clarifier/sand-gravel bed operation prior to the plant switching over to the MF/RO system.

The sludge treatment/disposal costs and some other costs have not been quantified. The chemical costs were considerable, exceeding $3500/day.

Table 1:
Chemical/Power Costs with Conventional Treatment

Component	Daily Consumption, lbs	Unit Cost in USD	Total Cost in USD
Sulfuric Acid—93% (lb)	8054	0.05	402.70
Caustic Soda—50% (lb)	16000	0.18	2880,00
Sodium Aluminate—40% (lb)	1000	0.20	200.00
Lime—100% (lb)	750	0.06	45.00
Power –KWH	1630	0.05	81.50
Total Daily Cost			$3609
Total Yearly Cost			**$1,317,358**

The costs for caustic soda and sulfuric acid are extremely high, owing to the fact that the demineralizer train was regenerated at least once a day. Sodium aluminate/lime was used for the lime softening operation.

Table 2 shown below lists the chemical addition and power costs in the plant after Pall's integrated system was operational. There was a dramatic lowering of the chemical costs.

Table 2.
Chemical/Power Costs with Pall Integrated System

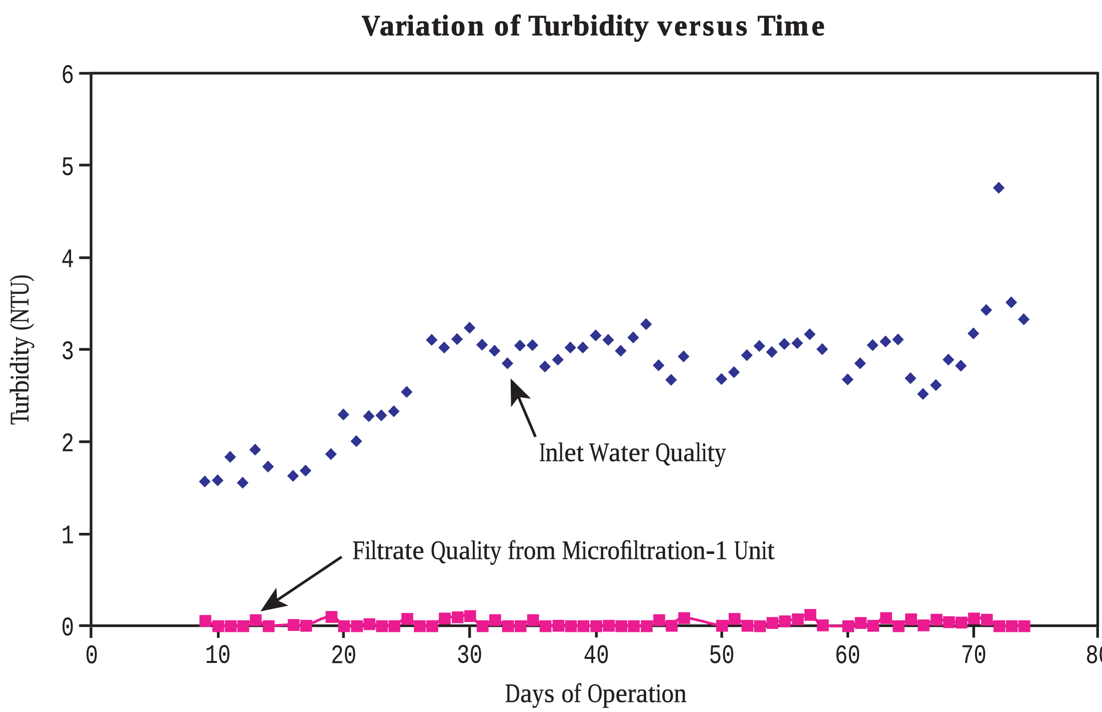
Component	Daily Consumption, lbs	Unit Cost in USD	Total Cost in USD
Sod. Hypochlorite-12%(lb)	26	0.13	3.4
Citric Acid—50% (lb)	21.4	0.54	11.6
Caustic Soda—50% (lb)	181	0.18	32.6
Sod. Bisulfite—38% (gal)	58	0.43	24.9
Antiscalant—100% (gal)	2.2	35.00	77.0
Sulfuric Acid—93% (gal)	0	0.05	0
Power—KWH	2800	0.05	140.0
Total Daily Cost			$289.5
Total Yearly Cost			**$105,650**

The principal benefit of the Pall system is the significant improvement in the regeneration of the ion exchange units. The regeneration cycle in the demineralizers improved from daily to once every 5-6 days. This led to a steep decrease in the use of caustic soda and sulfuric acid used in the resin bed regeneration. The use of sodium aluminate and lime was eliminated by bypassing the clarifier operation. The chemicals used to clean the MF/RO system during EFM and CIP (sodium hypochlorite, caustic soda and citric acid) are commodity chemicals and usage quantities are negligible compared to the conventional system. Antiscalant was used to prevent LSI scaling in the RO unit, while sodium bisulfite was used for dechlorination (described later). All of these chemicals resulted in a daily cost of approximately $150.

As indicated in Tables 1 and 2, the resulting daily savings in chemical/power costs is $3310 per day ($3600 - $290), or about $1.2 million per year.

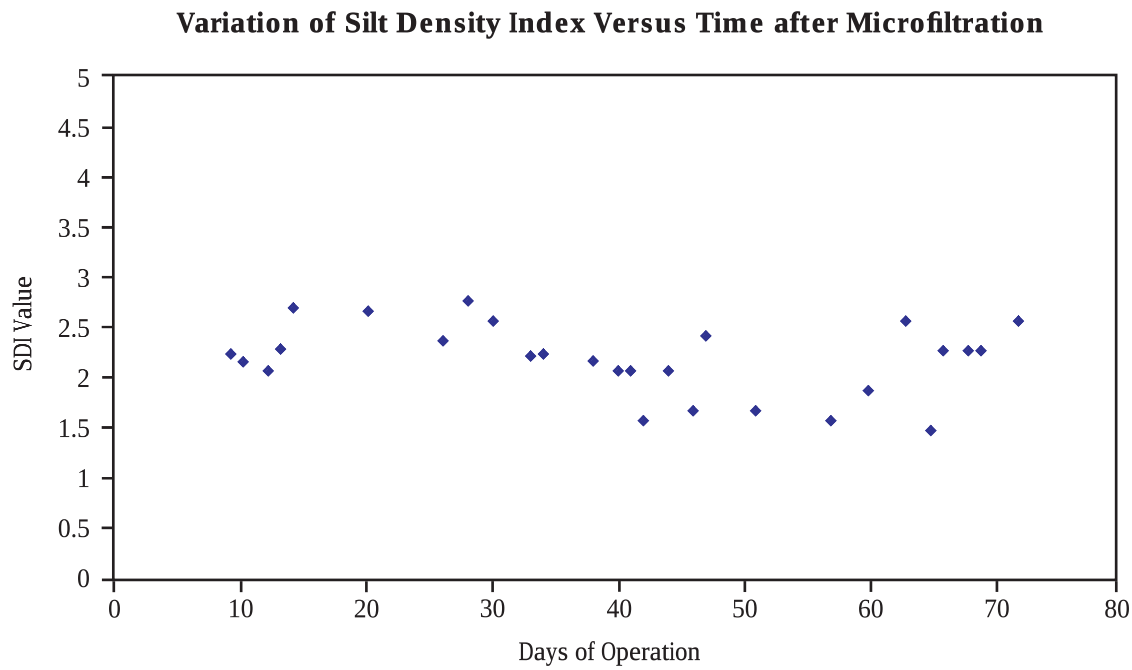
Figure 2 shows the variation of the turbidity of the incoming surface water and the turbidity of the filtered water from the MF unit with time over a period of several months. The incoming water varies in the range of 1.5 - 4 NTU, with occasional higher values. MF filtrate always exhibited turbidities below 0.05 NTU, with a majority of the readings less than 0.02 NTU.

Figure 2: Turbidity of incoming water and permeate from the MF Unit



The classic Silt Density Index (SDI) method was used to determine the fouling potential of the RO membrane. SDI is measured manually before the RO "guard" filter. Figure 3 demonstrates the variation of SDI. All the readings were in the range of 1-3, with a majority of the SDI values being below 2.0. This again demonstrates consistent MF performance and fouling protection for the RO.

Figure 3:
Variation of Silt Density Index after Microfiltration



The flow rates to both the MF Units vary in a wide range, depending on the demand. Trans Membrane Pressure (TMP) readings across MF Unit 1 have been plotted in Figure 4 below. Since the variation in flow rates is wide, the normalized TMP values are shown. It is important to note that the normalized TMP values appear to increase marginally with time but do not show a steep increase, which normally indicates that a chemical CIP is required. We commented earlier that Enhanced Flux Maintenance (EFM) is being carried out once a day to control the rise in TMP values. Nevertheless, a CIP procedure is carried out every 60 days on both MF units as a precautionary step to optimize MF performance.

Figure 4:
Trans Membrane Pressure Normalized for Flow Rate variation versus time

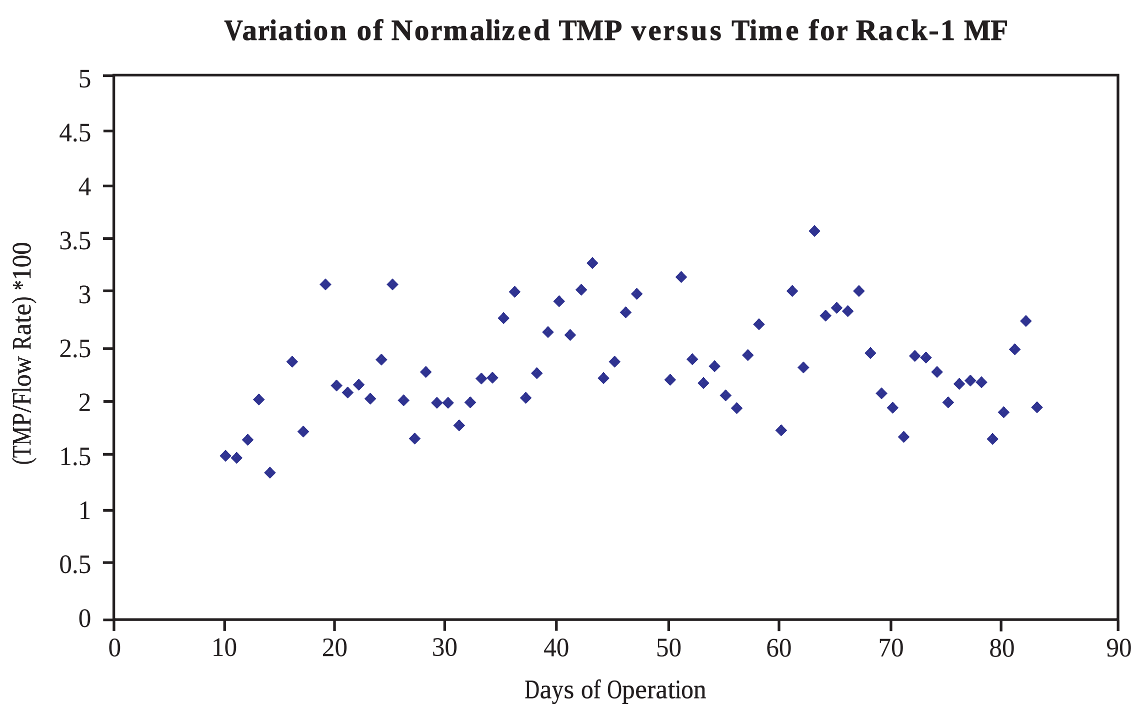
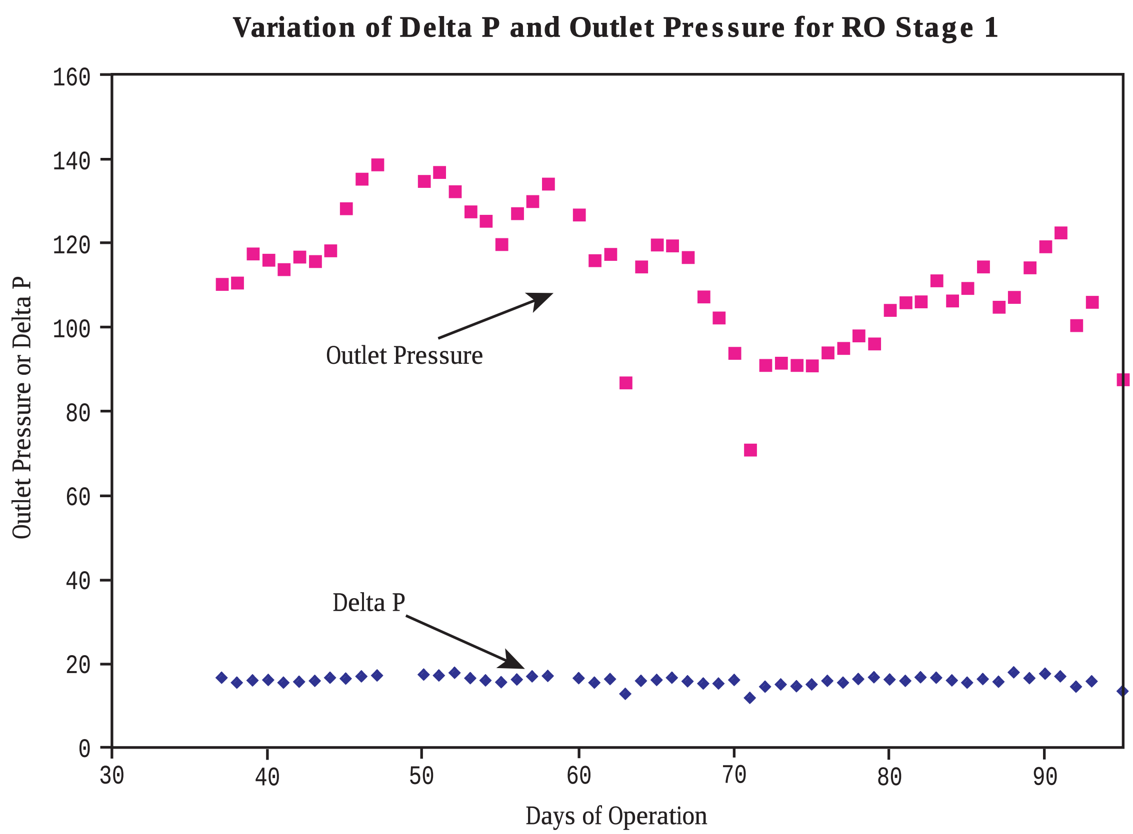


Figure 5 shows the operation of Stage 1 of the RO unit. The outlet pressure over several months is steady and actually declines slightly. The figure also demonstrates the pressure drop across the elements in Stage 1 and it shows no increase. This demonstrates the excellent RO performance of Stage 1, and is characteristic of a very low fouling tendency. Although not shown here, similar results were obtained for Stages 2 and 3 of the RO unit.

Figure 5:
Variation of outlet pressure and differential pressure across RO Stage 1



Operational Challenges

Although the utility has achieved satisfactory performance in more than 15 months of continuous operation with the MF/RO unit, some technical challenges had to be met:

1. Filtered water tanks were old and unpainted. Therefore, even though the MF filtrate was of very high quality, the SDI at the RO inlet was consistently high (> 5). Due to these high suspended solids, the RO "guard" (cartridge) filter would not last more than a week. Upon investigation, we found that the filtered water tank had all the lime sludge and the iron crud as the tank was never painted. A high-density polyethylene (HDPE) tank was brought on site to replace the existing filtered water tank, which was then cleaned. With the HDPE tank online, the SDI at the RO inlet was consistently below 3.0.

2. During the early summer, the "guard" (cartridge) to the RO unit, a two-micron Ultipleat® High Flow cartridge filter needed replacement every two or three days. This time it was not the SDI that was fouling the cartridge filter as the SDI was below 3. However, the fouling was from the microbial growth due to algae blooms in the lake. The microbial growth had to be stopped in order to increase the life of the cartridge filters. It was recommended that sodium hyprochlorite be added in front of the MF units to maintain free chlorine residue in the filtrate tank. Further, we wanted to utilize the residual chlorine in the cartridge filter to prevent the microbial growth. Therefore it was decided to move the sodium bisulfite dosing downstream of the cartridge filter. In other words, the system-engineered design was changed. These changes resulted in the run length of the cartridge filter increasing from one week to five months. These steps helped to mitigate the problems associated with algae formation on the cartridge filter.

Indirect Savings

The utility power plant deploys a Powdex condensate polishing system (three vessels per unit) for handling the condensate. These systems are installed to meet stringent boiler feed water requirements, to improve the reliability of production, and to increase the efficiency of the power plant. Prior to installation of Pall's integrated system, the conductivity from the condensate system to the boilers was elevated, possibly due to high total organic carbon content. These precoatable filters were precoated at a very high frequency – once a day. Since it costs approximately $850/pre-coat, the plant was spending $1100/day for pre-coating work for the two polishing units during operating times and start-ups.

Since the operation of the integrated system commenced, the frequency of the pre-coating has decreased from once a day to once a week. The double-membrane (MF/RO) IMS system was effective in reducing total organic carbon content to very low levels in the condensate, and this had an immediate positive impact on the performance of the condensate polishing system. The total precoat cost decreased, contributing to substantial savings of approximately $250,000/yr. These savings were in addition to the $1.2 million/yr saved in chemical costs, as described earlier.

Return on Investment

The cost of the Pall Integrated System was approximately $1.2 million.

Savings from chemical costs from installation of system: $1.2 million/yr.

Savings from improved performance of polishing system: $250,000/yr.

Hence, total savings to the plant: $1.2 +$0.25 = **$1.45 million/yr.**

The return on investment was achieved in less than 10 months of operation.

Conclusions

1. Pall's integrated system resulted in considerable direct savings on chemical costs and improved ion exchange unit run times.

2. Considerable indirect savings were achieved by reducing the frequency of pre-coat operation in the condensate polishing system. Also included in these costs was the average lifespan of the precoatable elements. Changing elements every two years may extend to five years.

3. Challenges associated with the plugging of the RO pre-filters in summer were overcome with an innovative technical solution.

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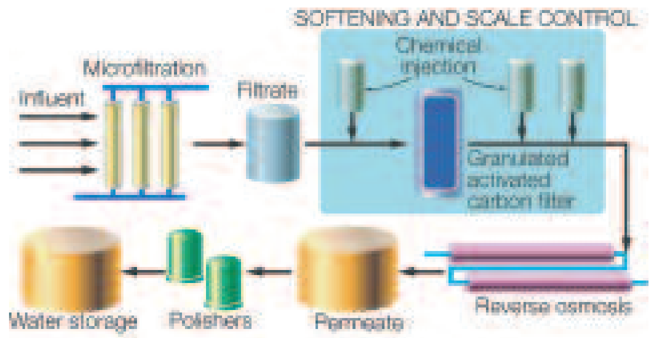
PGMFROSTR June 2009

Power Generation

2004 A Burbank: Link power, wastewater treatment to conserve potable water, reduce cost

COMBINED CYCLE JOURNAL, First Quarter 2004 Reprinted with permission.

To conserve potable water, California's Water Resources Control Board requires powerplant developers to use what it calls treated reclaim water for cooling-tower makeup or to install air-cooled condensers as an alternative to wet towers. While some developers might consider this restrictive, it's business as usual for Burbank Water & Power which first began using treated wastewater for cooling-tower makeup 35 years ago.



Microfiltration is first step in Burbank's water treatment system, followed by softening, reverse osmosis, polishing

Innovation never stops at Burbank, however. In June 2002, the utility unveiled a treatment system that converts tertiary-treated municipal wastewater into high-quality demineralized water for power augmentation in its new LM6000 gas turbine (GE Power Systems, Atlanta, GA) and for makeup for two existing boilers. This system enables Burbank to operate its generating facilities without using any potable water from the city.

The new gas turbine was installed at the utility's Olive plant in spring 2002. It is equipped with the manufacturer's Sprint+ option which permits water injection to cool compression stages and thereby increase the machine's power output by about 9% at ISO conditions and by more than 20% when ambient temperature is above 90°F. The Mark 6 control system supplied with the LM6000 regulates water injection to maintain the optimum temperature for maximum compression.

Bear in mind that ultrapure water is critical for compression augmentation and for the unit's inlet fogging system. It must be free of all solid contaminants and of dissolved metallic and silica salts. Reason: Impurities will plate on turbine blades, causing efficiency loss, and contribute to erosion and corrosion of nozzles and blades, which can result in premature replacement. Water-quality specifications for gas-turbine applications often surpass those for steam-plant condensate systems. Power Supply Manager Dennis Moran says that injection of demineralized water into the compressor is the least-cost way of generating additional power at Olive, given the site's tight spacing and other considerations.

Executives at the nation's public utilities are particularly sensitive to the reliability and cost of energy services because their retail customers, in effect, own the company and they typically have little tolerance for price increases. So when Burbank began planning a water treatment system for the LM6000 it focused on an influent flexible system—one that could operate on reclaim as well as potable water without modification—and placed a high priority on cost containment.

The treatment system selected yields a product water that has 10 times the purity of makeup water the plant was buying for its steam units before the LM6000 was installed. Puretec Inc., Ventura, Calif, the primary contractor for the project, owns, operates, and maintains the treatment system for Burbank. *Con't*

Treatment begins with microfiltration. An Aria™ MF unit from Pall Corp, East Hills, NY, eliminates all solid contaminants above 0.1 micron in size. MF effluent is essentially free of solids, colloidal silica, and bacteria. It is piped to a temporary storage tank with sufficient volume to permit operation of the RO unit and polishing demineralizers at peak efficiency while the Pall filter undergoes periodic self-cleaning. Next step is chemical treatment for softening and to prevent scaling, and flow through a granulated activated carbon filter to remove residual chlorine. The resultant filtrate, with an average total dissolved solids (TDS) of 650 ppm, is piped to the suction inlet of Puretec's E-frame, dual-pass RO skid. It reduces the mineral and salt load in the influent by 99%, yielding a product effluent with 1.5 ppm TDS. Permeate is piped to a 120,000-gal tank for storage and degasification. On demand, the RO permeate is pumped from the storage tank through a set of mixed-bed polishing demineralizers to remove any remaining ionic material. CCJ

Pall's Aria Membrane Water Treatment System.

About Pall Aria™ Membrane Water Treatment System

Pall Aria microfiltration (MF) systems provide consistent high purity water for plant make-up and feed to RO systems for a wide range of influent water sources and water quality. Used extensively around the world, Pall Aria Systems satisfy any and all water requirements including the ability to produce boiler quality feedwater as well as drinking water that meets today's stringent standards. Pall Aria Systems are influent flexible, meaning they can take influent of up to 1000 NTUs and consistently produce effluent of less than 0.05 NTUs in a single pass.

Pall Aria Systems use uniquely designed filtration modules in a hollow fiber configuration to remove fine particulates, bacteria, cysts and oocysts. Iron and magnesium can be removed by pre-oxidation, and total organic carbon can be reduced by direct coagulation. The hollow fibers are highly permeable membranes resulting in high water flux rates.

Metals, biological contaminants and bacteria in RO feedwater can quickly escalate operating and maintenance costs. Designed for ease of operation, Pall Aria Systems consistently provide a reliable quality feed to RO systems. Pall Aria Systems are complete turnkey solutions to treat water flows from 75 to 875 GPM. They can be easily installed and require little space and maintenance. When real estate is of concern, Pall Aria Systems handle more than three times the flow of conventional systems per square foot of floor space. Additionally, the capitalized water treatment cost with a Pall Aria System is less than 50% per one thousand gallon basis of a typical clarifier.

Pall Aria Systems are fully automated to offer the technology, consistency, and ease of operation needed in today's pursuit for efficient, clean and reliable power production. Utilities worldwide look to Pall to provide an unsurpassed level of safety, quality, purity, and economic value.

Case Study

Power Generation

EnCana Keeps the Water Flowing with Pall

Cavalier Power Plant Deploys Pall Aria™ Microfiltration System to Treat Cooling Tower Blowdown Water and Provide Feed Water to RO Units

Overview

Headquartered in Calgary, EnCana Corporation is one of the largest oil and gas companies in the world.

Formed in 2002, the company is involved in operations in Alberta, British Columbia, Saskatchewan, the Rocky Mountains, Texas, and Nova Scotia. EnCana has received numerous awards for its environmental initiatives and is recognized on the Dow Jones Sustainability Index.

The Challenge: Quality Feed Water

In 2006, the Cavalier Power Plant found itself unable to provide enough quality feed water to its RO units. The inlet water had very high levels of sub-1µm particles as well as an immeasurable high SDI. The multimedia filters that were in place at the time were simply not capable of producing water of sufficient quality or quantity. The multimedia filters also required the addition of costly chemical coagulants.

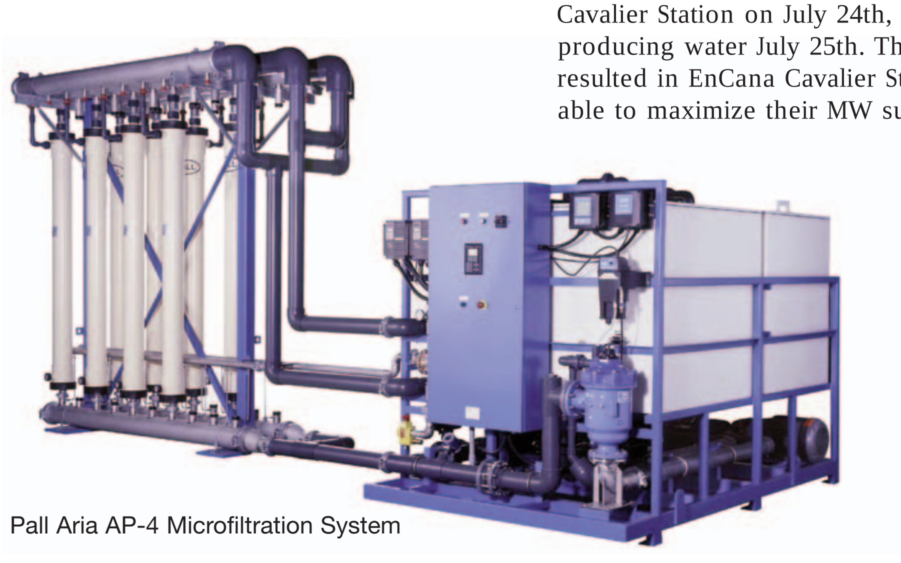
Experiencing rapid RO fouling and reduced water plant capacity, Cavalier was forced to resort to the expensive measure of trucking in DI water from another plant.

The Solution: Pall Aria™ AP-4 Microfiltration System

The level of small particles fouling the RO units, which could not be removed by the current filters, clearly indicated that a new technology was needed. After an extensive evaluation, Cavalier believed that MF/UF was the best solution, and reached out to Pall Corporation.

“Pall’s MF has a reputation for being tough and reliable,” says Brad Swainston, Water Treatment Plant Lead Operator, at EnCana’s Cavalier Power Station. “Also, Pall was most willing to accommodate us with a trial.”

Pall agreed to provide a Pall Aria AP-4 microfiltration system for a three-month trial period, guaranteeing < 3 SDI and < 1 NTU. If these parameters were not achieved, Pall agreed to refund all rental fees paid to that point, and to take back the AP-4. The unit was shipped from the Pall factory on July 14th, 2006, was commissioned at EnCana Cavalier Station on July 24th, and was producing water July 25th. This in turn, resulted in EnCana Cavalier Station being able to maximize their MW supply to the



Pall Aria AP-4 Microfiltration System

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grid, only one day after receiving shipment of the Pall AP4.

It wasn't long before the Pall units proved their value. As a testament to that, EnCana was so satisfied with the results at the Cavalier plant that a second AP-4 was ordered in October, 2006

"We use our Pall AP-4 microfilters extensively in the CT blowdown recovery system at the Cavalier Power Station," says Swainston. "The overall filtration capacity of our redundant AP-4 unit exceeds the filtered water requirements at our RO inlet by roughly a factor of 2 times. This extra filtration capacity has been used to filter a portion of the raw water make up to the cooling tower and also part of the cooling water itself. This process reduces the suspended solids loading on the cooling tower and in turn increases the efficiency of our CW chemistry."

The most important benefit of this system was that it rendered the original cooling water side stream multimedia filters obsolete. These units used an excessively high volume of water for their backwash, creating a lot of waste. Also these filters were not capable of removing fine solids (sub 10 micron), so Cavalier's cooling water solids loading was weighted heavily with fine particulate. "In essence," adds Swainston, "the AP-4 units have reduced cooling tower waste water quantity and increased cooling water quality."

The cost of water treatment for the 12 months prior to installing the Pall Aria system was \$.99/megawatt hour. Of that, \$.25/megawatt hour was spent on multimedia filter coagulant.

"The addition of the microfilters allowed us to discontinue the use of coagulant, enabling a \$.25/megawatt hour savings," reports Swainston. "We were also hauling sludge from our blowdown pit at a cost of \$10,000 to \$15,000 a month for trucking and disposal. Now we're able to haul sludge once a year for an additional savings of \$.25/megawatt hour."

"Since implementing the Pall Aria AP-4 systems, Cavalier's water plant has proved extremely reliable," concludes Swainston. "This, in-turn, has increased over-all plant reliability and availability.

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Case Study

Power Generation

Texas Plant Revamps its RO Pre-treatment with Pall Aria™ Microfiltration System

Introduction

Until 2002, a supercritical plant in Texas equipped with three 750MW Westinghouse steam turbines and CE tangential supercritical boilers, was using a clarifier for pre-treatment of cellulose acetate RO membranes to provide condensate make-up.

The Problem

The large clarifier exhibited signs of corrosion due to the acidic treatment of the water in the process. In addition, the quality of the water was deteriorating, and conductivity increased due to ferric sulfate and caustic addition. The plant also reported difficulty in stabilizing water chemistry: an average of 2 or 3 days to stabilize the system after a change in demand or influent chemistry.

The plant was experiencing an increase in the cost of chemicals (up to $50,000/year) to try to catch up with a failing and deteriorating system. Initial estimate of repair and upgrade to the clarifier system was $300,000.

The Solution

A Pall Aria™ automated microfiltration (MF) system was used to replace the entire pre-treatment train. The system treats raw water from the 77,000 acre lake nearby for use in the plant RO system.

The Pall Aria solution comprises two AP-4 systems totaling 600gpm capacity. Both units are controlled from a single PLC and maintain consistent water effluent to the RO system, without chemical treatment. Water quality is maintained at 0.04 NTU.

Since installation in February 2002, the Aria system has been providing high purity water with minimum intervention and greater degree of flexibility to the plant.

Pall AP-4 Aria microfiltration system to treat 300 gpm (total output for 2 AP-4 is 600 gpm to the plant)

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The Benefits

- A consistent water quality of 0.04 NTU out of the Aria system, for a wide range of upstream water conditions
- At least 6 months operation between CIP (clean in place)
- The ability to change flow on demand from the PLC without major adjustment
- Reduction of the maintenance required for the pre-treatment process by a factor of 6
- Extension of the service life of the filter element upstream of RO, from 3 days to over 6 months.
- A great reduction in space needed for water treatment (by over 60%)
- 6-month Return on Investment
- Reduced man hours by 100,000 hours
- Chemical reduction of $50,000 per year
- Savings of $250,000 per year, previously spent on filter media for clarifier
- 3 years with 0 hours downtime
- Savings of $2000 per month, previously spent on Polymer addition
- First year savings of $500,000

PALL Power Generation

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PGCS4

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Case Study

Pall Generates Cost Savings for the 2007 Coal Plant of the Year

Westar Energy's Lawrence Plant Deploys Pall Aria™ Microfiltration System to Treat River Water

Overview

Westar Energy is the largest electric energy provider in Kansas, delivering reliable power to more than 675,000 customers.

Sitting on 600 acres in the northern edge of town, Westar's 69-year-old Lawrence, Kansas plant was recently named 2007 Coal Plant of the Year by the PRB Coal User's Group.

The Challenge: Reduce Water Expenses

Prior to 2007, the Lawrence Power Plant was relying on city water as its makeup water source. For the years 2004-2006, the plant spent almost $625,000 on water, about 87% of which was for city water.

The plant was relying on sand filters and clarifiers, but was not getting the results it needed.

The Solution: Pall Aria™ AP-4 Microfiltration System

The Lawrence plant had a five-year contract with a company to provide sand filtration, but the plant struggled to get the purity it needed. In fact, the plant was never able to realize consistent reliability. When the contract expired in late 2006, the plant installed a Pall Aria AP-4 microfiltration system.

Designed specifically to treat surface water like the water the plant was pulling from the Kansas River, the system performed very well. After incorporating a clean water flush before every shutdown, the plant has enjoyed excellent reliability. Currently, the Pall Aria system is providing high purity water with minimum intervention and greater degree of flexibility to the plant.

Westar Energy's Lawrence Plant

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"We run for five days and shut down for two days, and we flush the membranes with city water each time we shut down," says Vince Avila, Plant Engineer at Lawrence. "The system has handled all the seasonal changes in the water and has performed very well."

According to Avila, the plant saved more than $77,000 on water in 2007 – a savings he expects the plant to realize on an annual basis. "Expensive city water used to be a staple," he says. "Now we've gotten it where it should be – as an emergency measure."

Westar Lawrence Plant Water Costs

Pre Pall Aria System Implementation

Year	City	River	Total
2004-2006	$180,788 (average per year)	$27,180 (average per year)	$207,968 (average per year)

Post Pall Aria System Implementation

Year	City	River	Total
2007	$84,846	$45,492	$130,338

The Pall Aria system helped the Lawrence plant save more than $77,000 on water in 2007.

Pall Aria System Weathers the Storm

In May of 2007, the Pall Aria MF system was put to a test that neither the Lawrence plant nor Pall could have anticipated; heavy rain from an already deadly storm system caused severe flooding of the Kansas River.

The plant, which was now taking almost all of its water from the river, saw turbidity, normally in the 25-30 range, average 470 NTU for the entire month, with turbidity spikes reaching 2,200 NTU. The Pall Aria system proved to be up to the challenge; incredibly, the plant did not need to switch to city water one single time.

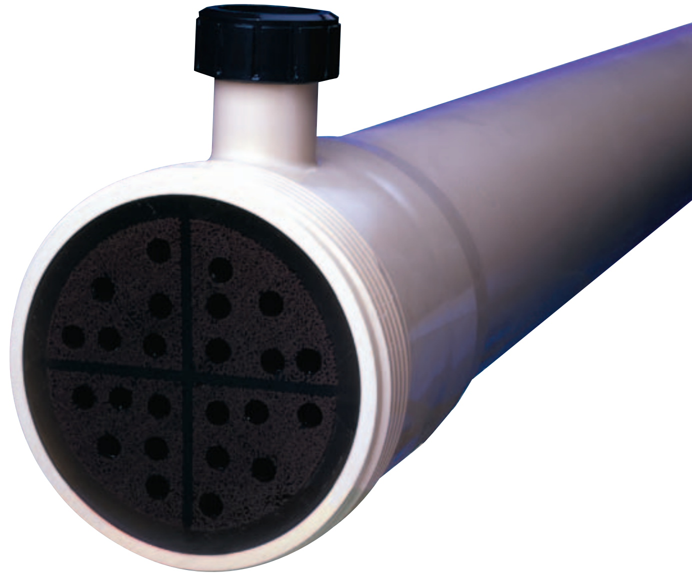
"Every piece of debris from the banks ended up in the river," says Vince Avila. "We wouldn't have been surprised if the system ground to a halt. But it stayed in operation the entire time."

"Every piece of debris from the banks ended up in the river. We wouldn't have been surprised if the Pall Aria system had ground to a halt. But it stayed in operation the entire time."

Vince Avila, Plant Engineer

In addition to its ruggedness, the plant is also impressed with the user-friendly nature of the Pall unit; since there are only two lab techs on staff for the entire plant, it was critical that the solution save man-hours.

"The system has performed very well for us," concludes Avila. "We take a set of readings in the morning, and if everything is OK, the system requires very little interaction."



Pall Power Generation

A Leader in Fluid Purification Technologies for the Power Generation Industry

Pall advanced filtration and separation science and high-quality manufacturing are applied on all fluids throughout the power plant to improve reliability and ensure available and profitable power.

With stringent treatment regulations and a growing demand for safer water, treatment systems must ensure strict compliance with purity standards. Filtration is critical to the success of your water treatment system in meeting purity goals, and traditional filtration methods such as sand and granular mixed media are often inefficient, labor-intensive, and costly.

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system. The Pall Aria line of water treatment systems uses hollow-fiber microfiltration or ultrafiltration membrane technology to produce pure water from any water source, delivering a consistent, high-quality water source for as much as 50% less than the cost of purchased water.

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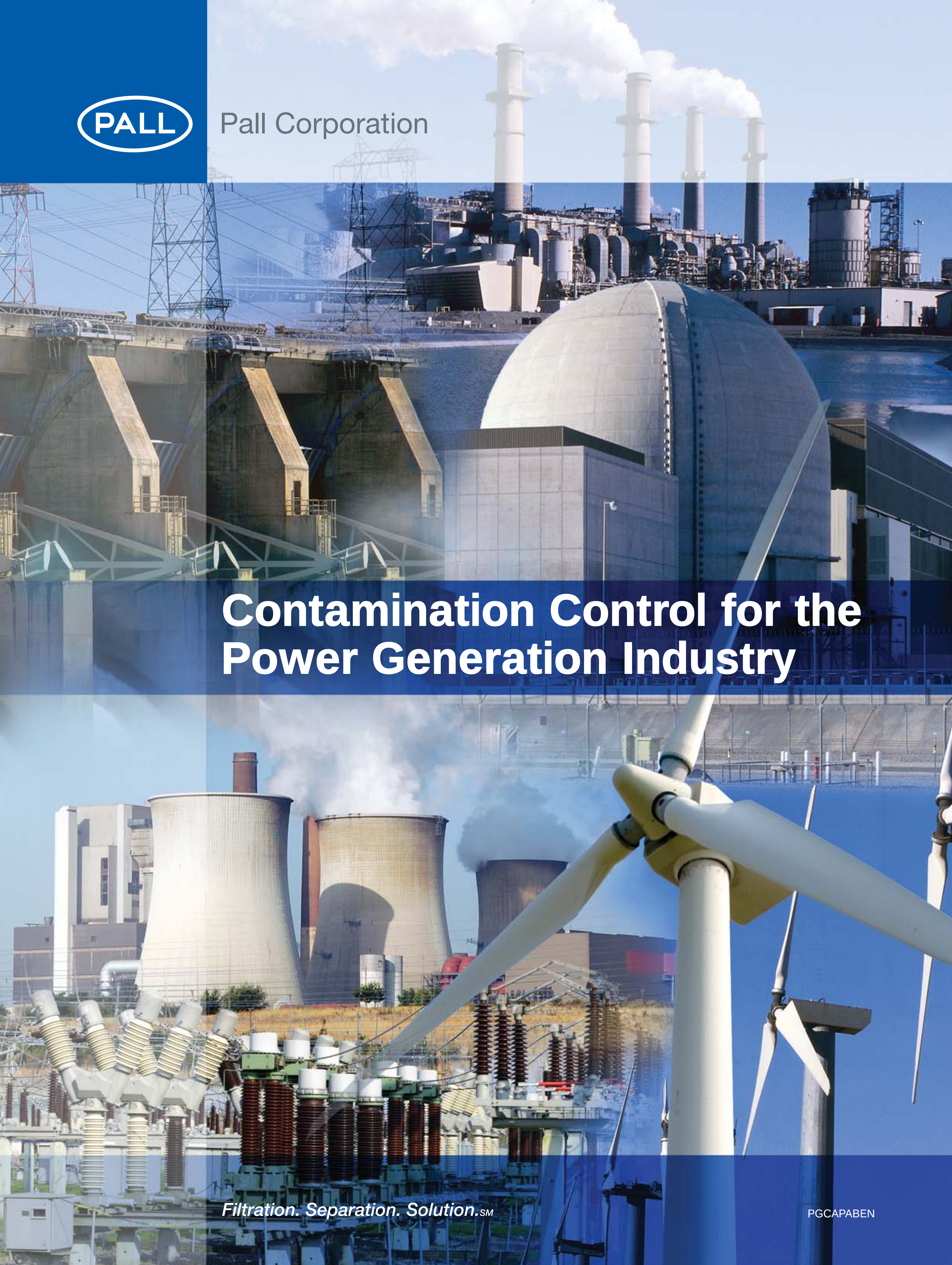
Filtration. Separation. Solution.SM



Pall Corporation

Contamination Control for the Power Generation Industry

*Filtration. Separation. Solution.*SM

PGCAPABEN

Introduction to Pall Power Generation

Pall - Your integrated partner in Power Generation

Pall Corporation is a global company solving complex contamination, separation and purification problems.

Pall's Power Generation Group is part of Pall Energy Division and as such serves the power generation market around the world. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment.

The power generation industry trusts Pall as a solution provider

Pall is a worldwide leader in fluid purification technologies for the power generation industry. Pall advanced separation science and high quality manufacturing are applied on all fluids throughout the power plant to ensure cleaner, safer, more reliable power with higher profitability.

Pall can solve your purification challenges in any size of application, from small flows and simple installations to large flows and complex systems, from the supply of filter elements to fully-integrated turnkey systems.

Benefit from Pall's expertize and customized services

Pall is much more than a filter company. Pall specializes in fluid management, leveraging our unmatched capabilities to make your operation more successful. Our expertize has enabled us to build a large library of proprietary core materials, which we can modify to separate, remove, or selectively capture the most elusive contaminants.

Total Fluid Management℠

Pall has the ability to design, manufacture, and install economical, integrated systems as well as service them. Pall's Total Fluid Management (TFM) program for power generation plants help plant operators and engineers manage, control and monitor plant water, fuels and oil resources. This approach results in a reduction in total operating costs associated with fluids, operation and maintenance on critical components. Combining products with consulting services, commissioning and flushing assistance, Pall is the ideal partner for the power generation industry.

'Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment'

Contamination Control

Why is it so important to take care of fluid cleanliness?

Solid, liquid and dissolved contaminants present in liquids and gases will cause operating and maintenance problems on power production assets like boilers, turbines or transformers.

Left unchecked, these contaminants increase O&M costs, decrease thermal efficiency and output, and threaten environmental compliance of power plants.

Such issues can be solved by the use of highly effective, reliable and correctly applied filtration and separations technologies.

Applications:

Fossil Generation

Power plants around the world choose Pall to ensure the quality of their condensate water, the purity of their lubrication oil and the reliability of turbine control system operation. Pall products reduce downtime with unsurpassed flushing and oil treatment capabilities, technologies and on-site assistance. Pall water treatment systems also control and maintain make-up water and waste stream purity.

Nuclear Generation

Pall filtration systems help nuclear plants of all reactor types to maintain low levels of radioactive contamination throughout the water cycle. Pall filters reduce costs and maximize output by protecting the NSSS system, filtering the reactor pool and polishing condensate water:

- Less downtime
- Lower chemical usage
- Improved safety
- Optimal operating efficiency

Renewable Energy

Pall technology takes part in the development of renewable energy sources. From the filtration of hydroelectric turbine control and lubrication oil to the protection of windmill gearboxes or the purification of biomass gases, Pall employs state of the art technology to ensure that greener is always cleaner.

Transmission and Distribution

Energy availability also depends on a reliable and efficient grid. Pall products protect the critical purity of insulating oils. Pall online purifiers allow the online/onload treatment of transformer oil and insulation, dramatically reducing maintenance and downtime costs. By controlling water and fine particulate matter, Pall® Ultipor® WG filters protect LTC contacts, prevent OCB oil degradation and extend maintenance intervals.

‘Let Pall help you optimize the performance of your generating equipment by improving fluids contamination control!’

Fossil Fuel Generation

Fuel Treatment Systems

With unmatched experience in the oil and gas industry worldwide, Pall brings complete solutions to the treatment of liquid and gas fuel for power plants. Combination of particulate filtration and high efficiency coalescence provide a fuel quality that meets the most stringent specifications of new generation combustion systems. The efficiency of Pall liquid/liquid and liquid/gas coalescers is only matched by their ease of use, low maintenance and long life.

Process Water Management

Water Supply Systems

Pall filters and membrane systems combine into a complete water treatment chain to ensure consistent, uninterrupted process water with minimal chemical usage, optimum quality and an unmatched ease of use and service. With microfiltration, ultrafiltration, reverse osmosis or filter cartridges, Pall offers the widest range of water filtration products.

Condensate Water

Boilers and turbines are protected by Pall condensate filtration systems, either in backwash or disposable configuration. For any system pressure of flowrate, Pall combines media science and system engineering expertize to offer the best protection against corrosion transport.

Pall HGCOld and HGPPB backwash systems offer:

- Engineering expertize to ensure long, economical operation, in demin-precoat or straight filtration mode
- Variety of media ranges and materials to adapt to any condensate flow conditions

Pall Ultipleat® High Flow disposable filters offer:

- Small footprint even for full flow installation
- Proprietary crescent shaped pleat geometry
- High efficiency, high flux filtration at ratings from 100 to 1 micron
- Simple element replacement

'high efficiency filtration, purer fuel, reduced pollutant emissions, low energy consumption, protection from erosive and corrosive wear, with minimal maintenance.'

Hot Gas Filtration

Pall has the full complement of fluid management products for hot gas filtration for the latest combustion technologies including ceramics for biomass and coal gasification, plus products that reduce pollutant emissions driving the movement towards efficient, clean and low cost energy.

Steam Turbines

Lubrication

Pall's full range of oil filtration and oil purification products combine to provide the best possible protection of the bearings and shaft against wear and corrosion. By efficiently and economically removing moisture, particles and gases from lubricating oils, Pall products ensure that critical machinery is protected and that the oil remains in pristine condition.

Hydrogen Seal Oil

The task of protecting seals from abrasive wear, and preventing water from ingressing into the generator falls on the turbine lubrication oil control system. The solid and moisture protection from the Pall TLC helps maintain hydrogen purity and minimize maintenance on the seals.

Control

The hydraulic systems controlling the steam valves are some of the most sensitive and critical components around the steam turbine. Pall products combine filtration, dehydration and ion exchange to protect and even reclaim hydraulic fluids, whether mineral or synthetic. With proper filtration and fluid treatment, critical valves are protected against stiction and erosive wear, and hydraulic fluids are protected against thermal degradation or acid formation.

Nuclear Power

‘Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.’

State-of-the-art media design, application experience and unsurpassed removal efficiencies have made Pall the world standard in nuclear safety, control, radioactive waste treatment and fuel pool clean-up. Pall products shorten outages, increase operating efficiency and minimize exposure with the backing of expert customer support worldwide.

Fine Ratings Programs

For many years, Pall filtration systems have been used in the most sensitive nuclear applications of PWR coolant systems. Today, the cleanest plants use Pall nuclear grade filters to reduce the out of core radiation levels and reduce overall personnel exposure. The fine ratings program is a step by step reduction of filtration level down to 0.1 micron in order to decontaminate the coolant systems progressively, ensuring better operation, easier maintenance and reduced exposure.

Media

Pall provides innovative disposable and back-washable media in a wide range of micron removal ratings, developed, designed and manufactured under the strictest quality controls for exceptional performance, reliability, and consistency.

Elements

Pall’s disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radioactive waste, fewer change outs and added protection for equipment and personnel.

CVCS and Coolant Pump Seals

Pall Ultipor GF Plus media is positively charged and rated down to 0.1 micron. These rapidly remove radioactive material and provide the highest level of safety in the primary loop.

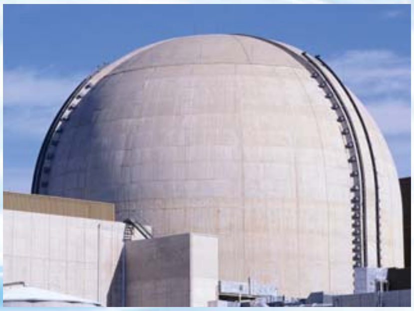
Pall Ultipor GF Plus elements filters the cooling water, protecting against seal wear and plant exposure with unsurpassed integrity, efficiency and durability. Pall filters provide the best way to reduce out of core radiation, personnel exposure and costs.

By removing minute solid particles, Pall Ultipor GF Plus filters are also used to protect the seals of the main coolant pumps. Reduction in abrasive wear of the seal, shown by a drastic reduction in leak rates, ensure longer life and lower seal replacement costs.

Nuclear Condensate Systems

Pall backwashable condensate filtration systems are an industry standard for BWR protection. In precoatable or straight filtration mode, Pall elements combine very high efficiency with strong integrity and durability. Backed by unmatched system design and operation expertize, Pall filters are the most effective way to maintain feed water purity, reduce ion resin consumption and protect the steam generators.

Pall traps and laterals protection feature an all-metallic porous media combining a very high void volume with high mechanical and thermal resistance up to 600F. With removal levels from 400 down to 18 micron, the Pall Rigimesh® line offers the best protection against resin leakage and fouling.



Renewable Energy

Hydroelectric Power

Clean hydroelectric generation depends greatly on the reliability, availability and response of the turbine control mechanisms and lubrication systems. By ensuring that the lubricating and hydraulic oils are maintained in pristine condition, Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs. Combined with Pall analysis capability and monitoring equipment, they form the ultimate protection against component related outages, high oil replacement costs and sluggish system response.

The combination of fine particle control and efficient moisture removal protects the oil films and the components. By consistently maintaining oil cleanliness lower than a ISO 16/14/12 life of roller or journal bearings can be drastically extended.

Filtration and Moisture Control - A Total Fluid Management solution

Pall Ultipleat SRT filters are especially designed to remove clearance size particles known to cause fatigue wear of the bearings, abrasive wear of the governor control valves and fluid degradation. With superior resistance to cyclic flows and no electrostatic discharge, the Pall Ultipleat SRT filter performs at its peak under the toughest of conditions.

When moisture is kept well under the saturation level of the oil, the process of oil oxidation can be stopped and with it, corrosion in the lube and control system. In hydroelectric plants, Pall purifiers and air dessicant breathers maintain moisture levels under 30%RH, and protect lubrication and hydraulic fluids against water ingression.

'Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs.'

Wind Power

Gearbox Protection

When the gearbox faces variable loads, and operates in vibrating and extreme environments, it needs to be protected by a filtration system able to deliver specified cleanliness under stress conditions, at all times, consistently, and reliably. Pall wind turbine lube filtration systems combine design simplicity, ease of service, light weight with the performance of Ultipleat SRT technology.

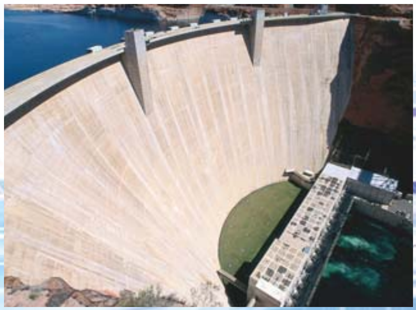
To ensure total cleanliness control, oil is protected against water or dirt ingression by Pall breathers, and its quality can be remotely monitored with Pall moisture and particle sensors.

Remote Monitoring of Oil Condition

The ability to detect oil quality problems early is a critical step in ensuring viability of remote windfarms. Oil contamination can be a strong indicator of component wear, its detection is the key for switching from reactive to predictive maintenance practices. With Pall capability for remote particle and moisture sensing equipment, wind turbines are never left alone, as far as they may be.

Biomass

Pall ceramics and metallic filter technologies are used to purify combustible gas in hot and chemically challenging environments such as in gasification processes and protect burners and turbines downstream. With advanced design capabilities for large blowback gas filter systems, Pall participates actively in the development of renewable combustible sources.



Pall Technology Services

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation technologies and services into a production process to yield the highest efficiency at the lowest cost. The Pall TFM program covers a wide range of filtration products, advanced technologies and services to improve system operation and increase productivity.

Our global team of scientists and engineers support TFM

Pall offers a variety of services to help you maximize productivity within your plant. We deliver TFM to you with the support of our global teams of Scientific and Laboratory Services (SLS). Located in more than 30 countries, our scientists and engineers provide these services locally, with broad-based assistance from Pall's worldwide technical support network. Our experts work directly with you to determine how Pall products and technologies can benefit your process.


Consultancy


Servicing


Flushing Services


Filtration Equipment Hire

Our customized system services include:

Commissioning and Flushing

Pall has the most extensive network of distributors and customer service centers in the world. Pall provides flushing, monitoring and consulting during plant overhaul, turbine start-up or system flushes worldwide. With Pall products, monitoring equipment and field expertize, our start-up assistance programs enable users to get back on-line faster, cheaper and more efficiently to maximize output, flexibility and operating profits.

Cleanliness Audit

A cleanliness audit can uncover contamination problems and their detrimental effects. Our laboratory staff and field engineers have at your disposal lab-scale and analytical equipment and field pilot-scale units. By sampling at various locations throughout the process, we collect, quantify and identify solid and liquid contaminants to determine their origin and provide you with recommendations for corrective action. Our recommendations are designed to help you optimize your processes and increase the reliability of your equipment at the lowest possible cost.

Process Audits / Consultancy

Pall offers troubleshooting, audit and consulting services to identify opportunities for process improvements that lead to increased productivity. Improvements are defined, for instance, as the reduction of operating costs or maintenance operations. An audit involves data collection and proposal review, followed by a technical report documenting the findings and suggestions for improvement.

Filtration Equipment Rental

When you need to rent filtration and purification equipment to conduct spot depollution of system fluids, to conduct large-scale pilot testing or to use while permanent equipment is being manufactured, contact Pall. Our rental services can provide equipment on the spot, so that you can handle upsets promptly.

Combustion Turbines and Combined Cycle

In all aspects of the operation of a combined cycle plant, Pall employs state-of-the-art technology to ensure a consistently high quality supply of water, fuels and lubricating oil to the machines. With gas treatment solutions to reduce emissions and environmental impact, Pall is the complete partner for CCPP operators looking to improve operation, save on fuel and water costs and improve system reliability and availability.

Fuels

Pall's expertize in liquid and gas fuel treatment ensures that combustion turbines are constantly protected from the mechanical and chemical attacks due to fuel impurities. Pall fuel treatment solution combines very efficient particulate filtration with coalescence to remove moisture or aerosols in the fuels. The result is a drastic reduction in the presence of solids, gels, water and salts in the fuels entering the combustion chamber.

Pall is also an expert in the treatment of alternative fuels and is an industry standard for coal and biomass gasification systems, with a range of ceramic and metallic filtration systems. With unmatched experience in materials and system designs, Pall hot gas filtration systems are at the core of some of the newest and most promising power generation designs.

Liquid / Liquid and Liquid / Gas Coalescers

Oil Mist Eliminator

Machine Protection

Whether industrial or aeroderivatives, combustion turbines are protected by Pall oil filters in the lubrication and control systems. By stopping the chain reaction of wear in rolling or journal bearings of the turbine, Pall filters protect the machine against downtime, repairs and bearing wear.

Pall oil mist eliminators reduce emissions of oil vapour to the atmosphere using Pall liquid / gas coalescers. Their efficiency and low resistance to flow means that the system reservoirs can breathe without restriction and with no detectable oil emissions into the plant.

Water Systems

In combined cycle plants, the availability and quality of water is critical for both the heat recovery boilers and the combustion turbine itself. Pall membrane systems ensure consistently pristine water meeting the most stringent purity requirements of new generation combustion turbines and high pressure boilers. With a wide range of ultra and microfiltration membranes, reverse osmosis, cartridge filtration and polishing systems, Pall brings the complete water management solution to combined cycle plants. The result is a cleaner combustion, better operation of Nox control systems, protection of the boiler against corrosion and FAC and reduced water usage overall.

Pall Aria System

Ultipleat High Flow Particulate Filters

Technologies For Contamination Control And Monitoring

Pall filtration and separation technology

Pall designs and supplies a wide range of media, filters, and systems to remove contaminants from liquids and gases.

These products, along with our service capabilities and technical expertize, enable us to fulfill diverse fluid purification requirements throughout all power generation processes.

Ultipleat High Flow/Coreless Filter Elements

Particulate Filtration for Liquids and Gases

Pall designs, manufactures and markets the widest range of solid contamination control products anywhere. Pall filters can remove minute solid particles from liquid or gas streams, across a wide range of temperature, pressure, and chemical conditions. These particulate filters can be made of glass fibres, polymers, metals or ceramics. With various shapes, sizes and micron ratings, they offer economic, efficient and durable contamination control in some of the most critical applications in power plants.

HNP006 Oil Purifier

Coalescence and Dehydration

Removal of moisture and aerosols from oils or fuels is paramount in order to protect machines like combustors or bearings. Moisture and aerosols carry chemical and solid contaminants responsible for deposits, chemical attacks or fluid degradation. Results can be devastating outages and high maintenance costs. Pall coalescers and oil purifiers have what it takes to remove unwanted contaminants from hydrocarbons, down to their solubility levels, and even beyond. Combustion chambers, injectors, bearings or seals all benefit from complete removal of moisture contaminants from fuels and oils.

Membrane Technologies

Membrane Technologies are by far the most effective methods for water processing applications. The Pall range of membrane systems includes microfiltration, ultrafiltration and reverse osmosis membrane technology. Pall Aria™ water treatment systems for example use hollow fiber microfiltration membranes to produce pure water from any water source. They remove bacteria, iron, manganese, arsenic, and other solid particulate to deliver water that consistently measures up to the toughest cleanliness and quality standards.

Pall membranes are used for production of make-up water, recycling of blowdowns and wastewater, as well as water fed protection for combustion turbines.

Contamination Monitoring

Solid Contamination Monitors

Obtaining accurate and reliable fluid cleanliness data quickly in order to detect abnormal contamination is a key factor in ensuring the efficiency of industrial processes and reducing downtime.

Reliable monitoring solutions ...whatever the conditions ...whatever the fluid

Pall have portable devices that resolve detection problems by giving plant operators the ability to measure the cleanliness of even the most troublesome fluids reliably, simply, and quickly, and prevent unnecessary and costly machinery downtime.

The Pall PCM400W Cleanliness Monitor can confirm cleanliness of almost every kind of system fluid.

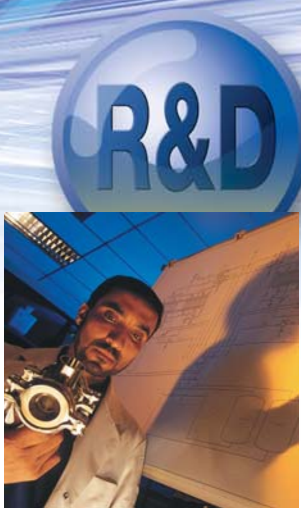
The Pall PCM400W uses multiple mesh blockage technology to address the common problem of inaccurate or unreliable results when monitoring fluids that are dark, cloudy, or contaminated by water or air. Additionally it can read fluid temperature and saturated water content (when appropriate).

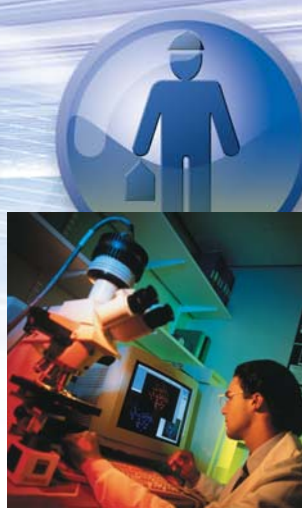
PCM400W

Pall Water Sensors

Wherever possible, oils should be operated without the presence of free or emulsified water.

Pall Water Sensors detect water in solution within the fluid, displayed as a percentage saturation or expressed as a parts per million (PPM) reading. Options include the handheld unit for a 'point-in-time' reading or the permanent unit which can provide continuous or timed monitoring.





Research and Development

Working with equipment and component manufacturers in these markets, Pall custom designs products and purification systems that are fully integrated into oil and gas industry applications.

These products extend component service life, enhance safety and improve the operating reliability of all processing systems.

Scientific and Laboratory Services

A principal element in Pall's customer support operations is our Scientific and Laboratory Services (SLS) Department. Filtration problems arising in the field can be assessed and simulated in the laboratory. Close monitoring by Pall scientists can determine the engineered solution to your contamination and separation problems and advise accordingly.

Sales and Support

The sales and support team comprises a group of experienced specialists located in Europe, the USA and across Asia with distributors and representatives worldwide. We offer a comprehensive sales and service support to all customers around the world.

Quality

The policy of Pall is to design and manufacture products to the highest and most current standards of quality, safety and reliability. To implement this policy, the organisational structure and the procedures by which Pall operates are fully defined in quality management systems, approved to ISO 9001:2000

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Because of developments in technology these data or procedures may be subject to change. Consequently we advise users to review their continuing validity annually. Part numbers quoted above are protected by the Copyright of Pall Europe Limited.

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PALL Power Generation

Case Study

Filtering Feed Water Reduces Boiler Tube Failures

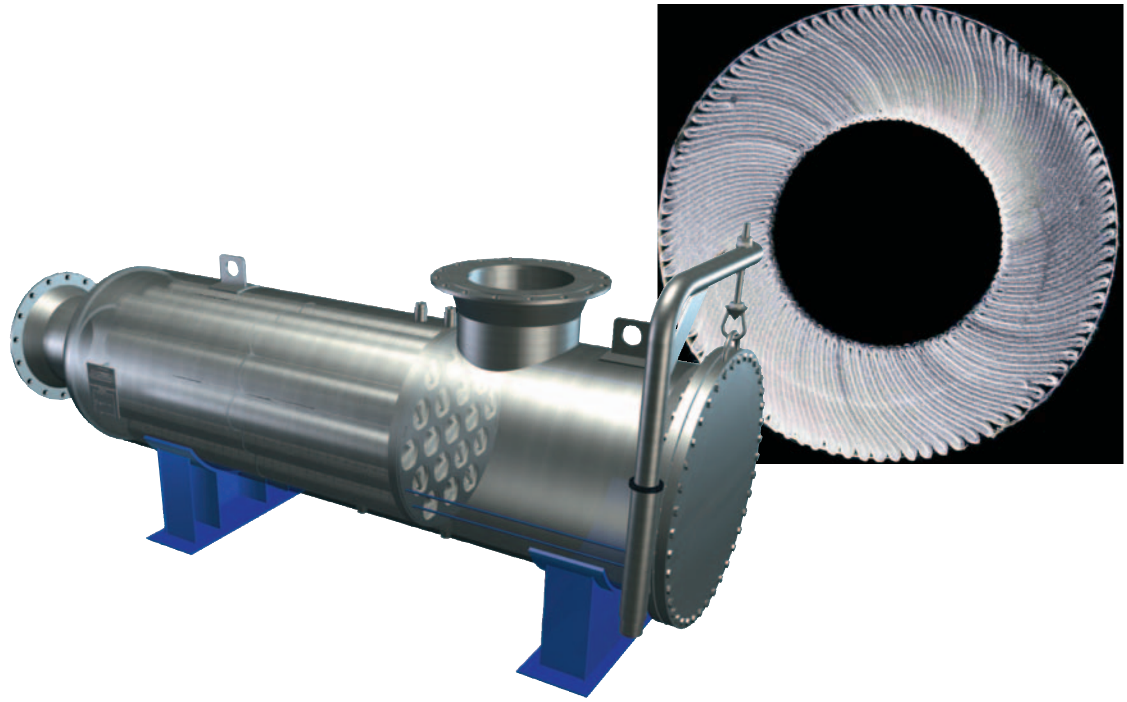
The Problem

During the 1990s, one unit of a two-unit drum type power plant in Colorado began suffering increased boiler water- wall tube failures due to hydrogen damage and under deposit corrosion from iron and copper components in the system. Under deposit corrosion is caused by concentrated contaminants building up on the boiler tube surface and eventually corroding and weakening the tube. This in turn results in large gouges, thinning of the tube, and eventual failure which can cause unplanned plant outages.

In 1996 the unit experienced ten tube failures. The ten unscheduled outages resulted in twenty days of lost generation revenue plus the expenses to repair the failed tubes. The station estimated total lost revenue of $3.5 million in 1996.

A systematic investigation of all parameters contributing to the tube failures was initiated. The results of the investigation identified condenser and economizer makeup to the boiler as the primary source of metallic contaminants contributing to under deposit corrosion.

The greatest amount of particulate metal oxide is transported to the boiler during unit startup. By reducing the metal transport to the boiler, the committee expected to reduce deposits, and subsequently reduce boiler related forced outages.



Pall Ultipleat® High Flow (UHF) filters control iron, silica, and copper in a small footprint designed for partial to full-flow filtration (up to 30,000 GPM).

*Filtration. Separation. Solution.*SM

The Solution

Pall Corporation supplied an Ultipleat High Flow filtration system to remove metals and other particulate from the water before they can be transported to the boiler during startup.

The solution was an assembly consisting of a 38″ diameter filter housing containing 19 Ultipleat High Flow filter cartridges. The system filters 100% of startup flow and provides β6=5,000 removal efficiency for particulates 6 microns and larger. High efficiency filtration is the key for the near total elimination of metal transport to the boiler.

Based on the success the plant had with the Pall Ultipleat High Flow installation, the plant installed an identical system in its other unit.

The Benefits

- No forced outages caused by boiler water wall tube failures since March of 2001
- Reduced boiler blow down
- Faster return to the grid after scheduled outages
- Increase in revenue generation for the plant
- Minimized copper deposition on turbine blades
- Reduced operating cost of makeup water system
- Reduced phosphate hideout, resulting in decreased chemical treatment costs

PALL® Power Generation

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*Filtration. Separation. Solution.*SM

PGCS2

PALL Power Generation

Pall Water Treatment Solutions for Power Generation

*Filtration. Separation. Solution.*SM

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Pall advanced filtration and separation science and high quality manufacturing are applied on all fluids throughout the power plant to improve reliability and ensure clean, available, and profitable power.

With stringent water treatment regulations and a growing demand for safer water, treatment systems must ensure strict compliance with purity standards. Filtration is critical to the success of your water treatment system in meeting purity goals, and traditional filtration methods such as sand and granular mixed media are often inefficient, labor intensive, and costly.

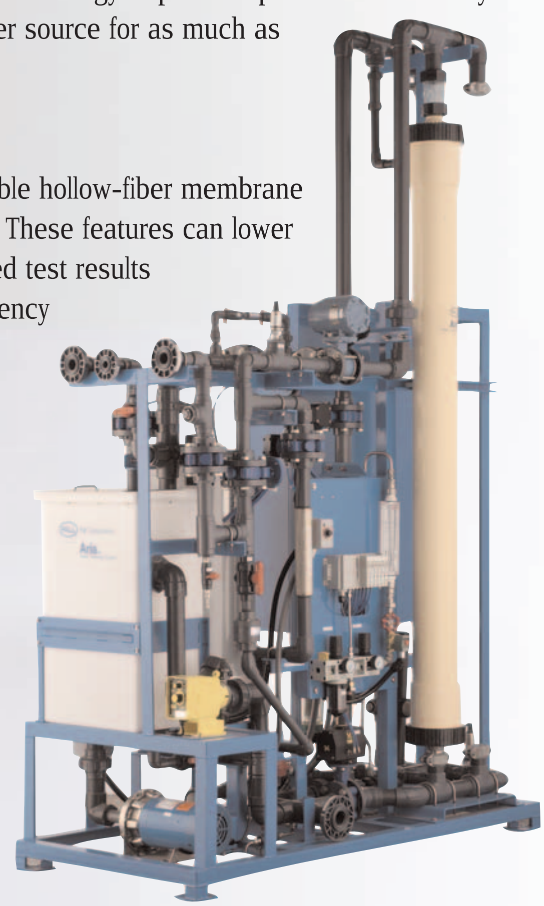
If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria™ Integrated MF/RO system. The Pall Aria line of water treatment systems uses hollow-fiber microfiltration or ultrafiltration membrane technology to produce pure water from any water source, delivering a consistent, high-quality water source for as much as 50% less than the cost of purchased water.

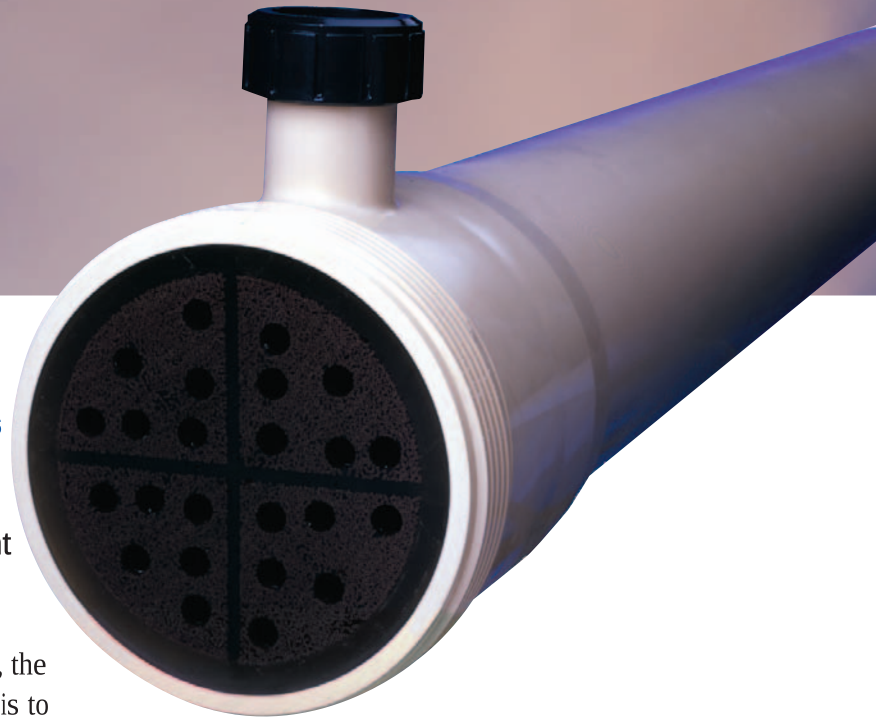
Cost-effective, efficient, and flexible

At the heart of the Pall Aria system is a highly permeable hollow-fiber membrane with high flow-per-unit area and a high recovery rate. These features can lower the cost of each gallon of water you treat. Documented test results and actual system performance demonstrate the efficiency of the membrane-based Pall Aria filtration system.

You can purchase the Pall Aria system for stand-alone use or for integration with your existing equipment. It's modular design offers flexibility and allows you to customize your system for your unique process application and integration requirements.

The Pall Aria system is offered as both a hollow-fiber MF system for pre-RO, or combined with Pall RO for a complete Pall Aria MF/RO package.





Pall Aria Water Treatment Systems for Plant Water Supply

Water – the most critical component for cost-effective power production

As water becomes increasingly scarce, the biggest issue facing power production is to secure high quality water supply in adequate quantity. New power technologies face an ever-increasing demand for ultra-pure water from alternative sources.

Conventional water treatment systems may not accommodate the strict quality requirements for peak operation of delicate RO membranes, nor are these systems flexible or scalable. Should water quality vary, conventional systems may take a long time to adjust. A pre-treatment system may look like the solution, but the majority of these systems require a lot of space and maintenance.

The Pall Aria System – Safe, reliable, economical, and efficient

The Pall Aria water treatment system is the best way to manage every aspect of water usage. Pall Aria systems are revolutionary turnkey systems designed to provide high-quality water exceeding even the most stringent requirements, from any water source, including: surface water, groundwater, reclaimed water, or secondary effluent.

The Pall Aria water treatment system purifies water for use in steam plant make-up water, gas turbine water supply, drinking water, and cooling tower blow-down. It has a small footprint and is so reliable it significantly reduces water supply costs.

Pall Aria water treatment systems are super-efficient, versatile, and tough:

- Influent Flexible – Pall Aria systems handle variations in water quality/flow rates without interruption
- Consistently provides maximum water quality with minimum intervention
- Reduces the need for chemical treatment prior to RO
- Reduces water supply costs through low chemical usage, low maintenance and small footprint
- Pall Aria systems can be monitored and controlled remotely

Designed to meet water management challenges in power generation, Pall Aria water treatment systems are an economical, flexible, and reliable solution for all your plant water needs.

Pall Aria for Make-Up Water

Pall Aria microfiltration (MF) systems provide consistent high purity water for plant make-up and feed to RO systems for a wide range of influent water sources and water quality. Used extensively around the world, Pall Aria Systems satisfy any and all water requirements including the ability to produce boiler quality feedwater as well as drinking water that meets today's stringent standards.

Pall Aria systems are influent flexible, meaning they can take influent of up to 500 NTUs and higher and consistently produce effluent of less than 0.05 NTUs in a single pass. Pall Aria systems use uniquely designed filtration modules in a hollow fiber configuration to remove fine particulates, bacteria, cysts and oocysts. Iron and manganese can be removed by pre-oxidation, and total organic carbon can be reduced by direct coagulation. The hollow fibers are highly permeable membranes resulting in high water flux rates.

Metals, biological contaminants and bacteria in RO feedwater can quickly escalate operating and maintenance costs. Designed for ease of operation, Pall Aria systems consistently provide a reliable quality feed to RO systems. The systems are complete turnkey solutions to treat water flows from 75 to 875 GPM. They can be easily installed and require little space and maintenance. When real estate is of concern, Pall Aria systems handle more than three times the flow of conventional systems per square foot of floor space. Additionally, the capitalized water treatment cost with a Pall Aria system is less than 50% per one thousand gallon basis of a typical clarifier.

Pall Aria Integrated MF/RO Systems

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system. Not only can the Pall Aria MF/RO system reduce your cost for purchased water, it can provide water that consistently meets critical water quality requirements while effectively protecting the environment.

Value

- Acquire a consistent, high-quality water source for as much as 50% less than the cost of purchased water.
- Decrease dependency on purchased water.
- Reduce wastewater discharge by as much as 80%.
- Reclaim a scarce water resource by using industrial clarified effluent.
- Increase operating profit by reusing an existing resource.
- Obtain a source of high-quality water for critical plant and utility use.

Is This an Opportunity for You?

- Do regulations require you to reuse water before your plant can undergo expansion?
- Do you have more than 100 gpm ($23m^3$/hr) of waste effluent that can be reclaimed?
- Do you need high-quality water for boilers and utility operations?
- Are you interested in significant operating cost savings?
- Is your present total water cost more than \$4.00 per 1000 gals (\$1.00/m^3)?
- Does your effluent have the following characteristics: TSS <100 mg/l, BOD <100 mg/l, FOG <20 mg/l, and TDS < 2,500 mg/l?

Why the Pall Aria Integrated MF/RO System?

- Assures consistent production of high quality water from a reclaimed source.
- Provides an integrity testable, positive barrier to TSS and microbial contaminants.
- Protects downstream processes such as electrodeionization (EDI).
- Delivers highly purified, low TDS water.

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

Pall Mobile Water Solutions

When facing source water problems, downtime from equipment malfunctions or emergencies, seasonal surges in consumption, or increased demand that exceeds system capacity, municipal and industrial water providers need a solution to rapidly increase production. If they're in the process of building a new facility, they might need a water treatment system to ensure a smooth transition while the old plant is being decommisissioned. Pall Corporation offers a solution that supplements or replaces your system on a permanent or temporary basis – "water treatment on wheels."

The Pall mobile water treatment system comprises a complete, automated, packaged Pall Aria microfiltration membrane system mounted in a 48´ or 53´ box trailer. With appropriate site preparation and minimal labor, the system can be operational within hours. All that is required is to supply the source water, connect the effluent pipe, and add 460 VAC 3-phase power.

Using the same state-of-the-art hollow fiber membranes as hundreds of installed Pall Aria systems worldwide, the mobile system transforms ground water, surface water, or secondary effluent into water that is free from harmful bacteria, cysts, and particles. More than one million gallons of water a day can be filtered, to 0.1µm at 90-97% efficiency, for drinking or industrial use.

The Pall Aria system's redundant racks are mounted on skids inside the trailer. Up to 40 microfiltration membrane modules are contained in each rack. The system has a flexible configuration and can be engineered to operate in tandem with other water treatment technologies, such as Pall mobile RO systems.

In addition to housing the system components, the trailer holds equipment to monitor system operation and ensure that the water meets the required quality specifications. Safety features include two exits with platforms and stairs, an eyewash station, interior and emergency lighting, and a glow-in-the-dark walkway.

Membrane Filtration for Safe Drinking Water

Pall Aria water treatment systems are specifically designed to produce drinking water that meets today's stringent standards. The systems use uniquely designed filtration modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources.

- Suspended Solids/Turbidity
- Viruses
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Organics

The Microza* hollow fiber membranes are highly permeable resulting in high water production rates. Each hollow-fiber module provides high active surface area of up to 538 ft^2. Pall's dedication to a simplified process and control design has produced a family of systems that are characterized by:

- Tough, long-service hollow-fiber membranes
- Operator-friendly controls
- Simple surface water treatment without coagulation
- Easily integrity tested modules
- Unique air scrub and flush operation
- High efficiency, low waste
- Excellent compatibility with chlorine and common treatment chemicals
- Minimal cost of operation
- Easy installation using modular skids
- Compact system footprint
- Full system NSF 61 listing
- ISO 9001-certified manufacturing
- ETV-certified for surface water treatment rule

* Microza is a trademark of Asahi Kasei Corporation

Site testing has confirmed that Pall Aria systems meet or exceed EPA standards for safe drinking water. The system is also the first to receive “full system” certification in accordance with ANSI/NSF 61 specifications.

From 20 million gallons a day for the City of Pittsburgh to local drinking water systems at power plants, Microza MF hollow fibers and Pall Aria systems deliver a safe, automated, and flexible drinking water supply.

Pall Corporation offers a broad range of financing and rental programs. Please contact your Pall representative for details.

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r e g e n e r a b l e

PMM® Filter Elements

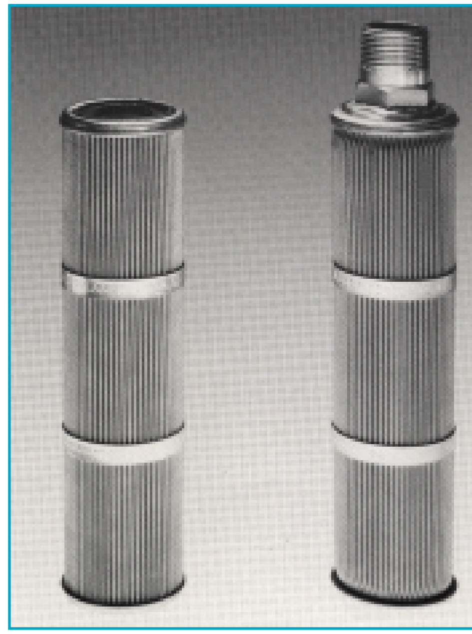
Description

PMM® medium is a thin, sintered matrix of 316L stainless steel powder within the pore structure of stainless steel wire mesh. It combines the best qualities of Pall PSS® sintered powder medium and Pall Rigimesh® sintered woven wire mesh medium. The **PMM** filter is designed so that the sintered bonds are at the points of contact, producing an extremely strong porous material whose wires do not shift and whose pore size integrity is continuously maintained. Designs are available suitable for temperatures up to 1250°F (677°C).

Operating Characteristics

Standard cartridges are capable of withstanding a minimum collapse differential pressure of 125 psid (8.6 bard) in the forward flow (outside-in) direction at up to 600°F† (315°C) and 10 psid (.7 bard) in the reverse flow direction. Optional design available for 50 psid (3.4 bard) reverse flow.

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F (232°C).



Sizes

The standard **PMM** filters are cylindrical forms, 2-½" in diameter in 10" multiple lengths, up to 40". For AB style **PMM** filters consult the factory.

Technical Information

Table 1. PMM elements and their characteristics

Filter Grade	Removal Ratings: Liquid Service[1] – Rating at % Efficiency (µm) 90%	99%	99.9%	100%	Gaseous Service[2]: Weight % Removal	100% Removal (µm)	Clean Pressure Drop: Liquid Service – Aqueous[3] psi/gpm/ft²	mbar/lpm/m³	Gaseous Service – Air[4] psi/acfm/ft²	mbar/m³/hr/m²	Recommended Flow Density: Aqueous gpm/ft²	Air acfm/ft²
M020	0.1	0.5	1	2	>99.99	0.4	0.87	1.47	0.093	.350	0.1-75	3-10
M050	0.6	2	4	5	99.99	0.6	0.49	.83	0.051	.192	0.1-75	3-10
M100	2	5	8	10	99.97	1.3	0.28	.47	0.030	.113	0.2-1	5-20
M150	5	9	12	15	99.96	2.5	0.17	.29	0.017	.064	0.5-3	7-25
M200	8	13	16	20	99.93	4.0	0.07	.12	0.007	.026	0.7-4	10-30
M250	10	16	21	25	99.90	9.0	0.02	.03	0.002	.008	1-5	15-40

(1) Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.

(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.

(3) Pressure drop obtained by multiplying value shown by actual flow desired, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area selected. See Table II for areas.

(4) Pressure drop in obtained by multiplying value shown by actual gaseous flow rate desired, ratio of viscosities, all divided by total filtration area selected. See Table II for areas.

Part Numbers/Ordering Information

Table II. Standard Configurations of PMM Elements

100% Removal Rating (µm)	PMM Series Element Part Numbers: 1000 Series	Threaded Element 1000 Series
2	MBS 100 ■ M020 ▲	P24 ◆ ● M020 ▼
5	MBS 100 ■ M050 ▲	P24 ◆ ● M050 ▼
10	MBS 100 ■ M100 ▲	P24 ◆ ● M100 ▼
15	MBS 100 ■ M150 ▲	P24 ◆ ● M150 ▼
20	MBS 100 ■ M200 ▲	P24 ◆ ● M200 ▼
25	MBS 100 ■ M250 ▲	P24 ◆ ● M250 ▼

■ Code	◆ Code	Nominal Length (in.)	Area ft²	m²
1	**10**	10	1.5	.14
2	**20**	20	3.0	.28
3	**30**	30	4.5	.42
4	**40**	40	6.0	.26

▲ Code	Gasket Option
H13 (Std.)	Buna N (Nitrile)
H	Viton*
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service
RE	Reinforced for 50 psid (3.4 bard) reverse flow

*Trademark of E.I. du Pont de Nemours & Co.

● Code	Connection
4	1″ NPT
6	1¹/₂″ NPT

▼ Code	Other Options
RE	Reinforced for 50 psid (3.4 bard) reverse flow
C9	Cleaned for oxygen service

Housing Information

A full selection of standard Pall industrial housings are available for **PMM** elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) (426°C) and chemical service. Custom designed housings for specific applications are also available.

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Because of developments in technology these data or procedures may be subject to change. Consequently we advise users to review their continuing validity annually.

Pall Corporation has offices and plants throughout the world in locations including: Argentina, Australia, Austria, Belgium, Brazil, Canada, China, France, Germany, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Poland, Puerto Rico, Russia, Singapore, Spain, South Africa, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, the United States and Venezuela. Distributors are located in all major industrial areas of the world.

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Pall Corporation

Profile® II Filters

Absolute Rated, Economical, High Efficiency Depth Filter Cartridges

Description -- Profile® II Filters

Each Profile® II element has...

An inner (downstream) section in which the pore diameter is constant. This section provides absolute rated filtration.

and...

An outer (upstream) section in which the pore diameter varies continuously from that of the absolute rated section up to 120 micrometers* (µm).

An absolute rating, which may only be assigned to a filter with a fixed pore structure, assures consistent, high quality filtration. The upstream section provides effective prefiltration for every particle with a diameter larger than the rated size. The continuity of the variable pore section, its wide range of pore sizes, and its depth, combine to provide extraordinarily long life in service.

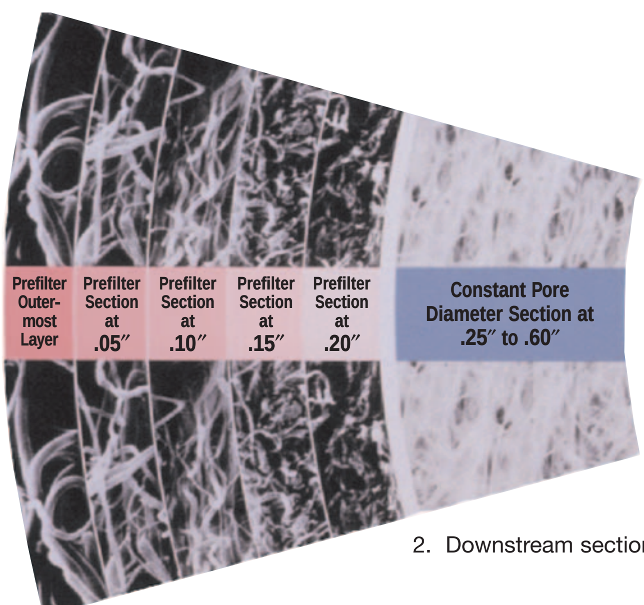
Pore size variation within the Profile II medium is achieved by varying the fiber diameter, while maintaining uniform density — and hence, uniform compressibility. Profile II elements contain effective pore sizes varying over a range as much as 40 to 1, a ratio many times higher than is achievable by simply varying density. Because uniform density and compressibility are maintained, Profile II elements can be made at lower density, and for this reason, have higher void volume — which means more pores and longer service life. No other competitive filter is made with this type of construction.

The thinner the fiber used to manufacture a fibrous structure, the greater the number of pores within the structure. A medium with more pores will provide greater service life. Also, the thinner the fibers, the smaller the pores within a medium. Profile II filter medium is constructed of ultra-thin fibers. As a result, the finest grade of the Profile II series of elements achieves an absolute rating of 0.3 µm. No commercially available competitive filter of similar appearance which we have tested provided absolute removal efficiency below about 5 µm.

Profile II cartridge filters are available in polypropylene, nylon, polyphenylene sulfide and positively charged polypropylene. The positively charged polypropylene Profile II-Plus™ cartridges provide enhanced removal of bacteria, viruses, bacterial endotoxins and particles which are negatively charged in suspension (most particles). The materials of construction for Profile II Plus filters differ from polypropylene Profile II cartridges only with respect to the modified acrylic-derived polymers which are permanently grafted to the continuous polypropylene fibers and which provide the positive zeta potential in aqueous service. The fibers in all Profile II filters may for all practical purposes be considered continuous. No surfactant or binder resin is used — the fibers are "bonded" by intertwining during the manufacturing process.

Profile II filters have a low level of extractables and due to the choice of available materials of construction they have wide temperature and chemical compatibility. Based on the widely accepted modified F-2 Filter Performance Test, when compared at equal efficiency, Profile II elements can be expected to yield longer service cycles, in some cases by factors of six or more, compared with existing products of similar physical appearance.

* One micrometer (µm) referenced as a micron, is 1/1000 of a millimeter or 1/25,400 of an inch. The smallest visible particle is about 30 to 50 µm in diameter.



2. Downstream section

1. Continuously graded upstream section

Profile II RF Style Filter

Shown above are sample sections of Profile II filter medium from a typical Profile II element at 300X. The photomicrographs illustrate the new principles of Profile II elements. 1. Continuously profiled pore size upstream section. 2. Absolute rated constant pore downstream section. Note the continuously decreasing fiber diameter in the profiled upstream section and the constant fiber diameter in the downstream section.

Applications

Acid Filtration

Wine and Beer Filtration

Automotive Paint Filtration

Coolant Water Filtration at a Nuclear Plant

Profile II cartridges and Profile II Plus cartridge filters may be utilized either upstream of finer Profile II filters or finer pleated filters — or alone as final filters. Representative applications include:

General Service: rinse water, reverse osmosis system prefiltration, water — prior to and/or after demineralization.

General Process Industries: printing inks, adhesives, liquid detergents, dyestuffs, fabric coatings, paper coatings, electroplating solutions, metal etching solutions, audio and video tape, automotive paints, can coatings, coil coatings, computer tape coatings, floppy and rigid disc coating, chemicals for photographic film development.

Electronic Industries: photoresists, acids, bases, solvents, etchant liquid mixtures, cryogenic gases, etchant gases, D.I. water prefiltration and post filtration, R.O. water prefiltration, prefiltration prior to absolute filtration.

Chemical/Petrochemical Industries: monoethanolamine and diethanolamine for gas scrubbing, monomers, polymers, glycols, herbicides and pesticides, catalysts, product polishing, photoresists, acids, bases, solvents, deep disposal well fluids.

Film and Fiber Industries: monomers, quench water, slurry additives, delusterants, slip agents, D.I. water, solvents, spin finishes, aqueous salt solutions.

Power Generation Industries: makeup water, laundry drain waste water, steam generator blowdown prefilters, filter demineralizer septa.

Pharmaceutical Industry: small and large volume parenterals, ophthalmics, oral medications.

Biological Industry: serum and serum fractions, tissue culture media, vaccine preparations, microbiological growth media, media makeup water, diagnostic sera.

Veterinary Industries: parenterals, therapeutic sera.

Fermentation Industries: liquid growth media, makeup water, intermediates, final liquid products, additives.

Food and Beverage Industries: bottled water, wine, beer, soft drinks, flavors, storage tank/reactor vents, corn syrup, edible oils, milk and distilled spirits.

Features and Benefits

Features	Advantages	Benefits
Absolute Rated Medium	• Consistent, verifiable filtration due to fixed pore structure.	• Reproducible production yields and absolute particle retention.
Constant Density Medium with Tapered Pores	• Longer service life — in some cases by factors of six times or greater.	• Lower filtration costs per year. • Lower waste disposal costs per year. • Quicker filling rates.
Small Diameter Fibers in Medium	• Longer service life. • Finer removal ratings than generally available.	• Lower yearly filtration costs. • Fewer filtration stages. - lower filtration costs - less downtime • Elimination or reduction of recirculation to achieve product clarity. • Improved product yields.
No Surfactants or Binders	• Low extractables.	• Consistent production yields and quality.
Polypropylene Medium	• Wide chemical compatibility. • Can remove trace quantities of oil.	• Multiple applications within one plant. • Reduced crater defects with paints.
Polypropylene Medium Available with a Positive Charge	• Enhanced removal of particles in aqueous fluids.	• Improved product yields. • Lower yearly filtration costs.
Continuous Fibers	• No media migration.	• Improved reliability. • Consistent production yields and quality.
Materials of Construction are FDA Listed	• Cartridge is appropriate for use in the pharmaceutical, biological, and food & beverage industries.	• Consistent, high quality filtration in stringent applications.
Available in a "P" Option for Pharmaceutical Applications	• Quality Control Procedures: 1. Manufacturing in controlled environment by specially trained personnel. 2. Statistical testing of filter effluent for: - particle and fiber counts - oxidizables by USP $KMnO_4$ consumption test - pH shift - pyrogens using LAL test • Cartridge can be *in-situ* steam sterilized.	• Performance tested.
Manufacturing Facilities in the U.S. and Europe	• Consistent product quality. • Continuous product availability.	• Consistent production yields.

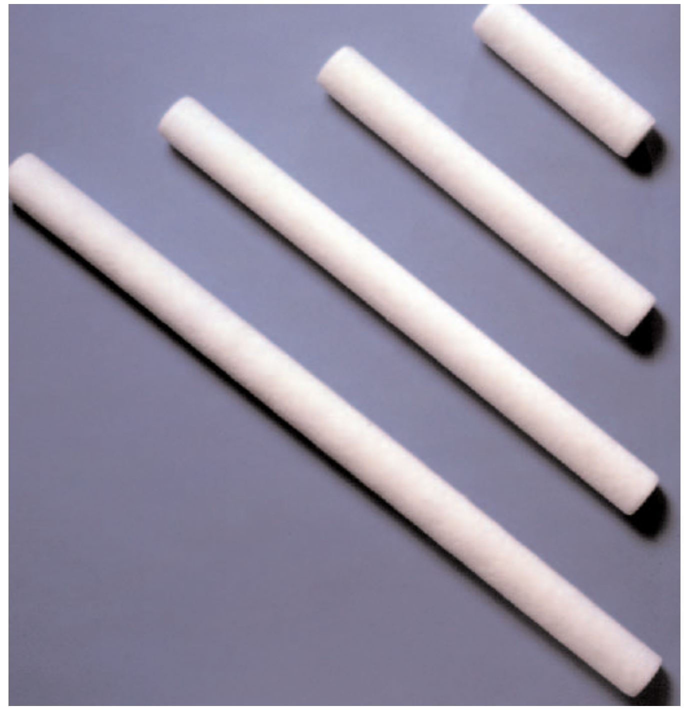
Styles

Style: RF Style

Description: Double open-ended, 2-1/2" diameter element. The cartridge is constructed of either polypropylene, nylon, polyphenylene sulfide or positively charged polypropylene medium. Cartridge sealing is ensured by using a tie-rod seal nut in a Pall Profile II housing and by spring engaged knife edge sealing surfaces in competitive housings. The polypropylene cartridge is also available with elastomeric gaskets heat welded to each end. This cartridge may be used in competitive cartridge housings with blunt knife edge sealing surfaces, where cartridge to housing fluid bypass is suspected.

Service: General Industrial

Housing: See Table 7



RF Style Profile II filter cartridges available in 10", 20", 30" and 40" lengths.

Style: AB Style - Code 3, 7, 8

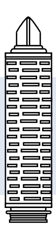
Description: Single open-ended, 2-3/4" diameter element with double external O-rings at one end. Available in polypropylene and positively charged polypropylene medium.

Service: Most commonly used in pharmaceutical, food & beverage and electronic applications. The cartridge may be hot water sanitized. Only P grade filters may be *in-situ* steam sterilized.

This style cartridge is also recommended for applications where the filters are heated for any reason above 122˚F (50˚C) and the temperature is then reduced by 36˚F (20˚C) or more prior to filtration.

Housing: See Table 7

AB Style Code 7 Profile II filter cartridges available in 10", 20", 30" and 40" lengths.



The distinctive fin at one end of the filter cartridge identifies it as a Pall product and is a trademark of Pall Corporation.

Ordering Information

Filter Selection Guidelines

For optimum efficiency and throughput, it is recommended that you select a filtration scheme based on flow and differential pressure requirements.

To select your filter simply:

A. Select desired level of filtration (refer to Table 8 for reference).

B. Select filter cartridge style and grade by referring to Tables 1, 2, 3, 4 and 5.

C. Confirm that the Profile II filter medium selected is compatible with the fluid and the operating temperature. See Table 9.

D. Determine the required number of 10 inch filter modules by dividing the system flow rate by the typical flow rate per 10 inch module given in Table 6. Calculate the clean pressure drop to verify that it is acceptable.

E. Refer to Table 7 for ordering information on housings. Determine stacking array (number of cartridges and length) of RF or AB series filter element(s) for selected housing.

F. Refer to Table 2 to complete ordering information for desired filter element(s).

For example: You require a filter cartridge for 40 µm removal in an RF style. Your flow rate is 100 gpm. Therefore, from Table 6 you require approximately 6-10, 10" filter modules (100 gpm divided by 15 gpm per 10" cartridge). From Table 7, you require a P04 housing which can accept four 20" or 30" filter cartridges. Four 20" filter cartridges (8, 10" filter modules) meet your requirements.

The part number for your filter cartridge would be:

R2F400

The part number stands for:
R: style-retrofit
2: 20" length
F400: 40 µm absolute rated, polypropylene Profile II medium

Table 1 – Maximum Operating Conditions

Cartridge[1]	Materials of Construction		Maximum Differential Pressure[2] (psid)	Temperature	
	Medium	Support Core		°F	°C
Polypropylene Profile II	Polypropylene	Polypropylene	15 30 50 60	180 158 122 86	82 70 50 30
Profile II Plus	Polypropylene with positive zeta potential	Polypropylene	15 30 50 60	180 158 122 86	82 70 50 30
Nylon Profile II	Nylon	Glass filled polypropylene	35 50 75	180 158 86	82 70 30
	Nylon	Glass filled nylon	50 70 80 90	300 212 158 86	150 100 70 30
Profile A/S	Polyphenylene Sulfide	316L Stainless Steel	30 40	400 200	205 93

[1] P grade AB Style elements can be heated to 125°C (257°F), for example during *in-situ* steam sterilization or in an autoclave, and subsequently cooled to ambient temperature prior to use. AB style elements may be constructed of either a polypropylene or a positively charged polypropylene medium.
[2] For higher differential ratings and for compatible fluids, Profile II cartridges are available with glass filled polypropylene cores on a special order basis. Please contact the Pall Sales Department or your local distributor.

Table 2 – Standard Configurations of Profile II Filter Cartridges

A. Polypropylene and Positively Charged Polypropylene Profile II Element Part Numbers

Removal Rating (µm)	RF and RMF Series	AB Series Code 3,7,8 -Hot water sanitization -In situ **steam sterilization** **(P grade only)**
0.3[1]	–	AB ▲ Y003 ● ▼ ✚ ★
0.5[1]	R ■ ▲ F 005 ➣	AB ▲ Y005 ● ▼ ✚ ★
0.7[1]	–	AB ▲ Y007 ● ▼ ✚ ★
1	R ■ ▲ F 010 ● ➣	AB ▲ Y010 ● ▼ ✚ ★
3	R ■ ▲ F 030 ● ➣	AB ▲ Y030 ● ▼ ✚ ★
5	R ■ ▲ F 050 ● ➣	AB ▲ Y050 ● ▼ ✚ ★
7	R ■ ▲ F 070 ➣	AB ▲ Y070 ▼ ✚ ★
10	R ■ ▲ F 100 ➣	
12	R ■ ▲ F 120 ➣	
15	R ■ ▲ F 150 ➣	
20	R ■ ▲ F 200 ➣	
30	R ■ ▲ F 300 ➣	
40	R ■ ▲ F 400 ➣	
70	R ■ ▲ F 700 ➣	
90[1]	R ■ ▲ F 900 ➣	
120[1]	R ■ ▲ F 1200 ➣	

[1] Extrapolated values.

B. Nylon Profile II Element Part Numbers

Removal Rating (µm)	RFN Element Part Number
5	R ✷ ✦ FN050
10	R ✷ ✦ FN100
20	R ✷ ✦ FN200
30	R ✷ ✦ FN300
40	R ✷ ✦ FN400
70	R ✷ ✦ FN700

C. Profile A/S Element Part Numbers

Removal Rating (µm)	RFN Element Part Number
5	RLS ✦ FPS050
10	RLS ✦ FPS100
20	RLS ✦ FPS200
40	RLS ✦ FPS400
70	RLS ✦ FPS700

O-Ring Option	Code ★
Silicone - standard	H4
Viton A	H
Ethylene Propylene	J

Nominal Length, (Inches)	Code ✦
10	1
20	2
30	3
40	4

Charge Option	Code ●
Positive Zeta Potential	Z

Application	Code ✚
Pharmaceutical	P
Other	Omit

Adaptor Materials	Adaptor Configuration	O-ring Size	Code ▼
Polypropylene	Flat top, double O-ring	222	3
Polypropylene	Finned end bayonet lock, double O-ring	226	7
Polypropylene	Finned end, double O-ring	222	8

Inner Core Material Construction	Code ✷
Glass Filled Polypropylene (Standard)	GY
Glass Filled Nylon (Option)	GN

Gasket Material	Code ➣
Alloy of Polypropylene and Ethylene Propylene Diene Monomer (EPDM)	H21

Nominal Length (Inches)	Code ▲
10	1
20	2
30	3
40	4

Gasket	Code ■
None	No Symbol
Elastometric Material*	M**

* Provides a positive sealing surface to eliminate potential fluid bypass in competitive housings with blunt knife edges.

** When the M symbol is selected the part number must end in H21 code.

Table 3 – Profile II Filter Cartridges Removal Ratings

Cartridge Grade	Liquid Service Removal Rating, µm 90%	99%	99.9%	99.98%	Gaseous Service DOP (0.3 µm) Removal Efficiency (%)[3]
003	<0.5[1]	<0.5[1]	<0.5[1]	<0.5[1]	>99.9999
005	<0.5[1]	<0.5[1]	<0.5[1]	<0.5[1]	>99.9999
010	<0.5[1]	<0.5[1]	<0.5[1]	1.0	>99.9999
030	<1.0[1]	1.8	2.5	3.0	>99.9999
050	2.0	3.0	4.0	5.0	>99.9999
070	3.5	5.0	6.0	7.0	>99.9999
100	6.5	7.5	9.0	10.0	99.2
120	7.0	9.0	11.0	12.0	96.5
150	8.0	10.0	13.0	15.0	88.0
200	10.0	14.0	18.0	20.0	84.8
300	14.0	18.0	26.0	30.0	67.0
400	20.0	30.0	35.0	40.0	48.3
700	32.0	50.0	70.0	–[2]	34.0
900	50.0	78.0[1]	90.0[1]	–[2]	25.0
1200	60.0	100.0[1]	120.0[1]	–[2]	10.0

[1] Extrapolated values.
[2] Precise evaluation of the 100% removal efficiency for these coarse grades is not possible with the test procedure utilized.
[3] The test containment, dioctyl phthalate (DOP) is a 0.3 µm suspension in air. Air flow used for these data was 20 CFM/10" cartridge, except grade 700 and coarser, which were run at 4 CFM.
For more information on Profile II filter cartridges see Element Data Sheet E1.

Table 4 – Profile II Plus Cartridge Filters Removal Ratings

Cartridge Grade	Removal Rating Independent of Zeta Potential (µm at % Efficiency) 90%	99.98%	Bacteria[2] Endotoxin Removal Capacity (Endotoxin Units/ 10″ Cartridge)
003Z	<0.5[1]	<0.5[1]	>1.6 x 10^8
005Z	<0.5[1]	0.5[1]	>1.6 x 10^8
007Z	<0.5[1]	0.7[1]	>1.6 x 10^8
010Z	<0.5[1]	1.0	>1.6 x 10^8
030Z	<1.0[1]	3.0	>1.6 x 10^8
050Z	2.0	5.0	>1.6 x 10^8

[1] Extrapolated values.
[2] One endotoxin unit is equal to 0.10 nanograms of *E. Coli* 055:B5 endotoxin. Cartridges were challenged with 1.6 x 10^8 Endotoxin Units (E.U.) without passing any detectable amount of endotoxin (<0.5 EU/ml).
For more information on Profile II Plus filter cartridges see Element Data Sheet E1Z.

Table 5 – Profile A/S Filter Cartridges Removal Ratings

Cartridge Grade	Liquid Service Removal Rating, µm 90%	99%	99.9%	99.98%
050	<1.0[1]	2.5	4.0	5.0
100	6.0	8.0	9.0	10.0
200	11.0	15.0	18.0	20.0
400	15.0	20.0	30.0	40.0
700	20.0	30.0	50.0	70.0[1]

[1] Extrapolated values.

Table 6 – Profile II and Profile II Plus Filter Cartridges Flow Characteristics

Profile II and Profile II Plus (Z) Cartridge Grades	Clean Pressure Drop: Aqueous Service PSI/GPM Per 10″ Cartridge[1] Polypropylene and Nylon			Clean Pressure Drop: Gas Service CFM of Air/PSI Per 10″ Cartridge[2]	Typical Aqueous Flow GPM/10″ Cartridge
	Profile II Cartridges All Series	Profile II Plus Cartridges All Series	Profile A/S Cartridges	Profile II and Profile II Plus Cartridges All Series	
003(Z)	3.5	4.5	–	2.3	1 – 2.0
005(Z)	2.8	3.5	–	2.7	1 – 2.5
007(Z)	2.7	2.7	–	3.1	1 – 2.5
010(Z)	2.6	2.6	–	3.6	1 – 3.0
030(Z)	1.5	1.5	–	6.4	2 – 5
050(Z)	0.8	0.8	–	11.0	3 – 8
070	0.5	–	–	17.0	5 – 12
100	0.3	–	0.35	29.0	6 – 15
120	0.2	–	–	36.0	6 – 15
150	0.15	–	–	44.0	8 – 15
200	0.10	–	0.10	75.0	10 – 15
300	0.08	–	–	119.0	10 – 15
400	0.05	–	0.09	207.0	10 – 15
700	<0.05	–	0.03	415.0	10 – 15
900	<0.05	–	–	640.0	10 – 15
1200	<0.05	–	–	1000.0	10 – 15

[1] Pressure drop in PSI per GPM for a single 10" cartridge. For multiple elements, divide by the number of cartridges. For fluids other than water, multiply by the viscosity in centipoise.

[2] For longer cartridges, increase the flow rates in proportion. The flow rates listed do not take into account pressure losses due to flow in the internal diameter of the elements which become significant above about 40 to 60 CFM.

Profile II and Profile II Plus Filter Cartridges

Table 7 – Housing Selection

Element Style	Housing Series	Materials of Construction	Stacking Array	Flow Range (GPM)	Maximum Allowable Pressure/Temp. PSIG	°F	Housing Data Sheets*
RF, RMF	PC401	Carbon Steel or 316 Stainless Steel	1 x 10″ 1 x 20″ 1 x 30″	to 15 to 30 to 38	400	300	H14
	PC04	Carbon Steel or 316 Stainless Steel	4 x 10″ 4 x 20″ 4 x 30″	to 120 to 120 to 120	230 215	300 300	H15
	PC07	Carbon Steel or 316 Stainless Steel	7 x 20″ 7 x 30″ 7 x 40″	to 210 to 368 to 420	230 215	300 300	H16
	PC15	Carbon Steel or 316 Stainless Steel	15 x 20″ 15 x 30″ 15 x 40″	to 340 to 480 to 675	230 215	300 300	H17
	P23	Carbon Steel or 316 Stainless Steel	23 x 30″ 23 x 40″	to 820 to 1240	205 215	300 300	H18
	P38	Carbon Steel or 316 Stainless Steel	38 x 30″ 38 x 40″	to 1630 to 1930	200 215	300 300	H19
AB Code 7	ALI in-line flow sanitary**	316L Stainless Steel	1 x 5″, 10″, 20″, 30″, 40″	to 20	150	284	–
	ALT “T” -flow sanitary**	316L Stainless Steel	1 x 10″, 20″, 30″, 40″	to 20	150	284	
	CLL4	316L Stainless Steel	1 x 10″, 20″, 30″	to 20	400	250	H26
	STL03 “T” -flow sanitary multistack	316L Stainless Steel	3 x 10″, 20″, 30″, 40″	to 100	125	200	–
	STL06 “T” -flow sanitary multistack	316L Stainless Steel	6 x 10″, 20″, 30″, 40″	to 200	125	200	–
	STL10 “T” -flow sanitary multistack	316L Stainless Steel	10 x 20″, 30″, 40″	to 200	125	200	–
	PCY	Polypropylene	1 x 10″, 20″	to 15	150	100	H39

*For more information on the housings listed see the appropriate Housing Data Sheet.

**Available with 50psig/3.4 bar at 300°F/149°C 316 SS jackets.

Removal Ratings – Bringing Order to Confusion!

There is no universally accepted system for determining removal ratings of cartridge filters in liquid service. As an example, a number of depth type filters rated at 1 micrometer (µm) were evaluated using a modified OSU F-2 test method (see below) and were found to have absolute ratings of 15 to 25 µm. All had virtually no removal at 1 µm. Rating methods used by the various manufacturers may be arbitrary and results obtained by different methods cannot be compared.

The OSU F-2 test method developed at Oklahoma State University in the 1970's has received wide acceptance for use on lubricating and hydraulic fluids. Pall Corporation uses this method for its oils extensively, and has adapted it for use with water in the range from 0.5 to 30 µm. A second modification uses oil and covers the range from 40 to 120 µm.

Profile II Replacement Filters

Some competitive elements deviate greatly from their assigned ratings. For example, one element rated at 0.5 µm nominal, had an efficiency of 90% at 8 µm and virtually zero efficiency at 0.5 µm in the modified F-2 test. A 1µm rated element of the same brand had a 90% efficiency at 6 µm! Both can be replaced by 10 µm rated Profile II elements which offer about equal removal and a probable two to four-fold increase in life.

Table 8 lists the nearest equivalent Profile II element to some of the more commonly used depth type filters. Therefore, in virtually all cases, when the contaminant added values were compared at *equal efficiency*, the Profile II element capacity was higher, often by a factor of two to three or more. Life in service may be different due to contaminant characteristics and process conditions. In general, longer life will be obtained when a Profile II element replaces a conventional depth filter with equal or similar OSU F-2 removal efficiency values.

Table 8 – Replacing Conventional Depth Filters with Profile II Elements

Manufacturer	Material	Part Number	Manufacturers Rating µm	Nearest Equivalent Profile II Element Rating µm
Cuno	Cotton String Wound	DCCFY	1	15
		DCCFA	3	15
		DCCFB	5	40
		DCCFC	10	40
		DCCFF	25	40
	Polypropylene String Wound	DPPFY	1	30
		DPPFA	3	40
		DPPFB	5	40
		DPPFC	10	40
		DPPFF	25	70
	Molded Fiber	G78A3	3	30
		G78B3	5	40
		G78C8	10	70
		G78F3	25	70
	Polyethylene Coated Polypropylene	AU9A11N	3	15
	Polyethylene Coated Polypropylene	AU9B11N	5	30
	Polyethylene Coated Polypropylene	AU9C11N	10	40
Commercial	Cotton String Wound	39R10	1	10
		27R10	3	15
		23R10	5	20
		19R10	10	30
		15R10	20	40
	Polypropylene	MBC10M10A	10	10
		MBC20M10A	20	20
		MBC40M10A	40	30
Hytrex	Polypropylene	GX01	1	30
		GX03	3	30
		GX05	5	70
		GX10	10	70
		GX20	20	70
Nippon Roki	Polypropylene	HT10	0.1	7
		HT20	0.2	5
		HT30	0.3	7
		HT40	0.4	7
		HT50	0.5	10
		HT55	0.5	15
		HT60	0.6	20
		HT60a	0.7	15
		HT80	0.8	20

Note: Many competitive depth cartridges are constructed of materials other than polypropylene. In many cases Profile II cartridges, constructed of polypropylene or nylon, may be suitable replacements provided that either of these materials has the required temperature and chemical compatibility. See Table 9.

Table 9 – Profile II Compatibility Data

Chemical Classification	Examples	Polypropylene	Nylon	Polyphenylene Sulfide
Inorganic Acids	Hydrochloric, Dilute Sulfuric, Dilute Nitric, Boric, Phosphoric	GR	T	NR GR
Organic Acids	Acetic	GR	T	GR
Bases (Alkalies)	Sodium Hydroxide, Potassium Hydroxide Amines, Quaternary Ammonium Hydroxide	GR	T	GR
Salt Solutions	Aluminum Chloride, Sodium Sulfate, Sodium Nitrate	GR	T	T
Brines	Sodium Chloride, Potassium Chloride, Sodium Bromide, Calcium Chloride	GR	T	GR
Oxidizers	Peroxides, Peracids	NR	NR	NR
Organic Solvents	Ethers, Esters, Amides, Ketones	GR	GR	GR
	Alcohols, Cellosolves, Glycols	GR	GR	GR
	Aromatics (Benzene, Toluenes, Xylenes)	NR	GR	T
	Petroleum Products (Gasoline, Kerosene)	NR	GR	GR
	Hydrocarbons (Hexane, Octane, Fats, Oils, Petroleum Ether)	T[1]	GR	GR
	Halogenated Hydrocarbons (Methylene Chloride, Perchloroethylene)	T[1]	T	T
Water (Ambient)		GR	GR	GR
(Hot – up to 180˚F without oxidants)		GR	NR	GR
(Hot – with oxidants)		NR	NR	T
Air (Ambient & Hot)		NR	NR	GR
Recommended temperature limits for most organic fluids unless evaluated on an individual basis		150˚F	200˚F	200˚F
Recommended temperature limits for most compatible organic fluids unless evaluated on an individual basis		180˚F	200˚F	200˚F
Maximum temperature limits for any fluid after evaluation on an individual basis		180˚F	300˚F	400˚F

Disclaimer:

- The compatibility data presented in this chart is for general guidance only. Because so many factors can affect the chemical resistance of a given product, you should pre-test under your own operating conditions observing applicable safety practices such as those given on the Material Safety Data Sheet for each chemical. If any doubt exists about specific applications, please contact Pall Corporation.

GR=Generally Recommended
NR=Not Recommended
T=Evaluate on An Individual Basis
[1] Recommended maximum temperature must not exceed 90˚F.

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Pall Corporation is a world leader in fluid clarification. From its organization in 1946, Pall Corporation has developed products to meet the critical filtration needs of industry: protecting people, products, and systems through the capture and removal of contaminants in a variety of applications. Pall products serve three broad markets which include Fluid Processing, Aeropower and Health Care. The company is different from other filter companies for three important reasons:

- Pall is a highly integrated manufacturer and leader in the development and production of filter media which are made by a variety of proprietary methods which include metallurgy, papermaking, chemical deposition, plastic extrusion, and others.

- Pall is the leader in design and manufacture of sophisticated housings that encase the filter cartridges.

- Pall has vast technical resources. The unique human resource, the Scientific Laboratory Services (SLS) Department, is staffed with skilled engineers and scientists and equipped with the most sophisticated analytical instruments available to help solve the complex contamination problems associated with fluid clarification.

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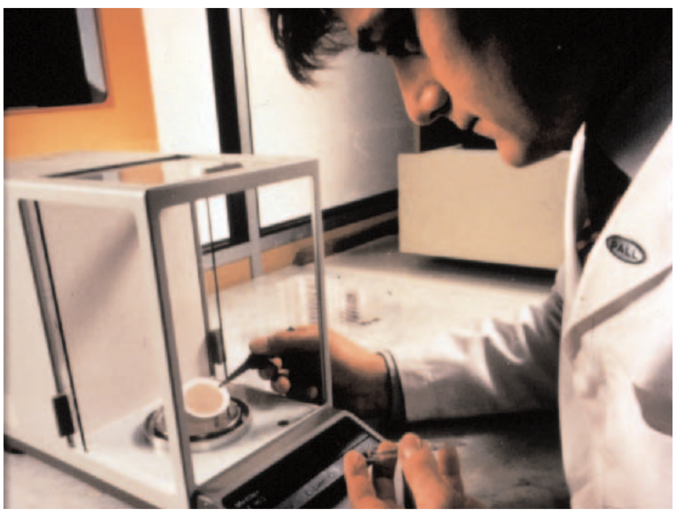

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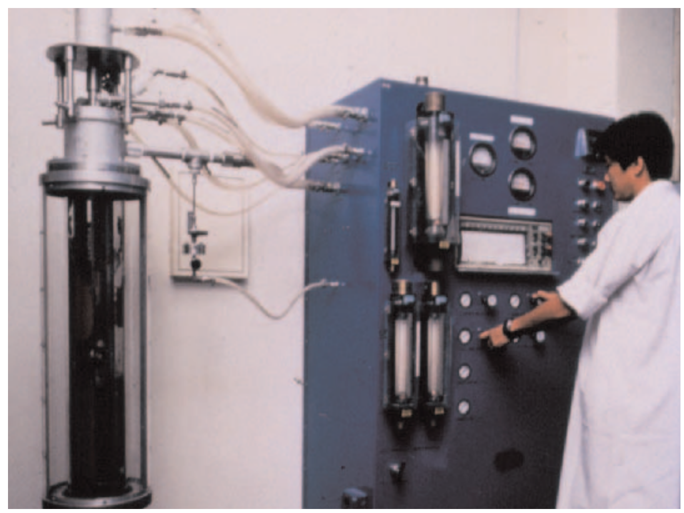

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PRO 400f

Pall Corporation

PSS® Series Filter Elements

Description

The PSS® Series filter medium is composed of 316 low-carbon stainless steel powder sintered together in an inert environment. The resulting fixed pore structure medium provides quantitative particle removal efficiency without media migration or particle unloading. The inherently high void volume of this medium offers low resistance to flow and high dirt holding capacity. These filters offer broad temperature and chemical compatibility with the added economy of being repeatedly cleanable. PSS filters are used in many applications within the chemical process industry, in many aggressive environments, where critical filtration levels are required. Such applications include industrial gases (cryogenic and high temperature), steam, solvent, heat transfer fluids, polymers, chemical intermediates, food and beverages. PSS Series filter media have high chemical stability and do not impart taste, odor or extractables to the effluent. Designs are available for temperatures up to 1250°F with appropriate alloy selection.

Figure 1. Standard PSS Series Filter Elements

Operating Characteristics

Standard 316 stainless steel cartridges are capable of withstanding a minimum collapse differential pressure of 50 psid in the forward flow (outside-in) direction to 600°F † and 50 psid in the reverse flow direction.

† *Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F.*

Sizes

Standard PSS filters are available in three styles. Industrial (1000 style) cartridges are 2 ⅜-inch diameter double open-ended modules in incremental lengths of 10 inches; sanitary design (AB style) are closed on one end with an O-ring piston seal on the other end; and cylindrical elements, which are 1 ½-inches or 2 ⅜-inches in diameter, closed on one end with a threaded fitting connection on the other.

Table 1. PSS Elements And Their Characteristics

Filter Grade	Removal Ratings						Clean Pressure Drop		Recommended Flow Density	
	Liquid Service[1]				Gaseous Service[2]		Liquid Service	Gaseous Service		
	Rating in µm at % Efficiency				Weight %	100%	Aqueous Pressure Drop[3]	Air Pressure Drop[4]	Aqueous	Air
	50%*	90%	99%	100%	Removal	Removal µm	psi/gpm/ft²	psi/acfm/ft²	gpm/ft²	acfm/ft²
PO5	0.5	2	3	5	99.99	0.4	0.85	0.091	0.5 - 2	5 - 10
PO9	2	4	7	9	99.98	0.8	0.27	0.030	0.75 - 3	10 - 30
H	5	7	9	13	99.97	1.3	0.23	0.024	1 - 4	15 - 40
F	8	12	15	20	99.94	2.8	0.052	0.0054	2 - 6	15 - 50
E	15	22	25	35	99.80	11.0	0.019	0.0013	2 - 7	20 - 60
D	20	28	40	55	99.50	20.0	0.0068	0.0007	3 - 10	25 - 80

* *These removal ratings should be used when comparing PSS to competitive grades.*

(1) *Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.*

(2) *Weight percent removal data based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.*

(3) *Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft²) selected. See Table 2 for area.*

(4) *Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities* $\frac{\text{Actual viscosity of gas (in cp)}}{\text{0.018 (viscosity of air)}}$ *all divided by total filtration area (ft²) selected. See Table 2 for area.*

Part Numbers/Ordering Information
Table 2. Standard Configuration of PSS Elements

100% Removal Rating	PSS Series Element Part Number			
	100 Series	AB Series	Cylinder Series	
			2 ⅜" Diameter Elements With 1" or 1 ½" NPT(5)	1 ½" Diameter Elements With ¼" NPT(5)
5	MBS100■PO5▲	AB■PO57▲	C-23-●◆PO5	C-14-★◆PO5
9	MBS100■PO9▲	AB■PO97▲	C-23-●◆PO9	C-14-★◆PO9
13	MBS100■PH▲	AB■PH7▲	C-23-●◆PH	C-14-★◆PH
20	MBS100■PF▲	AB■PF7▲	C-23-●◆PF	C-14-★◆PF
35	MBS100■PE▲	AB■PE7▲	C-23-●◆PE	C-14-★◆PE
55	MBS100■PD▲	AB■PD7▲	C-23-●◆PD	C-14-★◆PD

Code ▲	Gasket Option
H13	Nitrile (Std.)
H	Fluorocarbon Elastomer
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service

Code ■	Nominal Length (in)	Area (ft^2)
1	10	0.5
2	20	1.0
3	30	1.5

Code ◆	Connection
1	¼" NPT
4	1" NPT
6	1 ½" NPT

Code ●	Nominal Length (in)	Area (ft^2)
06	6	0.31
09	9	0.47
18	18	0.9
19	19(5)	0.98

Code ★	Nominal Length (in)	Area (ft^2)
06	6	0.2
09	9	0.29
18	18	0.59

(5) C-23-19 has connection Code 6. Other C-23 part numbers have Code 4. All C-14 part numbers have Code 1.

Housing Information
A full selection of standard Pall industrial housings are available for use with PSS elements. Custom designed housings for specific applications are also available. Contact your Pall representative for more information.

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Filtration. Separation. Solution.SM

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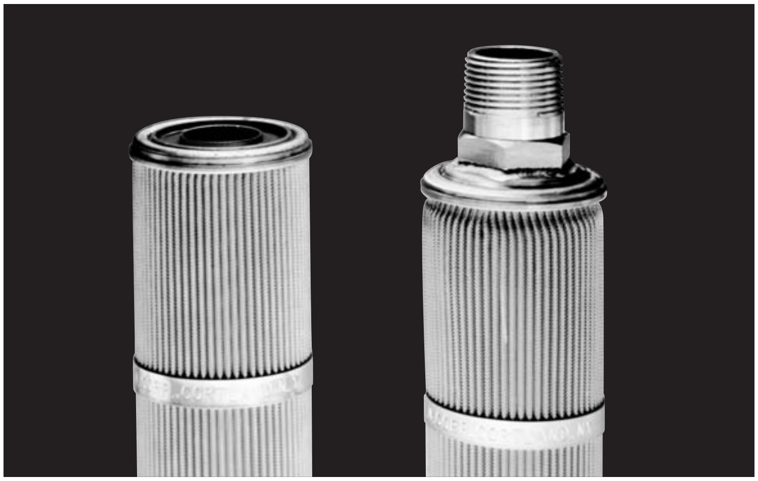
Rigimesh® Filter Elements



Description

Rigimesh® porous metal filter elements are extremely permeable and are constructed of high dirt capacity stainless steel (type 304 or 316L) woven wire mesh. Rigimesh media outperform other meshes because they are sintered woven wire meshes with higher void space. Pall sinters the wires at their points of contact, producing an extremely strong porous material whose wires will not shift under stress and whose pore size integrity is continually maintained. This patented Pall process permits use of finer diameter wires in manufacturing the filter medium. The net result is a filter with more pores per unit area, providing more dirt-holding capacity than that of an unsintered mesh made from coarser wires. Designs are available which are suitable for temperatures up to 600˚F/315°C.

Operating Characteristics

Standard cartridges are capable of withstanding a collapse differential of 125 psid in the forward flow (outside-in) direction and up to 600°F† and 10 psid in the reverse flow direction.

Sizes

The standard Rigimesh filters are cylindrical forms of pleated medium, 2 $\frac{1}{2}$ inches in diameter in 10 inch multiple lengths, up to 30 inches. For AB style Rigimesh filters consult the factory.

Table I. Rigimesh Elements and Their Characteristics

Filter Grade	Removal Ratings				Clean Pressure Drop		Recommended Flow Density	
	Liquid Service[1] Rating In µm At % Efficiency		Gaseous Service[2]		Liquid Service	Gaseous Service	Aqueous	Air
	98%	100%	Weight % Removal	100% Removal (µm)	Aqueous Pressure Drop[3] psi/gpm/ft^2	Air Pressure Drop[4] psi/acfm/ft^2	gpm/ft^2	acfm/ft^2
Z*	1.5	15	99.92	2	0.035	0.0038	1 – 5	10 – 40
K	5	18	99.45	13	0.0073	0.0008	2 – 8	20 – 60
J	10	25	99.20	18	0.0020	0.00025	3 – 10	25 – 80
M	17	45	98.65	25	0.0015	0.00019	4 – 15	30 – 100
R	40	70	–	55	0.0006	0.00008	5 – 20	35 – 150
S	70	105	–	85	0.0004	0.00006	6 – 25	40 – 200
T	145	225	–	175	0.0003	0.00005	7 – 30	45 – 240
A	300	450	–	350	Negligible	Negligible	8 – 40	50 – 300

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450˚F.

* Supramesh sintered powder metal and mesh composite medium.

(1) Liquid removal efficiency ratings are based on hard spherical particles.

(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings are calculated values.

(3) Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft^2) selected. See Table II for areas.

(4) Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities $\frac{\text{actual cp of gas}}{0.018\ \text{(viscosity of air)}}$ all divided by total filtration area (ft^2) selected. See Table II for areas.

Table II. Standard Configurations of Rigimesh Elements

100% Removal Rating (µm)		Rigimesh Series Element Part Numbers	
Liquids	Gases	1000 Series	Threaded Element Series
15	2	MB ■ 100 ▼ RZ ●	◆ – 24 – ▲ – ■ – RZ
18	13	MB ■ 100 ▼ RK ●	◆ – 24 – ▲ – ■ – RK
25	18	MB ■ 100 ▼ RJ ●	◆ – 24 – ▲ – ■ – RJ
45	25	MB ■ 100 ▼ RM ●	◆ – 24 – ▲ – ■ – RM
70	55	MB ■ 100 ▼ RR ●	◆ – 24 – ▲ – ■ – RR
105	85	MB ■ 100 ▼ RS ●	◆ – 24 – ▲ – ■ – RS
275	175	MB ■ 100 ▼ RT ●	◆ – 24 – ▲ – ■ – RT
450	350	MB ■ 100 ▼ RA ●	◆ – 24 – ▲ – ■ – RA

Gasket Options	● Code
Viton*	H
Teflon*	H2
Silicone	H4
Buna-N (Std.)	H13
Ethylene Propylene	J
Butyl	J1
Neoprene	J2
Ethylene Propylene for Steam Service	J7

Nominal Length (in)	■ Code (Area (ft^2)) MB S / MB L	MB F / MB LF
10	1.0	2.0
20	2.0	4.0
30	3.0	6.0

Nominal Length (in)	▼ Code
10	1
20	2
30	3

Area (ft^2)	◆ Code P	F
1.0	1.0	–
2.0	2.0	4.0
3.0	3.0	–
4.0	–	4.0
6.0	–	6.0

Nominal Length (in)	▲ Code
10	10
20	20
30	30

Housing Information

A full selection of standard Pall industrial housings are available for Rigimesh elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) and chemical service. Custom designed housings for specific applications are also available.

Connection	■ Code
1″ NPT	4
1 $^1/_2$″ NPT	6

S= 304 hardware and 304 L medium.

L= 316 hardware and 316L medium.

* Trademark of E.I. du Pont de Nemours & Company.

Table III. Housings for Rigimesh Elements

Type of Element	Housing Available
MB ■ 100 Series	See Housing Data Sheets H1, H3-11, and H14-19.
Threaded Connector Series	See Housing Data Sheets H48, H49, and H50.

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Please contact Pall Corporation for product applicability to specific National legislation and/or Regional Regulatory requirements for water and food contact use.

Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid.

*Filtration. Separation. Solution.*SM

SCHUMATHERM™
Products Information

Scanning Electron Micrograph

1. General Material Description

SCHUMATHERM filter elements are a high-quality porous fireclay ceramic. This material is distinguished by its good chemical and thermal resistance. Therefore cylinders or tiles made of SCHUMATHERM filter ceramic can be used for a large variety of applications as long as special process conditions do not require other process specific materials. One main application for SCHUMATHERM filter cylinders is the use as support material for precoat filtration. The surface structure and the high permeability of SCHUMATHERM builds an ideal support for the precoat.

2. Fields of Applications

SCHUMATHERM (ST)	Examples
Precoat filter for liquids	▪ Filtration of beer, water, glucose syrup; beer yeast recovery
Particle filter for gases	▪ Coarse filter for biogas
Diffuser	▪ Aeration of potable water (e.g. de-acidification)
Fluidization	▪ Hot fluidized bed processes; ash transportation; conveying of red. iron slurry

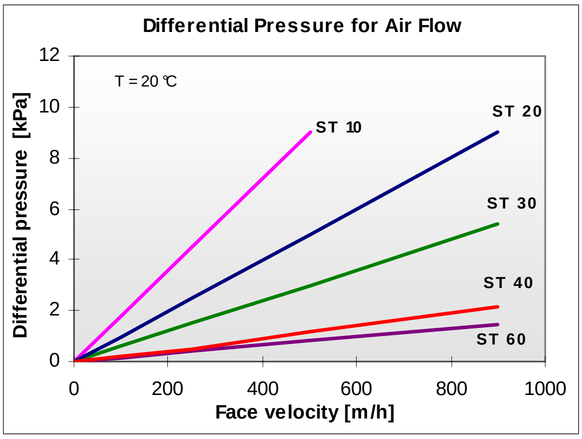
Further applications possible.

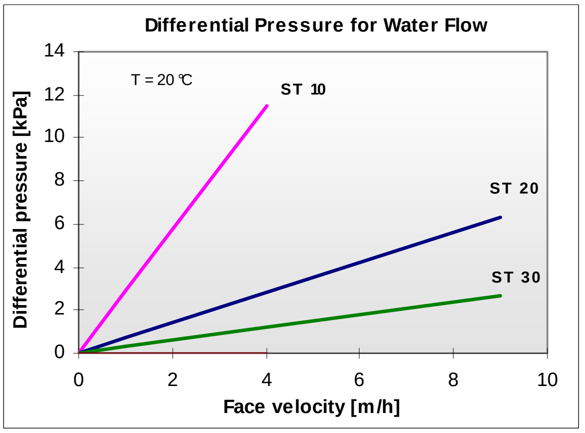
3. Physical Properties

SCHUMATHERM (ST)	Unit	10	20	30	40	60
Filtration fineness for liquids	µm	2.5	15	30	40	50
Filtration fineness for gases	µm	1.5	3	6	8	10
Porosity	%	40	40	35	35	35
Material density	g/cm^3	1.5	1.5	1.5	1.5	1.5
Specific permeability [1]	$10^{-13}m^2$	45	75	125	310	470
Bending strength [2]	MPa	> 12	> 10	> 9	> 9	> 8
Bursting pressure	bar	> 30	> 25	> 20	> 20	> 15
Max. temperature resistance [3]	°C	800	800	800	800	700
Thermal expansion coefficient (25 - 800°C)	$10^{-6}/K$	5.8	5.8	5.8	5.8	5.8
Dimensions Do / Di	mm	70 / 40	70 / 40	70 / 40	70 / 40	70 / 40

[1] = calculated from differential pressure AIR, [2] = O-ring strength, compression, [3] = depending on operating conditions

4. Differential Pressure Diagram





The physical data are valid for the dimensions listed in table „Physical Properties".

5. Chemical Resistance

SCHUMATHERM filter ceramic is resistant against acids, saline solutions and organic solvents, liquid or gaseous. It is not resist to hydrofluoric acid. SCHUMATHERM filter ceramic is resistant up to pH 10 in the alkaline range.

6. Standard Dimensions

	Type	Do / Di [mm]	Length [mm]	Area [m²]	Weight [kg]
Cylinder	10, 20, 40, 60	70 / 40	500	0.11	2.0
Cylinder	20, 30	120 / 70	500	0.19	5.6
Cylinder	10, 20, 40, 60	70 / 40	1000	0.22	4.0
Tile	20, 30	L x W: 500 x 500	H: 30	0.25	11.3

Special dimensions and special products on request.

7. General Information

- SCHUMATHERM filter ceramic can be utilised in the food and beverage industry in accordance with the German Foodstuffs and Consumer Goods Act and according to the European Directive 89/109/EEC – referring to directives 2002/72/EC and / or 84/500/EEC and their amendments, as appropriate.
- SCHUMATHERM filter ceramicis approved for the utilization in drinking water according to German regulations DVGW W270 and the KTW recommendation.
- SCHUMATHERM filter ceramic can be machined using hard metal tools.
- Ceramic elements are to be handled with care.
- Elements can be glued using commercial or special ceramic glues. Careful consideration should be taken regarding operating temperature and chemical resistance.

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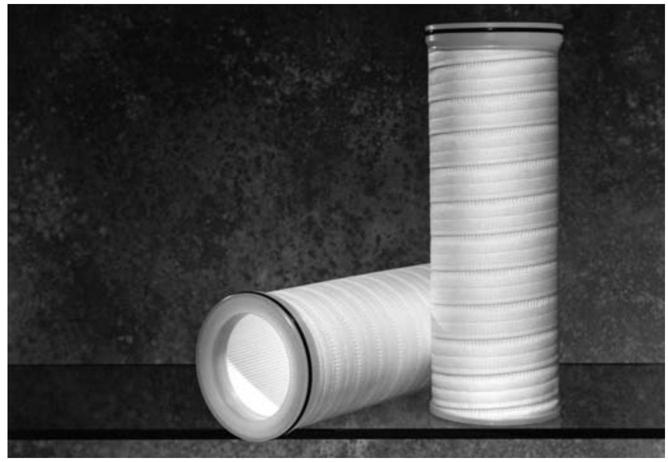
Pall Corporation

Selection Guide
Ultipleat® High Flow Filter System

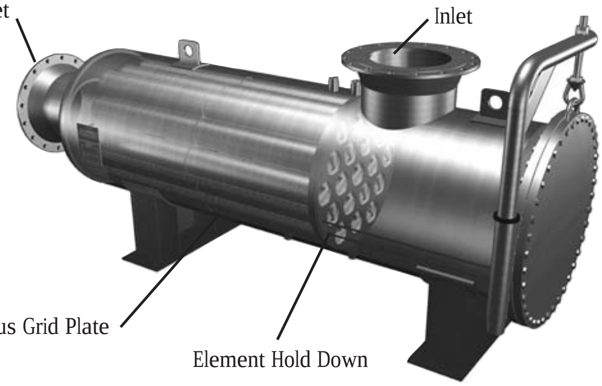
Description

The Ultipleat® High Flow filter is a large diameter, coreless, single open ended, pleated cartridge with an inside to outside flow pattern. The filter's unique crescent-shaped pleat geometry, combined with its large 6 inch (152.4 mm) diameter and proprietary range of available Pall filter media, allows you to use significantly fewer filters and smaller housings for high flow rate applications. Systems can handle up to 30,500 gpm (115,443 lpm).



Benefits

- Up to 50% smaller filter system possible
- Up to 40 times fewer elements to change out
- Higher flow rates per filter cartridge - up to 500 gpm (1900 lpm)
- Available in 20 inch (508 mm), 40 inch (1016 mm), 60 inch (1524 mm) and 80 inch (2032 mm) lengths
- Coreless, all plastic construction to minimize waste disposal
- Absolute rated filter medium for reproducible performance
- Inside to outside flow configuration - all debris stay within the filter



Materials of Construction

Filter Medium Type	Filter Medium	Support/Drainage Materials	End Caps	Wrap Materials
HDC® II Medium	High Area Polypropylene Structure	Polypropylene	Glass Filled Polypropylene	Polypropylene and Polyolefin Hotmelt
Profile® Medium in Ultipleat Format	Pleated Polypropylene Depth Structure	Polypropylene	Glass Filled Polypropylene	Polypropylene
Ultipor® GF Medium	Resin Bonded Glass Fiber / Polyester Support	Polyester / Nylon	Glass Filled Acetal	Polyester and Polyamide Hotmelt
Ultipleat CAS Medium	Pleated Polypropylene / Polyether Sulfone Membrane	Polypropylene	Glass Filled Polypropylene	Polypropylene

Operating Conditions

	Polypropylene Medium/ CAS Composite Medium	Glass Fiber Medium[2]
Maximum Differential Pressure[1] (normal inside to outside flow)	50 psid at 180˚F 3.4 bar at 82˚C	50 psid at 250˚F 3.4 bar at 121˚C

1) For fluids compatible with the filter element at the stated temperature.
2) Maximum temperature in aqueous systems is 140˚F / 60˚C

Ordering Information/Specifications

Filter Cartridge Part Number: HFU ▲ ● ◆

Code ▲	Filter Dimensions, nominal, diameter (in/mm) x length (in/mm)	Suggested Maximum Water Flow Per Cartridge (gpm/lpm/mgd)
620	6/152.4 x 20/508	175/663/0.25
640	6/152.4 x 40/1016	350/1325/0.5
660	6/152.4 x 60/1524	500/1900/0.7
680	6/152.4 x 80/2032	500/1900/0.7

Filter Cartridge Pressure Drop (typical) per Filter Length Shown[2]

Medium Type	Grade ●	Absolute Liquid Removal Rating (microns) at 99.98% by particle count[1]	20 inch length		40 inch length		60 inch length		80 inch length	
			psid/100gpm	mbar/M^3/hr	psid/100gpm	mbar/M^3/hr	psid/100gpm	mbar/M^3/hr	psid/100gpm	mbar/M^3/hr
HDC II Medium	J060	6	0.158	0.48	0.080	0.24	0.058	0.17	0.040	0.012
	J100	10	0.120	0.36	0.060	0.18	0.040	0.12	0.030	0.009
	J200	20	0.100	0.30	0.050	0.15	0.033	0.10	0.025	0.008
Profile Medium in Ultipleat Format	UY020[4]	2	1.091	3.31	0.540	1.64	0.362	1.10	0.270	0.082
	UY045	4.5	0.489	1.48	0.242	0.73	0.162	0.49	0.121	0.037
	UY060	6	0.395	1.20	0.196	0.59	0.131	0.40	0.098	0.030
	UY100	10	0.344	1.04	0.170	0.52	0.114	0.35	0.085	0.026
	UY200	20	0.243	0.74	0.120	0.36	0.080	0.24	0.060	0.018
	UY400[3]	40	0.182	0.55	0.090	0.27	0.060	0.18	0.045	0.014
	UY700[3]	70	0.040	0.12	0.020	0.06	0.013	0.04	0.010	0.003
	UY1000[3]	90	0.027	0.08	0.013	0.04	0.009	0.03	0.007	0.002
Ultipor GF Medium	GF020	2	0.219	0.66	0.110	0.33	0.073	0.22	0.055	0.017
	GF060	6	0.180	0.55	0.090	0.27	0.060	0.18	0.045	0.014
	GF100	10	0.159	0.48	0.080	0.24	0.053	0.16	0.040	0.012
	GF200	20	0.119	0.36	0.060	0.18	0.040	0.12	0.030	0.009
	GF400[3]	29	0.100	0.30	0.050	0.15	0.033	0.10	0.025	0.008
Ultipleat CAS Medium	CAS010	1	1.496	4.54	0.740	2.25	0.496	1.51	0.370	1.12

1) The test procedure used is an adaptation of ISO 4572, modified to determine the micron size above which particles are quantitatively removed.
2) Multiply this value by the total system flow to determine the aqueous pressure drop. For fluids other than water, multiply this value by the fluid's viscosity at the operating temperature in centipoise. This value is the pressure drop across the Ultipleat® High Flow filter(s) only; it must be added to the pressure drop contribution from the Ultipleat High Flow filter housing.
3) Precision evaluation of the 99.98% removal efficiency for these coarse grades is not possible with the ISO modified test procedure utilized. The removal efficiency was determined by the maximum spherical particle analysis.
4) 2 micron at 99% efficiency

Code-Filter O-Ring ◆		Material
H13	(Standard for glass fiber and aramid fiber filters)	Buna N
H13U[1]		Buna N U-Cup
J	(Standard for polypropylene filters)	Ethylene Propylene
JU[1]		Ethylene Propylene U-Cup
H4		Silicone
H		Fluoroelastomer

[1] U-Cup seal is standard for the 1 micron composite filter.

Housing Design

Three configurations are available: horizontal*, vertical and centerpipe design.

The in-line horizontal configuration eliminates the need for a platform, or ladder, to remove the filters from the housing.

Vertical vessels may be more appropriate when floor space is limited. However, a platform may be needed to easily remove the elements.

** Required for 80 inch lengths*

In both the standard horizontal and vertical configurations, the inlet pipe is located between the filter element tubesheet and housing lid. The larger the vessel diameter, the longer the distance to reach in and remove the elements from the vessel. In a centerpipe vessel the housing lid is closer to the filter tubesheet. When the lid is opened the filters are easily accessible for installation and removal. Centerpipe vessels are larger in diameter, and more costly.

- Designed to the ASME, section VIII, division 1 code
- Maximum differential pressure across tubesheet: 75 psid (5.17 bar) maximum
- Standard housing gasket: spiral wound 304 stainless steel mineral fiber
- Carbon steel exterior surfaces: sandblasted and coated with an inorganic zinc
- Vent and drains: 1 inch FNPT
- Corrosion allowance: 1/8 inch

Housing Ratings

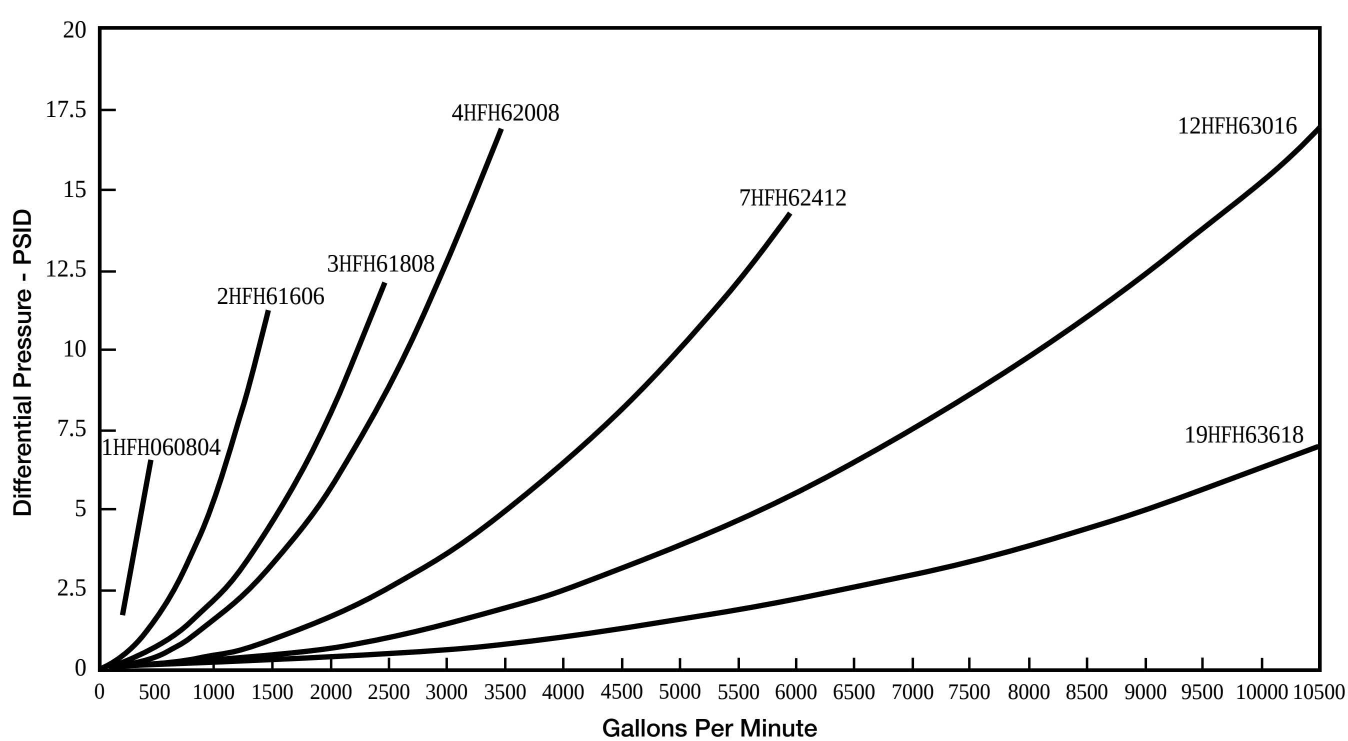
Vessel Material	Tubesheet and Hold Down Plate Material of Construction	Pressure Rating in Psig/Bar g at 140°F / 60°C
Carbon steel	304 stainless steel	275 psig (18.95 bar)
304 stainless steel	304 stainless steel	259 psig (17.85 bar)
304L stainless steel	304L stainless steel	216 psig (14.89 bar)
316 stainless steel	316 stainless steel	261 psig (17.99 bar)
316L stainless steel	316L stainless steel	216 psig (14.89 bar)

Filter Installation and Filter Seal Mechanism

To install a filter element, remove the element hold down plate by lifting it off the locating pins. Lubricate the O-ring on the open-end of the filter with a compatible fluid, and slide the closed end of the filter into the perforated cage, which is welded to the tubesheet. Seat the elements in place by pressing down on the open-end of the filter until the element is snug in the tubesheet. This provides a seal between the filter and housing via the filter O-ring. The open-end cap must be below the tubesheet surface. After installing all the filter cartridges, reinstall and secure the element hold down plate by guiding it over the locating pins on the tubesheet. The purpose of the hold down plate is to prevent the elements from becoming dislodged in the event of reverse flow.

A filter element tool is provided with each housing to aid with the installation and removal of the filter cartridges. This tool eliminates the need for an operator to reach within the filter vessel to either remove or install filters.

Figure 1: Ultipleat High Flow Horizontal Housings (Aqueous Housing Pressure Drop - PSID)



Ordering Information-Standard Horizontal and Vertical Housings

Part Number	No Of Filters	Rated Flow Per Housing- GPM/LPM 60″ Long Filter	Nominal Housing Diameter (in/mm) (D)	Inlet/Outlet Flange Diameter (in/mm)	Maximum* Horizontal Housing Overall Length (in/mm) (L)	Horizontal Housing Height (in/mm (H)	Distance Between Housing and Lid and Tubesheet (in/mm	Housing* Weight Empty (lbs/kg)	Housing* Weight Full Of Water (lbs/kg)	Housing Cover Swing Opening (in/mm)
1HF ■ ● 0804F1▲ ◆	1	500/1893	9/219.1	4/101.6	89/2261	32/817	14.5/368.3	471/214	621/282	9.0/228.6
2HF ■ ● 1606F1▲ ◆	2	1000/3785	16/406.4	6/152.4	100/2527	40/1023	22.7/576.3	1172/532	1771/803	25.8/654.6
3HF ■ ● 1808F1▲ ◆	3	1500/5680	18/457.2	8/203.2	104/2642	43/1093	26.2/665.2	1583/718	2384/1081	27.3/692.8
4HF ■ ● 2008F1▲ ◆	4	2000/7570	20/508.0	8/203.2	105/2654	46/1175	26.4/669.6	2087/947	3048/1382	29.8/756.3
7HF ■ ● 2412F1▲ ◆	7	3500/13248	24/609.6	12/304.8	112/2832	59/1487	31.9/809.6	3250/1474	4762/2160	34.3/870.6
12HF ■ ● 3016F1▲ ◆	12	6000/22710	30/762.0	16/406.4	121/3073	58/1480	38.7/982.7	4670/2118	7306/3314	38.0/964.9
19HF ■ ● 3620F1▲ ◆	19	9500/35958	36/914.4	20/508.0	129/3264	68/1718	43.4/1101.6	7060/3202	11121/5045	44.8/1138.8

* *For 60 inch filter lengths*

Ordering Information - Horizontal Orientation, Centerpipe Designed Housings

Part Number	No. Of Filters	Rated Flow Per Housing- GPM/LPM 60 in Long Filter	Nominal Housing Diameter (in/mm) (D)	Inlet/Outlet Flange Diameter (in/mm)	Maximum* Horizontal Housing Overall Length (in/mm) (L)	Horizontal Housing Height (in/mm) (H)	Distance Between Housing and Lid and Tubesheet (in/mm)	Housing* Weight Empty (lbs/kg)	Housing* Weight Full Of Water (lbs/kg)	Housing Cover Swing Opening (in/mm)
7HF ■ C ● 2808F1▲ ◆	7	3500/13248	28/711	8/203.2	104.3/2648	57.0/1448	4.9/124	4056/1840	6229/2825	36/914
8HF ■ C ● 3012F1▲ ◆	8	4000/15140	30/762	12/304.0	117.6/2988	58.3/1480	6.1/154	4707/2135	7348/3333	40/1018

* *For 60 inch filter lengths*

Code ■	Housing Configuration
H	Horizontal
V	Vertical

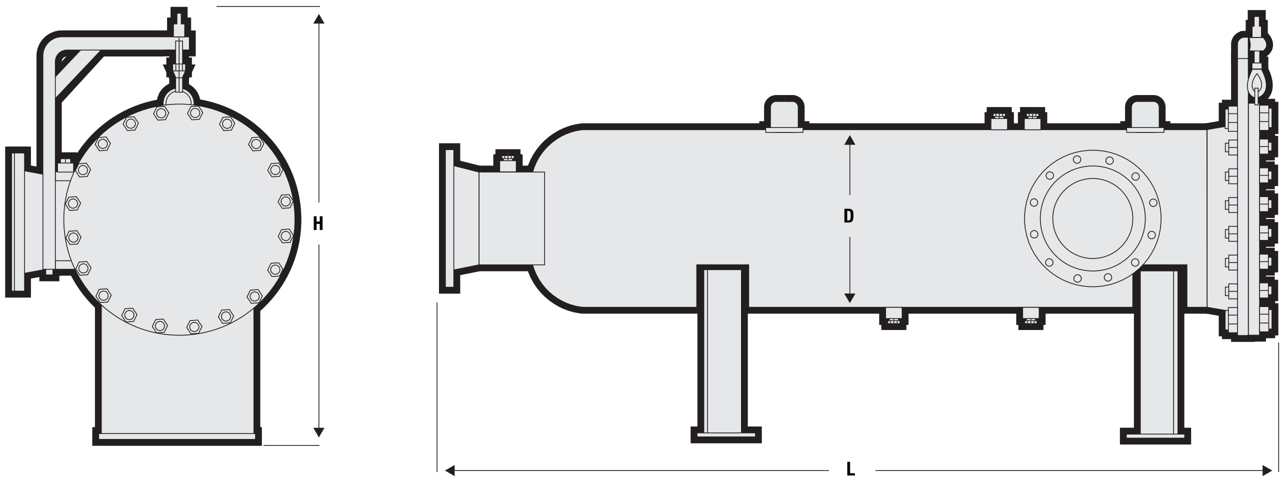
Code ▲	Housing Metallurgy
285	Carbon Steel Vessel, 304 Stainless Steel Tubesheet
S3	304L Stainless Steel
S8	304 Stainless Steel
L3	316L Stainless Steel
L8	316 Stainless Steel

Code ●	Nominal Cartridge Length (in/mm)
2	20/508
4	40/1016
6	60/1524
8	80/3032

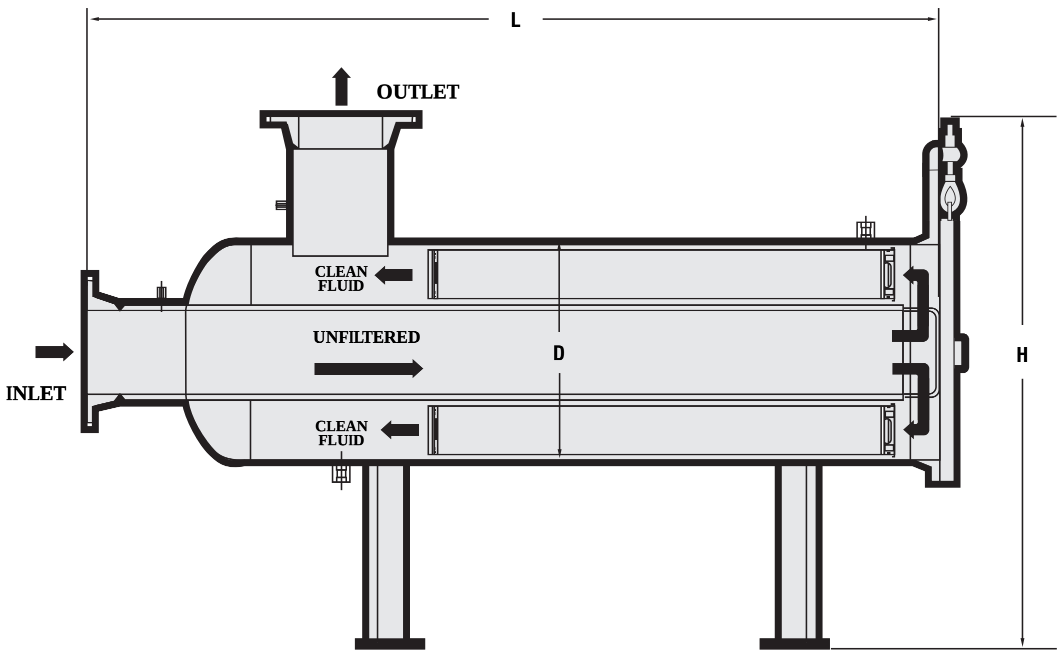
Code ◆	Optional Outlet Size[1] Horizontal Housings
XU	Upper Outlet Location
XL	Lower Outlet Location

[1] *If the housing is to be used as a prefiller to a horizontal liquid/liquid coalescer, then the vessel should be ordered using the XU or XL option for the outlet location. The orientation of the outlet should be the same as that of the sump on the coalescer. In this way no buildup of coalesced liquid will occur in the prefilter.*

Horizontal Housings



Horizontal Housings, Centerpipe Design



Ultipleat High Flow Filter System Reduces Costs

Begin reducing your capital and operating costs today. Contact your local Pall distributor, or call Pall directly for an Ultipleat High Flow system quotation.

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GDS 131b

December 2009

Pall Corporation

Ultipleat® High Flow 1 Micron Element

Description

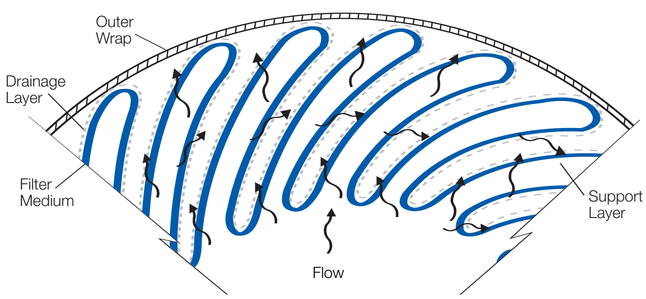
The 1 µm Ultipleat High Flow Element is a large diameter, coreless, single open ended, pleated cartridge with an inside to outside flow pattern. The filter's unique, crescent-shaped pleat geometry, combined with its large 6.3" (16 cm) diameter allows you to use fewer filters to remove fine particles and cysts in high flow applications.

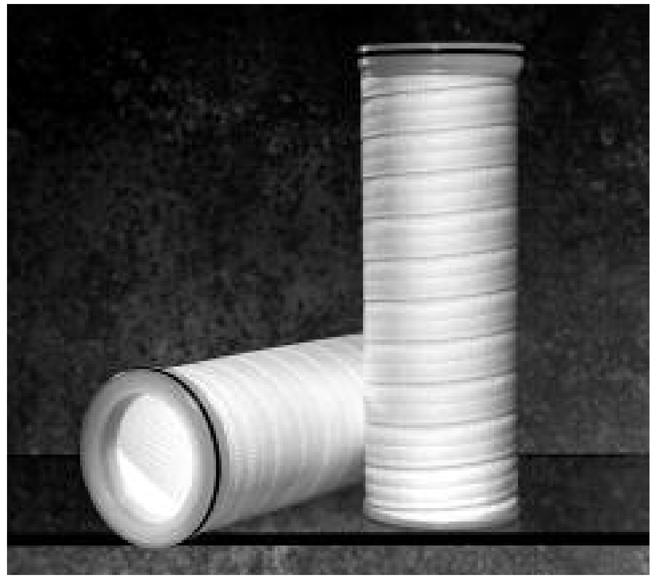
Benefits

- High flow rates per element
- Low cost of installation and filtration
- Fewer elements per change out
- 1 µm absolute[1] filtration
- Polyethersulfone media provides greater than 3 log reduction of *Giardia oocysts* and *Cryptosporidium*
- Inside to outside flow configuration retains all particulate matter inside the element
- Coreless, all plastic construction to minimize waste disposal
- U-cup element seal ensures high level removal efficiencies

[1] *Particle Removal Rating*

Crescent-Shaped Pleat Geometry with Inside to Outside Flow





Ultipleat High Flow Elements

Performance Specifications

- Water flow rate
  - 20" length – 68 gpm/psid (257 lpm/70 mbar)
  - 40" length – 135 gpm/psid (511 lpm/70 mbar)
  - 60" length – 204 gpm/psid (772 lpm/70 mbar)
- Maximum forward differential pressure
  - 50 psid @ 180˚F (3.44 bar @ 82˚C)
- Maximum operating temperature
  - 180˚F (82˚C)
- Sanitization
  - Can be sanitized with hot water (185˚-194˚F/85˚-90˚C) for a maximum of 100 cycles (1 cycle = 10 minutes) without compromising the removal efficiency of the filter.
  - Peracetic acid, chlorinated alkaline products and other sanitization chemicals may be used. Contact Pall for recommended procedures.

Applications

- Incoming water filtration
- Barrier to cysts and oocysts
- Prefilter for bottled water sterilizing filters
- Food and beverage processes

Product Specifications

Materials of Construction

Filter Media:	1 µm polyethersulfone
Outer Sleeve and End Caps:	Polypropylene
Drainage and Wrap:	Polypropylene
Wrap Adhesive:	Polyolefin hot melt
Filter Seal:	FDA compliant ethylene propylene

Dimensions

Diameter:	6.3" (16 cm)
Length:	20", 40", 60" (51 cm, 102 cm, 152 cm)

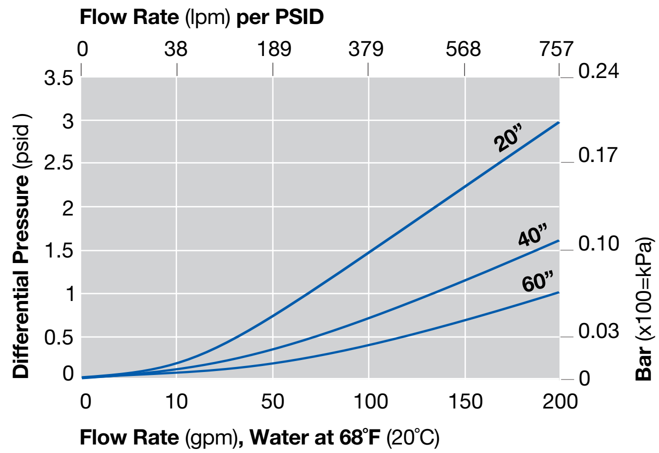
Other Ultipleat High Flow Elements

Ultipleat High Flow elements are available in other filter media with absolute ratings of 2, 4.5, 10, 20, 40 and 100 µm. Contact Pall for more information.

Housing Design

A single element, sanitary designed housing is available for use with the 1 µm Ultipleat High Flow element. Industrial style housings are also available. Contact Pall for more information.

1 µm Ultipleat High Flow



Ordering Information

Product Part Number: HFU6 ◆ CAS010JUW

Code ◆	Length
20	20" (51 cm)
40	40" (102 cm)
60	60" (152 cm)

Pall Corporation

Bad Kreuznach – Germany
0049 671 8822 0 telephone
0049 671 8822 200 fax

Portsmouth – United Kingdom
0044 23 92 30 33 03 telephone
0044 23 92 30 25 06 fax

New York – USA
001 516 484 5400 telephone
001 516 625 3610 fax

Melbourne – Australia
0061 395 8481 00 telephone
0061 395 8466 47 fax

Paris – France
0033 1 30 6138 00 telephone
0033 1 30 6157 08 fax

Milano – Italy
0039 02 47 79 61 telephone
0039 02 41 22 985 fax

foodandbeverage@pall.com

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Bulletin #FB 102-D 11/065

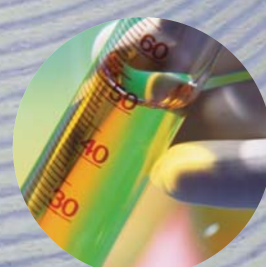
PALL

Pall Corporation

Ultipleat®

High Flow Filter Systems

Designed for Large Flow Applications



*Filtration. Separation. Solution.*SM

ULTIPLEAT®

Ultipleat High Flow Filter Systems

...fewer elements
smaller housings
higher flow rates
and bigger cost savings

The Pall Ultipleat® High Flow filter system addresses your need for an economical and reliable filter system for high flow applications. You no longer have to rely on traditional bag or cartridge filter systems that do not meet all of your requirements.

Smaller, more economical filter systems

This proven filtration technology has advanced to the next level with even higher flow rates per filter cartridge. In fact, just one six-inch diameter Ultipleat High Flow filter element can handle up to 500 gpm (1900 lpm). The unique crescent-shaped pleat geometry, combined with its large diameter and proprietary range of available filter media, permits use of significantly fewer elements and smaller housings for high flow applications. Greater performance may now be achieved with a system that is two to four times smaller than conventional depth or pleated filter technologies. Smaller systems are also less costly to install and maintain (see Figure 1).

Lower waste disposal costs

Longer service life and coreless construction equate to minimized disposal volumes and costs. Use of Ultipleat High Flow elements result in up to four times less volume of spent cartridges than conventional depth filters (see Figure 2).

The inside-to-outside flow configuration and coreless construction of the Ultipleat High Flow element allows it to be tightly compacted to further minimize disposal costs. Also, since no metallic components are used in the element, incineration is a disposal option.

Waste disposal savings are even greater when the longer service life of Ultipleat High Flow filters is considered. Less frequent change outs provide even fewer elements for disposal.

Lower maintenance costs

Maintenance requirements and production downtime is dramatically reduced with 30 times fewer filters to change out versus conventional depth filters (see Figure 3). Removal of spent elements is neither difficult nor messy since all of the solid contamination is trapped inside of the filter.

Filter Comparison-500 GPM at 5 micron

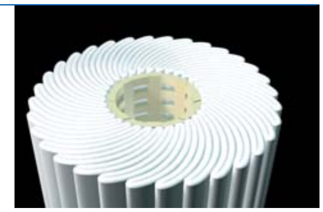


FIGURE 1. TYPICAL HOUSING DIAMETER

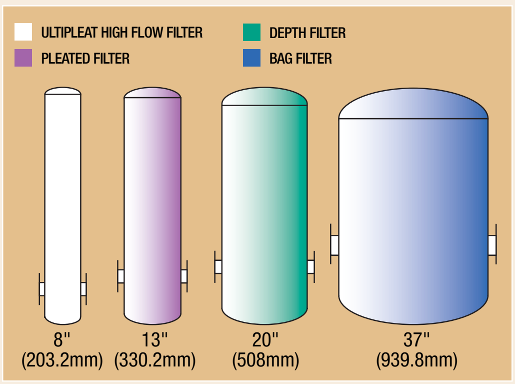


FIGURE 2. TYPICAL DISPOSAL VOLUME PER CHANGEOUT

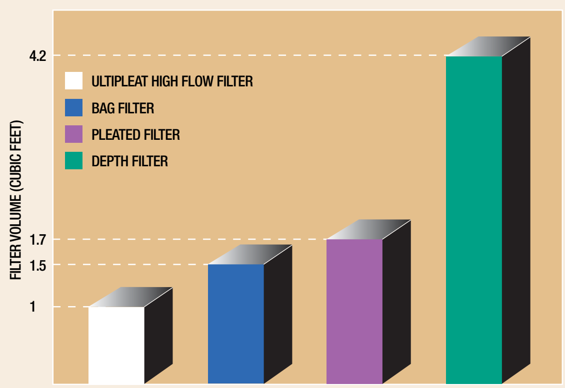
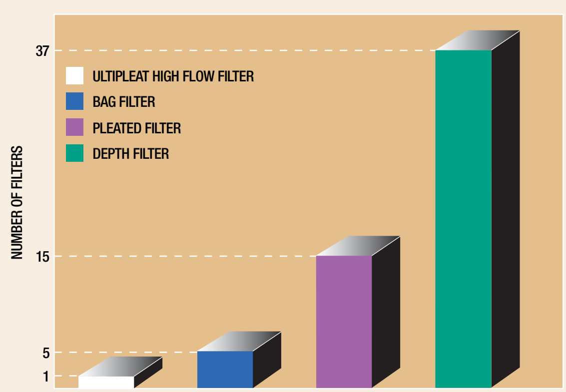
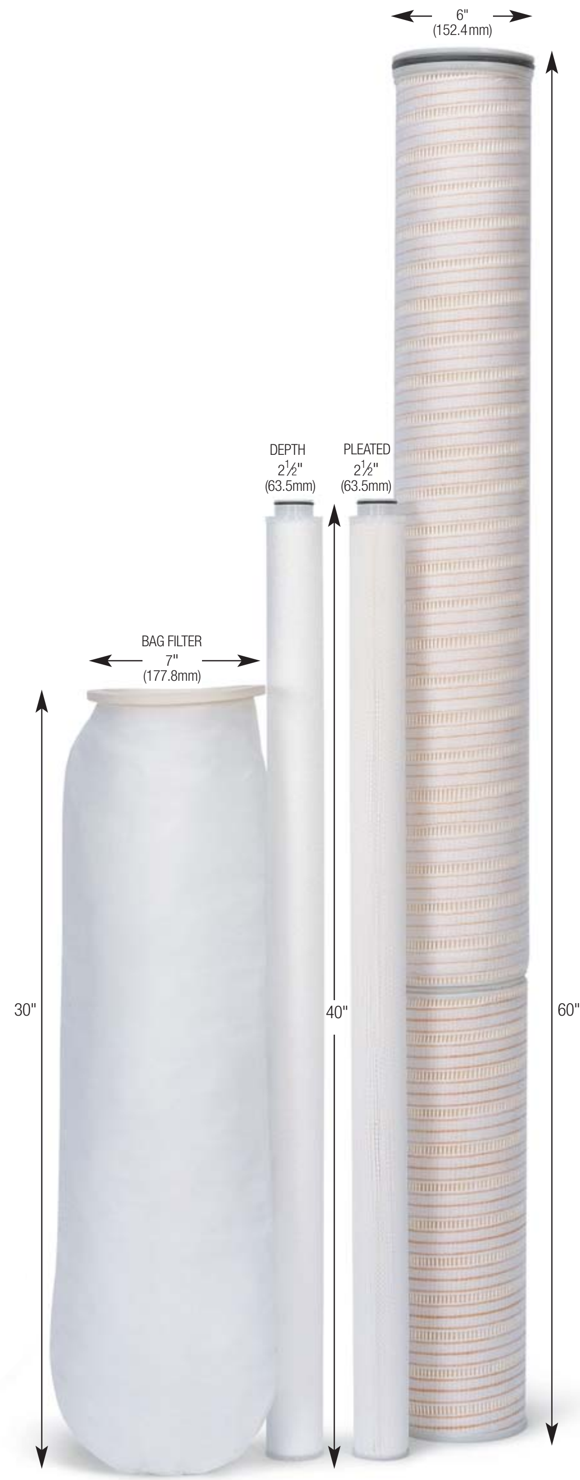


FIGURE 3. TYPICAL NUMBER OF FILTERS





Ultipleat High Flow Filter System Applications

Biopharmaceutical:

Pharmaceuticals, Cosmetics, Fragrances, Toiletries, Bioprocesses

Food & Beverage:

Beer, Wine, High Fructose Corn Syrup, Fats, Edible Oils, Soft Drinks, Dairy, Juice, Cyst and Oocyst Barrier, Bottled Water, Pre-RO, Utility Water

Fuels & Chemicals:

Chemical Plants, Refineries, Amines, Diesel Fuel, Specialty Chemicals, Petrochemicals, Polymer, Oil Recovery, Film, Fiber and Resins, High Performance Plastics

Machinery & Equipment:

Electrodeposited Primers, Paints & Coatings, Pulp and Paper, Automotive Manufacturing, Mobile Equipment, Primary Metals

Microelectronics:

Makeup Water, Semiconductors, Microlithography, Chemical Mechanical Polishing, Process Chemicals

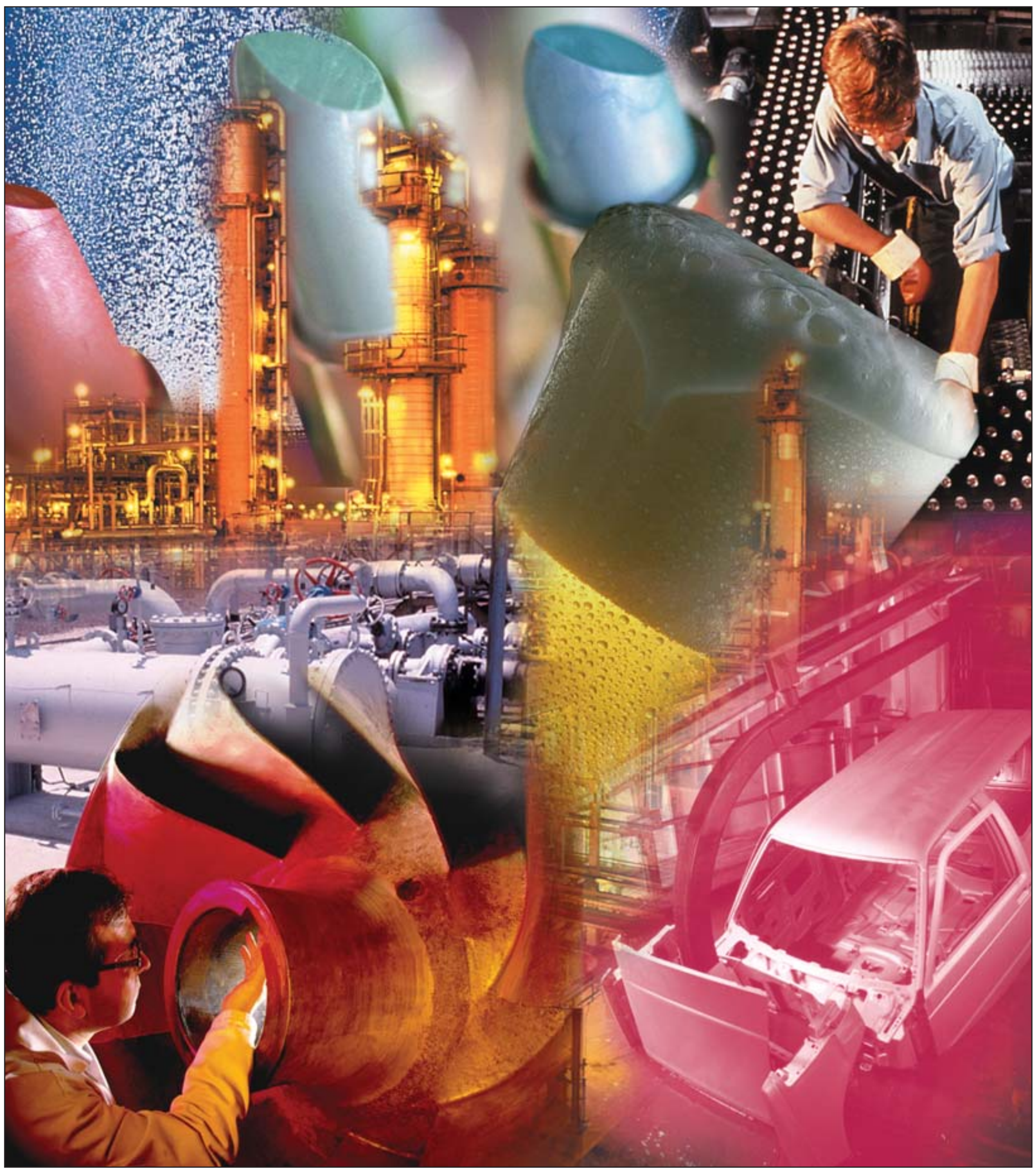
Power Generation:

Boiler Condensate, Nuclear and Fossil Power Plants, Cogeneration, Gas Turbines

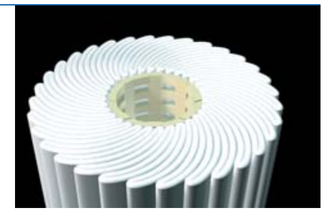
Water Processing:

Reverse Osmosis, Centralized Water Systems, Process Water, Municipalities, Desalination, Process Waste Water

Ultipleat High Flow filter systems are used in a wide variety of applications where high flow rates and long service life are primary requirements. These filter systems are used successfully in installations ranging up to 4,000 gpm (15,142 lpm).



Optimize filter life and lower operating costs with smaller Ultipleat High Flow filter systems

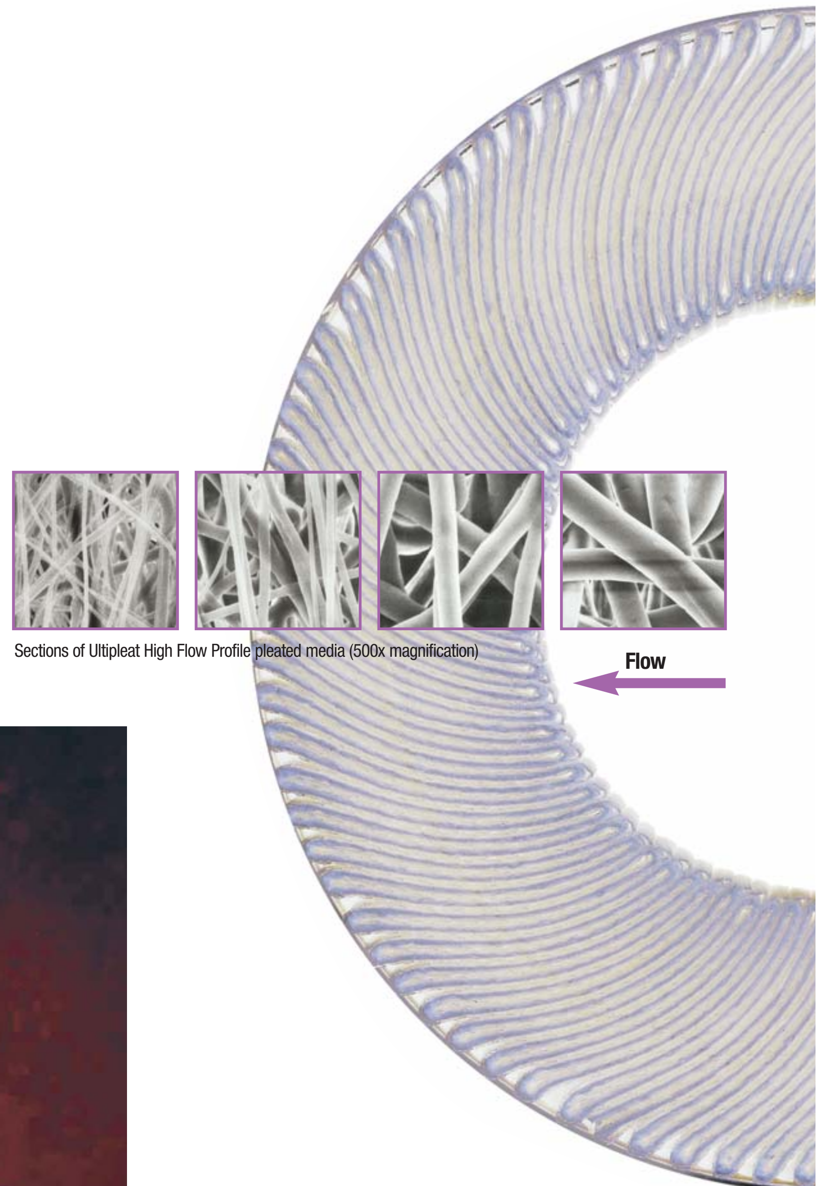


Long filter service life and low operating costs you require will not be compromised with the smaller Ultipleat High Flow filter systems due to innovative product features.

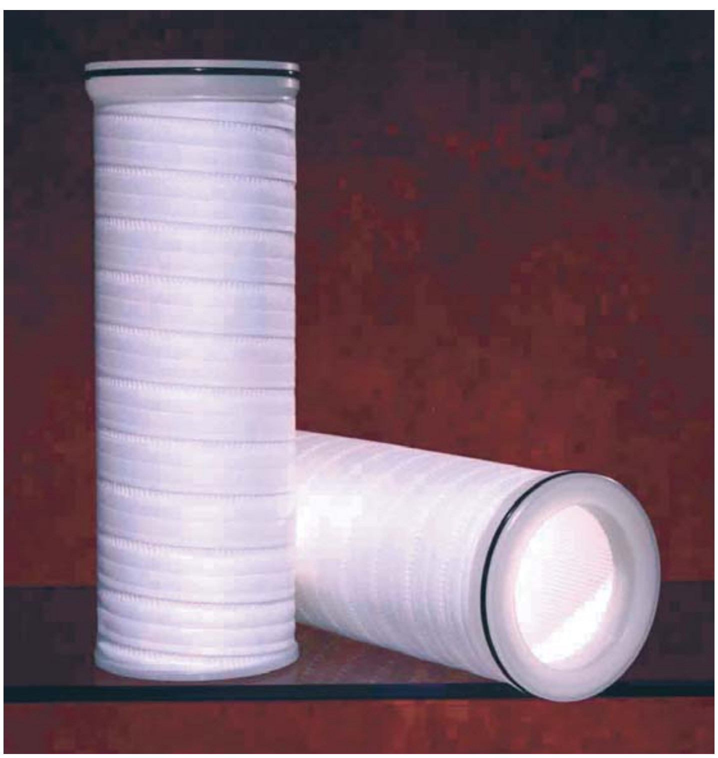
Innovation: High performance filter media

Many of the available filter media have a tapered pore structure made from fine fibers. This results in a range of filter media with excellent dirt holding capacity and low resistance to flow. In addition, the fixed pore media provide precise and reliable fluid quality.

Result: Economical and reproducible filtration



Sections of Ultipleat High Flow Profile pleated media (500x magnification)



Innovation: Ultipleat filter technology

The Ultipleat High Flow filter system is an extension of Pall's proprietary Ultipleat filter technology. The crescent-shaped pleat design of the Ultipleat High Flow filter allows for a large amount of filter area to be packed into one cartridge capable of handling up to 500 gpm (1900 lpm). Such a high flow rate combined with long filter service life in a small vessel, results in the lowest overall cost of ownership. No other filter can provide such performance. However, large filter area is only one aspect behind the superior performance of the Ultipleat High Flow filter.

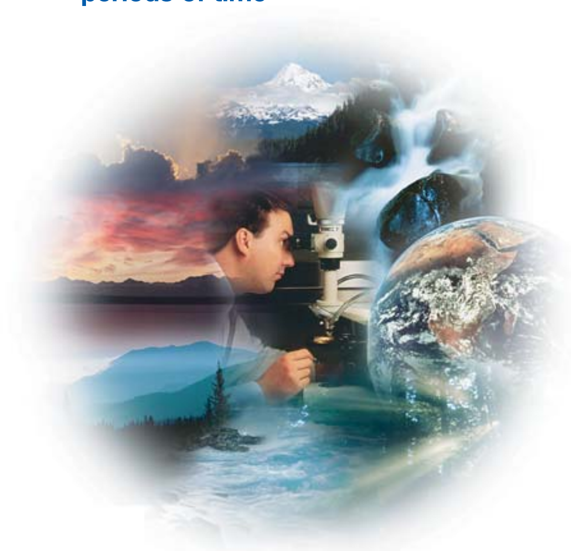
Uniform flow distribution over the filter's entire surface is the key.

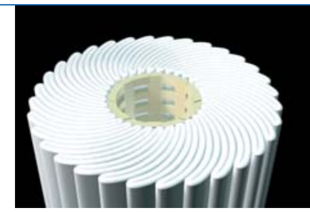
The fluid flow is completely uniform across the entire surface of the filter medium. The evenly distributed flow is maintained since the flow channel is the same width and length on both sides of the filter medium (see Figure 4). This uniform flow is maintained, even with high differential pressures across the element, due to the uniquely designed upstream support and downstream drainage layers. These layers, which sandwich the filter medium, hold the flow channels open. The pleats are then held in place and preserved by the proprietary external helical wrap that is bonded to each pleat tip along the outer diameter of the cartridge. Comparatively, the upstream flow channel of the medium in a conventional triangular shaped pleat structure is much more open than the downstream side (see Figure 5). Consequently, the flow is highest at the bottom of the pleat. This non-uniform flow distribution may result in areas of rapid plugging where the flow is the highest. Additionally, such a flow pattern through a conventional triangular shaped pleat structure may cause inconsistent particle removal.

The drainage and support materials used in conventional pleated filters are often thin and structurally weak. Consequently, pleats may become compacted thereby resulting in lower flow rates and, thus, limited on stream filter service life (see Figure 5).

Ultipleat High Flow filter's uniform flow yields:

- **Maximum filter service life**
- **Reliable particle removal**
- **Low resistance to flow for longer periods of time**





UNIFORM FLOW DISTRIBUTION
AMOUNT OF FLOW DEPICTED BY SIZE OF ARROW

Ultipleat High Flow Filter Construction

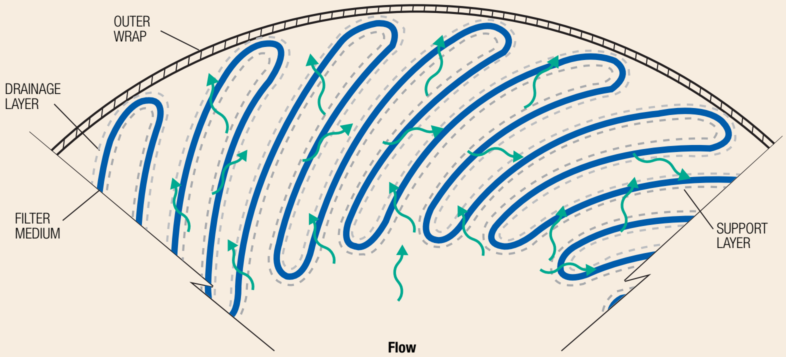
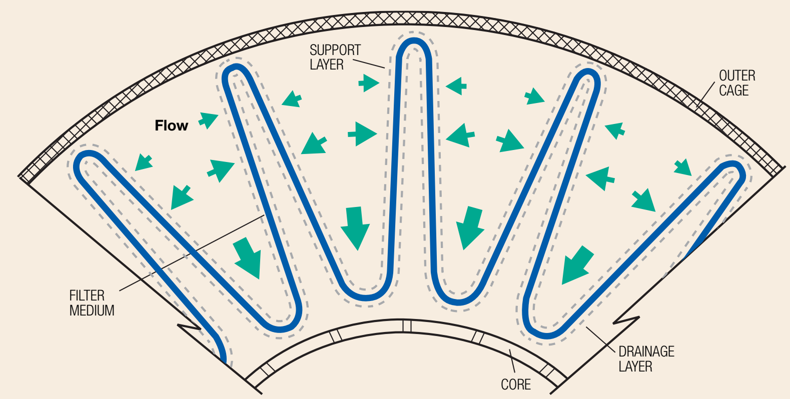


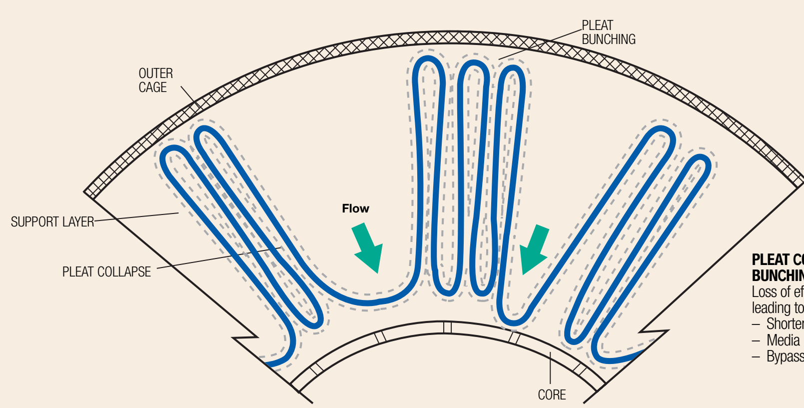
Figure 4.

NON-UNIFORM FLOW DISTRIBUTION
AMOUNT OF FLOW DEPICTED BY SIZE OF ARROW

Conventional Pleated Element Construction



Pleat Collapse and Bunching in a Poorly Designed Filter



PLEAT COLLAPSE AND BUNCHING
Loss of effective area leading to:
- Shorter filter service life
- Media migration
- Bypass of contaminants

Figure 5.

Filter Ordering Information

Part Numbers HFU

Select the appropriate part number from the tables below.

Medium Type	Code	Absolute Liquid Removal Rating at 99.98% Efficiency by Count[1] (um)	Maximum Allowable Pressure Drop at Temperature		Typical Element Aqueous Pressure Drop[2]					
					20" Length		40" Length		60" Length	
			(PSID/Bar)	Temp. (°F/°C)	(PSID/GPM)	(mBarD/M³/H)	(PSID/GPM)	(mBarD/M³/H)	(PSID/GPM)	(mBarD/M³/H)
HDC®-II Pleated Polypropylene[3]	J060	6	50/3.4	180/82	0.0016	0.48	0.0008	0.24	0.0005	0.15
	J100	10	50/3.4	180/82	0.0018	0.55	0.0006	0.18	0.0004	0.12
	J200	20	50/3.4	180/82	0.0011	0.30	0.0005	0.15	0.0003	0.09
Ultipleat Profile® Pleated Depth Polypropylene[3]	UY020[4]	2	50/3.4	180/82	0.0089	3.0	0.0054	1.6	0.0037	1.1
	UY045	4.5	50/3.4	180/82	0.0046	1.4	0.0023	0.70	0.0015	0.46
	UY060	6.2	50/3.4	180/82	0.0064	1.9	0.0032	1.0	0.0021	0.64
	UY100	10	50/3.4	180/82	0.0034	1.0	0.0017	0.52	0.0011	0.33
	UY200	20	50/3.4	180/82	0.0024	0.8	0.0012	0.36	0.0008	0.24
	UY400[5]	50	50/3.4	180/82	0.0018	0.55	0.0009	0.27	0.0006	0.18
	UY700[5]	70	50/3.4	180/82	0.004	0.11	0.0002	0.05	0.0001	0.04
	UY1000[5]	90	50/3.4	180/82	0.0008	0.26	0.0004	0.11	0.0003	0.08
Ultipor® Glass Fiber[6]	GF020	2	50/3.4	250/121	0.0022	0.67	0.0011	0.33	0.0007	0.21
	GF060	6	50/3.4	250/121	0.0039	1.2	0.0019	0.58	0.0013	0.40
	GF100	10	50/3.4	250/121	0.0016	0.49	0.0008	0.24	0.0005	0.15
	GF200	20	50/3.4	250/121	0.0012	0.36	0.0006	0.18	0.0004	0.12
Ultipor® GFK Medium	P100[7]	10	50/3.4	180/82	0.0016	0.49	0.0008	0.24	0.0005	0.15
	GFK100	10	50/3.4	250/121	0.0020	0.607	0.001	0.304	0.0007	0.213
Ultipor® K Medium	K200	20	50/3.4	200/93[8]	0.0031	0.941	0.0015	0.455	0.001	0.304
Ultipleat® Polyethersulfone Membrane[3]	CAS010	1	50/3.4	180/82	0.0128	3.9	0.0074	2.3	0.0049	1.5

Code	Filter Dimensions (in/mm)**
620	6/152.4 x 20/508
640	6/152.4 x 40/1016
660	6/152.4 x 60/1524

Footnotes:

1. The test procedure used is an adaption of ISO 4572, modified to determine the micron size above which particles are quantitatively removed.
2. Pressure drop in PSIG per GPM for the cartridge length shown. Multiply this value by the total system flow to determine the aqueous pressure drop. Next for fluids other than water, multiply this value by the fluid viscosity (in centipoise) at the operating temperature. Divide this calculated pressure drop by 3. This will determine the number of filters required to have a 3 psig/(0.2 bar) pressure drop across the filter elements at startup. This value is the pressure drop across the Ultipleat High Flow filter(s) only-it must be added to the pressure drop due to the Ultipleat High Flow housing to determine the total system pressure drop. Refer to the housing ordering information table to select a housing that can hold the number of filters you calculated.
3. Polypropylene medium and polyethersulfone membrane filters are made with FDA listed materials with the exception of the glass reinforced polypropylene end caps.
4. 99% efficiency.
5. Filters rated by Maximum Spherical Particle Passed test.
6. Maximum temperature in aqueous systems is 140°F/60°C.
7. Filter optimized for hydrogen peroxide working solution.
8. Rating in Aqueous Service
9. U-Cup Seal is standard for 1 micron CAS010 polyethersulfone filter.

40" FILTER CARTRIDGE

Code	O-ring Materials
H13 (Standard for glass fiber filters)	Buna N
J (Standard for polypropylene filters)	Ethylene Propylene
H4	Silicone
H	Fluorocarbon Elastomer
H1	FEP Encapsulated Fluorocarbon Elastomer
H13U	Buna N U-Cup Seal
JU	Ethylene Propylene U-Cup Seal
JUW[9] (FDA Listed Materials)	Ethylene Propylene U-Cup Seal*

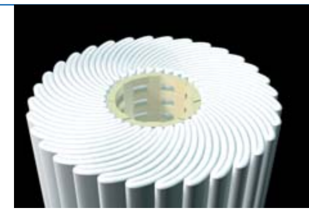
* Manufactured from Ethylene Propylene which is listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.

Sizes**

Filter Diameter (in/mm)	Filter Length (in/mm)	Suggested Maximum Flow of Water (GPM/LPM)
6/152.4	20/508	175/663
6/152.4	40/1016	350/1325
6/152.4	60/1524	500/1900

** All dimensions are nominal.

High Purity Ultipleat High Flow Filter Systems



Cyst and Oocyst Protection with Ultipleat High Flow Systems

The one-micron Ultipleat High Flow filter with our proprietary polyethersulfone membrane provides greater than 3 log reduction of *Giardia oocysts and Cryptosporidium cysts*. This unsurpassed removal of *Cryptosporidium and Giardia* from process water gives manufacturers the protection required to provide their customers with safe products.

Sanitization of Ultipleat High Flow 1-Micron Filters

Ultipleat High Flow 1-micron filters may be sanitized by any of the following methods:

- Hot water: 185°-194°F (85°-90°C)
- For information on other sanitization chemicals/methods, contact Pall.

High Purity Housings

Housing Design Features

Orientation	Horizontal or Vertical
Pressure/Temperature Rating	145psi (10.0 bar)@176°F (80.0°C)
Housing Seal	FDA-listed Ethylene Propylene
Material	316L Stainless Steel
Electropolish finish	32 µ-inch/0.8 µm Ra
Number of elements	1

Part Numbers ▲ ■ 1 ● G ◆ J

Code ▲	Housing Design
UHFS	Sanitary, electropolished
EWHF	Non-electropolished

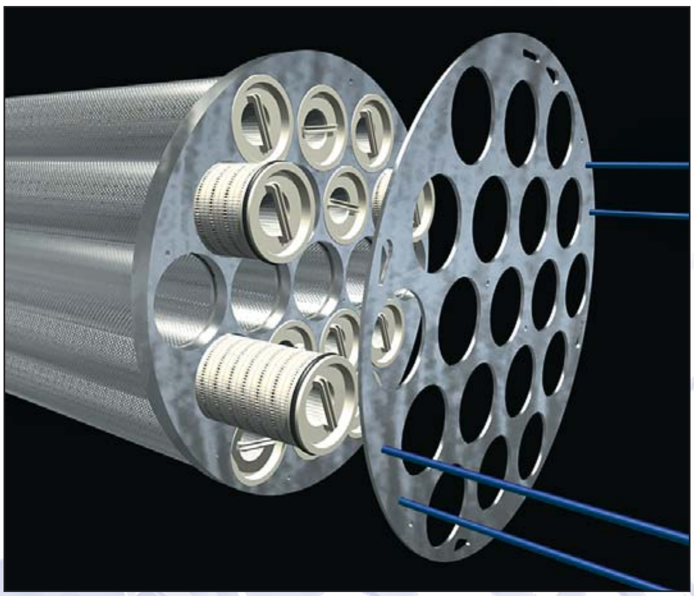
Code ●	Nominal Element Length (in/mm)
2	20/508
4	40/1016
6	60/1524

Code ■	Housing Configuration
H	Horizontal
V	Vertical

Code ◆	Inlet/Outlet Connection
31	2″ Tri-clamp
47	3″ Tri-clamp
NW80	80 mm DIN
NW100	100 mm DIN

Industrial Housing Designs

A series of housings are available in both horizontal and vertical configurations. The inline horizontal configuration minimizes pressure drop and is more easily accessible for filter changeout. Vertical configurations are an option, depending on your application and space limitations.



Unique filter element-to-tubesheet seal, is shown here with element hold down plate.

INDUSTRIAL HOUSING DESIGN FEATURES

Design	ASME, section VIII Division 1 code
Orientation	Horizontal or vertical
Maximum Differential Pressure Across Tubesheet	75 psid (5.2 bar) maximum
Standard Closure Gasket	Spiral wound 304 stainless/ mineral filler
Exterior Surfaces	Sandblasted and coated with an inorganic zinc primer
Vent and Drains	1″ (2.54 cm) FNPT

INDUSTRIAL HOUSING DESIGN RATINGS

Vessel Material	Pressure Rating at 180°F (82°C) (PSIG/Bar)	Pressure Rating at 275°F (135°C) (PSIG/Bar)
Carbon steel	265/18.3	237/16.3
304 stainless steel	243/16.8	212/14.6
304L stainless steel	202/13.9	180/12.4
316 stainless steel	247/17.0	220/15.2
316L stainless steel	202/13.9	180/12.4

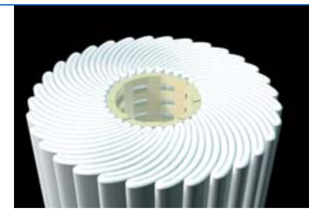
Innovation: Unique element sealing mechanism

In multi-cartridge housings, the elements are sealed into the tubesheet, independent of the housing closure, utilizing a unique sealing arrangement.

Result: Consistent fluid quality

These innovations make the Ultipleat High Flow filter system a compact, economical, environmentally sound and user-friendly product that will provide the highest performance and best overall value.

Industrial Housing Ordering Information



ASME Coded Pressure Vessels

Select the appropriate part number from the tables below.

Part Number	Number of Filters	Aqueous Rated Flow Per Housing (GPM/LPM[1])	Nominal Housing Outer Diameter (D) (in/mm)	Inlet/Outlet Flange Diameter (in/mm)	Housing Overall Length (L) (in/mm)	Horizontal Housing Height (H) (in/mm)	Housing Weight Empty (Lbs/KG)	Housing Weight Full of Water (Lbs/KG)
1HF ■ ● 0804F1 ▲ ◆	1	500/1893	8⅝/219.1	4/101.6	89/2261	32/817	471/214	621/282
2HF ■ ● 1606F1 ▲ ◆	2	1000/3785	16/406.4	6/152.4	100/2527	40/1023	1172/532	1771/803
3HF ■ ● 1808F1 ▲ ◆	3	1500/5680	18/457.2	8/203.2	104/2642	43/1093	1583/718	2384/1081
4HF ■ ● 2008F1 ▲ ◆	4	2000/7570	20/508	8/203.2	105/2654	46/1175	2087/947	3048/1382
7HF ■ ● 2412F1 ▲ ◆	7	3500/13248	24/609.6	12/304.8	112/2832	59/1487	3250/1474	4762/2160
12HF ■ ● 3016F1 ▲ ◆	12	6000/22710	30/762	16/406.4	121/3073	58/1480	4670/2118	7306/3314
19HF ■ ● 3620F1 ▲ ◆	19	9500/35958	36/914.4	20/508	129/3264	68/1718	7060/3202	11121/5045

1. The housing aqueous pressure drop at the maximum flow rating with the connection sizes noted will be approximately 5 psig (0.3 bar). To calculate the actual housing pressure drop, multiply this aqueous pressure drop by the fluid's specific gravity. This housing pressure drop must be added to the filter pressure drop calculated on page 9, above to determine the pressure drop of the Ultipleat High Flow Filter System.

Code ■	Housing Configuration
H	Horizontal
V	Vertical

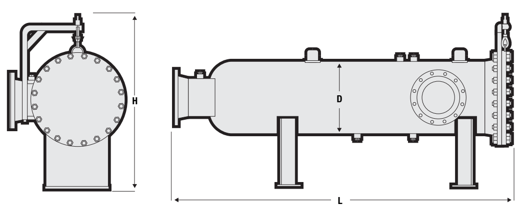
Code ●	Nominal Cartridge Length (in/mm)
2	20/508
4	40/1016
6	60/1524

Code ▲	Housing Metallurgy
285	Carbon steel vessel, 304 stainless steel tubesheet
S3	304L Stainless steel
S8	304 Stainless steel
L3	316L Stainless steel
L8	316 Stainless steel

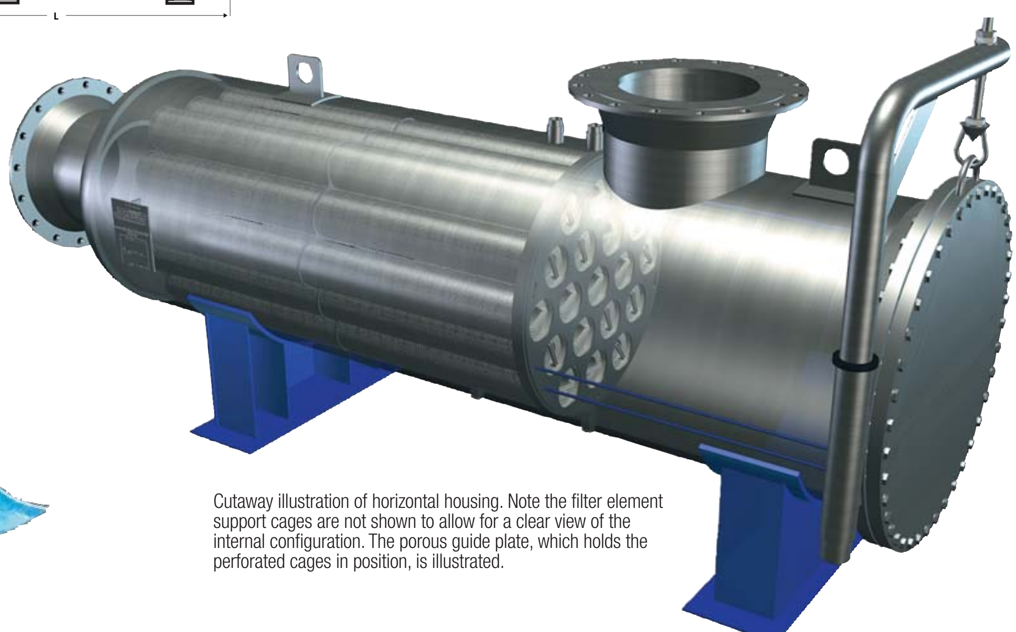
Code ◆	Optional Outlet style[1] Horizontal Housings
XU	Upper Outlet Location
XL	Lower Outlet Location

[1] If the housing is to be used as a prefilter to a horizontal liquid/liquid coalescer, then the vessel should be ordered using the XU or XL option for the outlet location. The orientation of the outlet should be the same as that of the sump on the coalescer. In this way no buildup of coalesced liquid will occur in the prefilter.

Horizontal Housings



For information on larger horizontal housings, Pall's family of vertical housings, or noncode housing designs for these filter cartridges, please contact Pall or your distributor.



Cutaway illustration of horizontal housing. Note the filter element support cages are not shown to allow for a clear view of the internal configuration. The porous guide plate, which holds the perforated cages in position, is illustrated.

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UHF100 (version H)

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WATER-FINE™ Series Filter Cartridges

DI and High Purity Water Filter

- Proprietary Highly Asymmetric Polysulfone Membrane Media
- Absolute Rated at >99.9% Efficiency with Retention Ratings from 0.05 to 1.2 µm
- Superior Flow Rates and Long Service Life
- High Purity Polypropylene Hardware
- End Configurations to Fit Most Housings

Performance Specifications

Filter Grades (>99.9% Retention Rating by Standard Latex Bead Challenge):
0.05, 0.1, 0.2, 0.45, 0.65, 0.8, 1.2 µm

Maximum Differential Pressure:
70 psid (4.8 bard) @ 120°F (49°C)
50 psid (3.4 bard) @ 180°F (82°C)

Recommended Change Out Differential Pressure[1]:
35 psid (2.4 bard)

FDA Listed Materials:
Manufactured from materials, which are FDA listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations.

Sanitizing Agents:
Cartridge may be sanitized in place with common oxidizing agents. Consult factory for compatibility information.

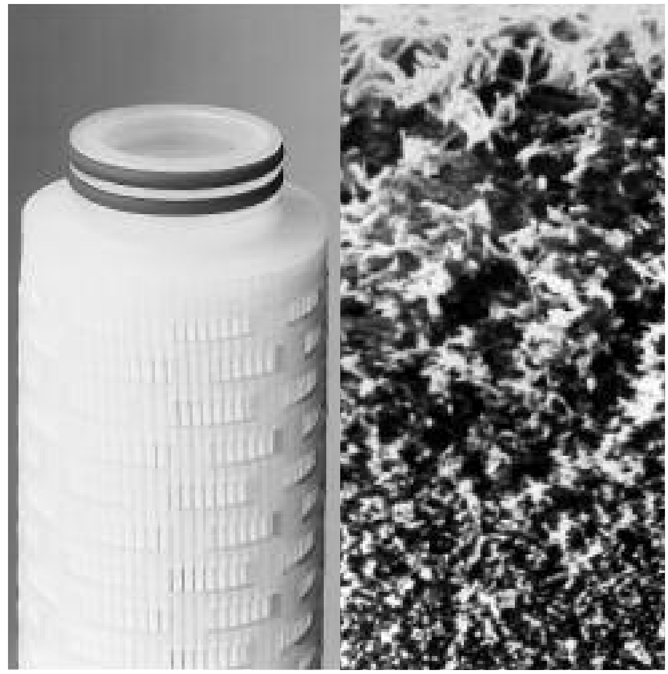
Rinse-Up:
Cartridges will rinse-up to 18 Megohm-cm with a minimum of throughput.

Pre-Rinsing:
A pre-rinse is available upon request. Specify code 314 at end of Water-Fine description.

Product Specifications

Materials of Construction:

Filter Media:	Highly Asymmetric Polysulfone Membrane
Support Material:	Polypropylene
Hardware:	Polypropylene
Surface Treatment:	Hydroxypropylcellulose
Sealing:	Thermal Bond
Gaskets/O-rings:	Silicone Elastomer, EPDM, Buna N, Viton[2] A, FEP Encapsulated Silicone



Dimensions (nominal):

Outside Diameter:	2 ⅝" (6.6 cm)
Lengths:	4" (10.2 cm), 9 ¾" (24.8 cm), 10" (25.4 cm), 19 ½" (49.5 cm), 20" (50.8 cm), 29 ¼" (74.3 cm), 30" (76.2 cm), 39" (99.1 cm), 40" (102 cm)
Surface Area:	6.1 ft^2 (0.57 m^2) per 10" (25.4 cm) equivalent

Product Applications

- Pre and Post Filter for DI Water
- Point-of-Use Filter for DI Water
- Filtration of Aqueous Chemical Solutions

[1] - Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

[2] - Registered trademark of DuPont Dow.

Liquid Flow Specifications

Filter Grade (µm)	DI Water Flow per 1 psid (gpm/10" (25.4 cm) equivalent)
0.05	1.0 (3.8 lpm)
0.1	1.7 (6.4 lpm)
0.2	3.0 (11.4 lpm)
0.45	5.5 (20.8 lpm)
0.65	6.0 (22.7 lpm)
0.8	7.0 (26.5 lpm)
1.2	8.0 (30.3 lpm)

Part Numbers/Ordering Information

WFN ■ – ● U ◆ – ▼ ▮ (e.g., WFN0.2–10US-M3 314)

Code ■	Filter Grades
0.05	0.05 µm
0.1	0.1 µm
0.2	0.2 µm
0.45	0.45 µm
0.65	0.65 µm
0.8	0.8 µm
1.2	1.2 µm

Code ●	Cartridge Lengths (nominal)
4	4"
9.75	9.75"
10	10"
19.5	19.5"
20	20"
29.25	29.25"
30	30"
39	39"
40	40"

Code ◆	Gasket/O-ring Materials
S	Silicone (standard O-rings)
E	EPDM
V	Viton A
N	Buna N (standard gaskets)
T	FEP Encapsulated Silicone
X	No O-ring required (M2 only)

Code ▼	End Configurations
Blank	DOE with elastomer gasket seals & end caps
1X	DOE, 1" (2.54 cm) extended core
M2	SOE flat closed end fits housing with 020 O-ring post
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[3]
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[3]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[3]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[3]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[3]
M10	DOE, internal O-rings (fits other manufacturers' housings)[3]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X-style)[3]
M20	SOE, internal O-ring (same as M10), closed end with deep recess

Code ▮	Pre-Rinse Option
Blank	No Pre-Rinse
314	Pre-Rinse

[3] - *For details, contact Pall Corporation.*

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Bulletin #E-2135-4C

1/05

Pall Corporation

Cost-Saving Alternative to Lime Softening

The Pall Aria™ Integrated MF/NF System

If you are dependent on lime softening to pretreat surface water and influent water for general utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/NF system.

The Pall Aria MF/NF system leverages advanced dual-membrane technology for process water treatment. This hollow-fiber microfiltration (MF) and nanofiltration (NF) system has been proven to reduce overall operational costs by 15-20%. It can also achieve consistent and high-quality product water, with a significantly smaller footprint, less waste, and no need for sludge dewatering, hauling, and disposal.

Value

- Ensure consistent, high-quality water.
- Maximize control over your water treatment operation.
- Minimize footprint, waste, and disposal costs.
- Reduce operating expenses by as much as 20%.

Is This an Opportunity for You?

- Does your water quality vary or periodically fail to meet specifications?
- Is consistent water quality important to you?
- Do you typically use more than 100 gpm (23 m^3/hr) of water for boilers and utility operations?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/NF System?

- Produces consistent quality water without upsets from a lime softening operation.
- Eliminates sludge dewatering and disposal costs.
- Improves the removal of hardness and alkalinity in treated water.
- Reduces chemical costs and usage.
- Improves ion exchange water treatment.

Key Industries

- Automotive
- Chemical processing
- Food and beverage
- Hydrocarbon processing
- Mining
- Power
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

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Pall Corporation has offices and plants throughout the world.

PASNF1

Pall Corporation

Cost-Saving Alternative to DI Operation

The Pall Aria™ Integrated MF/RO System

If you use demineralizers to treat your surface water influent for boiler and utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/RO system.

Utilizing this hollow fiber microfiltration and reverse osmosis system can result in more efficient, lower-cost makeup water and demineralizer operations. The Pall Aria MF/RO system eliminates conductivity spikes and reduces silica, thereby improving the performance of your demineralizer system. It also extends resin life by increasing the interval between regenerations and reducing acid and caustic consumption.

Value

- Maximize control over your water treatment operation.
- Improve water quality.
- Minimize waste and disposal costs.
- Reduce operating expenses by as much as 50%.

Is This an Opportunity for You?

- Does your demineralizer system require frequent regeneration?
- Does fouling or attrition from particulate abrasion result in a resin life of less than 10 years?
- Does silica cause you problems with downstream boiler operation?
- Does your operation suffer from conductivity spikes?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/RO System?

- Reduces particulate and microbiological fouling attrition.
- Significantly reduces backwash requirements.
- Reduces regeneration chemical usage and waste.

Key Industries

- Automotive
- Chemical processing
- Electronics
- Food and beverage
- Hydrocarbon processing
- Power
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
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Pall Corporation has offices and plants throughout the world.

PASRO3

Cost-Saving Alternative to Clarifier and Multimedia Filtration Operations

The Pall Aria™ Integrated MF/RO System

If you are dependent on clarifiers and multimedia filters to treat surface water and influent water for boiler and utility applications, you could benefit from upgrading to a Pall Aria Integrated MF/RO system.

The Pall Aria MF/RO system leverages advanced dual-membrane technology for process water treatment. This hollow-fiber microfiltration (MF) and reverse osmosis (RO) system has been proven to reduce overall operational costs by 15-20%. It can also achieve consistent and high-quality product water, with a significantly smaller footprint, less waste, and no need for sludge dewatering, hauling, and disposal.

Value

- Reduce operational costs by as much as 20%.
- Improve water quality.
- Eliminate water variability to downstream unit operations.

Is This an Opportunity for You?

- Do seasonal or frequent operational conditions cause variability in your makeup water?
- Does poor water quality and variability stress your downstream unit operations (such as demineralizer, softener, or boiler and utility operations)?
- Are you interested in significant savings on operating costs for water treatment?

Why the Pall Aria Integrated MF/RO System?

- Eliminates source water variability caused by fluctuations in seasonal and operational conditions.
- Reduces TDS and ensures high-quality water to downstream unit operations.
- Provides the consistency and high quality required for critical applications.

Key Industries

- Chemical processing
- Electronics
- Food and beverage
- Hydrocarbon processing
- Mining
- Power
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
- Streamlined system design and operation using our experience of over 60 years in the field of water treatment.
- Lifetime system support from filtration experts with excellent track records for customer satisfaction.

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PASRO2

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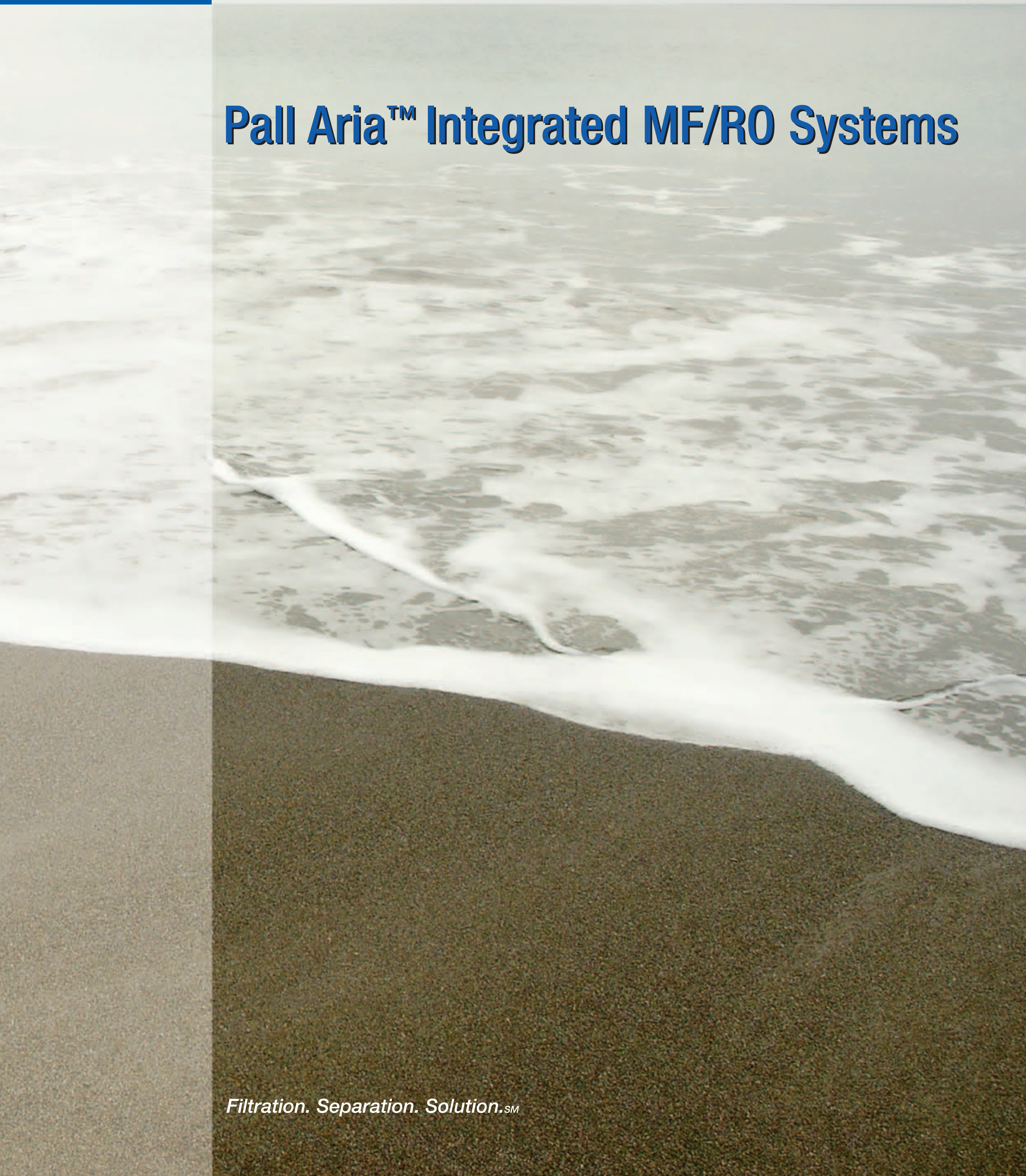

Pall Aria™ Integrated MF/RO Systems

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Pall Aria™ Integrated MF/RO Systems for Cost-Effective Treatment of Plant Make-Up Water

Water scarcity resulting from man-made and natural influences such as growing populations, expanding industrial usage, climate change and drought, is a challenge faced by water producers and users worldwide. High-pressure reverse osmosis (RO) and nanofiltration membrane systems have been used for many years to remove dissolved substances from water, with mixed success. The pretreatment typically used with these processes—conventional (sand) filters with coagulation, followed by cartridge filters—has proven to be ineffective and expensive in the long-term. On the other hand, when microfiltration is used to pre-treat the water, spiral-wound RO membrane systems are a reliable and cost-effective alternative that has become the technology of choice for many plant make-up water applications.

In addition to choosing the most effective technology, industrial high-purity water users are concerned with maximizing production volume by ensuring ongoing operation of the make-up water system. If the system comprises components from several vendors, the troubleshooting process can take much longer. **When the components of the make-up system are sourced through a single vendor, the responsibility is clear, and service and support are optimized.**

An Integrated Make-Up Solution from Pall, the Global Leader in Filtration and Separations

To meet the need to produce pure water for make-up, Pall Corporation offers complete, packaged, spiral-wound RO and nanofiltration systems, fully integrated with our proven microfiltration membrane technology for pretreatment. As the global leader in filtration solutions, Pall has been a trusted supplier to municipalities, industries and government for over 60 years. Pall's water processing team applies its expertise in process design, membrane science, system engineering, and manufacturing to deliver truly optimized make-up water systems.

Major MF and RO Components

Two major components comprise the Pall Aria™ MF/RO integrated system: the Pall Aria microfiltration membrane system for pretreatment, and an RO membrane system. Ion exchange may also be used if necessary. Both systems are constructed from standard "building blocks"—prefabricated skids of valve and module racks.

- **The Pall Aria microfiltration membrane system—** removes suspended solids from source water during the pretreatment process. Pall Aria microfiltration membranes are the most robust in the industry, with the longest warranty. In fact, a Pall customer in California with more than 700 modules experienced fiber breakage of only 1 in 3,073,400 over a 40-month period.* More than 300 filtration systems using the membrane technology incorporated in Pall's systems have been sold worldwide.

- **A Pall reverse osmosis membrane RO system—** captures dissolved salts and other impurities from pretreated water with spiral-wound RO technology, the industry standard for RO systems. Spiral-wound RO modules capitalize on an extremely high ratio of filter area to hold-up volume. With feedwater that is optimally pre-treated, these modules allow the greatest output of treated water with the lowest energy use.

Recover Energy From Your Process

After analyzing the energy requirements and costs for your specific process, Pall will recommend and implement a state-of-the-art device to recover energy from the pressured brine stream. By recycling this energy to power the pumps on the RO system, your cost of water production will be reduced.

* Based on the CalWater, Bakersfield, CA installation.

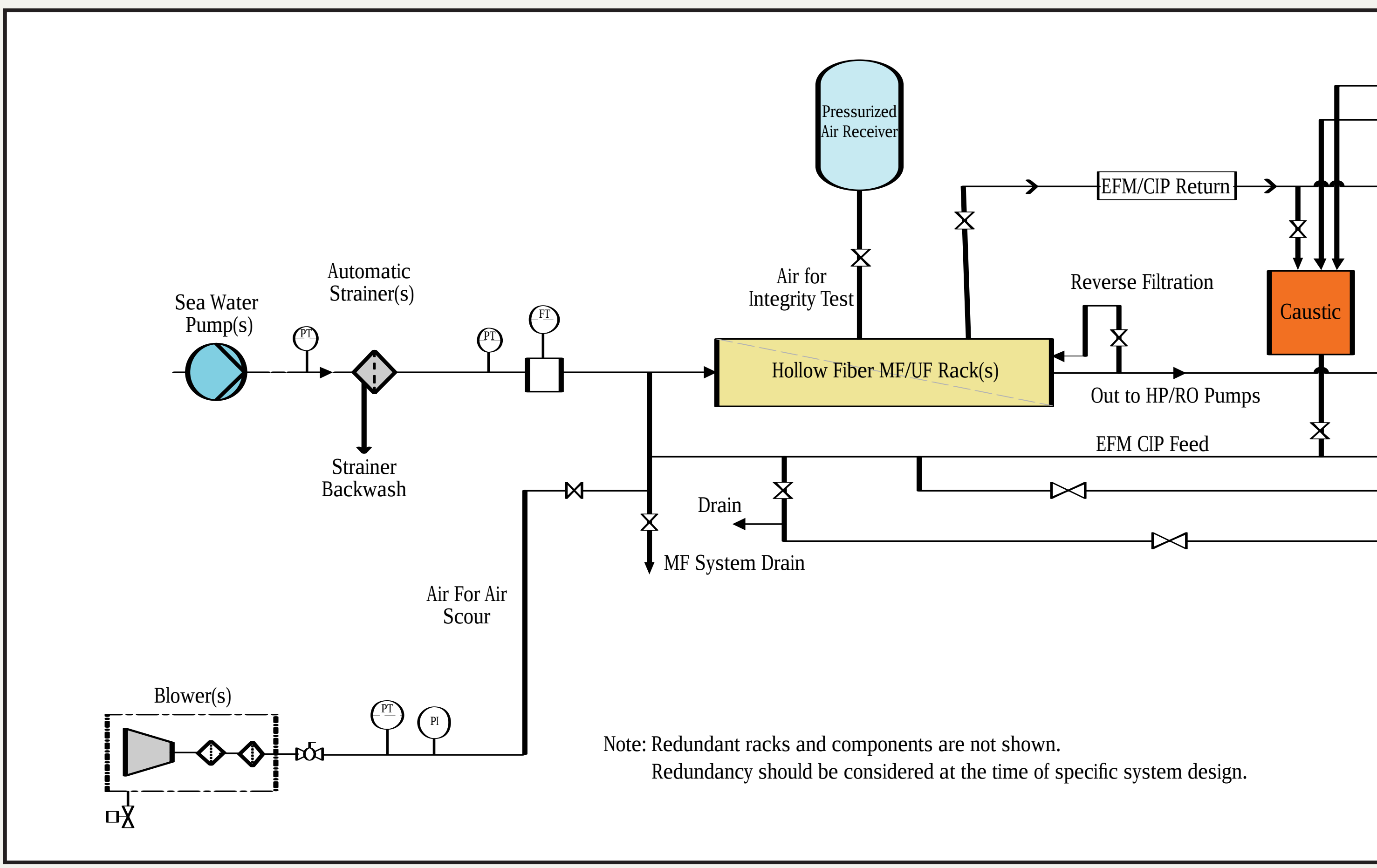
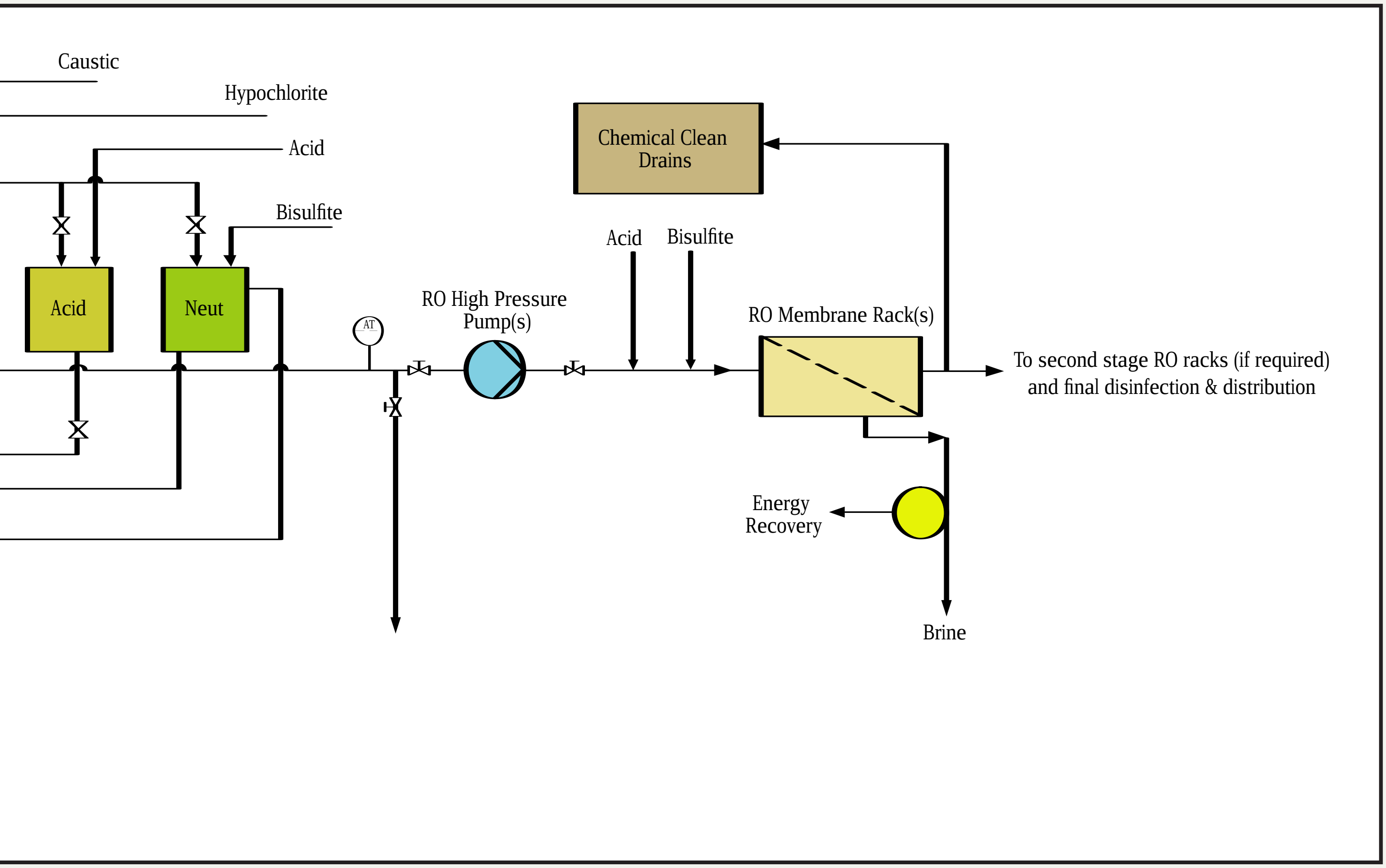


Figure 1—Simplified process flow diagram: Pall Aria™ Integrated MF/RO System

Reduce Your Risk and Long-Term Costs

In addition to the energy conservation benefits of our MF/RO solution, Pall provides you with the following cost-saving, efficiency, and risk-reduction advantages.

- **Smaller footprint**—Membrane systems have a smaller footprint and lower long-term costs than conventional filtration technologies. The pre-engineered design and assembly of the integrated MF/RO system enables you to reduce space requirements, thereby reducing facility costs.
- **Lower overall cost of water production**—Pall sales and process engineers are available to provide estimates for capital and operating costs to enable you to derive and evaluate the overall cost of water using a Pall integrated MF/RO system. We're convinced that our system will realize cost savings over systems supplied by others who are not filtration experts. Our experienced engineers design and package systems that optimize operations and maintenance.
- **Longer lifespan of the RO membranes**—By pretreating raw make-up water with microfiltration membranes, Pall's integrated system exposes the RO membranes to a lower volume of particulate matter. This protective capability reduces the number of membrane cleanings, increases efficiency, and prolongs the life and value of the RO system.
- **Redundant components maximize uptime**—The MF and RO system modules are redundant, enabling the integrated system to maximize uptime for critical water delivery applications.
- **Lower chemical use**—There are no pre-treatment chemicals to mix, feed, and adjust when feedwater conditions change.
- **Long-term reliable operation**—By developing a make-up process that is tailored to your feed water characteristics and treatment needs, Pall will ensure the long-term, reliable operation of your MF/RO system. Further, your system can be matched with a customized service plan.
- **Single point of responsibility**—With a single supplier for your entire make-up system, potential problems will be addressed more rapidly, thereby reducing the potential risk of downtime and reduced production.



Technical and Support Services for Long-Term Reliability

To help ensure trouble-free operation of your system, Pall offers a comprehensive portfolio of technical support services. These services can help you:

- Gain technical expertise without adding head-count
- Realize optimized system performance and product quality
- Increase system reliability
- Enjoy cost-effective operation and maintenance

Your Pall representative will help you choose one or more of the following services to support your MF/RO integrated system:

- 24/7 Service Support
- CIP (Clean-In-Place)
- Commissioning and Start-up
- Emergency Service
- Inspection and Maintenance
- Membrane Cleaning Study
- Operation And Maintenance (O&M)
- Process Audit
- Process Consulting
- Process Monitoring Systems
- Remote Monitoring
- Spare Parts Inventory Management
- System Optimization
- Technical Support
- Training
- Water Analysis

How to Get Started

Pall's integrated MF/RO system combines the strengths of Pall's membrane microfiltration technologies, engineering and technical expertise, and comprehensive support for high-yield production of pure water for plant make-up. Please contact your local Pall representative for more information and a free analysis of your feedwater and treatment requirements.

Power Generation

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PGMFROENa

Pall Corporation

Purification and Reuse of Industrial Clarified Effluents

The Pall Aria™ Integrated MF/RO System

If you need an additional supply of pure water for critical and utility operations, you could benefit from a Pall Aria Integrated MF/RO system.

By using best-in-class treatment chemicals with a combination of hollow-fiber microfiltration (MF) and reverse osmosis (RO), we can provide you with a highly efficient system for reclaiming effluent water. Not only can the Pall Aria MF/RO system reduce your cost for purchased water, it can provide water that consistently meets critical water quality requirements while effectively protecting the environment.

Value

- Acquire a consistent, high-quality water source for as much as 50% less than the cost of purchased water.
- Decrease dependency on purchased water.
- Reduce wastewater discharge by as much as 80%.
- Reclaim a scarce water resource.
- Increase operating profit by reusing an existing resource.
- Obtain a source of high-quality water for critical plant and utility use.

Is This an Opportunity for You?

- Do regulations require you to reuse water before your plant can undergo expansion?
- Do you have more than 100 gpm (23m^3/hr) of waste effluent that can be reclaimed?
- Do you need high-quality water for boilers and utility operations?
- Are you interested in significant operating cost savings?
- Is your present total water cost more than $4.00 per 1000 gals ($1.00/m^3)?
- Does your effluent have the following characteristics: TSS <100 mg/l, BOD <100 mg/l, FOG <20 mg/l, and TDS < 2,500 mg/l?

Why the Pall Aria Integrated MF/RO System?

- Assures consistent production of high-quality water from a reclaimed source.
- Provides an integrity testable, positive barrier to TSS and microbial contaminants.
- Protects downstream processes such as electrodeionization (EDI).
- Delivers highly purified, low TDS water.

Key Industries

- Chemical processing
- Food and beverage
- Hydrocarbon processing
- Metal working
- Mining
- Pharmaceuticals
- Primary metals
- Pulp and paper

Features

- Standard designs for trouble-free operation.
- Touch-screen controls for simple operation.
- Modular design for rapid integration.
- Multiple membrane barriers for process protection.

Why Pall?

- Flexible water management: outsource operations, service contract, or service-on-demand.
- Flexible project financing: capital purchase, lease-to-own, rent, or purchase treated water.
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PASRO4

PALL Water Processing

Pall Aria℠ AP-Series Water Treatment Systems

Pall Aria Water Treatment System with control panel and modules.

Pall Aria AP-Series Water Treatment Systems

Pall Aria℠ AP-Series Water Treatment Systems are specifically designed to meet the drinking water treatment requirements of small communities. Aria systems use uniquely designed Pall Microza* membrane modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources:

- Turbidity
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Arsenic

Each 0.1µm hollow fiber module provides high active surface area (538ft^2 - 50m^2). The hollow fiber modules in the Aria system are highly permeable resulting in high water production rates.

Pall's dedication to simplified process design and control logic has produced a family of systems that are characterized by:

- Full System NSF 61 Certification
- Long Service Life Hollow Fiber Membranes
- Operator Friendly Control Interface
- Simple Clean-In-Place Operation
- High Recovery
- Low Cost of Operation
- Easily Installed Modular Skids
- Compact System Footprint
- ISO 9000 Certified Manufacturing
- Optional Auxiliary Equipment

View of Hollow Fiber Membrane Module Cut-away.

Aria AP-Series System Performance

Pall Microza membrane systems have been approved for potable water supply. The Aria hollow fiber membrane system was the first to receive a "full system" certification in accordance with ANSI / NSF 61 Specifications.

Extensive testing has been done across the USA including:

- University of New Hampshire
- Croton Reservoir, NY
- Highland Reservoir, PA
- Meeteetse Reservoir, WY
- Oregon Parks Department
- North Slope Borough WTP, AK
- Youngs River, OR
- Stoney Creek, VA
- Westover, PA
- Caney, KS
- Kernville, CA
- Basalt, UT
- Crested Butte, CO
- Hobart, NY

Site testing confirmed Pall Aria Water Treatment Systems meet or exceed EPA standards for safe drinking water, such as the requirement of the Surface Water Treatment Rule (as amended December 16, 1998).

** Microza is a trademark of Asahi Kasei Corporation.*

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Table 1: Pall Membrane Microbial and Particulate Removal

Contaminants	Typical Removal*
Giardia	> 6 log
Cryptosporidium	> 6 log
MS2 coliphage or bacteriophage	0.5 - 3 log
Turbidity	< 0.1 NTU

*Based on third party testing

Aria AP-Series System Specifications

Aria AP-Series System Components

Standard system components consist of 1 to 60 membrane modules, a feed tank, one feed pump, one reverse filtration pump, manual on/off and automatic valving, filtrate flow meter, pressure and temperature sensors, and PLC control.

Aria AP-Series System Operation

Maximum Inlet Pressure to Module: 45 psi (3 bar)
Maximum Operating Temperature: 104˚F (40˚C)

Aria AP-Series System Specifications

Module Housing: PVC, ABS or other
Gasket: EPDM
Potting Material: Silicone and Epoxy or Urethane
Panel: NEMA 4
Tanks: Polyethylene
Piping: Lower Manifold and Air: Stainless Steel (other piping: PVC)
Hollow Fiber Membrane: PVDF
Pumps: Horizontal Stainless Steel Centrifugal

System Service

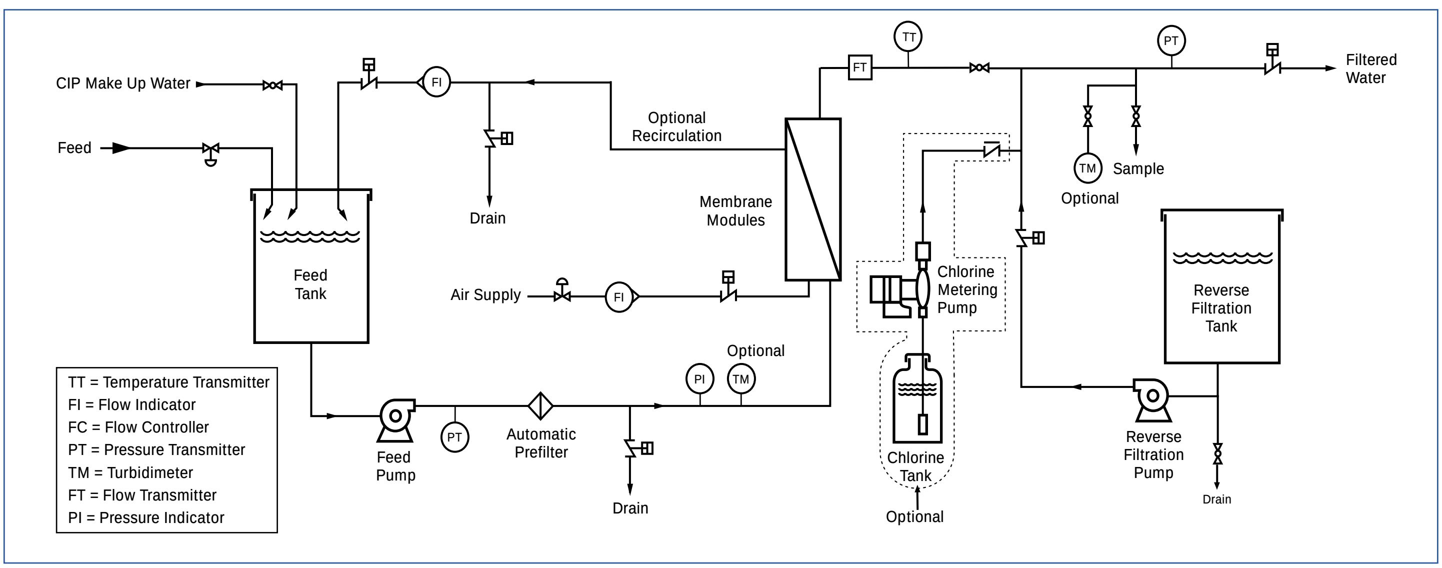
Remote monitoring of system performance available as an online service. On-site service and maintenance contract also available.

Table 2: Standard Filtration Skid Specifications

Model Number	Maximum Number of Modules	Maximum Flow Rate (gpm [m^3/hr])	Footprint (L x W x H) (Feet) Installed
AP-1	2	3-25 [1-7]	6 x 2.8 x 9.7
AP-2	8	10-50 [2.3-12]	8 x 4.1 x 9.9
AP-3	10	25-175 [6-40]	10 x 6.9 x 10.3
AP-3x	20	25-175 [6-40]	(1) 22.9 x 5.7 x 10.8
AP-4	36	50-350 [15-80]	(1) 24 x 6.8 x 10.8
AP-6	60	200-700 [45-150]	(1) 27 x 17 x 10.8

(1) Module Rack is off the skid. Other configurations allow variation in footprint.

Process Flow Diagram for the Pall Aria AP-Series Water Treatment System



PALL Water Processing

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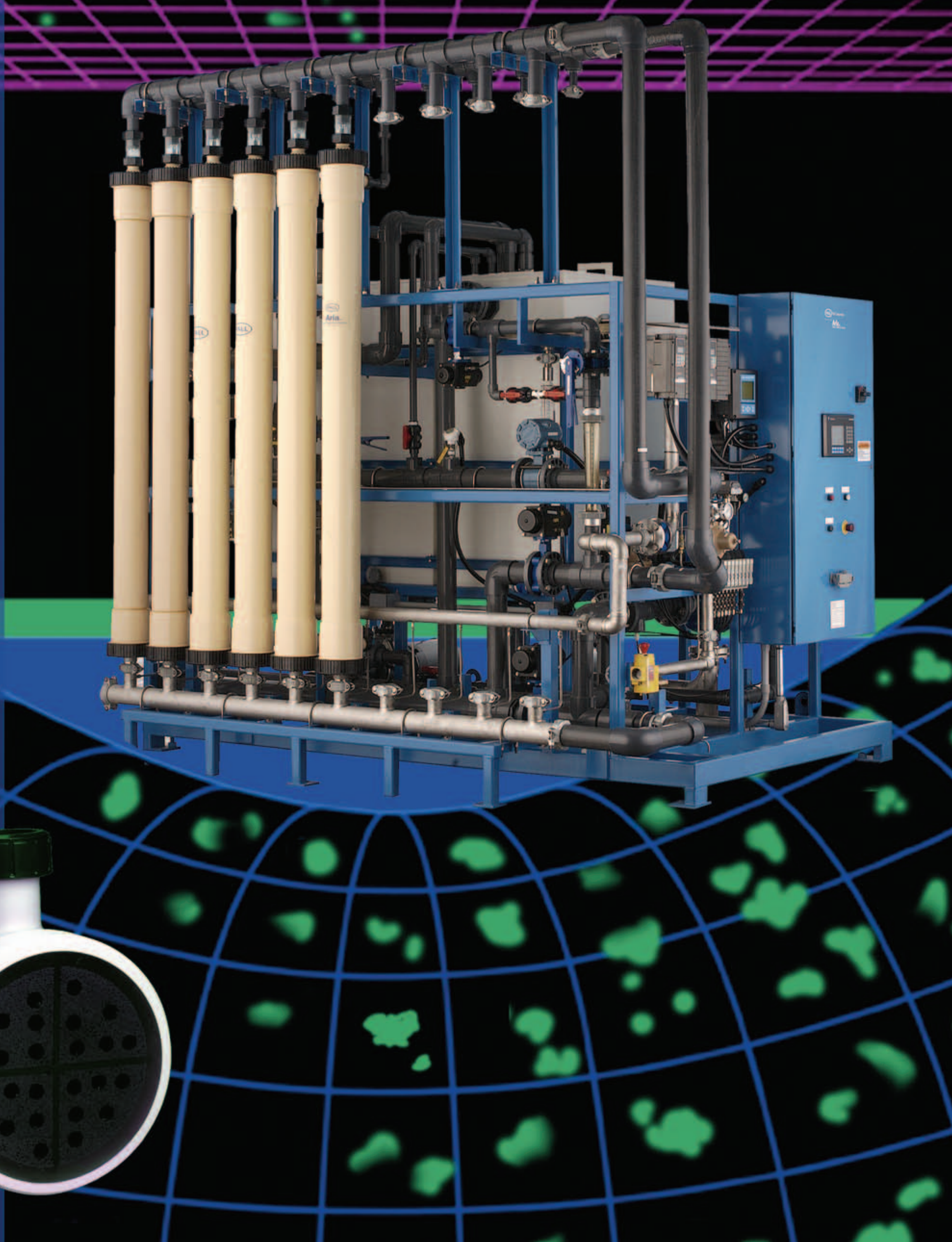
Pall Corporation

Pall Aria™ AP-Series Packaged Water Treatment Systems



*Filtration. Separation. Solution.*SM

Pall Aria™ AP-Series Packaged Water Treatment Systems

Installations

Point Hope, AK

Wainwright, AK

Nuiqsut, AK

Point Lay, AK

Atqasuk, AK

Anchorage, AK

Kaktuvik, AK

Kernville, CA

Burbank, CA

Membrane Filtration for Safe Drinking Water

Pall Aria™ water treatment systems are specifically designed to produce drinking water that meets today's stringent standards. The systems use uniquely designed filtration modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources.

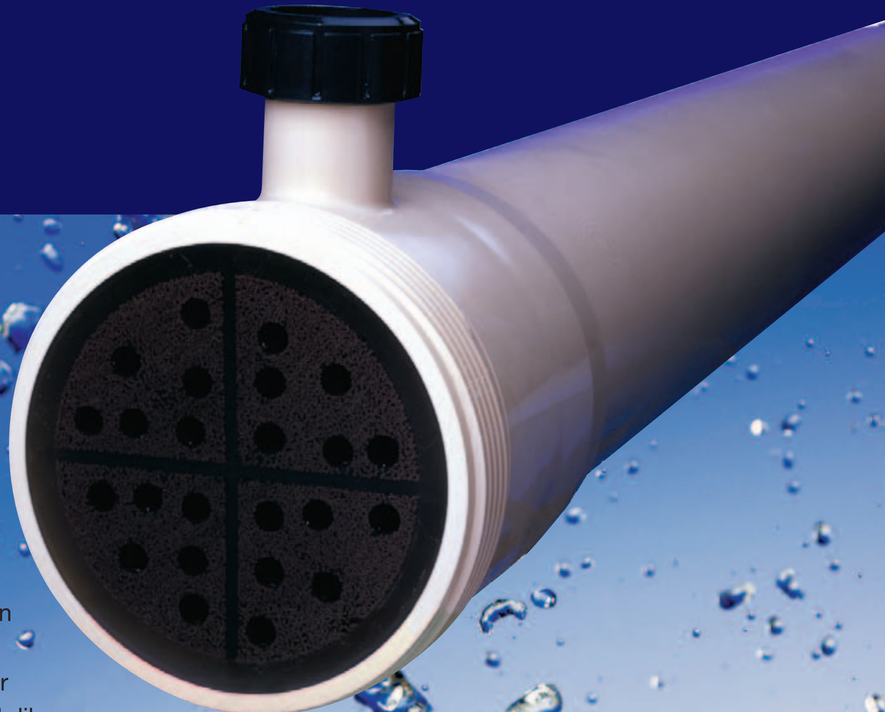
- Suspended Solids/Turbidity
- Viruses
- Bacteria
- Cysts and Oocysts
- Iron and Manganese
- Arsenic
- Organics

The Microza[1] hollow fiber membranes are highly permeable resulting in high water production rates. Each hollow fiber module provides high active surface area of up to 538 ft^2. Pall's dedication to a simplified process and control design has produced a family of systems that are characterized by:

- Tough, long-service hollow fiber membranes
- Operator friendly controls
- Simple surface water treatment without coagulation
- Unique air scrub and flush operation
- High efficiency, low waste
- Excellent compatibility with chlorine and common treatment chemicals
- Minimal cost of operation
- Easy installation using modular skids
- Compact system footprint
- Full system NSF 61 listing
- ISO 9001 certified manufacturing
- ETV certified for surface water treatment rule

Site testing confirmed Pall Aria Systems meet or exceed EPA standards for safe drinking water. The system is also the first to receive 'full system' certification in accordance with ANSI/NSF 61 Specifications.

[1] Microza is a registered trademark of Asahi Kasei Corp., Ltd. Pall Aria is a trademark of Pall Corporation.



Membrane filtration is a pressure driven process that uses a semi-permeable (porous) membrane to separate particulate matter from soluble components in the carrier fluid, such as water. In Pall Aria systems, microfiltration or ultrafiltration membranes act much like a very fine sieve to retain particulate matter, while water and its soluble components pass through the membrane as filtrate, or filtered water. The retained solids are concentrated in a waste stream that is discharged from the membrane system. The pore size of the membrane and the integrity of the sealing mechanism controls the fraction of the particulate matter that is removed. Microza membranes, with their fine pore size and absolute seal, remove virtually all of the fine matter, such as silica, bacteria, and parasite cysts.

Pall Aria Systems - Overview

Installations

- Forestville, CA
- Avon, CO
- Pinellas Park, FL
- Hobart, NY
- Youngs River, OR
- Beverly Beach Park, OR
- Bullards Beach, OR
- Astoria, OR
- Hite Marina, UT

Transforming Water from Any Source to Match Your Requirements

Pall Aria water treatment systems are used to filter ground and surface waters for drinking water supply and industrial uses, and secondary wastewater effluent for reuse.

Ground Water

- Lowers turbidity and removes microbial pathogens from ground water under the influence of surface water.
- Removes iron and manganese with oxidation.
- Removes arsenic with coagulation.

Surface Water

- Lowers turbidity and removes microbial pathogens from raw water drawn from rivers, streams, lakes, and reservoirs.
- Removes organics with coagulation to improve disinfection by-products rule compliance, taste and odor.

Secondary Wastewater Effluent

- Removes suspended solids and reduces SDI prior to RO treatment for reuse.
- Removes bacteria and other pathogens, and suspended solids to produce water suitable for landscape irrigation and similar reuse applications.

Pall Membrane Microbial and Particulate Removal

Contaminants	Typical Removal [2]	
	Microfiltration (MF)	Ultrafiltration (UF)
Giardia	>6 (log)	>6 (log)
Cryptosporidium	>6 (log)	>6 (log)
MS2 Coliphage or Bacteriophage	0.5 – 2.5 log[3]	4.5 – 6 log[3]
Turbidity	<0.1 ntu	<0.1 ntu

[2] Based on third party testing.
[3] Virus removal varies depending on coagulation process upstream of system.

Application Guidance

Design Parameter	Ground Water (GW)		Surface Water		Secondary Wastewater
	Under the Influence of Surface Water	High Iron & Manganese	Low TOC or Turbidity	High TOC or Turbidity	
Contaminants	Turbidity & Microbial Pathogens	Iron & Manganese	Turbidity & Microbial Pathogens	Turbidity & Microbial Pathogens	Suspended Solids & Pathogens
Pretreatment	None	Oxidation & Precipitation	Strainer	Strainer, Oxidation, or Coagulation	Disinfection & Strainer
Filtered Water Quality	Turbidity <0.05 ntu No Detectable Giardia & Crypto	Turbidity < 0.05 ntu Iron & Manganese < 0.05 mg/L	Turbidity <0.05 ntu No Detectable Giardia & Crypto	Turbidity <0.05 ntu up to 60% TOC Removal	SDI ≤3 Turbidity <0.05 ntu

Pall Aria Systems - Specifications

Packaged for Fast, Easy Installation

Pall Aria water treatment systems are highly flexible, production scale, membrane filtration packages, designed to filter a wide range of feed streams. Standard systems are available in the following skid-mounted configurations.

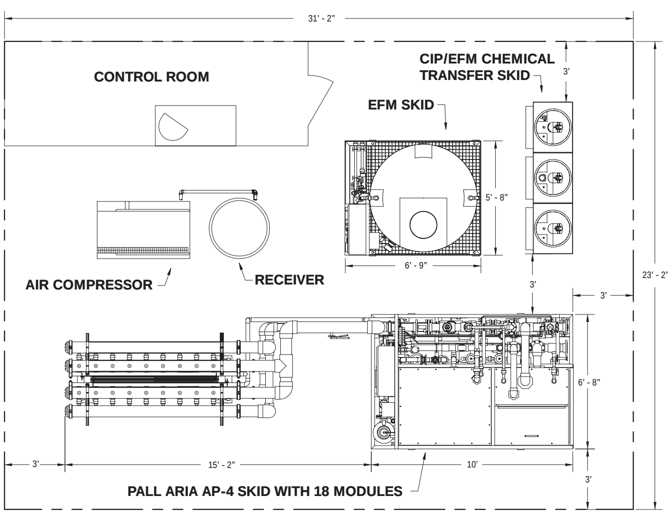
Standard System Specifications

Model Number	Maximum Number of Modules	Filtered Water Capacity (gpm [m^3/hr])	Dimensions (L x W x H : ft [m]) Shipped[4]	Installed
AP-1	2	3-25 [0.7-5.7]	6.1 x 2.8 x 6.5 [1.9 x 0.9 x 2.0]	6 x 2.8 x 9.8[7]
AP-2	8	10-50 [2.3-11.4]	8.1 x 2.8 x 6.5 [2.5 x 0.9 x 2.0]	8 x 4.1 x 9.9[7]
AP-3	10	25-200 [5.7-45.4]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3]	9.5 x 6.9 x 10.3[7]
AP-3x	20	25-200 [5.7-45.4]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3][5, 6]	8.8 x 18.6 x 10.8[5]
AP-4	36	50-350 [11.4-79.5]	10 x 6.8 x 7.7 [3 x 2.1 x 2.3][5, 6]	10.8 x 20.8 x 10.8[5]
AP-6	60	200-700 [45.4-159]	10 x 6 x 6.8 [3 x 1.8 x 2.1][5, 6, 8]	19.1 x 17 x 10.8[5, 8]

4 Crating add 0.5 ft. [0.15m] to each dimension.
5 Module rack is off the skid.
6 Module rack shipped as crated parts kit.
7 Control skid w/attached module rack.
8 Two freestanding tanks 5′6″ wide x 7′6″ high, shipped separately for each skid.

Optional and Auxiliary Equipment

- Modem for Remote Access
- Auto Dialer for Alarms
- PC for Operator Interface Terminal and Data Acquisition
- Feed or Filtrate Turbidimeters
- Oxidant Dosing Systems
- Air Compressor Systems
- EFM Systems to Reduce System Costs
- Disinfectant Dosing Systems
- Coagulant and CIP Chemical Storage/Dosing Systems
- Filtrate Particle Counter



Typical treatment plant layout for 500,000 gallons per day.

Auxiliary equipment to improve treatment capabilities is available on separate skids, which are equipped with distributed controls that can be integrated into a master control system to provide optimal, automatic integrated system operation.

Installations

Basalt, UT

Lake Powell UT

Stoney Creek, VA

Ashford, WA

Meeteetse, WY

Point of Rocks, WY

Manati, Puerto Rico

Burleigh Falls, Canada

Bruce Mines, Canada

Panel Ray, Mexico

Standard Components

A standard Pall Aria AP Package consists of 1 to 60 membrane modules, one feed/CIP tank and pump, one reverse filtration tank and pump, manual and automatic valves, flow meter, pressure and temperature sensors, PLC control, control panel, and a painted carbon steel frame. Other items can be added on request. Separate auxiliary skids are available for compressed air and chemical feed/pre-oxidation.

- Painted Carbon Steel Frame
- 316 SST Pumps W/TEFC Motors and VFDs
- PVC and Stainless Steel Piping
- Butterfly Valves (Manual and Air Operated)
- PE Tanks with Level Control
- PLC Controls and Software
- Instrumentation (Digital and 4-20 ma Analog Signal)
- NEMA-4 Electrical Enclosures

Operating Conditions

- Maximum Inlet Pressure: 44 psi (3 bar)
- Maximum Operating Temperature: 104˚F (40˚C)
- Minimum Operating Temperature: 33˚F (1˚C)

Utility Requirements

Electrical Connection:

AP 1:	1 ph	230v	50 A
AP 2:	1 ph	230v	30 A or
	3 ph	230v	25 A or
	3 ph	460v	15 A
AP 3/3x:	3 ph	230v	40 A or
	3 ph	460v	25 A
AP 4:	3 ph	460v	40 A
AP 6:	3 ph	460v	70 A

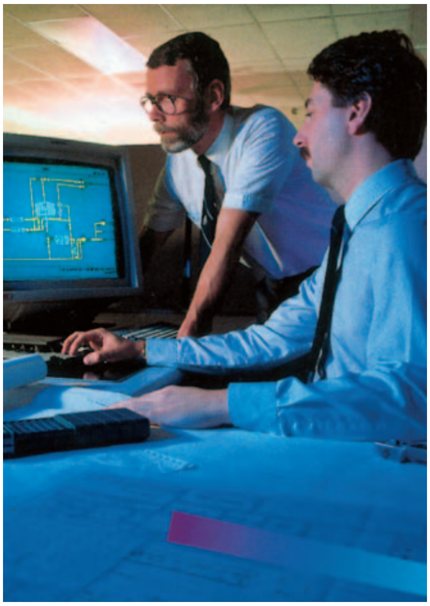
Other voltage can be accommodated, if required. Water Supply for CIP: 75-95˚F (25-35˚C)

Module cutaway showing hollow fibers.

Microza Hollow Fiber Microfiltration Module[9]

- Membrane Material: PVDF
- Pore Rating: 0.1 micron (μm)
- Fiber OD / ID: 1.3 mm/0.7 mm
- Active Filter Area: 538 ft^2
- Module Size: 6" diameter x 79" long
- Housing: PVC or ABS
- Gasket: EPDM
- Potting Material: Silicone Epoxy or Urethane

[9] Ultrafilters also available



Pall R&D Team Members

NSF System Listing

Pall's family of hollow fiber membrane systems were the first "full systems" to be listed in accordance with ANSI/NSF 61 specifications. The Pall Aria system is manufactured from NSF approved materials and meets all requirements for potable water service.

ISO 9000 Certification

Pall's North American manufacturing, engineering, sales and marketing operations have received ISO 9001 registration from Lloyd's Register of Quality Assurance Limited. ISO 9001, which also covers design and development functions, represents the highest, most comprehensive level of ISO 9000 Certification. The quality system and procedures are regularly audited to assure compliance and proper record keeping before the certification is renewed.

Clean Water, Clean System

Filtration (Normal Production)

Feed water enters the bottom of the module and is distributed uniformly to the outside of the fibers. Since it is under pressure, the water passes through the hollow fiber membranes and filtered water exits from the top of the module. Under normal conditions, all of the feed water flows through the membranes and exits as filtered water. Depending on feed quality, a small amount of the feed water may be circulated past the outside of the hollow fibers. This flow prevents the accumulation of foulants and debris on the surface of the membrane and helps evenly distribute flow though the membrane fibers.

Air Scrub

As water is filtered, rejected particulate accumulates in the module or on the membrane fiber's surface. The effect is a flow restriction in the module, resulting in an increase in trans-membrane pressure (TMP). Air Scrubbing (AS) is a mechanical process to remove the debris from the module and decrease the rate of overall increase in trans-membrane pressure.

AS is usually initiated at a preset interval of water throughput. As a secondary trigger, AS is initiated if the rate of TMP increase exceeds a specified maximum. The air injection valve opens and air is injected at low pressure into the feed side of the module. At the same time, filtrate that has been collected in the Reverse Filtration (RF) tank is pumped in the reverse direction through the module and out through the main system drain. Air and RF flow are then stopped. At this point, most if not all of the accumulated debris in the module have been swept to drain.

To complete the cycle, a forward flush (FL) is implemented, circulating feed water from the feed tank on the outside (feed side) of the membrane fibers at high velocity. This fast flow of liquid is directed through the excess recirculation port of the module to drain. This further dislodges and removes from the module debris that was captured by the membrane fibers.

This fully automated cycle is included in every Pall Aria System and occurs every 20-120 minutes, and stops forward filtrate flow for about 1.5-2 minutes.

Enhanced Flux Maintenance (EFM)

To assure maximum efficiency and lowest total cost of ownership, Pall has developed techniques to keep the membranes free of fouling materials. EFM is a patent pending, fully automated process that uses warm water with mild chemical solutions tailored to specific foulants that may be present in the application on a daily basis. EFM is used to reduce the times when a partially fouled membrane results in a system operating at less than peak efficiency.

The benefits to using EFM are a smaller system footprint, which reduces floor space and facility heating and cooling costs, and a lower average trans-membrane pressure, which reduces pumping energy.

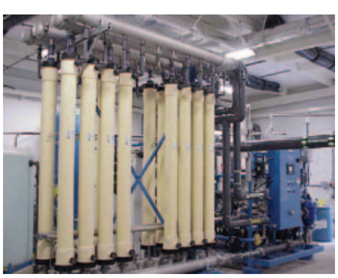
The durable, strong and chemical resistant hollow fiber which is incorporated into every Pall Aria System makes this possible. Best of all, it can be subjected to thousands of EFM cycles with no reduction in service life.

In addition, the flexible, control system on-board the Pall Aria System allows EFM to be enabled only when warranted by feedwater conditions.

EFM capability is included on the Pall Aria AP-1 System and can be included via an auxiliary skid mounted EFM system on the larger Pall Aria AP-Series systems.

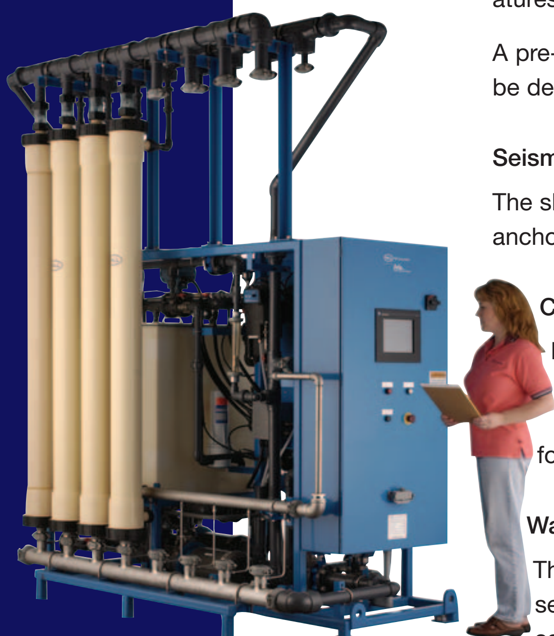
Chemical Clean In Place (CIP)

Backwash and EFM are designed to remove particulate matter and foulants. In most applications, it will occasionally be necessary to perform a complete CIP process. The CIP process is a 2-step protocol using an acidic solution and a caustic solution with chlorine. This process will return the modules to "nearly new" condition and can be performed hundreds of times over the life of the modules.



Due to the low frequency of CIP operation, the process is designed as a semi-automated process. The rinse cycles are programmed for manual initiation. This process requires minimal operator intervention to “setup” the system for CIP and can be achieved by turning 5 manual valves.

Pictured on the left is a Pall Aria System installed at Stoney Creek, VA.



Pretreatment Requirements

Pall Aria water treatment systems provide reliable, low maintenance performance. A 400-µm strainer is included on the feed water line to prevent debris from clogging small passages in the system.

Enclosures

A heated structure is required where freezing temperatures are expected. A roof may be required in other areas to prevent damage from sunlight and high temperatures.

A pre-engineered metal, concrete, or wood frame building is acceptable and can be designed to meet many aesthetic concerns.

Seismic Design

The skid can be modified for use in Seismic Zone 4 areas (highest hazard). An anchoring plan will be furnished upon request.

CIP Conditions

Pall recommends that all chemicals for treatment and CIP be purchased in solution form. Water for CIP should be heated to 90-100°F (31-38°C). Contact Pall to obtain the recommended CIP procedures and specifications for chemicals.

Wastewater Disposal

The RF and AS wastewater and CIP wastes can be discharged to a sanitary sewer if available. In areas without sanitary sewers, the RF and AS wastewater can be discharged to a settling pond to remove suspended solids. The clarified supernatant may be discharged to a local receiving stream or recycled to the plant feed water. Pilot testing may be required before recycling the supernatant. If sanitary sewers are unavailable, CIP wastes should be combined and neutralized prior to collection and disposal by a waste hauler. These wastes, can be disposed of like septic system sludge. The customer is responsible for contacting the local regulatory agencies and obtaining the appropriate permits and approvals before initiating any discharge of process wastewater.

Contact Us for Support or Information

Remote online monitoring of system performance by Pall water specialists and membrane maintenance contracts are available from Pall. Contact your local Pall representative or Pall Corporation to obtain more information.

PALL Water Processing

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Reorder Code. WP-300 (Version C) 8/06 3M BRD

PALL Pall Corporation

Nexis® T Series Filter Cartridges

Description

- Proprietary CoLD Melt™ fiber technology
- Continuous gradient pore structure media provides both prefiltration and final filtration
- Proprietary center core for greater mechanical strength and chemical resistance (0.5 - 10 µm)
- Resists contaminant unloading even at high differential pressures
- Computer controlled CoLD Melt manufacturing process increases product consistency
- Polypropylene media construction
- Thermally bonded structure - not employing adhesives
- Plastic and metal spring assembly end configurations are available

Performance Specifications

Filter grades[1]

0.5, 1, 3, 5, 7, 10, 15, 20, 25, 30, 40, 50, 75, 100, 120, 150, 200 µm

Maximum differential pressure

0.5-10 µm:	1.03 bard @ 82°C (15 psid @ 180°F)
	1.72 bard @ 66°C (25 psid @ 150°F)
	4.14 bard @ 30°C (60 psid @ 86°F)
15-120 µm:	1.72 bard @ 60°C (25 psid @ 140°F)
	3.45 bard @ ambient (50 psid @ ambient)

Recommended change-out differential pressure[2]

2.4 bard (35 psid)

Food and water contact use

Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Rinse-up

Rinse-up to 18 Megohm-cm with a minimum of throughput.

Autoclaving

Single-open-end Nexis T series filter cartridges can be autoclaved for 30 minutes at 121°C (250°F) under no end load conditions. However, filter cartridges should be allowed to cool to normal system operating temperatures prior to use.

Steam sterilization

Not recommended.

[1] >90% retention rating by ASTM F-795 test. Nexis T series filter cartridge retention ratings are based on Pall's Dynamic Efficiency test protocol. This single pass, destructive challenge test is based on ASTM F-795 test procedures for determining the performance of a filter medium. Fine test dust is used as the test contaminant for filters in the 0.5 to 20 micron range. Coarse test dust is used for micron ratings above 20 micron. Additional information can be obtained by contacting Pall Corporation.

[2] Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

Product Specifications

Materials of construction

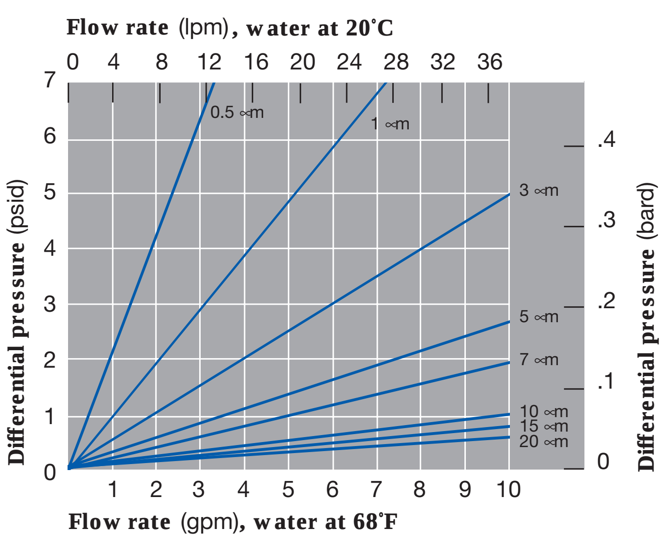
Filter media:	Polypropylene
Hardware:	Polypropylene
Gaskets/O-rings:	Silicone elastomer, EPDM, nitrile, fluorocarbon elastomer, FEP, thermoplastic elastomer (DOE only), FEP encapsulated silicone elastomer, FEP encapsulated fluorocarbon elastomer

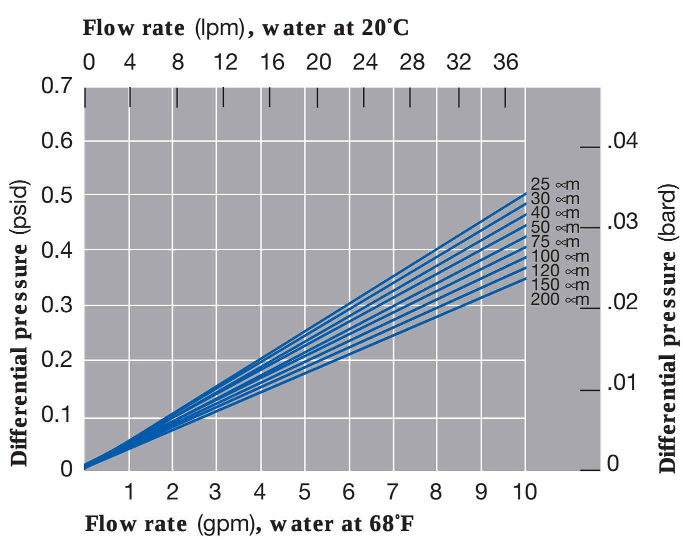
Dimensions (nominal)

Outside diameter:	6.4 cm (2.5 in)
Lengths:	10.2 cm (4 in), 12.7 cm (5 in), 24.8 cm (9.75 in), 25.1 cm (9.875 in), 25.4 cm (10 in), 49.5 cm (19.5 in), 50.8 cm (20 in), 74.3 cm (29.25 in), 76.2 cm (30 in), 99.1 cm (39 in), 100.3 cm (39.5 in), 102 cm (40 in)

Pall's proprietary CoLD Melt fiber media technology is designed to assure efficient use of the entire gradient depth of the filter. The CoLD Melt process produces a mixture of micro-thin fibers intermingled and thermally bonded with large diameter CoLD Melt fibers to provide an integral support and fluid transport network. The large internal void area created by the CoLD Melt process enables Nexis T filter cartridges to capture more contaminant than conventional cartridges while the rigid support fibers hold the filtration fibers firmly in place. The result is less potential random unloading of contaminant and more efficient filtration under a variety of operating conditions.

Typical Flow vs. Differential Pressure for Application Sizing[3]





Unit conversion: 1 bar = 100 kPa

[3] Due to the very low flow resistance of the media in the more open grades, pressure drop is primarily related to turbulent loss through the center core. Flow rate is for a 25.4 cm (10 in) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Ordering Information

Pall Part Number = NXT [1] – [2] U – [3] [4]

Table 1

Code	Filter grades (µm)
0.5	0.5
1	1
3	3
5	5
7	7
10	10
15	15
20	20
25	25
30	30
40	40
50	50
75	75
100	100
120	120
150	150
200	200

Table 2

Code	Cartridge lengths (cm/in) nominal
4	10.2 / 4
5	12.7 / 5
9.75	24.8 / 9.75
9.875	25.1 / 9.875
10	25.4 / 10
19.5	49.5 / 19.5
20	50.8 / 20
29.25	74.3 / 29.25
30	76.2 / 30
39	99.1 / 39
39.5	100.3 / 39.5
40	102 / 40

Table 3

Code	End configurations
Blank	DOE industrial (no end caps)
1X	DOE, 2.54 cm (1 in) extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[4]
M3H	SOE large diameter closed end, external 222 O-rings
M4	SOE fin end, external 222 O-rings with locking tabs (silicone and EPDM O-rings only)
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[4]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[4]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[4]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[4]
M10	DOE, internal O-rings (fits other manufacturers' housings)[4]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X style)[4]
M18	SOE flat closed end, external 222 O-ring
M20	SOE with internal O-rings (same as M10), closed end with deep recess
DOE	DOE with elastomer gasket seals and end caps
H21	DOE, Santoprene gasket seal
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

[4] For details, contact Pall Corporation.

Table 4

Code	Gasket/O-ring materials
S	Silicone
N	Nitrile
E	EPDM
V	Fluorocarbon elastomer
T	Expanded PTFE (gaskets) - DOE option FEP encapsulated silicone (O-rings) - SOE option
F	FEP encapsulated fluorocarbon elastomer (O-rings)
Y	Santoprene

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Pall Corporation has offices and plants throughout the world. For Pall representatives in your area, please go to www.pall.com/contact.

Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 0 830 191; US 5,591,335; US 5,653,833; US 5,681,469; US 5,690,782; US 5,730,820; US 5,733,581; US 5,741,395; US 5,783,011.

Filtration. Separation. Solution.SM

1669-7C Produced in the USA June 2010

PALL Pall Corporation

Nexis® A Series Filter Cartridges

Description

- Rated at >99.9% efficiency[1] with retention ratings from 0.5 to 120 µm
- Proprietary CoLD Melt™ fiber technology
- Resists contaminant unloading even at high differential pressures
- Micro-denier melt blown filtration fibers
- Media manufactured with a continuous gradient pore structure
- All-polypropylene construction
- Free of adhesives, binders, resins, and silicone
- Proprietary center core for added strength (0.5 - 20 µm)
- Fast rinse-up to 18 Megohm-cm
- Certification of conformance including lot identification

Performance Specifications

Filter grades
0.5, 1, 3, 5, 10, 20, 30, 40, 50, 70, 90, 120 µm

Maximum differential pressure

0.5-20 µm:	1.03 bard @ 82°C (15 psid @ 180°F)
	1.72 bard @ 66°C (25 psid @ 150°F)
	4.14 bard @ 30°C (60 psid @ 86°F)
30-120 µm:	1.72 bard @ 60°C (25 psid @ 140°F)
	3.45 bard @ ambient (50 psid @ ambient)

Recommended change-out differential pressure[2]
2.4 bard (35 psid)

Food and water contact use
Please contact Pall Corporation to verify that the product conforms to your national legislation and/or regional regulatory requirements for water and food contact use.

Purity
Nexis A series filter cartridges are free of adhesives, binders, resins, and silicone.

Rinse-up
Rinse-up to 18 Megohm-cm with a minimum of throughput.

Autoclaving
Single-open-end Nexis A series filter cartridges can be autoclaved for 30 minutes at 121°C (250°F) under no end load conditions. However, filter cartridges should be allowed to cool to normal system operating temperatures prior to use.

Steam sterilization
Not recommended.

1 >99.9% retention rating by ASTM F-795 test.

2 Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

Product Specifications

Materials of construction

Filter media:	Polypropylene
Hardware:	Polypropylene
Gaskets/O-rings:	Silicone elastomer, EPDM, nitrile, fluorocarbon elastomer, Santoprene[3] (DOE only), FEP, FEP encapsulated silicone, FEP encapsulated fluorocarbon elastomer

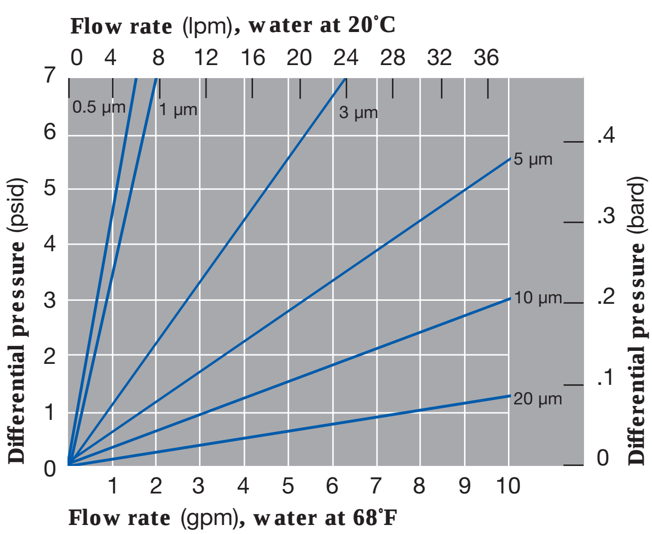
Dimensions (nominal)

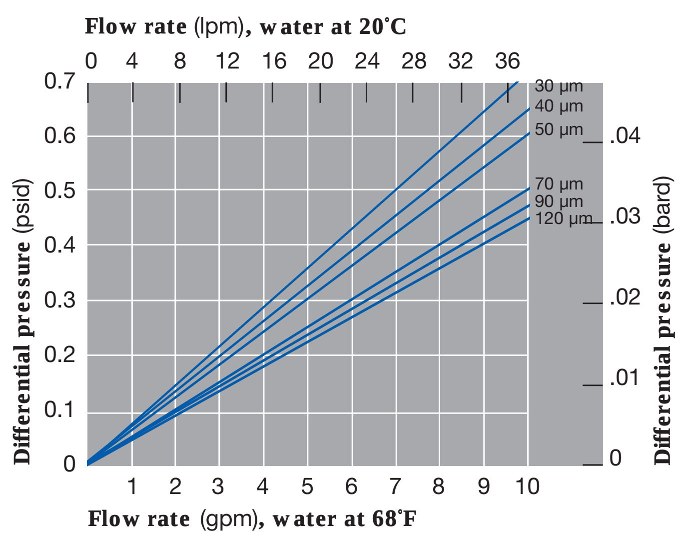
Outside diameter:	6.4 cm (2.5 in)
Lengths:	10.2 cm (4 in), 12.7 cm (5 in), 24.8 cm (9.75 in), 25.1 cm (9.875 in), 25.4 cm (10 in), 49.5 cm (19.5 in), 50.8 cm (20 in), 74.3 cm (29.25 in), 76.2 cm (30 in), 99.1 cm (39 in), 100.3 cm (39.5 in), 102 cm (40 in)

Particle Removal Ratings[4] (µm)

Cartridge Designation	99.9% Efficiency	90% Efficiency
NXA 0.5	0.5	<0.5
NXA 1	0.95	0.65
NXA 3	2.8	1.5
NXA 5	4.1	3.4
NXA 10	9.5	4.7
NXA 20	18.5	13
NXA 30	27	18
NXA 40	36	20
NXA 50	46	27
NXA 70	65	42
NXA 90	85	55
NXA 120	105	65

Typical Flow vs. Differential Pressure for Application Sizing[5]





Unit conversion: 1 bar = 100 kPa

[3] Registered trademark of Advanced Elastomer Systems.

[4] >90% and 99.9% retention ratings by ASTM F-795 test.

[5] Flow rate is for a 25.4 cm (10 in) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Ordering Information

Pall Part Number = NXA [1] – [2] U – [3] [4]

Table 1

Code	Filter grades (µm)
0.5	0.5
1	1
3	3
5	5
10	10
20	20
30	30
40	40
50	50
70	70
90	90
120	120

Table 2

Code	Cartridge lengths (cm/in) nominal
4	10.2 / 4
5	12.7 / 5
9.75	24.8 / 9.75
9.875	25.1 / 9.875
10	25.4 / 10
19.5	49.5 / 19.5
20	50.8 / 20
29.25	74.3 / 29.25
30	76.2 / 30
39	99.1 / 39
39.5	100.3 / 39.5
40	102 / 40

Table 3

Code	End configurations
Blank	DOE industrial (no end caps)
1X	DOE, 2.54 cm (1 in) extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[6]
M3H	SOE large diameter closed end, external 222 O-rings
M4	SOE fin end, external 222 O-rings with locking tabs (silicone and EPDM O-rings only)
M5	DOE, internal 120 O-rings (retrofits 213 O-ring style)[6]
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)[6]
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)[6]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[6]
M10	DOE, internal O-rings (fits other manufacturers' housings)[6]
M11	SOE flat closed end, internal 120 O-ring (retrofits other manufacturers' X style)[6]
M18	SOE flat closed end, external 222 O-ring
M20	SOE with internal O-rings (same as M10), closed end with deep recess
DOE	DOE with elastomer gasket seals and end caps
H21	DOE, Santoprene gasket seal
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

[6] For details, contact Pall Corporation.

Table 4

Code	Gasket/O-ring materials
S	Silicone
N	Nitrile
E	EPDM
V	Fluorocarbon elastomer
T	Expanded PTFE (gaskets) FEP encapsulated silicone (O-rings)
F	FEP encapsulated fluorocarbon elastomer (O-rings)
Y	Santoprene

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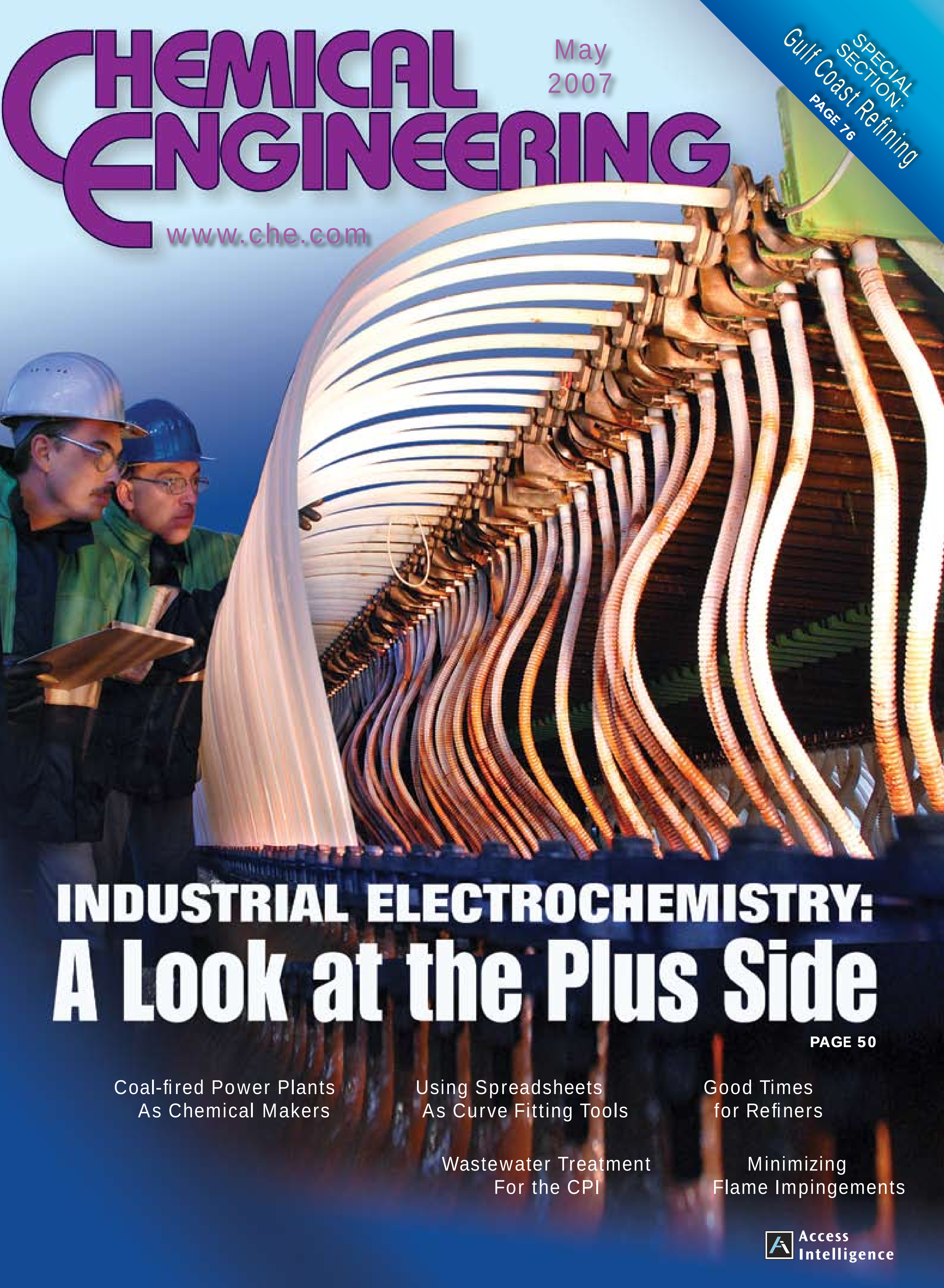
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MICROFILTRATION For CPI Wastewater

Consider this method for high-purity water needs, including that for steam generation and biofuels processing

Brad Buecker
Kansas City Power & Light Co.

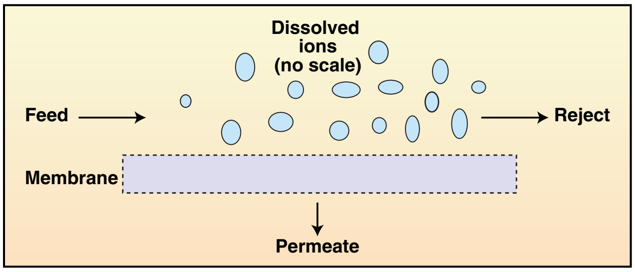

FIGURE 1. **In crossflow filtration, a portion of the water is forced through the membrane while the dissolved solids flow with the remainder to the waste stream outlet**

Pure water is an essential ingredient in the manufacture of a vast amount of products in the U.S. and, of course, throughout the world. In the industry for which I work, electricity generation, high-purity water is an absolute must for feeding high-pressure steam generators. But of course, steam generation is also important in the petroleum-refining and petrochemical industries, pharmaceutical plants, the steel and non-ferrous metals industries, and so on. Furthermore, high-purity water for other processes — computer-processor and circuit-board manufacturing come quickly to mind — is also an absolute necessity. And, let's not forget the blossoming biofuels industry.

As has been reported in this magazine and elsewhere, the techniques of microfiltration (MF) and ultrafiltration (UF) are gaining popularity as pretreatment methods for industrial makeup-water production. This article outlines fundamental principles of these technologies, and why they are replacing previous technologies. It also discusses lessons I have learned from direct experience with a microfiltration system.

Filtration issues

As a precursor to microfiltration review, consider filtration from both sides (particle-size wise) of MF. (See *Chem. Eng*, January 2007, pp. 40–44, for an excellent article on cartridge filtration [*1*].) Direct filters operate on the simple principle of particulate capture, where the solids latch onto or lodge between filter fibers. As the article outlines, direct filtration can remove particles down to 0.5 microns in size — excellent indeed! The major drawback to direct filtration is that the filters foul irreversibly, and thus must be replaced on a regular basis. Excessive particulate loading will minimize the advantages of direct filtration.

At the ultimate end of the filtration spectrum is reverse osmosis (RO), which has found wide acceptance in many industries for its ability to remove dissolved ions. People often think of RO membranes as having discrete pores, but this is a misconception. A more accurate description is a membrane with torturous paths whose effective diameters are only angstroms in size. RO does not remove impurities by direct filtration, but rather via an electromechanical process whereby water forms a boundary layer along the membrane surface and "pore" walls. The extremely small pore size and water boundary layer prevent the passage of most dissolved ions, particularly larger ions such as calcium, magnesium, bicarbonate, chloride, and sulfate. The inability for the large ions to pass through the membranes greatly reduces the ability of small ions — Na+ is the primary example — to pass, as the solution must maintain ionic neutrality.

Via the technique of crossflow filtration, where the pressurized feed to the RO passes tangentially to the membrane surface, a portion of the water is forced through the membrane while the dissolved solids flow with the remainder to the waste stream outlet (Figure 1). Placement of membranes in series allows water recovery values typically around 75% with solids rejection of 99% or better with modern membranes. RO has become important, especially in the power industry, as an ionic load-reducing mechanism ahead of ion-exchange polishers.

Microfiltration's role

So, how does microfiltration fit into the water treatment scheme? The point to remember is that industrial makeup originates from a primary water source such as a lake, river, underground aquifer, or perhaps even the ocean. All surface supplies contain suspended solids in varying degrees. We have already noted that direct filters, such as the cartridge devices that protect RO membranes, will quickly foul when overloaded, which would be the case if they served as the primary filter of surface supplies.

The upside of this issue is that effective upstream pretreatment is required ahead of the final polishing devices. For many years, the pretreatment technology of choice was clarification followed by media filtration. Certainly, this technique is very

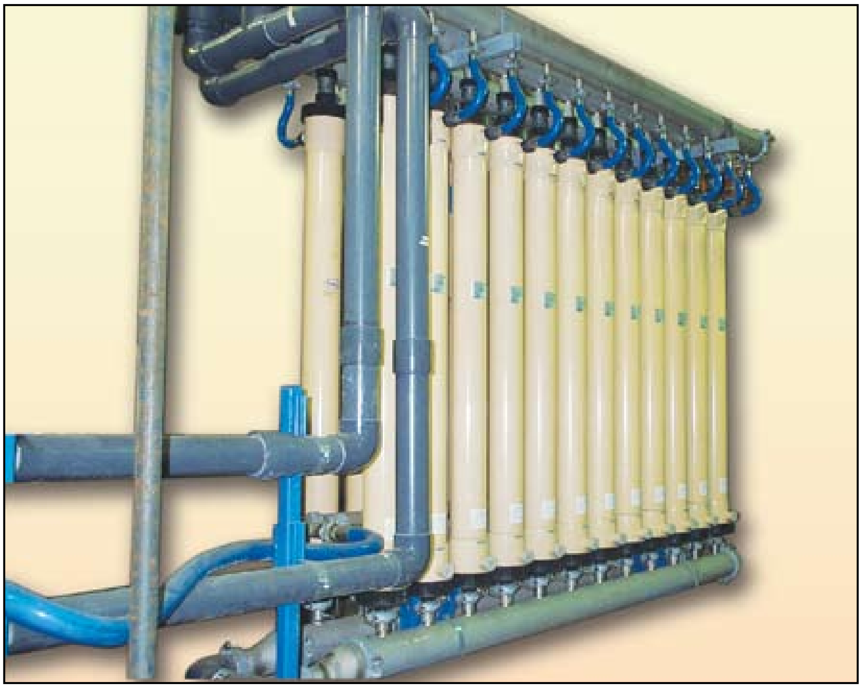

FIGURE 2. **Most membrane housings use hollow-fiber membranes that are spaghetti-sized in diameter**

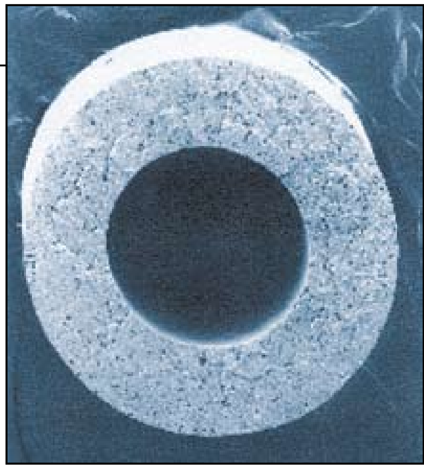

FIGURE 3. **Magnified view of a hollow fiber membrane**

viable, and the technology has improved over time just like everything else. However, even the most modern clarifiers require feed of a coagulating chemical followed by feed of a flocculating chemical. Operator attention is necessary to ensure that the clarifier beds do not overflow due to improper chemical feed or changes in the inlet water quality, a common issue with surface-water supplies. Not infrequently, operators may find a depleted or vanished bed due to malfunction of a sludge, blowdown valve.

MF and UF are becoming popular because the processes utilize crossflow filtration, similar to RO but with a different type of membrane, to continuously filter makeup water. Particulate material 0.1 micron in size and even smaller is removed by the membranes, with minimal operator attention required [*2*].

Membrane configuration

The most popular systems utilize hollow-fiber membranes, which are spaghetti-sized in diameter. This author's direct experience is with the unit shown in Figure 2.

Each of the pressure vessels contains approximately 6,000 hollow-fiber membranes. Raw water enters the vessels from the bottom and is collected in headers at the top of the skid for downstream distribution.

The fibers are all manufactured of polyvinylidene fluoride (PVDF). PVDF is quite tough and corrosion resistant, and is an excellent material for this application, in large part because pore sizes can be larger (and operating pressures much lower) than for RO. PVDF is not suitable for RO membranes, because the material cannot be fabricated to establish the extremely small pore size.

Like RO, MF and UF units are also designed for crossflow filtration, in which the water flows along the membrane surfaces and the filtered water passes through the walls. The typical configuration is raw water flow along the outside of the membrane, with permeate flow into the hollow area of the fibers. An outside-in flow-path configuration is preferred by many, as the particles can be more easily flushed from the membranes during cleaning than with the opposite flow pattern. The common process is to produce filtered water for a set period of time, followed by a regular but relatively short backwashing step. In the system shown above, the operators normally set the process flow timer within a 10- to 20-min range, interrupted by a one-minute scrub with filtered water via an inside-out flow path. The backwash cycle also includes an air scrub, on the external membrane surfaces, to scour particles.

Lessons learned

Even with regular backwash cycles, MF membranes will accumulate solids over time. Periodically, a unit shutdown and off-line cleaning is required. Cleaning may be performed on a regular basis, say once a quarter, or may be set up on an as-needed basis by monitoring the differential pressure across the membranes.

A common method involves a stepwise circulating wash (perhaps two hours or so) with a warm (100°F), dilute sodium hydroxide (1%) and sodium hypochlorite (500 parts per million [ppm]) solution, a rinse with filtered water, a two-hour cleaning with a warm citric acid solution (0.5%), and then another rinse. We have found that cleaning every two to three months is good for maintaining membrane cleanliness. The unit takes water from a lake, where the maximum turbidity may reach 15 nephelometric turbidity units (NTU). This value is low compared to other sources, such as a river, where heavy rains upstream may produce temporary turbidity readings in the hundreds of NTU.

For these more-challenging applications, systems are available with a supplemental semi-automatic cleaning system that will shut the unit down and clean the membranes with acid and caustic on a timed interval or based on membrane differential pressure. I say semi-automatic because the plant chemists or technicians are still responsible for ensuring the proper chemical mixes in the cleaning feed tanks.

We also discovered that continuous

feed of a residual oxidizing biocide, (0.2–0.5-ppm concentration) was excellent for controlling microbiological growth in the membranes. PVDF is quite resistant to common biocides. We feed a compound that produces bromine due to the fact that the inlet raw water typically has a pH in the range of 8.0 to 8.5. Simple bleach is not particularly effective at alkaline pH.

This particular system replaced an aging clarifier and sand filters, where annual chemical, operating, and maintenance costs were $80,000 or more per year. Calculated costs for the microfilter are $20,000 per year, mostly for power consumption by the feed pump and the regeneration pump. This calculates to $0.15 per 1,000 gal of water produced. Except for repair of a few mechanical couplings on interconnecting lines, maintenance requirements have been minor.

Future issues

The need for pure water continues to grow. As was mentioned in the introduction to this article, the biofuels industry is one such area of expanded growth. *Chemical Engineering* and other important publications have provided steady reports on the issues related to the biofuels industry [*2–5*] and the fact that if cellulose-based fuel can be produced efficiently, the market will really expand. Of course, water is a vital ingredient in biofuel manufacturing. However, there is a twist to this issue, and it applies to other industries as well. The twist is that fresh water supplies are becoming more scarce, with the result that water conservation is taking on increased importance. This issue was brought out quite clearly at a biorenewables conference held at Iowa State University in November 2006 [*6*].

Of course, excitement ran through the crowd as scientists discussed new advances with regard to biomass-to-fuel developments. However, the seminar included many pragmatic papers and roundtable discussions on auxiliary issues. Topics included the logistics of collecting biomass, effects of biomass collection on subsequent soil quality, transport of finished products, and the effects of high water usage on groundwater sources and other supplies in and near the physical locations of biorefineries and biofuels plants. Recycling of waste streams almost certainly will become very important, and this is where microfiltration coupled with downstream treatment can be of great benefit. Wastewater typically picks up many suspended solids, and if these can be economically removed, subsequent polishing by RO and/or ion exchange returns the fluid to top quality.

Recycling will not be confined to the biorenewables industry. I regularly see or hear reports of other facilities that are considering the use of “gray” water for plant makeup. Gray water is often only thought of as the effluent from a sanitary wastewater plant, although it can be waste from other sources. The key point is that these waters frequently contain suspended solids of several-hundred ppm concentration. Steady-state removal of the particulates, as is offered by microfiltration, opens a window to recycling. ■

Edited by Rebekkah Marshall

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6. A Call to Action Summit, November 28, 2006, Iowa State University, Ames, Iowa.

Author

Brad Buecker (Email: beakertoo@aol.com) is the air quality control specialist at a large, Midwestern power plant. He has previous experience as a chemical cleaning services engineer, a water and wastewater system supervisor, and a consulting chemist for an engineering firm. He also served as a results engineer, flue gas desulfurization (FGD) engineer, and analytical chemist for City Water, Light & Power, Springfield, Ill. Buecker has written more than 70 articles on steam generation, water treatment, and FGD chemistry, and he is the author of three books on steam generation chemistry and steam generator fundamentals published by PennWell Publishing, Tulsa, Okla. Buecker has an A.A. in pre-engineering from Springfield College in Illinois and a B.S. in chemistry from Iowa State University. He is a member of ACS, AIChE, ASME, and NACE.

Pall Corporation

Marksman™ Series Filter Housings

For Use With Marksman Series Filter Elements

- One, Four, Seven and Nine Around Models Available
- Other Sizes Available Upon Request
- ASME U and UM Stamps Available For All Sizes
- Housings Constructed of 316L Stainless Steel For Corrosion Resistance
- Baskets Included
- Swing Bolt Closure Design Ensures Secure Sealing and Easy Change Out
- Adjustable Length Legs And Side In/Out Flow Design On Single Element Housing Button
- Side In/Side Out Flow Design On Multi-Around Housing Allows For Easy Piping Layout

Housing Specifications

Maximum Operating Pressure:

Stainless Steel:	150 psig (10.3 bar) @ 200˚F (93˚C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:

Non-Code:	Available for all sizes
Code:	ASME U or UM stamp available for all sizes

Connections:

Inlet/Outlet:	2" – 8" Flange
Option:	2" NPT for 1-Around, Size #1 Model
Drain[1]:	1 $^1/_2$" NPT
Vent:	1" NPT ($^1/_4$" NPT on single housing)
Gauge[1]:	$^1/_4$" NPT (Upstream/Downstream)

Shell O-rings:	Nitrile (standard), Silicone Elastomer, Neoprene, Ethylene Propylene, Fluorocarbon Elastomer,

Filter Element Specifications

Marksman housings are designed to accept the entire family of Marksman filter elements, including Marksman Duo-Fine® filters, Marksman NEXIS® A Filters, Marksman Poly-Fine® II Filters, Marksman Poly-Fine XLD Filters. Size 1, Size 2, and 40" (102 cm) cartridges are available with our proprietary sliding flange. Refer to individual data sheets for detailed information on Marksman Series filter elements.

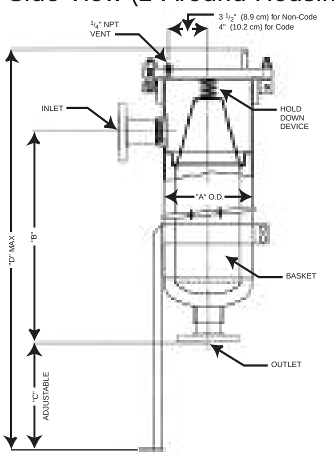
[1] - Applies to multi-around housing only.

Dimensional Data (nominal)[3]

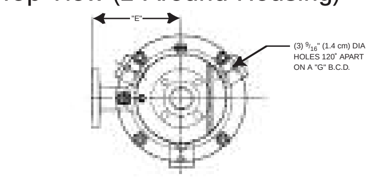
Model	Number of Cartridges	Size (nominal)	Code	Liquid Flow Rate[4] (gpm)	Dimensions (inches) A (shell OD)	B	C	D (height)	E	F	G	Inlet/ Outlet	Dry Weight (pounds)[5]
1MAR1	1	1	N	60 (227 lpm)	8 1/2 (21.6 cm)	21 1/2 (54.6 cm)	12 1/2 (31.8 cm)	43 (109 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	2 (5.1 cm)	77 (35 kg)
1MAR2	1	2	N	120 (454 lpm)	8 1/2 (21.6 cm)	35 (89 cm)	12 1/2 (31.8 cm)	57 (145 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	3 (7.6 cm)	110 (50 kg)
1MAR1	1	1	Y	60 (227 lpm)	8 1/2 (21.6 cm)	21 1/2 (54.6 cm)	11 (28 cm)	43 (109 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	2 (5.1 cm)	123 (55.8 kg)
1MAR2	1	2	Y	120 (454 lpm)	8 1/2 (21.6 cm)	35 (89 cm)	11 (28 cm)	57 (145 cm)	10 (25.4 cm)	N/A	11 7/8 (30.2 cm)	3 (7.6 cm)	138 (62.6 kg)
4MAR2	4	2	Y	480 (1817 lpm)	20 (50.8 cm)	25 (63.5 cm)	20 (50.8 cm)	79 (200 cm)	16 (40.6 cm)	32 (81.3 cm)	20 1/4 (51.4 cm)	6 (15.2 cm)	570 (258.5 kg)
7MAR2	7	2	Y	840 (3179 lpm)	24 (61 cm)	25 (63.5 cm)	20 (50.8 cm)	79 (200 cm)	18 (45.7 cm)	36 (91.4 cm)	24 1/4 (61.6 cm)	6 (15.2 cm)	740 (335.6 kg)
9MAR2	9	2	Y	1080 (4088 lpm)	30 (76.2 cm)	21 (53.3 cm)	24 (61 cm)	84 (213 cm)	21 (53.3 cm)	42 (107 cm)	30 7/8 (78.4 cm)	8 (15.2 cm)	1220 (553.3 kg)

3 - 40" (102 cm) housing specifications are available upon request.
4 - Flow rates listed are for depth cartridges. Consult factory for more specific information.
5 - Weights listed are for vessels with flange connections.

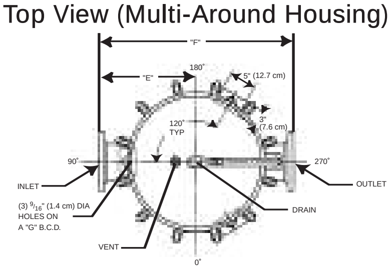
Side View (1-Around Housing)



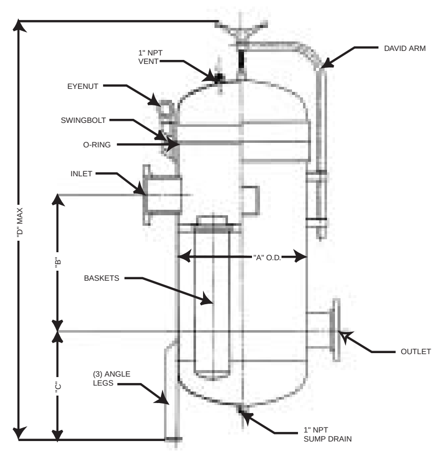
Top View (1-Around Housing)



Top View (Multi-Around Housing)



Side View (Multi-Around Housing)



Part Numbers/Ordering Information

■ MAR ● -316L – ◆ ▼ – ▮ 150 ◗ (e.g. 1MAR1–316L–2–C150UM)

Code ■	No. of Marksman Elements
1	1
4	4
7	7
9	9

Code ●	Cartridge Lengths (nominal)
1	Size 1 Bag
2	Size 2 Bag
4	40" Length

Code ▼	Connection Styles
Blank	NPT
F	Flange

Code ◆	Inlet/Outlet Connection Sizes
2	2"
3	3"
6	6"
8	8"

Code ▮	Code Construction
C	Code Construction
Blank	Non Code Construction

Code ◗	ASME Stamp Designation
UM	UM Stamp
U	U Stamp

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Filtration. Separation. Solution.SM

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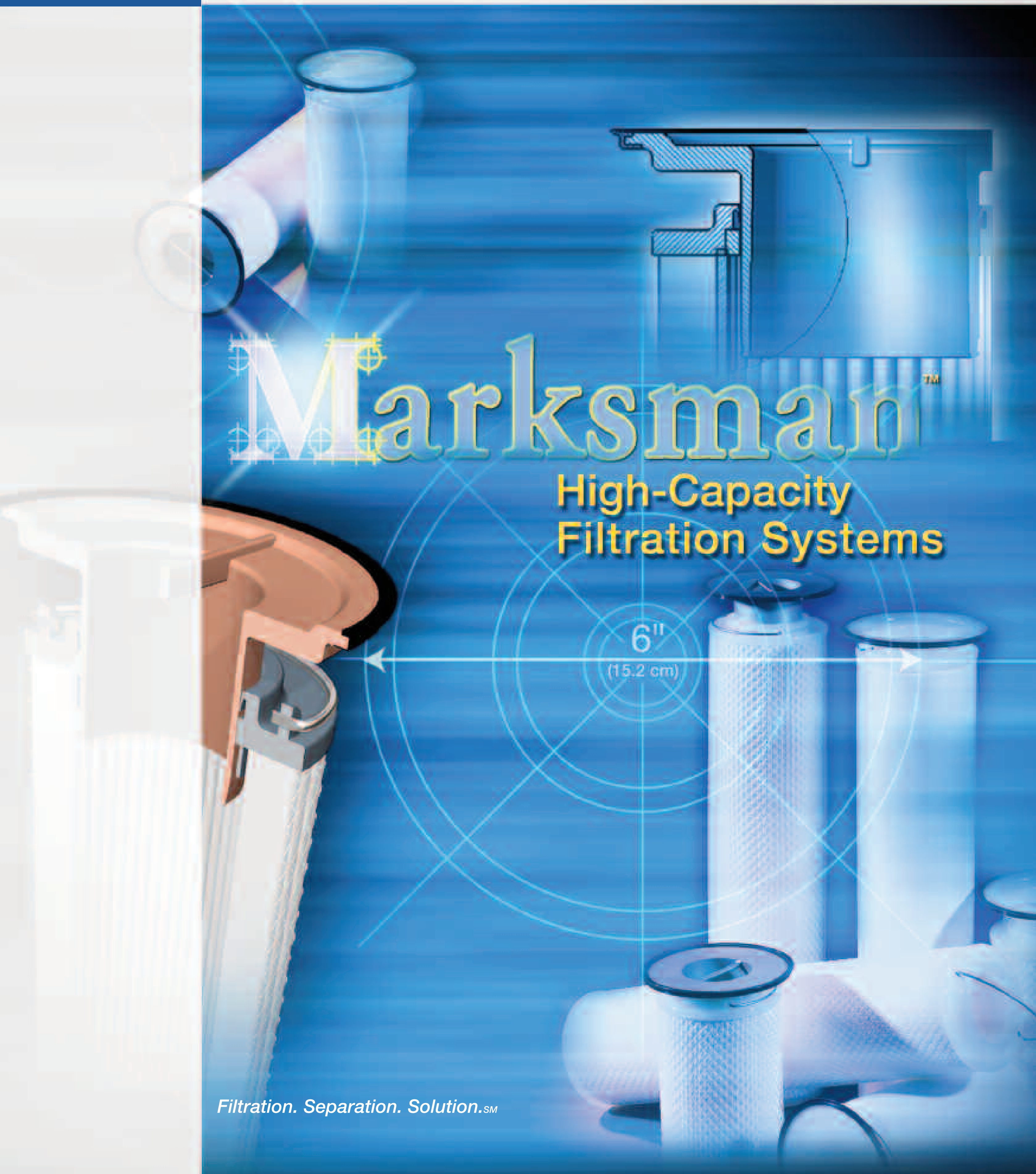


Expanding the Filtration Horizon

High-Performance Filtration

Pall, a world leader in filtration and separations technology, has developed a range of filters that combines the performance advantages of cartridge filters with the ease-of-use of bag filter systems. The resulting Marksman™ Series filters offer a unique combination of benefits and economics. Filtration customers now have a smart, cost-effective alternative to bag filters.

At the heart of the Marksman Series of filters is Pall's proprietary filter media. Pall's range of advanced filter media provides higher removal efficiencies and longer service life than most other filters of equal efficiency. The unique configuration of the Marksman filters offers significantly higher surface area than conventional filters or bag technologies and exceptional dirt-holding capacity.

Exceptional Flexibility

Ease of Use

The large 6 in (15.2 cm) diameter Marksman Series filters easily retrofit into existing Size 1 and Size 2 bag housings. In addition, these high-capacity filters also fit into the new Size 4 (40 in/101.6 cm) Marksman housing. One Size 2 Marksman Series filter replaces up to 16 standard 10 in (25.4 cm) filters, making change-outs quick and easy.

The user-friendly design of the Marksman Series filters eliminates the hardware commonly associated with cartridge filtration systems. Also, there are no tube guides, springs, or compression plates to maintain. This results in faster cartridge change-outs and reduces system downtime.

In addition, the inside-to-outside fluid flow ensures that the unwanted particles are trapped within the element. This significantly reduces the possibility of contaminating the clean, downstream side of the filter housing during element change-out.

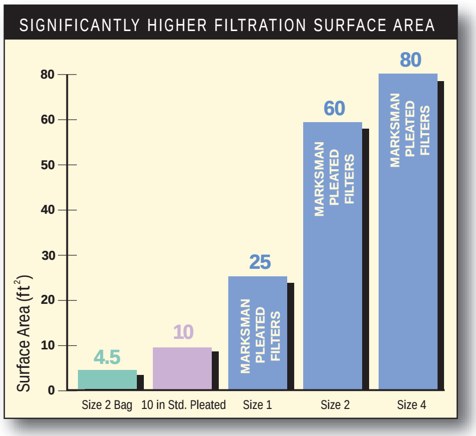
Adaptability

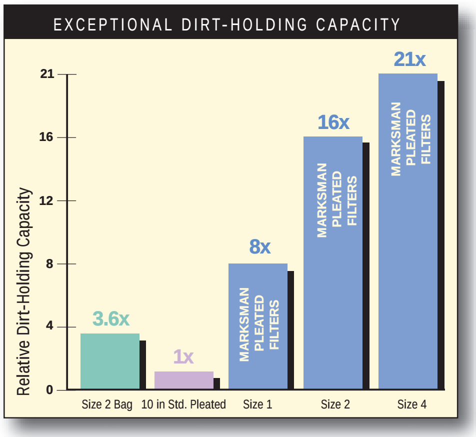
No longer will filtration performance be limited by the original selection of system hardware. As filtration requirements change, Marksman Series filters can easily retrofit into existing bag systems, with little or no additional hardware investment.

For example, Marksman Series filters can be used during normal process conditions, where bag filters may be used for short periods of time during upset conditions. Similarly, Marksman filters can be used for critical batches, while bag filters may be used for less critical production runs. Marksman Series filters can also be used as a complementary technology to existing bag filters.

Lower Operating Costs

Marksman Series filters deliver lower operating costs than most conventional filters for critical applications. The high surface area and resulting long service life translates into fewer cartridge change-outs and lower disposal costs. The large diameter configuration is more economical than the equivalent number of standard 10 in (25.4 cm) filters, thus delivering additional savings on filter purchases.





The graphs above compare high-efficiency bags and 10 in (25.4 cm) standard pleated filters with Marksman PFT filters. The comparison is typical for most filter grades.

Unique Design

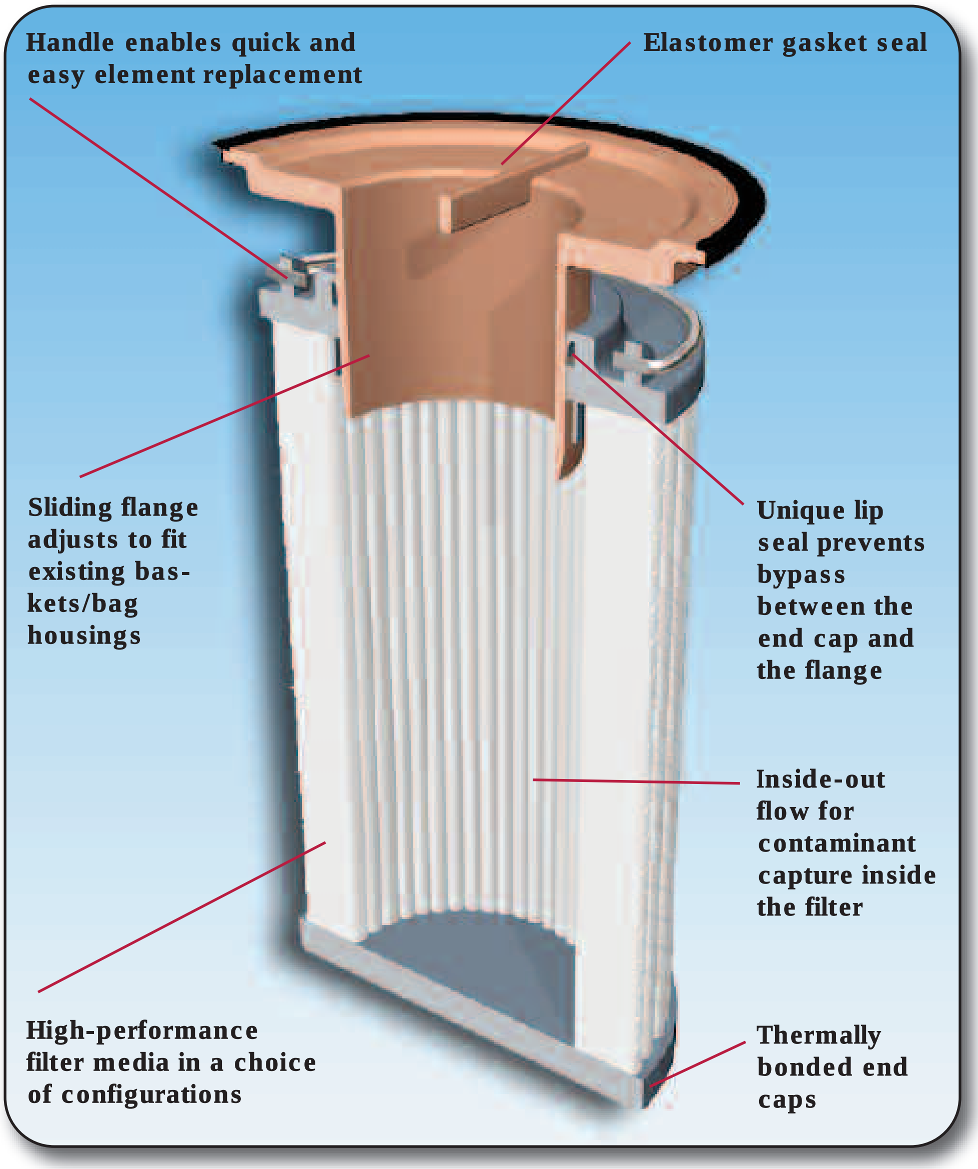
Innovative Technology

Marksman Series filters are manufactured in Pall's state-of-the-art facilities and contain the most advanced melt-blown and pleated media in the industry. Pall's proprietary melt-blowing technology produces media for the sole purpose of filtration. Our attention to detail throughout the entire manufacturing process ensures a high-quality product with unmatched performance.

Other technology benefits include:

- Unsurpassed consistency
- Consistent[1] removal efficiencies
- High-porosity for maximum dirt-holding capacity
- Wide range of product offerings (polypropylene and glass media)
- Customized products for specific applications

[1] *Removal efficiencies based upon a modified ASTM F795 Dynamic Single Pass Efficiency Test.*



Marksman Series Filter Elements	Construction	Filter Grades
Marskman DFN filters	Pleated surface glass filter	1.5 to 40 microns
Marksman NXA filters	Melt-blown polypropylene depth filter with proprietary CoLD Melt™ technology	5 to 70 microns
Marksman PFT filters	Pleated surface melt-blown polypropylene filter	1 to 150 microns
Marksman XLD filters	Pleated depth melt-blown polypropylene filter	1.5 to 70 microns

Features and Benefits

Product Feature	Product Benefit	Customer Benefit
Large 6 in (15.2 cm) diameter element	• High-flow capacity • High surface area	• Lower filtration costs due to fewer filter elements • Lower labor costs due to fewer cartridge change-outs • Lower energy costs as a result of lower initial differential pressures • Quick and easy filter change-outs • Lower disposal costs
High-performance, proprietary media	• Precise filtration performance • Highly consistent performance • Wide range of removal ratings	• High-performance filtration in critical applications • Consistent and reproducible filtration results over time • Less rework due to inconsistent filtration
Inside-to-outside flow	• Contaminant captured inside the filter • Eliminates contaminant falling into the downstream (clean) section of the housing during element change-outs	• Faster element change-outs • Faster system start-ups • Improved product quality
Unique adjustable flange design	• Retrofits most existing Size 1 and Size 2 bag filter housings and baskets • Size 4 (40 in/101.6 cm) fits a standard 40 in Marksman housing • Flexibility to use bag filters or cartridges	• No need to purchase new hardware • Uses existing bag filter systems • Lower capital costs • Easy to switch from bag filtration to cartridge technology
All polypropylene construction	• Wide chemical compatibility	• Compatible with a wide range of fluids • Ease of disposal
No center core	• Less flow resistance • Lower initial pressure drops	• Improved flow rates • Lower energy costs
Re-usable stainless steel flange (option)	• Reduces element volume • Lower cost to replace elements • Can be used in higher temperature applications	• Lower disposal volumes • Reduced filtration costs • Extends usability in elevated temperature applications

Product Line

Marksman filters are available in four configurations ...

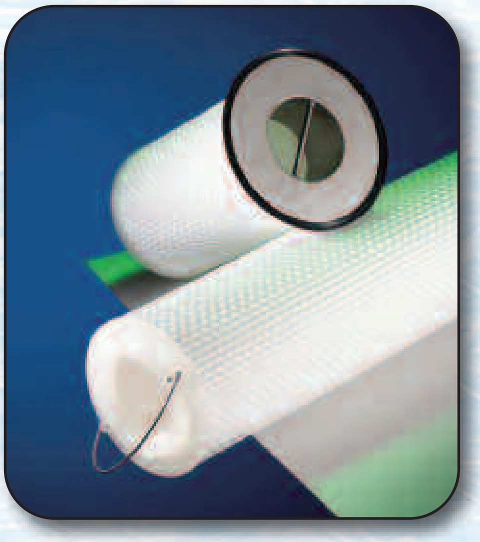
Marksman PFT Series Filters

Marksman PFT filters are constructed of ultra-thin, proprietary melt-blown Poly-Fine® filter media. These high surface area, pleated, polypropylene filters deliver extremely long service life and are ideal for classifying filtration and for capturing non-deformable particulate.

Marksman XLD Series Filters

Marksman XLD (eXtended Life Depth) Series filters have a unique pleated depth configuration. They feature a thicker, multi-layered pleat pack that combines the best of pleated and depth technologies into a single cartridge.

The proprietary Poly-Fine media incorporated into the Marksman XLD Series filter makes these filters ideal for applications where the long life of a pleated filter is desired, and the presence of deformable particles requires the use of depth media.



Product Line

Marksman DFN Series Filters

Marksman DFN filters are constructed of micro fiberglass Duo-Fine® media. These 6 in (15.2 cm) diameter filters have a wide chemical compatibility and offer long service life. They are available in a variety of filter grades for specific applications.

Marksman NXA Series Filters

Marksman NXA filters deliver the same performance advantages of Pall's Nexis® Series filters, by utilizing the same proprietary CoLD Melt technology. The unique Co-located Large Diameter fiber construction produces a fiber matrix with excellent structural integrity to assure that the media does not shift, compress, or unload captured contaminant.

The proprietary manufacturing process produces a melt-blown depth filter with precise removal efficiencies, excellent consistency, and exceptional void volume for high contaminant-holding capacity.

An additional benefit of the inside-out flow configuration is that the finest filtration zone is on the outside of the filter, where the greatest surface area resides.

Product Line

Marksman Series Housings

Pall offers a complete range of Marksman Series filter housings for use with Marksman Series filters. Pall's ISO 9001 manufacturing facility operates under a world-class manufacturing philosophy with a never-ending focus on continuous improvement.

The 316L stainless steel Marksman housings are available in Size 1, Size 2, and Size 4 to accommodate a wide range of filters and bags. Single- and multi-cartridge housings, code and non-code designs are offered. Custom-engineered housings are also available. Contact a Pall representative for more information about custom designs.

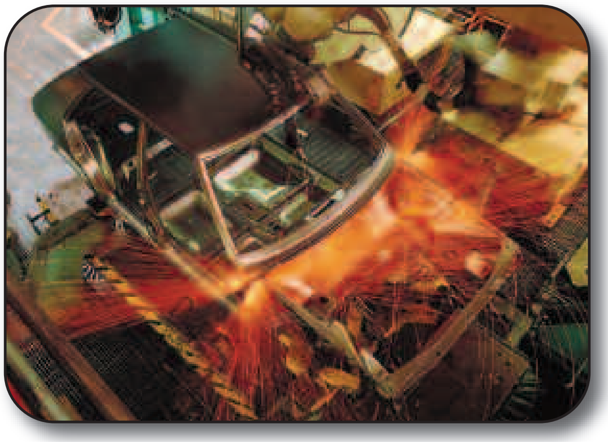
Size 1 and Size 2 Marksman housings are equipped with standard bag housing baskets and allow the flexibility to switch between Marksman filters and traditional bags. The Size 4 housing is designed to hold only a 40 in (101.6 cm) length filter. All Marksman housings are sized to optimize the dirt-holding capacity of the element.

Marksman Filter Applications

Industry Applications

Automotive/ Industrial In-plant:	Parts washing, machine tool coolant, make-up water, pre-and post-RO, E-coat filtration, auto coatings, water and oil-based metal working fluids, wash rinses and baths
Chemicals:	Intermediates and fine chemicals
Electronics:	Pre-RO, process cooling water, wastewater, reclaim water, inks, CD/DVD, magnetic media, slurries
Food & Beverage:[2]	Edible oils, corn syrup and sweeteners, food grade ethanol
Mining:	Make-up water for water/glycol fluids, long wall applications (raw water and emulsion return, emulsion top up)
Oil & Gas:	Amine, glycol
Power Generation:	Condensate, make-up water, water injection, cooling water
Primary Metals:	Make-up water, pre-and post-RO, process fluids, coatings, wire drawing
Pulp and Paper:	Trim squirts, shower water, seal protection
Refineries:	Amine, sour water

[2] ***Food and Water Contact Use:*** *Please contact Pall Corporation for product applicability to specific National Legislation and/or Regional Regulatory requirements for food and water contact use.*



Total Fluid Management℠

Pall is much more than a filter company. We are fluid management specialists who strive to make our customers' operations more successful. Our Total Fluid Management (TFM) program consists of a wide range of filtration products and services designed to help maintain a specified level of fluid cleanliness, leading to improved operations and reliability of the systems involved. To this end, we have developed a comprehensive program that leverages our strengths and provides true value to our customers.

We offer a variety of customized productivity and system services as part of our TFM program. A partial list of these services includes:

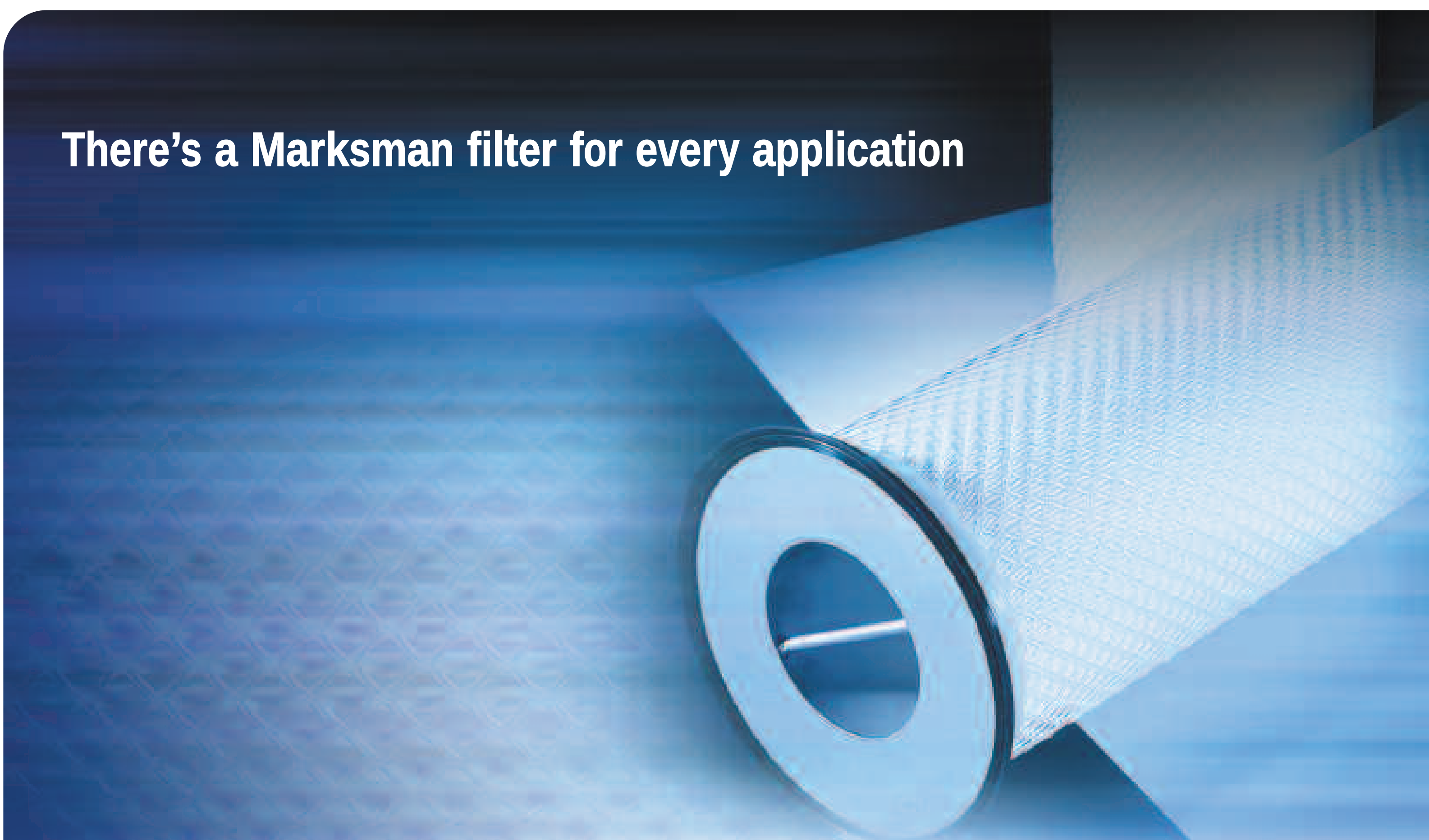
- Cleanliness/process audits
- Laboratory and pilot testing
- Customized product development
- Commissioning
- Equipment rental
- Remote monitoring
- Training seminars
- Reliability engineering
- Troubleshooting and system support
- System maintenance/service contracts

Pall Corporation – A Leader in Filtration Technologies

For more than 60 years, Pall Corporation has been solving complex contamination, separations and purification problems for diverse customers around the globe. With revenues of more than $2 billion, Pall is the largest and most diverse filtration, separations, and purifications company in the world. Our products and services allow customers to meet regulatory requirements and increase output while reducing total cost of ownership. Our enabling technologies help make customers' products better, safer, and even possible.

With offices in more than 30 countries, we are well-positioned to provide assistance to customers on the local level, as well as offer broad-based, worldwide support when needed. At the core of our support network is our Scientific and Laboratory Services (SLS) department, an extensive global network of scientists and engineers who are experts in their field.

We invite you to learn more about Pall's wide array of products and services. For more information, contact your Pall representative or visit us on the web at: www.pall.com.


There’s a Marksman filter for every application

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*Filtration. Separation. Solution.*SM

PIMARKSMANEN Printed in the USA. June 2009

Pall Corporation

LMO Series Filter Housings

Accepts 4 in (10.2 cm), 10 in (25.4 cm), 20 in (50.8 cm), or 30 in (76.2 cm) Double Open End Filter Cartridges[1]

- Operating pressure to 175 psig (12.1 bar) @ 200°F (93°C) permits use in a wide range of applications
- Cast iron, brass, or 316 stainless steel materials of construction
- In-line inlet and outlet connections for easy installation
- Optional T-handle permits replacement of filter cartridge without tools

Housing Specifications

Maximum Operating Pressure:
175 psig (12.1 bar) @ 200˚F (93˚C)

__NOTE:__ Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:	**Head**	**Shell**
LMO:	Cast Iron[2]	316 Stainless Steel
LMOB:	Cast Brass	316 Stainless Steel
LMOS:	Cast 316 Stainless Steel	316 Stainless Steel

Connections:

Inlet/Outlet:		$^3/_8$", $^1/_2$", $^3/_4$", or 1" NPT
Drain:	LMO:	Drain Plug, 316 Stainless Steel, $^1/_4$" NPT
	LMOB:	Petcock, Brass, $^1/_4$" NPT
	LMOS:	Drain Plug, 316 Stainless Steel, $^1/_4$" NPT

Shell O-rings: Ethylene Propylene (standard), Nitrile, FEP, Fluorocarbon Elastomer, Neoprene, Silicone Elastomer

Cover Nut O-ring: FEP (standard)

Bracket Option:
Nickel plated steel brackets are available as standard option.

T-Handle Option:
T-handle cover nuts are available in carbon steel or 316 stainless steel. Standard units are supplied with hex nuts.

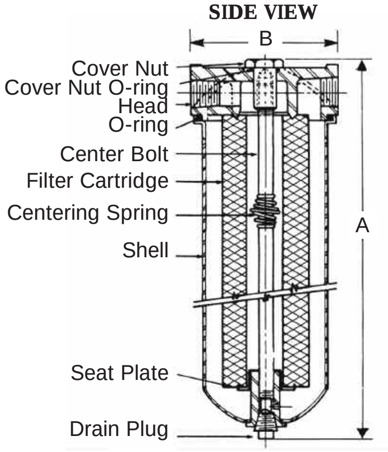
Flange Option:
150 lb. ANSI raised face flanges are available for $^1/_2$", $^3/_4$" and 1" LMOS stainless units only.

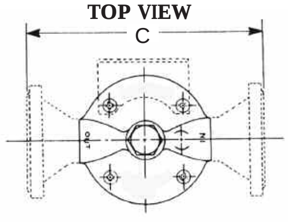
__NOTE:__ Non-compressible filters such as pleated, carbon, and membrane cartridges are not recommended for use with this housing. LMO Spring Seal and LMO Vari-Seal™ housings are designed to accommodate non-compressible filter cartridges. For metallic filter cartridges use the LMO Vari-Seal housings only.

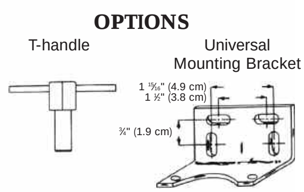
[1] When fitting with 4 in (10.2 cm) DOE membrane filters, please order filters under Code 550 to assure proper fit.
[2] Painted exterior.

Dimensional Data (nominal)

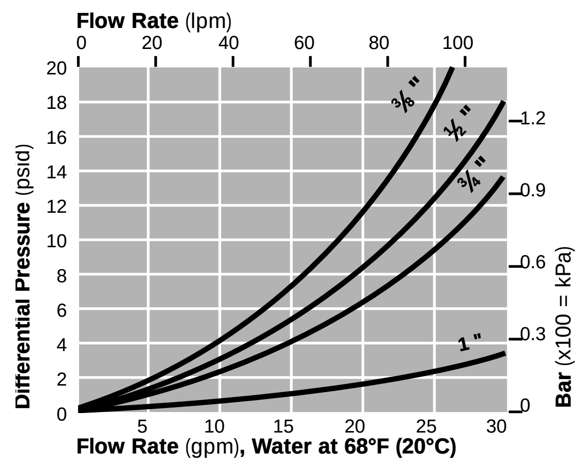
Model	Flow Rate[3] gpm (lpm)	Dimensions inches (cm) A	B	C	Weight lb (kg)
LMO4 - ⅜	to 4 (15.1)	7 ¼ (18.4)	4 ¾ (12.1)	-	2 ¾ (1.3)
LMO10 - ⅜	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 (2.7)
LMO10 - ½	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10 - ¾	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10 - 1	to 10 (37.9)	13 ½ (39.3)	4 ¾ (12.1)	-	6 ¾ (3.1)
LM020 - ¾	to 20 (75.7)	23 ⅜ (59.4)	4 ¾ (12.1)	-	8 ½ (3.9)
LMO20 - 1	to 20 (75.7)	23 ⅜ (59.4)	4 ¾ (12.1)	-	9 (4.1)
LMO4B - ⅜	to 4 (15.1)	7 ⅞ (20)	4 ¾ (12.1)	-	2 ¾ (1.3)
LMO10B - ⅜	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 (2.7)
LMO10B - ½	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10B - ¾	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10B - 1	to 10 (37.9)	14 (35.6)	4 ¾ (12.1)	-	6 ¾ (3.1)
LMO20B - ¾	to 20 (75.7)	24 ⅛ (61.3)	4 ¾ (12.1)	-	8 ½ (3.9)
LMO20B - 1	to 20 (75.7)	24 ⅛ (61.3)	4 ¾ (12.1)	-	9 (4.1)
LMO30B - ¾	to 30 (113.6)	34 (86.4)	4 ¾ (12.1)	-	10 (4.5)
LMO30B - 1	to 30 (113.6)	34 (86.4)	4 ¾ (12.1)	-	10 ½ (4.8)
LMO4S - ½	to 4 (15.1)	7 ¼ (18.4)	4 ¾ (12.1)	-	4 (1.8)
LMO10S - ½	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	-	6 ¼ (2.8)
LMO10S - ¾	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	8 ⅞ (22.5)	6 ¼ (2.8)
LMO10S - 1	to 10 (37.9)	13 ½ (34.3)	4 ¾ (12.1)	9 ⅛ (23.2)	6 ¾ (3.1)
LMO20S - ¾	to 20 (75.7)	23 ½ (59.7)	4 ¾ (12.1)	8 ⅞ (22.5)	8 ½ (3.9)
LMO20S - 1	to 20 (75.7)	23 ½ (59.7)	4 ¾ (12.1)	9 ⅛ (23.2)	9 (4.1)
LMO30S - ¾	to 30 (113.6)	33 ½ (85.1)	4 ¾ (12.1)	8 ⅞ (22.5)	10 (4.5)







Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Part Numbers/Ordering Information

LMO ● ◗ – ◆ ▼ (e.g., LMO100S–¾ F)

Code ●	Cartridge Lengths
4[1]	4"
10	10"
20	20"
30[4]	30"

Code ◗	Materials of Construction
Blank	Cast Iron and 316 Stainless Steel
B	Cast Brass and 316 Stainless Steel
S	316 Stainless Steel

Code ◆	Connection Sizes
⅜	⅜"
½	½"
¾	¾"
1	1"

Code ▼	Connection Styles
Blank	NPT
F	Flange

[3] *Dependent upon cartridge selection, fluid viscosity and allowable pressure drop at various flow rates. Refer to cartridge nomograph to determine initial pressure drop of filter cartridge.*

[4] *NOT AVAILABLE with cast iron head and carbon shell.*

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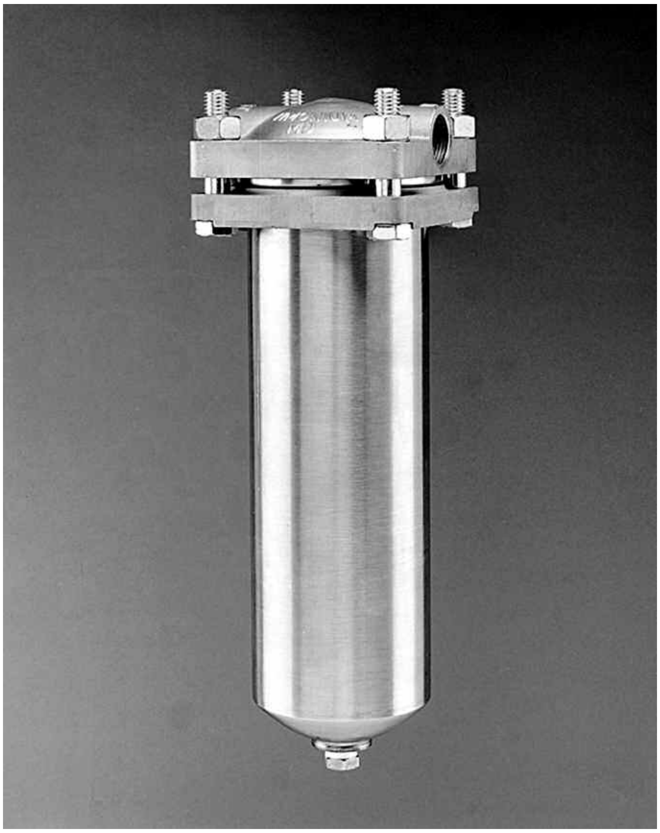
Pall Corporation

LMO High Pressure Series Filter Housings



Accepts 10 in (25.4 cm) or 20 in (50.8 cm) Double Open End Filter Cartridges

- Designed and constructed specifically for high pressure applications (750 or 1000 PSIG)
- Standard multi-bolt closure design provides safe, trouble-free sealing
- In-line inlet and outlet connections ensure easy installation
- Eye nut and flange options available
- Not for use with non-compressible filter cartridges such as pleated, carbon, metallic, and membrane.
  For non-compressible cartridges use the LMOVS-HP/VHP Series housings.

Housing Specifications

Maximum Operating Pressure:

HP: 750 psig (51.7 bar) @ 250°F (121°C)
VHP: 1000 psig (69 bar) @ 250°F (121°C)

Material of Construction:

316 Stainless Steel

Connections:

Inlet/Outlet:	¾" NPT
Drain:	¼" NPT

Shell O-rings: Ethylene Propylene (standard), Nitrile, FEP, Fluorocarbon Elastomer, Neoprene, Silicone Elastomer

Eye Nut Option:

Zinc plated steel eye nuts are available. Four eye nuts (Part #T10640030) are required. Standard units are supplied with hex nuts.

Flange Option:

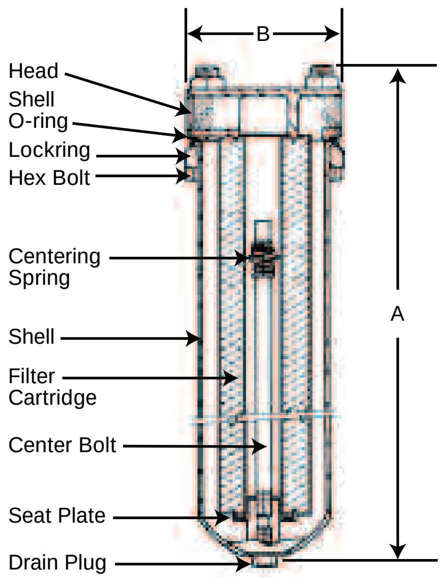
LMOHP housings are available with ¾" welded flanges.

Dimensional Data (nominal)

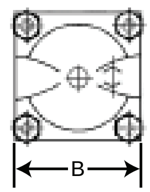
Model	**Flow Rate**[1] **gpm**	**Dimensions (inches)** A	B	**Weight (pounds)**
LMO10S – ¾ HP	to 10 (37.9 lpm)	13 (33 cm)	4 ⅜ (11.1 cm)	10 (4.5 kg)
LMO20S – ¾ HP	to 20 (75.7 lpm)	23 (58.4 cm)	4 ⅜ (11.1 cm)	13 (5.9 kg)
LMO10S – ¾ VHP	to 10 (37.9 lpm)	13 (33 cm)	4 ⅜ (11.1 cm)	10 (4.5 kg)
LMO20S – ¾ VHP	to 20 (75.7 lpm)	23 (58.4 cm)	4 ⅜ (11.1 cm)	13 (5.9 kg)

[1] *Dependent upon cartridge selection, fluid viscosity, and allowable pressure drop.*

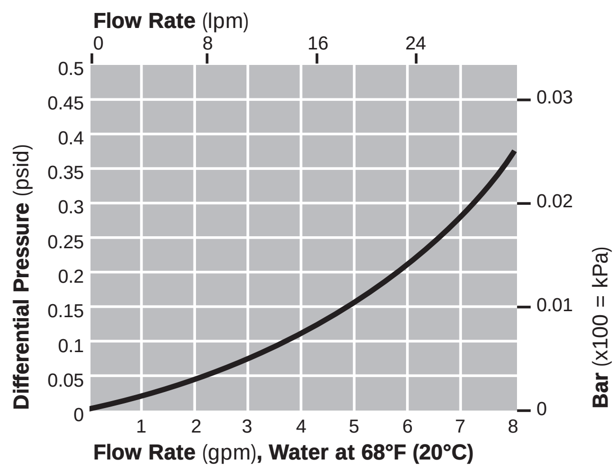
SIDE VIEW



TOP VIEW



Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Part Numbers/Ordering Information

LMO ● S – ¾ ▼ ✪ (e.g., LMO10S–¾FHP)

Code ●	**Cartridge Lengths**
10	10"
20	20"

Code ▼	**Connection Styles**
Blank	NPT
F	Flange

Code ✪	**Pressure Rating**
HP	750 psig @250˚F
VHP	1000 psig @250˚F

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Filtration. Separation. Solution.SM

1732-12C

October 2009

Pall Corporation

JD Series Filter Housings

All Natural Polypropylene 20″ Single Cartridge Housing

- Constructed from all natural polypropylene components with no fillers, colorants, plasticizers or lubricants
- Economical alternative to fluoropolymer, stainless steel or other high purity vessels
- Housing designed to accept SOE filter cartridges with 222 o-ring sealing
- Excellent chemical compatibility for use with semiconductor grade chemicals, CMP slurry, magnetic coatings, electronic etching solutions, DI and reagent grade water
- Accommodates standard 20″ (50.8 cm) Pall M3 (Code 3) style filter cartridges

Housing Specifications

Maximum Operating Pressure:
100 psig (6.9 bar) @ 100°F (38°C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Material of Construction:
All natural polypropylene – no fillers, colorants, plasticizers or lubricants

Connections:

Inlet/Outlet:	3/4″ FNPT
Vent/Gauge:	1/4″ FNPT
Drain:	1/4″ FNPT

Shell O-rings: Fluoroelastomer (standard), Nitrile, Silicone Elastomer

Replacement Cap Plug Kit:
For vents/drains – includes 1 plug and 1 O-ring (Part # T11039030)

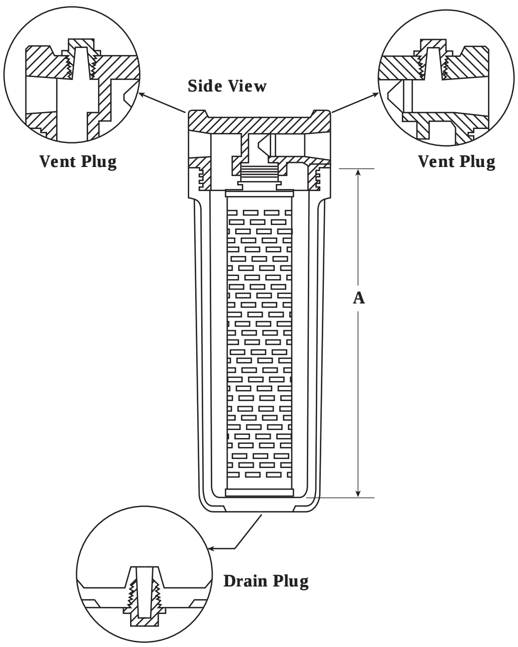
Use of this product in a manner other than in accordance with Pall's current recommendations may lead to injury or loss. Pall cannot accept liability for such injury or loss.

JD SERIES FILTER ASSEMBLIES SHOULD NOT BE USED WITH FLUIDS INCOMPATIBLE WITH THE MATERIALS OF CONSTRUCTION, INCLUDING CLEANING AGENTS. INCOMPATIBLE MATERIALS ARE THOSE, WHICH CHEMICALLY ATTACK, SOFTEN, STRESS CRACK OR ADVERSELY AFFECT THE MATERIALS OF CONSTRUCTION IN ANY WAY. USERS SHOULD CHECK THE COMPATIBILITY OF PROCESS FLUIDS BEFORE USE.

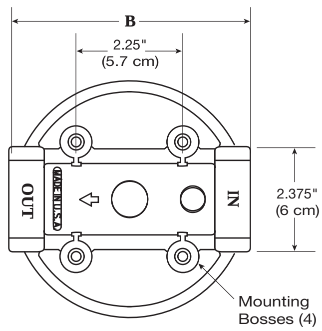
Dimensional Data (nominal)

Model	Liquid Flow Rate[1] (gpm)	Dimensions (inches)		Weight (pounds)
		A	B	
JD20	to 20 (75.7 lpm)	$19^{15}/_{16}$ (50.6 cm)	$5^{1}/_{8}$ (13 cm)	4.25 (1.9 kg)

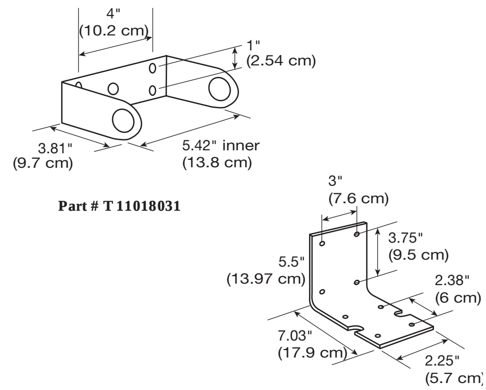
[1] *Dependent upon cartridge selection, fluid viscosity, and allowable pressure drop.*



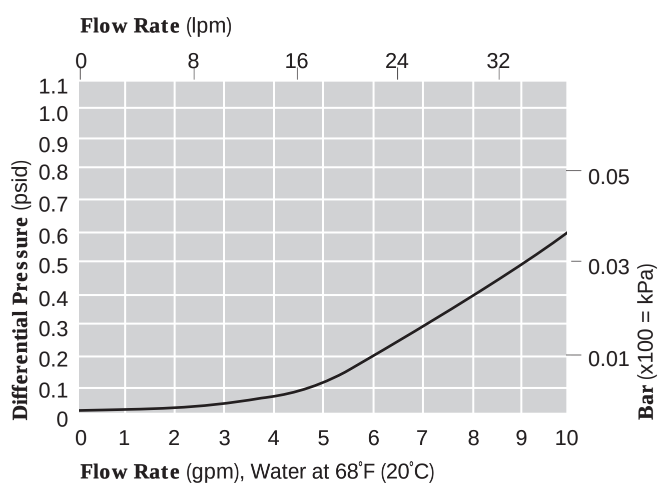
Top View



Optional Mounting Brackets



Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by the specific gravity of the fluid.

Part Numbers/Ordering Information

JD20 – 3/4 ◆ (e.g., JD20 – 3/4 N)

Code ◆	O-ring Materials
Blank	Fluoroelastomer
N	Nitrile
S	Silicone

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Pall Corporation

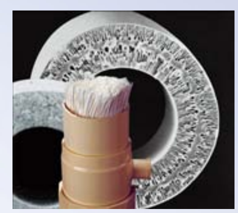
Industrial Water Treatment Programs

Pall Corporation is the global leader in the rapidly growing field of filtration, separation and purification. Pall is also recognized as being one of the largest water treatment companies in the world. Pall's broad capabilities and technologies for industrial water customers include:

- Total treated water capacity greater than 800 MGD and growing
- More than 25 installations specifically designed for wastewater reuse for utility water makeup and boiler feedwater
- Experts in water reuse engineering and water balance evaluations

Pall is recognized for its expertise in Industrial processes. For decades Pall has applied its separation and filtration knowledge and technologies to solve a variety of complex and critical applications.
We understand the origin of your process waters and their characteristics. <u>Our understanding of your process places Pall in the best position to define solutions for water treatment and reuse</u>. We have experience in treating or developing solutions for some of the most difficult and troublesome process waters. Our technologies are applied to remove mercury, selenium, hydrocarbons, and other troublesome contaminants.

Our integrated systems include coupled MF/UF/NF/RO designs that offer:



- Reduced system footprint
- Dramatic extension of RO membrane life
- Elimination of inter-stage pumping which simplifies operation and reduces operating costs
- Integrated ion exchange designs to provide turnkey solutions
- Conversion of raw water, C/T blowdown, or process water into high-quality boiler feedwater. Over 80 installations.

Our core technologies include a unique hollow fiber MF/UF membrane that can be configured in either an inside-out cross flow or an outside-in dead-end configuration. This allows Pall to optimize designs for the widely variable waters that your plant may generate or need to process.

- PVDF membrane is highly resistant to chemical attack
  - Unparalleled integrity
  - 0.00031% failure rate documented in a 5-year study. That equates to 6 fiber failures out of a population of 1,905,000 fibers in a 5-year period!
- Hydrophilic membrane types (PAN and certain ceramics) provide more resistance to oil fouling

Pall ceramic systems and technologies offer superior resistance to thermal and chemical degradation when facing water with extremes in pH and temperature. Pall manufactures ceramic membranes and modules that are utilized in systems optimized for specific characteristics. Pall ceramic technologies and systems are based on a variety of membrane configurations. Porous alumina structures are lined with asymmetric membrane layers made of alpha-alumina, zirconia, and titania which offer a range of ultrafiltration efficiencies.

We invite you to learn more about Pall and our Industrial water capabilities. Visit us on the web or contact your local Pall representative.

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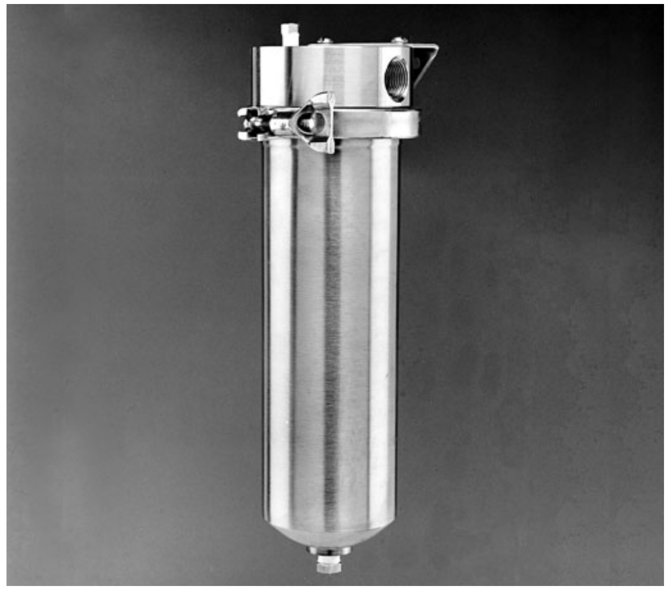
ENABLING A GREENER FUTURE

Pall Corporation

IDO Series Filter Housings



175 PSIG, Accepts Pall M3 (Code 3) Style 222 O-ring Single Open End Cartridges

- Positive Cartridge Sealing Minimizes Fluid Bypass
- Accepts 4″ (10.2 cm), 10″ (25.4 cm), 20″ (30.8 cm) or 30″ (76.2 cm) M3 (Code 3) Style Cartridges
- Unique Housing Design Has No Internal Parts
- Tri-Clamp Sealing Requires No Special Tools to Open or Close Housing
- Design Permits Visual Inspection of Cartridge Seal Prior to Closing Housing
- Optional Tri-Clamp Bracket Allows Easy Cartridge Replacement

Housing Specifications

Maximum Operating Pressure:
175 psig (12.1 bar) @ 150°F (66°C)

NOTE: Maximum operating pressure ratings are vessel ratings only. Safe operating temperature and pressure will depend on filter cartridge and gasket/O-ring used. For inquiries on compatibility, contact the factory or your Pall distributor.

Construction:

Head:	316L Stainless Steel
Shell:	316 Stainless Steel
Tri-Clamp:	304 Stainless Steel
Vent Plug:	316 Stainless Steel
Drain Plug:	316 Stainless Steel

Connections:

Inlet/Outlet:	¾″ NPT
Vent:	⅛″ NPT
Drain:	¼″ NPT

Shell O-rings:	EPDM (standard) Neoprene, FEP, Silicone Elastomer, Buna N, Viton[1] A

Bracket Options:

Universal:	Nickel Plated Steel
Tri-Clamp:	316 Stainless Steel

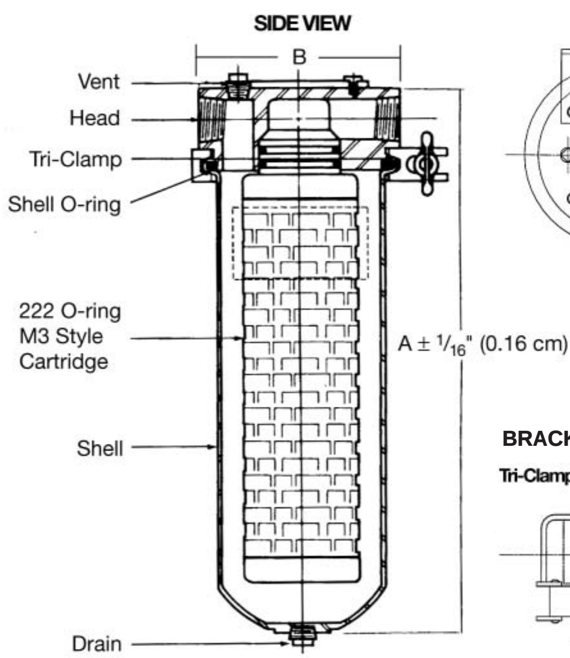
Interior Finish:	#4 Final Finish

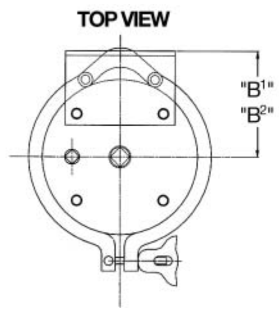
[1] *Registered trademark of DuPont Dow.*

Dimensional Data (nominal)

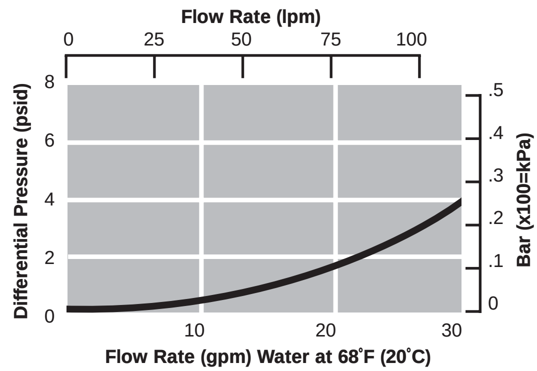
Model	Liquid[2] Flow Rate (gpm)	Dimensions (inches) A	B	Dry Weight (pounds)
IDO4S-¾	to 4 (15.1 lpm)	8 ½ (21.6 cm)	4 ⅛ (10.5 cm)	8 (3.6 kg)
IDO10S-¾	to 10 (37.9 lpm)	14 ¾ (37.5 cm)	4 ⅛ (10.5 cm)	9 (4.1 kg)
IDO20S-¾	to 20 (75.7 lpm)	24 ¾ (62.9 cm)	4 ⅛ (10.5 cm)	10 (4.5 kg)
IDO30S-¾	to 30 (113.7 lpm)	34 ¾ (88.3 cm)	4 ⅛ (10.5 cm)	13 (5.8 kg)

[2] *Dependent on cartridge selection, fluid viscosity, and allowable pressure drop. See graph above for housing pressure drop at various low rates. Refer to specific cartridge nomograph to determine initial pressure drop due to the filter cartridge.*





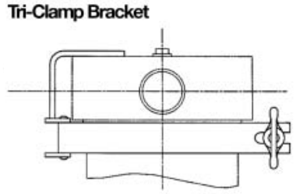
Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

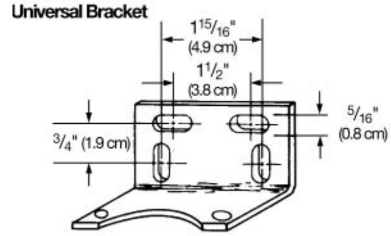
BRACKET OPTIONS

Tri-Clamp Bracket



Part #T10876032
B¹ = 2 3/4" (7.0 cm)

Universal Bracket



Part #T10567035
B² = 2 1/2" (6.4 cm)

Part Numbers/Ordering Information

IDO ● S – 3/4 ✷ (e.g., IDO10S–3/4CB)

Code ●	Cartridge Lengths
4	4"
10	10"
20	20"
30	30"

Code ✷	Mounting Brackets
Blank	Universal
CB	Tri-Clamp

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Bulletin #1718-12C 12/07

Pall Corporation

IDL Series
Filter Housings

- Single Cartridge Housings Accept Double Open End, RF and 1001 Style Filters
- All Stainless Steel Materials of Construction
- Accepts 1 in (2.54 cm), 4 in (10.2 cm), 10 in (25.4 cm), 20 in (50.8 cm), and 30 in (76.2 cm) Lengths
- V-Band Clamp Features a Quick Opening T-Handle
- Variety of Inlet/Outlet Sizes and O-ring Seal Options Offered
- Optional Mounting Brackets Available

Housing Specifications

Design Ratings[1]:

V-band Clamp Design: 260 psig (17.9 bar) @ 100˚F (40˚C)
200 psig (13.8 bar) @ 300°F (150°C)
114 psig (7.9 bar) @ 347°F (175°C)[2]

NOTE: Above ratings apply to housing only. Cartridge and housing O-ring selection may impose different and narrower limitations.

Materials of Construction:

Head:	316L Stainless Steel
Bowl:	316 Stainless Steel

Connections:

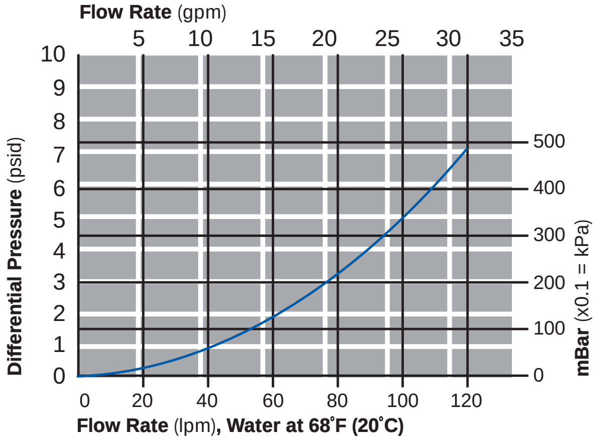
Inlet/Outlet:	¾" NPT, 1" NPT, ¾" BSPT, 1" BSPT, 1" BSPP
Flange Option:	150 lb. ANSI raised face flanges or BS4504 flanges available for 1" IDL Housings
Vent/Drain:	¼" NPT, BSPT or BSPP (refer to ordering information for complete details)

Shell O-rings: FEP Encapsulated Fluorocarbon Elastomer, Silicone Elastomer, Fluorocarbon Elastomer, Nitrile, Ethylene Propylene, Ethylene Propylene for Steam Service

Bracket Option: Stainless steel brackets are available as a standard option.

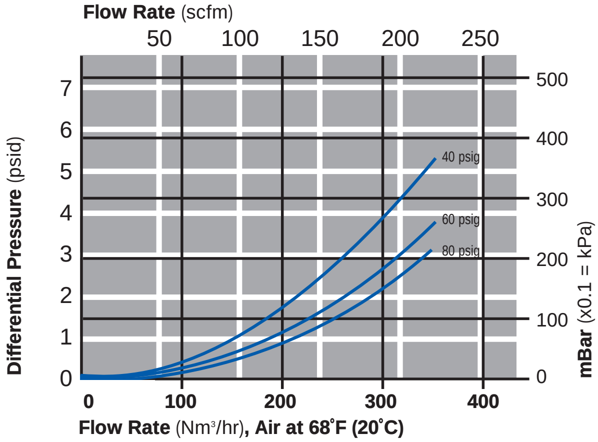
[1] - Fully vacuum rated.
[2] - For continuous steam service.

Housing Differential Pressure vs. Liquid Flow Rate



For liquids other than water, multiply differential pressure by specific gravity.

Housing Differential Pressure vs. Air Flow Rate



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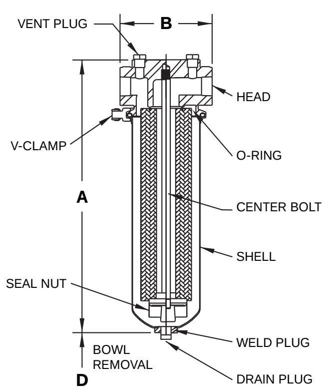
Dimensional Data

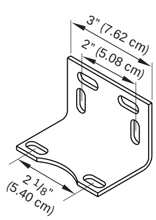
Model	Flow[3] Rate (gpm/lpm)	Dimensions A in/mm	B in/mm	C in/mm	D in/mm	Volume Gal/L	Weight Empty Threaded Nozzle lbs/Kg	Flanged Nozzle lbs/Kg
IDLD01	1/3.78	5.81/147.57	4.81/122	9.81/250	3.75/95.25	0.41/.15	4.5/2.0	———
IDLD04	4/15	8/203	4.81/122	9.81/250	6/153	0.11/0.4	5.1/2.3	11.9/5.4
IDLD1	10/38	14.25/362	4.81/122	9.81/250	12.63/321	0.34/1.3	5.7/2.6	12.5/5.7
IDLD2	20/76	24.25/516	4.81/122	9.81/250	22.5/572	0.74/2.8	6.7/3	13.5/6.1
IDLD3	30/114	34.25/870	4.81/122	9.81/250	32.38/822	1.14/4.3	7.7/3.5	14.5/6.6
IDL101	1/3.78	5.81/147.57	4.81/122	9.81/250	3.75/95.25	0.41/.15	4.5/2.0	———
IDL104	4/15	8/203	4.81/122	9.81/250	6/153	0.11/0.4	5.1/2.3	11.9/5.4
IDL11	10/38	14.25/362	4.81/122	9.81/250	12.63/321	0.34/1.3	5.7/2.6	12.5/5.7
IDL12	20/76	24.25/516	4.81/122	9.81/250	22.5/572	0.74/2.8	6.7/3	13.5/6.1
IDL13	30/114	34.25/870	4.81/122	9.81/250	32.38/822	1.14/4.3	7.7/3.5	14.5/6.6

[3] - Dependent on inlet/outlet selection.

Side View



Optional Mounting Bracket



Part #T10567035

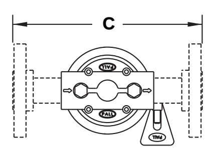
Part Numbers/Ordering Information

IDL ■ ● G ◆ ▼ ▮ (e.g., IDL D 04 G N12 C2 H13)

Code ■	Cartridge Style
D	DOE/RF V-band
1	1001 V-band

Code ●	Bowl Length
01	1" (available in N16 and B16 option only)
04	4"
1	10"
2	20"
3	30"

Top View



Code ◆	Inlet/Outlet And Vent/Drain Size
N12	¾" NPT/¼" NPT
N16	1" NPT/¼" NPT
B12	¾" BSPT/¼" BSPT
B16	1" BSPT/¼" BSPT
B17	1" ANSI Flange/¼" BSPT
N17	1" ANSI Flange/¼" NPT
P17	1" ANSI Flange/¼" BSPP
P19	1" BSPP/¼" BSPP
B35	1" BS4504 Flange/¼" BSPT
P35	1" BS4504 Flange/¼" BSPP

Code ▼	Housing Options
Blank	Blank
C2	Passivated
C9	Cleaned For Oxygen Service

Code ▮	Seal Materials
H	Fluorocarbon Elastomer
H1	FEP Encapsulated Fluorocarbon Elastomer
H4	Silicone
H13	Nitrile
J	Ethylene Propylene
J7	Ethylene Propylene for Continuous Steam Service

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Please contact Pall Corporation for product applicability to specific National legislation and/or Regional Regulatory requirements for water and food contact use.

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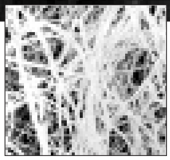
POWER GENERATION
HYDRO-GUARD™ PPT SERIES PLEATED
POLYPROPYLENE FILTER CARTRIDGES

Fixed Pore Structure Filter Cartridges for Use in Power Plants

- Increased Surface Area
- Proprietary Melt Blown Filter Medium with Ultrafine Filaments
- Efficiency Tested Under Power Plant Conditions
- Absolute Rated at 99.98%
- Meets NQA-2-1989 (N45.2.1-N45.2.23) (Updated NQA-1-10-1979)



Outer Pre-filtration Layer

Product Description

The Hydro-Guard PPT is a pleated filter cartridge designed specifically for use in power plants. Filter features such as increased surface area, reduced extractables and absolute retention make this product better suited to the demands of power plant filtration applications than many products currently in use. The Hydro-Guard PPT is a next generation filter constructed of 100% polypropylene made by a patented* melt blowing technique.

In liquid applications where corrosion products are the predominant contaminant, the Hydro-Guard PPT increases filtration productivity by providing longer filter life and reduced extractables.

The Hydro-Guard PPT is tested using conditions that model power plant environments, not those of the chemical processing industry. Performance has been proven reliable and cost effective in numerous North American and international power plants. Customer references are available upon request.

Product Features	Benefits	Customer Benefits
High surface area	Lower pressure drops Increased filter life	Fewer element changes Less customer exposure to chemistry
100% polypropylene	Virtually no extractables Easy disposal Radiation resistant	Concerns eliminated with regard to chemistry changes Reduced start-up costs
Tighter pore distribution on media surface	Reduces pore plugging Dynamic cake filtration Absolute retention	Fewer cartridge change-outs Meets critical filtration requirements
Fits standard filter housings	Easy retrofit into existing housings	No hardware changes
Lower extractables and better radiation stability	Avoid filter caused chemistry problems	Quicker start-up No rinse-up required
Tested for power plant environments	Reliable performance in power plant applications	Successful experience provides for effective solutions

*U.S. Patent Nos.: 5,829,708 5,955,012

Pall Corporation

Bulletin #PG-500-1C

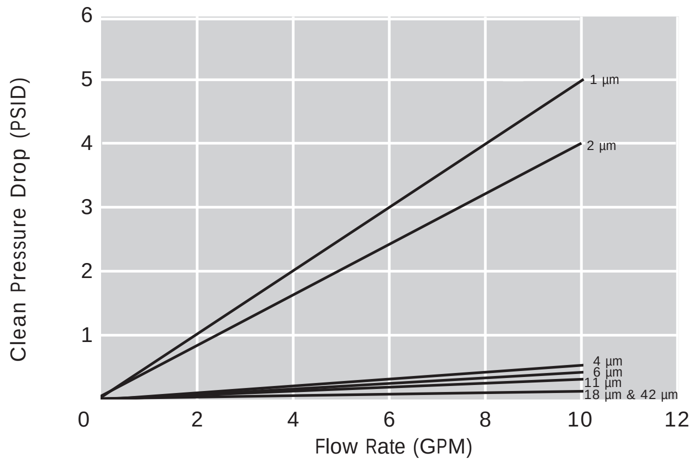
POWER GENERATION
HYDRO-GUARD PPT SERIES PLEATED POLYPROPYLENE FILTER CARTRIDGES

Materials of Construction

Filter Media:	Melt Blown Polypropylene
Hardware:	Polypropylene
Sealing:	Thermal Bond
Support Material:	Polypropylene
Gaskets:	Buna N, EPDM, Silicone, Viton A
O-rings:	Silicone, EPDM, Buna N, Viton A

Performance Parameters

Hydro-Guard PPT Filter: Pressure Drop vs. Flow Rate



Differential Pressures are in PSID based on flow in GPM through a 10-inch cartridge.

Ordering Information

HG PP T 4 -30 -P -E -M8 -B

Hydro-Guard (HG)

Pleated Polypropylene (PP)

T = Thermal Bond

Retention Ratings (absolute):
1, 2, 4, 6, 11, 18, 42 µm

Cartridge Lengths (nominal):
10”, 20”, 30”, 40”

Center Core:
P = Polypropylene

Gasket/O-ring Materials:
S - Silicone
V - Viton A
N - Buna N (Standard Gaskets)
E - EPDM
D - EPR Blue Dot

End Configurations:
DOE– Double open end with elastomer gasket seal
1X – Double open end industrial. 1” extended core
M3 – SOE flat closed end, external 222 O-rings (replaces MILLIPORE® code 0)
M6 – SOE flat closed end, external 226 O-rings (replaces Millipore code 6)
M7 – SOE fin end, external 226 O-rings (replaces Millipore code 7)
M8 – SOE fin end, external 222 O-rings (replaces Millipore code 5)
M19- 119 O-ring

Bubble Point Options:
No Symbol = 10% Bubble Point
B = 100% Bubble Point

Pall Corporation

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powergen@pall.com e-mail

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PALL Power Generation

HYDRO-GUARD® PG Series Filter Cartridges

Pleated Glass Media Filter Cartridges for Use in Power Plants

- Sub-micron Glass Filaments Ensure Mechanical Sieving of Iron Oxides and Other Particles
- Polyester Support Material to Prevent Media Migration
- Bubble Point Tested for Excellent Consistency
- Absolute Construction For >99.9% Efficiency (by ASTM F-795 Test)
- Efficiency Tested Under Power Plant Operating Conditions
- Optimized Surface Area for Highest Iron Oxide Loading

Product Description

The Hydro-Guard PG excels in power plant applications requiring high performance at a lower cost. Documented cost savings can be expected with the use of the Hydro-Guard PG pleated filter.

Constructed for long life in applications such as rad-waste and make-up water, the Hydro-Guard PG typically lasts five to six times longer than some depth type filters. Mechanical sieving prevents contaminant unloading during fluctuating power plant system conditions.

The cartridge assembly consists of proprietary pleated microfiberglass media with polyester support layers upstream and downstream. Surface retention design avoids iron oxide pore plugging.

The Hydro-Guard PG is tested under conditions that simulate power plant operating environments, not those of other industries. Performance has been proven reliable and cost effective in numerous North American and international power plants.

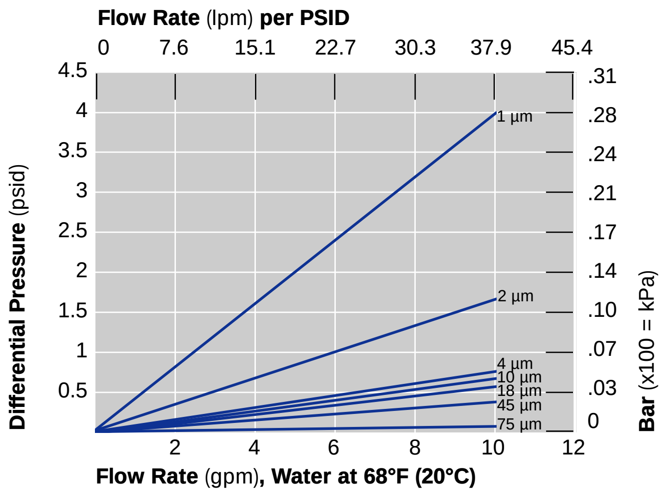
Materials of Construction

Filter Media:	Borosilicate microfiberglass with acrylic binder
Gaskets/O-rings:	Siliconer, Buna N, Viton[1] A, EPDM, FEP
Support Material:	Spun-bonded polyester
Hardware:	Polypropylene
Sealing:	Thermal Bond

[1] - Registered trademark of DuPont Dow.

Product Feature	Product Benefit	Customer Benefit
Fixed pore structure prevents particle unloading	>99.9% Efficiency	Complete protection of downstream equipment and system
Tight surface pores assist in the formation of filter cakes	Extended filter life	Fewer cartridge changeouts
Fits standard filter housings	Easy retrofit into existing housings	No hardware changes
Manufactured under ISO 9001 guidelines	Excellent performance in rad waste and make-up water applications	Improved system productivity
Tested specifically for power plant environments	Long history of reliable performance in power plant applications	Meets or exceeds filtration requirements

Typical Flow vs. Differential Pressure for Application Sizing



Flow rate is per 10" (25.4 cm) cartridge. For liquids other than water, multiply the differential pressure by the fluid viscosity in centipoise.

Part Numbers/Ordering Information

HGPGT ■ – ● P – ◆ – ▼– ▮ (e.g. HGPGT 4 – 30P – N – M8 – B)

Code ■	Filter Grades*
1	1 µm
2	2 µm
4	4 µm
7	7 µm
10	10 µm
18	18 µm
45	45 µm
75	75 µm

Code ●	Cartridge Lengths (nominal)
4	4" (10.2 cm)
10	10" (25.4 cm)
20	20" (50.8 cm)
30	30" (76.2 cm)
40	40" (102 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
E	EPDM
V	Viton A
T	FEP

** Based on typical application usage.*

*** For details, contact Pall Corporation.*

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and endcaps
1X	DOE industrial, 1" extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M5	Double open end, internal O-rings (retrofits other manufacturers' O-ring)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
M19	119 O-ring

Code ▮	Bubble Point
Blank	10% Bubble Point
B	100% Bubble Point

PALL Power Generation

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Filtration. Separation. Solution.SM

Bulletin #PG-900-3C 4/03

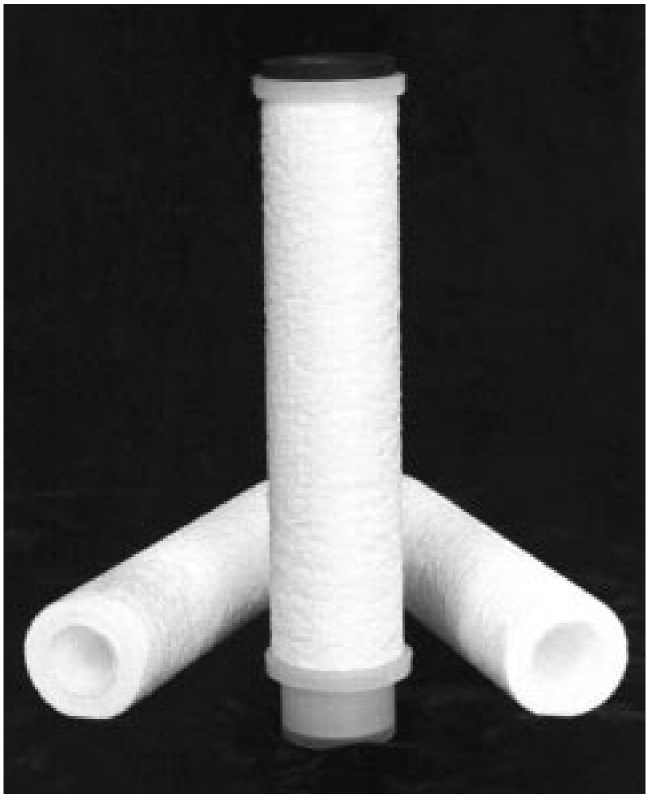
PALL Power Generation

HYDRO-GUARD® COLD R Series Filter Cartridges

Advanced Resin Retaining Backflushable Technology

- Melt Blown Filter Element for use in Backflushable, Resin Precoated Power Plant Applications
- Reduced Precoat Resin Application
- Proprietary Air Backwash Protocol
- Reduced Extractables
- Free of Adhesives, Binders and Silicones
- Rigid Pore Structure Results in more Consistent, Reliable, and Reproducible Filtration
- Resists Collapse or Compression Under Increasing Differential Pressure
- Resin Precoat Remains Uniform on Surface for Reduced Possibility of Bleed Through

The Hydro-Guard CoLD R filter element is manufactured by a unique, proprietary process called CoLD MELT. This technology creates a filtration matrix with small, micro-thin fibers to remove particles and Co-located Large Diameter fibers to for added strength. The CoLD Melt process permits the creation of multiple filtration zones within a single filter cartridge. The multi-zone design produces a gradient pore structure, which effectively captures particles on the outer surface of the cartridge. The interior sections have a more open pore structure to efficiently remove resin and contaminants from the cartridge during the backwash process.



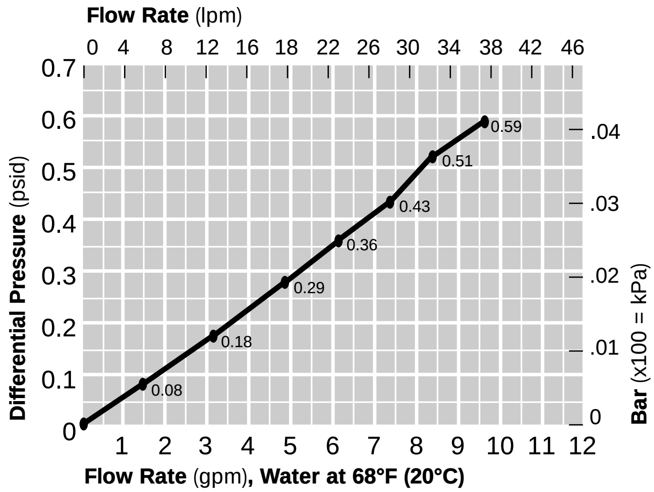
Product Feature	Product Benefit	Customer Benefit
Reduced Resin Application	Reduced Powdered Resin Precoat Consumption	Lower Resin and Resin Disposal Costs
Backflushable Filter Element	Longer Element Service Life Reduced Number of Filter Changeouts	Filter Disposal Costs Reduced Minimizes Exposure in Radioactive Applications
Proprietary CoLD Fiber Technology	Consistent Filtration Under Dynamic Operating Conditions Rigid Structure Multiple Filtration Zones	High Performance Filtration No Cartridge Collapse or Resin Bleed Through Contaminants Remain on Surface for Efficient Backflush
All Polypropylene	Virtually No Extractables Incinerable Limited or No Rinse-up Required on Condensate	Wide Range of Chemical Compatibility Reduced Startup Costs
Various Sealing Configurations	Flexibility in Design and Manufacturing	Retrofits into Existing Pressure Vessels
Backflush with Pressurized Air	More Efficient than Water only Assisted Backflush	Reduced Operating Costs

Performance Specifications

Maximum Operating Temperature:
150°F (65°C)

Maximum Differential Pressure:
30 psid (2.07 bar) @ 150°F (65°C)

Typical Flow vs. Differential Pressure for Application Sizing



Product Specifications

Materials of Construction

Filter Media:	Polypropylene
Hardware:	Polypropylene
Sealing:	Thermal Bond
Gasket/O-ring Materials:	EPDM (standard), Silicone, Buna N, Viton[1] A

Part Numbers/Ordering Information

HGCoLDR – ● – P – ◆ – ▼ (e.g. HGCoLDR–70–P–PSF–DOE)

Code ●	Cartridge Lengths
50	50" (127 cm)
60	60" (152.4 cm)
70	70" (178 cm)
80	80" (203.2 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
V	Viton A
E	EPDM

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and end caps
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
PEA	Retrofit for 2" (5.1 cm) seat cups
SOE	Other

[1] - Registered trademark of DuPont Dow.

*** For details, contact Pall Corporation.*

PALL Power Generation

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powergen@pall.com e-mail

Visit us on the Web at www.pall.com or www.filterite.com

Pall Corporation has offices and plants throughout the world in locations including: Argentina, Australia, Austria, Belgium, Brazil, Canada, China, France, Germany, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Poland, Puerto Rico, Russia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, United Kingdom, United States, and Venezuela. Distributors are located in all major industrial areas of the world.

Filtration. Separation. Solution.SM

PALL Power Generation

HYDRO-GUARD® PPB Series Backflushable Filter Cartridges

The Most Extensively Used Backflushable Pleated Filter in Power Plant Condensate

- Backflushable Pleated Filter Designed Specifically for Use in Power Plants
- The Hydro-Guard PPB is Used in Condensate With or Without Resin Precoat
- Constructed With the Highest Purity Materials (no fillers, talcs, TiO_2 or surfactants) for Minimal Rinse-up Time
- Surface Area Exceeds That of Conventional Condensate Filters by a 20:1 ratio for Lower Pressure Drops, Increased Filter Life and Longer Backflush Cycles
- Eliminates Costs Associated with Use and Disposal of Powdered Resins
- Iron Oxide and Suspended Copper are Typically Reduced by 98%[+]
- Absolute Construction and Surface Retention for Efficient Backflushing and Particle Removal

Performance Specifications

Maximum Operating Temperature:
180°F (82.2°C)

Maximum Differential Pressure:
40 psid (2.8 bar) @ 150°F (65°C)

Product Feature	Product Benefit	Customer Benefit
Backflushable filter element	Longer on stream life Reduced number of filter changeouts	Lower disposal costs Reduced personnel exposure to radiation during filter changeouts
High surface area	Longer run times Higher dirt holding capacity	Lower operating costs Fewer backflushes for reduced disposal costs
All Polypropylene	Virtually no extractables Incinerable Radiation Resistant No rinse-up required	Concerns eliminated with regard to chemistry changes Reduced startup costs (i.e. downtime rinse-up water, etc.)
Modular design	High structural integrity	Easy retrofit into existing pressure vessels
Absolute Construction	Highly efficient particle removal	Less damage from iron and copper in boiler and turbine Quicker plant startups Fewer boiler cleanings

Product Specifications

Materials of Construction

Filter Media:	Polypropylene
Support Material:	Polypropylene
Hardware:	Polypropylene
Sealing:	Thermal Bond
Gasket/O-ring Materials:	EPDM (standard), Others available

HGPPB also offered in tubesheet and cage designs.

Pressure Drop/Flow Data

Model	Delta Pressure ΔP = (k) (Flow Rate)
HGPPB1	Δ = (0.50) Flow Rate
HGPPB2	Δ = (0.40) Flow Rate
HGPPB4	Δ = (0.05) Flow Rate
HGPPB10	Δ = (0.03) Flow Rate
HGPPB18	Δ = (0.01) Flow Rate
HGPPB42	Δ = (0.01) Flow Rate

This information is with water at ambient temperatures. Differential pressures are in PSID based on flow in GPM through a 10" (25.4 cm) element.

Part Numbers/Ordering Information

HGPPB – ■ – ● – P – ◆ – ▼ (e.g. HGPPB–2–70–P–E–DOE)

Code ■	Filter Grades*
1	1 µm
2	2 µm
4	4 µm
10	10 µm
18	18 µm
42	42 µm

** Based on typical application usage.*

*** For details, contact Pall Corporation.*

[1] - Registered trademark of DuPont Dow.

Code ●	Cartridge Lengths (nominal)
10	10" (25.4 cm)
20	20" (50.8 cm)
30	30" (76.2 cm)
40	40" (102 cm)
50	50" (127 cm)
60	60" (152.4 cm)
70	70" (178 cm)
80	80" (203.2 cm)

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
V	Viton[1] A
E	EPDM

Code ▼	End Configurations
DOE	DOE with elastomer gasket seal and endcaps
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)**
M6	SOE flat closed end, external 226 O-rings (retrofits other manufacturers' Code 6)**
M7	SOE fin end, external 226 O-rings (retrofits other manufacturers' Code 7)**
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)**
COOP	Fine thread direct screw in
TVO	Extended neck for better sealing
PAK	Easy installation and removal; double seals for high integrity
PEA	Retrofit for 2" (5.1 cm) seat cups
AERO	Connects directly to tube sheet without additional hardware

PALL Power Generation

Power Generation Systems Division
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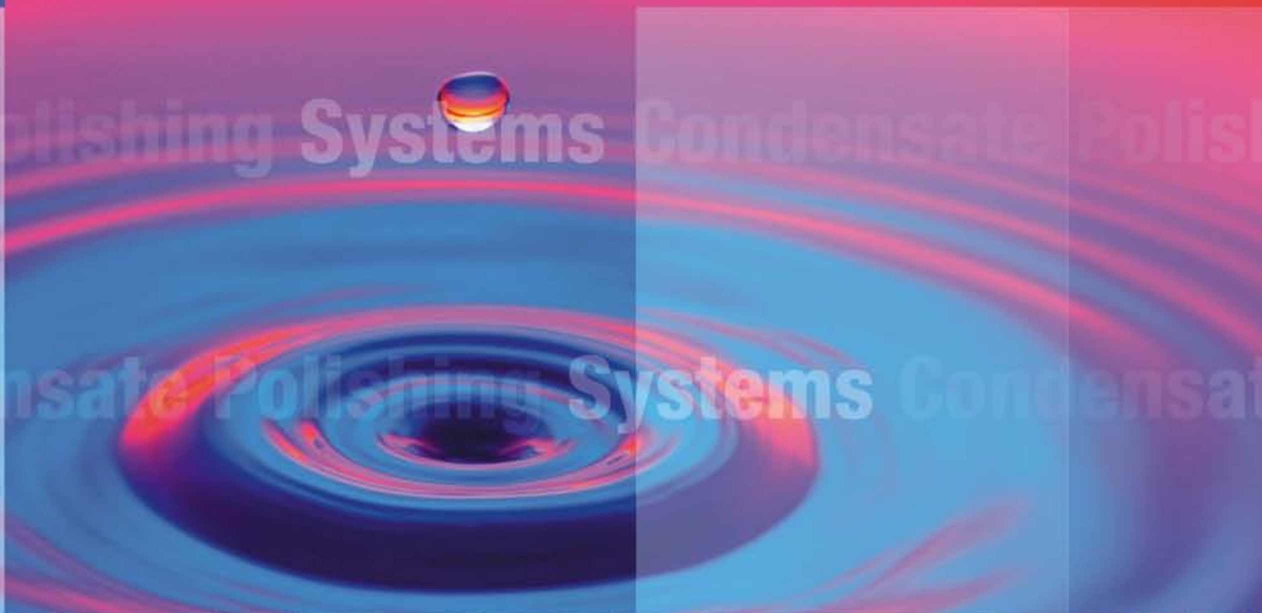
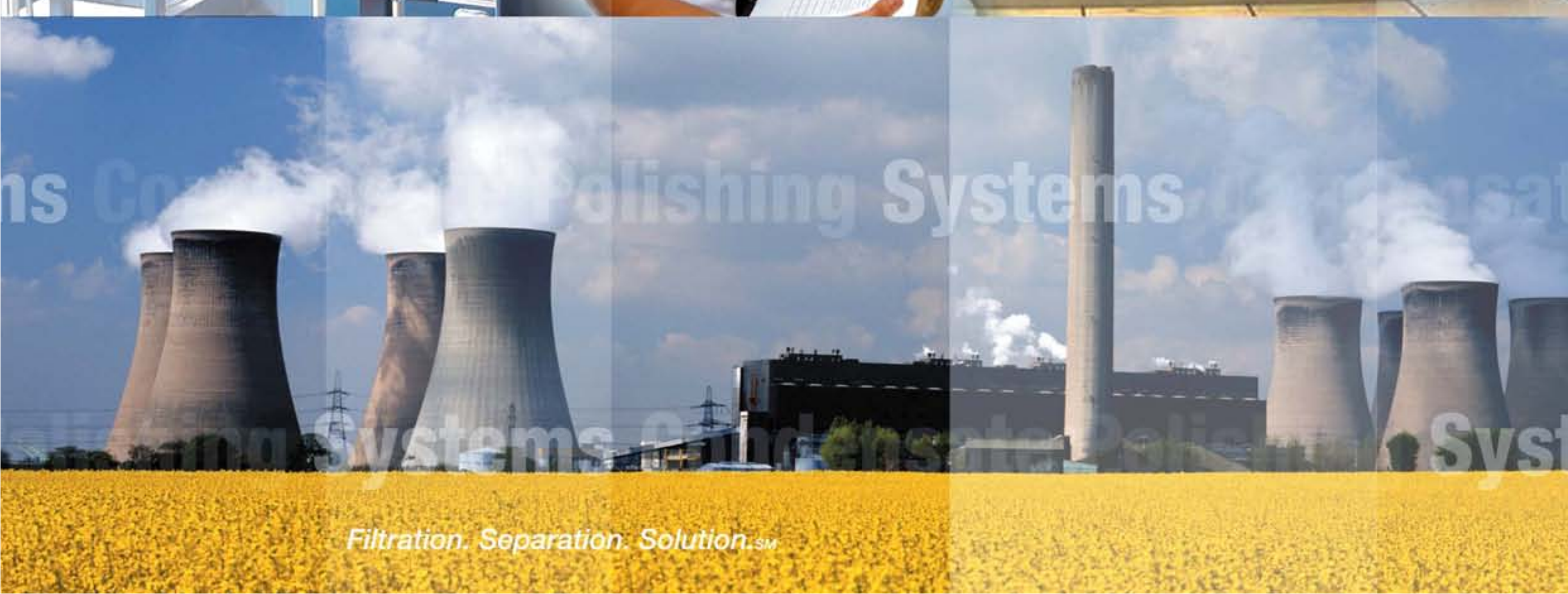
PALL Power Generation



Power Generation Condensate Polishing Systems



Filtration. Separation. Solution.SM

MOST RELIABLE, COST EFFECTIVE CONDENSATE FILTRATION SOLUTION

The power industry is installing hundreds of new condensate polishing systems as a result of increasingly stringent boiler feed water requirements, the need for greater power production reliability, and the demand for higher efficiency power plants. Pall Power Generation is the industry leader in providing filtration systems for power plant condensate.

Our combination of cutting edge filtration products and a wide range of system components, backed by extensive experience and expertise, enables Pall to offer you the optimum condensate polishing system.

If you need to retrofit an existing system, implementing one of our advanced solutions can result in significant process improvements.

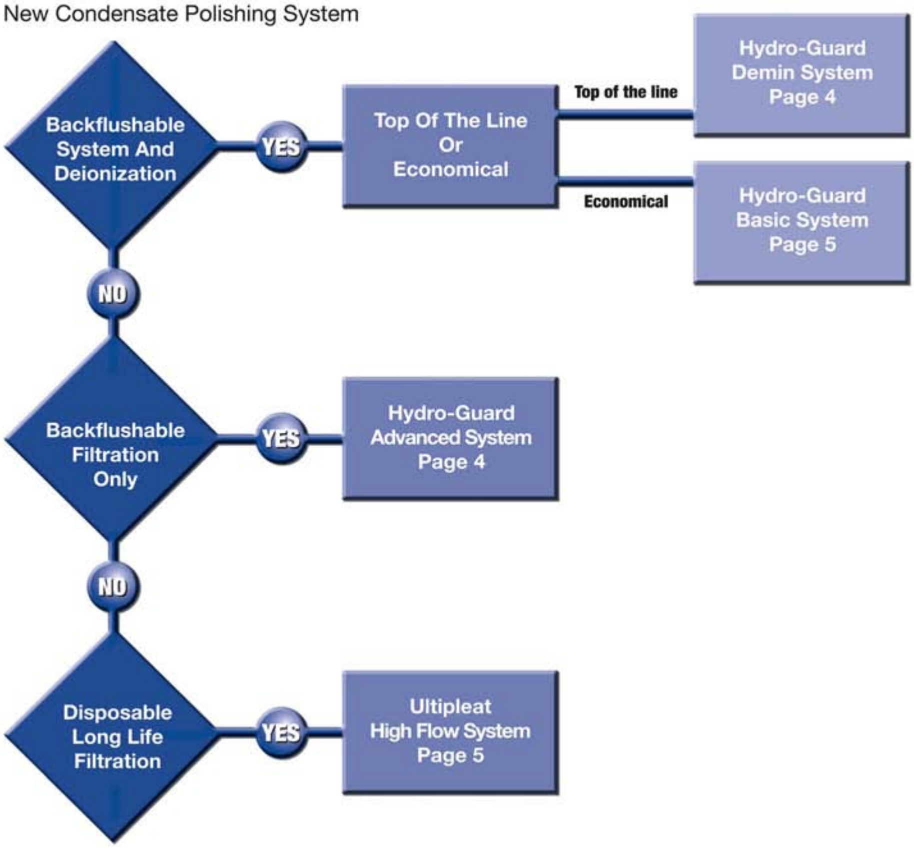
The following pages guide you on selecting the ideal system for your application. Each of Pall's four condensate polishing systems is engineered to address specific application requirements in a particular type of power plant.

Pall Power Generation Field Engineers, in conjunction with Pall's Design Engineers, outline the system advantages and recommend the most performance appropriate, cost effective, condensate polishing system.

High energy backflush blasts contaminant from the surface of the filter.

Pall System Selection

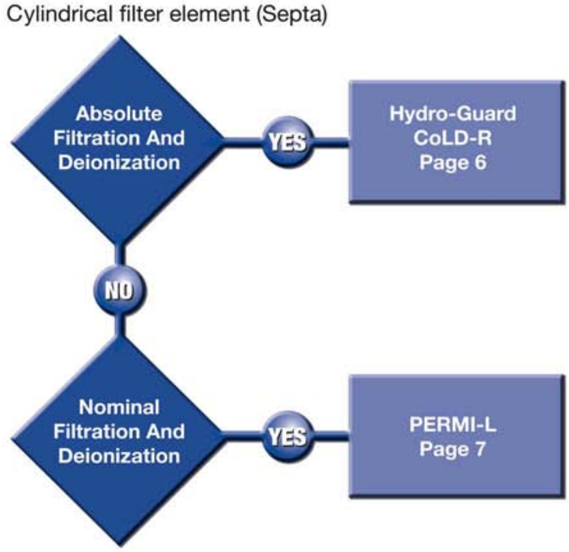
New Condensate Polishing System



Filter Element Selection (new or existing systems)

High surface area + absolute filtration

Cylindrical filter element (Septa)



Pall Offers a Complete Line of Full Systems

PALL HYDRO-GUARD® DEMIN SYSTEM

Description

The Pall Hydro-Guard Demin System is the highest quality backflushable filtration and deionization system using absolute, high surface area Hydro-Guard PPB-R filters.

Performance

- Delivers excellent condensate deionization combined with absolute iron oxide filtration.
- Solves dissolved and suspended copper, silica and sulfate concerns.
- Cleans resin and captured suspended contaminants from the filters for long filter service life and uniform precoating by using Pall's proprietary backflush protocol effectively.

Features and benefits

- High energy backflush
- Simple operation
- High quality valves
- Uniform precoating
- Operator friendly controls and components
- Easy installation

Filter recommendations

- Hydro-Guard PPB-R filter element
- Hydro-Guard CoLD R or Permi-L filter elements

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers

PALL HYDRO-GUARD ADVANCED (NON-PRECOAT) SYSTEM

Description

Advanced backflushing protocol, absolute filtration, and the highest quality components make the Hydro-Guard Advanced System the first choice for critical condensate applications.

Performance

- Designed for absolute removal of suspended iron oxide, copper, and other particulate without powdered resin precoating or other filter aids.
- Particle removal efficiencies in excess of 98% can be expected.
- Effectively removes captured particulate from the filter surface thus insuring long filter service life, high condensate throughput between backflushes and low-pressure drops.

Features and benefits

- No expensive and labor-intensive powdered resin precoating
- No hazardous waste disposal
- Reduced power plant start-up time
- Reduced or eliminated copper deposition on turbine blades
- Reduced down stream deep bed cleanings and regenerations

Filter recommendations

- Hydro-Guard PPB filter element

Applications

- Excellent for both fossil and nuclear applications.
- Full flow recommended for once-through super critical boilers.
- Partial flow or start-up only usage may be adequate for drum boiler power plants.

PALL ULTIPLEAT® HIGH FLOW SYSTEM

Description

This proprietary, large diameter, disposable filter system features long filter life and easy filter change outs.

Performance

- Delivers excellent condensate filtration combined with absolute iron oxide removal.
- Captures suspended copper, silica, and sulfate contaminants effectively.
- Captures suspended contaminants inside the filter cylinder for clean and simple filter element removal and disposal via Pall's unique filter construction that uses an inside-out flow design.

Features and benefits

- Patented "Laid Over Pleat Design" permits high flow rates within a given filter envelope.
- Up to 50% smaller filter systems possible.
- Dramatic reduction in number of filter elements to handle.
- All plastic, coreless construction minimizes waste disposal.
- Standard vessels capable of flow rates from 250 to 5000GPM.

Filter recommendations

- Ultipleat High Flow filter cartridge

Applications

- Condensate filtration during plant start-up
- Combined cycle condensate
- Small coal fired plants

PALL HYDRO-GUARD BASIC (BACKFLUSHABLE) SYSTEM

Description

This deionization and backflushable filtration system features a capital cost conserving alternative to the Hydro-Guard Demin System.

Performance

The Hydro-Guard Basic System is an economical system for applications that do not require the critical performance offered by the Hydro-Guard Demin System. This is the basic workhorse of condensate particulate filtration and is ideal for start-up use or full flow use on a tight budget.

Features and benefits

- Effective backflushing saves filter replacement costs
- Absolute iron oxide retention
- Effective deionization
- Basic, reliable valves, controls, and piping designs

Filter recommendations

- Hydro-Guard CoLD R filter element

Applications

- Predominantly used in drum boiler and combined cycle power plants for start-up, partial flow, or full flow condensate polishing.

PALL SYSTEM RETROFITS

Performance

Outdated components on older systems could be hurting your facility's productivity. You can replace outdated control panels, tube sheet assemblies, filter sealing hardware, valves, pumps, precoating systems and filter vessels with quality Pall retrofits. Also, upgrade obsolete string wound filters in existing vessels with high performance elements such as the HGCoLD R Melt Blown backflushable filter.

Features and benefits

- Ensure fewer system breakdowns and repairs with new valves, pumps and filter sealing hardware.
- Achieve longer runs between backflushes, better filtration efficiency, and more productive use of powdered resin precoats with Pall's advanced filter technologies.
- Replace unreliable, irreparable analog systems at reasonable cost with state of the art digital control systems.

Applications

- All 15-year or older powdered resin precoat systems
- Any system using string wound filters
- Any existing backflushable system with analog controls
- Systems using springs to seal filter cartridges

PALL HYDRO-GUARD PPB AND PPB-R BACKFLUSHABLE FILTER CARTRIDGES

Performance

- Absolute iron oxide and insoluble copper retention plus long life and robust construction are reasons that the Hydro-Guard PPB is the most extensively used backflushable pleated filter in power plant condensate worldwide.
- HGPPB filter cartridges are designed for filtration use without powdered resins.
- HGPPB-R filter cartridges, with reduced pleat height, are designed for use with powdered deionization resin for filtration and deionization in one step.

Features and benefits

- Backflushable filter element
- Highly efficient particle removal
- All polypropylene construction
- Low pressure drop
- High surface area
- No fillers, talcs, TiO_2, or surfactants

Applications

- HGPPB Series filter cartridges perform best when used with the Hydro-Guard Advanced Backflush System.
- HGPPB-R Series filter cartridges are included with the Hydro-Guard Demin Backflush System.

PALL HYDRO-GUARD COLD R FILTER ELEMENTS

Performance

- Hydro-Guard CoLD R filters are specifically designed for use in backflushable, resin precoated power plant applications. The powdered resin removes dissolved and suspended copper, silica, and sulfate contaminants.
- The HGCoLD R filter provides a rigid, low-pressure drop surface to hold the resin in a consistently even layer from top to bottom.

Features and benefits

- CoLD fiber construction resists media compression common to conventional string wound filters.
- Melt bonded connections prevent bypass, common to string wound filters.
- No surfactants, binders, or adhesives that can be extracted into the process.
- Proprietary construction traps resin at the filter medium surface.

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers

PALL PERMI-L FILTER ELEMENTS

Performance

Replacement of conventional string or metal filters in existing vessels with high performance PERMI-L filter elements results in improved filtration, resin life, and dissolved contaminant removal efficiency.

Features and benefits

- Used with conventional backflush systems.
- Retrofits into existing hardware or can be custom designed for the application.
- Made with continuous filament yarn for added durability. No fiber deterioration or migration.
- Uniquely designed and processed filament minimizes extractables and eliminates start-up rinse.

Applications

- Used in both Fossil and Nuclear applications.
- Is currently used in many conventional systems.
- Designed for removal of ionic contaminants and iron oxides.
- Can also be supplied for high temperature (300ºF/150ºC) use.

PALL FILTER SEALING HARDWARE

Performance

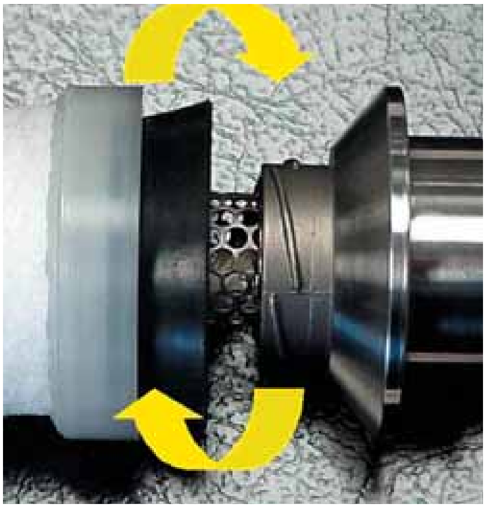
For installations using spring type sealing devices, consider upgrading to a higher integrity sealing system. The Power Seal Pak is cutting edge technology and is ideal for retrofitting bottom tube sheet condensate filter demineralizers or for new vessel construction. The new Power Seal Pak stainless steel hardware attaches directly to the standing tubes on the bottom tube sheet after removal of the 'old' hardware.

Features and benefits

- One-piece construction
- Reusable full flow center core
- Patented pressure energized sealing from gasket to core
- Manufactured according to ISO standards
- Operator friendly installation
- Use with any Hydro-Guard filter

Applications

- Full flow condensate for air cooled condensers
- Combined cycle condensate
- Once through super critical boilers, drum boilers, BWR condensate, and PWR condensate



PALL SCIENTIFIC LABORATORIES & QUALITY CONTROL

Pall's Manufacturing Expertise

Highly trained manufacturing personnel melt blow polymeric filter media and assemble condensate filters in a clean, controlled environment. Modern techniques and cutting edge equipment, applied according to ISO9001-2000 standards, result in the highest quality filters for the customer. Condensate customers rely on Pall manufacturing's consistency, dependability and on-time delivery.

Proprietary manufacturing equipment, patented filter products, and rigorous quality control measures make Pall's condensate filter offering unique and highly desired around the world.

Efficiency testing lab

Extractables testing lab

Pleated manufacturing area

Melt blown area

Pall's Scientific and Laboratory Services

Pall's Scientific and Laboratory Services (SLS) team consists of hundreds of scientists and engineers, most with advanced degrees working in 41 labs around the world. These filtration experts can apply their years of experience investigating and solving the often complex problems surrounding fluid clarification and membrane-based separation processes to provide you with the best solution for your particular application.

Working jointly with customers, SLS team members evaluate filters, employing post-use, state-of-the art particle counting and other advanced techniques in order to establish optimum filter life. Should a standard product not meet your needs, custom solutions can also be developed. SLS support and service are available to all Pall customers, worldwide.

Whether pushing the envelope to develop cutting edge solutions or assisting with routine, day-to-day operations, Pall customers can count on SLS for a proactive response that is fast and particularly tuned in to the unique filtration requirements in their specific applications.

PALL® Power Generation

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Reorder Code: PG2000-B

Pall Corporation

UH319

UH319 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Side and Top Manifold Mounting

Port Size 1½"

UH319

HIGH PRESSURE FILTERS

UH319 Series Filters - Manifold Mount

Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 600 L/min (160 US gpm)
- Pressures to 420 bar (6100 psi)
- Ports, 1½" top and side manifold mount

Notes and Specifications

Filter Housing

- Maximum Working Pressure: 420 bar (6100 psi)
- Rated Fatigue Pressure: 0-240 bar (3500 psi) per NFPA T2.06.01R2-2001 CAT C/90 (1 million cycles), verified by testing at 0-280 bar (4050 psi) for 1 million cycles. Contact Pall for applications with higher pressures at lower cycles
- Typical Burst Pressure: 1500 bar (21,750 psi)
- Fluid Compatibility: Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range: Fluorocarbon Seals: -29˚C to 120˚C (-20˚F to 250˚F) 60˚C (140˚F) maximum in HWCF or water glycol fluids
- Bypass Valve Setting: 4.5 bard (65 psid)
- Indicator Pressure Setting: 3.5 bard (50 psid)
- Materials of Construction: Head: Ductile Cast Iron Tube and Cover: Carbon steel

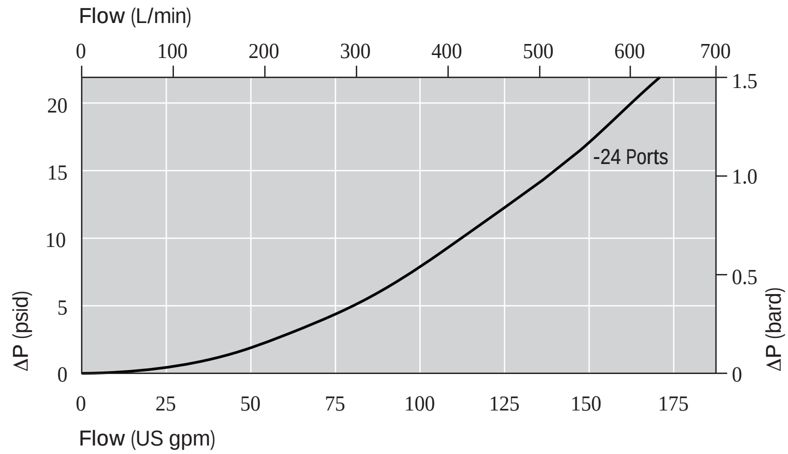
Filter Element

- Filter Element Burst Pressure: 10 bard (150 psid)
- Ultipleat SRT Element Construction: Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UH319 Series 13" length housing with S24 (1½") side manifold mount ports using AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.30 x 1.2/0.9) bard (housing)

+ ((300 x 1.09/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.40 (housing) + 0.68 bard (element)

= 1.08 bard (15.7 psid)

UH319 Series Filters - Manifold Mount

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 319 [Table 1] [Table 2] ++ [Table 3] Z G 9 X106

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UH 319 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 2: Housing Port Options

Code	Port
K24	1½" top mount manifold
S24	1½" side mount manifold

Table 3: Housing Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bar (3000 psi)
SS	Stainless Steel Indicator: use at operating pressures > 200 bar (3000 psi)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

UH319

HIGH PRESSURE FILTERS

('H' option housing shown)

UH319 Series Filters - Manifold Mount

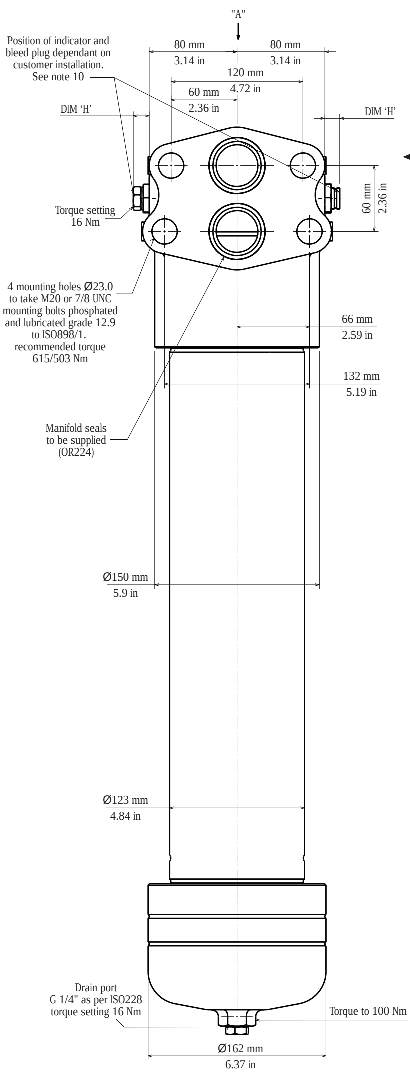
Technical Information

'C' & 'H' Housings - S24 Side manifold mounting

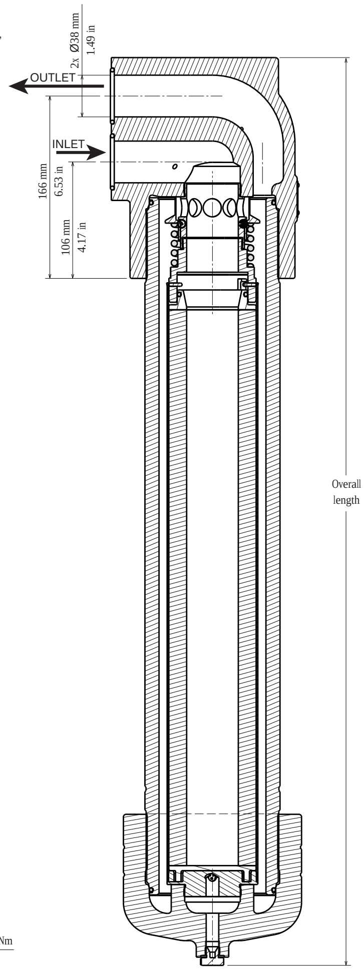
Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	473 (18.62)	521 (20.51)	286 (11.26)	140 (5.51)	39.3 (86.7)
13	608 (23.94)	655 (25.79)	421 (16.58)	140 (5.51)	44.3 (97.7)
20	778 (30.63)	826 (32.52)	591 (23.27)	140 (5.51)	50.6 (111.6)
40	1287 (50.67)	1334 (52.52)	1099 (43.27)	140 (5.51)	69.4 (153)

'C' & 'H' Housings - K24 Top manifold mounting

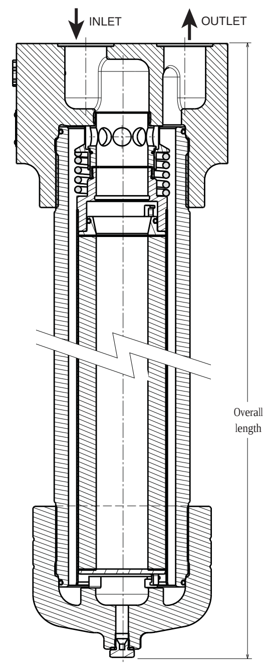
Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	456 (17.95)	470 (18.50)	286 (11.26)	140 (5.51)	46.9 (103.4)
13	591 (23.27)	604 (23.78)	421 (16.58)	140 (5.51)	51.9 (114.4)
20	761 (29.96)	775 (30.51)	591 (23.27)	140 (5.51)	58.2 (128.3)
40	1269 (49.96)	1283 (50.51)	1099 (43.27)	140 (5.51)	77 (169.8)



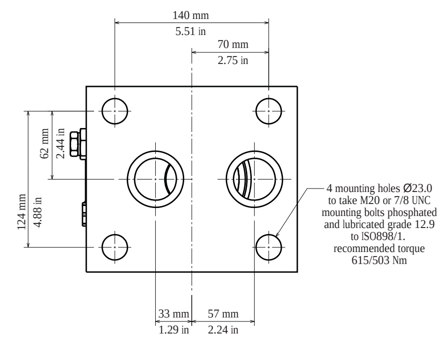
UH319HS24 Option



Section on centerline UH319HS24 Option



Section on centerline UH319HK24 Option



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Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 667,800; EP 982,061; EP 1,380,331; EP 1 656 193; US 5,543,047; US 5,690,765; US 5,725,784; US 6,113,784; US 7,083,564; US 7,318,800.

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IMUH319MMEN Printed in the UK. April 2009.

Pall Corporation

AquaSep® Plus/PhaseSep® Series Vertical Filter Housings

Description

Pall AquaSep® Plus /PhaseSep® Filter Housings provide a range of standard vessels to complement the Pall AquaSep Plus and PhaseSep liquid/liquid coalescers, two products used to remove water from a wide range of chemicals, fuels, and hydrocarbon streams found in the refinery and process industries. These housings, which are designed with Pall's specially engineered double tube sheet, are available for both the 40- and 60-inch AquaSep Plus and PhaseSep stacks. They can accommodate from one (1) to 104 stacks.

Specifications

1. Housings are designed and stamped in accordance with ASME/ANSI BPVC Section VIII.
2. Design Ratings
   Pressure: 12.1 to 19.7 bar/175 to 285 psig
   Temperature: 148.9°C/ 300°F
3. Carbon Steel Construction
4. Vent and Drain Connections, as well as Pressure Tap Ports
5. Automatic Control Options Available

Element Sealing Mechanism

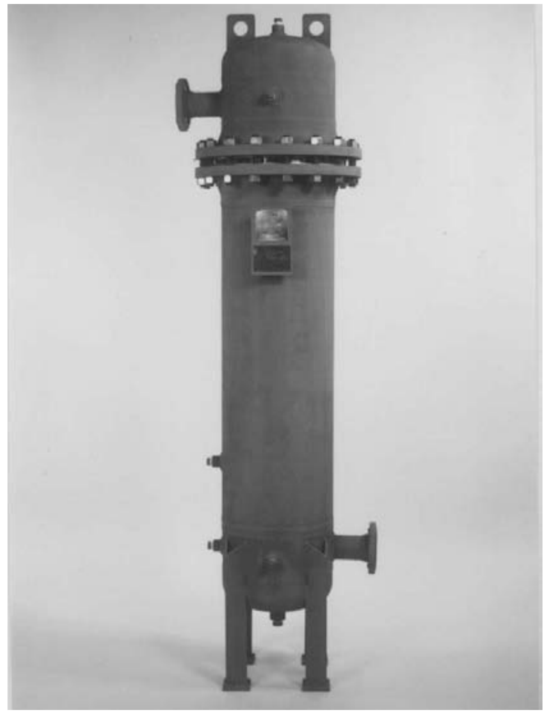
Pall AquaSep Plus/PhaseSep liquid/liquid coalescers are installed within the housing by securing the separator-coalescer stack into the top tube sheet. The stack is engaged into a seal post on the bottom tube sheet (internal O-ring) and engaged into the top tube sheet (external O-ring). A hold-down plate is placed over the top of an installed coalescer-separator stack and secured in place.

Filter Element Selection

The Pall AquaSep Plus/PhaseSep coalescer-separator elements listed in Table 1 have a 3¾ in/9.53 cm outer diameter and are available in 20 in/50.8 cm and 40 in/ 101.6 cm lengths. Please refer to Element Data Sheets GAS-4107 or GAS-4105 for additional information.

Operating Characteristics

All types and grades of AquaSep Plus elements are rated to withstand a maximum temperature of 65.6°C/150°F, while PhaseSep elements withstand a maximum temperature of 148.9°C/300°F in compatible fluids. Both elements have an initial design pressure drop of 2 psid, with a recommended changeout pressure of 15 psid.



Standard AquaSep Plus/PhaseSep Series Housing.

Key Benefits

Combination of these housings with Pall AquaSep Plus/ PhaseSep elements provide many benefits, including:

- Lower operating costs
- Lower capital costs (minimized envelope size)
- Lower weight
- Maximum flexibility

Table 1. Pall AquaSep Plus and PhaseSep Elements for Use in AquaSep Plus/PhaseSep Housings

Part Number	Description	Outer Diameter (mm/in)	Length (mm/in)
LCS2B1AH	AquaSep Plus Coalescer	953 /3¾	508 / 20
LCS4B1AH	AquaSep Plus Coalescer	953 /3¾	1016 / 40
LCS2H1AH	PhaseSep Coalescer	953 /3¾	508 / 20
LCS4H1AH	PhaseSep Coalescer	953 /3¾	1016 / 40
LSS2F2H*	PhaseSep Separator	953 /3¾	508 / 20

** PhaseSep and AquaSep Plus coalescers are always connected to a separator in the vertical configuration.*

Table 2. Selection Guide*

▲ AQ ● ■ F1 285*

Code ▲	Number of Stacks
1	1
2	2
4	4
7	7
14	14
31	31
46	46
63	63
104	104

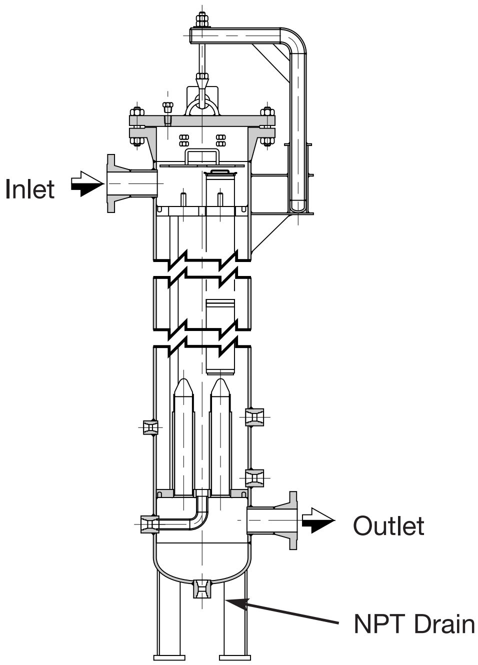
Code ●	Length of Stack† (mm/in)
L	1016/40
H	1524/60

** All vessels designed at ANSI 150 lb., 19.7 bar/285 psig at 37.8°C/100°F. Additional sizes are available at higher ANSI classes as specials. All vessels greater than 406mm/16in diameter will have a 12.1 bar/175 psig rating.*

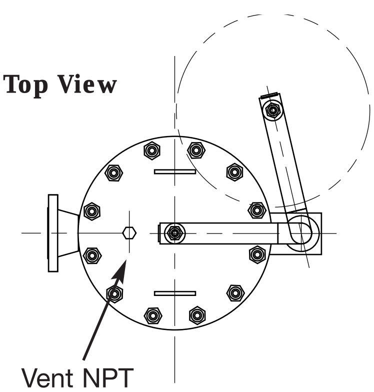
† Stack length includes coalescer and separator stacks.

Code ■	Outer Housing Diameter (mm/in)	Connection (mm/in)
0801	203/8	25/1
0802	203/8	51/2
1202	305/12	51/2
1203	305/12	76/3
1403	356/14	76/3
1404	356/14	102/4
1604	406/16	102/4
1606	406/16	152/6
2404	610/24	102/4
2406	610/24	102/4
2406	660/26	152/6
2606	660/26	152/6
2608	660/26	203/8
3608	914/36	203/8
3610	914/36	254/10
4210	1067/42	254/10
4812	1219/48	305/12
4814	1219/48	356/14
6014	1524/60	356/14

Engineering Drawing of a Standard AquaSep Plus/PhaseSep Housing



Top View



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Pall Corporation

AquaSep® Plus L/L Coalescer System Effectively Separates Water from Petroleum Products and Chemicals

Introduction

Entrained water in liquid hydrocarbons and chemicals can be a problem. This is particularly true for fuels that contain high concentrations of surfactants which are readily present in hydrocarbons and chemicals (see below). Surfactants make water removal difficult for conventional liquid/liquid coalescers and other water separation equipment because they lower the interfacial tension between the water and the continuous phase fluid.

The same problem can occur when attempting to separate oil from water. The presence of surfactants also leads to disarming of the coalescer. Pall's AquaSep Plus coalescer will efficiently separate water from a hydrocarbon stream without disarming.

Common Sources of Surfactants in Hydrocarbon and Chemical Processes

- Sulfur compounds
- Organic acids
- Well treating chemicals
- Anti-static chemicals
- Detergents
- Corrosion inhibitors
- Chemical additives

Coalescer Information

The Pall AquaSep Plus coalescer is a multiple stage system. It first removes particulate matter, then coalesces and separates the dispersed phase liquid from the continuous phase liquid.

For removal of water from hydrocarbons, the AquaSep Plus coalescer will remove entrained water to a level of below 15 ppmv over a wide range of conditions:

- Inlet water concentration as high as 3% water by volume (i.e., 30,000 ppmv.)
- Interfacial tension as low as 3.0 dyne/cm

For removal of oil from water, the AquaSep Plus coalescer will remove free oil from water over a wide range of conditions in the horizontal configuration.

Liquid/Liquid Coalescer Elements

Stage 1: Prefiltration

Due to the fine pore structure of this coalescer medium, Pall recommends that a prefilter be installed upstream of the coalescer assembly to properly control particulate matter in the liquid stream. Installing a prefilter significantly extends the life of the coalescer and reduces particulate concentration in the filter effluent to meet solids specifications.

To maximize the service life of AquaSep Plus coalescers, each coalescer is constructed with an integral prefilter.

Stage 2: Coalescence

The hydrocarbon and water mixture enters the coalescing element and flows inside to outside (see Figure 1). This is where small droplets of dispersed phase liquid come together, or coalesce, as the mixture moves through the depth of Pall's specially formulated coalescer medium.

Stage 3: Separation

In separating water from fuel, water-free fuel and large water droplets flow toward the separator located directly below the coalescer stage. Flow is outside to inside (see Figure 1). The separator medium is hydrophobic, which prevents water from entering the separator. Only water-free fuel flows through the separator. Water and fuel are removed by separate drain connections.

In separating oil from water, a settling zone is designed downstream of the coalescer. In the settling zone, the large coalescer droplets are separated due to gravity (see Figure 2).

Benefits

Continuously Efficient in Liquid Separation and Particle Removal for Improved Fluid Quality and Value

The effective liquid separation and the particulate removal abilities of the AquaSep Plus coalescer system significantly reduces off-spec product incidents, thereby saving reprocessing and transportation costs.

Low Cost Liquid Separation and Solids Removal

Due to AquaSep Plus coalescer's longer life and superior liquid separation efficiency, the overall cost of liquid separation is low especially when compared to other less efficient methods. The integral prefilter within the AquaSep Plus coalescer maximizes element service life.

Does Not Disarm; Increases Service Life

Pall's specially formulated medium coalescer contains no glass fiber and does not disarm in the presence of surfactants. This results in longer service life than conventional coalescers. The prefilter stage removes particulates and also extends the filter service life.

High Performance Design Results in Smaller Assembly Size

The high performance AquaSep Plus coalescer stack design promotes an even flow distribution permitting a high rate of flow. As a result, fewer coalescer cartridges are required to efficiently remove water from fuel. This results in a small economic assembly size.

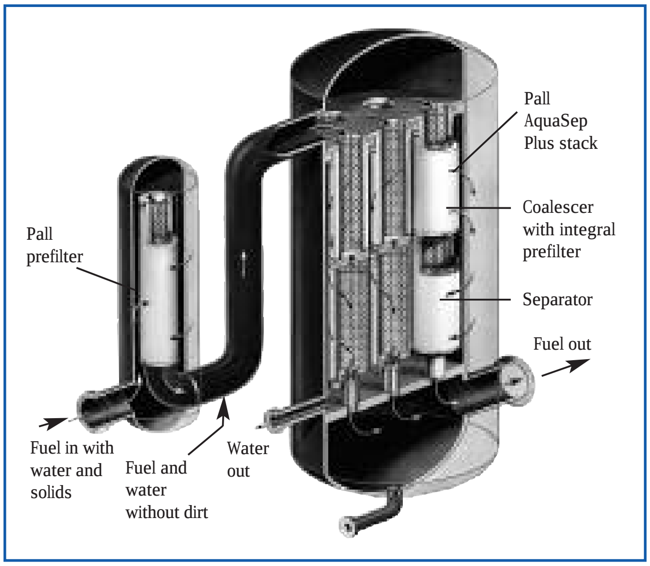

Figure 1: AquaSep Plus Liquid/Liquid Coalescer System

Lower Disposal and Maintenance Costs

The long, useful life of the AquaSep Plus cartridges, is obtained from Pall's specially formulated non-disarming high voids volume medium that is properly protected by Pall prefilters. Overall results are fewer cartridge changeouts for low maintenance and disposal costs.

Unique Stack Design

Pall's coalescer element is stacked on top of a separator element. This design optimizes the flow distribution from the coalescer to the separator, ensuring that each separator has an equal flow. In conventional two-stage systems, the separators are located at different distances from the coalescer, causing an unequal distribution of flow to the separator. These conventional two-stage systems require several coalescer elements for each separator. Pall's stack design results in overall smaller assembly size and a longer coalescer/separator life.

Fluid Compatibility

Pall's AquaSep Plus liquid/liquid coalescer is compatible with refined products including:

- All gasolines
- Diesel
- Kerosene
- Lube oils
- Aromatics
- Petrochemicals
- LPG

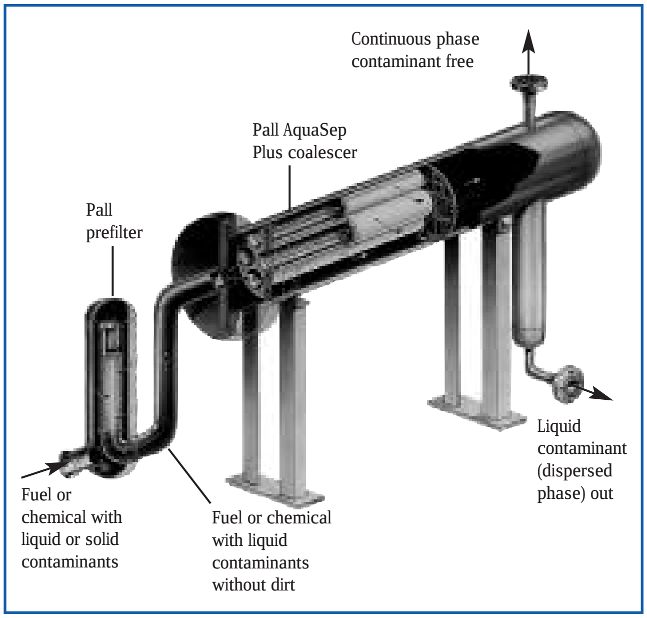

Figure 2: Pall AquaSep Plus Liquid/Liquid Separation System with Coalescer in a Horizontal Housing

Mechanism of Coalescing with Conventional Glass Medium

One of the biggest operational problems for conventional liquid/liquid coalescers is disarming. When a liquid/liquid coalescer is performing efficiently, water molecules bond with components on the glass fiber called a silenol functional group. The water molecules that collect on the glass fiber coalesce with incoming water molecules to form a large droplet, which will eventually become heavy enough to drain from the coalescer. In an efficiently operating coalescer, once a droplet has fallen from an active site, the coalescing process repeats (see Figure 3).

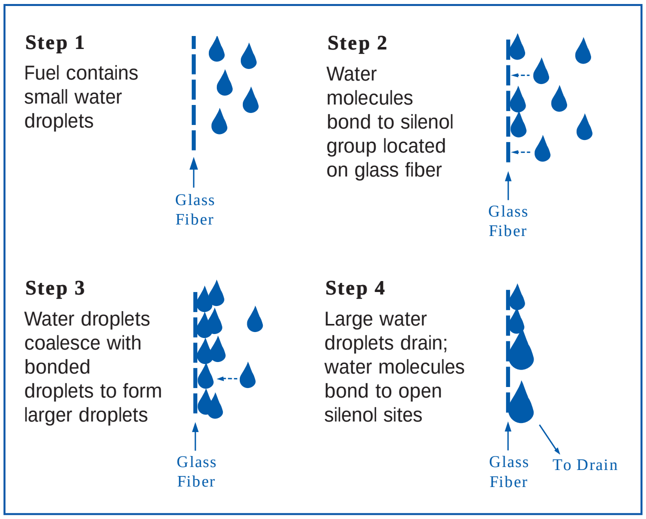

Figure 3: Mechanism for Coalescing

Disarming occurs when surfactants bond with the silenol group. The silenol group has a greater affinity for surfactant molecules than for water molecules. As the surfactant molecules bond to the glass fibers, the water molecules pass quickly through the medium (see Figure 4). This greatly reduces water removal efficiency, increasing the probability of a product quality problem, and short coalescer service life, which, in turn, results in frequent changeout and increased disposal costs of coalescer filter elements.

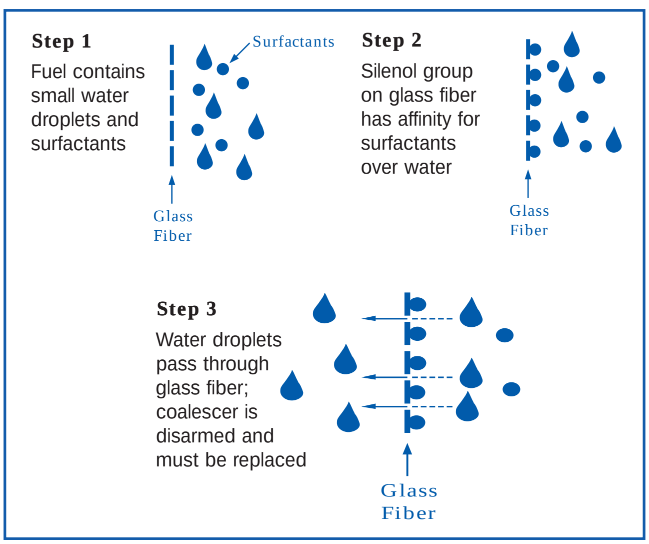

Figure 4: Mechanism for Disarming

Performance Claims and Specifications

Maximum Temperature:	66°C/150°F
Initial Pressure Drop:	0.14 bard/2 psid
Recommended Changeout:	1.03 bard/15 psid

Ordering Information

Part Number	Description	Outer Diameter (cm/in)	Length (cm/in)
LCS2B1AH	AquaSep Plus Coalescer	9.53/3¾	50.8/20
LCS4B1AH	AquaSep Plus Coalescer	9.53/3¾	101.6/40
LSS2F2H	Separator	9.53/3¾	50.8/20

Please call your Pall representative to confirm compatibility for a specific application.

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Pall Corporation

CLARIS® Series Filter Cartridges

High Consistency Polypropylene Melt Blown Cartridge

- Graded Pore Structure Enhances Dirt Holding Capacity
- E-core, an Extruded Fibrous Core, Provides Excellent Strength
- Unique Proprietary Process
- Easy and Safe Cartridge Incineration and Disposal
- All Polypropylene Construction
- Free of Surfactants, Binders, and Adhesives
- NSF Certified
- Plastic and Metal Spring Assembly End Configurations Available

Performance Specifications

Filter Grades:
1, 3, 5, 10, 20, 30, 50, 75 µm

Maximum Differential Pressure:
50 psid (3.45 bar) @ ambient
25 psid (1.72 bar) @ 140˚F (60˚C)

Recommended Change Out Differential Pressure[1]:
35 psid (2.4 bar)

FDA Listed Materials:
Manufactured from materials, which are listed for food contact applications in Title 21 of the U.S. Code of Federal Regulations. Product in compliance with EU Directive 2002/72/EC for plastic in food contact (in simulants A, B, C and D).

Toxicity:
All polypropylene components meet the specifications for biological safety as per the USP for Class VI-121˚C plastics (gaskets/O-rings excluded).

Purity:
Claris Series filter cartridges are free of surfactants, anti-static agents, binders, and adhesives.

Product Specifications

Materials of Construction:

Filter Media:	Polypropylene
End Caps[2]:	Polypropylene
Extended Core[2]:	Stainless Steel
Extruded Core:	Polypropylene
Gaskets/O-rings[2]:	Silicone Elastomer, Buna N, Viton[3] A, EPDM, Santoprene[4]

Dimensions (nominal):

Outside Diameter:	2 ½" (6.4 cm)
Inside Diameter:	1" (2.7 cm)
Lengths:	9 ¾" (24.8 cm), 9 ⅞" (25.1 cm), 10" (25.4 cm), 19 ½" (49.5 cm), 19 ⅘" (50.3 cm), 20" (50.8 cm), 29 ¼" (74.3 cm), 29 ½" (74.9 cm), 29 ¾" (75.6 cm), 30" (76.2 cm), 39" (99.1 cm), 40" (102 cm), 50" (127 cm)

NSF
COMPONENT

This Claris Series filter cartridge is tested and Certified by NSF International under ANSI/NSF Standard 42 for materials only.

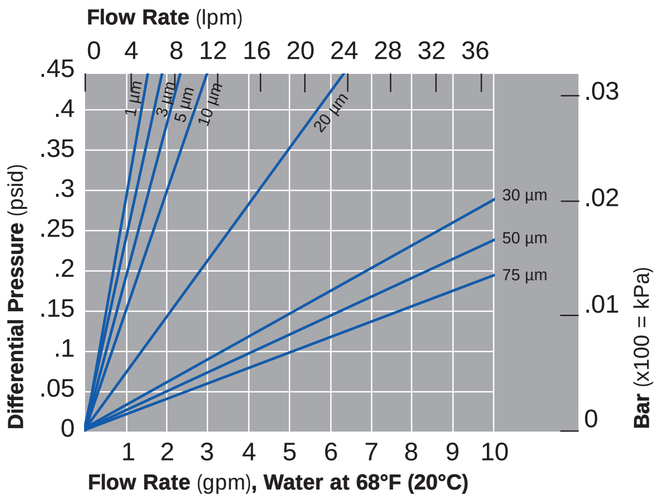
[1] - Provided that the maximum differential pressure is not exceeded based on temperature limits defined above.

[2] - These components are not NSF certified.

[3] - Registered trademark of DuPont Dow.

[4] - Registered trademark of Advanced Elastomer Systems.

Typical Flow vs. Differential Pressure for Application Sizing



Flow rate is per 10" (25.4 cm) cartridge. For liquids other than water, multiply differential pressure by fluid viscosity (cP).

Part Numbers/Ordering Information

CLR ■ – ● ▼ ◆ (e.g. CLR 3–20DOES)

Code ■	Filter Grades[5]
1	1 µm
3	3 µm
5	5 µm
10	10 µm
20	20 µm
30	30 µm
50	50 µm
75	75 µm

Code ●	Cartridge Lengths (nominal)
9.75	9.75"
9.875	9.875"
10	10"
19.5	19.5"
19.8	19.8"
20	20"
29.25	29.25"
29.5	29.5"
29.75	29.75"
30	30"
39	39"
40	40"
50	50"

Code ▼	End Configurations
Blank	DOE industrial (no end caps)
DOE	DOE with elastomer gasket seals & end caps
H21	DOE, Santoprene gasket seal
1X	DOE industrial, 1" (2.54 cm) stainless steel extended core
M3	SOE flat closed end, external 222 O-rings (retrofits other manufacturers' Code 0)[6]
M8	SOE fin end, external 222 O-rings (retrofits other manufacturers' Code 5)[6]
M18	SOE flat closed end, external 222 O-ring
XK	SOE plastic spring assembly, saw cut end
SI	SOE metal spring/polypropylene cap, saw cut end

Code ◆	Gasket/O-ring Materials
S	Silicone
N	Buna N
E	EPDM
V	Viton A

5 - Based on typical application usage.

6 - For details, contact Pall Corporation.

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Filtration. Separation. Solution.SM

Coreless Ultipor® III Filter Elements

Pall Coreless Ultipor III filters provide all the performance advantages of Ultipor III filter elements in a totally metal-free package. Like our standard Ultipor III filter elements, Coreless filters feature a helical outer wrap, high strength upstream and downstream support, and Ultipor III filter medium. Coreless filters, however, use reinforced polymer end caps, and do not include an internal core (the core is a part of the filter housing).

With Coreless Ultipor III filters, Pall has created a product that not only provides unparalleled system component protection, extended fluid life, and reduced element disposal frequency, but also reduces disposal costs and is environmentally friendly.

Features

Incinerable
Pall Coreless Ultipor III elements are constructed without metal components. Reinforced polymer end caps and filter support add BTU value in waste-to-energy facilities.

Crushable
Elimination of a structural core from a disposable filter element facilitates crushing. Elements can be folded to easily fit into drum packing equipment. Packed volume is reduced as much as 50%.

Lightweight
Pall Coreless Ultipor III elements weigh an average 60% less than comparable elements with cores. This not only reduces waste, but also saves on transportation costs.

Easy Change-out
Plugged filter elements can be pulled off of the permanent core with little effort. A new element slides easily over the core for fast installation.

Simple Retrofit
Many existing Pall housings can be quickly upgraded to coreless technology on-site. A one time conversion kit is required, including a core which becomes a permanent part of the filter assembly.

Contact Pall for information on the availability of retrofit kits for standard Pall housings.

Reduce Disposal Costs through Waste Minimization

Pall Coreless Ultipor III elements have been designed to assist in waste reduction and environmental protection.

ΔP Devices
Threaded Deltadyne® Differential Pressure Indicators and Switches

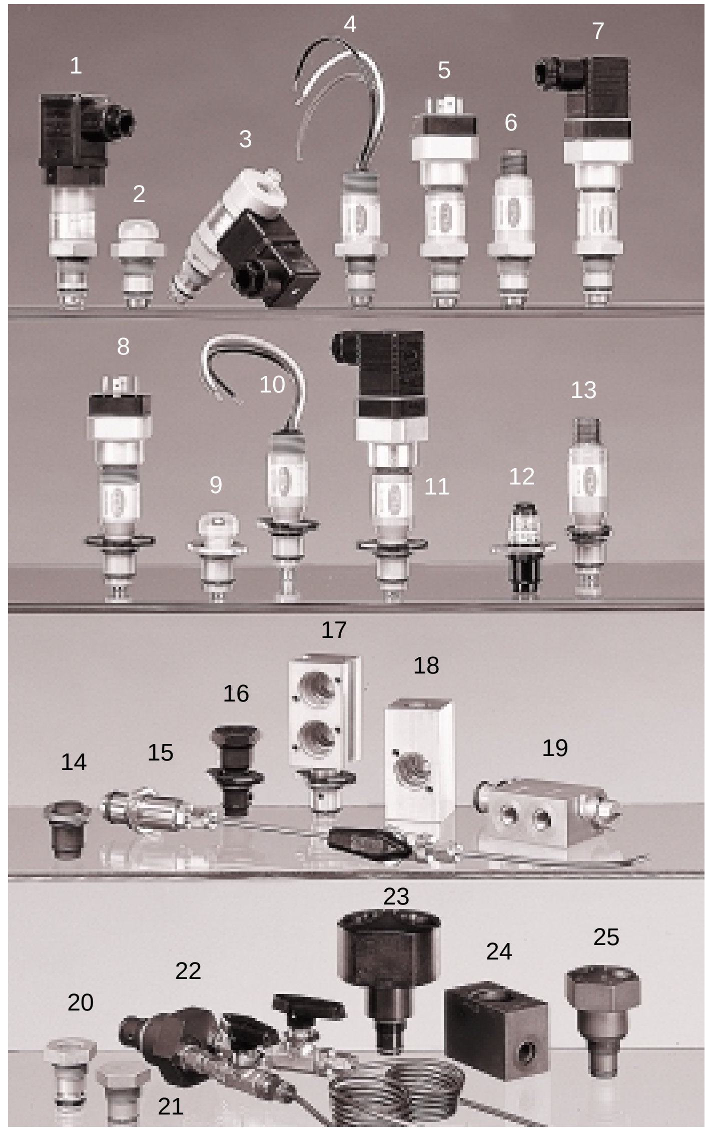
Operation

Deltadyne differential pressure devices operate by sensing the differential pressure between ports upstream and downstream of the filter element. The differential pressure acts on a piston/magnet assembly that is contained in the Deltadyne device. When the differential pressure across the internal piston/magnet assembly reaches a preset value, determined by the range spring, the piston assembly moves downward sufficiently to reduce the attractive force between the magnet and indicator button or switch actuator lever. The indicator or switch spring then overcomes the reduced magnetic force to release the button or actuate the switch to signal the need for element change.

A magnet coupling isolates the pressurized fluid from the electrical or mechanical actuator. This eliminates dynamic seals and exposed cams, thus avoiding a leakage point common to other types of warning devices, particularly those which are connected to the bypass valve. Deltadyne devices respond only to differential pressures; they can withstand system pressures up to the design limit of 6000 psi (414 bar).

Notes and Specifications

Maximum acceptable Working pressure:	6000 psi (414 bar)
Temperature Range:	-45°F to 275°F (-43°C to 135°C)
Rated Fatigue Pressure 10^7 cycles per NFPAT.2.6.1-1974:	3000 psi (207 bar)
Seals:	Internal: Fluorocarbon External: Nitrile or Fluorocarbon
Housing Material:	Aluminum (Stainless Steel or Other Materials Available)
Electrical Switch Ratings:	4 amp @ 110 VAC, 28 VDC (resistive) 2 amp @ 110 VAC, 28 VDC (inductive) SPDT, automatic reset
Electrical Switch Circuit:	C — A Normally Closed B Normally Open
Installation:	Deltadyne switches and indicators fit Pall housings that have a threaded differential pressure port. A mounting block is available for remote installation.



Ordering information for Deltadynes and accessories (including photo reference number) can be found on pages 140 and 141.

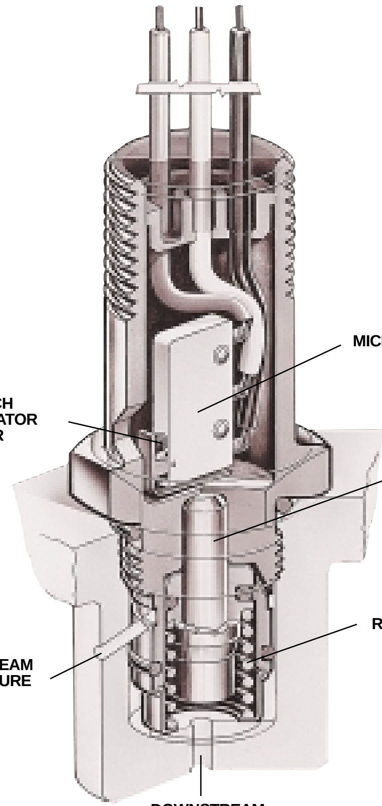
Deltadyne Switches and Indicators

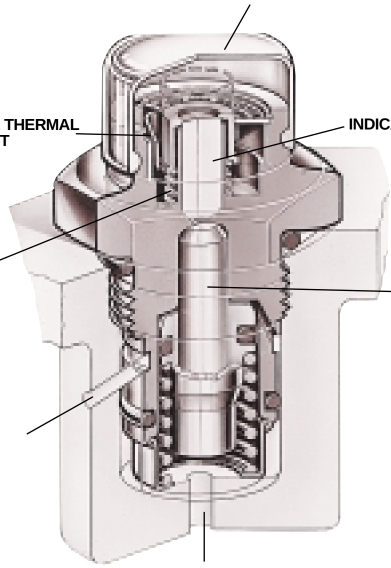
Electrical Switches

Deltadyne electrical switches have an automatic reset function that allows them to be used as system warm-up monitors. High fluid viscosity associated with low temperature start-ups will cause a higher pressure drop across the filter element. Deltadyne switches will signal high differential pressure until the system reaches operating temperature. As the system warms up, the differential pressure is reduced, and the range spring returns the piston assembly to its normal position, thus restoring the magnetic force between the magnet and the actuator lever. The restored magnetic force is sufficient to overcome the switch spring force, allowing the single pole double throw switch (SPDT) to signal a differential pressure below the switch setting.

Single Pole Double Throw Switch:

The SPDT switch allows this device to be used in a typical green-red light circuit. When the green light signals pressure drop below the actuation pressure, there is element life remaining. The red light signals pressure drop above the preset value... either a cold start or the need for an element change. The two-light circuit also serves as a continuity check; one of the two lights should always be on.





Visual Indicators

Memory: All Deltadyne visual indicators show whether a preset differential pressure has been exceeded at any time – even after the system is shut down. When the factory-set differential pressure is exceeded, the red button pops up and stays up until it is manually reset. When the differential pressure is reduced, the range spring returns the piston assembly to its normal position; however, the gap between the magnet and the now extended indicator button is too great for magnetic force to overcome the button spring force. The button, therefore, remains in the extended position until differential pressure is reduced and the button is manually reset.

Thermal Lockout: An optional bimetallic thermal lockout prevents actuation below 32°F and allows actuation above 80°F system temperature. Between 32°F and 80°F the thermal lockout device is in transition. Above 80°F the indicator will actuate when the element is plugged and the differential pressure exceeds the pre-set limit.

Threaded Indicators
Ordering Information

RC [TABLE 1 CODE A] [TABLE 2] [TABLE 3] [TABLE 4] [TABLE 1 CODE B]

Table 1

Code A	Code B	Description	Filter Assembly Part Number Code	"H" Dimension	Photo Reference Number
778NZ	Omit	Aluminum threaded visual indicator with memory and thermal lockout	P	0.9" (23 mm)	2
860MZ	Omit	Aluminum threaded visual indicator with memory– without thermal lockout	D	0.9" (23 mm)	2
861CZ	Omit	Aluminum threaded switch with 6" flying leads	L	1.72" (44 mm)	4
771BZ	Omit	Aluminum threaded switch with 3-pin military electric connector	S	2.25" (57 mm)	6
861CZ	YT	Aluminum threaded switch with DIN (Hirshman) 4-pin connector	T	3.75" (95 mm)	5
861CZ	YM	Aluminum threaded switch with DIN (Hirshman) 4-pin connector and matching connector cap	M	3.75" (95 mm)	7
861CZ	YR110AC	Aluminum threaded switch with DIN (Hirshman) 4-pin connector, matching connector cap and 110 VAC indicator lights	R11A	4.37" (111 mm)	1
861CZ	YR220AC	Aluminum threaded switch with DIN (Hirshman) 4-pin connector, matching connector cap and 220 VAC indicator lights	R22A	4.37" (111 mm)	1
861CZ	YR24DC	Aluminum threaded switch with DIN (Hirshman) 4-pin connector, matching connector cap and 24 VDC indicator lights	R24D	4.37" (111 mm)	1
0113CZ	Omit	Aluminum threaded body with both visual and electrical switch with DIN (Hirshman) connector and a connector cap (manual reset)	V	2.7" (69 mm)	3

Table 2.

Code	Differential Pressure Setting	Bypass Valve Setting
084	16±3 psid (1.1±0.2 bar)	22 or 25 psid (1.5 or 1.7 bar)
090	35±5 psid (2.4±0.3 bar)	50 psid (3.5 bar)
097	100±15 psid (7.0±1.0 bar)	Non-bypass

Table 3.

Code	External Seal	Fluid Service
H	Nitrile	Petroleum, water oil emulsions, water glycol, HWCF
Z	Fluorocarbon	Specified synthetics

Table 4.

Code	Material Option
Omit	Aluminum
SS	Stainless Steel

Threaded Filter Accessories

Part Number	Description	Photo Reference Number
1128465	Port plug kit–Buna ("B" option)	21
1128466	Port plug kit–Fluorocarbon ("B" option)	21
1326139	Dual port ¼" SAE upstream and downstream adapter plug–Buna ("F" option)	25
1326140	Dual port ¼" SAE upstream and downstream adapter plug–Fluorocarbon ("F" option)	25
1326193	Dual indicator adapter plug–Buna	23
1326194	Dual indicator adapter plug–Fluorocarbon	23
1129754	Gauge adapter plug kit plug–Buna	20
1313883	Gauge adapter plug kit plug–Fluorocarbon	20
1326191	Indicator remote mounting block	24
1196634	"Y" block fluid sampling kit	22

Flanged Indicators
Ordering Information

Plastic Visuals

Part Number	Pressure Setting	Description	Filter Assembly Part Number Code	"H" Dimension	Photo Reference Number
H (H) 8630DL-16	16 psid (1.1 bar)	Plastic flanged visual indicator with memory and no thermal lockout	DL	0.9" (23 mm)	12
H (H) 8630DL-35	35 psid (2.5 bar)	Plastic flanged visual indicator with memory and no thermal lockout	DL	0.9" (23 mm)	12
H (H) 8630PL-16	16 psid (1.1 bar)	Plastic flanged visual indicator with memory and thermal lockout	PL	0.9" (23 mm)	12
H (H) 8630PL-35	35 psid (2.5 bar)	Plastic flanged visual indicator with memory and thermal lockout	PL	0.9" (23 mm)	12

Aluminum Visuals

Part Number	Pressure Setting	Description	Filter Assembly Part Number Code	"H" Dimension	Photo Reference Number
H (H) 7001DM-16	16 psid (1.1 bar)	Aluminum flanged visual indicator with no thermal lockout	DM	0.9" (23 mm)	9
H (H) 7001DM-35	35 psid (2.5 bar)	Aluminum flanged visual indicator with memory and no thermal lockout	DM	0.9" (23 mm)	9
H (H) 7001PM-16	16 psid (1.1 bar)	Aluminum flanged visual indicator with memory and thermal lockout	PM	0.9" (23 mm)	9
H (H) 7001PM-35	35 psid (2.5 bar)	Aluminum flanged visual indicator with memory and thermal lockout	PM	0.9" (23 mm)	9

Aluminum Switches

Part Number	Pressure Setting	Description	Filter Assembly Part Number Code	"H" Dimension	Photo Reference Number
H (H) 8630LL-16	16 psid (1.1 bar)	Aluminum flanged switch with 3 wire leads and 1⁄2 inch NPT conduit connection	LL	1.72" (44 mm)	10
H (H) 8630LL-35	35 psid (2.5 bar)	Aluminum flanged switch with 3 wire leads and 1⁄2 inch NPT conduit connection	LL	1.72" (44 mm)	10
H (H) 8630SL-16	16 psid (1.1 bar)	Aluminum flanged switch with 3-pin military electrical connector	SL	2.25" (57 mm)	13
H (H) 8630SL-35	35 psid (2.5 bar)	Aluminum flanged switch with 3-pin military electrical connector	SL	2.25" (57 mm)	13
H (H) 8630TL-16	16 psid (1.1 bar)	Aluminum flanged switch with DIN (Hirshman) 4-pin connector	TL	3.75" (95 mm)	8
H (H) 8630TL-35	35 psid (2.5 bar)	Aluminum flanged switch with DIN (Hirshman) 4-pin connector	TL	3.75" (95 mm)	8
H (H) 8630ML-16	16 psid (1.1 bar)	Aluminum flanged switch with DIN (Hirshman) 4-pin connector and matching cap	ML	3.75" (95 mm)	11
H (H) 8630ML-35	35 psid (2.5 bar)	Aluminum flanged switch with DIN (Hirshman) 4-pin connector and matching cap	ML	3.75" (95 mm)	11

Flanged Filter Accessories

Part Number	Description	Photo Reference Number
1303068	Port plug kit–Buna ("BL" option)	14
1303069	Port plug kit–Fluorocarbon ("BL" option)	14
1303665	Dual port 1⁄4" SAE upstream and downstream adapter plug–Fluorocarbon ("FL" option)	19
1308337	Dual indicator adapter plug–Buna	17
1313999	Dual indicator adapter plug–Fluorocarbon	17
1305244	Gauge adapter plug kit–Buna	16
1305245	Gauge adapter plug kit–Fluorocarbon	16
1310814	Indicator remote mounting block	18
1325112	Universal fluid sampling kit	15

Dirt-Fuse® Filter Elements

The ultimate in reliability for high pressure filters is the Dirt-Fuse high collapse filter element. Used in Pall non-bypass filter housings, these elements are designed for protection of critical system components. They are designed to withstand full system pressure (up to 3000 psid, 210 bar) without damage or collapse. These filters are ideal for protecting contaminant-sensitive components such as servo and proportional valves.

If service is ignored, and the system is allowed to operate with a dirty filter element, the differential pressure builds across the element and system flow gradually shuts off without dirt bypassing the filter. Incorporating Ultipor® III media in a special pressure resistant design, these elements ensure that only filtered fluid makes its way to critical system components.

Common applications that benefit from Pall non-bypass filters incorporating Dirt-Fuse elements include:

- Plastic blow molding
- Plastic injection molding
- Industrial component test stands
- Die casting
- Flight simulators
- Machine tools
- Edge guide controls
- Gauge controls
- Motion control simulators

Features:

1. An upstream support mesh promotes uniform, pleat spacing and strength. This reduces pleat flexing and promotes uniform flow through the filter, even under severe cold start or pressure surge conditions.

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

2. Media is made up of inert, inorganic fibers securely bonded into a fixed, tapered pore structure that preserves high particle removal efficiency throughout the life of the element. Tapered pores capture particulate through the entire media depth for maximum dirt holding capacity.

   Benefit: Consistent filter performance and extended service life.

3. Tighter downstream support mesh promotes drainage and adds strength under high differential pressure conditions.

   Benefit: Reliable, consistent performance and resistance to high differential pressure conditions.

4. Rugged, high strength core provides protection against element collapse at differential pressure as high as 3000 psi (210 bar).

   Benefit: Optimum protection of critical components under all operating conditions.

Fuels and Chemicals

Scientific & Technical Report GDS119

High Efficiency Coalescers Increase On-Line Process Analyzer Sensor Reliability

Presented at the Analysis Division 48th Annual Spring Symposium,
Calgary, Alberta Canada, April 27-30, 2003

by

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High Efficiency Coalescers Increase On-Line Process Analyzer Sensor Reliability

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Abstract

On-line process analyzers have become common place in industrial plants and are becoming more complex and numerous each year. One of the most critical issues with the use of on-line sensors is their vulnerability to fouling and the potential harmful outcomes of inaccurate measurements such as non optimized process control leading to loss of revenue. Also of concern is the need for costly replacement parts due to corrosion and maintenance related to frequent repairs or cleanings. Advances in separation technology of liquid / gas coalescers and liquid / liquid coalescers and their application to sensor protection are presented. The use of specially engineered polymeric media has advanced the state of the art for separating liquid aerosols from gases and breaking emulsions in liquid systems. Separation mechanisms in the newly developed technology are described along with how this technology is applied to analyzer protection. Installations of this separation technology include protection of near infra red sensors in gasoline blending, density meters and gas chromatography analyzers in fuel gas, and sensors used to monitor sour water. Case histories from a European Refinery and Canadian Refinery are presented covering the installation details and cost-benefit analysis.

Introduction

Sampling systems for process analyzers consist of all the equipment required to present an analyzer with a clean, representative sample of a fluid stream, and to dispose of that sample once processed. When the analyzer is part of an automatic control loop, the reliability of the sampling system is as important as the reliability of the analyzer, or the control equipment. Sampling systems have several functions. The sample must be withdrawn from the process, transported, conditioned, introduced into the analyzer, then disposed of upon completion of the analysis. A common problem in sample-system design is the lack of representative, "real" time information concerning the properties of the process fluid at the sampling point.

Another common problem is the lack of understanding regarding the level of fluid clarification required so that the analyzer may process the sample without malfunctioning for long periods of time. Some fluid streams may require such extreme conditioning and treating, such that the sampling system and its pre-conditioning train become miniature on-line processing plants. These systems pose many of the same fabrication, reliability, and operating problems as small-scale pilot plants – except that the sampling system typically must operate reliably for much longer periods of time. When installing an analyzer protection system, careful consideration should be made to avoid removal (by either physical separation or adsorption) of the components that are intended to be measured as this could lead to serious errors.

Sample conditioning usually involves the removal of contaminants or some deleterious component from the sample mixture and/or the adjustment of temperature, pressure and flow rate of the sample to parameters acceptable to the analyzer. Some of the most common contaminants that must be removed are rust, scale, corrosion products, deposits due to chemical reactions, water or some other aqueous phase, tars, and gums. The presence of these contaminants even in trace quantities can lead to analyzer failure. Water, for example, can damage a gas chromatographic column packing or mask the C-H absorbency in the infra-red spectrum. High efficiency coalescer technology has been applied successfully for the protection of near infra-red (NIR), gas chromatography (GC), pH probes, sulfur in gasoline analyzers, density meters, motor octane number (MON), research octane number (RON), and color analyzers.

In this paper, application of novel high efficiency coalescing technology is discussed along with critical factors for successfully employing this sample conditioning option in fast loop sampling systems.

Coalescer Technology

Coalescers are designed especially to separate either liquid aerosols from a gas stream or to break liquid / liquid emulsions. They can be constructed from fibers made of various materials including glass, metal, polymers and fluoropolymers. The coalescer media can be configured as pleated sheets or as a depth type, but have in common a pore gradient that goes from smaller to larger sizes in the flow direction and an outer coarse sleeve material to complete the coalescing process. In principle, coalescers can operate indefinitely as long as they are not exposed to solid contaminants. In practice, coalescer systems, with proper pre-filtration, typically achieve service lives varying from six months to two years. A schematic of the coalescing process showing the growth or coalescence of droplets as they pass through the coalescer medium is given below in Figure 1.

Coalescing systems operate in three stages: separation of solids, coalescence of small drops into large drops, and finally the separation of the large coalesced drops from the purified continuous stream. During the coalescing process the inlet drop sizes are in the sub micron to low micron size range and after passing through he coalescer are in the millimeter size range. Both liquid / gas and liquid / liquid coalescer technology have been successfully applied to analyzer technology.

Liquid / Gas Coalescers

Liquid / gas coalescers are the latest development in the history of liquid / gas separation units. Their performance is superior to knock-out drums, vane separators, mesh pads, and combinations of filter separators and vane or mesh packs. These older devices rely on inertial separation mechanisms, and work well for larger

Figure 1: Coalescing in the Medium

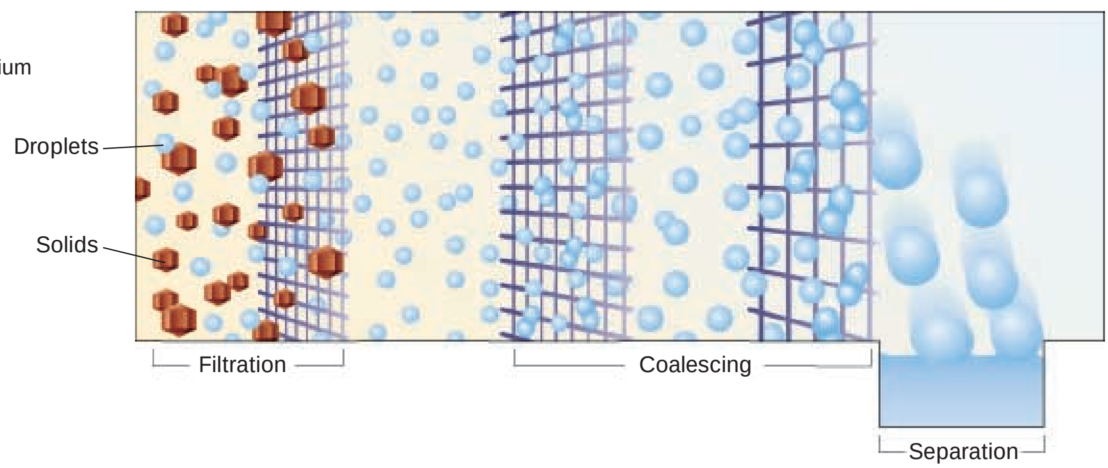
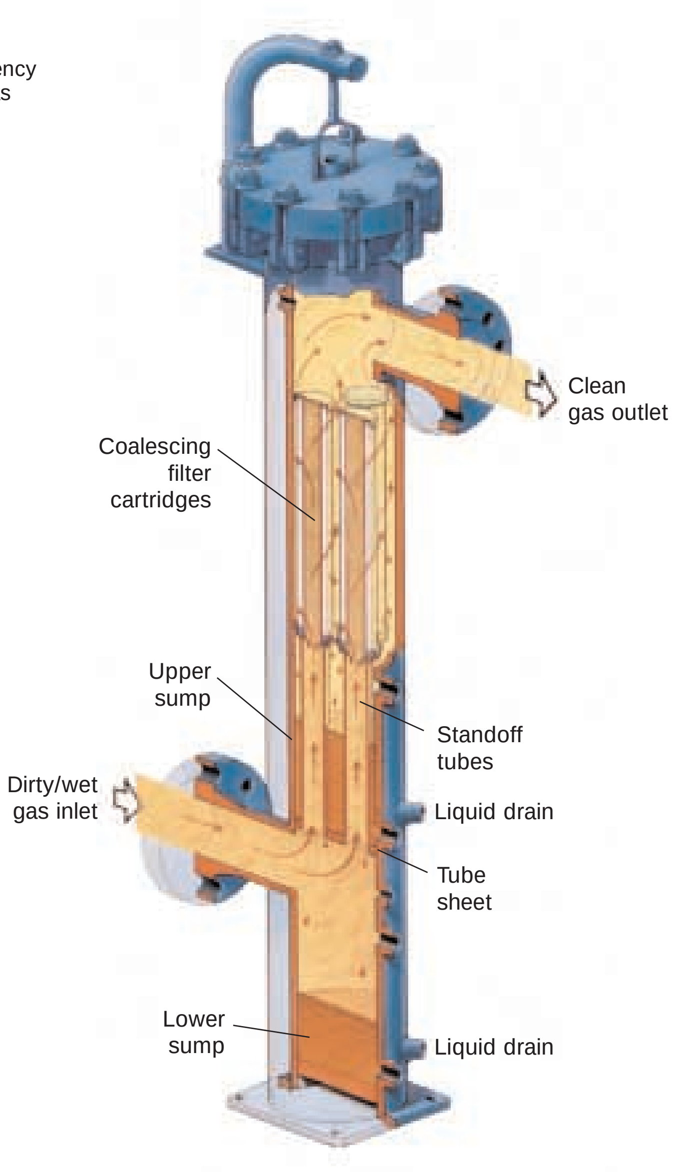


Figure 2:
High Efficiency Liquid / Gas Coalescer



aerosol droplets (>5 micron), but lose efficiency at reduced flow rates.

High efficiency, vertical liquid / gas coalescers have been used extensively in gas processing in the last decade. They offer the advantage of increased removal capability of fine droplets (down to 0.3 micron in size and to levels as low as 3 ppb), and are able to operate efficiently at low flow rates. A recent innovation in liquid / gas coalescer design is to use a surface treatment[1,2] to prevent the wetting of the coalescer media with the aerosol liquids, thereby increasing the allowable flux, decreasing fouling tendency, and decreasing pressure drop losses.

A schematic of an industrial size liquid / gas coalescer system is provided in Figure 2.

Liquid / Liquid Coalescers

Liquid / liquid coalescer systems are used extensively to dry jet fuel and are finding increasing applications for refinery and chemical process streams.[3-7] These systems can be divided into two broad categories: vertical with separator stage, and horizontal with gravity separation. Schematics of the vertical and horizontal coalescer configurations are given in Figures 3-4.

Both configurations employ a coalescence stage. In the vertical configuration, a hydrophobic barrier repels the coalesced aqueous drops in a second separation stage. In the horizontal configuration, a settling zone achieves separation of the coalesced drops. The vertical configuration is used to separate water from hydrocarbons when the interfacial tension is greater than 3 dyne/cm. At lower interfacial tensions, or for oil from water separations, the horizontal configuration is used. Typically, the process stream leaving the liquid / liquid coalescer will have a concentration of less than 15 ppmv of free dispersed contaminant phase.

Traditional coalescers have used glass fiber media, which works well for emulsions that have interfacial tensions greater than 20 dyne/cm. New coalescer media, constructed with novel formulated polymers and fluoropolymers[5] are effective for emulsions having interfacial tensions as low as 0.5 dyne/cm. An improved design of the vertical liquid / liquid coalescer has been to stack the coalescers on top of the separators, as opposed to older designs that had the separators located in a separate section of the housing. This new design improved the flow distribution, and thereby increased the separator utilization.

Figure 3:
Vertical Liquid / Liquid Coalescer

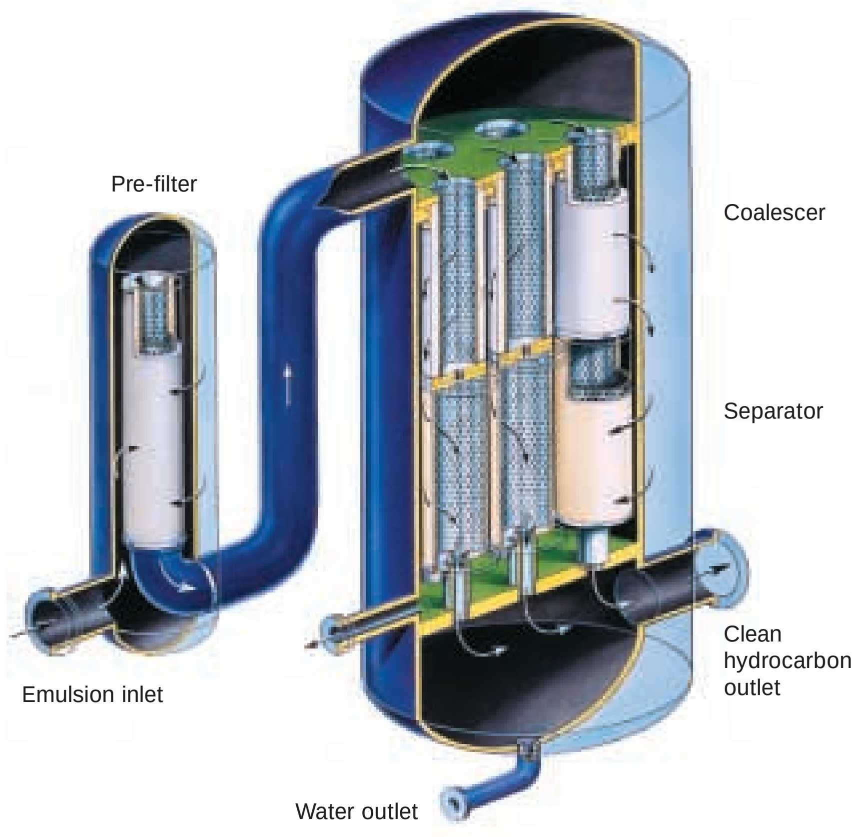
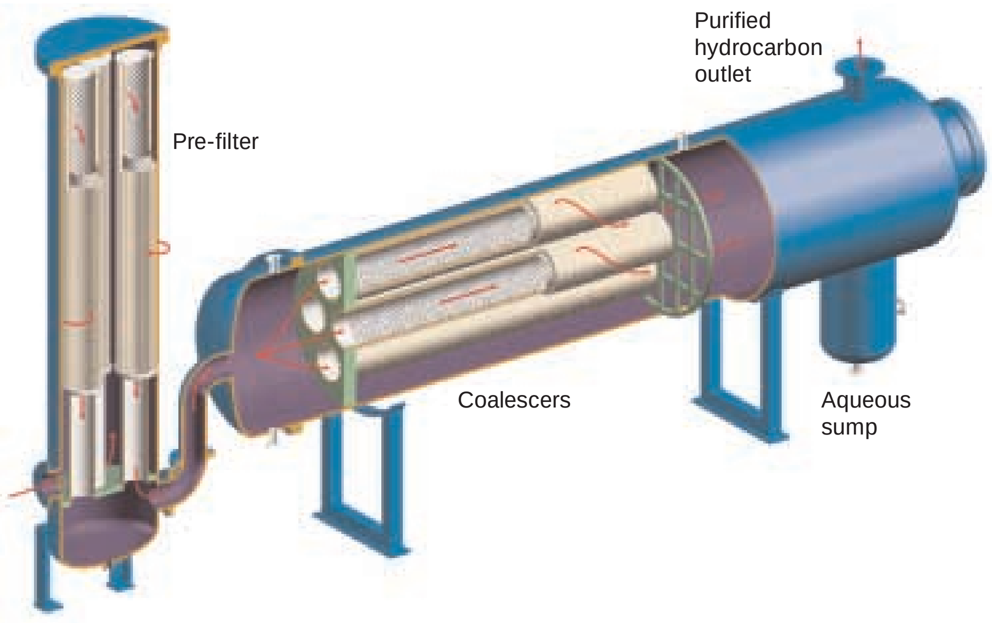


Figure 4:
Horizontal Liquid / Liquid Coalescer System



Surfactant

Problems Created at Solid / Liquid and Liquid / Liquid Interfaces

Surfactants are present naturally in crude oil and as a result are in refined petroleum products. During the oxidation process and the caustic re-circulation in sulfur removal processes, surfactants can be concentrated to high levels.

Surfactants that have been identified in caustic treaters include sulfides, mercaptides, naphthenic acids, cresylic acids and phenol homologs.[8] Petroleum naphtha sulfonates have also been identified as naturally occurring petroleum surfactants that are especially detrimental to conventional glass fiber coalescers.[9] The surfactants can adsorb at the solid / liquid interface (coalescer fibers) or at the liquid / liquid interface (water/oil).

When surfactants concentrate on the coalescer fibers this is known as "disarming". The coalescer fibers are shielded from the passing aqueous droplets and this results in poor separation efficiency. Generally, the disarming phenomenon does not occur unless the interfacial tension between the water and fuel is less than 20 dyne/cm. When specially formulated polymeric coalescer medium was used instead of glass fiber, disarming was not observed.[5,6] The coalescing performance of a polymeric medium can be greatly enhanced by modification of surface properties that cannot be accomplished with glass fiber medium.

Surfactants can also concentrate at the water/fuel interface and this can lead to very small droplets and stable emulsions. A survey of caustic–hydrocarbon emulsions showed the interfacial tensions varied from 0.5 dyne/cm to 12.4 dyne/cm.[3] To separate these types of emulsions, special consideration must be applied to the pore size and distribution in the coalescer media to intercept and coalesce the small droplets.

Sampling System Configuration

In order to apply coalescing technology to analyzer protection, scaled down versions of the industrial systems are required. The use of fast loop sampling systems are critical to ensure that representative (fresh) fluid is analyzed for real time optimal process control. Here, a high flow rate is maintained in a loop that goes through the pre-filter and coalescer and is then re-routed back to the process. A smaller stream of the purified fluid is drawn off for analysis.

An important distinction between the use of coalescers in analyzer protection and full scale industrial use is that the contaminant phase is re-routed back into the process stream. This configuration allows for less instrumentation as it is not critical to monitor the separated contaminant fluid for level control since it is purged continuously back into the process. This leads to a different flow path in the coalescer housing whereby the fast loop flow rate is passing out through the normal collection sump connections back to the process, while a smaller sampling flow is leaving the normal main outlet port. Representative schematics of a fast loop sampling system for a liquid / liquid coalescer system and a liquid / gas coalescer system are provided below in Figures 5-6.

Figure 5: Fast Loop for Liquid / Liquid Coalescer

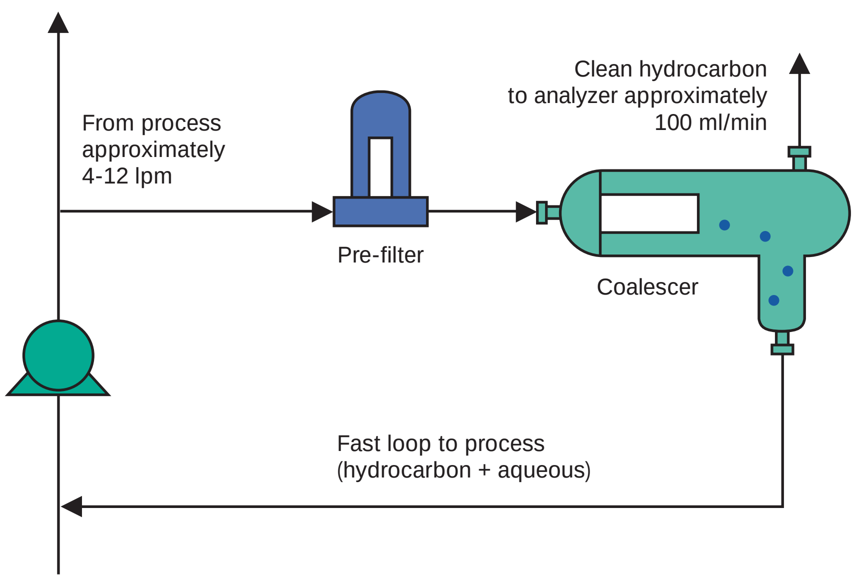
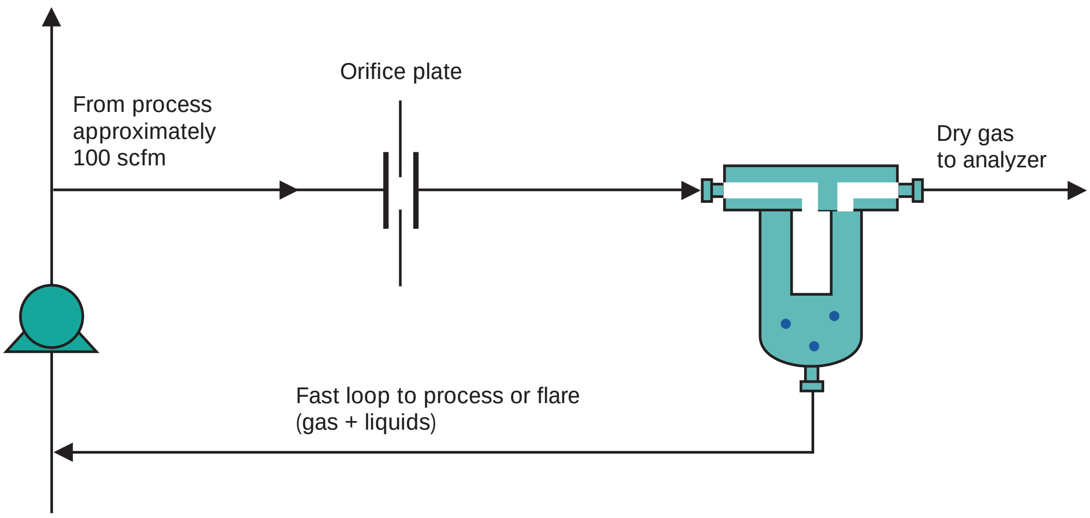


Figure 6:
Fast loop for Liquid / Gas Coalescer



Case History - European Refinery

Background / Problem

At a European Refinery, the presence of caustic water in the sampling system caused fouling of the on-line NIR analyzers for gasoline blending. The hydrocarbon stream was composed of caustic treated heavy cat naphtha (HCN) and light cat naphtha (LCN). The fast loop flow rate was 1.3 lpm (0.35 gpm) at an operating pressure of 10 barg (145 psig), and an operating temperature that varied from 5-35˚C (41-95˚F) with an interfacial tension of 10 dyne/cm.

Many gaseous and liquid compounds absorb infrared radiation to some degree. The degree of absorption at specific wavelengths depends on molecular structure and concentration. Process instruments generally are of the non-dispersive type. That is, the detector is exposed to a wide-wavelength band of radiation. This contrasts with the normal laboratory instrument, which uses a scanning monochromator to isolate successive narrow-wavelength bands. The main components of a process instrument are the radiation source, sample cell and detector. The radiation source is commonly a heated wire, which yields radiation over the analytically useful portion of the infrared spectrum. The main requirement is stability of emission. The radiation source window was being fouled by salt deposits from the caustic water that led to issues with the emission stability.

The refinery controls the gasoline blending by means of both a feed-forward loop and a feed-back loop. The feed-back loop is in an analyzer house and the refinery had managed to combat the problem of salt fouling by a series of sample conditioning steps. The feed-back sample passed through a 70 µm nominal filter and was cooled by means of a Vortex cooler followed by a low efficiency coalescer. Post coalescing, the stream would go through a 0.5 µm PTFE hydrophobic membrane filter to block and reject water. A final heating stage was employed to dissolve any remaining aqueous phase before the sample was introduced into the NIR analyzer.

Such extensive conditioning of the feed-forward loop, however, was not possible as the analyzer was on-site immediately after gasoline storage tanks with no facilities to readily heat or cool the streams. These analyzers were being by-passed due to salt fouling, and as a result, the refinery was relying only on feed-back control. Revenue losses were considered significant due to inaccurate blending. The NIR analyzer was used to determine the octane number and without accurate readings, the blending did not result in the optimum octane values.

Solution

The refinery decided to protect four naphtha blending stream NIR analyzers using high efficiency liquid / liquid coalescers. Each system contained a single liquid / liquid coalescer constructed of fluoropolymer media that was 152 mm (6 inch) in length by 64 mm (2.75 inch) diameter. The coalescer had a maximum rated flow of 19 lpm (5 gpm). The coalescer housing was made of 316 L stainless steel with a pressure rating of 16 barg (240 psig) and hold up volume of 4 liter (1.06 gallon). A nylon depth style filter with an absolute rating of 10 µm was used to protect the coalescer. The pre-filter was 127 mm (5 inch) in length by 64 mm (2.5 inch) diameter. The pre-filter housing was made of 316 L stainless steel with a pressure rating of 16 barg (240 psig) and hold up volume of 2 liter (0.53 gallon).

The installation of the high efficiency liquid / liquid coalescer sample conditioning system was found to surpass other traditional technology that had been previously employed in terms of efficiency and effectiveness in preventing fouling. The feed-forward loop which had never before operated was now providing the necessary control information, without the need for multi-staged 'tweaking.' With implementation of the new coalescer solution the losses due to poor blending were eliminated. The cost of each high efficiency liquid / liquid coalescer sample conditioning system was less than 5,000 US dollars and resulted in an estimated payback period of one week.

Case History - Canadian Refinery

Background / Problem

At a Canadian Refinery, the presence of amine and heavy hydrocarbons in the fuel gas sampling system caused fouling of the on-line fuel gas density and gas chromatographic analyzers. The fast loop flow rate was 100 scfm at an operating pressure of 3.8 barg (55 psig) and operating temperature of 176˚C (80˚F). Previously, the sample was passed through a nominally rated pre-filter followed by a conventional liquid / gas coalescer. Due to poor protection and amine ingression, the analyzers were not operable.

Solution

The refinery decided to protect four streams, using high efficiency liquid / gas coalescers. Each system contained a single liquid / gas coalescer constructed of glass fiber media that was specially surface treated to prevent wetting. The coalescer was 254 mm (10 inch) long by 70 mm (2.75 inch) diameter. The coalescer had a maximum rated flow of 200 scfm. The coalescer housing was made of carbon steel with a pressure rating of 20.7 barg (300 psig).

After one year with the high efficiency liquid / gas coalescer installation, the refiner experienced no further problems with analyzer fouling. Furthermore, the protection provided by the coalescer allowed for on-line control of the amine contactor permitting improved gas quality, and reduced amine losses. The cost of each of the high efficiency coalescer sample conditioning systems was less than 5,000 US dollars and resulted in an estimated payback period of a few weeks.

Conclusions

The application of high efficiency coalescer technology to analyzer protection has been proven to be a cost effective means of ensuring analyzer reliability. Advanced coalescer materials allow for the separation of aerosols from gases and the separation of difficult emulsions that could not be accomplished with previous technologies. The use of the fast loop configuration with small scale coalescers has resulted in very simple separation systems that don't require level controls or automated discharge valves. Case histories from a Canadian and European refinery showed that these analyzer protection systems are relatively inexpensive and have very short pay back periods.

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GDS119

Fuels and Chemicals

Scientific & Technical Report GDS116

High Performance Liquid/Gas Coalescers for Compressor Protection

Presented at the 1999 Compressor Workshop, Lambton College, Sarnia, Ontario, April 28

by

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Scientific & Technical Report

High Performance Liquid/Gas Coalescers for Compressor Protection

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Abstract

Mechanical failures of reciprocating and centrifugal compressors can be caused in many instances by solid and liquid aerosol contamination in the intake gas. Protection of compressors by high efficiency liquid/gas coalescing filters has proven to be an effective means of reducing compressor maintenance and unscheduled shutdowns. A review of different liquid-gas separation devices is given with emphasis on high efficiency liquid-gas coalescers. On-site field test methods for determining aerosol contamination levels are presented along with a summary of extensive field results. Commercial experience with liquid-gas coalescers at different refinery and gas plant applications are discussed with operation experience and economic justification.

Introduction

Compressors are used for a number of applications within the refinery, chemical, gas processing, and gas transmission industries. While a number of different types of compressor designs exist, fundamentally they can be divided into positive displacement and centrifugal categories. Positive displacement involves the compression of gas by trapping the gas in isolated chambers that are then reduced in size before the gas is ejected. Reciprocating, screw and multi-lobe are examples of positive displacement compressors. In this paper, we will focus on reciprocating compressors due to their widespread use. Centrifugal compressors operate by accelerating the gas through the use of rotating blades and then restricting the exiting gas so that it is compressed in the process. These compressors can be of radial or axial design.

Contaminants in the inlet gas can have a severe effect on compressor reliability. A recent study[1] has found that at least 20% of all reciprocating compressor failures can be attributed to inlet gas contaminants. Even when the compressors are not having catastrophic failure, a costly maintenance schedule may be followed where the compressor is shut down every six months or less for inspection and minor repairs. A preventative system using a high performance liquid/gas coalescer system, however, has been found to provide protection of the compressor for a two-year period.

Gas contaminants are made up of solid particulates and liquid aerosols, often including a high percentage in the submicron size range. Solids are usually corrosion products (iron oxides or iron sulfides), salts or silt. Liquids can be hydrocarbons (refinery products, lube oil, condensate), aqueous (water, alcohol, dissolved salts, caustic, acid) or a combination of both. Contaminants will affect reciprocating and centrifugal compressors in different ways.

Reciprocating Compressor

Reciprocating compressors contain a cylinder and piston assembly with intake and exhaust valves similar to the familiar automobile engine. The gas enters the cylinder through intake valves, is compressed by the action of the piston confined in the cylinder, and then expelled through outlet valves. The motion of the piston is driven by a separate gas engine, turbine or electric motor. The valves play a crucial role in the compressor allowing the gas into the cylinder and for ejection of the gas after compression. The valves are especially prone to fouling from inlet gas contaminants. A build up of contaminants on the valves can lead to sticking valves or valves with partial bypass, resulting in a reduced compression ratio and increased power consumption. The build up of contaminants inside the cylinder can also damage the piston rings, pistons, and the cylinder wall. A survey[2] of 200 compressor users found that the cost of an unscheduled shutdown has been estimated for hydrogen gas service to range from $40,000 to $100,000 (US dollars) per day in lost production revenue not including repairs. The primary mode of failure was cited as the compressor valves followed by the pressure packings. The leading process improvements recommended by the compressor users was to install improved liquid/gas coalescing systems and gas filtration.

Centrifugal Compressor

Centrifugal compressors impart a dynamic head to the inlet gas by use of high speed impellers that are confined in a casing containing stationary diffusors. While centrifugal compressors are less sensitive to inlet gas contaminants, they are still adversely affected. For centrifugal compressors, the primary contaminant related problem is the build up of foulants on the rotating blades (also known as salting). This can lead to a partial blockage in the flow path causing increased power consumption and can create an imbalance in the blades leading to serious mechanical failures due to resultant vibrations if left unchecked. Usually, the centrifugal compressors are taken off-line for cleaning at regular intervals and this represents a substantial cost for maintenance.

Liquid/Gas Separation Options

Currently there are a number of liquid-gas separation technologies and a brief review of some of these options is presented. An important design feature in liquid/gas separators, the turn down ratio, is also discussed for the different separation equipment. The turn down ratio is the ratio of the design flow rate to the operating flow rate at which good separation is still achieved. A high turn down ratio indicates that the separation equipment will operate effectively even at reduced flow rates.

Knock Out Separator

Also known as the gravity settler, the knock out pot or drum is a vessel that allows the gas to expand and as a result, the gas velocity is reduced. Gravitational forces cause the larger droplets (usually > 300 µm) to separate from the gas stream. Generally, these systems require a large vessel and are used primarily for bulk removal and slugs. As the flow rate is decreased or the vessel diameter design is increased, a higher efficiency will result and so the turn down ratio is high for these separation systems. Also, waxy or fouling material will not cause plugging and these systems operate with a low differential pressure. The knock out or gravity settler is not recommended as the only separation equipment, as fine mist will not be removed. These systems do play an important role in a multistage system of aerosol removal as the front line separation device.

Centrifugal Separator

Also known as cyclone separators, the rotating action of the gas creates centrifugal forces much higher than the gravitational forces in the knock out drums, allowing for a greater efficiency of separation. Generally, the centrifugal separators can remove liquid aerosols greater than 10 μm with high efficiency, but will allow the finer aerosols to pass. As the gas flow rate is lowered, the centrifugal force will be reduced and, as a consequence, the aerosol removal efficiency will also be diminished. This gives the centrifugal separator a poor turn down ratio. Similar to the knock out separators, waxy or fouling material will not cause plugging and these systems operate with a low differential pressure.

Vane Separator

Vane separators consist of metal baffles or plates within a vessel that present a tortuous path for the gas flow so that aerosol droplets impinge on the metal surfaces. Once the drops contact the metal surfaces they pool together and are drained by gravity. The principal separation mechanism for vane separators is inertial impaction. In this case, the aerosol droplets will deviate from the gas streamlines and impact onto the vanes. As the flow rate is lowered, the driving force for separation is lessened, resulting in a poor turn down ratio and decreased separation efficiency at low flow rates. Vane separators can offer good separation for aerosol drops greater than 10 μm and are able to handle high liquid inlet concentrations.

Mesh Pad

A mesh pad, or mist eliminator consists of a pad that is composed of fibers or knitted mesh that is usually placed at the top of a vertical vessel. As the gas passes through the pad, aerosol drops are intercepted by the fibers and coalesce into larger drops until the pad is saturated with liquids that drain from the pad to the bottom of the vessel by gravity. The mesh pads provide more surface area for drops to collide as compared to the vane separator, but still operate on the same primary separation mechanism of inertial impaction. For inertial impaction, the separation efficiency is decreased by lowering the flow, and the turn down ratio is poor. Mesh pads generally have good removal ratings for droplets greater than 10 μm and can be designed to process high inlet liquid loadings.

Liquid/Gas Coalescers

The coalescer cartridge is usually made from glass fiber media that is supported by a metal core and contains a much finer pore size and larger surface area as compared to mesh pads or vane separators. The fine pore size allows for a different mechanism of separation for the coalescers. The coalescers are able to intercept the aerosol droplets by direct interception (sieving) as well as by the method of diffusional interception. Separation by the diffusion mechanism is caused by the random (Brownian) motion of the fine aerosol droplets that increase the probability of collision with coalescer fibers. The diffusional interception and direct interception differ from inertial impaction in that as the gas flow rate is decreased, the removal efficiency increases and, therefore, provides for a high turn down ratio. Properly designed high efficiency liquid-gas coalescers can provide separation of aerosols as low as 0.1 μm.

High efficiency liquid/gas coalescers are generally constructed from glass fibers since this material allows for a fine porous structure with fiber diameters of a few microns. The small pore size is needed to achieve greater capture and separation of these fine aerosols. The separation of liquid aerosol contamination with high performance liquid/gas coalescer cartridge systems has found widespread acceptance in refinery and gas plants in recent years for a number of applications[3,4,5] including protection of compressors, turbo equipment, burner nozzles, amine and glycol contactors, molecular sieve beds, and hydrotreater catalyst beds. This has largely been the result of traditional separation approaches including knock out vessels, centrifugal separators, mesh pads or vane separators not meeting the end user's requirements for aerosol reduction. The primary rationale for the use of high efficiency coalescers is that significant aerosol contaminant exist in the plants that are in the sub micron and low micron size range[6].

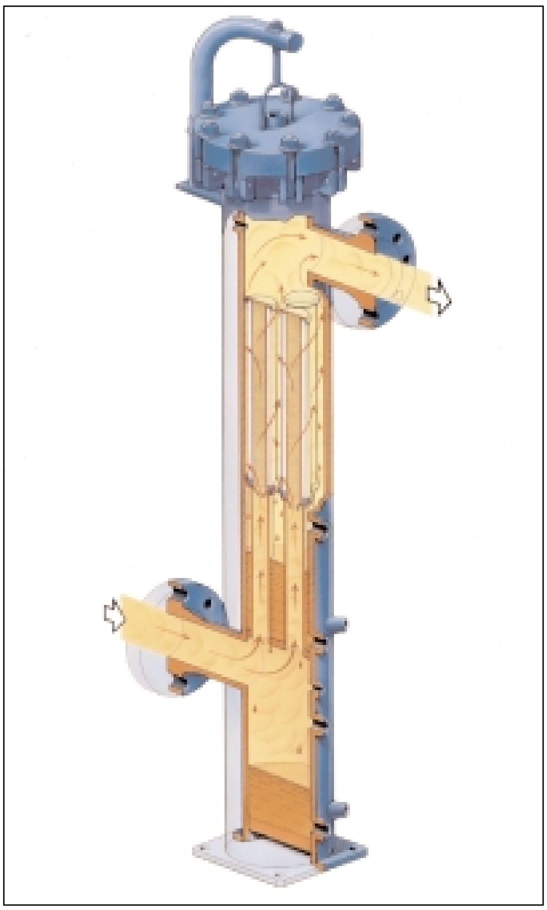


Figure 1
Pall Vertical High Efficiency Liquid/Gas Coalescer System

Another significant benefit of the liquid/gas coalescer is that this type of separation device can be operated at significantly lower flow rates than the initial design flow rate which means it has a high turn down ratio. This is due to the fact that the separation mechanisms are based primarily on diffusion and direct interception unlike vane separators and mesh pads that rely heavily on inertial separation principles. This allows the high efficiency liquid/gas coalescer systems a greater degree of flexibility and they can operate at peak performance even for high turn down ratios (reduced flow rates) which can occur during commonly encountered partial plant shutdowns and upset conditions. Generally, the high efficiency liquid/gas coalescers are used for inlet aerosol concentrations of less than 1,000 ppmw (0.1%) and are placed downstream of other bulk removal separators as the final stage. Outlet concentrations for these high efficiency liquid/gas coalescers are as low as 0.003 ppmw[6,7,8].

The use of a surface treatment[9] on high performance vertical liquid/gas coalescer cartridge systems has been proven to significantly enhance performance by allowing higher flow rates or smaller housing diameters compared to untreated coalescers.

A Pall vertical high efficiency liquid/gas coalescer system is depicted in Figure 1. The inlet gas with liquid aerosol contamination first enters at the bottom of the housing into a first stage knock out section. Here any slugs or larger size droplets (approximately > 300 µm) are removed by gravitational settling. The gas then travels upward through a tube sheet and flows radially from the inside of the cartridges through the coalescer medium to the annulus. The inlet aerosol distribution is in the size range of 0.1 µm - 300 µm and after passing through the coalescer medium is transformed to enlarged coalesced droplets in the size range of 0.5 - 2.2 mm. The advantage of flowing from the inside to outside of the coalescer cartridge is that the gas velocity can be more easily adjusted in the annulus by selecting the optimum housing diameter to prevent re-entrainment of coalesced droplets.

As the gas leaves the coalescer cartridge and travels upward in the annulus it contributes to the total flow, thereby increasing the annular velocity. The annular velocity is modeled as a linear function with vertical distance, and the annular velocity is zero at the bottom of the cartridge and increases to a maximum value at the top of the cartridge.

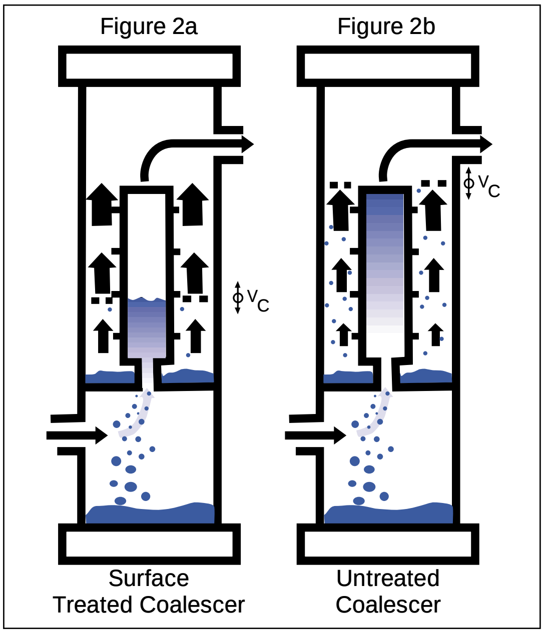


Figure 2a and 2b
Effect of Surface Treatment on Annular Velocity

Once the coalesced droplets are formed, they immediately drain vertically downward in the coalescer medium pack. The surface treatment greatly enhances this drainage and, as a direct consequence of the treatment, the coalesced droplets are shielded from the upward gas flow in the annulus in most of the length of the coalescer cartridge. The coalesced droplets are first exposed to the annular gas flow when they appear on the external face of the coalescer medium pack at the bottom third of the coalescer cartridge (See Figure 2a). Once the coalesced droplets are released to the annular space they are subject to the force of the upward flowing gas. The trajectory of the coalesced droplets is modeled on a force balance between gravity settling and the drag force created by the gas flow past the droplets. This analysis leads to the calculation of a critical annular velocity for re-entrainment.

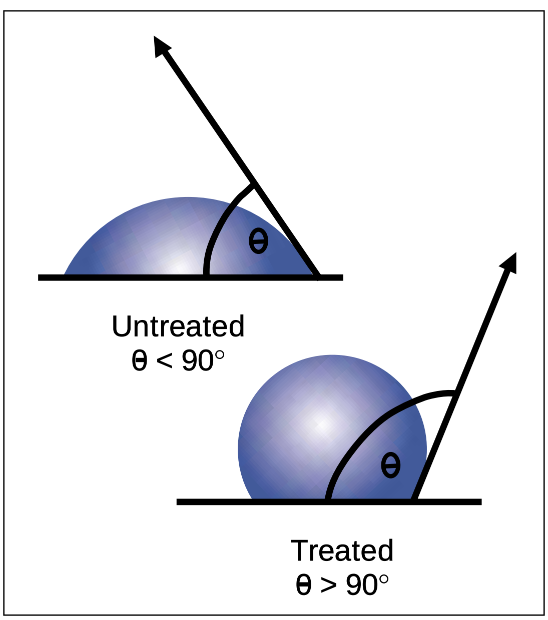
Due to the surface treatment, there are minimal coalesced droplets present in the annulus above the drainage point at the bottom third of the coalescer cartridge. For a coalescer cartridge that is not specially surface treated, the coalesced liquids are present throughout the length of the coalescer in the annulus space and the critical annular velocity for re-entrainment is given for the top of the element (See Figure 2b). For the treated coalescer, it is allowable to have annular velocities greater than the critical value for re-entrainment in the portion of the annulus space where there are no liquids present. This allows the maximum annular velocity at the top of the coalescer cartridge to be about three times the critical re-entrainment value needed at the vertical position of the lower one-third of the cartridge height where liquids are present.

Therefore, the maximum annular velocity at the top of the coalescer cartridge is found to be about three times greater than the value for an untreated coalescer. The annulus area is determined using the maximum allowable annular velocity and designed to be of sufficient size to prevent re-entrainment and as small as possible to minimize the housing diameter.

The liquid/gas coalescer is constructed of an inner rigid stainless steel core around which is placed the active pleated glass fiber coalescer medium. The pore structure in the coalescer medium is tapered by using layers of increasing pore size. The inlet gas first encounters the smallest pores that increase with penetration distance to allow for more space as the coalesced droplets grow. The pleated coalescer medium is supported by a mesh structure to provide mechanical strength which is then followed by a coarse outer wrap which serves as a drainage zone. The entire coalescer cartridge is treated with an aqueous fluorocarbon emulsion which penetrates through the depth of the glass fiber coalescer medium and drainage layers leaving a thin fluorocarbon coating on all of the surfaces. The result is that the surface energy of the coalescer medium is lowered sufficiently to prevent most liquids from wetting out the coalescer fibers.

This treatment effectively creates a coalescer medium which is both hydrophobic (water repellent) and oleophobic (oil repellent). This effect can be characterized through use of contact angle measurements. In Figure 3, a droplet is placed on a surface treated glass fiber and an untreated glass fiber. The degree at which the droplet is spread out or wetted is measured by the contact angle of the liquid with the solid. For drops which are not strongly adsorbed to the solid surface, the contact angle is greater than 90 degrees while the untreated wetted surface has a contact angle approaching zero degrees. Another way to demonstrate this effect is to dip a section of the coalescer medium into a test liquid and compare to an untreated coalescer section. The treated coalescer medium quickly sheds the liquid, while the untreated coalescer medium absorbs the liquid and acts as a sponge.

Figure 3
Contact Angle of Treated and Untreated Coalescer Medium

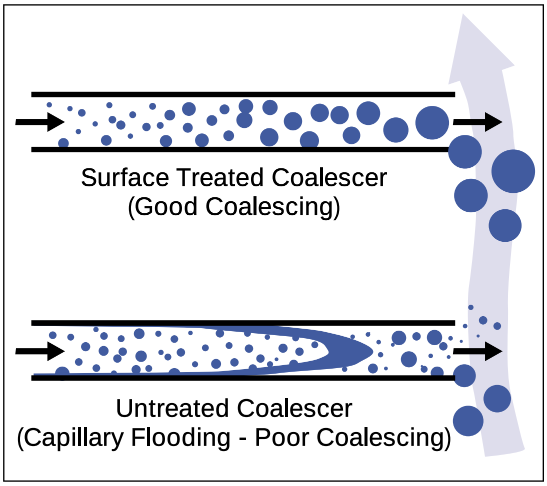


The degree that the liquid aerosols wet out the coalescer fibers has remarkable effects on coalescer performance. One such effect is capillary flooding which is illustrated in Figure 4. Liquid aerosols entering an idealized cylindrical pore made from untreated coalescer medium result in the liquids forming a continuous layer along the walls of the capillary. As more liquids enter the pore, the liquids coating the pore walls build up and eventually block the pore completely. The gas pressure then rises in the pore and ultimately causes the drop to be ejected from the pore in such a manner that the drop is atomized into a number of smaller droplets. These droplets are smaller than the largest drop size possible by coalescence, and are re-entrained by the annular flow. A surface treated coalescer pore behaves quite differently, and the liquids do not wet the capillary walls due to the weak interaction between the liquid aerosols and the surface treated pore walls. The drops instead tend to coalesce with each other throughout the length of the pore, and when they leave the coalescer medium are at the largest possible size by coalescence. The large drops then settle by gravity and are not re-entrained. Notice in the case of the treated coalescer pore that the walls of the pore do not become wetted out, and that the capillary cross section is never blocked so that atomization does not occur.

Another effect of the surface treatment is that it provides the coalescer with anti-fouling abilities. Most of the solids in the gas are associated with the liquid aerosol droplets. The ability of the surface treated coalescer to repel these droplets and not wet out also prevents solid contaminants from adhering to the coalescer fibers. This allows the coalescer to provide an extended service life over non-treated coalescers. Typical field service life encountered for the surface treated coalescer is from 1 - 2 years while traditional coalescers have been found in specific cases to last from 2 - 6 months.

The surface treatment also allows the coalescer to operate with less hold up volume of liquids as they tend to drain quickly due to the low attraction between the coalescer fibers and the liquid drops forming. The result is that a less obstructed pathway is created for the gas passing through the coalescer and, consequently, a lower overall pressure drop is experienced as compared to untreated coalescers.

Figure 4
Effect of Surface Treatment on Media Velocity



The primary effect of the surface treatment is to enhance drainage of the coalesced liquids. This results in improved capability to handle higher inlet liquid concentrations, higher annular velocities and lower pressure drop.

Modeling the Liquid/Gas Coalescer

The modeling of the liquid/gas coalescer system can be divided into two basic aspects for performance: media velocity and annular velocity. The other consideration to be taken into account is pressure drop. The pressure drop for a given system can be decreased by using more coalescer elements.

Media Velocity

The media velocity (v_{med}) is defined as the actual flow rate divided by the coalescer filter area:

$$V_{med} = Q_a/NA_{med} \qquad (1)$$

where: Q_a = actual system flow rate (at system conditions)

N = number of coalescers

A_{med} = media area for one coalescer

and Q_a is obtained from the standard system flow rate (Q_s):

$$Q_a = Q_s Sg\rho_{air,stp}/\rho_g \qquad (2)$$

where: Sg = gas specific gravity

$\rho_{air,stp}$ = density of air at standard temperature and pressure

ρ_g = density of gas at system conditions

The media velocity is not the actual velocity through the open pores of the media, but rather an average by convention over the combined pore area and solid matrix area in the spatial plane normal to the flow direction. The maximum media velocity for a coalescer construction is related to a number of factors intrinsic to the particular coalescer design and to the physical properties of the system. Four steps have been identified with the mechanism of the formation and removal of droplets in the coalescer medium:

1) capture
2) coalescing
3) release
4) drainage

The formation of the coalesced droplets first involves the capture of the small aerosols onto the fibers of the coalescer medium. The actual coalescing or merging of the fine droplets is believed to take place on the fibers and especially at fiber intersections. The coalesced droplets are then released from the fiber due to the drag force of the gas flow exceeding the adsorption energy. This process is repeated through the depth of the coalescer medium until the coalescing process is completed and the largest possible stable droplet size is achieved. During the coalescing stages, the growing droplets are also draining downward inside the media pack due to the force of gravity.

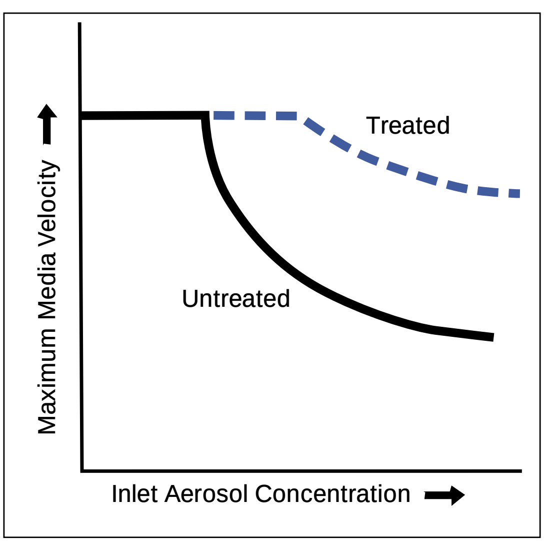
The surface treatment allows the release and drainage process to proceed at a faster rate which, in turn, frees up more coalescing sites on the fibers and allows the coalescer to process higher inlet liquid aerosol concentrations than the untreated coalescer medium.

Effect of System Conditions on Media Velocity

The ability of the coalescer medium to perform effectively will also depend on the system environment. While different coalescer constructions will exhibit quantitative differences, they will follow the same qualitative behavior. The media velocity has been determined to depend on system parameters such as inlet aerosol concentration, aerosol density, gas density, and gas viscosity. An analysis of how the inlet liquid aerosol concentration affects the maximum media velocity is presented in Figure 5 for surface treated and untreated coalescer media.

At low aerosol concentrations, the maximum media velocity is constant and is unaffected by aerosol levels. Under these conditions the media is limited by the capture mechanism and is not affected by drainage. At higher levels of aerosol concentration, the coalescer medium becomes limited by drainage and is inversely proportional to the aerosol concentration. The effect of the surface treatment on this process is to enhance the drainage and allow for higher maximum media velocities under the same aerosol loading when limited by drainage. The plot of the surface treated coalescer media is based on an increase in drainage ability of about threefold. The effect of the increased drainage of the surface treatment is to extend the constant portion of the plot and raise the drainage limited curve to three times the untreated value.

Figure 5
Effect of Surface Treatment and Liquid Loading on Media Velocity



Annular Velocity

The annular velocity (v_{ann}) is defined as the actual flow rate divided by the annulus area:

$$v_{ann} = Q_a/A_{ann} \qquad (3)$$

where: A_{ann} = cross sectional annular area defined as the cross sectional area of the housing without coalescers minus the area of the coalescer end caps:

$$A_{ann} = \pi R_h^2 - N\pi R_c^2 \qquad (4)$$

where: π = numerical constant (3.14....)
R_h = radius of the housing
R_c = radius of coalescer end cap
N = number of coalescers

The enlarged droplets leaving the coalescer media pack can be assumed to be as large as possible for the given flow conditions when complete coalescence has occurred. Therefore, the coalesced droplet diameter will be the same for any specific design of the coalescer cartridge as long as complete coalescence has been achieved. If complete coalescence is not achieved, the calculation of the coalesced droplets must take into account the degree of coalescence.

In most industrial applications, the coalesced droplets will range in size from 0.5 - 2.2 mm and will be mostly influenced by the interfacial tension which is significantly affected by the liquid density, system temperature, and system pressure. As the pressure is increased, the gas density will increase while the liquid density is only slightly affected. The solubility of the gas in the liquid is enhanced with increasing pressure. This leads to a substantial decrease in interfacial tension with increasing pressure and, consequently, to significantly smaller coalesced droplets at the higher pressures.

Once the coalesced droplet size has been estimated, the next step is to determine the maximum annular velocity that can be sustained without re-entrainment. In general, the coalesced droplets will produce Reynolds numbers (Re) outside of the creeping flow regime (< 0.1) and Stokes law. Instead, a force balance is used between the liquid droplets settling by gravity and the drag force of the gas flowing upwards in the opposite direction.

Determination of Minimum Housing Diameter

The housing diameter is determined from the area of the annulus and the area of the coalescer end caps. The maximum annular velocity at the top of the coalescer cartridges is used to determine the annular area required. The value of the maximum annular velocity [v_{ann} (max)] at the top of the coalescer cartridges is dependent on the critical annular velocity for re-entrainment (v_c) and the vertical location at which the coalesced droplets are present in the free annulus space. This relationship can be described as follows:

$$v_{ann}\,(\max) = k_a v_c \qquad (5)$$

where: k_a = annular velocity enhancement factor due to drainage

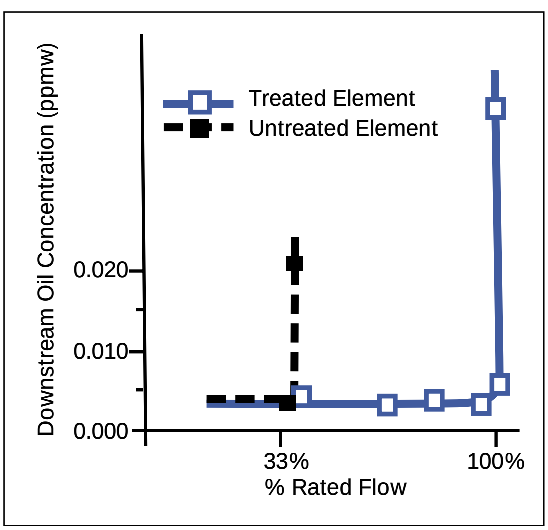


Figure 6
Laboratory Results for Treated and Untreated Liquid/Gas Coalescer Performance

For the untreated coalescer medium the coalescer cartridge is completely wetted and coalesced droplets are present in the annulus space up to the top of the annulus where the annular velocity is highest. There is no drainage enhancement and $k_a = 1$. The maximum annular velocity to prevent re-entrainment is then equal to the critical value for re-entrainment:

Untreated Coalescer:

$$v_{ann}\,(\max) = v_c \qquad (6)$$

The effect of the surface treatment is to greatly increase the drainage and the annular velocity at the top of the coalescer cartridge can now be significantly higher than the critical value since there are no coalesced droplets present in the annulus except in the bottom third of the cartridge. The maximum annular velocity is now determined with $k_a = 3.1$ as follows:

Surface Treated Coalescer:

$$v_{ann}\,(\max) = 3.1 v_c \qquad (7)$$

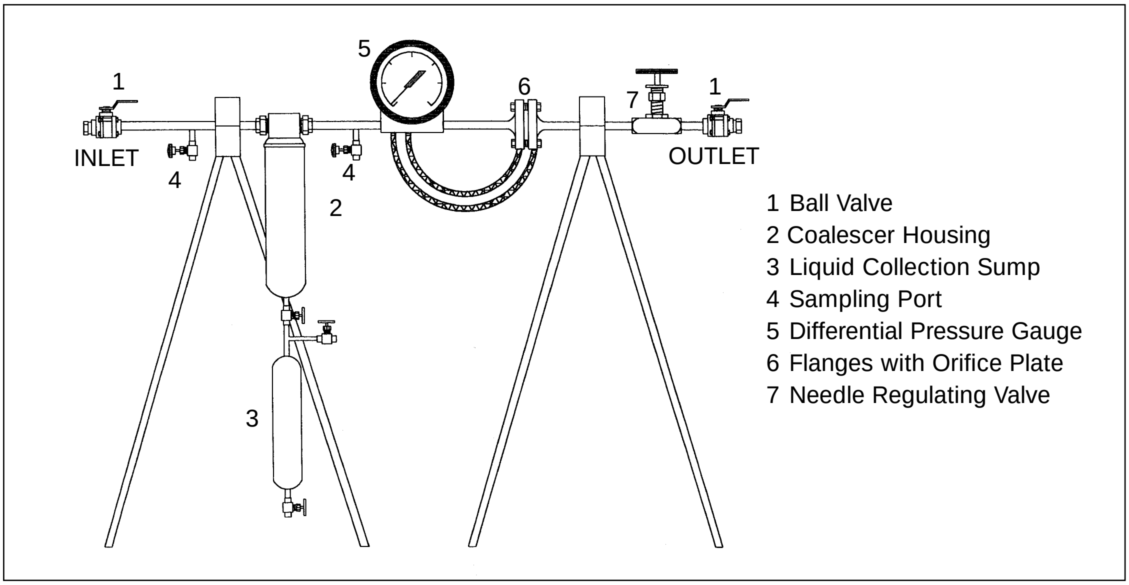
Convincing evidence for the enhanced maximum annular velocity given by equation (5) has been demonstrated by laboratory tests[6,7,8] and is presented in Figure 6. Visual observations during these tests also confirm that liquids are present on the outside of the coalescer pack only at the bottom third for the surface treated coalescer and are present throughout the length of the wetted untreated coalescer.

Pilot Scale Liquid/Gas Coalescer Tests

A pilot scale Pall high performance liquid/gas coalescer was used to sample a sidestream of gas to determine the liquid aerosol concentration.

A schematic of the coalescer test stand is presented in Figure 7. The test apparatus consisted of a Pall Coalescer test housing that held a five inch length test coalescer. The test stand was equipped with needle valves and an orifice meter to control the gas flow rate.

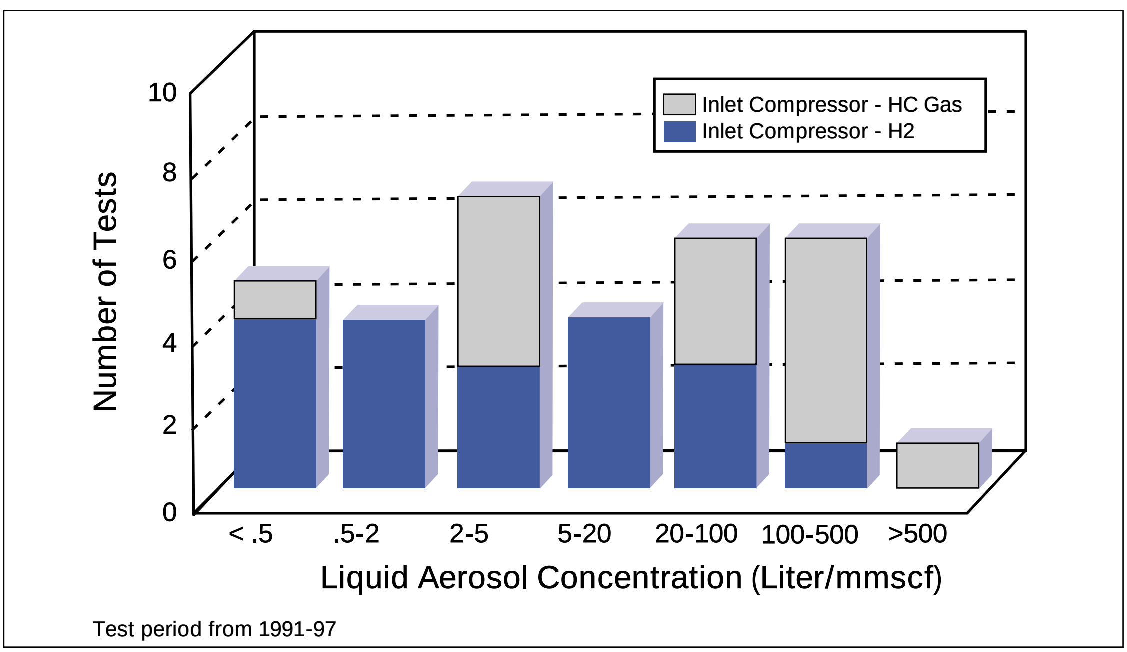
Figure 7
Pall Pilot Scale Liquid/Gas Coalescer Test Equipment



The test equipment had been pressure tested up to 1,500 psig and contained 1″ stainless steel tubing and NPT end connections. A computer sizing program was used to correlate the differential pressure across the orifice plate to the gas flow rate. A small gas sidestream (approximately 4 acfm) was flowed through the test coalescers for the test period (1/2 - 2 days). The concentration of liquid aerosol removed from the inlet gas was then calculated from the amount of gas flowed through the test stand and the volume of liquid collected.

The solid aerosol content in the gas was determined by an in-line field test method whereby gas solids were collected on analysis membranes at system conditions. Test apparatus consisted of a 47 mm test jig, metering valves, pressure gauge, and a spring loaded flow meter to control the gas flow. The test jig was loaded with a pre-weighed analysis membrane rated at 0.01 μm in gas service. The gas was flowed through the test jig at approximately 1 acfm for 4-8 hours to trap gas contaminants. The sampled gas analysis membranes were then placed in a filtration funnel and rinsed with 0.2 μm filtered solvents by the application of vacuum to remove any oil or liquid contaminants. The rinsed membranes were then dried in an oven at 80°C, desiccated and brought to constant weight. The total suspend-

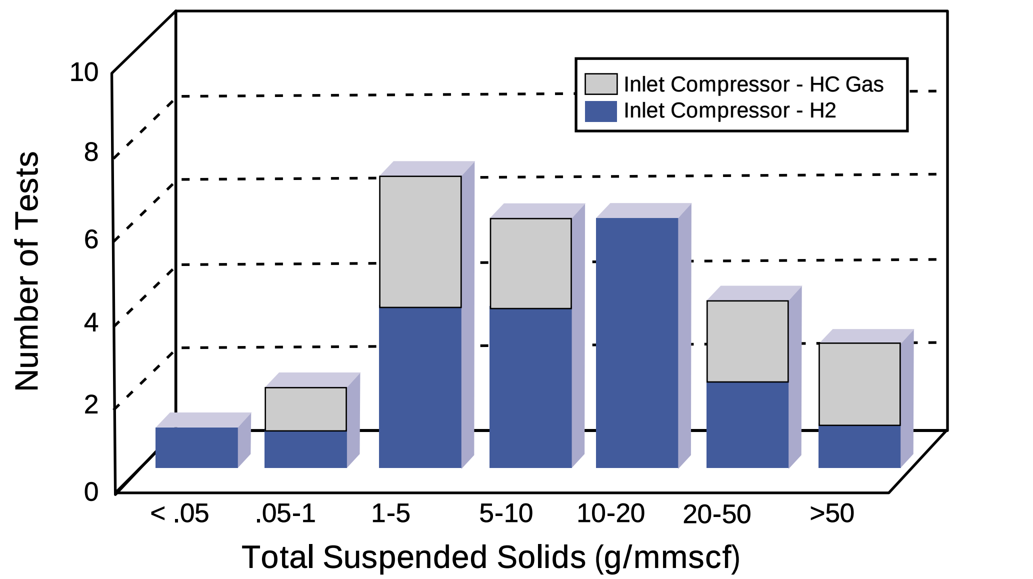
Figure 8
Pall Sidestream L/G Coalescer Field Test Results at Inlet to Compressor



ed solids were determined from the membrane weight difference and the total amount of gas flowed through the test jig.

Field data collected at the inlet to compressors from gas processing plants, gas transmission stations, and refineries are presented in Figures 8-9. The data shows that high levels of solids and liquids are challenging compressors in actual service. The liquids were found to range from < 0.5 liter/mmscf to > 500 liter/mmscfd with most of the tests in the range of 2 – 500 liter/mmscfd. The solids were found to vary from < .05 g/mmscf to > 50 g/mmscf with most of the tests indicating solids in the range of 1 to 50 g/mmscf. These tests were conducted downstream of multiple separation devices including knock out pots, filter-vane separators and mesh pads. The field tests for the liquid content were run over extended periods up to two days, and this was found to be crucial in obtaining representative data as fluctuations in the gas contaminant levels are commonplace in gas streams.

Figure 9
Pall Solid Concentration Field Test Results at Inlet to Compressor



Test period from 1991-97

Commercial Equipment

Application of the high efficiency liquid/gas coalescer to three different applications are presented below:

Case 1:
North Sea Offshore Platform

An Offshore Platform in the North Sea has been operated by an alliance team that processes approximately 363,000 kg/hr of Natural Gas at 45.5 bar absolute and 32°C. The platform has successfully operated for a number of years supplying gas to the UK using a centrifugal compressor.

Problem

Costly maintenance to the compressor system was a major drawback and the alliance decided that improved liquid/gas separation was required to alleviate this situation. The platform compressor was being challenged with natural gas that contained a high concentration of produced water from the wells. This water was saturated with salt that ultimately crystallized in the compressor causing it to trip-out. Each incident required costly cleaning, rebuilding and, most importantly, off-line time for the platform and the onshore processing plant in the UK. Approximately 0.5 tons of salt were deposited in the centrifugal compressor casing over an operating period of about six months.

The actual cost for this non-conformance, before installation of the Pall SepraSol™ high performance liquid/gas coalescer, is estimated to be upwards of $1,000,000/year, taking into account unscheduled repairs, lost sales gas production and the prospect of penalty payments as a direct result of the lost production.

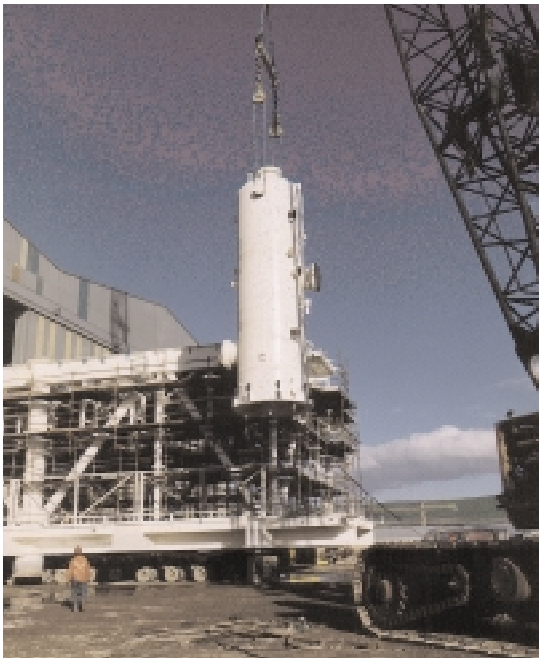


Figure 10
Liquid/Gas
Coalescer Unit

Solution

A Pall SepraSol high performance liquid/gas coalescer system was designed to reduce the inlet free liquid concentration of 1860 ppmw of produced water down to 0.003 ppmw in the effluent. A three stage system was used to achieve this separation performance goal while reducing the footprint and overall weight of the system. The separation system consisted of a single vertical vessel of approximately 2 meters diameter, with an overall height of 9.3 meters. A special mesh pad and 130 coalescing cartridges were used in the internals. The design code was BS5500, category 1 with 24 inch inlet and outlet nozzles.The final operational weight for the complete system was 77 tons. A photograph of the assembled liquid/gas coalescer unit prior to installation on the platform is provided in Figure 10.

As the gas first enters the vessel, free liquids with a diameter > 300 microns are separated in the lower sump by gravity. The second stage consists of a specially configured mesh pad to remove liquid droplets greater than about 10 micron. The liquids knocked out by gravity and the mesh pad are pooled together into the lower sump. The final gas treatment stage occurs in the upper section that contains the Pall SepraSol high performance liquid/gas coalescing cartridges. Here, the fine mist or sustainable aerosols in the range of 0.1 microns and larger are coalesced into large drops in the millimeter range that are subsequently separated by gravity into an upper sump. Both upper and lower sump are drained automatically using a level sensor and automated valves.

Since installation, the Pall liquid/gas coalescing system has worked flawlessly and has met the alliance's expectations. There have been no further instances of compressor trip-out or need for unscheduled maintenance, and the salt deposition problem has been completely eliminated, with complete user satisfaction.

Case 2:
USA Midwest Natural Gas Transmission

Process

A natural gas compressor station located in the USA Midwest contains two trains that process an estimated 14 mmscfd of gas. The compressors are of a reciprocating design and the natural gas is being fed to a triethylene glycol (TEG) dehydration plant to remove water vapor prior to sales distribution.

Problem

Solid and liquid aerosol contamination were passing through existing liquid/gas coalescers leading to fouling of the compressor valves and a resultant unscheduled shutdown for repairs. The cost to rebuild the compressor including downtime, labor, parts, and loss of production was in excess of $250,000. The existing coalescers were also being fouled requiring changeout every 6 - 8 weeks.

Solution

Pall SepraSol high performance liquid/gas coalescers were installed upstream of the compressor in the existing vessel that was 24 inches in diameter and held 19 coalescers. The high efficiency coalescers had a patented surface treatment that renders them oleophobic (oil repellent) and hydrophobic (water repellent). The result was that the new coalescers were able to effectively reduce the liquid and solid aerosol contaminant down to undetectable limits and also achieve a service life of 12-13 months. Since the installation of the high efficiency coalescers, the compressor has not had any unscheduled shutdowns and the gas transmission company decided to install Pall SepraSol liquid/gas coalescers in its other coalescing units.

Case 3:
Canadian Refinery: Recycle Hydrogen

Process

A reciprocating compressor is used in a recycle hydrogen gas stream at a Canadian refinery. The hydrogen is a feed to a high pressure hydrocracker with a flow rate of 57.5 mmscfd, a pressure of 1,800 psi and a temperature of 120°F. The gas originates from a platforming unit which also has a knockout pot containing a mesh pad liquid/gas separator.

Problem

Excessive liquid aerosols were being carried over from the platformer unit in the form of a fine hydrocarbon aerosol that was passing through the mesh pad/knockout separator. On occasion, upsets could also lead to the presence of ammonia chlorides in the aerosol stream as organic chlorides are injected into the platformer to enhance catalytic activity.

The reciprocating compressor on the hydrogen recycle stream was experiencing maintenance problems due to valve and cylinder fouling. This caused unscheduled shutdowns every 2-3 months. The fouling material was determined to be polymerized hydrocarbon sludge. Compressor repairs cost $375,000 annually and additional margin losses of $22,000 for each day of shutdown.

Solution

A Pall SepraSol high efficiency liquid/gas coalescer was installed upstream of the recycle compressor. This unit was constructed of carbon steel for a design pressure rating of 2,050 psig to ASME Code Section VIII, Div. 1, with a 12 inch diameter and 4 inch, 1500# RFWN flanges. The unit contained a lower knockout sump for any liquid slugs and an upper sump containing four high efficiency liquid/gas coalescers to separate the fine aerosol mist.The relatively small size of this coalescer installation represented a modest investment for the refinery. After the coalescer unit was installed the unscheduled compressor shutdowns were eliminated. The coalescer elements lasted an average of 8 - 12 months.

Conclusions

High performance liquid/gas coalescers can play a vital role in compressor protection. Some of the key points covered in this paper included:

1) A high level of compressor problems are caused by solid and liquid aerosol contaminants in the inlet gas.
2) Proper protection of the compressor with high efficiency liquid/gas coalescers can extend the service life between maintenance to two years.
3) Field test results at the inlet to compressor systems indicate that high levels of aerosol liquids and solids are passing through widely used separation equipment.
4) Improved separation can be achieved by high performance liquid/gas coalescers.
5) All coalescer systems are not the same - surface treatment has been found to substantially increase the separation capability of liquid/gas coalescers and extend their service life.
6) Commercial experience at three sites provided economic justification of using high performance liquid/gas coalescers.

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PALL Pall Corporation

O purificador de óleo mais avançado do mundo e fabricado pelo maior líder em purificação de óleo da história...

Pall HLP6 Purificador de óleo

*Filtration. Separation. Solution.*SM

Resultado de 30 anos de experiência no controle da água para circuitos de lubrificação e de controle hidráulico.

Com um design baseado em 30 anos de experiência em campo, o purificador de óleo Pall HLP6 combina a excelente eficiência dos purificadores de transferência em massa com um nível excepcional de confiabilidade e facilidade de uso.

A contaminação da água em sistemas de óleo é a responsável pela maior parte da manutenção e problemas operacionais de componentes críticos em circuitos de lubrificação e circuitos hidráulicos. Desde turbinas de geração de energia até máquinas de papel. Esses problemas incluem:

- Aumento da corrosão no sistema, especialmente nos mancais
- Aumento da oxidação do óleo e acúmulo de ácidos
- Resposta lenta dos sistemas de controle

Nossa experiência na área demonstra que a remoção de água livre nunca é suficiente: apenas as centrífugas e os filtros coalescentes não são capazes de proteger os mancais contra corrosão e degradação de fluidos.

Água livre e água dissolvida

Em um sistema de óleo comum, as variações de temperatura modificam constantemente o conteúdo da água dissolvida do óleo. No local do reservatório, é importante a remoção não somente da água livre, como também de uma grande porção da água dissolvida. Essa é a única maneira de garantir que a água livre não aparecerá quando o fluido atravessar as partes frias do sistema, especialmente quando um resfriador de óleo for usado no retorno para o reservatório.

Remoção de água livre em um óleo de turbina comum: o aspecto transparente mostra a inexistência de água livre

HLP6

Torre

A experiência da Pall é ilustrada com mais precisão pela torre de separação recém-projetada. Com anéis recém-projetados para garantir uma superfície máxima de troca entre o óleo e o ar, o purificador Pall HLP6 maximiza a eficiência da remoção de água, graças a uma maior transferência de massa.

Novo eliminador de névoa

O conjunto de aço inoxidável no topo da torre elimina a transferência de óleo e drena o óleo misturado de volta à torre.

O sistema de fornecimento de óleo

Elimina a possibilidade de transferência. A partir de uma bomba de entrada dedicada, o óleo é fornecido sob pressão através de um coletor recém-projetado. O fornecimento de óleo é independente da condição de pressão principal, para resultar em uma instalação flexível, com melhor eficiência e de fácil operação.

Controle de nível otimizado

A bomba de saída ajusta a taxa de fluxo continuamente para manter um nível ideal dentro da torre. As variações do nível de fluidos são praticamente eliminadas.

Operação sem supervisão

O purificador Pall HLP6 é totalmente controlado por PLC e projetado para operar completamente sem supervisão.

Novo design da bomba de vácuo em estilo garra

Como não é suscetível a transferência de óleo, a bomba somente precisa de pequenas manutenções a cada 365 dias.

O purificador de óleo Pall HLP6 vem equipado com a tecnologia de filtração Ultipleat® SRT da Pall, o que há de mais recente no controle de partículas.

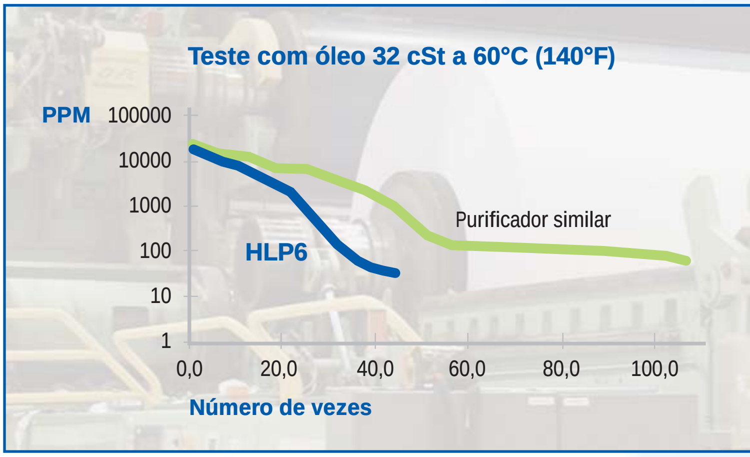
Com o sensor de água integrado da Pall, a condição da umidade do óleo pode ser monitorada constantemente, de forma fácil e precisa.

As opções para a instalação no chão, em rodízios ou conjunto completo de reboque tornam a instalação versátil (a opção do rodízio é exibida).

HLP6

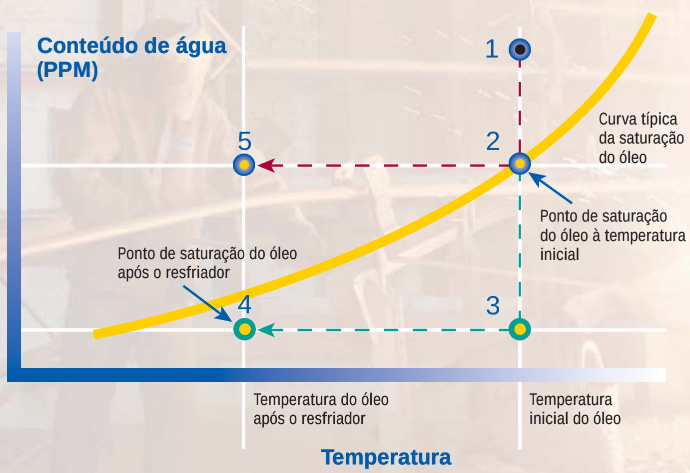
Desempenho

O purificador Pall HLP6 possui uma torre de vácuo que acabou de ser redesenhada, permitindo uma remoção muito eficiente da água. Ele foi projetado para remover 100% dos gases e água livres (sob condições estáveis), e até 80% dos gases e água dissolvidos. Também remove contaminantes sólidos com uma eficiência de 99,9% (até 3 mícrons).



O purificador de óleo HLP6 mostrou uma taxa de desidratação 40% mais rápida quando comparada com um purificador líder no mercado de tamanho similar.

A remoção de água livre nunca é suficiente!



1 O teor inicial de água está acima do nível de saturação (água livre).

2 A capacidade máxima de remoção de água por dispositivos de “remoção de água livre” (filtros coalescentes, centrífugas, etc.) chega ao ponto de saturação do óleo.

3 O teor de água atingido com a desidratação por transferência de massa encontra-se significantemente abaixo do ponto de saturação do óleo.

4 O teor de água atingido com a desidratação por transferência de massa permanece abaixo do ponto de saturação do óleo, mesmo quando este é resfriado. Isto evita a formação de água livre prejudicial.

5 Se somente a água livre for removida à temperatura inicial, a quantidade de água livre prejudicial no óleo pode aumentar significantemente quando este for resfriado.

O controle da água dissolvida e também da água livre no reservatório é importante para garantir a ausência de água livre durante a operação. Com o purificador Pall HLP6, isso é feito de forma eficiente, fácil e confiável.

HLP6

Informações para pedidos

HLP6	Tabela 1	Tabela 2	Tabela 3	Tabela 4	Tabela 5	Tabela 6
	Tensão	Filtro	Selos	Instalação	Sensor de água	Idioma

Tabela 1: Opções de voltagem

W	480V - 60Hz - 3P (padrão)
1	575V - 60Hz - 3P
R	380V - 50Hz - 3P

Tabela 2: Opções do elemento filtrante

Código	$\beta x(c) \geq 1000$ com base na ISO 16889	Classificação CST*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

*CST: Teste de estabilização cíclica (Cyclic Stabilization Test) para determinar a classificação do filtro sob condições de estresse com base no SAE ARP4205

Tabela 3: Material de vedação

Z	Fluorocarbono (padrão)

Tabela 4: Configuração de instalação

C	Rodízios (padrão)
F	Instalação no chão (sem rodízios)
P	Conjunto de reboque

Tabela 5: Opção do sensor de água

W	WS10 Sensor de água

Tabela 6: Idioma

E	Inglês (padrão)

Peças de reposição	Código da peça Pall
Filtro de polimento	UE319A*20Z
Filtro coalescente de exaustão	OL4C (cat# 1305787)
Filtro de Ar	HC0293SEE5

Especificações

Vazão	6 GPM (22.7 l/min) at 60Hz
Viscosidade	3 cSt to 1000 cSt
Material de vedação	Fluorocarbono
Líquidos compatíveis	Líquidos derivados do petróleo e sintéticos.
Temperatura de operação	
Temperatura máxima de entrada do fluido	76°C (170°F)
Temperatura ambiente	de 3,9°C a 40,6°C (39°F a 105°F)
Proteção	NEMA 4 (IP65)
Códigos da tubulação	De acordo com a ANSI B31.1 – Power Piping Code (Código da tubulação de energia) De acordo com a ANSI B31.3 – Process Piping Code (Código da tubulação do processo)
Dimensões	72” A x 48” C x 32” L 183 cm A x 122 cm C x 81{F0} {F1}cm L (mesmas dimensões, com ou sem rodízios)
Peso	521 Kg (1150 lbs)
Conexões	Entrada – 1,5” FNPT Saída – 1,0” FNPT
Pressão de entrada	de -14” Hg a 10 PSI (-0,47 bar a 0,69 bar)
Pressão máxima de saída	80 Psig (5,5 barg)
Aquecedor	4KW Controlado por PLC
Esquema de pintura	Revestido por pó (adequado para serviços industriais com ésterfosfato)
Filtros	Filtros Pall da série SRT 319, cartucho de 20”, disponíveis a partir de 3 até 22 mícrons com eficiência de retenção de 99,9%

HLP6

Mais de 30 anos de experiência reunidos em uma das máquinas mais confiáveis que existe!

APLICAÇÕES ATENDIDAS

Geração de energia

- Óleo lubrificante da turbina principal
- Reservatório da bomba de alimentação da caldeira
- Óleo do transformador
- Sistemas EHC

Papel e celulose

- Lubrificante da parte molhada e do secador
- Lubrificante da seção das prensas e partes hidráulicas
- Lubrificante das turbinas a vapor e partes hidráulicas

Siderurgia

- Parte hidráulica do controle automático do regulador do moinho de cilindros
- Sistemas de lubrificação da engrenagem e do pinhão do moinho de cilindros
- Sistemas de lubrificação do retificador de cilindros

Industrial leve

- Recuperação do óleo a granel
- Modelagem por sopro
- Modelagem por injeção
- Óleos hidráulicos da máquina ferramenta
- Óleos hidráulicos da linha de transferência automotiva

Combustíveis e produtos químicos

- Caixas de engrenagem do extrusor
- Óleo lubrificante do compressor e da turbina
- Reservatório da bomba de alimentação da caldeira

PRINCIPAIS VANTAGENS

Melhorar o desempenho do sistema

- Menos atrasos operacionais dispendiosos
- Maior confiabilidade do sistema
- Menor tempo de parada como consequência das interrupções de serviço
- Consegue trabalhar usando óleos de maior viscosidade (até 1.000 cSt)
- Menor consumo de energia

Maior vida útil do fluido

- Grande redução das trocas de óleo devido à contaminação

Menor desgaste do sistema

- Menor frequência nas trocas de componentes
- Menor estoque de peças

Custos reduzidos para o descarte de fluidos

- A necessidade de descartar fluidos contaminados é reduzida visivelmente
- Custos reduzidos com o descarte de óleo usado

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IMHLP6BP Impresso nos EUA Novembro de 2009

Pall Corporation

From the historical leader in oil purification comes the most advanced oil purifier in the world...

Pall HLP6 Oil Purifier

*Filtration. Separation. Solution.*SM

The culmination of 30 years of expertise in water control for lubrication and hydraulic control circuits

With a design based on 30 years of actual field experience, the Pall HLP6 oil purifier combines the excellent efficiency of mass transfer purifiers with an exceptional level of reliability and ease of use.

Water contamination in oil systems is responsible for major maintenance and operational problems of critical components in lubrication and hydraulic circuits. From power generation turbines to paper machines, these problems include:

- Increased corrosion in the system, especially at bearing locations
- Increased oil oxidation and acid build-up
- Sluggish response of control systems

Our experience in the field has shown that it is never enough to remove free water: centrifuges and coalescers alone cannot protect bearings against corrosion and fluid degradation.

Free water and dissolved water

In a typical oil system, temperature swings constantly change the dissolved water content of the oil. At the reservoir location it is critical to remove not only free water, but also a large portion of dissolved water. This is the only way to ensure that free water will not appear when the fluid goes through the cool parts of the system, especially when an oil cooler is used downstream of the reservoir.

Free water removal in typical turbine oil: bright clear aspect shows absence of free water

HLP6

Tower
Pall expertise is best illustrated by the newly designed separation tower. Packed with newly designed rings to ensure maximum exchange surface between oil and air, the Pall HLP6 purifier maximizes water removal efficiency thanks to higher mass transfer.

New mist eliminator
Stainless steel packing at the top of the tower eliminates oil carryover and drains the coalesced oil back into the tower.

Oil delivery system eliminates carryover potential. From a dedicated inlet pump, the oil is delivered under pressure through a newly designed manifold. The oil delivery is independent of head pressure condition, for a very flexible installation, better efficiency and easy operation.

Optimized level control
The outlet pump continuously adjusts flow rate to maintain the optimum level inside the tower. Fluid level trips are virtually eliminated.

Unattended operation
The Pall HLP6 purifier is fully PLC controlled and designed to operate totally unattended.

New claw style vacuum pump design
Not susceptible to oil carryover, the pump only needs minor maintenance every 365 days.

The Pall HLP6 oil purifier comes equipped with Pall's Ultipleat® SRT filtration technology for ultimate particle control.

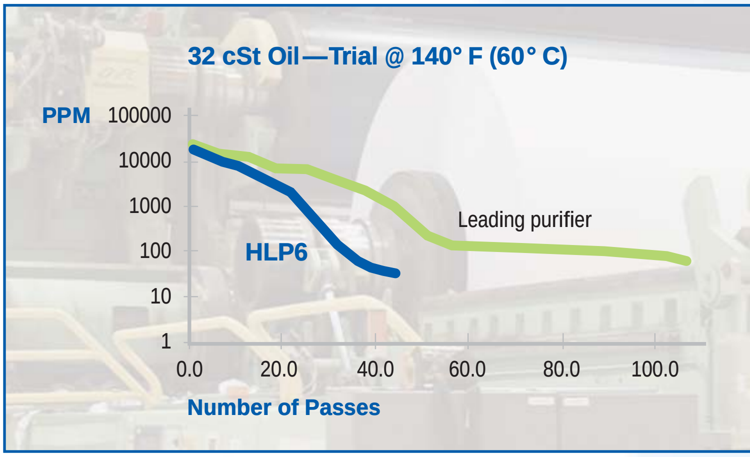
Floor mount, caster, or complete tow package options make for versatile installation (caster option shown).

With Pall's integrated water sensor, oil moisture condition can be continuously monitored, easily and precisely.

HLP6

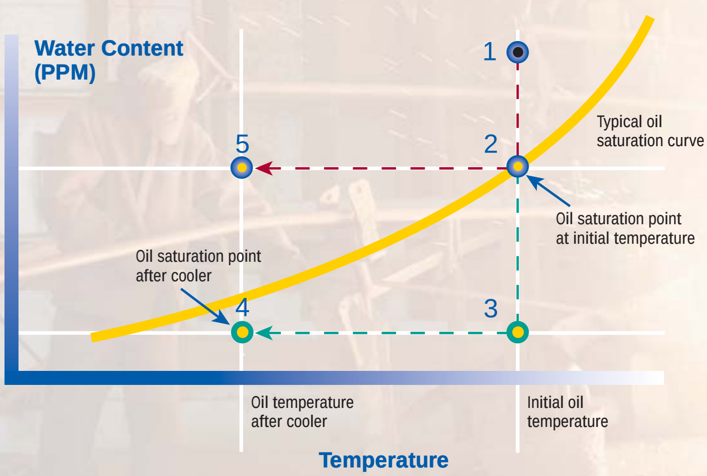
Performance

The Pall HLP6 purifier has a newly redesigned vacuum tower which allows for very efficient water removal. It is designed to remove 100% of free gases and water (under steady state conditions), and up to 80% of dissolved gases and water. It is also designed to remove solid contaminants, with efficiency of 99.9% (down to 3 microns).



The HLP6 oil purifier showed a 40% faster dehydration rate when compared to a leading, similarly sized purifier.

Removing free water is never enough!



1 Initial water content is above saturation (free water).

2 Maximum water removal capability of “free water removal” devices (coalescers, centrifuges, etc.) is to the oil’s saturation point.

3 Water content achieved with mass transfer dehydration is significantly below the oil’s saturation point.

4 Water content achieved with mass transfer dehydration remains below the oil’s saturation point even after oil is cooled. This prevents the formation of harmful free water.

5 If only free water is removed at initial temperature, when oil is cooled the amount of harmful free water in the oil can increase significantly.

Controlling the dissolved as well as the free water in the reservoir is critical in ensuring the absence of free water during operation. With the Pall HLP6 purifier, this is done efficiently, easily, and reliably.

HLP6

Ordering Information

HLP6	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
	Voltage	Filter	Seals	Mounting	Water Sensor	Language

Table 1: Voltage Options

W	480V - 60Hz - 3P (standard)
1	575V - 60Hz - 3P
R	380V - 50Hz - 3P

Table 2: Filter Element Options

Code	ßx(c) ≥ 1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

*CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 3: Seal Material

Z	Fluorocarbon (standard)

Table 4: Mount Configuration

C	Caster Wheels (standard)
F	Floor Mount (no casters)
P	Tow Package

Table 5: Water Sensor Option

W	WS10 Water Sensor

Table 6: Language

E	English (standard)

Spare Parts	Pall Part Number
Polishing Filter	UE319A*20Z
Exhaust Coalescer	OL4C (cat# 1305787)
Air Breather	HC0293SEE5

Specifications

Flow rate	6 GPM (22.7 l/min) at 60Hz
Viscosity range	3 cSt to 1000 cSt
Seal Material	Fluorocarbon
Fluid compatibility	Petroleum and synthetic based fluids.
Working Temperature Range	
Inlet Fluid Temperature	170°F (76°C) maximum
Ambient Temperature	39°F to 105°F (3.9°C to 40.6°C)
Enclosure	NEMA 4 (IP65)
Piping Codes	Conforms to ANSI B31.1 – Power Piping Code Conforms to ANSI B31.3 – Process Piping Code
Dimensions	72” H x 48” L x 32” W 183 cm H x 122 cm L x 81 cm W (same dimensions with or without casters)
Weight	1150 lbs (521 Kg)
Connections	Inlet – 1.5” FNPT Outlet – 1.0” FNPT
Inlet Pressure Range	-14” Hg to 10 PSI (-0.47 bar to 0.69 bar)
Maximum Outlet Pressure	80 Psig (5.5 barg)
Heater	4KW PLC Controlled
Paint Scheme	Powder-coated (suitable for industrial phosphate ester service)
Filtration	Pall’s SRT filter series 319, 20” cartridge, from 3 to 22 microns available at 99.9% efficiency

HLP6

Over 30 years of experience condensed into one of the most reliable machines ever!

APPLICATIONS SERVED

Power Generation
- Main turbine lube oil
- Boiler feed pump reservoir
- Transformer oil
- EHC systems

Pulp and Paper
- Wet end/dryer lube
- Press section lube and hydraulics
- Steam turbine lube and hydraulics

Primary Metals
- Roll mill automatic gauge control hydraulics
- Roll mill gear and pinion lube systems
- Roll grinder lube systems

Light Industrial
- Bulk oil reclamation
- Blow molding
- Injection molding
- Machine tool hydraulic oils
- Automotive transfer line hydraulic oils

Fuels and Chemicals
- Extruder gear boxes
- Compressor and turbine lube oil
- Boiler feed pump reservoir

KEY ADVANTAGES

Improved System Performance
- Fewer costly operational delays
- Increased system reliability
- Less downtime resulting from service interruptions
- Can work on higher viscosity oils (up to 1,000 cSt)
- Lower power consumption

Extended Fluid Life
- Greatly reduced oil change outs due to contamination

Reduced System Wear
- Less frequent component changes needed
- Smaller parts inventory required

Reduced Fluid Disposal Costs
- Sharply reduced need to dispose contaminated fluids
- Reduced waste oil disposal costs

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Pall Corporation

Le purificateur d'huile le plus innovant au monde par le leader historique dans la purification de l'huile...

Pall HLP6 Purificateur d'huile

*Filtration. Separation. Solution.*SM

L'aboutissement de 30 années d'expertise dans le contrôle de l'eau pour les circuits de contrôle hydraulique et de lubrification

Fruit de 30 années d'expérience sur le terrain, le purificateur d'huile Pall HLP6 allie l'excellence des purificateurs à transfert de masse à un niveau de fiabilité et de facilité d'utilisation exceptionnel.

La pollution aqueuse dans les circuits d'huile est à l'origine de la plupart des problèmes de fonctionnement et de maintenance des composants critiques des circuits hydrauliques et de lubrification. Des turbines génératrices de courant aux machines à papier, ces problèmes incluent :

- L'augmentation de la corrosion dans le système, en particulier au niveau des roulements
- L'augmentation de l'oxydation de l'huile et de la production d'acide
- La lenteur de réponse des systèmes de contrôle

Notre expérience dans le domaine nous a montré qu'il ne faut jamais se contenter d'éliminer seulement l'eau libre : les centrifugeuses et les coalesceurs ne peuvent, à eux seuls, protéger les roulements contre la corrosion et la dégradation des fluides.

Eau libre et eau dissoute

Dans un système d'huile typique, les oscillations de température modifient constamment la teneur en eau de l'huile. Au niveau du réservoir, il est primordial d'éliminer non seulement l'eau libre, mais également une grande partie de l'eau dissoute. C'est le seul moyen de garantir que l'eau libre ne réapparaîtra pas lorsque l'huile traversera les parties froides du système, en particulier lorsqu'un refroidisseur d'huile est utilisé en aval du réservoir.

Élimination de l'eau libre dans une huile pour turbine typique : l'aspect limpide et brillant de l'huile montre l'absence d'eau libre

HLP6

Tour
La nouvelle tour de séparation est l’illustration parfaite de l’expertise de Pall : le design innovant des anneaux du purificateur Pall HLP6 assure une surface d’échange maximale entre l’huile et l’air. L’élimination de l’eau est optimisée grâce au transfert de masse plus important.

Nouveau dévésiculeur
La garniture en acier inoxydable sur la partie supérieure de la tour élimine l’entraînement d’huile et renvoie l’huile coalescée dans la tour..

Système d’alimentation en huile
Élimination de tout risque d’entraînement. À partir d’une pompe d’alimentation dédiée, l’huile est fournie sous pression par l’intermédiaire d’un tout nouveau collecteur. L’alimentation en huile est indépendante de la condition de pression dans la tête pour une installation très flexible, une plus grande efficacité et un fonctionnement simple.

Contrôle de niveau optimisé
La pompe de refoulement règle le débit en continu pour maintenir le niveau optimal à l’intérieur de la tour. Les oscillations de niveau de fluide sont pratiquement éliminées.

Fonctionnement sans surveillance
Le purificateur Pall HLP6 est entièrement contrôlé par PLC pour un fonctionnement sans aucune surveillance.

Nouvelle pompe à vide multilobe au design innovant
Non sujette à l’entraînement d’huile, la pompe ne nécessite qu’un entretien mineur, tous les 365 jours.

Le purificateur d’huile Pall HLP6 est équipé de la technologie de filtration Pall Ultipleat® SRT pour un contrôle absolu des particules.

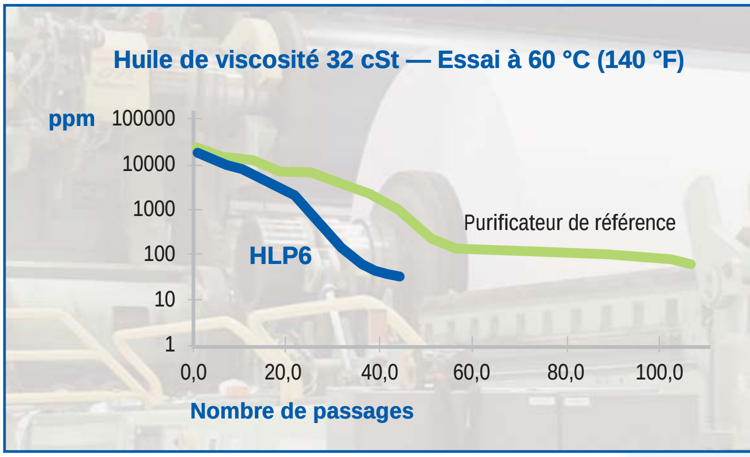
Disponible en montage au sol, à roulettes ou avec un système d'ancrage pour une installation polyvalente (le modèle à roulettes est présenté ici).

Le transmetteur d’humidité Pall intégré permet une surveillance continue, facile et précise du degré d’humidité de l’huile.

HLP6

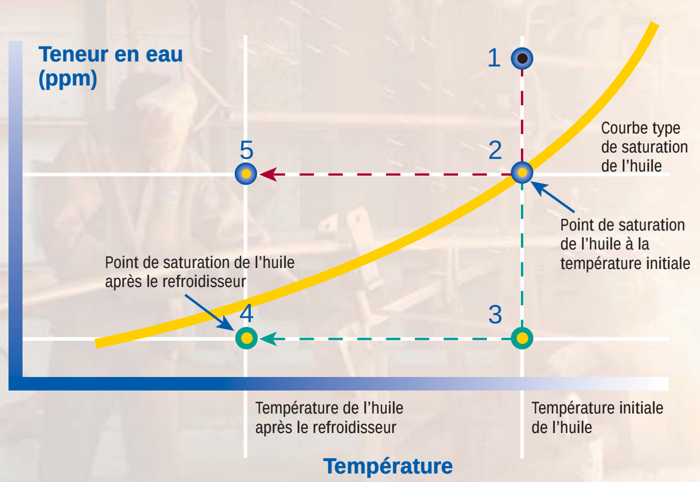
Performances

Le purificateur Pall HLP6 possède une nouvelle tour à vide qui permet une élimination très efficace de l'eau. Il est conçu pour éliminer 100 % de l'eau et des gaz libres (dans des conditions parfaitement stabilisées) et jusqu'à 80 % de l'eau et des gaz dissous. Il permet également d'éliminer les contaminants solides avec une efficacité de 99,9 % (jusqu'à 3 microns).



Le purificateur d'huile HLP6 a permis d'obtenir une déshydratation 40 % plus rapide qu'un purificateur de référence de taille similaire.

Ne jamais se contenter d'éliminer que l'eau libre !



1 La teneur initiale en eau est supérieure au point de saturation (eau libre).

2 La capacité maximale d'élimination d'eau des dispositifs d'élimination d'eau libre (coalesceurs, centrifugeuses, etc.) atteint le point de saturation de l'huile.

3 La teneur en eau obtenue par déshydratation par transfert de masse est significativement inférieure au point de saturation de l'huile.

4 La teneur en eau obtenue par déshydratation par transfert de masse reste inférieure au point de saturation de l'huile même après refroidissement de l'huile, empêchant ainsi la formation d'eau libre indésirable.

5 Si seule l'eau libre est éliminée à la température initiale, la quantité d'eau libre indésirable dans l'huile peut considérablement augmenter lorsque l'huile est refroidie.

Il est essentiel de contrôler à la fois la présence d'eau dissoute et d'eau libre dans le réservoir pour garantir l'absence d'eau libre en fonctionnement. Le purificateur Pall HLP6 permet d'y parvenir de manière efficace, facile et fiable.

HLP6

Information pour les commandes

HLP6 [Tableau 1] [Tableau 2] [Tableau 3] [Tableau 4] [Tableau 5] [Tableau 6]

	Tableau 1	Tableau 2	Tableau 3	Tableau 4	Tableau 5	Tableau 6
HLP6	Tension d'alimentation	Filtre	Joints	Configuration	Transmetteur d'humidité	Language

Tableau 1 : Choix de la tension d'alimentation

W	480 V - 60 Hz - 3P (standard)
1	575 V - 60 Hz - 3P
R	380 V - 50 Hz - 3P

Tableau 2 : Choix de l'élément filtrant

Code	ß x(c) ≥ 1000 selon ISO 16889	Valeur CST*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

*CST: Test de stabilisation cyclique réalisé d'après la norme SAE ARP4205

Tableau 3 : Matériau du joint

Z	Fluorocarbone (standard)

Tableau 4 : Configuration

C	À roulettes (standard)
F	Montage au sol (sans roulettes)
P	Système de remorquage

Tableau 5 : Choix du transmetteur d'humidité

W	Transmetteur d'humidité WS10

Tableau 6 : Langue

A	Anglais (standard)

Pièces de rechange	Référence Pall
Filtre de polissage	UE319A*20Z
Coalesceur d'échappement	OL4C (N° cat. 1305787)
Filtre à air	HC0293SEE5

Spécifications techniques

Débit	22,7 l/min (6 gpm) à 60 Hz
Plage de viscosité	3 cSt à 1 000 cSt
Matériau du joint	Fluorocarbone
Compatibilité des fluides	Fluides synthétiques et à base de pétrole (minérale)
Plage de la température de service	
Température d'entrée du fluide	76 °C (170 °F) maximum
Température ambiante	3,9 °C à 40,6 °C (39 °F à 105 °F)
Boîtier	NEMA 4 (IP65)
Codes de tuyauterie	Conforme à ANSI B31.1 – Power Piping Code (tuyauterie des installations d'énergie) Conforme à ANSI B31.3 – Process Piping Code (tuyauterie des raffineries de pétrole)
Dimensions	H 72" x L 48" x l 32" H 183 cm x L 122 cm x l 81cm (dimensions identiques avec ou sans roulettes)
Poids	521 Kg (1150 lbs)
Raccords	Entrée – 1,5" FNPT Sortie – 1,0" FNPT
Plage de pression d'entrée	-0,47 bar à 0,69 bar (-14" Hg à 10 psi)
Pression de sortie maximale	5,5 bar g (80 psi g)
Dispositif de chauffage	4 KW contrôlé par automate programmable (PLC)
Peinture	Revêtement avec peinture en poudre (adapté à une utilisation avec de l'ester phosphorique industriel)
Filtration	Filtres SRT Pall série 319, cartouche de 20", de 3 à 22 microns, avec une efficacité de 99,9 %

HLP6

Plus de 30 années d'expérience réunies dans l'une des machines les plus fiables à ce jour!

APPLICATIONS

Production d'énergie
- Système de lubrification de turbine
- Réservoir de pompe d'alimentation de chaudière
- Huile de transformateur
- Systèmes EHC

Pâte et papier
- Système de lubrification de la sécherie/partie humide
- Système de lubrification hydraulique pour la section des presses
- Système de lubrification hydraulique pour les turbines à vapeur

Métaux primaires
- Hydrauliques de contrôle de jauge automatique de laminoirs
- Systèmes de lubrification d'engrenages et de pignons de laminoirs
- Systèmes de lubrification pour rectifieuses

Industrie légère
- Régénération d'huile en vrac
- Moulage par soufflage
- Moulage par injection
- Huiles hydrauliques pour machines-outils
- Huiles hydrauliques pour lignes de transfert dans l'automobile

Carburants et produits chimiques
- Boîtes de transmission d'extrudeuses
- Huile de lubrification de turbines et de compresseurs
- Réservoir de pompe d'alimentation de chaudière

AVANTAGES CLÉS

Amélioration des performances des systèmes et composants
- Diminution des retards d'exploitation coûteux
- Meilleure fiabilité des systèmes et composants
- Réduction des temps de non production liés aux interruptions de service
- Compatible avec des huiles ayant une viscosité élevée (jusqu'à 1 000 cSt)
- Diminution de la consommation d'énergie

Augmentation de la durée de vie des fluides
- Diminution considérable des remplacements d'huile dus à la contamination

Réduction de l'usure des systèmes et composants
- Remplacements moins fréquents des composants
- Réduction des pièces en inventaire

Réduction des coûts d'élimination des fluides
- Réduction considérable de la nécessité d'éliminer les fluides contaminés
- Réduction des coûts d'élimination des huiles usées

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*Filtration. Separation. Solution.*SM

IMHLP6FR Imprimé aux États-Unis Novembre 2009

Pall Corporation

El líder histórico en purificación de aceite le presenta el purificador de aceite más avanzado del mundo...

Pall HLP6 Purificador de aceite

Filtration. Separation. Solution.SM

La culminación de 30 años de experiencia en control del agua para circuitos de lubricación y control hidráulico

Con un diseño basado en 30 años de experiencia real sobre el terreno, el purificador de aceite Pall HLP6 combina la excelente eficacia de los purificadores por transferencia de masa con un excepcional nivel de fiabilidad y facilidad de uso.

La contaminación de agua en los sistemas de aceite provoca importantes problemas operativos y de mantenimiento en componentes críticos de los circuitos de lubricación e hidráulicos. Desde turbinas de generación de electricidad hasta máquinas papeleras, estos problemas incluyen:

- Aumento de la corrosión en el sistema, especialmente en la posición de los rodamientos
- Aumento de la oxidación del aceite y de la acumulación de ácido
- Respuesta lenta de los sistemas de control

Nuestra experiencia en este ámbito nos ha demostrado que nunca es suficiente con eliminar el agua libre: las centrifugadoras y los filtros coalescentes solos no pueden proteger los rodamientos contra la corrosión y la degradación del fluido.

Agua libre y agua disuelta

En un sistema de aceite típico, las variaciones de temperatura cambian constantemente el contenido de agua disuelta en el aceite. En el depósito es fundamental eliminar no sólo el agua libre, sino también una gran parte del agua disuelta. Este es el único modo de asegurarse de que no aparezca agua libre cuando el fluido atraviese las partes frías del sistema, sobre todo cuando se utiliza un enfriador de aceite situado después del depósito.

Eliminación del agua libre en aceite de turbina típico: el aspecto brillante y transparente indica la ausencia de agua libre

HLP6

Torre

El mejor ejemplo de la experiencia de Pall es la torre de separación, con un nuevo diseño. Equipada con aros de nuevo diseño para obtener la máxima superficie de intercambio entre el aceite y el aire, el purificador Pall HLP6 maximiza la eficacia de eliminación del agua gracias a su mayor transferencia de masa.

Nuevo eliminador de niebla

El conjunto de acero inoxidable situado en la parte superior de la torre elimina el arrastre de aceite y vuelve a drenar el aceite producto de la coalescencia hacia la torre.

El sistema de suministro de aceite

elimina un potencial arrastre. Desde una bomba de entrada exclusiva, el aceite se suministra a presión a través de un colector de nuevo diseño. El suministro de aceite es independiente del nivel de presión para una instalación muy flexible, mayor eficacia y un uso sencillo.

Control de nivel optimizado

La bomba de salida ajusta continuamente el caudal para mantener el nivel óptimo en el interior de la torre, eliminando prácticamente los errores por nivel de fluido.

Funcionamiento sin vigilancia

El purificador Pall HLP6 está totalmente controlado por PLC y ha sido diseñado para funcionar sin ninguna vigilancia.

Nuevo diseño de la bomba de vacío de tipo mordaza

La bomba, no susceptible de arrastre de aceite, sólo precisa un pequeño mantenimiento cada 365 días.

El purificador de aceite Pall HLP6 viene equipado con la tecnología de filtración SRT Ultipleat® de Pall para el máximo control de las partículas.

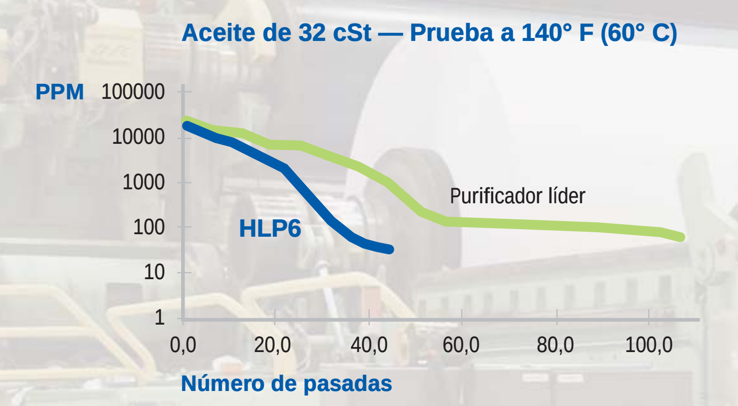
El sensor de agua integrado de Pall permite controlar de manera continua, sencilla y precisa el estado de humedad del aceite.

Las opciones de montaje sobre suelo, sobre ruedas o en un conjunto de remolque completo facilitan una instalación versátil (en la ilustración, la opción con ruedas).

HLP6

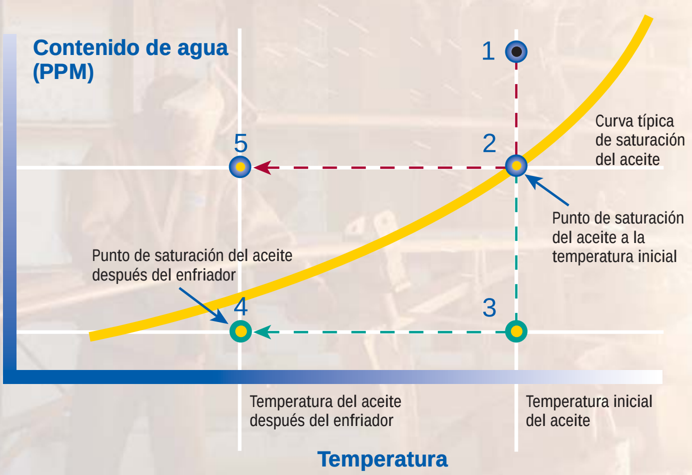
Eficiencia

El purificador Pall HLP6 posee una torre de vacío de nuevo diseño que permite una eliminación muy eficaz del agua. Ha sido diseñado para eliminar el 100% de los gases y el agua libres (en condiciones de estado estable) y hasta el 80% de los gases y el agua disueltos. También ha sido diseñado para eliminar los contaminantes sólidos con una eficacia del 99,9% (hasta 3 micras).



El purificador de aceite HLP6 ha demostrado una tasa de deshidratación un 40% más rápida que un purificador líder de tamaño similar.

¡La eliminación del agua libre nunca es suficiente!



1 El contenido de agua inicial se encuentra por encima de la saturación (agua libre).
2 La capacidad máxima de eliminación del agua de los dispositivos de “eliminación del agua libre” (filtros coalescentes, centrifugadoras, etc.) alcanza el punto de saturación del aceite.
3 El contenido de agua alcanzado con la deshidratación por transferencia de masa queda es muy inferior al punto de saturación del aceite.
4 El contenido de agua alcanzado con la deshidratación por transferencia de masa se mantiene por debajo del punto de saturación del aceite incluso una vez enfriado el aceite. Esto evita la formación de agua libre perjudicial.
5 Si sólo se elimina el agua libre a la temperatura inicial, cuando se enfría el aceite la cantidad de agua libre perjudicial en el aceite puede aumentar significativamente.

El control del agua disuelta además del agua libre en el depósito es fundamental para garantizar la ausencia de agua libre durante el funcionamiento. Con el purificador Pall HLP6 esto se consigue de una manera eficaz, sencilla y fiable.

Información para realizar pedidos

HLP6	Tabla 1	Tabla 2	Tabla 3	Tabla 4	Tabla 5	Tabla 6
	Tensión	Filtro	Juntas	Montaje	Sensor de agua	Idioma

Tabla 1: Opciones de tensión

W	480V - 60Hz - 3P (estándar)
1	575V - 60Hz - 3P
R	380V - 50Hz - 3P

Tabla 2: Opciones del Elemento Filtrante

Código	ßx(c) ≥ 1000 Basado en la norma ISO 16889	Nivel CST*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

*PEC (CST): Prueba de Estabilización Cíclica para determinar el rendimiento del filtro en condiciones de sobrecarga, de acuerdo con la norma SAE ARP4205

Tabla 3: Material de las juntas

Z	Fluorocarbono (estándar)

Tabla 4: Configuración de montaje

C	Sobre ruedas (estándar)
F	Montaje sobre suelo (sin ruedas)
P	Conjunto de remolque

Tabla 5: Opción de sensor de agua

W	Sensor de agua WS10

Tabla 6: Idioma

E	Inglés (estándar)

Piezas de repuesto	N.° de referencia de Pall
Filtro de pulido	UE319A*20Z
Filtro coalescente de escape	OL4C (cat. n.° 1305787)
Respiradero	HC0293SEE5

Especificaciones

Caudal	6 GPM (22,7 l/min.) a 60 Hz
Rango de viscosidad	De 3 cSt a 1000 cSt
Material de las juntas	Fluorocarbono
Compatibilidad con fluidos	Petróleo y fluidos de base sintética.
Rango de temperatura de operación	
Temperatura del fluido de entrada	170°F (76°C) máxima
Temperatura ambiente	De 39°F a 105°F (de 3,9°C a 40,6°C)
Carcasa	NEMA 4 (IP65)
Códigos para tuberías	Conforme a la norma ANSI B31.1— Código para tuberías de sistemas eléctricos Conforme a la norma ANSI B31.3 — Código para tuberías de procesos
Dimensiones	72” alto x 48” largo x 32” ancho 183 cm alto x 122 cm largo x 81 cm ancho (las mismas dimensiones con o sin ruedas)
Peso	1150 libras (521 kg)
Conexiones	Entrada – 1.5” FNPT Salida – 1.0” FNPT
Rango de presión de entrada	De -14” Hg a 10 PSI (de -0,47 bares a 0,69 bares)
Presión máxima de salida	80 Psig (5,5 barg)
Calentador	4 KW controlado por PLC
Pintura	En polvo (apto para servicio con éster-fosfato industrial)
Filtración	Filtro SRT de Pall serie 319, cartucho de 20”, de 3 a 22 micras, disponible con una eficacia del 99,9%

¡Más de 30 años de experiencia resumidos en una de las máquinas más fiables de todos los tiempos!

APLICACIONES DE USO

Generación de electricidad
- Aceite de lubricación de turbina principal
- Depósito de bomba de alimentación de caldera
- Aceite de transformador
- Sistemas de control electrohidráulico

Papel y pasta
- Lubricante de sección húmeda/secador
- Lubricante y sistema hidráulico de sección de prensas
- Lubricante y sistema hidráulico de turbina de vapor

Metales primarios
- Sistema hidráulico de control automático de calibre de laminador
- Sistemas de lubricación de engranaje y piñón de laminador
- Sistemas de lubricación de rectificadora

Aplicaciones industriales ligeras
- Recuperación de aceite a granel
- Moldeo por soplado
- Moldeo por inyección
- Aceites hidráulicos de máquinas herramienta
- Aceites hidráulicos de línea transportadora de automoción

Combustibles y productos químicos
- Cajas de engranajes de extrusoras
- Aceite lubricante de compresor y turbina
- Depósito de bomba de alimentación de caldera

PRINCIPALES VENTAJAS

Mejora del rendimiento del sistema
- Menos retrasos operativos costosos
- Mejora de la fiabilidad del sistema
- Menos paradas por interrupciones del servicio
- Funciona con aceites de mayor viscosidad (hasta 1.000 cSt)
- Menor consumo eléctrico

Prolongación de la vida útil del fluido
- Gran reducción de los cambios de aceite por causa de la contaminación

Menor desgaste del sistema
- Reducción de frecuencia de cambios de componentes
- Menor inventario de piezas requerido

Reducción de los costos de disposición final de fluidos
- Drástica reducción de la necesidad de eliminación de fluidos contaminantes
- Reducción de los costes de eliminación del aceite residual

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*Filtration. Separation. Solution.*SM

IMHLP6ES Impreso en los EE.UU. Noviembre 2009

Pall Corporation

IM006ENc

HNP006 Series

FLUID CONDITIONING PURIFIER

Fluid viscosities to 700cSt

Reliability of systems and the life of system components and fluids can be extended by minimizing water contamination.

The Pall HNP006 purifier is designed to remove water from oil in low volume systems or where access for conditioning equipment is limited.

Benefits

- **High-performance water, gas, and particulate removal**
- **Simple automated operation**
- **120V single phase electric connection**
- **Extended fluid life**
- **Minimized corrosion within systems**
- **Increased equipment reliability**
- **Reduced operating costs**

Pall HNP006 Portable Oil Purifier (front view)

Pall HNP006 Portable Oil Purifier (rear view)

Pall purifiers remove 100% of free water and in excess of 80% of dissolved water. They also remove 100% of free and entrained gases and in excess of 80% of dissolved gases.

The Pall HNP006 fluid conditioning purifier can be used as a fixed installation or portable unit that is easily removed and connected to any fluid system.

This compact purifier design is based on Pall's existing range of fluid conditioning products. Its size and weight allow for ease of handling through restricted openings and can be located close to existing systems where space is limited.

*Filtration. Separation. Solution.*SM

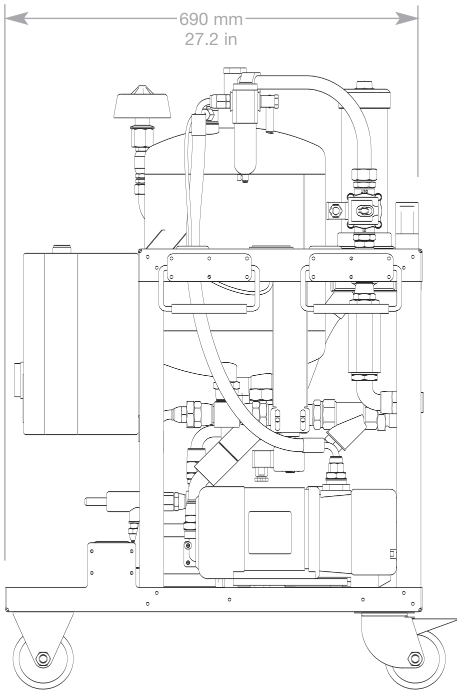
General Specifications

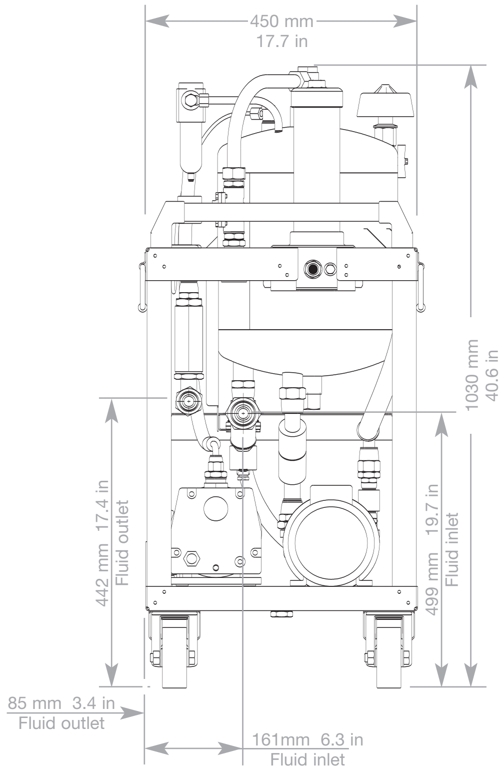
Dimensions:	690 mm x 450 mm x 1030 mm (27.2” x 17.7” x 40.6”)
Dry mass:	69 kg (152 lb.)
Inlet connections:	1 ¼" NPT
Outlet connections:	1" NPT
Flow Rate:	4.5 lpm (1.2 gpm)
Inlet pressure:	10 bar g (150 psi) maximum
Outlet pressure:	7 bar g (100 psi) maximum
Service temperature:	10ºC to 70ºC (50ºF to 158ºF)
Fluid viscosity:	700 cSt maximum
Operating vacuum:	-0.6 to –0.8 bar g (adjustable)
Power supply:	120V, 60 Hz single phase

Materials of Construction

Base Frame, Vessel	304 Stainless steel
Control box:	Plastic
Hoses:	Fluorocarbon
Seals:	Fluorocarbon

Note: **Pall** fluid conditioning purifiers comply with all applicable EC directives and bears the CE mark.





Ordering Information

Purifier Part Number= HNP006 G6 ZCT
HNP006 A++

Note: Please specify both part numbers when ordering.

Replacement Element Part Number= UE219 [Table 1] 08Z

Replacement Air Breather Element= R01F400

Other options available on request.

Table 1. Element Rating

Code	Filter Rating
AZ	ß $_{2.5(c)} \geq 1000$
AP	ß $_{5(c)} \geq 1000$
AN	ß $_{7(c)} \geq 1000$
AS	ß $_{12(c)} \geq 1000$
AT	ß $_{22(c)} \geq 1000$

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Pall Corporation

HNP074 Series

FLUID CONDITIONING PURIFIER

70 L/min • Fluid viscosities to 700cSt

**Reliability of systems, the service life of system components and fluids are extended by minimising water contamination.
The Pall HNP074 Purifier is designed to remove water from fluids thereby maintaining lubricity properties, minimising fluid oxidation and reducing aeration.**

Pall HNP074 Fluid Conditioning Purifier

Benefits of Pall HNP074 Purifier

- High performance water and gas removal
- Simple operation
- Extension of system fluid life
- Increased equipment reliability
- Minimised corrosion within systems
- Reduced fluid disposal
- **Reduced operating costs**

The Pall HNP074 Fluid Conditioning Purifier

Pall purifiers remove 100% of free water and in excess 80% of dissolved water. They also remove 100% of free and entrained gases and in excess of 80% of dissolved gases.

The Pall HNP074 fluid conditioning purifier can be used as a fixed installation or portable unit that is easily removed and connected to any fluid system.

This purifier design is based on the existing range of Pall fluid conditioning products, it allows for easy operation and control.

Automated controls, integral to the unit constantly monitor the operation of the purifier and will safely shutdown the unit if acceptable limits are exceeded.

Specifications

Dimensions:	680x1997x1580mm (26.8"x78.6"x62.2")
Dry mass:	390kg (860 lbs)
Inlet connections:	2" BSPP or 2" NPT
Outlet connections:	1½" BSPP or 1½" NPT
Flow rate:	70 L/min (18.5 US gpm) at 50 Hz 84 L/min (22.2 US gpm) at 60 Hz
Inlet pressure:	3.0 bar g (300 kPa / 44 psig) maximum
System back pressure:	4.35 bar g (435 kPa / 63.4 psig) maximum
Fluid operating temperature:	+10ºC to +70ºC (50°F to 158°F)
Fluid viscosity:	700 cSt (3300 SUS) maximum
Operating vacuum:	-0.6 to -0.8 barg [adjustable]
Power supply:	400VAC, 50Hz or 480VAC, 60 Hz
Total Motor power:	6.4kW @ 50Hz / 8.5kW @ 60Hz

Materials of Construction

Base frame:	Epoxy painted carbon steel
Vacuum vessel:	304 Stainless Steel
Fittings & fasteners:	Corrosion protected carbon steel
Control box:	Epoxy painted carbon steel
Hoses:	Nitrile or Chlorinated polyethylene
Seals:	Nitrile or Fluorocarbon

Note: Pall fluid conditioning purifiers comply with all relevant EC directives and bears the CE mark.

Ordering Information

* Refer to installation drawing for options.

Purifier Part No: **HNP074** [Table 1] [Table 2] [Table 3] [Table 4] [Table 5] **0 ***

Replacement Element Part No: **UE619** [Table 3] [Table 6] [Table 4]

Replacement Air Breather Element: **HC0293SEE5**

Table 1. Voltage

Code	Voltage
M	220 VAC
S	400 VAC
U	440 VAC
W	480 VAC

Table 2. Frequency

Code	Frequency
3	50Hz Ø3
4	60Hz Ø3

Table 3. Element Rating

Code	Rating (µm) ($\beta_{x(c)} \geq 1000$)**
AZ	2.5
AP	5
AN	7
AS	12
AT	22

** Beta ratios are designated using the symbol (c) to signify they were measured using the ISO16889 procedure.

Table 4. Seal Type

Code	Material
H	Nitrile
Z	Fluorocarbon

Table 5. Mounting Options

Code	Mounting	Outlet Filter length (in)	Connections
C	Mobile	20"	BSPP
N	Static	20"	BSPP
A	Mobile	40"	BSPP
B	Static	40"	BSPP
X	Mobile	20"	NPT
Y	Static	20"	NPT
V	Mobile	40"	NPT
W	Static	40"	NPT

Table 6. Element length

Code	Nominal Length (in)
20	20
40	40

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October 2006. Printed in England. IMHNP074EN/1006

Pall Corporation

HRP020/HRM

HRP020/HRM Purifier for Phosphate Ester Fluids

FLUID CONDITIONING PURIFIERS

*Filtration. Separation. Solution.*SM

HRP020/HRM Purifier for Phosphate Ester Fluids

Performance Requirements

Introduction

Phosphate ester is used extensively in industries requiring fire resistant fluids in their hydraulic or lubrication systems. In addition to its fire resistant properties phosphate ester is also an excellent lubricant, comparable with or better than mineral oils. In large steam turbines phosphate ester has nearly 40 years experience as the operating fluid in governor control systems. It is however more susceptible to degradation in the presence of water. Effective fluid conditioning is essential to avoid or break the fluid degradation cycle. The most damaging effect of fluid degradation is the formation of acids, which can in extreme cases corrode vital metal components.

Fluid Conditioning Requirements

To minimise fluid degradation the following parameters need to be controlled.

- **Keep the water level low.**

A water content of 1000 p.p.m. is often taken as the upper acceptable limit for water in phosphate ester, but 500 p.p.m. or less will ensure no effective hydrolysis, with the associated acid formation.

- **Minimise air entrainment in the reservoir fluid and at the pump.**

Air compression in the system pump can cause “dieseling” producing very high local temperatures with the associated fluid thermal stress and carbon formation.

- **Maintain a low acidity level.**

A total acid number, or neutralisation number, of 0.2 mg KOH/g is typically taken as the maximum acceptable level. This will however vary from one system supplier to another.

In addition to the provision of effective fluid conditioning it remains important that system design and plant maintenance ensure that water ingression and air entrainment are reduced to a minimum.

The ‘Pall’ HRP020 fluid conditioning purifier utilises the proven principle of vacuum dehydration to reduce water and entrained air in the fluid system.

The Pall Fluid Conditioning Purifier removes 100% of free water and as much as 80% of dissolved water. It also removes 100% of free and entrained gases and up to 65% of dissolved gases. Particulate removal is achieved using a 3 micrometer high Beta rated ($ß_{5(c)} \geq 1000$ rated) ‘Ultipor III’ filter element to filter the fluid before discharge back to the system reservoir.

The Pall Fluid Conditioning Purifier uses ion exchange resin elements to effectively scavenge any acid that may form. Ion exchange resins, unlike fullers earth or activated alumina, does not contain any extractable metals which can increase air entrainment and so promote “dieseling”. Pall ion exchange elements can recondition damaged phosphate ester and extend fluid life effectively lowering fluid costs.

Details of the Purifier and its operations can be found in the Pall brochure on the HNP021. A technical brief entitled “Improved Maintenance and Life Extension of Phosphate Esters Using Ion Exchange Treatment” is available on request and covers in detail the Pall position on reconditioning phosphate esters.

Fluid Conditioning System Offer In Modular Form

The purifier is supplied in a modular form comprising of an HNP021 series fluid conditioner connected downstream of the ion exchange unit. The ion exchange unit contains either 2, 4 or 7 resin elements, dependant on the system size to be treated. As a guide use 2 elements for systems less than 3000L, 4 elements for systems between 3000L and 6000L and 7 elements for systems up to 12,000L, above this size consult sales office. If the initial total acid number is greater than 0.5mg KOH/g, consult the Pall sales office before proceeding. In addition the ion exchange unit can be supplied for connecting to existing **Pall** purifiers where system acid levels have become unacceptable.

There is a flow switch in the main flow line on the HRM which indicates that the purifier is running. This means that the ion exchange units will be completely autonomous units with no requirement for on site wiring or commissioning to an existing purifier.

HRP020/HRM Purifier for Phosphate Ester Fluids

Instrumentation and Control

Specifications

Dry weight purifier:	160 kg
Ion exchange unit:	310 kg
Inlet/outlet connection:	1" BSP
Flow rate:	20 L/min
Total motor power:	3.7 KVA
Maximum viscosity:	300 cSt
Maximum service temperature:	70°C
Maximum inlet pressure:	2 bar g
Maximum outlet pressure:	7 bar g
Operating vacuum:	-0.8 bar g
Particulate filtration:	**Pall Ultipor III** ($\beta_{5(c)}\geq1000$)
Acid control elements:	**Pall** ion exchange resin element

Scope of supply

1 off purifier unit (HNP021 Series)
1 off ion exchange unit (HRM Series)
Connecting hose (3 metres)
Connecting electrical cable (5 metres)
1 off ion exchange element removal tool

HRP020/HRM Purifier for Phosphate Ester Fluids

Ordering Information

Purifier 'Pall' Part No: **HRP020** [Table 1] [Table 2] [Table 3] **Z** [Table 4]

Replacement Element 'Pall' Part No:

Inlet:	**HM55420**
Outlet:	**HC9100FKP8Z**
Air Breather:	**HC0293SEE5**
Resin Elements:	**HC0653FAG39Z**

Table 1

Code	Voltage*
R	380 V 3PH
T	415 V 3PH
U	440 V 3PH

*For other voltage please contact the sales office

Table 2

Code	Electrical Frequency
3	50 Hz
4	60 Hz

Table 3

Code	No. of Elements
02	2
04	4
07	7

Table 4

Code	Mounting
C	Castors and wheels fitted
N	Frame mounted

Ion Exchange Module Only Part No: [Table 3] [Table 1] [Table 2] [Table 4]
For fitment to 'Pall' Purifier

Replacement Resin Element Part No: **HC0653FAG39Z**

This is the standard anionic exchange element. For other ion exchange elements please contact the sales office.

Your distributor is:

PALL Pall Corporation

Pall Industrial Hydraulics
A division of Pall Europe Limited
Europa House, Havant Street
Portsmouth PO1 3PD, England

(023) 92303303 telephone
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Other international sales offices: Pall Industrial Hydraulics Corporation, East Hills N.Y.; Pall Fluides et Systemes, Paris; Pall GmbH, Frankfurt; Pall Italia Srl, Milan; Pall España, Madrid; Pall Canada Limited, Brockville, Ontario; Nihon Pall, Tokyo; Pall Industrial do Brasil, Ltda, São Paulo, Brazil; Pall (Schweiz) AG, Muttenz, Switzerland; Pall Filtertechnik GesmbH Vienna, Austria; Pall Poland Limited, Warsaw; Pall Korea Limited, Korea; Pall Fluid Clarification Pte Limited, Singapore; Pall Puerto Rico, Fajardo; Pall Australia, Pty Limited, Melbourne; Pall Filter (Beijing) Co. Limited, China; Pall Norge AS, Hønefoss, Norway; Pall BVBA, Brussels, Belgium; Pall Pharmalab PVT Limited, Bombay, India; Pall South Africa (Pty) Limited, Republic of South Africa.

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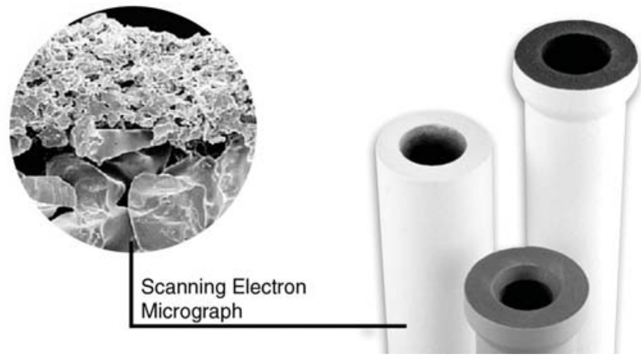
Pall Corporation

Pall Dia-Schumalith®
Filter Elements

Description

Pall **Dia-Schumalith** filter elements are successfully used as backwashable surface filters for particle separation from hot gases and aggressive liquids. They are made from a coarse porous support body of silicon carbide ceramically bonded with a fine filtering membrane.

Different membranes are available depending on field of application and demanded filtration efficiency. The combination of support body and membrane guarantees a low differential pressure at high filtration fineness and an excellent cleaning performance. **Dia-Schumalith** filter elements are especially used in the field of hot gas filtration due to its outstanding resistance to temperature changes.



Applications

- Backwashable surface filters for liquids
  - Catalyst recovery from reaction solutions, eg production of hydrogen peroxide and caprolactam
- Backwashable surface filters for gases
  - Fluid Catalytic Cracking processes (FCC)
  - Incineration processes, e.g PFBC of coal, radioactive contaminated waste
  - Gasification processes IGCC, e.g of coal, biomass, waste
  - Finest filtration of water vapour

Chemical Resistance[2]

Dia-Schumalith filter elements are resistant against acids, saline solutions and organic solvents, liquid or gaseous. They are not resistant to Hydrofluoric acid. **Dia-Schumalith** filter elements are resistant up to pH 10 in the alkaline range.

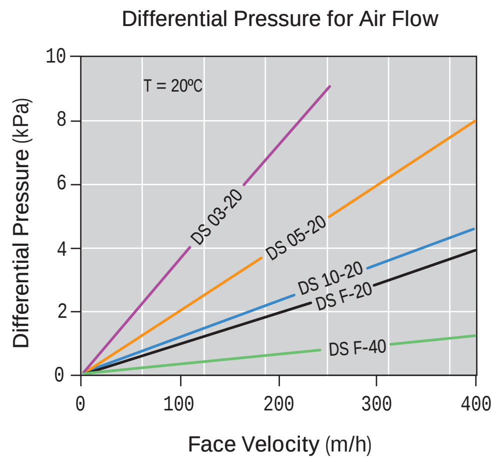
[2] As end use conditions can vary, it is the users responsibility to verify compatibility with their specific use conditions.

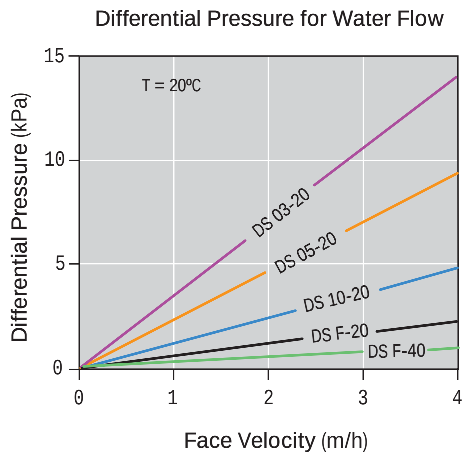
Technical Information

Dia-Schumalith (DS)	03-20	05-20	10-20	F-20	F-40
Filtration Grade for Liquids	0.5 µm	0.7 µm	<1 µm	2.5 µm	2.5 µm
Filtration Grade for Gases	<0.3 µm	<0.3 µm	0.3 µm	0.5 µm	0.5 µm
Support Material	SL 20	SL 20	SL 20	SL 20	SL 20
Membrane Type	DIA 03	DIA 05	DIA 10	DIA F	DIA F
Membrane Material	Mullite Grains	Mullite Grains	Mullite Grains	Al_2O_3 fibers / SiC Grains	Al_2O_3 fibers / SiC Grains
Porosity Support Material	38 %	38 %	38 %	38 %	38 %
Material Density	1.85 g/cm^3	1.85 g/cm^3	1.85 g/cm^3	1.85 g/cm^3	1.85 g/cm^3
Specific Permeability	15 $10^{-13} m^2$	25 $10^{-13} m^2$	55 $10^{-13} m^2$	65 $10^{-13} m^2$	15 $10^{-13} m^2$
Bending Strength (O-Ring Compression)	>20 MPa	>20 MPa	>20 MPa	>20 MPa	>15 MPa
Maximum Temperature Resistance[1]	1000 °C	1000 °C	1000 °C	1000 °C	1000 °C
Hot Gas Filtration Oxidizing Atmosphere	750 °C	750 °C	750 °C	750 °C	750 °C
Hot Gas Filtration Reducing Atmosphere	600 °C	600 °C	600 °C	600 °C	600 °C
Expansion Co-efficient (25 -1000 °C)	5.0 10^{-6}/K	5.0 10^{-6}/K	5.0 10^{-6}/K	5.0 10^{-6}/K	5.0 10^{-6}/K
Thermal Conductivity (200 °C)	2.5 W/m K	2.5 W/m K	2.5 W/m K	2.5 W/m K	2.5 W/m K
Dimensions (Do / Di)	60 / 40 mm	60 / 40 mm	60 / 40 mm	50 / 20 mm	60 / 30 mm

[1] depending upon operating conditions.

Flow vs Differential Pressure





General Information

- Special care has to be paid to the sealing when installing filter elements.
- Ceramic elements are to be handled with care.
- The filter elements should not be cut to any other length as cutting may damage the surface membrane.
- Elements can be glued using commercial or special ceramic glues.
- Careful consideration should be taken regarding operating temperatures and chemical resistance.

Ordering Information

Part Number	Dia-Schumalith	Type	Do / Di (mm)	Length (mm)	Area (m^2)	Weight (kg)
89451821	Cylinder	F-20	50 / 20	135	0.02	0.5
89452051		03-20	50 / 20	135	0.02	0.5
88269600		03-20	60 / 40	1,000	0.18	3.0
88270700		10-20	60 / 40	1,000	0.18	3.0
88276200		03-20	70 / 40	1,000	0.22	4.8
88276300		05-20	70 / 40	1,000	0.22	4.8
88276400		10-20	70 / 40	1,000	0.22	4.8
88276500		F-40	70 / 40	1,000	0.22	4.8
88269700	Candle	03-20 KK [3]	60 / 40	1,000	0.18	3.0
88270700		10-20 KK [3]	60 / 40	1,000	0.18	3.0
88284500		03-20 KK [3]	60 / 40	1,500	0.27	4.5
88270200		05-20 KK [3]	60 / 40	1,500	0.27	4.5
88286600		10-20 KK [3]	60 / 40	1,500	0.27	4.5
88222065		10-20 KK [3] pin	60 / 40	1,522	0.27	4.6
89580605		10-20 KK [3] pin	60 / 40	2,000	0.37	6.0
89580596		10-20 KK [3] pin	60 / 40	2,500	0.46	7.5

[3] Semispherical head

Please contact Pall for enquiries relating to dimensions not specified above.

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PIDIASCHUMALITHEN Printed in the UK. March 2009.

Pall Corporation

HTP

HTP070 Purifier for Dielectric Fluids

FLUID CONDITIONING PURIFIERS

Filtration. Separation. Solution. SM

PIH HTP070b

HTP070 Purifier for Dielectric Fluids
Technical Information

The HTP070 purifier permits treatment of the oil in a power transformer, while on-line and on-load.

Application Areas

The 'PALL' HTP070 oil purifier removes water, solid particles, air and other gases present in the dielectric fluids.

The operation of the HTP070 purifier is based on the principle of vacuum dehydration combined with fine filtration to remove particulate contamination.

The purifier is designed to treat power transformers while on load. It is an integrated unit consisting of a mobile purifier unit mounted on wheels, and incorporates an isolation system and has connection accessories.

In addition to on-load treatment of transformer oil, the purifier can be used for the treatment of bulk fluid.

The nature and detrimental effects of contamination in power transformers

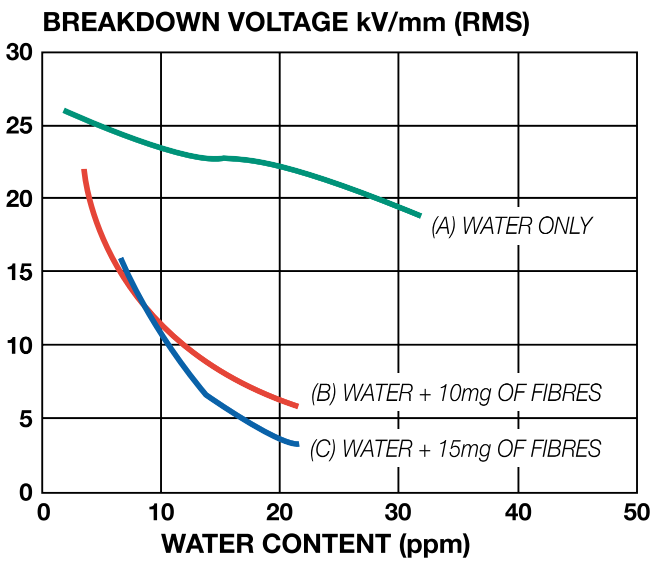
Excessive contamination is detrimental to the optimal performance of power transformers.

This contamination, whether liquid or solid, degrades the dielectric performance of the transformer insulating materials.

Figure 1, below, shows the damaging and costly effects on breakdown voltage of excessive water content, combined with high particle contamination, chiefly composed of cellulose fibres originating from paper and pressboard.

In addition, the water, which is a product of the decomposition of the cellulose insulation under thermal stress, is also a factor in accelerated ageing of the insulation paper.

Figure 1:
Effect of contamination on breakdown voltage of oil
(Source RGE January 1965)



Technical Information

**Figure 2:
Typical specification for a new transformer**

Water content at 20°C	< 10 ppm
Particle count according to ISO 4406	< 12/10
Particle count according to NAS 1638	< 4
Dielectric strength	> 75 kV

It is absolutely essential to keep the overall contamination level of the transformer oil in service at low levels to ensure the dielectric strength of the oil and to minimise the risk of transformer breakdown.

The table above shows typical values for a new transformer. They must be adapted to suit the type of transformer, its age, and technology.

A new approach to the treatment of transformers

A new method of treating transformers while on-load has been developed by **Pall** and EDF, working in partnership and departing from conventional technology. This process is the subject of an agreement between **Pall** and EDF which covers the treatment of power transformers under load using the HTP070 purifier, a specially designed unit for this application. The HTP070 purifier permits extremely high performances to be reached, without manual supervision except during connecting and disconnecting operations.

The development of this type of treatment offers the following advantages:

- A substantial reduction in direct and indirect treatment costs.
- Better control of the water content in both the transformer oil and the paper insulation.

The process allows treatments lasting several weeks and can therefore be much more efficient. Since such treatments do not require the transformer to be taken out of service, a major cost factor has been eliminated.

Remote Monitoring Package

The HTP 070 can be equipped with a remote monitoring package. The system involves the use of a Global Satellite Modem (GSM) or landline connected to the purifier PLC together with all necessary pressure transducers and moisture sensors.

This allows the operator

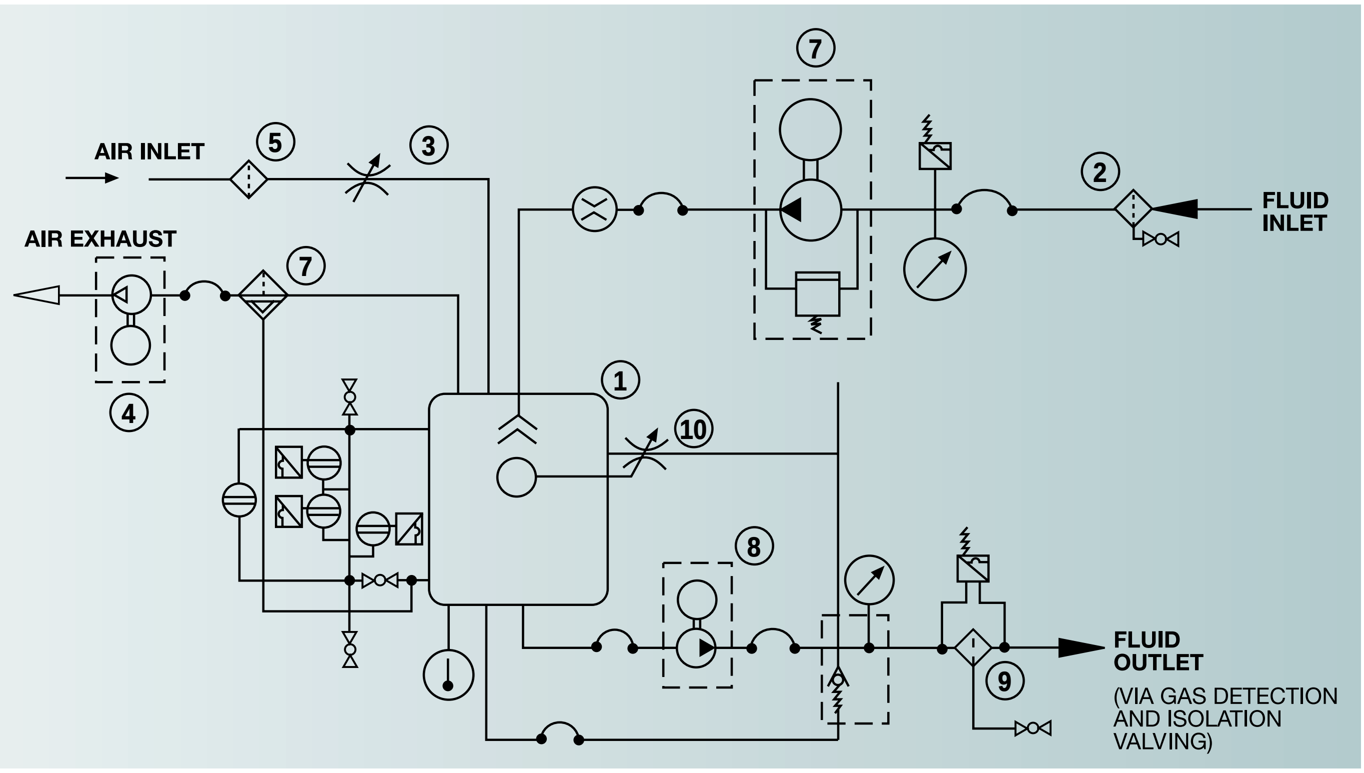
- access to the system data from the ‘Home Base’
- Allows the operator to down-load system history from base
- The monitor will ‘Ring Home’ in the event of a system alarm and indicate the nature of the alarm
- It can also be used to flag service points

This option has proved its value as the HTP 070 has to operate in remote ares for long periods.

HTP070 Purifier for Dielectric Fluids
Technical Information

Operating principles of purifier

Flow schematic



Operation

The fluid is pumped into the vacuum chamber (1) through the inlet strainer (2) by the inlet pump (7). A spray nozzle at the top of the chamber produces a cone of fluid with a thin film and a large surface area.

The vacuum chamber is maintained at approximately 10 mbar absolute by the vacuum pump (4). Air entering the chamber passes through an air breather (5), removing airborne contamination to avoid adding dirt to the system. The air expands rapidly through a restriction (3) to approximately 100 times its ambient volume which decreases the relative humidity inside the chamber to a fraction of the ambient level.

Gases and water vapour are transferred from the fluid surface to the upward flowing air thereby drying and degassing the fluid. The wet air is then exhausted via the oil mist separator (7) and vacuum pump (4) to atmosphere.

The purified fluid collects at the bottom of the chamber and is returned to the transformer or reservoir via the discharge pump (8) through the ß5(c)≥1000 high Beta performance ‘Ultipor III’ filter element (9). When the discharge filter element reaches the pre-set differential pressure a warning beacon is illuminated.

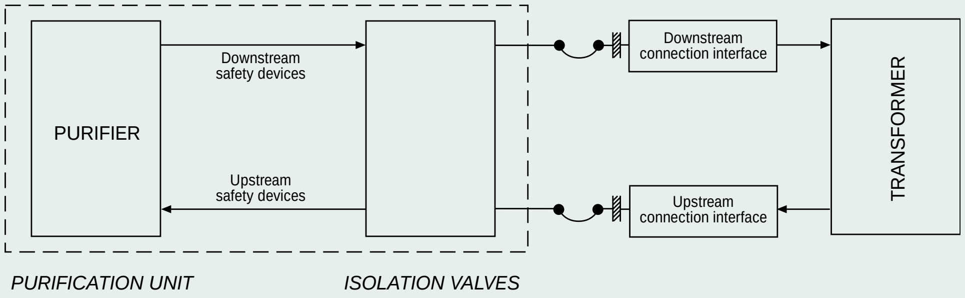
The fluid level in the vacuum chamber is maintained by a level sensor (10) which allows some of the fluid to circulate back to the chamber.

A sight glass is fitted to give visual confirmation of the fluid level in the chamber.

Downstream of the discharge filter (9) is a second vessel and associated valving (not shown) for the detection and removal of air bubbles in the transformer oil.

Transformer connection requirements

Schematic



In order to carry out the transformer treatment under load in complete safety, the purifying installation comprises the following elements:

- The isolation valves providing the connection of the HTP070 purifier to the transformer.
- Special connections providing the venting of pipework connecting the purifier to the transformer.
- Special equipment providing both air bubble and oil leak detection.

Operational sequence

- **Connection phase (transformer off-line)**
- **System powered-up**
- **Hose and purifier filling**
- **System safety checks**
- **Purifier run with isolation valves closed**
- **Isolation valves opened**
- **Transformer treatment phase**

The safety of the treatment is the combination of protection incorporated into the purifier, and the transformer's existing protective devices. The purifier's protective devices enable any irregular functioning to be detected by the PLC which controls the process and continuously monitors all critical aspects of the operation including the absence of bubbles in the treated fluid, and leaks in the system.

Checking the correct function of these safety devices is carried out by the operator prior to the start of the treatment, following a routine controlled by the PLC. System safety checks can be overridden only through a password protection function. The PLC has an on-line manual and a step by step user guide.

During the treatment of the transformer fluid, the automatic controls allow treatment to continue if required for several weeks with only routine weekly inspection.

Purifier performance

The purifier treatment will remove water, gases, and solid particles from the transformer oil.

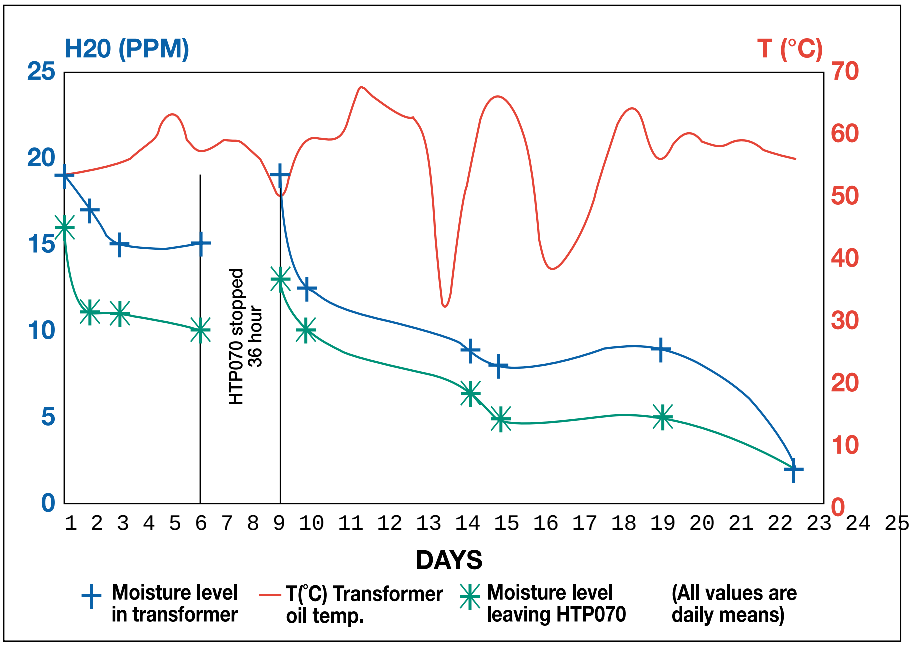
The purifier treats all three types of contamination at the same time.

The on-load method of treatment is preferred as during operation the oil is at a higher than ambient temperature which enhances water migration from the paper insulation into the oil where it can be removed by vacuum dehydration.

Technical Information

Figure 3:
Experience in treating a typical 23 MVA transformer

Since 1994, EDF has carried out a number of on-load transformer treatments with the **PALL** purifier on transformers containing between 6.5 and 35 tonnes of oil.



The above example shows the treatment of a transformer of 23 MVA containing 8.5 tonnes of oil. The water content before treatment was 30 ppm at 20°C and the water content several months after the treatment remained at 6 ppm at 20°C.

The treatment enabled some ten litres of water to be extracted from the transformer.

Comparison between on-load and conventional treatments

- The conventional treatment necessitates that the transformer is unavailable during treatment. On-load treatment requires minimum downtime, i.e. only during connecting and disconnecting of the treatment equipment.
- The direct cost of a treatment under load with the HTP070 purifier is very much less, since no special manning is required during the treatment period and no high energy heaters are used.
- The effectiveness of conventional treatment performed without a vacuum in the transformer is very limited, even with high fluid temperatures. On-load treatment with the HTP070 purifier enables the water contained in the transformers paper insulation to be extracted efficiently and remain effective in the long term.

HTP070 Purifier for Dielectric Fluids

Instrumentation and Controls

Special features and advantages

Special features	Advantages
Max. 32 A, 400 V, 3-phase supply. Hydraulic connections on isolating valves.	Simplicity and speed of electrical and hydraulic connections. Low electrical power. No need for water or compressed air.
Treatment without use of additional heaters.	Economy of operation, elimination of risks of thermal degradation of the oil and excessive thermal stresses on the equipment.
Fluid level and pressure sensors together with filter clogging indicators.	Simple and reliable functioning in the automatic mode.
Filter element rating ß5(c)≥1000.	Very rapid removal of fine particulate without risk of static build-up in the fluid.
Substantial frame fitted with wheels.	Mobility and safety when relocating.
Remote monitoring package available.	Allows the purifier performance to be monitored from the 'Home Base'.

Ordering information

Purifier reference:	HTP07040050UPHC
Replacement elements:	
Air filter:	HC0293SEE5
Suction filter:	HC8900EOS16H
Outlet filter:	HC0363FUZP39H
Vacuum pump coalescer filter:	HS75089 (4 off)
Air filter:	HS75088 (2 off)

HTP

FLUID CONDITIONING PURIFIERS

HTP070 Purifier for Dielectric Fluids

Specifications

General specification

Max viscosity at purifier:	70 cSt	
Temperature of fluid:	Temperature at base of transformer: 5°C to 70°C (intermittent 80°C)	
Weight of purifier alone:	1600 kg	
Dimensions of purifier:	Width:	1400mm
	Length:	2560mm
	Height:	1950mm
Oil capacity of purifier:	Approx.	300 litres

Purifier circuit

Flow:	70 litres/minute
Filter Rating:	ß5(C)≥1000 in compliance with ISO 16889

Materials

Frame:	Carbon steel
Vessels and pipework:	Stainless steel
Filter housing:	Aluminium alloy

Electrical requirements

Power supply:	Available in a range of voltages from 220 to 575V, three phase. Please specify preference.
Power consumption:	Max. 8 kW
Current supply:	Max. 32A

Note: For on-load treatment, the initial state of the oil and paper must allow normal and safe operation of the transformer. The PALL HTP070 purifier must not be used on fluids contaminated by toxic or volatile products, the vapours emitted being liable to present risks of explosion or otherwise endanger personnel. Strict compliance with the Safety Rules and with the Regulation in force at the point of use must be observed.

Pall Corporation

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Filtration. Separation. Solution.SM

Visit us on the web at www.pall.com/contaminationcontrol

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Your distributor is:

November 2000. Printed in England. CS23708/CS2M/11.00

Power Generation

Case Study

Pall Oil Conditioning System Reduces Combustion Gas Levels Significantly

Overview

With a capacity of 1,500 Megawatts of electricity and up to 1.5 million pounds per hour of process steam, Midland Cogeneration Venture Limited Partnership (MCV), located in Midland, Michigan, is the largest operating cogeneration plant in the United States, providing power for up to one million Michigan homes. In addition, MCV provides steam and electricity to Dow Chemical and steam to Dow Corning.

The Problem

The issue that the plant was having was related to the transformer. The plant previously used the standard process of gas removal, which means de-energizing the transformer, removing the oil for reclamation, and refilling. However, the plant began experiencing problems with one of its transformers. The problematic transformer had a gassing problem that caused the bracketry in the high voltage winding to overheat to more than 500ºC. When this occurs in the transformer, it can cause an "arcing" or faulting out. The manufacturer had no fix for this fault.

MCV considered its options. The plant had a spare transformer that could have been changed out at a cost of approximately $3 million, but in addition to the prohibitive cost, the plant feared that they'd have the same problem with the new transformer. Off-load treatment was also an expensive option due to the lost revenue of electricity sales plus penalties applied by Consumers Energy, with whom MCV is contracted to have a certain amount of available power at all times. MCV turned to Pall for help in finding a cost-effective solution.

Pall Corporation's HTP070 combines mass transfer dehydration, degasification, and particulate control with comprehensive safety, monitoring and trending capability for the online/onload treatment of power transformers.

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The Solution

After evaluating MCV's situation, Pall proposed its HTP070, an "online onload" oil conditioner designed to perform an oil treatment by removing moisture and gas from the oil and windings on a "live" transformer.

The HTP commissioning went very smoothly which allowed for re-energization of the transformer after three-and-a-half hours. Total outage time was around seven hours, which included the coordination of the switching by MCV.

The Benefits

- After treatment with the HTP070, MCV was able to lower the total combustible gas from +12,000 to <300ppm within a 10-day period.
- The level of combustible gas has remained at a satisfactory level following the treatment.
- Downtime was shortened from approximately eight days to seven hours. (This impressive time savings was possible because the HTP allows for the treatment to be done while the transformer is energized -- the only downtime the customer has is during the connecting phase).

Since each hour of outage would cost MCV approximately $28,000, the total amounted to $196,000 for the seven hours. MCV's previous outage, which included some maintenance/inspection activities, ran eight days. Applying the same rate to this time frame would result in $5,376,000 in lost revenue and contract penalties.

PALL® Power Generation

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PGCS3

Pall Corporation

The Pall PB35 Reservoir Blower has been developed to address the challenge of water vapor condensation inside oil reservoirs. It also addresses the problem of particulate ingression through poorly sealed reservoir hatches and access ways.

The PB35 delivers a steady stream of filtered air into the reservoir, evacuating moist air, and replacing it with dryer ambient air. The unit is a permanent mount and is specially designed for applications in the Pulp & Paper, Primary Metals, and heavy industries where elevated water content and airborne dirt ingression within oil reservoirs causes deterioration of performance.

Description

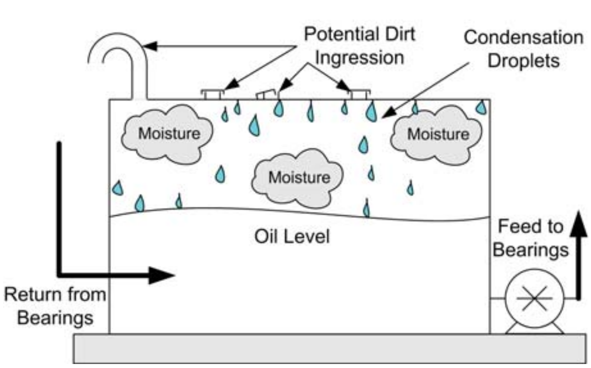
Most lubricating and hydraulic oil reservoirs contain a pocket of air between the fluid level and the top of the tank. Moisture collects in the air pocket and often condenses into water droplets which then fall back into the oil. Wet lubricating and hydraulic oils pose a significant threat to all system components.

Fluctuating fluid levels in the reservoir cause ambient air to be drawn in through any openings or cracks in the reservoir lid or cover. The in-rush of air may bring with it dirt particles that fall into the oil and elevate the contamination level of the entire reservoir. High particulate levels will reduce the effective life of all major system components including the filters.

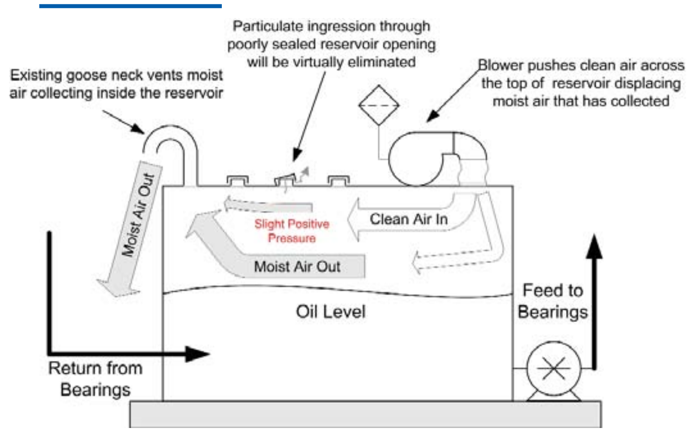
The PB35 Blower is mounted on top of the oil reservoir close to where the fluid pumps draw oil from the reservoir. The motor drives the blower and delivers clean, dry air across the top of the oil reservoir, displacing moist air that collects there. The slight positive pressure created by the blower prevents dirt ingression through poorly sealed hatches and access ways.

The continuous stream of clean air minimizes contamination and condensation within the reservoir and ultimately protects the components within the hydraulic and lube system.

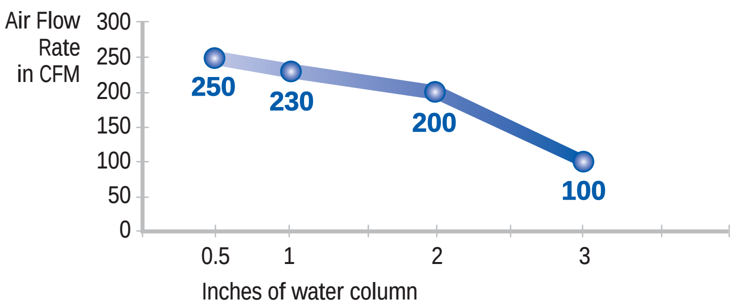
Unprotected reservoir



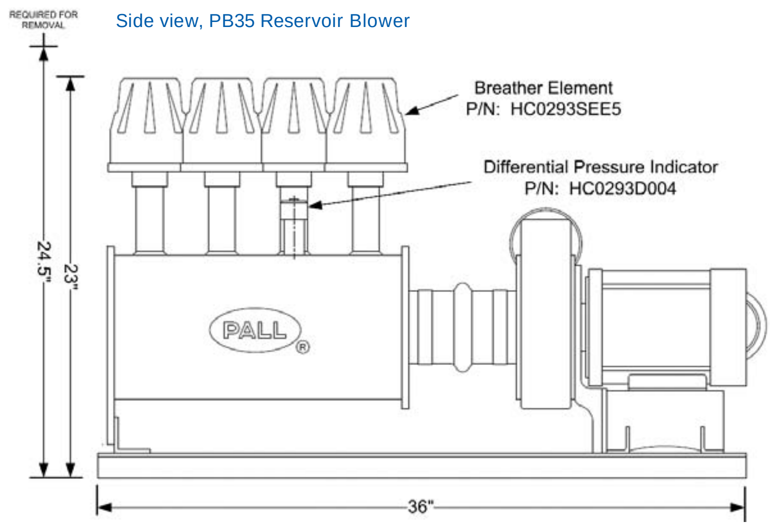
Protected reservoir



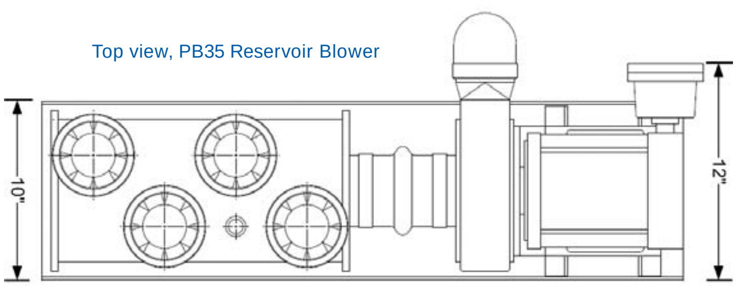
Flow Versus Backpressure



Side view, PB35 Reservoir Blower



Top view, PB35 Reservoir Blower



Ordering Information

PB35-■-▲-●

■	Voltage Options
W	230 or 480 / 3P / 60Hz
1	575 / 3P / 60Hz
R	380 / 3P / 50 Hz

▲	Breather Element
A	HC0293SEE5

●	Indicator
A	HC0293D004

Specifications

Weight	180 lbs (81 kg)
Air Outlet Port	4 inches (10.16 cm) ID hose
Enclosure	TEFC/TENV*
Controls	No controls; Hard-wired from circuit breaker panel
Motor Rating	1/3 HP
Full Load Amps	230V 1.4 amps 380V 1.0 amps 480V 0.7 amps 575V 0.5 amps

Spare Parts	Pall Part Number
Breather element	HCO293SEE5
Indicator	HCO293D004

*TEFC = Totally Enclosed, Fan-Cooled
TENV = Totally Enclosed, Non-Ventilated

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Please contact Pall Corporation for product applicability to specific National legislation and/or Regional Regulatory requirements for water and food contact use.

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IMPB35DSEN Printed in the USA October 2009

PALL Pall Corporation

Pall PCM200 series Fluid Cleanliness Monitor

Description

The Pall PCM200 Fluid Cleanliness Monitor is a cost effective monitoring device that provides accuarate, reliable assessment of system fluid cleanliness.

- Proven filter/mesh blockage technology (ISO 21018 Pt.3)
- Performance is not affected by water, air or opaque fluids
- Monitors dissolved water content as % saturation or ppm for specific fluids (PCM200W only)
- Low pressure (< 2 bar) on-line or off-line analysis
- Continuous monitoring capability
- Stores up to 500 test results
- PC-based trending software included
- Viscosity output in centistokes (cSt)
- Remote control and data acquisition via PC, PLC or optional hand-held display

Benefits

As part of continued component cleanliness 'pass off' checks or predictive maintenance programs, the PCM200 Fluid Cleanliness Monitor reports test data in real-time, so that ongoing assessments can be made.

Early detection of abnormal fluid cleanliness allows for timely investigation and corrective actions to be implemented. The PCM200 Fluid Cleanliness Monitor can be permanently installed on critical applications (including component test facilities) or used as a portable device for routine condition monitoring of various fluid systems.

The PCM200 Fluid Cleanliness Monitor has been designed for operators who require a cost effective, simple to use, low-pressure monitor. It can also be laboratory based or integrated into OEM equipment.

A key benefit of PCM cleanliness monitors is that they can be used on fluids that are not suitable for use with traditional Automatic Particle Counters, results are not affected by water, air or opaque fluids.

Applications

- Component wash fluids
- Cutting fluids
- Aqueous solutions
- Coolants
- Water glycols
- Mineral and synthetic oils
- Hydraulic and lubricating fluids
- Fuels

Pall PCM200 series
Fluid Cleanliness Monitor

Features

The front facia user interface contains 4 LED's and 2 COM Ports for unit operation and test. There are two RS232 communication ports for either optional 'hand-held' display or PC connection, or for PLC interface using a protocol already implemented in PCM200 series monitors.

The four LEDs indicate Power, Standby/Testing, Sampling and Hardware issues.

An optional 'hand-held' display allows simple menu driven inputs for sample identification, monitor configuration and data output in ISO4406, SAE AS4059 Table 1 (previously NAS1638) or SAE AS4059 Table 2 formats.

The optional 'hand-held' display shows real-time data and test results, which are automatically stored for subsequent trending and evaluation. Data can also be displayed on a remote PC or PLC using simple ASCI II commands.

Hand-held display
(Optional)

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Specifications

Power supply:	90 to 264 V AC Single Phase 47 - 63 Hz Auto Ranging IEC Mains Socket 18 to 24 V DC (60 W) XLR Socket
Fuse:	2 Amp
Compatibility:	Water glycols, aqueous solutions, Petroleum and synthetic oils (hydraulic lubricating, dielectric, etc.) fuels, industrial phosphate esters.
Seals:	Fluorocarbon
Fluid Cleanliness Monitoring Range:	ISO 4406: -/9/7 to -/21/17 SAE AS 4059 Table 1 Class 1 to 10 (derived from NAS 1638) SAE AS 4059 Table 2 Class > 6µm 1B to 10B > 14µm 1C to 10C
Fluid Water Content Monitoring Range:	0 to 100% Saturation ppm output (PCM200W only)
Operating Pressure:	0 to 2 bar (29 psi) max
Temperature:	5 °C to 80 °C (41 °F to 176 °F)
Viscosity Range:	1.5 cSt to 450 cSt (30 to 2,200 SUS)
Accuracy:	± ½ ISO code
Output:	2 x RS232
Enclosure:	IP65 (NEMA 4)
Weight:	9 kg (20 lb)

Ordering Information

Table 1: Part Number Information

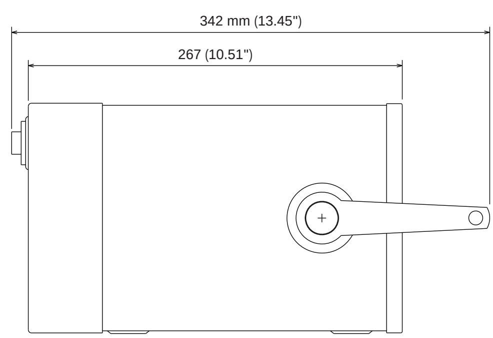
Order Part No.	Description
PCM200	Fluid Cleanliness Monitor without water sensor for aqueous fluids (wash fluids @ pH < 11.0)
PCM200W	Fluid Cleanliness Monitor with integrated water sensor for use with non-aqueous fluids (petroleum based fluids, industrial phosphate esters, mineral/synthetic oils)
PCM200B	Fluid Cleanliness Monitor without water sensor for aqueous fluids (wash fluids @ pH < 11.0) Complete with factory fitted mounting brackets
PCM200WB	Fluid Cleanliness Monitor with integrated water sensor for use with non-aqueous fluids (petroleum based fluids, industrial phosphate esters, mineral/synthetic oils) Complete with factory fitted mounting brackets

Table 2: Options List

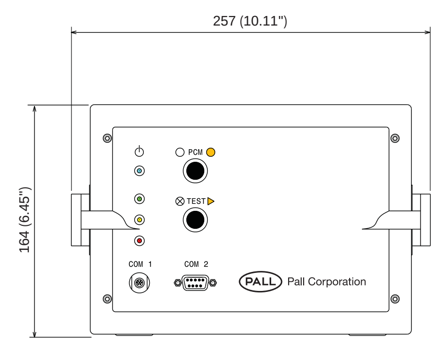
Order Part No.	Description
PCM200.DISP	Hand held display and cable
PCM200.PRT	Printer kit and accessories
PCM200-CASE	Transit case

PCM Fluid Cleanliness Trender software supplied with the PCM200 features:

- Graphical and spreadsheet reporting
- Trending capabilities
- Printable reports



Side View
(shown with handle for maximum dimensions)



Front View

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Pall Corporation

PCM400 series portable cleanliness monitor

The Pall® PCM400 is specifically developed as a portable diagnostic monitoring device that provides an assessment of system fluid cleanliness.

PCM400 Cleanliness Monitor

Benefits

As part of continued component cleanliness 'pass off' checks or predictive maintenance programs the PCM400 monitor quickly reports test data so that ongoing assessments can be made.

Early detection of abnormal fluid cleanliness allows for timely investigation and corrective actions to be implemented.

The PCM400 can be permanently installed to monitor critical applications (including component test facilities) or used as a portable device for routine condition monitoring of various fluid systems.

PCM400 monitor features

- Proven mesh blockage technology
- Results not affected by water or air
- Monitors dissolved water content (% saturation or PPM output for specific fluids (PCM400W only))
- High and low pressure on-line or off-line sampling
- Continuous monitoring
- 500 test memory
- ¼" BSP or test point hose connection
- PC-based trending software included
- Viscosity output in centistokes (cSt)
- Real time graphical representation

Operation

A detachable hand held touch screen programmer allows for simple menu driven input of sample identification, monitor configuration and data output in either ISO 4406, NAS 1638 or SAE AS 4059 formats.

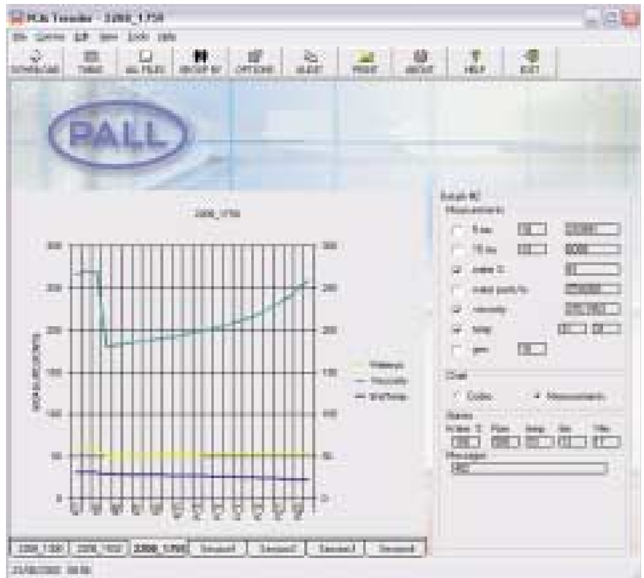
The hand held programmers display shows real time data and test results which are automatically stored for subsequent trending and evaluation.

Applications

- Component wash fluids
- Cutting fluids
- Aqueous solutions
- Coolants
- Water glycols
- Mineral and synthetic oils
- Lubricants
- Fuels

Specifications

Power supply:	90-230 VAC or integral 19 VDC battery
Temperature:	10°C to 80°C (50°F to 176°F)
Compatibility:	Water glycols, aqueous solutions. Petroleum and synthetic oils (hydraulic lubricating, dielectric, etc.) fuels, industrial phosphate esters.
Seals:	Fluorocarbon
Operating viscosity:	1.5 to 450 cSt (30 to 2,200sus)
Pressure:	0 to 315 bar (4568 psi) max
Range:	ISO 4406: 9/7 to 21/17 NAS 1638: 1 to 10 @ 5-15 µm SAE AS 4059: >6 µm 1B to 10B >14 µm 1C to 10C
Accuracy:	± 1/2 ISO code
Output:	RS232
Enclosure:	IP 65 (NEMA 4)
Weight:	10.8 kg (22 lb)
Dimensions:	340 x 240 x 265 mm (14 x 10 x 10 inches)



PCM Trender software features

- Graphical and spreadsheet reporting
- Trending capabilities
- Customer defined alarm limits
- Printable reports

Ordering Information

Pall Part Number	Description
PCM400W	Portable Cleanliness Monitor with integrated water sensor for use with non-aqueous fluids (Petroleum based fluids, industrial phosphate esters, mineral/synthetic oils).
PCM400	Portable Cleanliness Monitor (without water sensor) for aqueous fluids (wash fluids @ pH<11.0, water glycols, cutting fluids)

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Your distributor is:

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May 2003. Printed in England. PCM400/ME/00/0503

Pall Corporation

The PFC400W Series Portable Particle Counter

The Pall PFC400W laser particle counter is a portable diagnostic device that measures the size and quantity of particulate in industrial system fluids.

PFC400W Particle Counter

Features

- Proven laser light blockage technology
- Monitors dissolved water content (% saturation or PPM output)
- High and low pressure on-line sampling
- Off-line (bottle) sampling
- Performs single counts, timed counts, or continuous counting
- Wide fluid viscosity range
- 1000 run internal memory
- Integral battery allows for counting of 50 or more fluid samples between recharging
- Detachable, hand held programmer/display
- PC-based trending software
- Transport case

Benefits

Monitoring the trend of system fluid cleanliness as part of a predictive maintenance program helps identify abnormal conditions and potential problems. When observed, either additional fluid analyses may be performed or, prompt corrective actions can be implemented.

The PFC400W counter can either be permanently installed on-line to monitor critical applications (e.g. component test facilities) or used as a portable device for routine condition monitoring of various hydraulic, lubrication, and other fluid systems.

Operation

The PFC400W counter is simple to operate, with input of sample identification, counter configuration and data output requirements entered via the touch panel keyboard. Specific sampling “profiles” can be created (either via the programmer or a PC) and stored in the unit for immediate access and error-free testing.

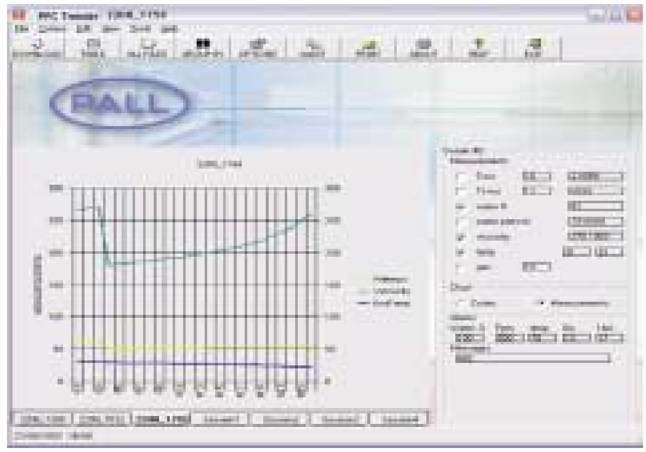
Fluid contamination levels are counted using state-of- the-art laser light blockage technology. Results are reported as codes or classes in accordance with ISO4406, SAE AS4059D, NAS1638 or DEF STAN 05-42. The analysis data (particle counts and codes or classes) can be downloaded from the hand held device to a PC via the RS232 communications port, and stored for subsequent trend analysis.

Applications include:

- Dielectric fluids
- Industrial phosphate esters
- Mineral / synthetic oils
- Lubricants
- Fuels

Specifications

Counting Sizes:	4, 6, 10, 14, 21, 30, 38 & 70 µm(c)
Cleanliness Code Ranges:	ISO 4406: 01 to 23 NAS1638: 00 to 12 SAE AS4059D: 000A to 12F DEF STAN: 400F to >6300F
Calibration:	Based on ISO 11171
Water content:	0% to 100% of saturation. Values can also be displayed as parts per million (ppm) (requires fluid constants)
Operating Pressures:	Low Pressure range: 0 to 5 bar (500kPa) (70 psi) High Pressure range: 4 to 400 bar (40,000kPa) (60 to 5,800 psi)
Operating Viscosity:	2 to 300 cSt (to 1,500 SUS)
Fluid operating Temperature:	10°C to 100°C (50°F to 212°F)
Fluid Compatibility:	Petroleum based fluids, industrial phosphate esters, mineral oils, dielectric fluids, kerosene coolants and synthetic fluids (aqueous fluids are unsuitable)
Seals:	Fluorocarbon
Sample Time:	<2 minutes (adjustable)
Power Supply:	100 - 240VAC, 50 – 60 Hz or 10VDC – 36VDC
Output:	RS232 D9 connector
Enclosure:	IP55, NEMA 4
Electromagnetic Compatibility:	Complies with EN50082-2, 1995 for immunity EC standard and also EN50081-1, 1992 standard for emissions
Weight:	9 Kg (19.8 lb)
Dimensions:	410 x 130 x 335 mm (16.1 x 5.1 x 13.2 inches)



Pall Cleanliness Trender software features

- Graphical or spreadsheet reporting of data downloaded from the PFC400W to a PC
- Printable reports
- Enables further trend analyses of the stored data
- Customer defined alarm limits

Ordering Information

Pall Part Number	Description
PFC400W	Portable Laser Particle Counter with integrated water sensor, for use with petroleum based fluids, phosphate esters, mineral & synthetic fluids; includes Cleanliness Trender software and transport case.
PFC400WPRTE	Optional thermal printer (EU)
PFC400WPRTUS	Optional thermal printer (US)

PFC400W Counter & Accessories

The PFC400W and all its accessories are supplied in a transport case designed to prevent damage to the counter.

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Your distributor is:

July 2003. Printed in England. PFC400W/CS/2M/0703

Pall PFD Reservoir Vent Filter/Dryer

1µm solid particulate removal rating
Isolation valve system
Sight window
Spin-on replacement filter canister

Provides optimum protection against water and particulate ingression into vented fluid systems.

Isolation valve system ensures only air entering the reservoir is directed to the PFD, resulting in longer life. Also, reverse flow through the filter/dryer is prevented, eliminating desiccant poisoning by oil vapor.

Applications

The PFD can be applied to hydraulic fluid reservoirs, fuel tank systems, gear lube oil systems, and other vented systems. Proven in the field, Pall's PFD reservoir vent filter/dryer reduces operating costs and improves system performance.

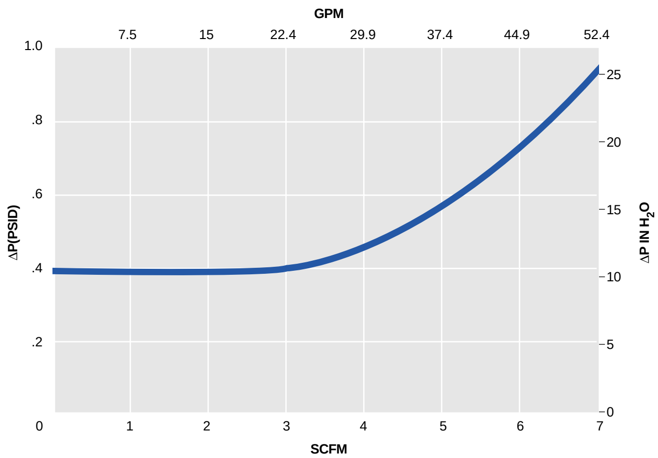
Notes and Specifications

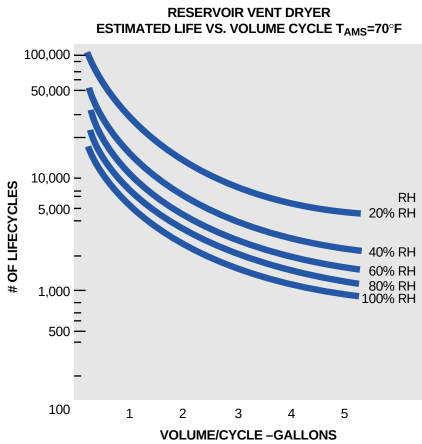
Temperature Range:	–65°F to 180°F (–54°C to 82°C)
Filtration Rating:	1 micron in air
Mounting:	Unit must be mounted vertically for proper operation

Performance Data

A maximum air flow of 7 SCFM is recommended, equivalent to 52 gpm air displaced in the reservoir. For hydraulic systems this flow (in SCFM), can be estimated by measuring the most rapid change in fluid level of the reservoir (feet per min), times the length and width of the reservoir.

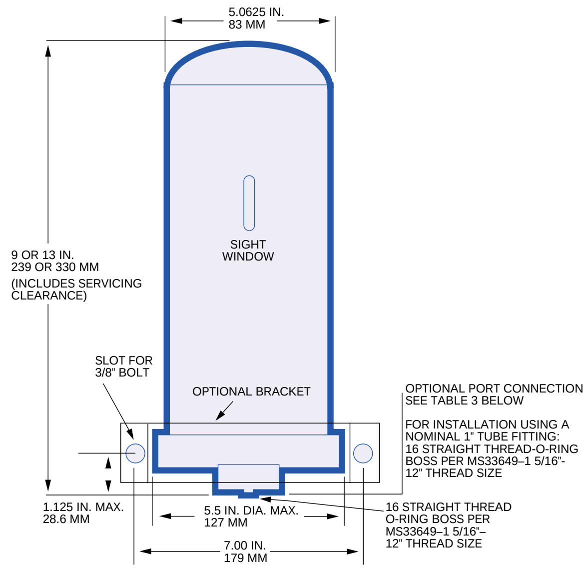
Service life is a function of relative humidity and the amount of air breathed into the reservoir. For applications without hydraulic cylinders, temperature swings will create a breathing effect. Assume 2% of the air volume in the reservoir is exchanged for every 10°F swing in temperature. The chart can be used to determine for how many of these "cycles" the PFD will last. For hydraulic systems also determine the amount of air breathed in by measuring the total changes in fluid level over a typical operational cycle.





NOTE:
DECREASE VOLUME/CYCLE BY APPROXIMATELY ONE HALF (1/2) WHEN UTILIZING THE 8" HIGH ASSEMBLY

Dimensional Drawings



Ordering Information

ASSEMBLY P/N: **PFD** [TABLE 1] [TABLE 2] [TABLE 3]

ELEMENT P/N: **PFD** [TABLE 1]

Table 1. Length Options

Code	Description
8	Nominal length in inches
12	Nominal length in inches

Table 2. Mounting Bracket Options

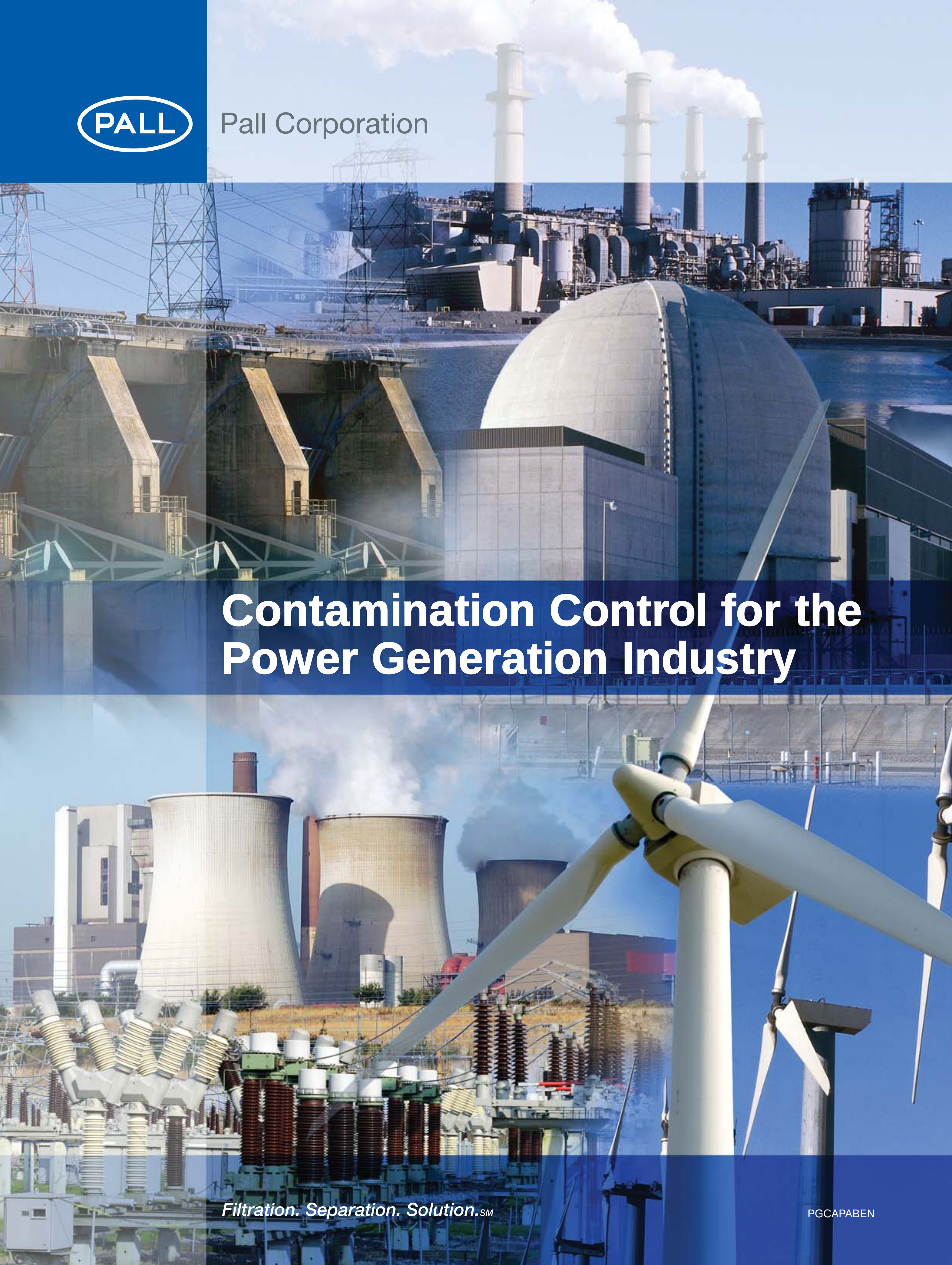
Code	Rating
A	No bracket
AB	With bracket permanently attached

Table 3. Port Options

Code	Description
Omit	1 5⁄16 –12 UNJ-3B (1" nominal tube)
R	1½ –16 UN-2B (Pall air breather adapters)

Compatible with Pall air breather adapters, see page 107.

AIR BREATHER
PFD VENT FILTER/DRYER



Pall Corporation

Contamination Control for the Power Generation Industry

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PGCAPABEN

Introduction to Pall Power Generation

Pall - Your integrated partner in Power Generation

Pall Corporation is a global company solving complex contamination, separation and purification problems.

Pall's Power Generation Group is part of Pall Energy Division and as such serves the power generation market around the world. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment.

The power generation industry trusts Pall as a solution provider

Pall is a worldwide leader in fluid purification technologies for the power generation industry. Pall advanced separation science and high quality manufacturing are applied on all fluids throughout the power plant to ensure cleaner, safer, more reliable power with higher profitability.

Pall can solve your purification challenges in any size of application, from small flows and simple installations to large flows and complex systems, from the supply of filter elements to fully-integrated turnkey systems.

Benefit from Pall's expertize and customized services

Pall is much more than a filter company. Pall specializes in fluid management, leveraging our unmatched capabilities to make your operation more successful. Our expertize has enabled us to build a large library of proprietary core materials, which we can modify to separate, remove, or selectively capture the most elusive contaminants.

Total Fluid Management℠

Pall has the ability to design, manufacture, and install economical, integrated systems as well as service them. Pall's Total Fluid Management (TFM) program for power generation plants help plant operators and engineers manage, control and monitor plant water, fuels and oil resources. This approach results in a reduction in total operating costs associated with fluids, operation and maintenance on critical components. Combining products with consulting services, commissioning and flushing assistance, Pall is the ideal partner for the power generation industry.

'Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment'

Contamination Control

Why is it so important to take care of fluid cleanliness?

Solid, liquid and dissolved contaminants present in liquids and gases will cause operating and maintenance problems on power production assets like boilers, turbines or transformers.

Left unchecked, these contaminants increase O&M costs, decrease thermal efficiency and output, and threaten environmental compliance of power plants.

Such issues can be solved by the use of highly effective, reliable and correctly applied filtration and separations technologies.

Applications:

Fossil Generation

Power plants around the world choose Pall to ensure the quality of their condensate water, the purity of their lubrication oil and the reliability of turbine control system operation. Pall products reduce downtime with unsurpassed flushing and oil treatment capabilities, technologies and on-site assistance. Pall water treatment systems also control and maintain make-up water and waste stream purity.

Nuclear Generation

Pall filtration systems help nuclear plants of all reactor types to maintain low levels of radioactive contamination throughout the water cycle. Pall filters reduce costs and maximize output by protecting the NSSS system, filtering the reactor pool and polishing condensate water:

- Less downtime
- Lower chemical usage
- Improved safety
- Optimal operating efficiency

Renewable Energy

Pall technology takes part in the development of renewable energy sources. From the filtration of hydroelectric turbine control and lubrication oil to the protection of windmill gearboxes or the purification of biomass gases, Pall employs state of the art technology to ensure that greener is always cleaner.

Transmission and Distribution

Energy availability also depends on a reliable and efficient grid. Pall products protect the critical purity of insulating oils. Pall online purifiers allow the online/onload treatment of transformer oil and insulation, dramatically reducing maintenance and downtime costs. By controlling water and fine particulate matter, Pall® Ultipor® WG filters protect LTC contacts, prevent OCB oil degradation and extend maintenance intervals.

'Let Pall help you optimize the performance of your generating equipment by improving fluids contamination control!'

Fossil Fuel Generation

‘high efficiency filtration, purer fuel, reduced pollutant emissions, low energy consumption, protection from erosive and corrosive wear, with minimal maintenance.’

Fuel Treatment Systems

With unmatched experience in the oil and gas industry worldwide, Pall brings complete solutions to the treatment of liquid and gas fuel for power plants. Combination of particulate filtration and high efficiency coalescence provide a fuel quality that meets the most stringent specifications of new generation combustion systems. The efficiency of Pall liquid/liquid and liquid/gas coalescers is only matched by their ease of use, low maintenance and long life.

Process Water Management

Water Supply Systems

Pall filters and membrane systems combine into a complete water treatment chain to ensure consistent, uninterrupted process water with minimal chemical usage, optimum quality and an unmatched ease of use and service. With microfiltration, ultrafiltration, reverse osmosis or filter cartridges, Pall offers the widest range of water filtration products.

Condensate Water

Boilers and turbines are protected by Pall condensate filtration systems, either in backwash or disposable configuration. For any system pressure of flowrate, Pall combines media science and system engineering expertize to offer the best protection against corrosion transport.

Pall HGCOld and HGPPB backwash systems offer:

- Engineering expertize to ensure long, economical operation, in demin-precoat or straight filtration mode
- Variety of media ranges and materials to adapt to any condensate flow conditions

Pall Ultipleat® High Flow disposable filters offer:

- Small footprint even for full flow installation
- Proprietary crescent shaped pleat geometry
- High efficiency, high flux filtration at ratings from 100 to 1 micron
- Simple element replacement

Hot Gas Filtration

Pall has the full complement of fluid management products for hot gas filtration for the latest combustion technologies including ceramics for biomass and coal gasification, plus products that reduce pollutant emissions driving the movement towards efficient, clean and low cost energy.

Steam Turbines

Lubrication

Pall’s full range of oil filtration and oil purification products combine to provide the best possible protection of the bearings and shaft against wear and corrosion. By efficiently and economically removing moisture, particles and gases from lubricating oils, Pall products ensure that critical machinery is protected and that the oil remains in pristine condition.

Hydrogen Seal Oil

The task of protecting seals from abrasive wear, and preventing water from ingressing into the generator falls on the turbine lubrication oil control system. The solid and moisture protection from the Pall TLC helps maintain hydrogen purity and minimize maintenance on the seals.

Control

The hydraulic systems controlling the steam valves are some of the most sensitive and critical components around the steam turbine. Pall products combine filtration, dehydration and ion exchange to protect and even reclaim hydraulic fluids, whether mineral or synthetic. With proper filtration and fluid treatment, critical valves are protected against stiction and erosive wear, and hydraulic fluids are protected against thermal degradation or acid formation.



Nuclear Power

> **'Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.'**

State-of-the-art media design, application experience and unsurpassed removal efficiencies have made Pall the world standard in nuclear safety, control, radioactive waste treatment and fuel pool clean-up. Pall products shorten outages, increase operating efficiency and minimize exposure with the backing of expert customer support worldwide.

Fine Ratings Programs

For many years, Pall filtration systems have been used in the most sensitive nuclear applications of PWR coolant systems. Today, the cleanest plants use Pall nuclear grade filters to reduce the out of core radiation levels and reduce overall personnel exposure. The fine ratings program is a step by step reduction of filtration level down to 0.1 micron in order to decontaminate the coolant systems progressively, ensuring better operation, easier maintenance and reduced exposure.

Media

Pall provides innovative disposable and back-washable media in a wide range of micron removal ratings, developed, designed and manufactured under the strictest quality controls for exceptional performance, reliability, and consistency.

Elements

Pall's disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radioactive waste, fewer change outs and added protection for equipment and personnel.

CVCS and Coolant Pump Seals

Pall Ultipor GF Plus media is positively charged and rated down to 0.1 micron. These rapidly remove radioactive material and provide the highest level of safety in the primary loop.

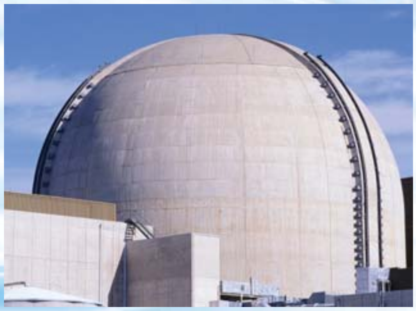
Pall Ultipor GF Plus elements filters the cooling water, protecting against seal wear and plant exposure with unsurpassed integrity, efficiency and durability. Pall filters provide the best way to reduce out of core radiation, personnel exposure and costs.

By removing minute solid particles, Pall Ultipor GF Plus filters are also used to protect the seals of the main coolant pumps. Reduction in abrasive wear of the seal, shown by a drastic reduction in leak rates, ensure longer life and lower seal replacement costs.

Nuclear Condensate Systems

Pall backwashable condensate filtration systems are an industry standard for BWR protection. In precoatable or straight filtration mode, Pall elements combine very high efficiency with strong integrity and durability. Backed by unmatched system design and operation expertize, Pall filters are the most effective way to maintain feed water purity, reduce ion resin consumption and protect the steam generators.

Pall traps and laterals protection feature an all-metallic porous media combining a very high void volume with high mechanical and thermal resistance up to 600F. With removal levels from 400 down to 18 micron, the Pall Rigimesh® line offers the best protection against resin leakage and fouling.



Renewable Energy

‘Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs.’

Hydroelectric Power

Clean hydroelectric generation depends greatly on the reliability, availability and response of the turbine control mechanisms and lubrication systems. By ensuring that the lubricating and hydraulic oils are maintained in pristine condition, Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs. Combined with Pall analysis capability and monitoring equipment, they form the ultimate protection against component related outages, high oil replacement costs and sluggish system response.

The combination of fine particle control and efficient moisture removal protects the oil films and the components. By consistently maintaining oil cleanliness lower than a ISO 16/14/12 life of roller or journal bearings can be drastically extended.

Filtration and Moisture Control - A Total Fluid Management solution

Pall Ultipleat SRT filters are especially designed to remove clearance size particles known to cause fatigue wear of the bearings, abrasive wear of the governor control valves and fluid degradation. With superior resistance to cyclic flows and no electrostatic discharge, the Pall Ultipleat SRT filter performs at its peak under the toughest of conditions.

When moisture is kept well under the saturation level of the oil, the process of oil oxidation can be stopped and with it, corrosion in the lube and control system. In hydroelectric plants, Pall purifiers and air dessicant breathers maintain moisture levels under 30%RH, and protect lubrication and hydraulic fluids against water ingression.

Wind Power

Gearbox Protection

When the gearbox faces variable loads, and operates in vibrating and extreme environments, it needs to be protected by a filtration system able to deliver specified cleanliness under stress conditions, at all times, consistently, and reliably. Pall wind turbine lube filtration systems combine design simplicity, ease of service, light weight with the performance of Ultipleat SRT technology.

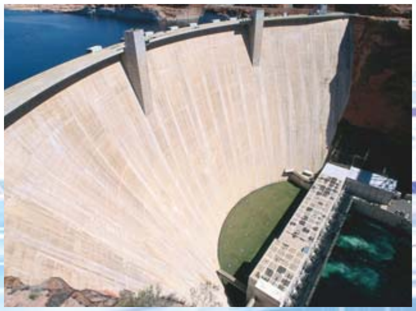
To ensure total cleanliness control, oil is protected against water or dirt ingression by Pall breathers, and its quality can be remotely monitored with Pall moisture and particle sensors.

Remote Monitoring of Oil Condition

The ability to detect oil quality problems early is a critical step in ensuring viability of remote windfarms. Oil contamination can be a strong indicator of component wear, its detection is the key for switching from reactive to predictive maintenance practices. With Pall capability for remote particle and moisture sensing equipment, wind turbines are never left alone, as far as they may be.

Biomass

Pall ceramics and metallic filter technologies are used to purify combustible gas in hot and chemically challenging environments such as in gasification processes and protect burners and turbines downstream. With advanced design capabilities for large blowback gas filter systems, Pall participates actively in the development of renewable combustible sources.



Pall Technology Services

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation technologies and services into a production process to yield the highest efficiency at the lowest cost. The Pall TFM program covers a wide range of filtration products, advanced technologies and services to improve system operation and increase productivity.

Our global team of scientists and engineers support TFM

Pall offers a variety of services to help you maximize productivity within your plant. We deliver TFM to you with the support of our global teams of Scientific and Laboratory Services (SLS). Located in more than 30 countries, our scientists and engineers provide these services locally, with broad-based assistance from Pall's worldwide technical support network. Our experts work directly with you to determine how Pall products and technologies can benefit your process.

Consultancy

Our customized system services include:

Commissioning and Flushing

Pall has the most extensive network of distributors and customer service centers in the world. Pall provides flushing, monitoring and consulting during plant overhaul, turbine start-up or system flushes worldwide. With Pall products, monitoring equipment and field expertize, our start-up assistance programs enable users to get back on-line faster, cheaper and more efficiently to maximize output, flexibility and operating profits.

Servicing

Cleanliness Audit

A cleanliness audit can uncover contamination problems and their detrimental effects. Our laboratory staff and field engineers have at your disposal lab-scale and analytical equipment and field pilot-scale units. By sampling at various locations throughout the process, we collect, quantify and identify solid and liquid contaminants to determine their origin and provide you with recommendations for corrective action. Our recommendations are designed to help you optimize your processes and increase the reliability of your equipment at the lowest possible cost.

Flushing Services

Process Audits / Consultancy

Pall offers troubleshooting, audit and consulting services to identify opportunities for process improvements that lead to increased productivity. Improvements are defined, for instance, as the reduction of operating costs or maintenance operations. An audit involves data collection and proposal review, followed by a technical report documenting the findings and suggestions for improvement.

Filtration Equipment Rental

When you need to rent filtration and purification equipment to conduct spot depollution of system fluids, to conduct large-scale pilot testing or to use while permanent equipment is being manufactured, contact Pall. Our rental services can provide equipment on the spot, so that you can handle upsets promptly.

Filtration Equipment Hire

Combustion Turbines and Combined Cycle

In all aspects of the operation of a combined cycle plant, Pall employs state-of-the-art technology to ensure a consistently high quality supply of water, fuels and lubricating oil to the machines. With gas treatment solutions to reduce emissions and environmental impact, Pall is the complete partner for CCPP operators looking to improve operation, save on fuel and water costs and improve system reliability and availability.

Fuels

Pall's expertize in liquid and gas fuel treatment ensures that combustion turbines are constantly protected from the mechanical and chemical attacks due to fuel impurities. Pall fuel treatment solution combines very efficient particulate filtration with coalescence to remove moisture or aerosols in the fuels. The result is a drastic reduction in the presence of solids, gels, water and salts in the fuels entering the combustion chamber.

Pall is also an expert in the treatment of alternative fuels and is an industry standard for coal and biomass gasification systems, with a range of ceramic and metallic filtration systems. With unmatched experience in materials and system designs, Pall hot gas filtration systems are at the core of some of the newest and most promising power generation designs.

Liquid / Liquid and Liquid / Gas Coalescers

Oil Mist Eliminator

Machine Protection

Whether industrial or aeroderivatives, combustion turbines are protected by Pall oil filters in the lubrication and control systems. By stopping the chain reaction of wear in rolling or journal bearings of the turbine, Pall filters protect the machine against downtime, repairs and bearing wear.

Pall oil mist eliminators reduce emissions of oil vapour to the atmosphere using Pall liquid / gas coalescers. Their efficiency and low resistance to flow means that the system reservoirs can breathe without restriction and with no detectable oil emissions into the plant.

Water Systems

In combined cycle plants, the availability and quality of water is critical for both the heat recovery boilers and the combustion turbine itself. Pall membrane systems ensure consistently pristine water meeting the most stringent purity requirements of new generation combustion turbines and high pressure boilers. With a wide range of ultra and microfiltration membranes, reverse osmosis, cartridge filtration and polishing systems, Pall brings the complete water management solution to combined cycle plants. The result is a cleaner combustion, better operation of Nox control systems, protection of the boiler against corrosion and FAC and reduced water usage overall.

Ultipleat High Flow Particulate Filters

Pall Aria System

Technologies For Contamination Control And Monitoring

Pall filtration and separation technology

Pall designs and supplies a wide range of media, filters, and systems to remove contaminants from liquids and gases.

These products, along with our service capabilities and technical expertize, enable us to fulfill diverse fluid purification requirements throughout all power generation processes.

Ultipleat High Flow/Coreless Filter Elements

Particulate Filtration for Liquids and Gases

Pall designs, manufactures and markets the widest range of solid contamination control products anywhere. Pall filters can remove minute solid particles from liquid or gas streams, across a wide range of temperature, pressure, and chemical conditions. These particulate filters can be made of glass fibres, polymers, metals or ceramics. With various shapes, sizes and micron ratings, they offer economic, efficient and durable contamination control in some of the most critical applications in power plants.

HNP006 Oil Purifier

Coalescence and Dehydration

Removal of moisture and aerosols from oils or fuels is paramount in order to protect machines like combustors or bearings. Moisture and aerosols carry chemical and solid contaminants responsible for deposits, chemical attacks or fluid degradation. Results can be devastating outages and high maintenance costs. Pall coalescers and oil purifiers have what it takes to remove unwanted contaminants from hydrocarbons, down to their solubility levels, and even beyond. Combustion chambers, injectors, bearings or seals all benefit from complete removal of moisture contaminants from fuels and oils.

Membrane Technologies

Membrane Technologies are by far the most effective methods for water processing applications. The Pall range of membrane systems includes microfiltration, ultrafiltration and reverse osmosis membrane technology. Pall Aria™ water treatment systems for example use hollow fiber microfiltration membranes to produce pure water from any water source. They remove bacteria, iron, manganese, arsenic, and other solid particulate to deliver water that consistently measures up to the toughest cleanliness and quality standards.

Pall membranes are used for production of make-up water, recycling of blowdowns and wastewater, as well as water fed protection for combustion turbines.

Contamination Monitoring

Solid Contamination Monitors

Obtaining accurate and reliable fluid cleanliness data quickly in order to detect abnormal contamination is a key factor in ensuring the efficiency of industrial processes and reducing downtime.

Reliable monitoring solutions ...whatever the conditions ...whatever the fluid

Pall have portable devices that resolve detection problems by giving plant operators the ability to measure the cleanliness of even the most troublesome fluids reliably, simply, and quickly, and prevent unnecessary and costly machinery downtime.

The Pall PCM400W Cleanliness Monitor can confirm cleanliness of almost every kind of system fluid.

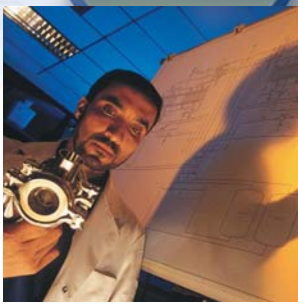
The Pall PCM400W uses multiple mesh blockage technology to address the common problem of inaccurate or unreliable results when monitoring fluids that are dark, cloudy, or contaminated by water or air. Additionally it can read fluid temperature and saturated water content (when appropriate).

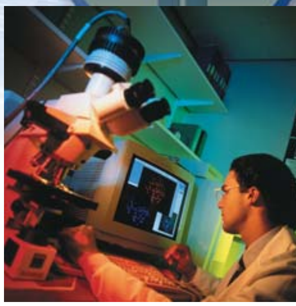
PCM400W

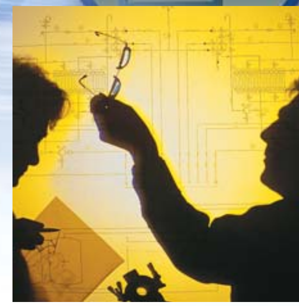
Pall Water Sensors

Wherever possible, oils should be operated without the presence of free or emulsified water.

Pall Water Sensors detect water in solution within the fluid, displayed as a percentage saturation or expressed as a parts per million (PPM) reading. Options include the handheld unit for a 'point-in-time' reading or the permanent unit which can provide continuous or timed monitoring.







Research and Development

Working with equipment and component manufacturers in these markets, Pall custom designs products and purification systems that are fully integrated into oil and gas industry applications.

These products extend component service life, enhance safety and improve the operating reliability of all processing systems.

Scientific and Laboratory Services

A principal element in Pall's customer support operations is our Scientific and Laboratory Services (SLS) Department. Filtration problems arising in the field can be assessed and simulated in the laboratory. Close monitoring by Pall scientists can determine the engineered solution to your contamination and separation problems and advise accordingly.

Sales and Support

The sales and support team comprises a group of experienced specialists located in Europe, the USA and across Asia with distributors and representatives worldwide. We offer a comprehensive sales and service support to all customers around the world.

Quality

The policy of Pall is to design and manufacture products to the highest and most current standards of quality, safety and reliability. To implement this policy, the organisational structure and the procedures by which Pall operates are fully defined in quality management systems, approved to ISO 9001:2000

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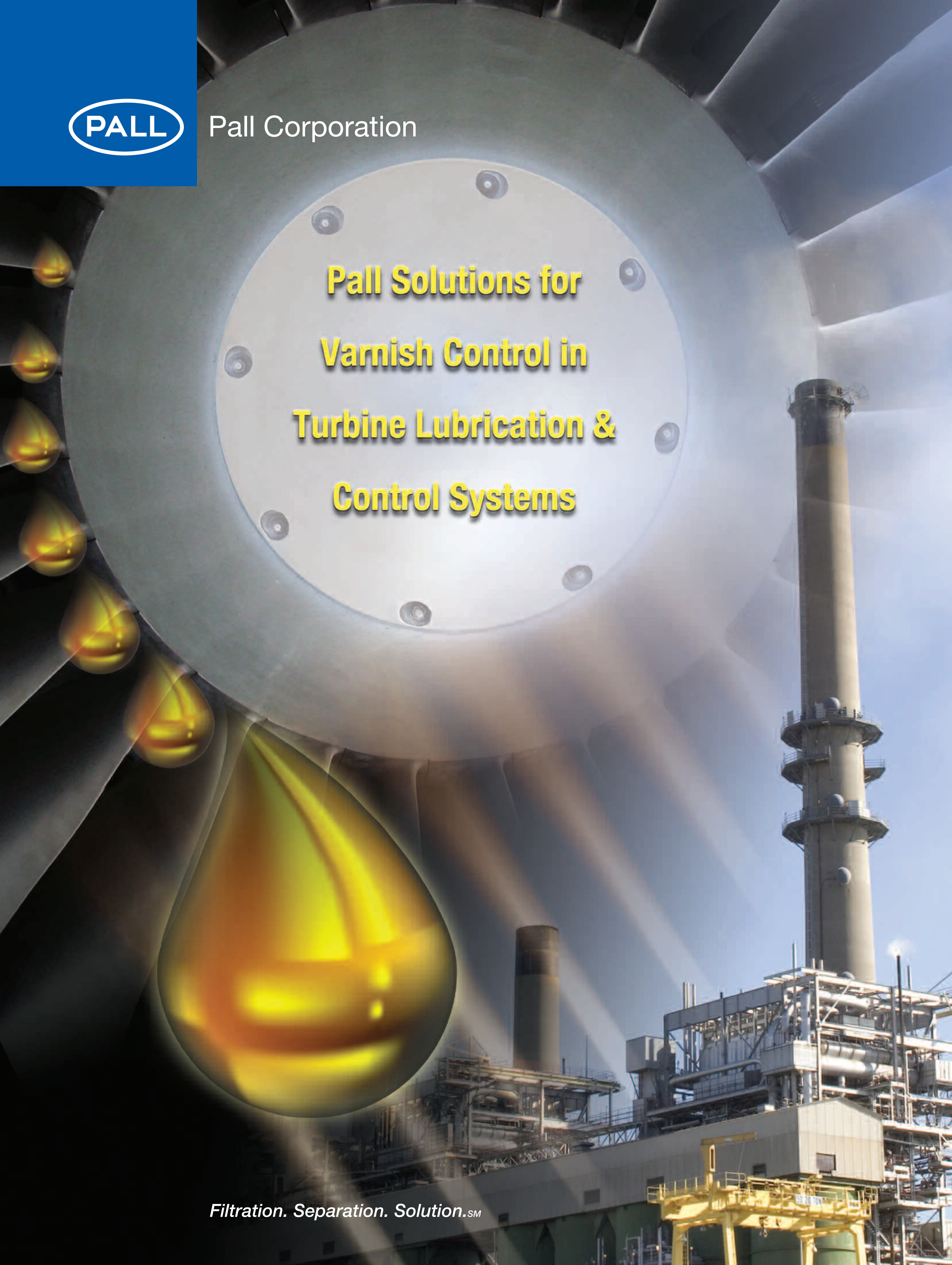


Pall Solutions for Varnish Control in Turbine Lubrication & Control Systems

*Filtration. Separation. Solution.*SM

PREVENTION

Varnish-forming materials are generated when the lubricating fluid is subjected to:

- **Oxidation**
  The presence of air, water, and particulate contamination in conjunction with high temperature can promote oxidation of the fluid and the resulting formation of precursors to varnish.
- **Thermal degradation**
  High fluid flow rates and shorter reservoir residence time promote air entrainment responsible for micro-dieseling and the resulting high temperature degradation of the fluid.

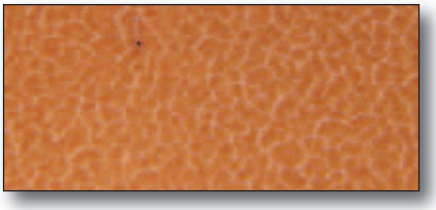
  Electrostatic discharge from filters also causes high temperature degradation of the fluid.

Expensive Consequences

Systems contaminated with varnish are prone to costly downtime and maintenance:

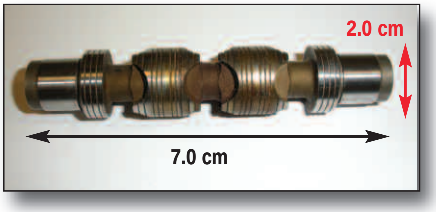
- Cost of replacement of control valves and other critical components
- Lost production due to unscheduled downtime
- Expensive fluid replacement and flushing procedures in extreme cases
- Poor cooling of the fluid due to contaminated heat exchangers

The consequences of varnish formation place a high burden on the profitability, availability, and reliability of power-producing turbines.



Photomicrograph of varnish forming material at 100x magnification

Filter housing internals coated with varnish



Heavily contaminated servo valve due to varnish deposit

Ultipor SRT GT lube element

Pall SRT media: removing one key precursor of varnish

SRT media (stress resistant technology) combines Pall's state-of-the-art filtration technology with an anti-static feature to make for optimum protection of the turbine lubrication system.

- Ultipor® SRT filter elements are rated at $\beta_X \geq 1000$, providing optimum protection against component wear. Pall's filtration media technology has been a standard for gas and steam turbines for years.
- Ultipor SRT filter elements are designed to effectively mitigate electrostatic discharge.
- Ultipor SRT filters are available for most power turbine designs, and are used by major turbine OEMs to mitigate filter-induced static discharge when high flow-rates and stringent oil cleanliness are specified.

The only viable long-term solution is a combination of preventive and corrective actions, all part of the Pall Total Fluid Management experience.

SOLUTION

Pall VRF Varnish skid

Pall Corporation has combined world-renowned filtration media science with excellence in system design to create a unique, robust solution for your varnish problems.

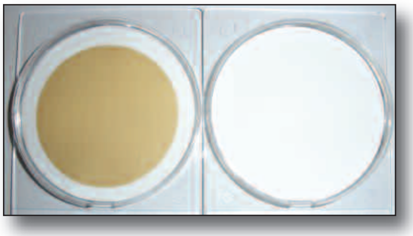
Pall VRF system

The Varnish Removal Filter (VRF) skid is proven to effectively remove varnish-forming material found in power turbine lubrication and control systems. Designed as a self-contained unit, it operates continuously in kidney-loop mode to process the turbine lubrication fluid reservoir.

The VRF skid incorporates an inlet strainer, a hydraulic pump, Pall VRF-PGG varnish removal modules, a Pall high-efficiency Ultipleat® SRT polishing filter, and an optional lubrication fluid cooler. This system flow rate is 11 gpm (42 lpm), large enough to efficiently treat most turbine lubrication systems in a matter of weeks.

Advantages of Pall VRF

- **Proven Efficiency**
  Field experience has shown varnish levels reduced from critical to well-below normal levels
- **Speed**
  Pall VRF system has one of the fastest clean-up times in the industry
- **Reliability**
  Proprietary adsorption technology packaged in a simple, proven system design results in a remarkably robust and reliable system
- **Fast Payback**
  Typical payback of the Pall VRF can be obtained in weeks (when accounting for replacement valve costs, unavailability of equipment, and lost production)



Varnish contained in fluid samples before and after treatment with Pall VRF system

Eliminating varnish in your combustion turbine will result in

- No varnish-related outages, leading to increased availability of your system
- Significant reduction in replacement parts costs
- Reliable and seamless start–up
- Lower energy consumption, and hence, a greener solution

Pall VRF varnish removal filters will take care of all the varnish-related problems in your turbines.

Pall Solutions for Varnish Control in Combustion Turbine Systems

Efficient control of varnish requires preventive as well as corrective measures. With a proven history in steam and gas turbine filtration, Pall Corporation has developed a complete solution to varnish removal and prevention of varnish formation in turbine lubrication and control systems. Combining the preventive power of antistatic SRT filtration technology with the advanced adsorption technology of the new Pall VRF varnish removal system, Pall introduces a complete, long-term, and cost-effective solution to your varnish problems…..

Take charge, protect your equipment, save on maintenance……

…. Pall Total Varnish Control

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Pall Corporation

Pall VRF
Varnish Remediation System

When varnish forms in combustion turbine lubrication and control systems, the effects can be devastating. Significant varnish build-up leads to:

- Sluggish control and/or equipment reliability issues
- Unscheduled maintenance operations/excessive parts replacement
- Problematic start-ups and/or shut-downs
- Forced equipment outages and lost production time

As the leader in gas turbine lubrication and hydraulic fluid control, Pall introduces a very efficient, simple, and proven varnish removal system. Pall VRF (Varnish Removal Filter) will dramatically reduce the varnish potential of the fluid, ensuring long, healthy operation, and control of gas turbines.

Performance

Field experience with Pall VRF on gas turbines showed a rapid and stable reduction in varnish potential rating (VPR℠)[1] well below the recommended levels. Pall VRF will maintain low varnish potential as the entire system gets cleaned up over time, literally pulling varnish off surfaces for removal. A turbine can be rid of varnish issues in a matter of a few weeks. The combination of Pall SRT filter technology to control varnish formation and the Pall VRF to remove existing varnish will ensure elimination of varnish-related problems.

Features

- Conforms to the ANSI B31.1 - Power Piping Code and the ANSI B31.3 - Process Piping Code
- Varnish removal vessel with specially designed adsorptive media, optimized for removal of varnish-forming precursors from the oil
- Outlet filtration with Pall Ultipleat® SRT technology, antistatic and rated at ß12(c) >1000 for additional protection and cleanliness
- Control system designed to maintain optimum oil temperature for the most efficient removal of varnish
- Simple, reliable operation requiring minimal operator attention

Benefits

- Simple, automated, and proven long-term efficiency
- Applicable to all turbine reservoir sizes

1 VPR℠ is a registered service mark of Analysts Incorporated.

Pall VRF equipped with standard cooler option.

- Faster system clean-up, usually within a few weeks
- Low energy consumption

Applications

- Combustion turbine lubricating and control systems
- Steam turbine lubricating and control systems
- Industrial hydraulic fluids

Dimensions

Width: 40˝ (1,016.0 mm)
Length: 76˝ (1,930.4 mm)
Height: 66˝ (1,676.4 mm)
Weight: Approx. 1,570 lb. (712.2 kg)

Design Characteristics

Flow Rate: 11 gpm (41.6 lpm) @ 60Hz
Maximum Inlet Viscosity: 500 SUS (100 cSt)
Inlet Pressure Range: –14˝ Hg (–0.47 Barg) to 10 psig (0.69 Barg)
Maximum design temperature: 160°F (71°C)
Standard electrical: 480V, 3 phase, 60 Hz; FLA = 8.0 amps
Cooler motor power: 2 HP
Pump motor power: 1.5 HP
Connection size: Inlet – 1.0 NPT, Discharge – 0.75 NPT
Piping: Stainless Steel Tubing – no flexible hoses

Materials of Construction

Materials of construction and paint are compatible with mineral-based fluids and include carbon steel, stainless steel, copper, brass, aluminum, bronze, and fluorocarbon seals. Consult factory for synthetic fluids.

Ordering information

VRF11-■-●-▲-◆-▼

■	Voltage options
W	480/3P/60Hz
1	575/3P/60Hz
R	380/3P/50Hz
T	415/3P/50Hz

●	Mechanical design
0	non coded
XX	Special: ASME/ANSI, PED, CRN, etc. Please consult factory.

▲	Cooler options
N	None
S	Standard air-over-oil cooler
HC	High-capacity water-over-oil cooler

◆	Mobility options
N	None
C	Casters
P	Tow package (rubber tires)

▼	Electrical design options
N	Standard = non-hazardous/non-explosion proof
ZZ	Special: NEC, IEC, CSA, ATEX, etc. Please consult factory.

Spare Parts	Pall Part Number
Varnish removal cartridges	VRF-PGG
Polishing filter element	UE219AS08Z
VRF vessel sealing gasket	55856
Spare o-rings (62mm x 4mm VITON 70 DURO) (used for cartridges, sealing lid, and center post)	54789

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PGVFDSENb

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Pall® Coreless Filter Elements

Pall Coreless filter elements combine Pall proven Profile® depth filter technology with a design that eliminates the core to provide a convenient, cost efficient and environmentally-friendly solution for high flow rate applications.

The large diameter filter element features low differential pressure polypropylene, nylon or polyphenylene sulphide (PPS) medium, meaning fewer elements are required for a given flow rate. Filter vessels are correspondingly smaller, resulting in lower capital and installation costs, as well as reduced operating costs.

Convenience

The Pall Coreless filter element fits over a 316L stainless steel core, which is retained inside the filter housing. At changeout, the element is simply pulled up over the core which is then ready to accept the replacement element. By retaining the metallic core, the Coreless design significantly reduces the amount of waste material to dispose of, providing a lower cost, more environmentally-friendly option.

Efficiency

Pall Coreless filter elements use the advanced and proven benefits of Profile medium's unique depth filter technology. The combination of a continuous graded pore prefilter section and a high performance inner section is an ideal combination, giving low clean differential pressure, high liquid flow rates and long service life.

Quality

The Pall Coreless filter element is manufactured to a very high standard of quality assurance and cleanliness, and in accordance with BS EN ISO 9001:2008.

Materials of Construction

Filter Element	Polypropylene, Nylon or Polyphenylene Sulphide (PPS)
Core Assembly	316L Stainless Steel

Pall Coreless Filter Element

Features

- Large diameter cartridge utilizing low differential pressure media.
- Separate stainless steel core retained in the filter housing.
- Proven depth filter technology / continuous graded pore structure.
- Polypropylene, nylon or polyphenylene sulphide (PPS) filter media.
- Fully disposable design.

Benefits

- Smaller systems with low capital cost, low installation costs and reduced operating costs.
- Providing high liquid flow rate capability, ease of fitment, low operating costs and increased cost efficiency.
- Reliable, consistent and verifiable filtration performance.
- Compatible with a wide range of applications.
- Less waste materials, lower cost of disposal and more environmentally-friendly.

Technical Information

Operating Characteristics in Compatible Fluids[1]

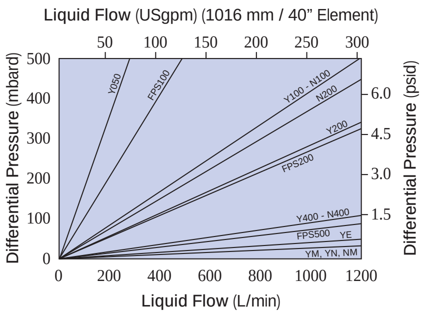
Maximum Differential Pressure	Operating Temperature Polypropylene	Nylon	Polyphenylene Sulphide (PPS)
4.0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1.0 bard (14.5 psid)	82 °C (179.6 °F)	130 °C (266 °F)	204 °C (400 °F)

[1] Compatible fluids are defined as those which do not swell, soften or attack any of the filter components

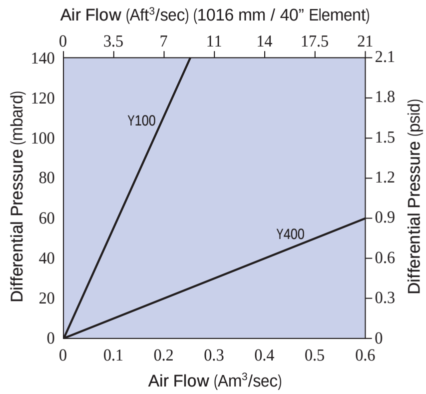
Core Assembly Seals (removable option only)

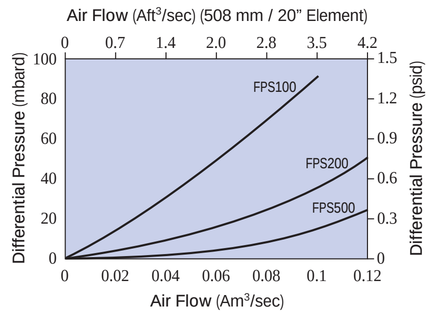
Seal Material
Ethylene Propylene Rubber (EPR)
Fluorocarbon Elastomer
FEP encapsulated Fluorocarbon Elastomer
Nitrile

Flow Rates



* For clean water at ambient temperature for liquids of viscosity other than 1cP multiply the ΔP by the viscosity in cP.





* For air at viscosity of 0.018cp. Correction for other gases: Use reading from Graph x

$$\frac{\text{Gas Viscosity}}{0.018\text{cP (Air)}} = \text{Actual Pressure Drop}$$

Ordering Information

This information is a guide to the part number structure and possible options. For availability of specific options, please contact Pall. Refer to Pall for housing details.

Element Part Number: E 60 ☐ ☐
Table 1 Table 2

Core Assembly (removable option) Part Number: EHS 60 ☐ ☐
Table 1 Table 3

Table 1: Nominal Length

Code	Description
2	508 mm (20")
4	1016 mm (40")

Table 3: Core Assembly Seal Options

Code	Description
J	Ethylene Propylene Rubber
HB	Fluorocarbon Elastomer
H1	FEP encapsulated Flurocarbon Elastomer
H13	Nitrile

Table 2: Media Options

Polypropylene[2]	Nylon[2]	Polyphenylene[3] Sulphide (PPS)	Removal Rating in Liquids (µm)	Removal Rating in Gases at 0.3 µm[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99.997 % (Y100) 99.999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99.995 % (Y400)
—	—	FPS500	50	99.869 % (FPS500)
YE[5]	—	—	Coarse grade media for use in E-coat paint baths	
YM[5]	NM	—	Coarse grade media for use in mica paint applications	
YN[5]	—	—	Coarse grade media for use in mica paint applications	

[2] Beta 5000, [3] Beta 1000 efficiency rating, [4] Determined in laboratory trials using sodium chloride aerosols at 300 Sm³ / hr,
[5] Pall Coreless paint application filter elements are not given removal ratings.

Replacement Core Assembly Seals

O-ring Seal	Part Number
Ethylene Propylene Rubber (EPR)	CA53418 and ORJPW-111P
Fluorocarbon Elastomer	LS00372 and LS00429
FEP encapsulated Fluorocarbon Elastomomer	CC62592 and CC62591
Nitrile	LS0043 and LS543

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Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 433,661; US 5,133,878.

PICOREENc Printed in the UK. January 2010

Pall Corporation

Éléments filtrants Pall® Coreless

Les éléments filtrants Pall Coreless associent la technologie éprouvée de filtre en profondeur Pall Profile® à une conception sans âme pour apporter une solution pratique, économique et écologique adaptée aux applications à haut débit.

L'élément filtrant de grand diamètre présente un milieu filtrant en Polypropylène, Nylon ou Sulfure de PolyPhénylène (PPS) générant des pressions différentielles basses ; ainsi moins d'éléments sont nécessaires pour un débit donné. Les corps de filtre sont par conséquent plus petits, ce qui réduit les coûts d'investissement, d'installation et d'exploitation.

Commodité

L'élément filtrant Pall Coreless s'adapte sur une âme en acier inoxydable 316L qui est intégrée dans le corps du filtre. Lors du remplacement, l'élément est simplement enlevé de l'âme qui est alors prête à recevoir le filtre de remplacement. Du fait que l'âme métallique reste en place, la conception Coreless réduit de manière significative la quantité de matériaux à retraiter, offrant ainsi une alternative plus économique et écologique.

Efficacité

Les éléments filtrants Pall Coreless utilisent les avantages avancées et prouvées de la technologie unique de filtre en profondeur du milieu filtrant Pall Profile. L'association d'une section de préfiltration à gradient (variation du diamètre des pores) et d'une section interne avec un diamètre de pores constants assurant le seuil de rétention absolu permet de générer des pressions différentielles initiales basses, des traitements de débits de liquide élevés et des longues durées de vie des éléments.

Qualité

L'élément filtrant Pall Coreless est fabriqué en respectant les exigences d'assurance qualité et de propreté, conformément à la norme BS EN ISO 9001:2008.

Matériaux de construction

Élément filtrant	Polypropylène, Nylon ou Sulfure de PolyPhénylène (PPS)
Âme	Acier inoxydable 316L

Élément filtrant Pall Coreless

Caractéristiques

- Cartouche de grand diamètre utilisant un milieu filtrant générant des pressions différentielles basses.
- Âme en acier inoxydable séparée, intégrée dans le corps de filtre.
- Technologie de filtre en profondeur éprouvée/structure à gradient de pores décroissants.
- Milieu filtrant en Polypropylène, Nylon ou Sulfure de PolyPhénylène (PPS).
- Conception entièrement jetable.

Avantages

- Systèmes plus petits avec des coûts d'investissement, d'installation et d'exploitation moindres.
- Traitement de fort débit de fluide, facilité d'installation, coûts d'exploitation réduits et rentabilité améliorée.
- Performances de filtration fiables, constantes et testables.
- Convient à un large éventail d'applications.
- Réduction du coût de traitement des déchets et meilleur respect de l'environnement.

Données techniques

Caractéristiques de fonctionnement avec les fluides compatibles[1]

Pression différentielle maximale	Température de service		
	Polypropylène	Nylon	Sulfure de PolyPhénylène (PPS)
4,0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1,0 bard (14,5 psid)	82 °C (179,6 °F)	130 °C (266 °F)	204 °C (400 °F)

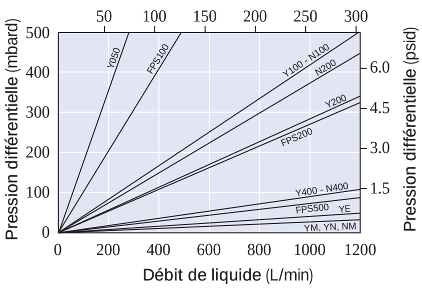
[1]Sont compatibles les fluides qui n'entraînent pas de gonflement, ne ramollissent pas, ni n'affectent pas les composants du filtre

Joints de l'âme (amovibles en option uniquement)

Matériau du joint
Ethylène Propylène
Elastomère Fluorocarbone
Élastomère Fluorocarboné encapsulé FEP
Nitrile

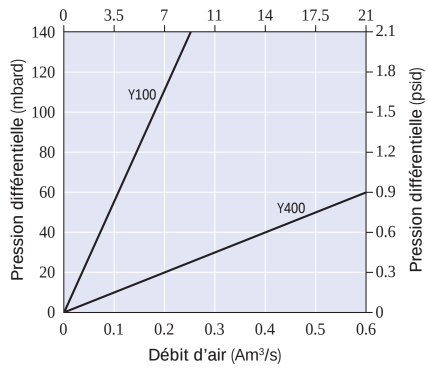
Débits

Débit de liquide (USgpm) (élément de 1016 mm/40")

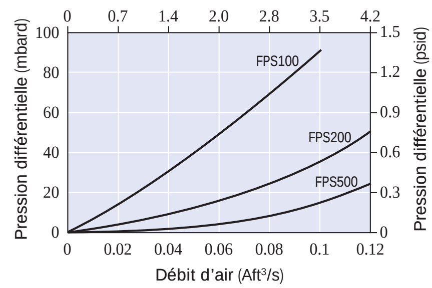


* Pour de l'eau propre à température ambiante, pour les liquides d'une viscosité autre que 1 cP, multiplier la perte de charge par la viscosité en cP.

Débit d'air (Aft³/s) (élément de 1016 mm/40")



Débit d'air (Aft³/s) (élément de 508 mm/20")



* Pour de l'air à une viscosité de 0,018 cP. Correction pour d'autres gaz : utiliser la lecture sur le graphique x

$$\frac{\text{Viscosité du gaz}}{0{,}018\text{cP (Air)}} = \text{Perte de charge réelle}$$

Informations pour les références

Ces informations précisent la structure des références et les options possibles. En ce qui concerne la disponibilité des options spécifiques, merci de contacter Pall. Consulter Pall pour plus de détails sur les corps de filtre.

Référence de l'élément :E 60 ☐ ☐

Tableau 1 Tableau 2

Référence de l'âme (amovible en option) : EH S 60 ☐ ☐

Tableau 1 Tableau 3

Tableau 1 : choix de la longueur

Code	Description
2	508 mm (20")
4	1016 mm (40")

Tableau 2 : choix du milieu filtrant

Polypropylène[2]	Nylon[2]	Sulfure de Poly-Phénylène[3] (PPS)	Seuil de rétention (µm) dans les liquides	Seuil de rétention dans les gaz à 0,3 µm[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99,997 % (Y100) 99,999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99,995 % (Y400)
—	—	FPS500	50	99,869 % (FPS500)
YE[5]	—	—	Milieu filtrant validé pour utilisation sur bains de peinture par électrodéposition	
YM[5]	NM	—	Milieu filtrant validé pour utilisation sur les applications de peinture à base de mica	
YN[5]	—	—	Milieu filtrant validé pour utilisation sur les applications de peinture à base de mica	

[2] Beta 5000, [3] Beta 1000, [4] Déterminé au cours d'essais en laboratoire utilisant des aérosols de chlorure de sodium à 300Sm³/h, [5] Les éléments filtrants Pall Coreless pour les applications de peinture n'ont pas de seuil de rétention défini (filtres qualifiés pour ces applications).

Tableau 3 : choix du joint de l'âme

Code	Description
J	Ethylène Propylène
HB	Élastomère Fluorocarboné
H1	Elastomère Fluorocarbone encapsulé FEP
H13	Nitrile

Remplacement des joints de l'âme

Joints toriques	Référence
Ethylène Propylène	CA53418 et ORJPW-111P
Élastomère Fluorocarboné	LS00372 et LS00429
Elastomère Fluorocarbone encapsulé FEP	CC62592 et CC62591
Nitrile	LS0043 et LS543

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PICOREFRc Imprimé au Royaume-Uni.. Février 2010

PALL Pall Corporation

Pall® Coreless Filterelement

Pall Coreless Filter kombinieren die bewährte Pall Profile® Tiefenfiltertechnologie mit einem Design, das auf den Stützkörper verzichtet und somit eine bequeme, kosteneffiziente und umweltfreundliche Lösung für Anwendungen mit hohen Flussraten bietet.

Das Filterelement hat einen großen Durchmesser und verfügt über ein Filtermedium für niedrigen Differenzdruck aus Polypropylen, Nylon oder Polyphenylensulfid (PPS). Das bedeutet, dass für eine gegebene Flussrate weniger Filterelemente benötigt werden. Die Filterbehälter sind entsprechend kleiner mit dem Ergebnis geringerer Investitions-, Installations- und Betriebskosten.

Bedienungskomfort

Das Pall Coreless Filterelement passt über einen 316l Edelstahlstützkörper, der im Innern des Filtergehäuses verbleibt. Beim Wechseln wird das Element einfach vom Stützkörper abgezogen, um das Austauschelement dann aufschieben zu können. Durch die Beibehaltung des Metallstützkörpers reduziert sich die Menge zu entsorgender Abfallstoffe erheblich, was das Coreless-Design zu einer kostengünstigen und umweltfreundlichen Option macht.

Wirkungsgrad

Pall Coreless Filterelemente nutzen die hoch entwickelten und bewährten Vorteile der einzigartigen Tiefenfiltertechnologie des Pall Profile Mediums.
Die Kombination von einem Vorfiltrationsabschnitt mit kontinuierlich abgestufter Porenstruktur und einem leistungsstarken inneren Bereich eignet sich ideal zur Gewährleistung eines niedrigen Differenzdrucks bei sauberem Filter, hoher Flussraten in Flüssigkeiten und langer Lebensdauer.

Qualität

Die Herstellung des Pall Coreless Filterelements erfolgt nach sehr hohen Qualitätssicherungs- und Reinheitsstandards und in Übereinstimmung mit BS EN ISO 9001:2008.

Verwendete Werkstoffe

Filterelement	Polypropylen, Nylon oder Polyphenylensulfid (PPS)
Stützkörper	316 L Edelstahl

Pall Coreless Filterelement

Merkmale

- Filterkerze mit großem Durchmesser unter Verwendung von Medien mit niedrigem Differenzdruck
- Separater, im Filtergehäuse verbleibender Edelstahlstützkörper
- Bewährte Tiefenfiltertechnologie / abgestufte Porenstruktur
- Filtermedien aus Polypropylen, Nylon oder Polyphenylensulfid (PPS)
- Vollständig Entsorgung möglich

Vorteile

- Kleinere Systeme mit geringen Investitions-, Installations- und Betriebskosten
- Geeignet für Anwendungen mit hohen Flussraten in Flüssigkeiten und leicht integrierbar bei niedrigen Betriebskosten und verbesserter Kosteneffizienz
- Zuverlässige, konstante und nachweisbare Leistung
- Für ein breites Spektrum von Anwendungen geeignet
- Weniger Abfallstoffe, geringere Entsorgungskosten und größere Umweltfreundlichkeit

Technische Informationen

Betriebseigenschaften mit kompatiblen Flüssigkeiten[1]

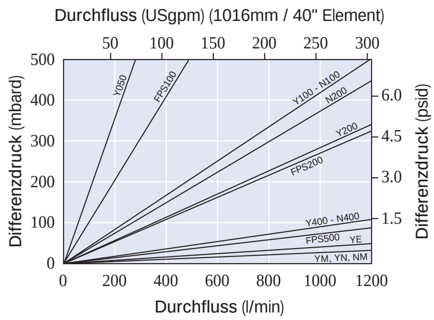
Maximaler zulässiger Differenzdruck	Betriebstemperatur Polypropylene	Nylon	Polyphenylene Sulphide (PPS)
4.0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1.0 bard (14.5 psid)	82 °C (179.6 °F)	130 °C (266 °F)	204 °C (400 °F)

[1] Kompatible Flüssigkeiten sind definiert als Flüssigkeiten, die die Filterkomponenten nicht aufquellen, aufweichen oder angreifen

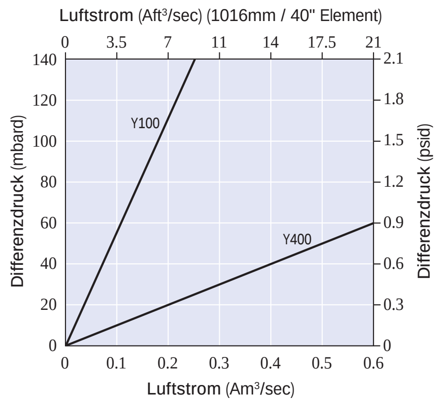
Dichtungen für die Stützkörper (nur herausnehmbare Variante)

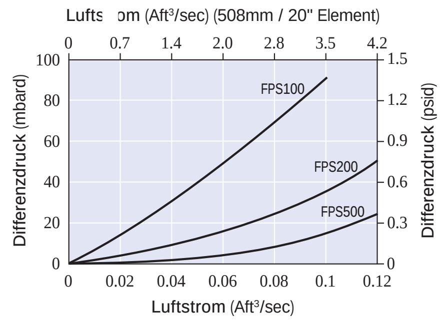
Dichtungsmaterial
EPR
Fluorcarbon-Elastomer
FEP ummanteltes FPM
NBR

Flussraten



* Für reines Wasser bei Raumtemperatur. Bei Flüssigkeiten mit einer anderen Viskosität als 1cP ist der ΔP mit der Viskosität in cP zu multiplizieren.





* Für Luft bei einer Viskosität von 0,018cP. Korrektur bei anderen Gasen: Wert aus Diagramm multiplizieren mit

$$\frac{\text{Gasviskosität}}{\text{0,018cP (Luft)}} = \text{Tatsächlicher Druckabfall}$$

Bestellinformationen

Diese Information dient als Anleitung für die Auswahl der Artikelnummer und möglicher Optionen. Für Informationen über spezifische Optionen wenden Sie sich bitte an Pall. Informationen über Gehäuse erhalten Sie ebenso bei Pall.

Artikelnummer Filterelement: E 60 ☐ ☐ (Tabelle 1, Tabelle 2)   **Stützkörper (austauschbare Variante), Artikelnummer: EH S 60 ☐ ☐** (Tabelle 1, Tabelle 3)

Tabelle 1: Längen

Code	Beschreibung
2	508 mm (20")
4	1016 mm (40")

Tabelle 3: Dichtungsvarianten für die Stützkörper

Code	Beschreibung
J	EPR
HB	Fluorcarbon-Elastomer
H1	FEP ummanteltes FPM
H13	NBR

Tabelle 2: Filtermedien

Polypropylen[2]	Nylon[2]	Polyphenylensulfid (PPS)[3]	Rückhalterate (μm) in Flüssigkeiten	Rückhalterate in Gasen bei 0.3 μm[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99,997 % (Y100) 99,999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99,995 % (Y400)
—	—	FPS500	50	99,869 % (FPS500)
YE[5]	—	—	Medien mit grober Porenstruktur für elektrostatische Lackierung	
YM[5]	NM	—	Medien mit grober Porenstruktur für Glimmer Farben	
YN[5]	—	—	Medien mit grober Porenstruktur für Glimmer Farben	

[2] Beta 5000, [3] Beta 1000, [4] In laborversuchen mit natriumchloridaerosolen bei 300 m³ N/h bestimmt, [5] Bei Pall Coreless Filterelementen für Lackieranwendungen werden keine Rückhalteraten angegeben.

Austauschdichtungen für den Stützkörper

O-ring	
EPR	CA53418 und ORJPW-111P
Fluorcarbon-Elastomer	LS00372 und LS00429
FEP ummanteltes FPM	CC62592 und CC62591
NBR	LS0043 und LS543

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FBSPAKLWADE Gedruckt in GB. Februar 2010

Pall Corporation

Elementi filtranti Pall® Coreless

Gli elementi filtranti Pall Coreless combinano la sperimentata tecnologia di filtrazione di profondità di Pall Profile® con un design che elimina la struttura interna di supporto al fine di fornire una soluzione conveniente, economica ed ecologica per le applicazioni con portate di fluido elevate.

L'elemento filtrante con ampio diametro ha un setto filtrante in polipropilene, nylon o in solfuro di polifenilene (PPS) con bassa perdita di carico, quindi per una determinata portata sono necessari meno elementi filtranti. I contenitori sono proporzionalmente più piccoli consentendo ridotti costi di investimento, di installazione e di gestione.

Convenienza

L'elemento filtrante Pall Coreless si adatta su una struttura interna di supporto in acciaio inossidabile 316l, che è fissata all'interno del contenitore del filtro. Al momento del cambio, l'elemento viene semplicemente sfilato dalla struttura interna che è pronta per accettare l'elemento di sostituzione. Avendo fissata la struttura di supporto all'interno del contenitore, il design Coreless riduce significativamente la quantità di prodotti da smaltire, consentendo un costo inferiore e una scelta più ecologica.

Efficienza

Gli elementi filtranti Pall Coreless utilizzano gli sperimentati vantaggi della tecnologia di filtrazione di profondità esclusiva del setto Pall Profile. La combinazione di una sezione del prefiltro con una porosità a scalare e di uno strato interno ad elevate prestazioni è ideale, poiché consente una pressione differenziale bassa, elevate portate di liquido e una lunga durata.

Qualità

L'elemento filtrante Pall Coreless è prodotto secondo il più elevato standard di garanzia di qualità e pulizia e in conformità a BS EN ISO 9001:2008.

Materiali

Elemento filtrante	Polipropilene, Nylon o Solfuro di Polifenilene (PPS)
Struttura interna di supporto	Acciaio inossidabile 316L

Elemento filtrante Pall Coreless

Caratteristiche

- Cartuccia a diametro ampio che prevede l'utilizzo di setto filtrante con bassa perdita di carico.
- Struttura interna in acciaio inossidabile fissata all'interno del contenitore del filtro.
- Tecnologia di filtrazione di profondità sperimentata/struttura con porosità a scalare
- Setto filtrante in polipropilene, nylon o in solfuro di polifenilene (PPS).
- Design completamente smaltibile.

Benefici

- Sistemi più piccoli con minori costi di investimento, di installazione e di gestione.
- Capacità di portate elevate di liquido, agevole manutenzione, costi di gestione bassi e maggiori vantaggi economici.
- Prestazioni di filtrazione affidabili, sicure e controllabili.
- Compatibile con una vasta gamma di applicazioni.
- Meno prodotti di scarto, costi inferiori di smaltimento e più ecologico.

Informazioni tecniche

Caratteristiche operative in fluidi compatibili[1]

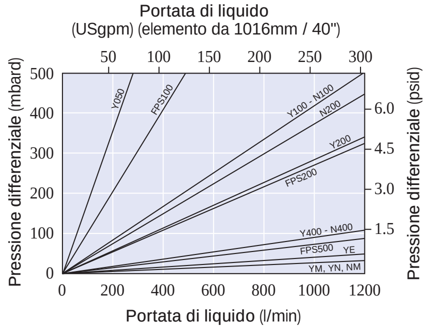
Pressione differenziale massima	Temperatura di esercizio Polipropilene	Nylon	Solfuro di polifenilene (PPS)
4,0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1,0 bard (14,5 psid)	82 °C (179,6 °F)	130 °C (266 °F)	204 °C (400 °F)

[2] Sono liquidi compatibili quelli che non si propagano, che non ammorbidiscono o intaccano i componenti filtranti.

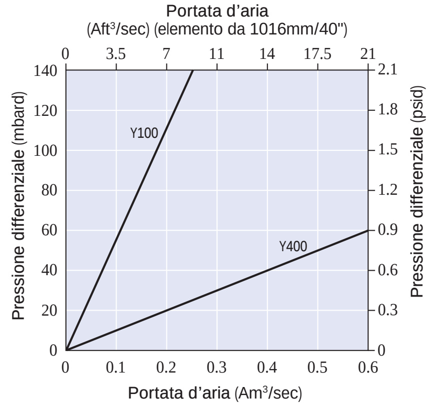
Tenuta della struttura interna (solo opzione rimovibile)

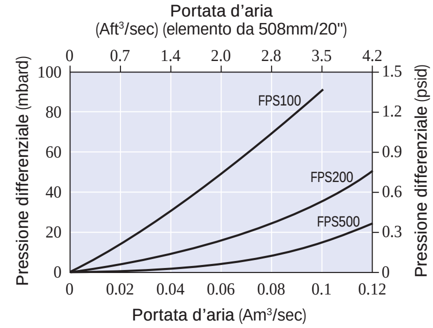
Materiale di tenuta
EPR
Flurocarbonio Elastomero
FEP encapsulated Fluorocarbonio Elastomero
Nitrilo

Portate



* Per l'acqua pulita a temperatura ambiente per i liquidi di viscosità diversa da 1cP moltiplicare la ΔP per la viscosità in cP.





* Per l'aria a una viscosità di 0,018cp. Correzione di altri gas: Utilizzare le istruzioni del grafico x

$$\frac{\text{Viscosità del gas}}{\text{0,018cP (Aira)}} = \text{caduta di pressione effettivo}$$

Informazioni per gli ordini

Queste informazioni rappresentano una guida per la struttura del codice articolo e per opzioni possibili. Per informazioni sulla disponibilità di opzioni specifiche, contattare Pall. Fare riferimento a Pall per dettagli sul contenitore.

Codice. dell'elemento: E 60 ☐ ☐ (Tabella 1, Tabella 2)

Codice articolo struttura interna di supporto (opzione removibile): EH S 60 ☐ ☐ (Tabella 1, Tabella 3)

Tabella 1: Opzioni di lunghezza

Codice	Descrizione
2	508 mm (20")
4	1016 mm (40")

Tabella 3: Opzioni di guarnizioni della struttura interna di supporto

Codice	Descrizione
J	EPR
HB	Fluorocarbonio Elastomero
H1	FEP encapsulated Flurocarbonio Elastomero
H13	Nitrile

Tabella 2: Opzioni del setto filtrante

Polipropilene[2]	Nylon[2]	Solfuro di polifenilene[3] (PPS)	Potere di rimozione di rimozione (μm) nei liquidi	Potere di rimozione in gas a 0.3 μm[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99,997 % (Y100) 99,999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99,995 % (Y400)
—	—	FPS500	50	99,869 % (FPS500)
YE[5]	—	—	Setti filtranti grossolani per utilizzo in bagni di vernice E-coat	
YM[5]	NM	—	Setti filtranti grossolani per utilizzo in applicazioni con vernice mica	
YN[5]	—	—	Setti filtranti grossolani per utilizzo in applicazioni con vernice mica	

[2] Beta 5000, [3] Beta 1000, [4] Determinato con prove di laboratorio usando aerosol di cloruro di sodio a 300 Sm³/h, [5] Gli elementi filtranti per applicazioni di vernice Pall Coreless non hanno indicazioni di potere di rimozione..

Sostituzione guarnizioni della struttura interna di supporto

O-ring	Codice
EPR	CA53418 e ORJPW-111P
Fluorocarbonio Elastomero	LS00372 e LS00429
FEP encapsulated Flurocarbonio Elastomero	CC62592 e CC62591
Nitrile	LS0043 e LS543

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PICOREITc Stampato nel Regno Unito. Febbraio de 2010

Pall Corporation

Бесстержневые фильтрующие элементы «Coreless» компании «Pall®»

Бесстержневые фильтрующие элементы Pall «Coreless» сочетают в себе проверенную технологию глубинной фильтрации «Profile»® компании «Pall» и конструкцию фильтрующего элемента без несущего стержня для удобства, экономичности и благоприятного отношения к окружающей среде при применении в устройствах с высокой скоростью потока.

Фильтрующий элемент большого диаметра изготавливается из материалов с низким перепадом давления - полипропилена, нейлона или полифениленсульфида (ПФС), что снижает количество фильтроэлементов для заданной скорости потока. Размеры корпусов, соответственно, уменьшаются, что приводит к уменьшению капитальных затрат и затрат на установку, а также снижает операционные издержки.

Удобство

Бесстержневой фильтрующий элемент «Coreless» от Pall надевается на стержень из нержавеющей стали 316L, закрепленный внутри корпуса фильтра. При замене фильтра элемент просто снимается со стержня, на который потом надевается новый элемент. Благодаря наличию металлического стержня конструкция «Coreless» значительно уменьшают количество подлежащего утилизации материала, обеспечивая снижение издержек, и более благоприятное отношение к окружающей среде.

Эффективность

Бесстержневые фильтрующие элементы «Coreless» от Pall обладают современными и проверенными преимуществами уникальной технологии глубинной фильтрации на основе фильтрующего материала Pall Profile. Комбинация секции предварительной фильтрации, имеющей плавный градиент размера пор, со внутренней секцией, обладающей высокой удерживающей способностью, является идеальным сочетанием, обеспечивающим низкий чистый перепад давления, высокие скорости потока жидкости и долгий срок службы.

Качество

Бесстержневой фильтрующий элемент «Coreless» от Pall произведен в соответствии с очень высокими стандартами контроля качества и чистоты в соответствии с BS EN ISO 9001:2008.

Материалы конструкции

Фильтрующий элемент	Полипропилен, нейлон или полифенилсульфид (ПФС)
Стержневой узел	Нержавеющая сталь 316LI

Бесстержневые фильтрующие элементы «Coreless» компании «Pall».

Характеристики

- Картридж большого диаметра, использующий фильтроматериал с низким перепадом давления.
- Отдельный стержень из нержавеющей стали, закрепленный в корпусе фильтра.
- Проверенная технология глубинной фильтрации / градиентная структура пор.
- Фильтрующий материал из полипропилена, нейлона или полифенилсульфида (ПФС).
- Конструкция, обеспечивающая полную утилизацию.

Преимущества

- Более компактные системы, не требующие больших капитальных затрат, затрат по установке и значительных операционных издержек.
- Обеспечивает возможность высокой скорости потока жидкости, легкой установки, низких операционных издержек и улучшения экономической эффективности.
- Надежный, последовательный и контролируемый результат фильтрации.
- Пригоден для широкого спектра задач.
- Уменьшение отходов, снижение стоимости утилизации и более благоприятное отношение к окружающей среде.

Техническая информация

Рабочие характеристики в совместимых средах[1]

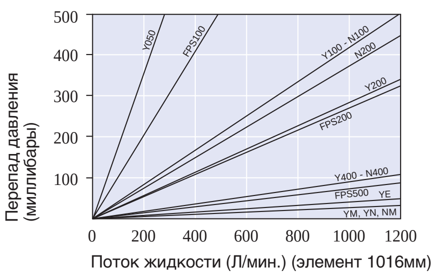
Максимальный перепад давления	Рабочая температура		
	Полипропилен	Нейлон	Полифенилсульфид (ПФС)
4.0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1.0 bard (14.5 psid)	82 °C (179.6 °F)	130 °C (266 °F)	204 °C (400 °F)

[1] Совместимые жидкости – это те жидкости, которые не приводят к разбуханию компонентов элемента, а также не размягчают и не разрушают их.

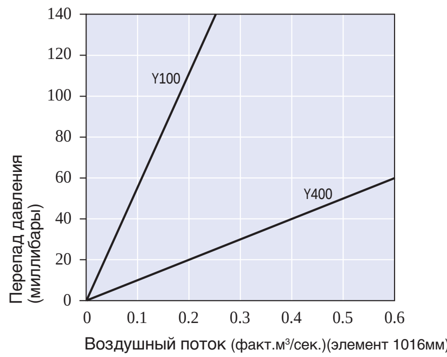
Уплотнения стержневого узла (только для съемных вариантов)

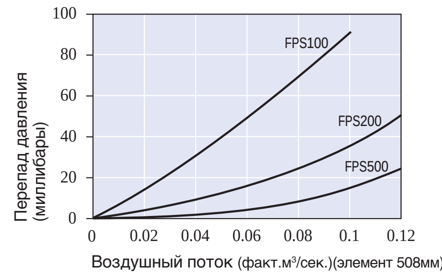
Материал уплотнения
Этиленпропиленовый каучук
Фторуглеродный эластомер
Фторуглеродный эластомер, заключенный в ФЭП
Нитрил

Скорость потока



* Для чистой воды при комнатной температуре, для жидкостей с вязкостью, отличной от 1сП умножьте ўР на коэффициент вязкости в сП.





* Для воздуха вязкостью 0.018сП. Корректировка для других газов: Используйте показатели графика x

$$\frac{\text{Вязкость газа}}{\text{0.018сП (Воздух)}} = \text{Фактический перепад давления}$$

Информация для оформления заказа

Данная информация является путеводителем по системе нумерации деталей и возможных вариантов заказа. О наличии конкретных модификаций, пожалуйста, обращайтесь в «Pall». Также обращайтесь в «Pall» для получения дополнительной информации о деталях корпуса.

Код детали: E 60 ☐ ☐ (Таблица 1, Таблица 2)

Код детали стержневого элемента (съемный вариант): EH S 60 ☐ ☐ (Таблица 1, Таблица 3)

Таблица 1: Длина фильтроэлемента

Код	Описание
2	508 mm (20")
4	1016 mm (40")

Таблица 3: материал уплотнения стержневого узла

Код	Описание
J	Этиленпропиленовый каучук
HB	Фторуглеродный эластомер
H1	Фторуглеродный эластомер, заключенный в ФЭП
H13	Нитрил

Таблица 2: Фильтроматериалы

Полипропилен[2]	Нейлон[2]	Полифенилсульфид (ПФС)[3]	Тонкость фильтрации (мкм) жидкостей	Тонкость фильтрации газов при 3мкм[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99,997 % (Y100) 99,999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99,995 % (Y400)
—	—	FPS500	50	99,869 % (FPS500)
YE[5]	—	—	Фильтроматериалы с крупными порами, применяемые в электролитических ваннах для гальванопокрытий	
YM[5]	NM	—	Фильтроматериалы с крупными порами, применяемые в устройствах для нанесения слюды	
YN[5]	—	—	Фильтроматериалы с крупными порами, применяемые в устройствах для нанесения слюды	

[2] Beta 5000, [3] Beta 1000, [4] Определено на основании лабораторных испытаний с использованием аэрозолей хлорида натрия при расходе 300 ст.м /ч, [5] Для бесстержневых фильтрующих элементов «Coreless» «Pall», применяемых в фильтрации красок, тонкости фильтрации не заданы.

Замена материалов уплотнения стержневого узла

Уплотнительное кольцо	
Этиленпропиленовый каучук	CA53418 и ORJPW-111P
Фторуглеродный эластомер	LS00372 и LS00429
Фторуглеродный эластомер, заключенный в ФЭП	CC62592 и CC62591
Нитрил	LS0043 и LS543

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Filtration. Separation. Solution.SM

PICORERUc Произведено в Соединённом Королевстве. Февраль 2010

Pall Corporation

Elementos filtrantes Coreless de Pall®

Los elementos filtrantes Coreless de Pall combinan la tecnología probada de filtración de profundidad Profile® con un diseño que suprime el núcleo, proporcionando una solución práctica, económica y respetuosa con el medio ambiente para aplicaciones de alto caudal.

El elemento de filtración de gran diámetro está provisto de un medio filtrante de polipropileno, nylon o sulfuro de polifenileno (PPS) de baja presión diferencial, siendo necesarios menos elementos para un mismo caudal. En consecuencia, las carcasas de los filtros son proporcionalmente más pequeñas, reduciendo los costes de inversión e instalación, así como los costes de operación.

Comodidad

El elemento filtrante Coreless de Pall se monta sobre un núcleo de acero inoxidable 316L que se aloja dentro de la carcasa del filtro. Para sustituirlo, simplemente se tira hacia arriba del elemento deslizándolo por el núcleo, el cual queda listo de esta forma para acoger el elemento de repuesto. Como el núcleo metálico se conserva, el diseño Coreless reduce significativamente la cantidad de material de desecho generada, brindando así una alternativa más económica y respetuosa con el medio ambiente.

Eficacia

Los elementos filtrantes Coreless de Pall incorporan las avanzadas y probadas ventajas de la exclusiva tecnología de filtración en profundidad del medio filtrante Pall Profile. La combinación de una zona de prefiltrado con un tamaño de poro graduado y una zona interna de alto rendimiento resulta una combinación ideal, obteniéndose bajas presiones diferenciales a filtro limpio, caudales elevados de fluido y una vida útil prolongada.

Calidad

El elemento filtrante Coreless de Pall se fabrica siguiendo los mayores estádares de aseguramiento de calidad e higiene, de acuerdo con la norma BS EN ISO 9001:2008.

Materiales de construcción

Elemento filtrante	Polipropileno, Nylon o Sulfuro de Polifenileno (PPS)
Conjunto del núcleo	Acero inoxidable 316L

Elemento filtrante Coreless de Pall

Características

- Cartucho de gran diámetro que incorpora medio filtrante de baja presión diferencial.
- Núcleo independiente de acero inoxidable alojado en la carcasa del filtro.
- Tecnología de filtración de profundidad probada y estructura de tamaño de poro graduada.
- Medios filtrantes de polipropileno, nylon o sulfuro de polifenileno (PPS).
- Cartucho completamente desechable.

Ventajas

- Sistemas más pequeños con menores costes de inversión, instalación y funcionamiento.
- Capaz de manejar caudales de líquido elevados, de fácil de montaje, con costes de operación reducidos y rendimiento mejorado.
- Filtración fiable, consistente y comprobable.
- Compatible con una amplia gama de aplicaciones.
- Menor cantidad de materiales de desecho, menores costes de eliminación y cuidadoso con el medio ambiente.

Información técnica

Especificaciones de funcionamiento con fluidos compatibles[1]

Presión diferencial máxima	Temperatura de operación Polipropileno	Nylon	Sulfuro de polifenileno (PPS)
4,0 bard (58 psid)	30 °C (86 °F)	32 °C (89.6 °F)	20 °C (68 °F)
1,0 bard (14,5 psid)	82 °C (179,6 °F)	130 °C (266 °F)	204 °C (400 °F)

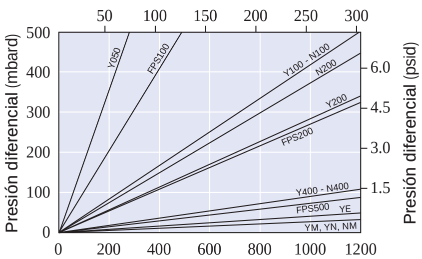
[1]Se entiende por líquidos compatibles aquellos líquidos que no hinchan, ablandan ni atacan ningún componente del filtro.

Juntas del conjunto del núcleo (sólo para la opción desmontable)

Material de las juntas
EPR
Elastómero de Flurorcarbono
Elastómero de Fluorocarbono encapsulado FEP
Nitrilo

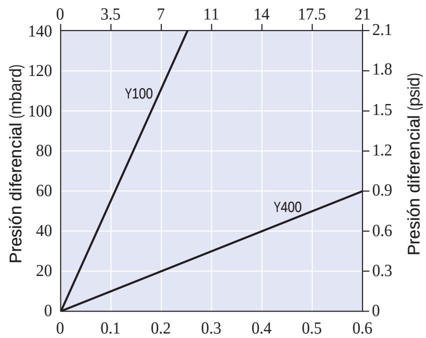
Caudales

Caudal de líquido
(USgpm) (elemento de 1016 mm /40")

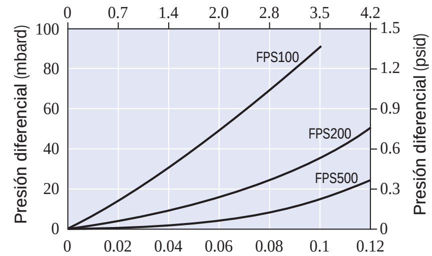


* Para agua limpia a temperatura ambiente. En líquidos cuya viscosidad sea distinta a 1cP, multiplique la pérdida de presión ({U916}p) por la viscosidad en cP.

Caudal de aire
(pies³/s) (elemento de 1016 mm /40")



Caudal de aire
(pies³/s) (elemento de 508 mm / 20")



* Para una viscosidad del aire de 0,018 cP. Corrección para otros gases: lectura del gráfico x

$$\frac{\text{Viscosidad del gas}}{\text{0,018cP (Aire)}} = \text{Caída real de presión}$$

Información para pedidos

Esta información orienta sobre la estructura de los n.º de referencia y las posibles opciones. Para consultar la disponibilidad y las opciones específicas, rogamos se pongan en contacto con Pall. Consulte con Pall también los detalles de las carcasas.

N.º de ref. del elemento: E 60 ☐ ☐ (Tabla 1, Tabla 2)

N.º de ref. del conjunto del núcleo (opción desmontable): EH S 60 ☐ ☐ (Tabla 1, Tabla 3)

Tabla 1: Longitudes disponibles

Código	Descripción
2	508 mm (20")
4	1016 mm (40")

Tabla 3: Juntas disponibles para el conjunto del núcleo

Código	Descripción
J	EPR
HB	Elastómero de Fluorocarbono
H1	Elastómero de Flurorcarbono encapsulado FEP
H13	Nitrilo

Tabla 2: Medios filtrantes disponibles

Polipropileno[2]	Nylon[2]	Sulfuro de polifenileno[3] (PPS)	Grado de filtración (µm) en líquidos	Grado de Retención en Gases de 0.3 µm[4]
Y050	—	—	5	—
Y100	N100	FPS100	10	99,997 % (Y100) 99,999 % (FPS100)
Y200	N200	FPS200	20	—
Y400	N400	—	40	99,995 % (Y400)
—	—	FPS500	50	99,869 % (FPS500)
YE[5]	—	—	Medios groseros para uso en baños de pintura E-coat	
YM[5]	NM	—	Medios groseros para uso en aplicaciones de pintura con mica	
YN[5]	—	—	Medios groseros para uso en aplicaciones de pintura con mica	

[2] Beta 5000, [3] Beta 1000, [4] Determinado por pruebas de laboratorio usando aerosol de cloruro sódico a 300 Sm³/hora, [5] A los elementos filtrantes Coreless de Pall no se les atribuyen grados de filtración para aplicaciones con pinturas.

Juntas de repuesto para el conjunto del núcleo

Juntas tóricas	N.º de referencia
EPR	CA53418 y ORJPW-111P
Elastómero de Fluorocarbono	LS00372 y LS00429
Elastómero de Flurorcarbono encapsulado FEP	CC62592 y CC62591
Nitrilo	LS0043 y LS543

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PICOREESc Impreso en Reino Unido. Febrero de 2010

Pall Corporation

PhaseSep® Coalescer Effectively Separates Liquid/Liquid Dispersions

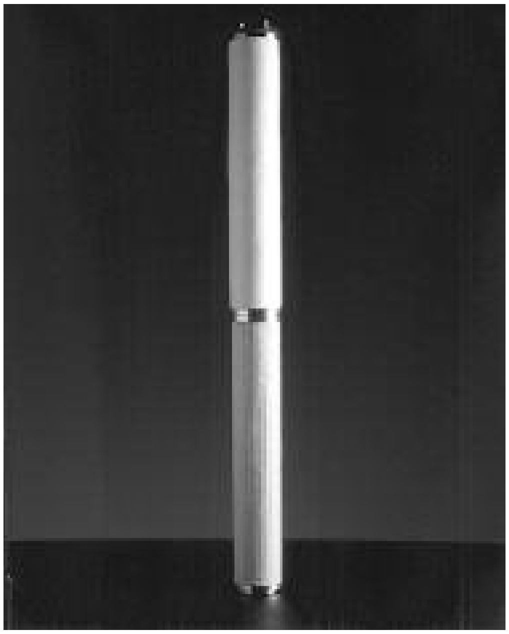

Figure 1: Pall PhaseSep® Liquid/Liquid Coalescer.

Introduction

The inability to efficiently separate liquid/liquid emulsions can be a very costly problem in the oil, gas and chemical industries. Liquid contamination can cause final products to be off-specification, rapid deactivation of downstream catalysts, corrosion of downstream storage facilities, and increased costs for wastewater treatment.

Separating liquid/liquid dispersions can be difficult depending on the physical properties of the two liquid phases. The specific gravity, viscosity and interfacial tension (IFT) of the two liquid phases are important parameters in determining how easy two liquids can be separated. Conventional coalescers begin to lose efficiency when the IFT gets below 20 dyne/cm. In addition, efficient separation is a function of the compatibility of the liquids with the coalescer medium. A good coalescing medium is not necessarily compatible with the liquids and a compatible medium is not necessarily a good coalescing medium.

Pall's PhaseSep® coalescer is available in several types of high efficiency coalescing medium which ensures that a Pall coalescer can be specified for virtually any liquid/liquid separation application in the oil, gas and chemical industries.

Typical Applications for PhaseSep Coalescers

- Removal of carried-over caustic from refinery fuels downstream of caustic treating processes.
- Separation of oil from water.
- Removal of water and caustic from online analyzer sampling systems.
- Separation of water from hydrogen peroxide working solutions.
- Separation of hydrogen peroxide working solutions from hydrogen peroxide.
- Removal of carried-over amine from hydrocarbon downstream of a liquid/liquid amine contactor.
- Removal of oil from ammonia.
- Separation of pyrolysis gas from quench water in ethylene plants.

The Pall PhaseSep system is a multiple stage system starting with filtration to remove particulate matter*, followed by either a one-stage or two-stage coalescer stack to separate the two liquid phases. PhaseSep coalescers will remove a liquid contaminant to a level of 15 ppmv and below over a wide range of conditions such as:

- Inlet liquid contaminant concentration as high as 10%.
- Interfacial tension greater than 0.5 dyne/cm.

* Pall recommends using Pall Ultipleat® High Flow filters with Ultipor® GF medium (β10 µm = 5000) or Pall filters with Epocel® medium (β10 µm = 5000) as a prefilter to extend the life of the PhaseSep coalescer. Consult a Pall distributor to determine compatibility with a specific fluid.

Description

A Pall PhaseSep system is available in two different configurations. Both configurations begin with a filtration stage to remove solid contaminants.

Prefiltration

Due to the fine pore structure of the coalescer medium, Pall recommends that a prefilter be installed upstream of the coalescer assembly. Removal of solids performs the following important functions:

1) Extends the life of the coalescer significantly.
2) Reduces particulate concentration meeting fluid specifications.
3) Decreases stability of the liquid/liquid emulsion, thereby making liquid/liquid separation easier.

Two different housing configurations are available for PhaseSep coalescers. Table 1 provides guidelines for selection.

Table 1: Coalescer Selection Guide

Process Condition	Recommended Product
Dispersed phase fluid is aqueous IFT > 3 dyne/cm.	PhaseSep coalescer/separator stack in a vertical housing
Dispersed phase fluid is aqueous IFT < 3 dyne/cm.	PhaseSep coalescer without separator in a horizontal housing
Both fluids are non-aqueous	PhaseSep coalescer without separator
Dispersed phase fluid is oil, continuous phase fluid is aqueous	PhaseSep coalescer in a horizontal housing without separator

Pall PhaseSep Coalescer/Separator Stack-Vertical Housing Setup

Pall's PhaseSep coalescer/separator stack should be used when the contaminant is an aqueous liquid such as water, caustic, or an amine solution and when the IFT is greater than 3.0 dyne/cm. (see Figure 2). Using Pall's coalescer/separator stack in Pall's unique vertical housing design is the most efficient technique for separating two liquids meeting the above criteria. The liquid/liquid mixture enters the coalescing element and flows inside to outside. This is where small liquid droplets suspended in the continuous phase come together, or coalesce, as the mixture moves through Pall's proprietary coalescer medium.

Contaminant-free liquid and large droplets of the dispersed phase flow toward the separator located directly below the coalescer stage. The flow is outside to inside. The separator medium is hydrophobic preventing the aqueous phase from entering the separator. Only the non-aqueous continuous phase fluid flows through the separator. The two liquids are removed by separate drain connections.

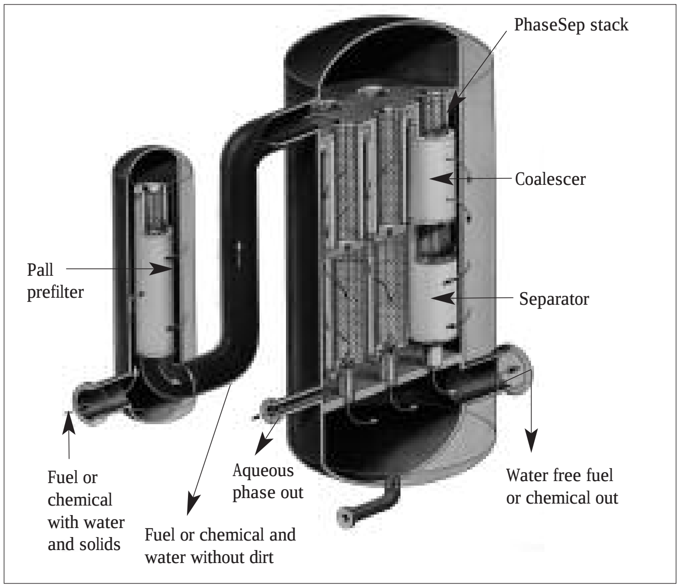

Figure 2: Pall PhaseSep Liquid/Liquid Separation System with Coalescer/Separator Stack in a Vertical Housing.

Pall PhaseSep Coalescer-Horizontal Housing Setup

In general, a PhaseSep coalescer without a separator is placed in a horizontal housing (see Figure 3). Pall's PhaseSep coalescer should be used in applications to separate non-aqueous liquid contaminants such as removing oil from water or separating two non-aqueous liquids. In addition, for liquids with ultra-low IFTs (less than 3.0 dyne/cm.), a PhaseSep coalescer installed in a horizontal housing will provide maximum liquid/liquid separation efficiency

In a horizontal housing, the liquid/liquid mixture enters the coalescing element and flows inside to outside. As is the case with the coalescer/separator stack, small liquid dispersed phase droplets suspended in the continuous phase come together, or coalesce, as the mixture moves through the PhaseSep coalescer. The large coalesced droplets of the dispersed phase separate by gravity in the horizontal housing and are removed. The size of the housing is a function of the IFT, viscosity, and specific gravity of the liquids.

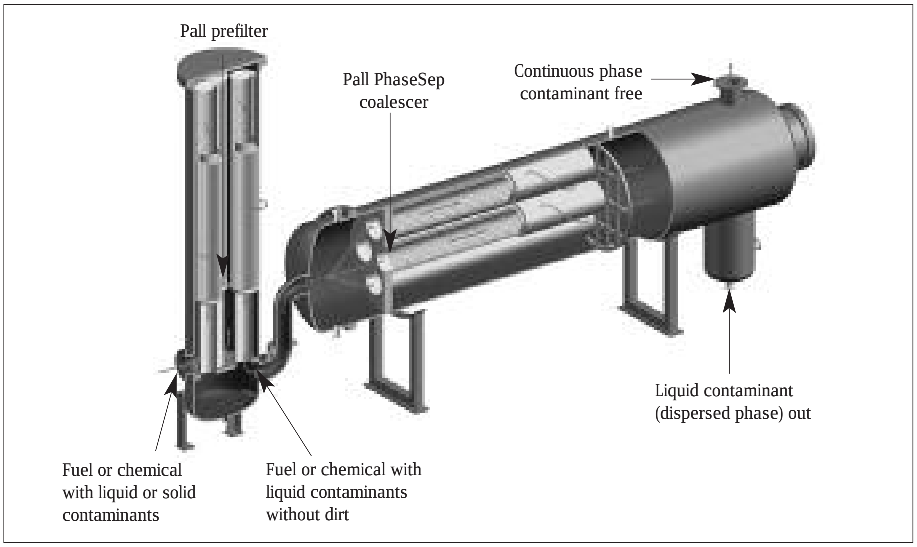

Figure 3: Pall PhaseSep Liquid/Liquid Separation System with Coalescer in a Horizontal Housing.

Benefits

- **Improved Fluid Quality and Value:** The superior liquid and particulate removal efficiency reduces incidents of off-spec product thereby saving reprocessing, downgrade and transportation costs. In addition, carried over liquid contaminants can cause costly corrosion problems in downstream equipment and can rapidly deactivate expensive catalysts in downstream processes.
- **Low-Cost Liquid and Solids Removal:** Due to the PhaseSep coalescer's long life and superior liquid removal efficiency, the overall cost of contaminant removal is low even when compared to other less efficient methods like salt driers, electrostatic separators and sand filters. Used in conjunction with these other removal techniques, the PhaseSep system will significantly reduce operating costs.
- **High-Performance Stack Design Results in Smaller Assembly Size:** The high performance PhaseSep system stack design promotes even flow distribution permitting a high rate of flow. As a result, fewer separator cartridges are required and this results in a small economic assembly size.
- **Lower Disposal and Maintenance Costs:** The long useful life of the PhaseSep cartridges obtained from Pall's specially formulated medium and prefilter results in fewer cartridge changeouts, reducing maintenance and changeout costs and cartridge disposal costs.
- **Quick Recovery from Process Upsets:** Pall's vertical vessel/stack design is much more forgiving when it comes to changes in process conditions. Because of the hydrophobic separator in the PhaseSep system stack, an increase in liquid contaminant concentration will have little or no effect on the effluent quality.
- **Separation of Ultra-Low IFT Emulsions:** PhaseSep coalescers have excellent coalescing properties, which can separate liquids that have ultra-low IFTs heretofore unable to be separated by conventional coalescers. With the combination of the PhaseSep coalescer and Pall's specially designed horizontal housing, the PhaseSep system has separated liquid/liquid emulsions with an IFT greater than 0.5 dyne/cm. Conventional coalescers begin to rapidly lose separation efficiency when the IFT gets below 20 dyne/cm.

Features

- **Unique Stack Design:** Pall's coalescer element is stacked on top of a separator element. This unique configuration optimizes the flow distribution from the coalescer to the separator, ensuring that each separator has an equal flow. In conventional two-stage systems, the separators are located at different distances from the coalescer, causing an unequal distribution of flow to the separator. These conventional two stage systems require several coalescer elements for each separator. Pall's stack design results in overall smaller assembly size and a longer coalescer/separator life.
- **Fluid Compatibility:** Pall's PhaseSep coalescer is available in several different materials to insure compatibility with virtually any type of liquid/liquid mixture.
- **Non-Disarming Medium:** Pall's non-disarming medium ensures the longest possible service life. Pall's specially formulated medium contains no glass fiber and does not disarm in the presence of surfactants. Disarming occurs when surfactants (either natural or additives) "coat" the surface of the medium thereby reducing the coalescing properties of the medium and the separation efficiency.

Performance Claims and Specifications

Maximum Temperature:	149°C/300°F
Initial Pressure Drop:	0.138 bard/2 psid
Recommended Changeout:	1.033 bard/15 psid

Ordering Information

Part Number	Description	Outer Diameter (cm/in)	Length (cm/in)
LCS2H1AH	PhaseSep Coalescer	9.53/3¾	50.8/20
LCS4H1AH	PhaseSep Coalescer	9.53/3¾	101.6/40
LSS2F1H	Separator	9.53/3¾	50.8/20

Compatibility

The PhaseSep coalescer is compatible with many corrosive chemicals encountered in the chemical and petrochemical industries like strong mineral and oxidizing acids, alkalies, metal etchants, liquid oxygen and essentially all organic solvents. For compatibility information with a specific chemical, please contact your Pall distributor or applications engineer.

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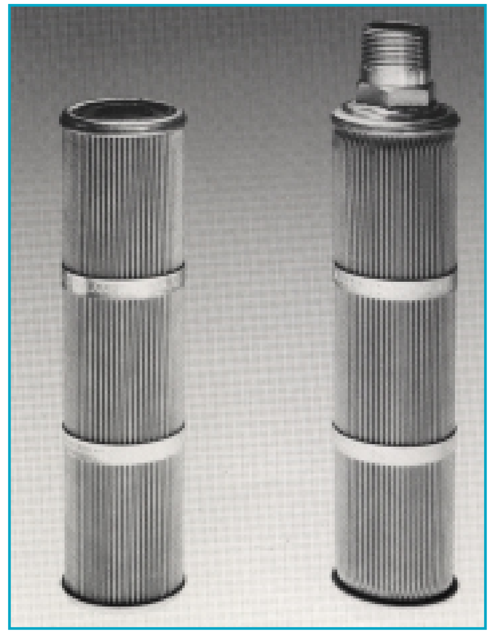
regenerable

PMM® Filter Elements

Description

PMM® medium is a thin, sintered matrix of 316L stainless steel powder within the pore structure of stainless steel wire mesh. It combines the best qualities of Pall PSS® sintered powder medium and Pall Rigimesh® sintered woven wire mesh medium. The **PMM** filter is designed so that the sintered bonds are at the points of contact, producing an extremely strong porous material whose wires do not shift and whose pore size integrity is continuously maintained. Designs are available suitable for temperatures up to 1250°F (677°C).



Operating Characteristics

Standard cartridges are capable of withstanding a minimum collapse differential pressure of 125 psid (8.6 bard) in the forward flow (outside-in) direction at up to 600°F† (315°C) and 10 psid (.7 bard) in the reverse flow direction. Optional design available for 50 psid (3.4 bard) reverse flow.

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F (232°C).

Sizes

The standard **PMM** filters are cylindrical forms, 2-½" in diameter in 10" multiple lengths, up to 40". For AB style **PMM** filters consult the factory.

Technical Information

Table 1. PMM elements and their characteristics

Filter Grade	Removal Ratings						Clean Pressure Drop				Recommended Flow Density	
	Liquid Service[1]				Gaseous Service[2]		Liquid Service		Gaseous Service			
	Rating at % Efficiency (µm) 90%	99%	99.9%	100%	Weight % Removal	100% Removal (µm)	Aqueous[3] psi/gpm/ft²	mbar/lpm/m³	Air[4] psi/acfm/ft²	mbar/m³/hr/m²	Aqueous gpm/ft²	Air acfm/ft²
M020	0.1	0.5	1	2	>99.99	0.4	0.87	1.47	0.093	.350	0.1-75	3-10
M050	0.6	2	4	5	99.99	0.6	0.49	.83	0.051	.192	0.1-75	3-10
M100	2	5	8	10	99.97	1.3	0.28	.47	0.030	.113	0.2-1	5-20
M150	5	9	12	15	99.96	2.5	0.17	.29	0.017	.064	0.5-3	7-25
M200	8	13	16	20	99.93	4.0	0.07	.12	0.007	.026	0.7-4	10-30
M250	10	16	21	25	99.90	9.0	0.02	.03	0.002	.008	1-5	15-40

(1) Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.
(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.
(3) Pressure drop obtained by multiplying value shown by actual flow desired, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area selected. See Table II for areas.
(4) Pressure drop in obtained by multiplying value shown by actual gaseous flow rate desired, ratio of viscosities, all divided by total filtration area selected. See Table II for areas.

Part Numbers/Ordering Information

Table II. Standard Configurations of PMM Elements

100% Removal Rating (µm)	PMM Series Element Part Numbers	
	1000 Series	Threaded Element 1000 Series
2	MBS 100 ■ M020 ▲	P24 ◆ ● M020 ▼
5	MBS 100 ■ M050 ▲	P24 ◆ ● M050 ▼
10	MBS 100 ■ M100 ▲	P24 ◆ ● M100 ▼
15	MBS 100 ■ M150 ▲	P24 ◆ ● M150 ▼
20	MBS 100 ■ M200 ▲	P24 ◆ ● M200 ▼
25	MBS 100 ■ M250 ▲	P24 ◆ ● M250 ▼

■ Code	◆ Code	Nominal Length (in.)	Area ft²	m²
1	**10**	10	1.5	.14
2	**20**	20	3.0	.28
3	**30**	30	4.5	.42
4	**40**	40	6.0	.26

▲ Code	Gasket Option
H13 (Std.)	Buna N (Nitrile)
H	Viton*
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service
RE	Reinforced for 50 psid (3.4 bard) reverse flow

*Trademark of E.I. du Pont de Nemours & Co.

● Code	Connection
4	1″ NPT
6	1¹/₂″ NPT

▼ Code	Other Options
RE	Reinforced for 50 psid (3.4 bard) reverse flow
C9	Cleaned for oxygen service

Housing Information

A full selection of standard Pall industrial housings are available for **PMM** elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) (426°C) and chemical service. Custom designed housings for specific applications are also available.

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27967/CS4M/06.2002

Pall Corporation

PSS® Series Filter Elements

Description

The PSS® Series filter medium is composed of 316 low-carbon stainless steel powder sintered together in an inert environment. The resulting fixed pore structure medium provides quantitative particle removal efficiency without media migration or particle unloading. The inherently high void volume of this medium offers low resistance to flow and high dirt holding capacity. These filters offer broad temperature and chemical compatibility with the added economy of being repeatedly cleanable. PSS filters are used in many applications within the chemical process industry, in many aggressive environments, where critical filtration levels are required. Such applications include industrial gases (cryogenic and high temperature), steam, solvent, heat transfer fluids, polymers, chemical intermediates, food and beverages. PSS Series filter media have high chemical stability and do not impart taste, odor or extractables to the effluent. Designs are available for temperatures up to 1250°F with appropriate alloy selection.

Figure 1. Standard PSS Series Filter Elements

Operating Characteristics

Standard 316 stainless steel cartridges are capable of withstanding a minimum collapse differential pressure of 50 psid in the forward flow (outside-in) direction to 600°F † and 50 psid in the reverse flow direction.

† *Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450°F.*

Sizes

Standard PSS filters are available in three styles. Industrial (1000 style) cartridges are 2 ⅜-inch diameter double open-ended modules in incremental lengths of 10 inches; sanitary design (AB style) are closed on one end with an O-ring piston seal on the other end; and cylindrical elements, which are 1 ½-inches or 2 ⅜-inches in diameter, closed on one end with a threaded fitting connection on the other.

Table 1. PSS Elements And Their Characteristics

Filter Grade	Removal Ratings						Clean Pressure Drop		Recommended Flow Density	
	Liquid Service(1)				Gaseous Service(2)		Liquid Service	Gaseous Service		
	Rating in µm at % Efficiency				Weight %	100%	Aqueous Pressure Drop(3)	Air Pressure Drop(4)	Aqueous	Air
	50%*	90%	99%	100%	Removal	Removal µm	psi/gpm/ft²	psi/acfm/ft²	gpm/ft²	acfm/ft²
PO5	0.5	2	3	5	99.99	0.4	0.85	0.091	0.5 - 2	5 - 10
PO9	2	4	7	9	99.98	0.8	0.27	0.030	0.75 - 3	10 - 30
H	5	7	9	13	99.97	1.3	0.23	0.024	1 - 4	15 - 40
F	8	12	15	20	99.94	2.8	0.052	0.0054	2 - 6	15 - 50
E	15	22	25	35	99.80	11.0	0.019	0.0013	2 - 7	20 - 60
D	20	28	40	55	99.50	20.0	0.0068	0.0007	3 - 10	25 - 80

* *These removal ratings should be used when comparing PSS to competitive grades.*

(1) *Liquid removal efficiency ratings are based on a modified F2 test method and actual particle count data.*

(2) *Weight percent removal data based on AC Fine Test Dust in air. Absolute retention ratings based on actual particle count.*

(3) *Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft²) selected. See Table 2 for area.*

(4) *Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities* $\frac{\text{Actual viscosity of gas (in cp)}}{\text{0.018 (viscosity of air)}}$ *all divided by total filtration area (ft²) selected. See Table 2 for area.*

Part Numbers/Ordering Information
Table 2. Standard Configuration of PSS Elements

100% Removal Rating	PSS Series Element Part Number: 100 Series	AB Series	Cylinder Series: 2 ⅜" Diameter Elements With 1" or 1 ½" NPT[5]	1 ½" Diameter Elements With ¼" NPT[5]
5	MBS100■PO5▲	AB■PO57▲	C-23-●◆PO5	C-14-★◆PO5
9	MBS100■PO9▲	AB■PO97▲	C-23-●◆PO9	C-14-★◆PO9
13	MBS100■PH▲	AB■PH7▲	C-23-●◆PH	C-14-★◆PH
20	MBS100■PF▲	AB■PF7▲	C-23-●◆PF	C-14-★◆PF
35	MBS100■PE▲	AB■PE7▲	C-23-●◆PE	C-14-★◆PE
55	MBS100■PD▲	AB■PD7▲	C-23-●◆PD	C-14-★◆PD

Code ▲	Gasket Option
H13	Nitrile (Std.)
H	Fluorocarbon Elastomer
J	Ethylene Propylene
J7	Ethylene Propylene for Steam Service

Code ■	Nominal Length (in)	Area (ft²)
1	10	0.5
2	20	1.0
3	30	1.5

Code ◆	Connection
1	¼" NPT
4	1" NPT
6	1 ½" NPT

Code ●	Nominal Length (in)	Area (ft²)
06	6	0.31
09	9	0.47
18	18	0.9
19	19[5]	0.98

Code ★	Nominal Length (in)	Area (ft²)
06	6	0.2
09	9	0.29
18	18	0.59

[5] C-23-19 has connection Code 6. Other C-23 part numbers have Code 4. All C-14 part numbers have Code 1.

Housing Information

A full selection of standard Pall industrial housings are available for use with PSS elements. Custom designed housings for specific applications are also available. Contact your Pall representative for more information.

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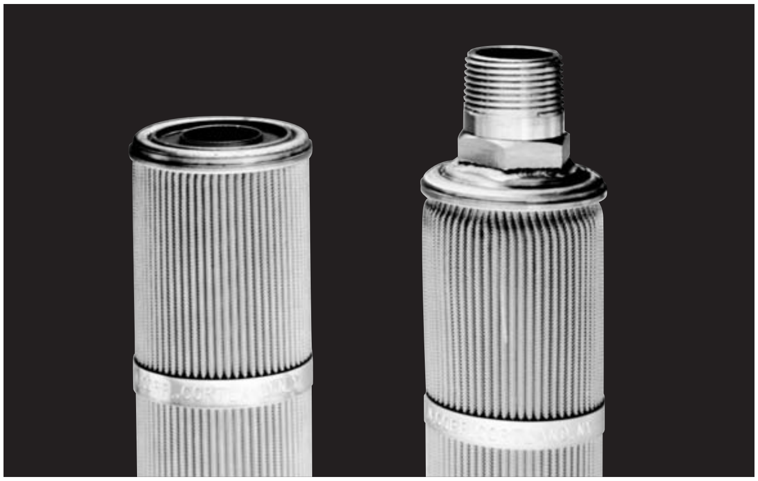
Bulletin #E12c 2/08

Pall Corporation

Rigimesh® Filter Elements



Description

Rigimesh® porous metal filter elements are extremely permeable and are constructed of high dirt capacity stainless steel (type 304 or 316L) woven wire mesh. Rigimesh media outperform other meshes because they are sintered woven wire meshes with higher void space. Pall sinters the wires at their points of contact, producing an extremely strong porous material whose wires will not shift under stress and whose pore size integrity is continually maintained. This patented Pall process permits use of finer diameter wires in manufacturing the filter medium. The net result is a filter with more pores per unit area, providing more dirt-holding capacity than that of an unsintered mesh made from coarser wires. Designs are available which are suitable for temperatures up to 600˚F/315°C.

Operating Characteristics

Standard cartridges are capable of withstanding a collapse differential of 125 psid in the forward flow (outside-in) direction and up to 600°F† and 10 psid in the reverse flow direction.

Sizes

The standard Rigimesh filters are cylindrical forms of pleated medium, 2 ½ inches in diameter in 10 inch multiple lengths, up to 30 inches. For AB style Rigimesh filters consult the factory.

Table I. Rigimesh Elements and Their Characteristics

Filter Grade	Removal Ratings				Clean Pressure Drop		Recommended Flow Density	
	Liquid Service[1] Rating In µm At % Efficiency		Gaseous Service[2]		Liquid Service	Gaseous Service	Aqueous	Air
	98%	100%	Weight % Removal	100% Removal (µm)	Aqueous Pressure Drop[3] psi/gpm/ft^2	Air Pressure Drop[4] psi/acfm/ft^2	gpm/ft^2	acfm/ft^2
Z*	1.5	15	99.92	2	0.035	0.0038	1 – 5	10 – 40
K	5	18	99.45	13	0.0073	0.0008	2 – 8	20 – 60
J	10	25	99.20	18	0.0020	0.00025	3 – 10	25 – 80
M	17	45	98.65	25	0.0015	0.00019	4 – 15	30 – 100
R	40	70	–	55	0.0006	0.00008	5 – 20	35 – 150
S	70	105	–	85	0.0004	0.00006	6 – 25	40 – 200
T	145	225	–	175	0.0003	0.00005	7 – 30	45 – 240
A	300	450	–	350	Negligible	Negligible	8 – 40	50 – 300

† Threaded connector series only. Due to seal limitations, 1000 Series suitable for applications up to 450˚F.

* Supramesh sintered powder metal and mesh composite medium.

(1) Liquid removal efficiency ratings are based on hard spherical particles.

(2) Weight percent removal data is based on AC Fine Test Dust in air. Absolute retention ratings are calculated values.

(3) Pressure drop in psi obtained by multiplying value shown by actual flow desired in gpm, viscosity of liquid in centipoise (if other than 1 cp), all divided by total filtration area (ft^2) selected. See Table II for areas.

(4) Pressure drop in psi obtained by multiplying value shown by actual gaseous flow rate desired (acfm), ratio of viscosities $\frac{\text{actual cp of gas}}{\text{0.018 (viscosity of air)}}$ all divided by total filtration area (ft^2) selected. See Table II for areas.

Table II. Standard Configurations of Rigimesh Elements

100% Removal Rating (µm)		Rigimesh Series Element Part Numbers	
Liquids	Gases	1000 Series	Threaded Element Series
15	2	MB ■ 100 ▼ RZ ●	◆ – 24 – ▲ – ■ – RZ
18	13	MB ■ 100 ▼ RK ●	◆ – 24 – ▲ – ■ – RK
25	18	MB ■ 100 ▼ RJ ●	◆ – 24 – ▲ – ■ – RJ
45	25	MB ■ 100 ▼ RM ●	◆ – 24 – ▲ – ■ – RM
70	55	MB ■ 100 ▼ RR ●	◆ – 24 – ▲ – ■ – RR
105	85	MB ■ 100 ▼ RS ●	◆ – 24 – ▲ – ■ – RS
275	175	MB ■ 100 ▼ RT ●	◆ – 24 – ▲ – ■ – RT
450	350	MB ■ 100 ▼ RA ●	◆ – 24 – ▲ – ■ – RA

Gasket Options	● Code
Viton*	H
Teflon*	H2
Silicone	H4
Buna-N (Std.)	H13
Ethylene Propylene	J
Butyl	J1
Neoprene	J2
Ethylene Propylene for Steam Service	J7

Nominal Length (in)	■ Code (Area (ft^2)) MB S / MB L	MB F / MB LF
10	1.0	2.0
20	2.0	4.0
30	3.0	6.0

Nominal Length (in)	▼ Code
10	1
20	2
30	3

Area (ft^2)	◆ Code P	F
1.0	1.0	–
2.0	2.0	4.0
3.0	3.0	–
4.0	–	4.0
6.0	–	6.0

Nominal Length (in)	▲ Code
10	10
20	20
30	30

Housing Information

A full selection of standard Pall industrial housings are available for Rigimesh elements. Threaded connector elements are designed to fit a special line of housings capable of a broader range of temperature (cryogenic to 800°F) and chemical service. Custom designed housings for specific applications are also available.

Connection	■ Code
1″ NPT	4
1 $^1/_2$″ NPT	6

S= 304 hardware and 304 L medium.

L= 316 hardware and 316L medium.

* Trademark of E.I. du Pont de Nemours & Company.

Table III. Housings for Rigimesh Elements

Type of Element	Housing Available
MB ■ 100 Series	See Housing Data Sheets H1, H3-11, and H14-19.
Threaded Connector Series	See Housing Data Sheets H48, H49, and H50.

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Pall Corporation has offices and plants throughout the world. For Pall representatives in your area, please go to www.pall.com/corporate_contact.asp

Please contact Pall Corporation for product applicability to specific National legislation and/or Regional Regulatory requirements for water and food contact use.

Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid.

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SCHUMATHERM™
Products Information

Scanning Electron Micrograph

1. General Material Description

SCHUMATHERM filter elements are a high-quality porous fireclay ceramic. This material is distinguished by its good chemical and thermal resistance. Therefore cylinders or tiles made of SCHUMATHERM filter ceramic can be used for a large variety of applications as long as special process conditions do not require other process specific materials. One main application for SCHUMATHERM filter cylinders is the use as support material for precoat filtration. The surface structure and the high permeability of SCHUMATHERM builds an ideal support for the precoat.

2. Fields of Applications

SCHUMATHERM (ST)	Examples
Precoat filter for liquids	▪ Filtration of beer, water, glucose syrup; beer yeast recovery
Particle filter for gases	▪ Coarse filter for biogas
Diffuser	▪ Aeration of potable water (e.g. de-acidification)
Fluidization	▪ Hot fluidized bed processes; ash transportation; conveying of red. iron slurry

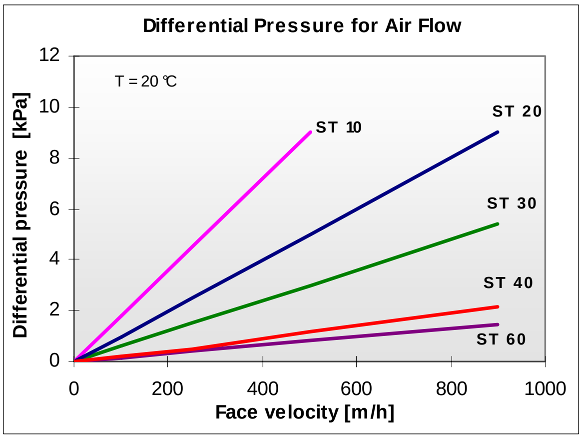
Further applications possible.

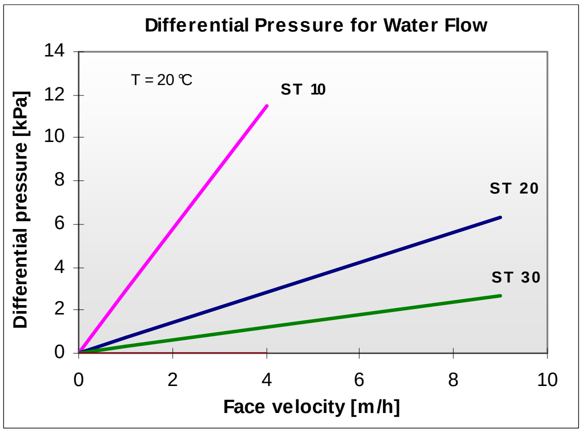
3. Physical Properties

SCHUMATHERM (ST)	Unit	10	20	30	40	60
Filtration fineness for liquids	µm	2.5	15	30	40	50
Filtration fineness for gases	µm	1.5	3	6	8	10
Porosity	%	40	40	35	35	35
Material density	g/cm^3	1.5	1.5	1.5	1.5	1.5
Specific permeability [1]	$10^{-13} m^2$	45	75	125	310	470
Bending strength [2]	MPa	> 12	> 10	> 9	> 9	> 8
Bursting pressure	bar	> 30	> 25	> 20	> 20	> 15
Max. temperature resistance [3]	°C	800	800	800	800	700
Thermal expansion coefficient (25 - 800°C)	$10^{-6}/K$	5.8	5.8	5.8	5.8	5.8
Dimensions Do / Di	mm	70 / 40	70 / 40	70 / 40	70 / 40	70 / 40

[1] = calculated from differential pressure AIR, [2] = O-ring strength, compression, [3] = depending on operating conditions

4. Differential Pressure Diagram





The physical data are valid for the dimensions listed in table „Physical Properties“.

5. Chemical Resistance

SCHUMATHERM filter ceramic is resistant against acids, saline solutions and organic solvents, liquid or gaseous. It is not resist to hydrofluoric acid. SCHUMATHERM filter ceramic is resistant up to pH 10 in the alkaline range.

6. Standard Dimensions

	Type	Do / Di [mm]	Length [mm]	Area [m²]	Weight [kg]
Cylinder	10, 20, 40, 60	70 / 40	500	0.11	2.0
Cylinder	20, 30	120 / 70	500	0.19	5.6
Cylinder	10, 20, 40, 60	70 / 40	1000	0.22	4.0
Tile	20, 30	L x W: 500 x 500	H: 30	0.25	11.3

Special dimensions and special products on request.

7. General Information

- SCHUMATHERM filter ceramic can be utilised in the food and beverage industry in accordance with the German Foodstuffs and Consumer Goods Act and according to the European Directive 89/109/EEC – referring to directives 2002/72/EC and / or 84/500/EEC and their amendments, as appropriate.
- SCHUMATHERM filter ceramicis approved for the utilization in drinking water according to German regulations DVGW W270 and the KTW recommendation.
- SCHUMATHERM filter ceramic can be machined using hard metal tools.
- Ceramic elements are to be handled with care.
- Elements can be glued using commercial or special ceramic glues. Careful consideration should be taken regarding operating temperature and chemical resistance.

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Pall Corporation

UFV03/05/10

UFV Series Filters

ULTIPLEAT® SRT MULTI-ELEMENT FABRICATED VESSELS

Port Size 4", 6" and 8"

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IMUFV3510EN

UFV03/05/10

FABRICATED VESSELS

UFV03/05/10 Series Filters

Technical Information

Features

- Patented laid-over pleat filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to:
  1500 L/min (400 Usgpm), UFV03 Series
  2500 L/min (650 Usgpm), UFV05 Series
  4500 L/min (1200 Usgpm), UFV10 Series
- Maximum pressure to 10 bar (145 psi)
- Port size 4", 6" and 8"

Notes and Specifications

Filter Housing

- Working Pressure Design:
  6 bar (90 psi)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Nitrile Seals -43°C to 80°C
  (-45°F to 175°F)
  Fluorocarbon Seals -29°C to 80°C
  (-20°F to 175°F), 60°C (140°F) maximum in HWCF or water-glycol fluids
- Materials of Construction:
  Carbon steel housing, nozzles and flanges
  Carbon steel transfer valve body with S/S valve ball or S/S butterfly disc on 'D' duplex model
- Finish:
  Interior finish: grit blast then coated with rust preventative
  Exterior finish: grit blast then coated with primer and paint

Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

Fabricated Vessels are designed and manufactured in compliance with ASME and PED requirements. Consult Pall for any further information.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.

	Flowrate		DP vessel	
	(L/min)	(Usgpm)	(mbard)	(psid)
UFV03	500	130	12	0.17
	1000	260	45	0.65
	1500	400	100	1.45
UFV05	500	130	3	0.04
	1500	400	26	0.38
	2000	530	45	0.65
	2500	660	70	1.01
UFV10	1000	260	4	0.06
	2000	530	14	0.20
	3000	790	30	0.43
	4500	1190	67	0.97

Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UFV03 series with 4" split flange ports using AS grade media. Operating conditions 500 L/min flow rate using a lubrication fluid of 150 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.012 x 1.2/0.9) bard (housing) + (500/3 x 0.26/1000) x (150/32 x 1.2/0.9) bard (element)

= 0.016 bard (housing) + 0.271 bard (element)

= 0.287 bard (4.2 psid)

UFV03/05/10 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

UFV [Table 1] [Table 2] [Table 3] [Table 4] **J0** [Table 5] [Table 6] [Table 7]

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

Table 1: Number of Elements

Code	Number of Elements
03	3
05	5
10	10

Table 2: Housing Assembly

Code	Assembly
S	Simplex
D	Duplex

Table 3: Changeover Valves*

Code	Changeover Valves
W	Butterfly Valve
T	Ball Valve

* Use only if duplex assembly is selected

Table 4: By-Pass Valve

Code	By-Pass Valve
G	4.5 bard - 65 psid
B	3.4 bard - 49 psid
N	Without

Table 5: Flange Connection

Code	Size	Rating
4	4" ANSI class 150 flanges	UFV03 series
6	6" ANSI class 150 flanges	UFV05 series
8	8" ANSI class 150 flanges	UFV10 series

Table 6: Seal Options

Code	Seal Options
Z	Fluorocarbon
H	Nitrile

Table 7: Pall Name Plate and Label Instruction Language Options*

Code	Language
EN	English
GR	German
FR	French
IT	Italian
SP	Spanish
DA	Danish
SW	Swedish
FI	Finnish
DU	Dutch
PO	Portuguese

* Use only if duplex assembly is selected

Section 2

Element P/N:

UE 319 [Table 1] **40 Z**

Table 1: Filter Element Options

Code	ßx(c) ≥1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Section 3

Differential Pressure Indicator

All Pall standard visual indicators or electrical switches can be fitted on these vessels. Contact Pall for any further information.

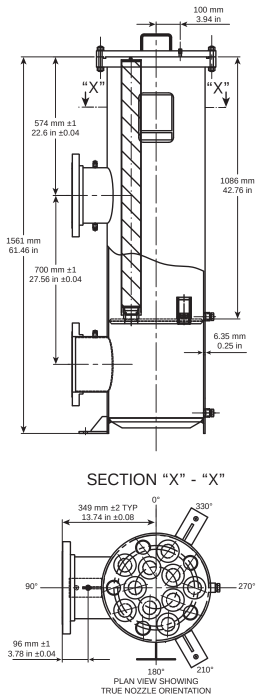
UFV03/05/10

FABRICATED VESSELS

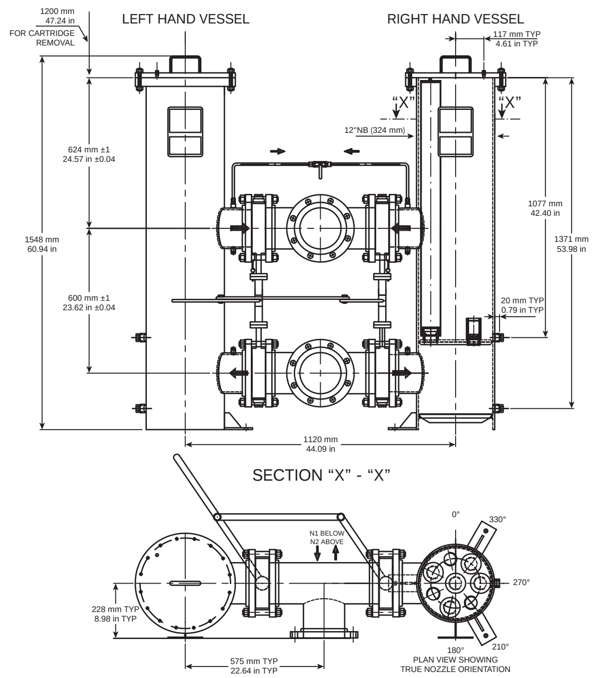
UFV03/05/10 Series Filters

Technical Information

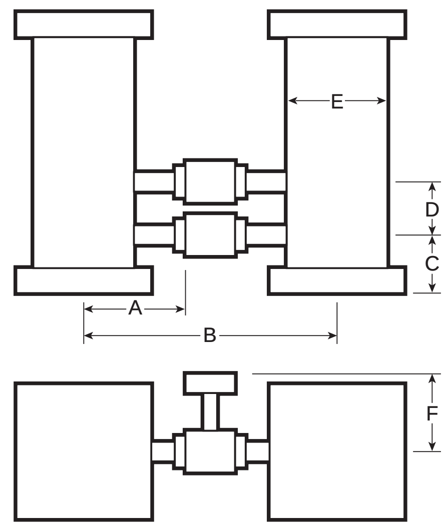
UFV10 Simplex Assembly



UFV05 Duplex Assembly with Butterfly Valve



Dimensional Drawings



UFV03 Series (J04 port option)

	'A' Simplex only	'B' Duplex only - W valve	'B' Duplex only - T valve	'C'	'D'	'E'	'F' Duplex only - W valve	'F' Duplex only - T valve	'G'
mm	245	947	643	190	500	273	178	185	1387
in	9.65	37.28	25.31	7.48	19.69	10.75	7.01	7.28	54.61

UFV05 series (J06 port option)

	'A' Simplex only	'B' Duplex only - W valve	'B' Duplex only - T valve	'C'	'D'	'E'	'F' Duplex only - W valve	'F' Duplex only - T valve	'G'
mm	261	1120	855	234	600	324	228	216	1458
in	10.28	44.09	33.66	9.21	23.62	12.76	8.98	8.50	57.4

UFV10 series (J08 port option)

	'A' Simplex only	'B' Duplex only - W valve	'B' Duplex only - T valve	'C'	'D'	'E'	'F' Duplex only - W valve	'F' Duplex only - T valve	'G'
mm	349	1378	1371	287	700	406	280	335	1561
in	13.74	54.25	53.98	11.3	27.56	15.98	11.02	13.19	61.46

For detailed engineering drawings contact Pall

Pall Corporation

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Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 667,800; EP 982,061; EP 1,380,331; EP 1 656 193; US 5,543,047; US 5,690,765; US 5,725,784; US 6,113,784; US 7,083,564; US 7,318,800.

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IMUFV3510EN Printed in the UK. June 2009

Pall Corporation

UH209

UH209 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Port Size ¾" and 1"

*Filtration. Separation. Solution.*SM

IMUH209ENd

UH209 Series Filters
Technical Information

Features
- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 110 L/min (30 US gpm)
- Pressures to 350 bar (5075 psi)
- Port size ¾" and 1"

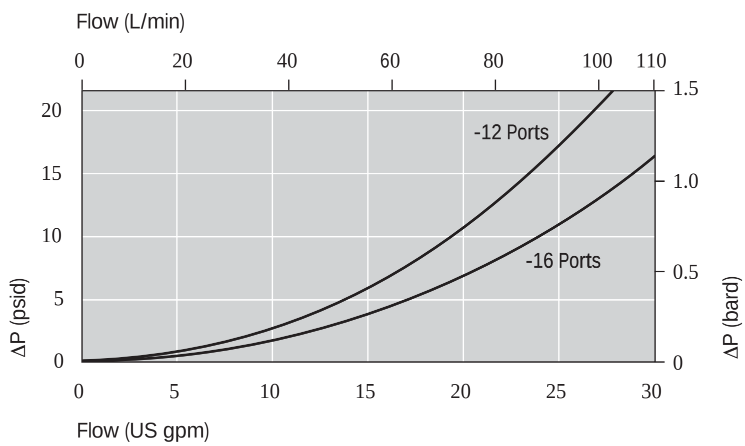
Notes and Specifications
Filter Housing
- Maximum Working Pressure:
  350 bar (5075 psi)
- Rated Fatigue Pressure:
  0-300 bar (4350 psi) per NFPA T2.06.01R2-2001 CAT C/90/* (1 million cycles), verified by testing at 0-353 bar (5120 psi) for 1 million cycles.
  Contact Pall for applications with higher pressures at lower cycles
- Typical Burst Pressure:
  1050 bar (15,225 psi)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Bypass Valve Setting:
  4.5 bard (65 psid)
- Indicator Pressure Setting:
  3.5 bard (50 psid)
- Materials of Construction:
  Head: Ductile Cast Iron
  Tube: Carbon steel

Filter Element
- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop
Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9.
Note: factors are per 1000 L/min and per 1 US gpm.

209 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
03	34.75 (1.904)	13.92 (0.763)	10.62 (0.582)	9.00 (0.493)	7.67 (0.420)
07	15.69 (0.860)	6.29 (0.345)	4.79 (0.262)	4.06 (0.222)	3.46 (0.190)

Sample ΔP calculation
UH209 Series 7" length housing with C16 (1" BSP) threaded ports using AN grade media. Operating conditions 50 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.2 x 1.2/0.9) bard (housing)

+ ((50 x 4.79/1000) x 50/32 x 1.2/0.9) bard element)

= 0.24 bard (housing) + 0.50 bard (element)

= 0.74 bard (11.2 psid)

UH209 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 209 H [Table 1] ++ [Table 2] Z G B

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall. The letter 'B' at the end of the Housing P/N designates an indicator port, fitted with a bleed plug.

Seal Kit P/N:

UH 209 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A12	¾" SAE J514 straight thread
A16	1" SAE J514 straight thread
C12	¾" BSP ISO 228 threads
C16	1" BSP ISO 228 threads

Table 2: Housing Length Options

Code	Length (in)*
03	3
07	7

* Nominal length

Section 2

Element P/N:

UE 209 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
03	3
07	7

* Nominal length

Section 3

Differential Pressure Indicator P/N:

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bard (3000 psid)
SS	Stainless Steel Indicator: use at operating pressures > 200 bard (3000 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

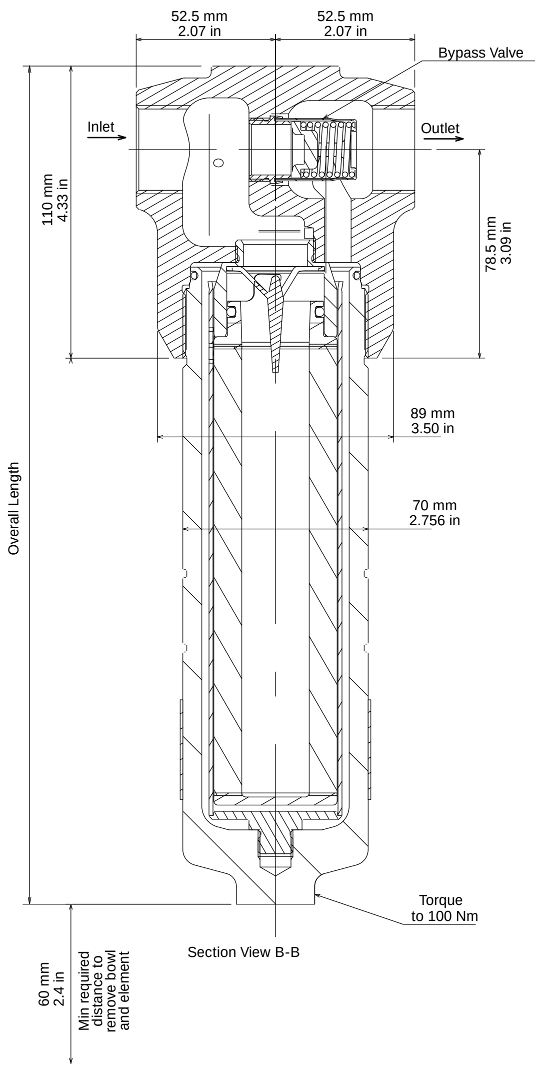
Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

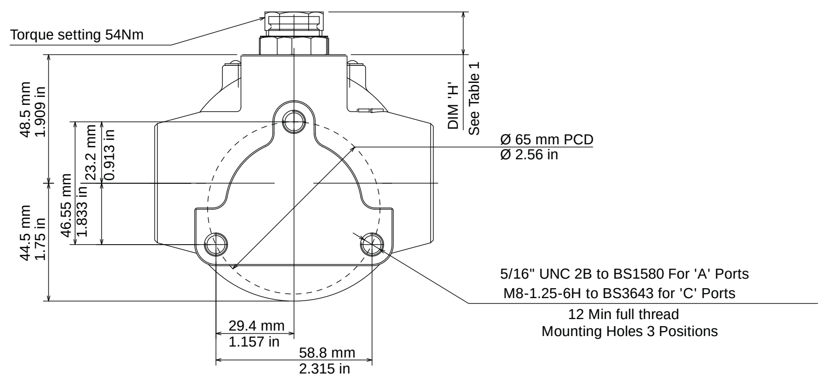
UH209 Series Filters

Technical Information



Section View B-B

Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)	Empty Weight kg (lb)
03	225 (8.9)	60 (2.4)	5.3 (11.7)
07	316 (12.4)	60 (2.4)	6.3 (13.9)



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IMUH209ENd Printed in the UK. April 2008.

Pall Corporation

UH219

UH219 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Port Size 1" and 1¼"

*Filtration. Separation. Solution.*SM

UH219 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 230 L/min (60 US gpm)
- Pressures to 420 bard (6100 psid)
- Port size 1" and 1¼"

Notes and Specifications
Filter Housing

- **Maximum Working Pressure:** 420 bard (6100 psid)
- **Rated Fatigue Pressure:** 0-360 bard (5220 psid) per NFPA T2.06.01R2-2001 CAT C/90/* (6 million cycles), verified by testing at 0-420 bard (6090 psid) for 6 million cycles. Contact Pall for applications with higher pressures at lower cycles
- **Typical Burst Pressure:** 1500 bard (21,760 psid)
- **Fluid Compatibility:** Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- **Temperature Range:** Fluorocarbon Seals: -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F) 60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- **Bypass Valve Setting:** 4.5 bard (65 psid)
- **Indicator Pressure Setting:** 3.5 bard (50 psid)
- **Materials of Construction:** Head and Cover: Ductile Cast Iron Tube: Carbon steel

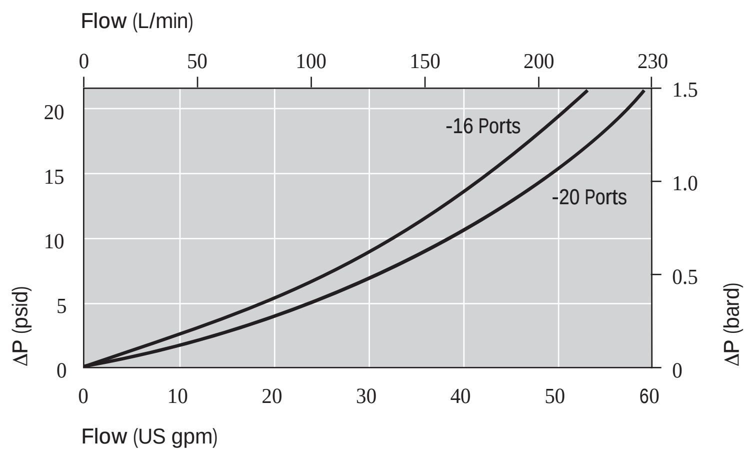
Filter Element

- **Filter Element Burst Pressure:** 10 bard (150 psid)
- **Ultipleat SRT Element Construction:** Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

219 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
04	20.07 (1.102)	8.51 (0.467)	5.72 (0.314)	3.55 (0.195)	2.69 (0.148)
08	9.93 (0.545)	4.21 (0.231)	2.83 (0.155)	1.76 (0.096)	1.33 (0.073)
13	5.95 (0.327)	2.52 (0.139)	1.70 (0.093)	1.05 (0.058)	0.80 (0.044)
20	3.95 (0.217)	1.68 (0.092)	1.13 (0.062)	0.70 (0.038)	0.53 (0.029)

Sample ΔP calculation

UH219 Series 8" length housing with C20 (1¼" BSP) threaded ports using AN grade media. Operating conditions 50 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.21 x 1.2/0.9) bard (housing)

+ ((50 x 2.83/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.28 bard (housing) + 0.29 bard (element)

= 0.57 bard (8.3 psid)

UH219 Series Filters
Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 219 [Table 1] [Table 2] ++ [Table 3] ZG9

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UH 219 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 3: Housing Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Table 2: Housing Port Options

Code	Port
A16	1" SAE J514 straight thread
E16*	1" Flange J518C code 62 with 7/16" -14 UNC holding bolts
A20	1¼" SAE J514 straight thread
E20*	1¼" Flange J518C code 62 with ½"-13 UNC holding bolts
C16	1" BSP ISO 228 threads
G16*	1" ISO 6162 split flange with M12 x 1.75 holding bolts
C20	1¼" BSP ISO 228 threads
G20*	1¼" ISO 6162 split flange with M14 x 2.00 holding bolts

* Maximum operating pressures 400 bar

Section 2

Element P/N:

UE 219 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$ß_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bard (3000 psid)
SS	Stainless Steel Indicator: use at operating pressures > 200 bard (3000 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

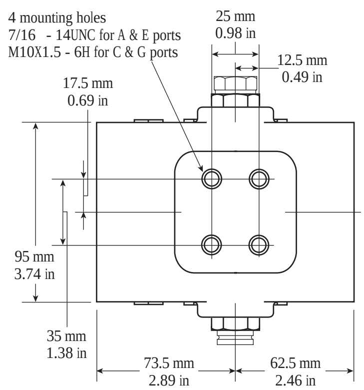
UH219

HIGH PRESSURE FILTERS

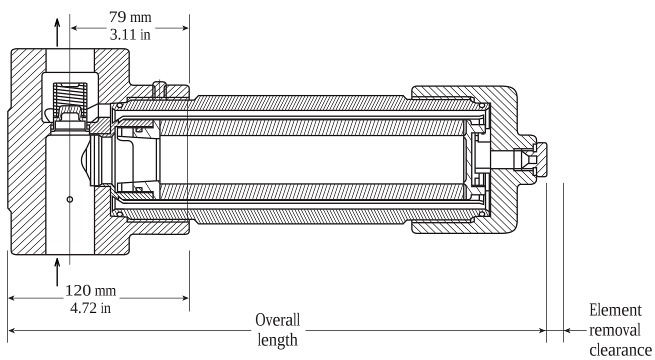
(‘C’ option housing shown)

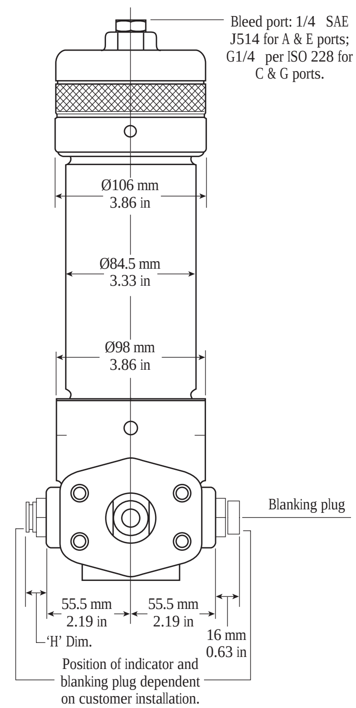
UH219 Series Filters

Technical Information



Length Code	‘C’ Option Overall Length mm (in)	‘H’ Option Overall Length mm (in)	‘C’ Option Element Removal Clearance mm (in)	‘H’ Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
04	255 (10)	267 (10.5)	102 (4)	100 (3.9)	12.7 (28.0)
08	357 (14)	369 (14.5)	203 (8)	100 (3.9)	14.5 (32.0)
13	492 (19.4)	504 (19.8)	338 (13.3)	100 (3.9)	17.0 (37.5)
20	662 (26)	674 (26.5)	508 (20)	100 (3.9)	20.5 (45.2)





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IMUH219ENb Printed in the UK. April 2008.

Pall Corporation

UH239

UH239 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Port Size 1¼" and 1½"

UH239

HIGH PRESSURE FILTERS

UH239 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 350 L/min (92 US gpm)
- Pressures to 420 bar (6100 psi)
- Port size 1¼" and 1½"

Notes and Specifications

Filter Housing

- **Maximum Working Pressure:** 420 bar (6100 psi)
- **Rated Fatigue Pressure:** 0-240 bar (0-3500 psi) per NFPA T2.06.01R2-2001 CAT C/90/* (1 million cycles), verified by testing at 0-280 bar (0-4050 psi) for 1 million cycles. Contact Pall for applications with higher pressures at lower cycles
- **Typical Burst Pressure:** 1500 bar (21,750 psi)
- **Fluid Compatibility:** Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- **Temperature Range:** Fluorocarbon Seals: -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F) 60 ˚C (140 ˚F) maximum temperature in HWCF or water glycol fluids
- **Bypass Valve Setting:** 4.5 bard (65 psid)
- **Indicator Pressure Setting:** 3.5 bard (50 psid)
- **Materials of Construction:** Head and Cover: Ductile Cast Iron Tube: Carbon steel

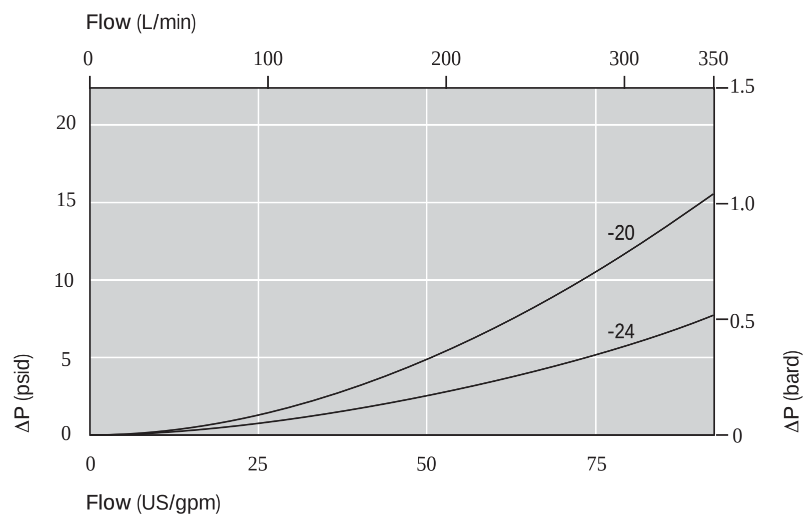
Filter Element

- **Filter Element Burst Pressure:** 10 bard (150 psid)
- **Ultipleat SRT Element Construction:** Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

219 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
13	5.95 (0.327)	2.52 (0.139)	1.70 (0.093)	1.05 (0.058)	0.80 (0.044)
20	3.95 (0.217)	1.68 (0.092)	1.13 (0.062)	0.70 (0.038)	0.53 (0.029)

Sample ΔP calculation

UH239 Series 13" length housing with C24 (1½" BSP) threaded port using an UE219 filter element with AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (S.G.) 1.2.

Total Filter ΔP
= ΔP housing + ΔP element
= (0.4 x 1.2/0.9) bard (housing)
+ ((300 x 1.70/1000) x 50/32 x 1.2/0.9) bard (element)
= 0.53 bard (housing) + 1.06 bard (element)
= 1.59 bard (23.1 psid)

UH239 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 239 C [Table 1] ++ [Table 2] ZG9

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UH 239 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port	Max. Operating Pressure
A20	1¼" SAE J1926 straight thread	420 bar (6100 psi)
A24	1½" SAE J1926 straight thread	
C20	1¼" BSP ISO 228 threads	
C24	1½" BSP ISO 228 threads	
E20	1¼" Flange J518C code 62 with ½"-13 UNC holding bolts	414 bar (3000 psi)
G20	1¼" ISO 6162 split flange with M12 x 1.75 holding bolts	400 bar (5800 psi)

* Maximum operating pressure 400 bar

Table 2: Filter Housing Length Options

Code	Length (in)*
13	13
20	20

* Nominal length

Section 2

Element P/N:

UE 219 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
13	13
20	20

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Indicator
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bar (< 3000 psi)
SS	Stainless Steel Indicator: use at operating pressures > 200 bar (> 3000 psi)

Table 3 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

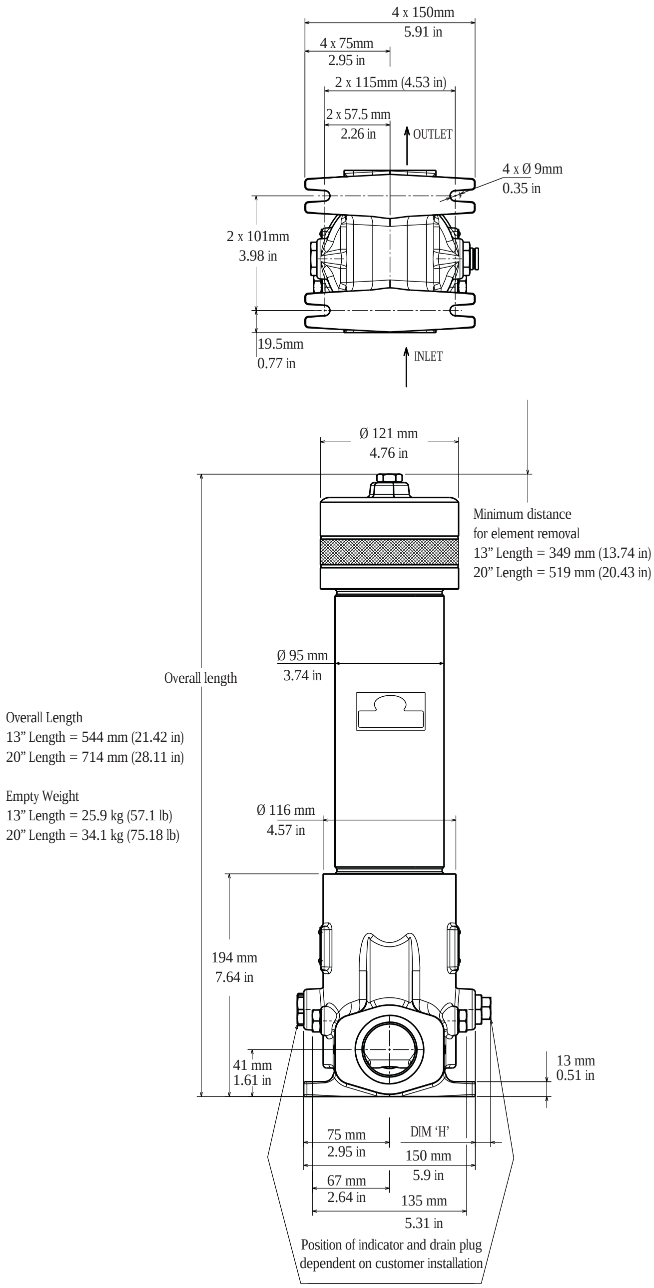
Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R' Indicator is selected from Table 1

UH239 Series Filters

Technical Information



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IMUH239EN Printed in the UK. March 2009.

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UH319

UH319 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Port Size 1¼", 1½" and 2"

UH319 Series Filters
Technical Information

Features
- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 600 L/min (160 US gpm)
- Pressures to 420 bar (6100 psi)
- Port size 1¼", 1½" and 2"

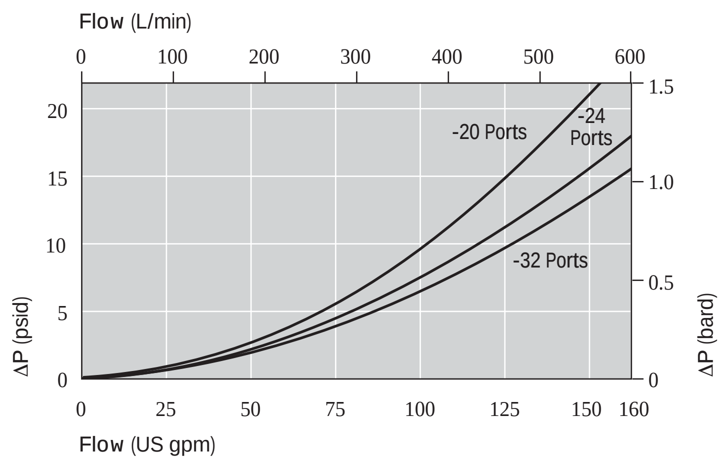
Notes and Specifications
Filter Housing
- Maximum Working Pressure:
  420 bar (6100 psi)
  (See Section 1, Table 2)
- Rated Fatigue Pressure:
  0-240 bar (3500 psi) per NFPA T2.06.01R2-2001 CAT C/90/*(1 million cycles), verified by testing at 0-280 bar (4050 psi) for 1 million cycles. Contact Pall for applications with higher pressures at lower cycles
- Typical Burst Pressure:
  1500 bar (21,750 psi)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Bypass Valve Setting:
  4.5 bard (65 psid)
- Indicator Pressure Setting:
  3.5 bard (50 psid)
- Materials of Construction:
  Head: Ductile Cast Iron
  Tube and Cover: Carbon steel

Filter Element
- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop
Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation
UH319 Series 13" length housing with G24 (1 1/2"SAE) split flange ports using AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.34 x 1.2/0.9) bard (housing)

+ ((300 x 1.09/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.45 (housing) + 0.68 bard (element)

= 1.13 bard (16.4 psid)

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 319 [Table 1] [Table 2] ++ [Table 3] Z [Table 4] 9 X106

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UH 319 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 3: Housing Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Table 4: Housing by-pass valve options

Code	Option
G	4.5 bard (65 psid) by-pass valve
C	4.5 bard (65 psid) by-pass valve with reverse flow

Table 2: Housing Port Options

Code	Port	Max. Operating Pressure
A20	1¼" SAE J1926 straight thread	420 bar (6100 psi)
A24	1½" SAE J1926 straight thread	
A32	2" SAE J1926 straight thread	
C20	1¼" BSP ISO 228 threads	
C24	1½" BSP ISO 228 threads	
C32	2" BSP ISO 228 threads	
D20	1¼" Flange J518C code 61 with 7/16"-14 UNC holding bolts	275 bar (4000 psi)
D24	1½" Flange J518C code 61 with ½"-13 UNC holding bolts	207 bar (3000 psi)
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts	207 bar (3000 psi)
E20	1¼" Flange J518C code 62 with ½"-13 UNC holding bolts	414 bar (6000 psi)
E24	1½" Flange J518C code 62 with 5/8"-11 UNC holding bolts	
E32	2" Flange J518C code 62 with ¾"-10 UNC holding bolts	
F20	1¼" ISO 6162 split flange with M10 x 1.5 holding bolts	250 bar (3625 psi)
F24	1½" ISO 6162 split flange with M12 x 1.75 holding bolts	200 bar (2900 psi)
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts	200 bar (2900 psi)
G20	1¼" ISO 6162 split flange with M12 x 1.75 holding bolts	400 bar (5800 psi)
G24	1½" ISO 6162 split flange with M16 x 2.00 holding bolts	
G32	2" ISO 6162 split flange with M20 x 2.50 holding bolts	

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	ß$_{x(c)}$ ≥1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bar (3000 psi)
SS	Stainless Steel Indicator: use at operating pressures > 200 bar (3000 psi)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

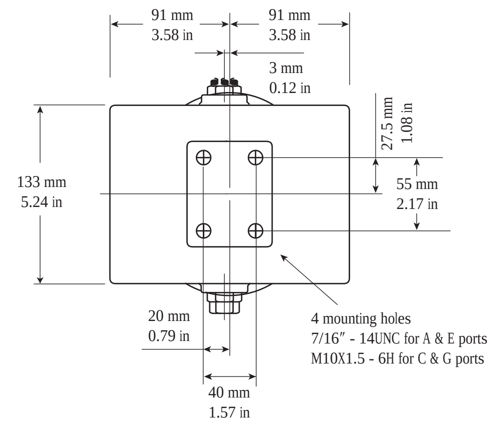
Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

HIGH PRESSURE FILTERS

UH319 Series Filters
Technical Information

('C' option housing with 'G' option bypass shown)

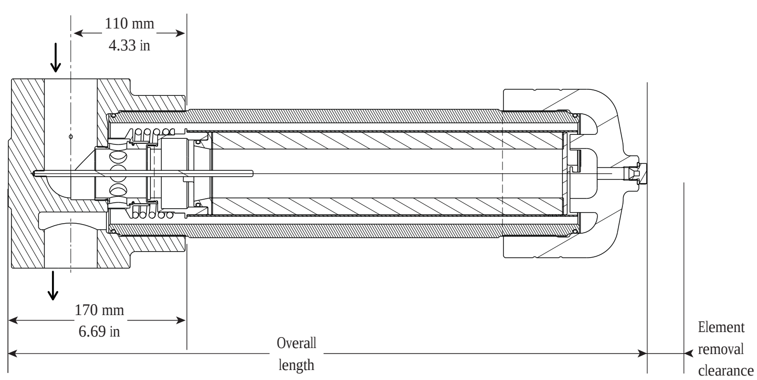


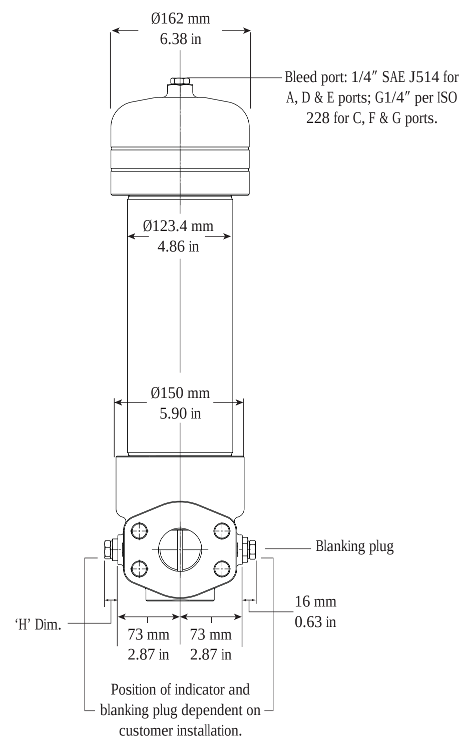
'C' & 'H' Housings with 'G' option bypass valve

Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	477 (18.78)	490 (19.29)	286 (11.26)	140 (5.51)	38.7 (85.3)
13	612 (24.09)	624 (24.57)	421 (16.57)	140 (5.51)	43.7 (96.3)
20	782 (30.79)	795 (31.30)	591 (23.27)	140 (5.51)	50 (110.2)
40	1290 (50.79)	1303 (51.30)	1099 (43.27)	140 (5.51)	68.8 (151.7)

'C' & 'H' Housings with 'C' option bypass valve

Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	537 (21.14)	551 (21.69)	459 (18.07)	140 (5.51)	42.3 (93.3)
13	672 (26.46)	686 (27)	594 (23.39)	140 (5.51)	47.3 (104.3)
20	842 (33.15)	856 (33.70)	746 (30.08)	140 (5.51)	53.6 (118.2)
40	1350 (53.15)	1351 (53.19)	1272 (50.08)	140 (5.51)	72.4 (159.6)





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Because of technological developments related to the products, systems, and/or services described herein, the data and procedures are subject to change without notice. Please consult your Pall representative or visit www.pall.com to verify that this information remains valid. Products in this document may be covered by one or more of the following patent numbers: EP 667,800; EP 982,061; EP 1,380,331; EP 1 656 193; US 5,543,047; US 5,690,765; US 5,725,784; US 6,113,784; US 7,083,564; US 7,318,800.

IMUH319ENd Printed in the UK. March 2009.

Pall Corporation

UH319

UH319 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Side and Top Manifold Mounting

Port Size 1½"

HIGH PRESSURE FILTERS

UH319 Series Filters - Manifold Mount
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 600 L/min (160 US gpm)
- Pressures to 420 bar (6100 psi)
- Ports, 1½" top and side manifold mount

Notes and Specifications

Filter Housing

- **Maximum Working Pressure:** 420 bar (6100 psi)
- **Rated Fatigue Pressure:** 0-240 bar (3500 psi) per NFPA T2.06.01R2-2001 CAT C/90 (1 million cycles), verified by testing at 0-280 bar (4050 psi) for 1 million cycles. Contact Pall for applications with higher pressures at lower cycles
- **Typical Burst Pressure:** 1500 bar (21,750 psi)
- **Fluid Compatibility:** Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- **Temperature Range:** Fluorocarbon Seals: -29˚C to 120˚C (-20˚F to 250˚F) 60˚C (140˚F) maximum in HWCF or water glycol fluids
- **Bypass Valve Setting:** 4.5 bard (65 psid)
- **Indicator Pressure Setting:** 3.5 bard (50 psid)
- **Materials of Construction:** Head: Ductile Cast Iron; Tube and Cover: Carbon steel

Filter Element

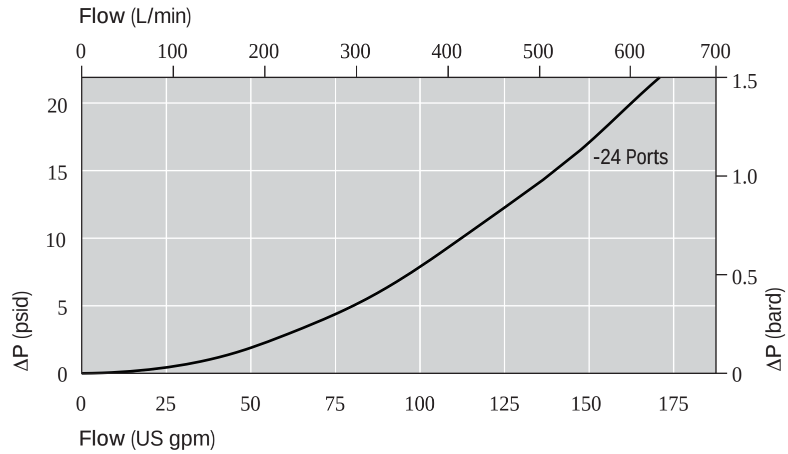
- **Filter Element Burst Pressure:** 10 bard (150 psid)
- **Ultipleat SRT Element Construction:** Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.

Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UH319 Series 13" length housing with S24 (1½") side manifold mount ports using AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.30 x 1.2/0.9) bard (housing)

+ ((300 x 1.09/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.40 (housing) + 0.68 bard (element)

= 1.08 bard (15.7 psid)

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UH 319 [Table 1] [Table 2] ++ [Table 3] Z G 9 X106

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UH 319 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 2: Housing Port Options

Code	Port
K24	1½" top mount manifold
S24	1½" side mount manifold

Table 3: Housing Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Differential Pressure Indicator Material

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bar (3000 psi)
SS	Stainless Steel Indicator: use at operating pressures > 200 bar (3000 psi)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

HIGH PRESSURE FILTERS

UH319 Series Filters - Manifold Mount

Technical Information

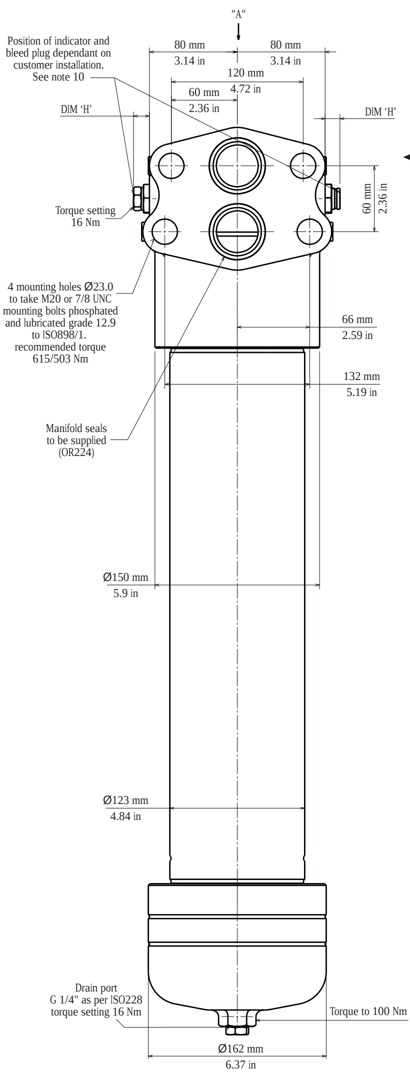
(‘H’ option housing shown)

‘C’ & ‘H’ Housings - S24 Side manifold mounting

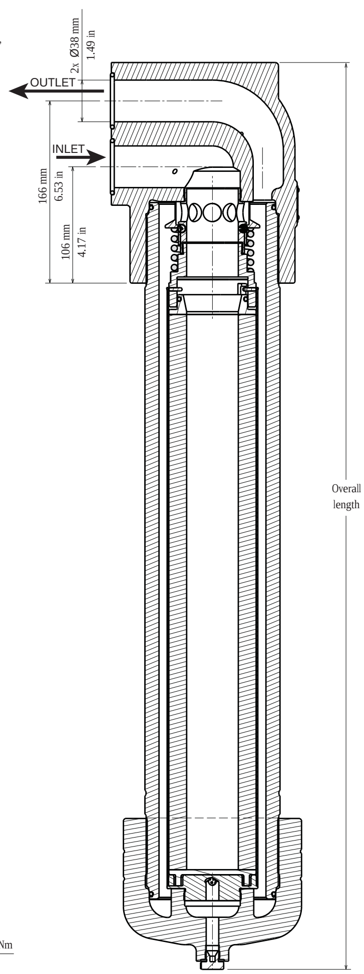
Length Code	‘C’ Option Overall Length mm (in)	‘H’ Option Overall Length mm (in)	‘C’ Option Element Removal Clearance mm (in)	‘H’ Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	473 (18.62)	521 (20.51)	286 (11.26)	140 (5.51)	39.3 (86.7)
13	608 (23.94)	655 (25.79)	421 (16.58)	140 (5.51)	44.3 (97.7)
20	778 (30.63)	826 (32.52)	591 (23.27)	140 (5.51)	50.6 (111.6)
40	1287 (50.67)	1334 (52.52)	1099 (43.27)	140 (5.51)	69.4 (153)

‘C’ & ‘H’ Housings - K24 Top manifold mounting

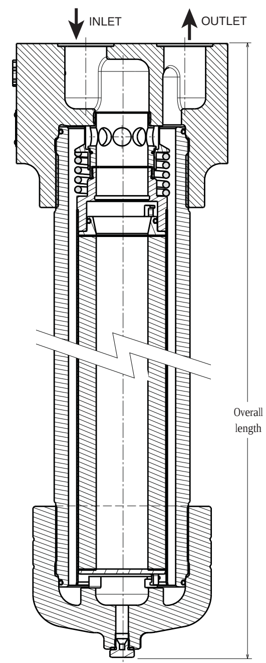
Length Code	‘C’ Option Overall Length mm (in)	‘H’ Option Overall Length mm (in)	‘C’ Option Element Removal Clearance mm (in)	‘H’ Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	456 (17.95)	470 (18.50)	286 (11.26)	140 (5.51)	46.9 (103.4)
13	591 (23.27)	604 (23.78)	421 (16.58)	140 (5.51)	51.9 (114.4)
20	761 (29.96)	775 (30.51)	591 (23.27)	140 (5.51)	58.2 (128.3)
40	1269 (49.96)	1283 (50.51)	1099 (43.27)	140 (5.51)	77 (169.8)



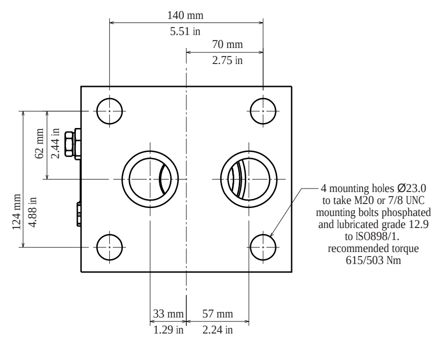
UH319HS24 Option



Section on centerline
UH319HS24 Option



Section on centerline
UH319HK24 Option



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Filtration. Separation. Solution.SM

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Pall Corporation

HYDRAULIC & LUBRICATION

Application Bulletin

POWER GENERATION

Application

Today's OEM steam turbine manufacturers require systems and sub-systems designed to simplify maintenance procedures as much as possible (filtration key features : filter size envelope, turbine reliability and operating availability, ease of filter changeout, etc).

The main lube system off-line filter is critical to ensure long, reliable service life of the turbine. During commissioning, $\beta_{5(c)}$>1000 filters are used to flush out the hydraulic/lube circuits

System Operating parameters:

Fluid:	ISO 32 or 68 Mineral oil
Pressure	10 bar (145 psi)
Flow:	1500 L/min (396 USgpm)
Max Temp.	50°C (92°F)

Problem

Deliver a cost-effective design for a high flow duplex filter that will:

- Achieve ISO 4406 code 17/15/12 cleanliness during commissioning and general operation
- Provide 12-18 month filter element life

Solution

Single element fabricated duplex vessel fitted with a Pall Ultipleat® SRT UE619 series, 40" length, 'AS' ($\beta_{12(c)}$ > 1000) element grade

Ultipleat® SRT filters protect steam turbine lubrication circuit

Pall **Ultipleat** SRT Duplex filter assembly

Results

- Fast commissioning using fine filtration and high dirt holding capacity filter elements
- Long service life and consistent fluid cleanliness levels
- Simple and safe handling; no interruptions to services during filter maintenance

Contact us at www.pall.com

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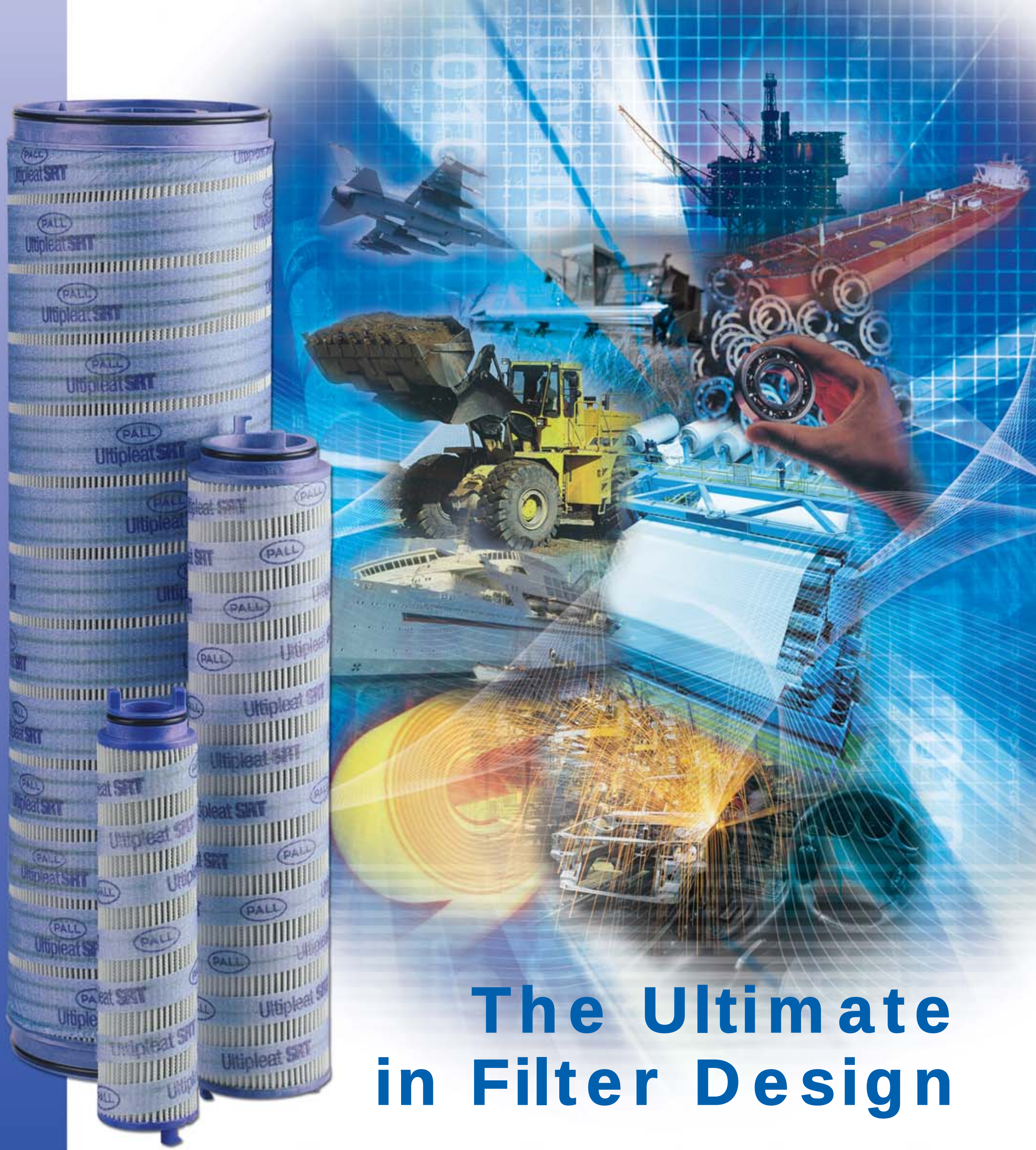
Ultipleat® SRT Filters

Stress Resistant Technology



The Ultimate in Filter Design

Filtration. Separation. Solution.SM

Ultipleat® **SRT Filters**

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

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

The Ultimate in Filter Design

Proprietary Wave-Shaped Pleat Geometry

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

Coreless/Cageless Construction

- 60% lighter than comparable filter elements with cores
- Reduces disposal costs (filter elements are incinerable, shreddable or crushable)

Stress-Resistant Filter Medium

- 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 filter element change

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 filter elements *incorporate anti-static materials to reduce charge generation and virtually eliminate static discharges.*

Auto-Pull Filter Element Removal Mechanism

Ultipleat SRT filter assemblies feature Pall's unique Auto-Pull filter 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 filter 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.

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

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

Benefit: Reliable, consistent performance

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

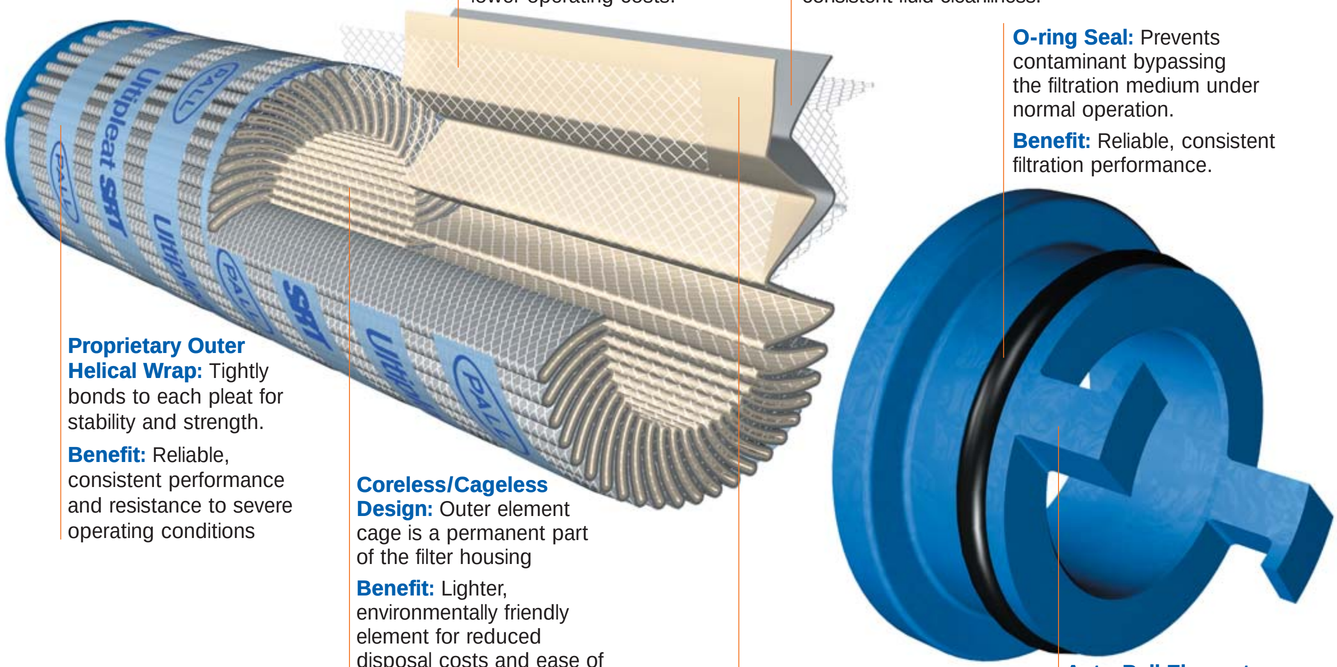
Benefit: Extended filter element service life for lower operating costs.

SRT Filtration Medium: 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 service life of the filter element and more consistent fluid cleanliness.

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

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 filter element change-out.

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

Benefit: Reliable, consistent performance

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

Benefit: Ease of filter element change-out.

SRT Filter Medium 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

The Shape of the Future

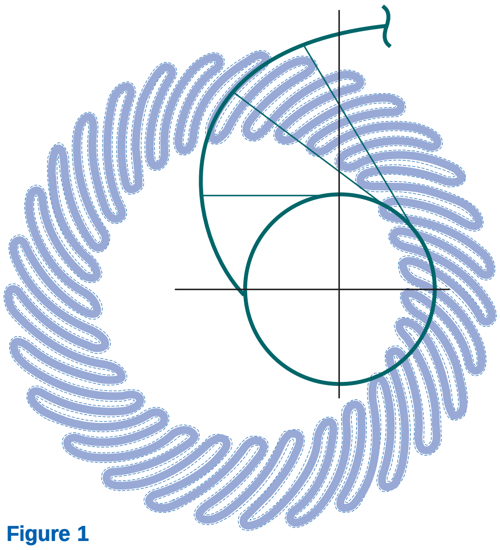


Figure 1

Key to the performance advantage in Ultipleat SRT filters is the wave-shaped pleat geometry.

Wave-shaped pleating:

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

Mathematically Optimized Filter Area

Figure 1 represents the geometric model used to determine the optimal pleat shape to maximize filtration area. Pall has determined that a geometric "involute" shape, more simply described as a wave shape, yields maximum pleat area. This wave-shaped pleat geometry represents the ultimate in pleat design, thus the name "Ultipleat".

Avoid Unused Volume

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

Uniform Flow Distribution

Traditional fan-pleated filter elements are structured such that fluid flow is less restricted in some parts and more restricted in others (see figure 2). 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 element during operation. In comparison, the pleats of Ultipleat SRT filter elements (figure 3) 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 filter element and, therefore, uniform buildup of dirt within the filtration medium. The result is greater dirt holding capacity and longer filter service life.

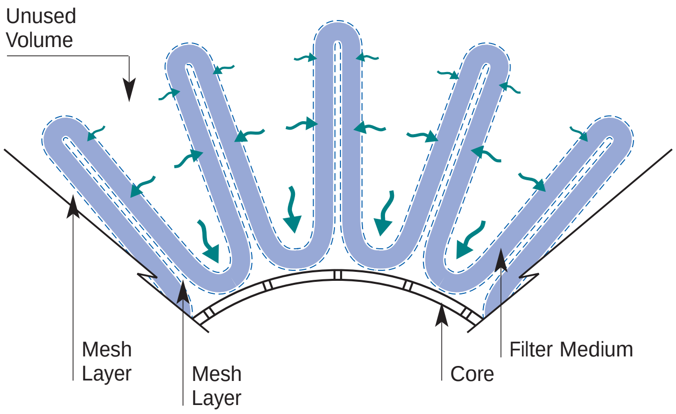


Figure 2. Conventional pleated filter element construction, showing Non-uniform flow distribution in a traditional fan-pleat filter

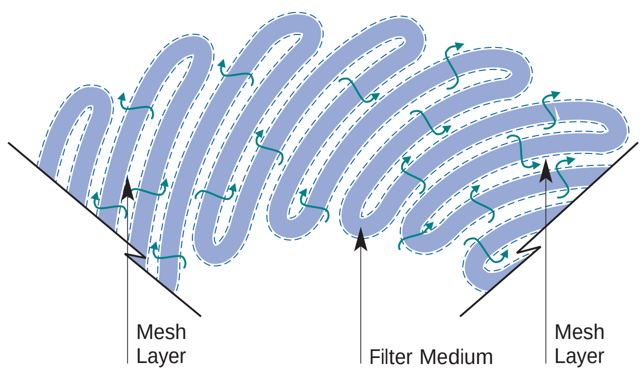


Figure 3. Ultipleat filter element construction, showing uniform flow distribution

The Ultimate in Filter Design

Pleat Stability

Figure 4 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 filtration area and filter service life. In contrast, the pleats in Ultipleat SRT filter elements touch and support each other (see figure 3) 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.

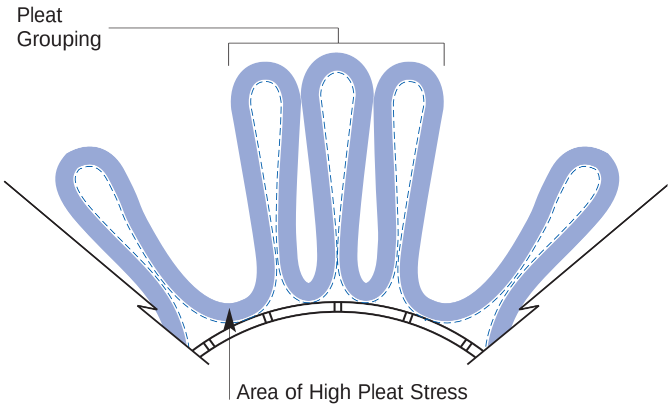


Figure 4. Pleat instability in a poorly supported filter element

Less is More (Smaller Element, Long Life)

The combination of maximized filter area, optimized pleat geometry, and uniform flow distribution in a stable, wave-shaped pleat geometry 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 filter element service life.

Figure 5 illustrates how a smaller Ultipleat SRT filter element can be used in place of a larger fan-pleat element. In the figure, the smaller Ultipleat SRT filter element has a slightly higher clean pressure drop, but the overall service life of the two different size filters is equivalent.

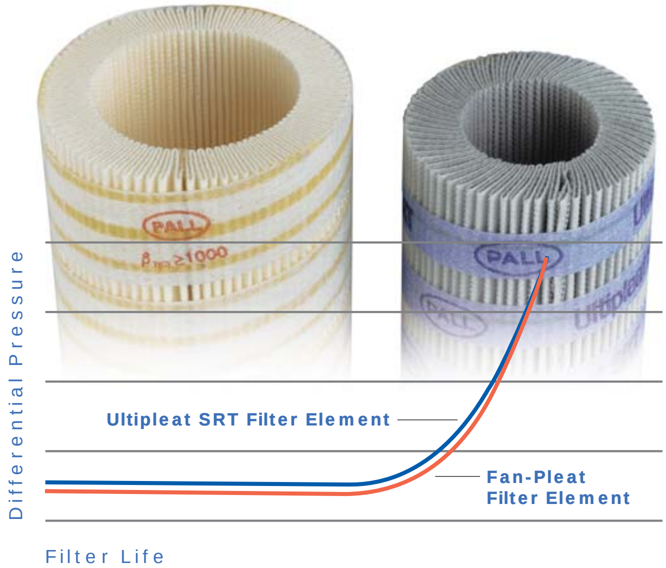


Figure 5. Filter life curve illustrating how a smaller Ultipleat SRT Filter element can achieve equivalent service life compared to a larger fan-pleat filter

Ultipleat **SRT Filter Specifications**

Element Collapse/Burst Rating (ISO 2941)

10 bard (150 psid)

Flow vs. Pressure Drop (ISO 3968)

See appropriate Ultipleat SRT housing literature.

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; filter 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

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

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

Other seal materials available on application

Quality Control

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

Reporting Filter Performance

Ultipleat SRT Filter Performance Rated as an ISO 4406 Cleanliness Code

Ratings Problem

- ISO 16889 (Beta ratings) are derived under steady state conditions.
- Real world conditions including cyclic variations in flow, pressure and dirt loading can affect filters, leading to a decline in Beta value with increasing element pressure drop.
- ISO 16889 filter performance test cannot differentiate the ability of different filter elements to handle these cyclic stresses.

Ratings Solution

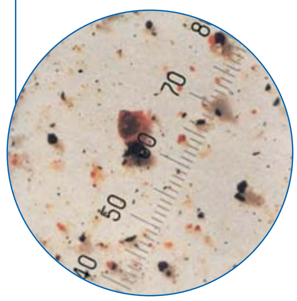
- Pall's Cyclic Stabilization Test (CST), based on SAE ARP 4205, applies cyclic flow (25 to 100% of rated flow) and contaminant loading during the test.
- CST ISO 4406 Cleanliness Code ratings are based on performance at 80% of the net terminal pressure drop, considered the worst operating condition.
- The stress-resistant design characteristics of Ultipleat SRT elements result in significantly lower ISO code ratings via the CST.

See The Difference:

- Shown right are photomicrographs representing the performance of ‘similar’ filters rated at 5 micron per ISO 16889 tested via the Cyclic Stabilization Test. Ultipleat SRT filters provide far superior particulate removal under the cyclic and dirt loading conditions.
- At 80% net terminal pressure drop, filter A is passing over 1200 times more 6 micron(c) and larger particles than the Ultipleat SRT filter, filter B 675 times more.

Filter A

ISO 4406 Cleanliness Code 20/17/13

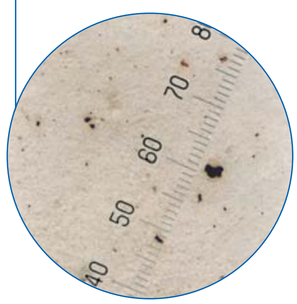


Particle Count Summary

Size	Particle Count per mL	ISO 4406 Code
>4 µm(c)	7,200	20
>6 µm(c)	970	17
>14 µm(c)	47	13

Filter B

ISO 4406 Cleanliness Code 19/16/11

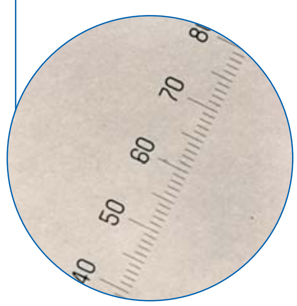


Particle Count Summary

Size	Particle Count per mL	ISO 4406 Code
>4 µm(c)	4,200	19
>6 µm(c)	540	16
>14 µm(c)	20	11

Ultipleat SRT

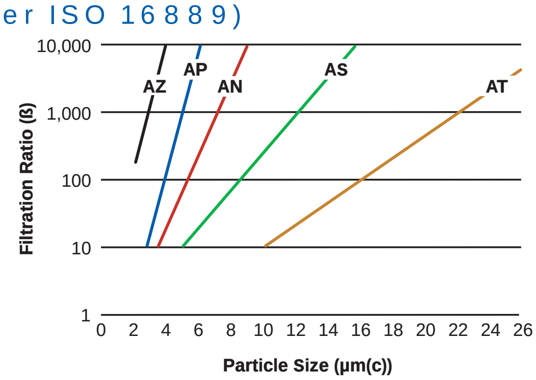
ISO 4406 Cleanliness Code 12/07/02



Particle Count Summary

Size	Particle Count per mL	ISO 4406 Code
>4 µm(c)	25	12
>6 µm(c)	0.8	7
>14 µm(c)	0.02	2

Multi-pass filter ratings (per ISO 16889)



Cleanliness Code Ratings

Code	ß$_{x(c)}$≥1000 per ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Note these ISO codes are laboratory measurements under standard conditions. Cleanliness measured in actual operation will depend on operating conditions and sampling method.


PALL
Ultipleat SRT

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Filtration. Separation. Solution.SM

November 2007. Printed in England. PIULTISRTEN/1107

Ultipor® III Filter Element Specifications

Multi-Pass Filter Rating
Per ISO16889

Standard Elements
Beta ratio = 1000 at 2.5, 5, 7, 12 and 22 µm(c)

Dirt-Fuse Elements
Beta ratio = 1000 at 5 and 15 µm(c)

Element Collapse Pressure Rating (ISO 2941)

Standard Elements
Pressure Line Filters:
290 psid (20 bar)

Return Line Filters:
150 psid (10 bar)

8310 Series Filters:
100 psid (7 bar)

Spin-Ons
100 psid (7 bar)

Dirt-Fuse Elements
3000 psid (207 bar)
9606 Series
600 psid (41 bar)

Coreless Elements
150 psid (10 bar)

Fluid Compatibility (ISO 2943)
Compatible with petroleum oils, water glycols, water-oil emulsions and high water content fluids. Fluorocarbon seals are available for industrial phosphate esters, diesters, and specified synthetics.

Flow Fatigue (ISO 3724)
Contact factory; element structure incorporates upstream and downstream medium support to achieve maximum fatigue cycle life.

Fabrication Integrity (ISO 2942)
Fabrication integrity is verified and assured during the manufacturing process by numerous evaluations and inspections including bubble point testing.

Flow vs. Pressure Drop (ISO 3968)
Flow vs. Pressure drop data (psid/gpm) is listed with each filter series. See appropriate filter series page.

Temperature Range
Nitrile Seals:
45°F (-43°C) to +225°F (107°C)

Fluorocarbon Seals:
-20°F (-29°C) to +250°F (120°C)

Note: maximum 140°F (-60°C) 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.

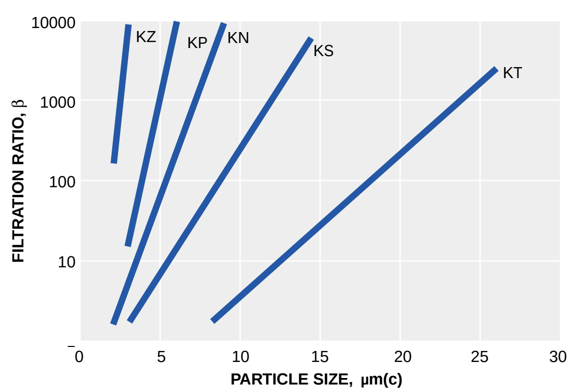
Filter Element Part Numbering

Example:

HC	9600	F	KP	16	H
1	2	3	4	5	6

1. **HC** Pall Industrial Hydraulics Company Filter Element
2. **9600** Filter Element Series (9601 for Dirt Fuse, 9604 for Coreless)
3. **F** Filter Cartridge ("S" for spin-on filter)
4. **KP** Media Grade - 5 µm(c)
5. **16** Nominal Length -16 inches
6. **H** Seal Material - Nitrile ("Z" for Fluorocarbon)

Pall Media Grade	µm Rating for β Value β=200	µm(c) Rating for β Value β=2	β=10	β=75	β=100	β=200	β=1,000
Ultipor III							
KZ	<1	<2	<2	<2	<2	2	2.5
KP	3	<2	<2	3.1	3.3	3.8	5
KN	6	2.1	3.4	5.0	5.2	5.7	7
KS	12	3.2	5.5	8.3	8.7	9.7	12
KT	25	7.2	11	15.8	16.5	18.2	22
Dirt Fuse							
DP	3	<2	<2	3.0	3.2	3.8	5
DT	17	3.3	6.3	10.1	10.7	12	15



Pall Corporation

PALL INDUSTRIAL

InFocus

Pall Ultipor® filter elements

Industrial

June 2009

Featuring

- High filtration efficiency rating $ßx(c) \geq 1000$
- High strength construction
- Coreless, cageless, filter element construction
- Wide fluid and temperature compatibility
- Same form and fit as Ultipor III filter elements

INTRODUCING ULTIPOR® FILTRATION Max

At Pall Corporation, we continually strive to improve our products and technologies to ensure that customers receive the very best in performance and value. We are now pleased to introduce a new addition to our industry-leading hydraulic and lubrication filter line - Ultipor Max filter elements.

Ultipor Max Filter Elements

Pall Ultipor Max filter elements fit directly in all Pall coreless 8304/8314 and 5000 series filter housings and represent an evolution of our proven Ultipor III filter element technology. The Ultipor Max element features a new composite/synthetic structure and lay-over pleat pleating. As a result, this element offers our customers longer service life with low initial pressure drop. To upgrade to this new element, simply select from the part numbers listed below.

Ultipor III	Ultipor Max
HC8304FKN39H (or Z) HC8314FKN39H (or Z)	HC8334FXN39Z
HC8304FKS39H (or Z) HC8314FKS39Z (or Z)	HC8334FXS39Z
HC8314FKR39H (or Z)	HC8334FKR39Z

Pall Corporation

PALL INDUSTRIAL

InFocus

Pall Ultipor® filter elements

Industrial

June 2009

Featuring

- High filtration efficiency rating $\beta_{x(c)} \geq 1000$
- High strength construction
- Coreless, cageless, filter element construction
- Wide fluid and temperature compatibility
- Same form and fit as Ultipor III filter elements

INTRODUCING ULTIPOR® FILTRATION Plus

At Pall Corporation, we continually strive to improve our products and technologies to ensure that customers receive the very best in performance and value. We are now pleased to introduce new additions to our industry-leading hydraulic and lubrication filter line - Ultipor Plus filter elements.

Ultipor Max Filter Elements

Pall Ultipor Plus filter elements fit directly in all Pall coreless 8304/8314 and 5000 series filter housings and represent an evolution of our proven Ultipor III filter element technology. The Ultipor Plus element features a new composite/synthetic structure. As a result, this element offers our customers longer service life with low initial pressure drop. To upgrade to one of these new elements, simply select from the part numbers listed below.

Ultipor III	Ultipor Plus
HC8304FKN39H (or Z) HC8314FKN39H (or Z)	HC8324FXN39Z
HC8304FKS39H (or Z) HC8314FKS39Z (or Z)	HC8324FXS39Z

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Power Generation

Ultipor® SRT Filter Elements

The Next Generation in Anti-Static, Stress-Resistant Media

Innovative Media Performance

Pall's new series of hydraulic and lube filter elements feature Ultipor® SRT (stress-resistant technology) media for unsurpassed performance and value. Ultipor SRT elements provide:

- Greatly reduced static charge build-up
- Low element pressure drop for small envelope size and long life
- Optimum performance at all stages of filter life for cleaner fluid
- Optimum performance under cyclic flow and pressure conditions for cleaner fluid

Ultipor SRT Filter Technology

Designing filter elements has traditionally been a question of balance. Make a filter finer and more efficient and you have to sacrifice clean pressure drop and/or service life, and with ever-increasing flow rate per M^2 (ft^2) of filter media (flux), static charging/discharging can lead to significant operational problems. With the Ultipor SRT filter design, we've improved the filter's ability to maintain fluid cleanliness while at the same time reducing clean pressure drop and adding more filter area to capture dirt while significantly reducing static charge generation. The result: better, more consistent system protection combined with long filter service life in an environmentally friendly package (see Table 2).

Ultipor SRT Filter Elements

Field Trials with New ESD Element

Problem System	Result from Using ESD Element
Power plant lube system – clicking noise	Eliminated noise and burn marks and reduced charging by ~98%
Power plant varnish formation	Maintained varnish potential levels

Conclusions

- Electrostatic charging can be a problem in hydraulic and lube systems (Varnish formation)
- Grounding housings and pipes does not reduce the charge generated
- Standard glass and paper media can create electrostatic charging
- New electrostatic dissipative filter substantially reduces charging and signs of noise, sparking, and filter damage, both in laboratory and field testing

Filter Media Charging Measurements

Sample description	Average charge generation in turbine lube oil (current, nA)	
	No heat exposure	After 149˚C (300˚F) for 1 hour
Standard glass fiber material	620 ± 100	1,200 ± 200
Surface modified standard glass fiber material	250 ± 40	490 ± 70
Glass fiber-based ESD material (SRT)	80 ± 20	80 ± 20

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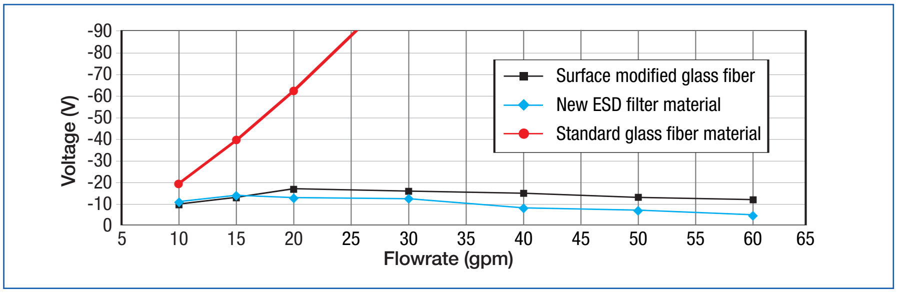

Figure 4 *Pleated Element Charging chart*

Table 1 Filter Performance Ratings

Ultipor SRT Filter Grade	ISO Code Rating per Stress-Resistance Test (80% ΔP)*
MP	15/10/04
MN	17/13/05
MS	19/16/06

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

Table 2 The Ultipor SRT Filter Advantage

Feature	Advantage	Benefit
Ultipor SRT media Construction	• Extremely low charge generation • Increased stability under cyclic or dirt	• Reduced rate of varnish formation • Cleaner fluid under cyclic conditions loading conditions • Highest performance throughout the filter's service life
Tapered pore media	• Dirt captured throughout the media depth	• Long filter service life
Tight fiber matrix with small fiber size	• High particle removal efficiency (Betas) • Consistent performance	• Cleaner fluid • Increased system protection
Thin media pack	• More filter area per element	• Long filter life • Lower filtration costs
Low pressure drop	• Smaller package size • Less cold start bypass • Longer filter life • Less stress on the filter element	• Lower package cost and less space requirement • Increased system protection • Lower element change-out cost • Consistent filter performance throughout its life

Ultipor SRT Filter Performance

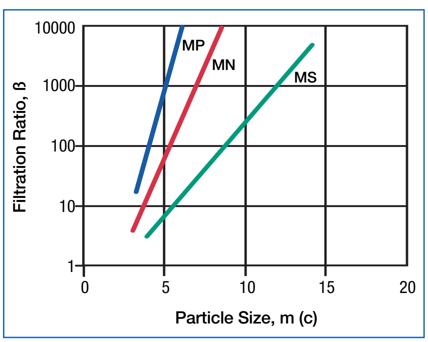

Figure 3 *Filtration Ratios per ISO 16889*

Specifications

Filter Ratings

- Stress-Resistance Test (80% Δp) ISO Code rating (see Table 1)
- Multi-pass filter ratings (per ISO 16889), see Figure 3

Element Collapse Pressure Rating (ISO 2941)

- 10 bar (150 psid)

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.

Filter Element Hardware

Corrosion protected end caps and core

Flow Fatigue (ISO 3724)

Contact factory; element structure incorporates upstream and downstream medium support to achieve maximum 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)

Notes: Maximum 60°C (140°F) for water-based fluids.
Maximum 93°C (199°F) for phosphate 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.

Ultipor SRT elements are available in many retrofit and upgrade configurations (Hilliard, Parker, Hydac etc). To verify correct part number and media choice, please contact your local Pall representative.

PALL® Power Generation

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PGESSRTENa

Pall Corporation

UP319

UP319 Series Filters

ULTIPLEAT® SRT HIGH PRESSURE FILTERS

Port Size 1¼", 1½" and 2"

Filtration. Separation. Solution. SM

IMUP319ENb

UP319

HIGH PRESSURE FILTERS

UP319 Series Filters

Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 600 L/min (160 US gpm)
- Pressures to 250 bar (3625 psi)
- Port size 1¼", 1½" and 2"

Notes and Specifications

Filter Housing

- **Maximum Working Pressure:**
  250 bar (3625 psi)
  For high cyclic applications, use UH319 series
- **Typical Burst Pressure:**
  1050 bar (15,230 psi)
- **Temperature Range:**
  Fluorocarbon Seals: -29˚C to 120˚C (-20˚F to 250˚F)
  60˚C (140˚F) maximum in HWCF or water glycol fluids

  Consult sales for other fluid group suitability
- **Bypass Valve Setting:**
  4.5 bard (65 psid)
- **Indicator Pressure Setting:**
  3.5 bard (50 psid)
- **Materials of Construction:**
  Tube: Carbon steel
  Head and Cover:
  Ductile Cast Iron

Filter Element

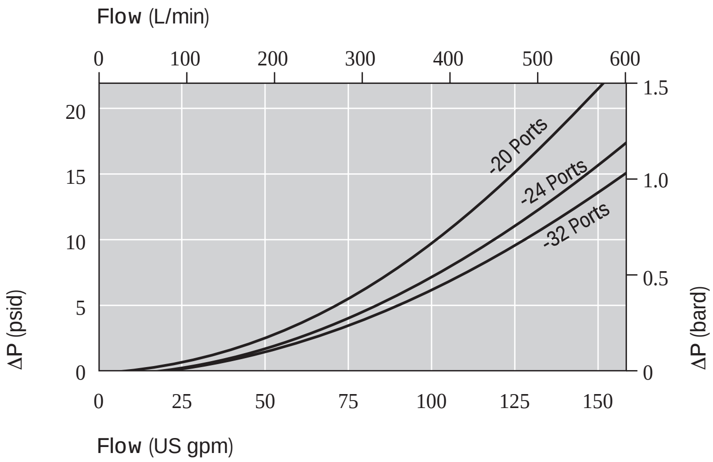
- **Filter Element Burst Pressure:**
  10 bard (150 psid)
- **Ultipleat SRT Element Construction:**
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design.

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.

Housing pressure drop is directly proportional to specific gravity..



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UP319 Series 13" length housing with F24 (1½" SAE) split flange ports using AN grade media. Operating conditions 200 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.14 x 1.2/0.9) bard (housing)

+ ((200 x 1.09/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.19 bard (housing) + 0.45 bard (element)

= 0.64 bard (9.3 psid)

UP319 Series Filters
Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UP 319 [Table 1] [Table 2] ++ [Table 3] ZG9

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports, one fitted with a plastic shipping plug and the other with a bleed plug.

Seal Kit P/N:

UP 319 SK Z

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 3: Housing & Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Table 2: Port Options

Code	Port
A20	1¼" SAE J514 straight thread
D20	1¼" Flange J518C code 61 with 7/16"-14 UNC holding bolts
A24	1½" SAE J514 straight thread
D24	1½" Flange J518C code 61 with ½"-13 UNC holding bolts
A32	2" SAE J514 straight thread
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts
C20	1¼" BSP ISO 228 threads
F20	1¼" ISO 6162 split flange with M10 x 1.5 holding bolts -250 bar rating
C24	1½" BSP ISO 228 threads
F24	1½" ISO 6162 split flange with M12 x 1.75 holding bolts -200 bar rating
C32	2" BSP ISO 228 threads
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts -200 bar rating

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Housing & Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] 091 Z [Table 2] [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2:

Code	Pressure Setting
Omit	Aluminium Alloy Indicator: use at operating pressures < 200 bar (3000 psi)
SS	Stainless Steel Indicator: use at operating pressures > 200 bar (3000 psi)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

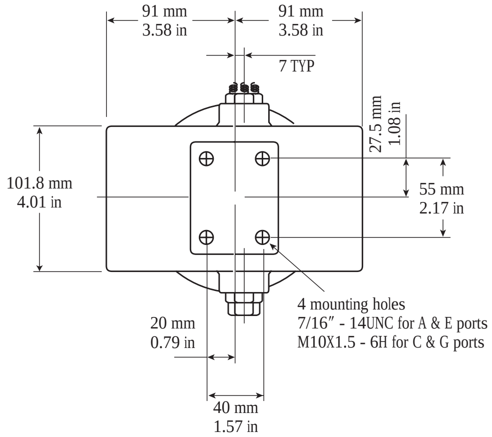
* Use only if 'R'Indicator is selected from Table 1

UP319

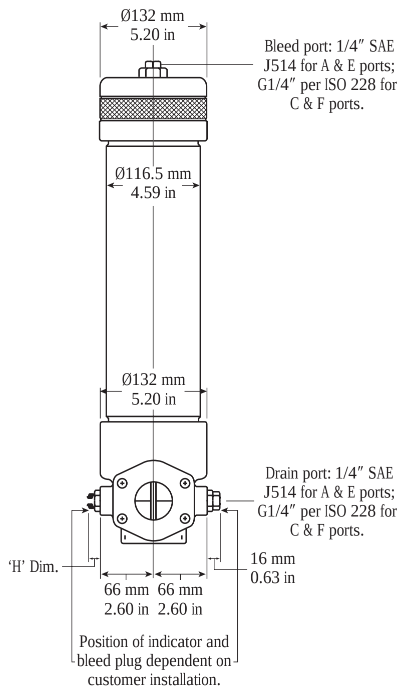
HIGH PRESSURE FILTERS

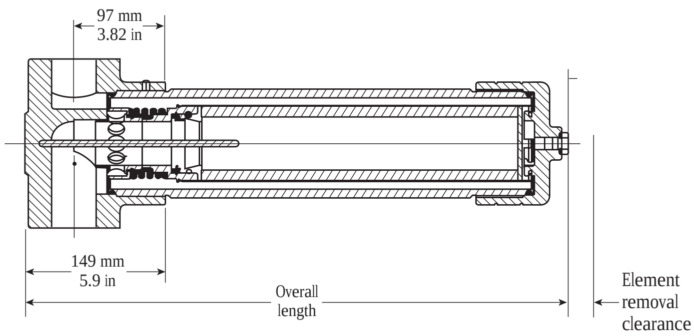
UP319 Series Filters

Technical Information



Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	442 (17.4)	455 (17.9)	205 (8.07)	138 (5.43)	29.7 (65.5)
13	577 (22.7)	590 (23.2)	340 (13.4)	138 (5.43)	33.4 (73.6)
20	747 (29.4)	760 (29.9)	510 (20.1)	138 (5.43)	38 (83.8)
40	1255 (49.4)	1268 (49.9)	1020 (40.2)	138 (5.43)	52 (114.6)





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Pall Corporation

UR209

UR209 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size ¾" and 1"

Filtration. Separation. Solution. SM

UR209

RETURN LINE FILTERS

UR209 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 120 L/min (32 US gpm)
- Pressures to 41 bar (600 psi)
- Port size ¾" and 1"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  41 bar (600 psi)
- Rated Fatigue Pressure:
  41 bar (600 psi)
  10^6 cycles per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  130 bar (2650 psi)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Materials of Construction:
  Aluminum alloy head and bowl.

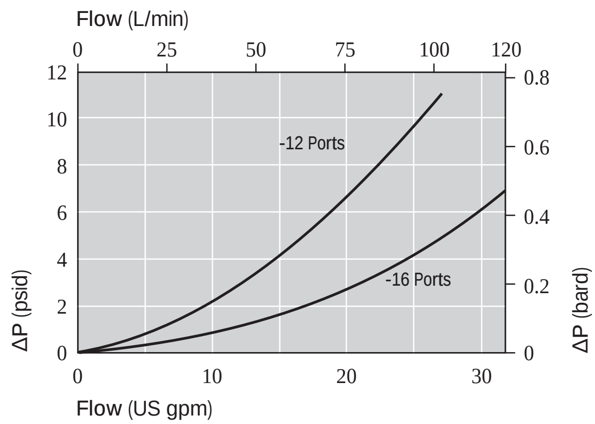
Filter Housing

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

209 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
03	34.75 (1.907)	13.92 (0.764)	10.62 (0.583)	9.00 (0.494)	7.67 (0.421)
07	15.69 (0.861)	6.29 (0.345)	4.79 (0.263)	4.06 (0.223)	3.46 (0.190)

Sample ΔP calculation

UR209 Series 3" length housing with C12 (¾" BSP) threaded ports using AN grade media. Operating conditions 20 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.07 x 1.2/0.9) bard (housing)

+ ((20 x 10.62/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.09 bard (housing) + 0.44 bard (element)

= 0.53 bard (7.7 psid)

UR209 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 209H [Table 1] **++** [Table 2] **Z** [Table 3] **F1** [Table 4]

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number F1 at the end of the Housing P/N designates 1 indicator port, fitted with a plastic shipping plug.

Seal Kit P/N:

UR 209 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A12	¾" SAE J514 straight thread
A16	1" SAE J514 straight thread
B12	¾" NPT Thread
B16	1" NPT Thread
C12	¾" BSP ISO 228 threads
C16	1" BSP ISO 228 threads

Table 2: Housing Length Options

Code	Length (in)*
03	3
07	7

* Nominal length

Table 3: Housing Bypass Valve Options

Code	Valve
A	1.7 bard (25 psid)
G	4.5 bard (65 psid)
N	Non-Bypass

Table 4: Other Options

Code	Description
OMIT	Aluminum alloy head and bowl (standard)
YS45	Anodized aluminum alloy finish for use with water glycols and HWCF

Section 2

Element P/N:

UE 209 [Table 1] [Table 2] **Z**

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$ß_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Element Length Options

Code	Length (in)*
03	3
07	7

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

13 [Table 1]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N 1373772) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options

Code	Rating	Indicator	'H' Dim.
75888	1.1 bard (16 psid)	'FD' Type Visual (auto reset) with thermal lockout	15mm (0.6in)
82233	3.5 bard (50 psid)		
75887	1.1 bard (16 psid)	'F5' Type Electrical switch (SPDT) maximum 24VDC single wire for switched ground connection	23mm (0.9in)
79743	3.5 bard (50 psid)		
73772	N/A	'FB' Type blanking plug	10mm (0.4in)

1.1 bard (16 psid) rating recommended for 'A' bypass valve
3.5 bard (50 psid) rating recommended for 'G' bypass valve

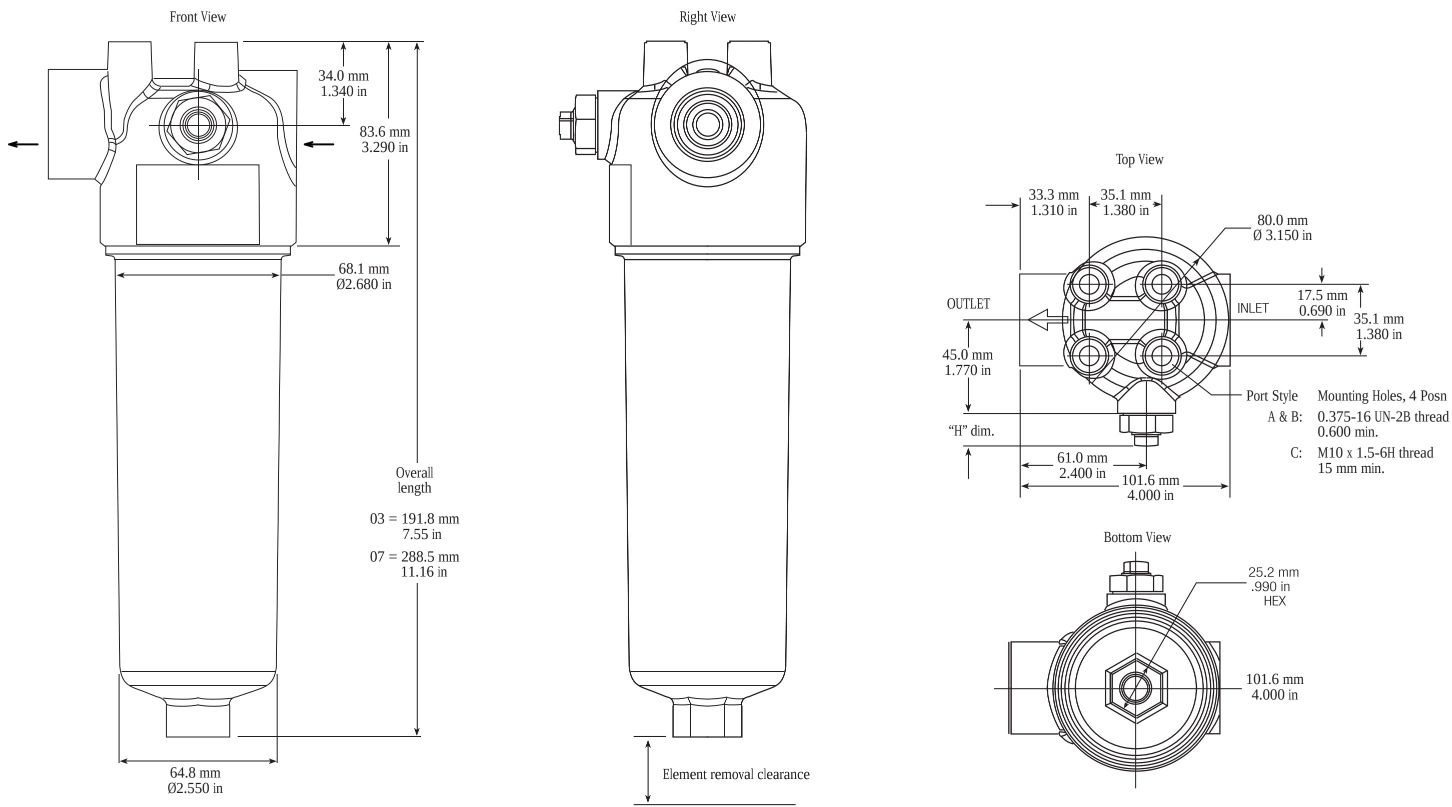
UR209

RETURN LINE FILTERS

UR209 Series Filters

Technical Information

Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)
03	192 (7.55)	69 (2.7)
07	283 (11.16)	69 (2.7



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IMUR209ENa Printed in the UK. March 2009.

PALL

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UR219

UR219 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size ¾", 1" and 1¼"

UR219

RETURN LINE FILTERS

UR219 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 265 L/min (70 US gpm)
- Pressures to 41 bard (600 psid)
- Port size ¾", 1" and 1¼"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  41 bard (600 psid)
- Rated Fatigue Pressure:
  41 bard (600 psid)
  10^6 cycles per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  145 bard (2100 psid)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Materials of Construction:
  Aluminum alloy head, tube and cap

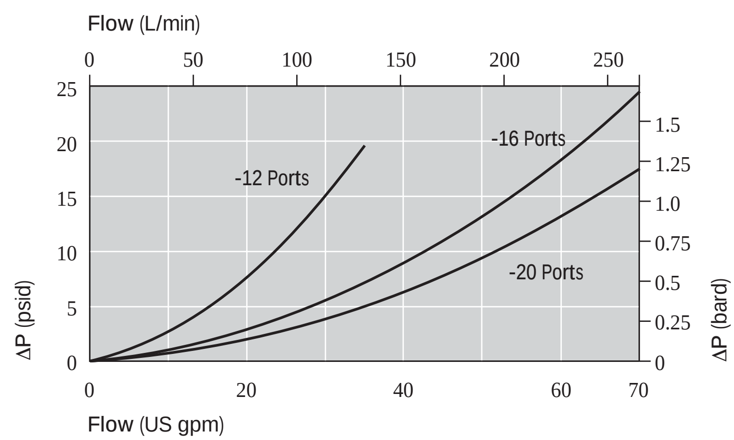
Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

219 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
04	20.07 (1.102)	8.51 (0.467)	5.72 (0.314)	3.55 (0.195)	2.69 (0.148)
08	9.93 (0.545)	4.21 (0.231)	2.83 (0.155)	1.76 (0.096)	1.33 (0.073)
13	5.95 (0.327)	2.52 (0.139)	1.70 (0.093)	1.05 (0.058)	0.80 (0.044)
20	3.95 (0.217)	1.68 (0.092)	1.13 (0.062)	0.70 (0.038)	0.53 (0.029)

Sample ΔP calculation

UR219 Series 13" length housing with C20 (1¼" BSP) threaded ports using AN grade media. Operating conditions 150 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.41 x 1.2/0.9) bard (housing)

+ ((150 x 1.70/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.55 bard (housing) + 0.53 bard (element)

= 1.08 bard (15.7 psid)

UR219 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 219 [Table 1] [Table 2] ++ [Table 3] Z [Table 4] 1

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The suffix '1' at the end of the Housing P/N designates 1 indicator port fitted with a plug.

Seal Kit P/N:

UR 219 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up) -standard
H	Head service (tube down)

Table 2: Housing Port Options

Code	Port
A12	¾" SAE J514 straight thread
A16	1" SAE J514 straight thread
A20	1¼" SAE J514 straight thread
C12	¾" BSP ISO 228 threads
C16	1" BSP ISO 228 threads
C20	1¼" BSP ISO 228 threads

Table 3: Housing Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Table 4: Housing Bypass Valve Options

Code	Valve	
A	1.7 bard - 25 psid	- Use 084 code indicator only
G	4.5 bard - 65 psid	- Use 091 code indicator only
N	Non-Bypass	- Use 091 code indicator only

Section 2

Element P/N:

UE 219 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	ß$_{x(c)}$ ≥1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] [Table 2] Z [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HA9000-P8-Kit Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Indicator Pressure Setting Option*

Code	Valve
084	For 'A' Valve Option - Housings (1.1 bard - 16 psid)
091	For 'G' and 'N' Valve Options - Housings (3.5 bard - 50 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

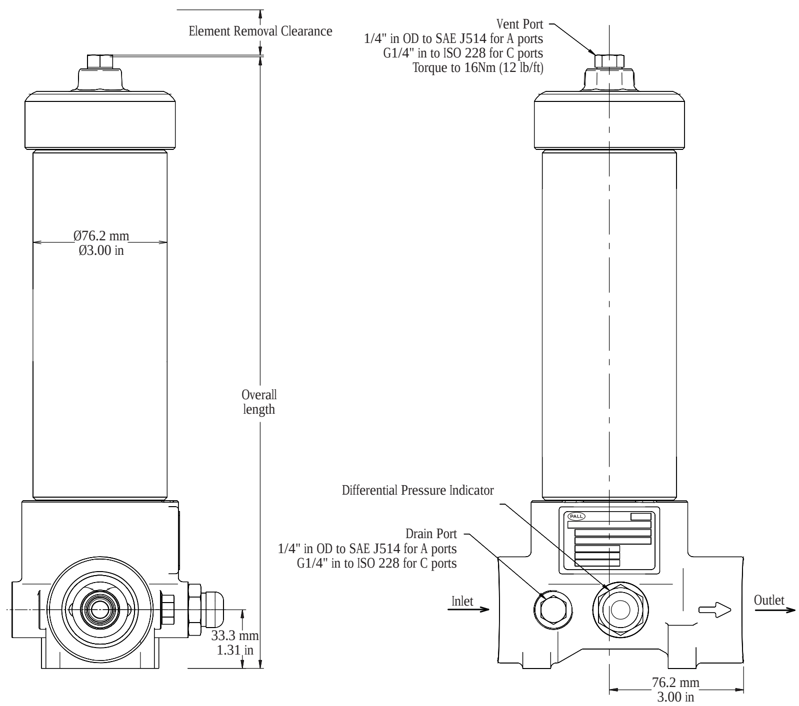
Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

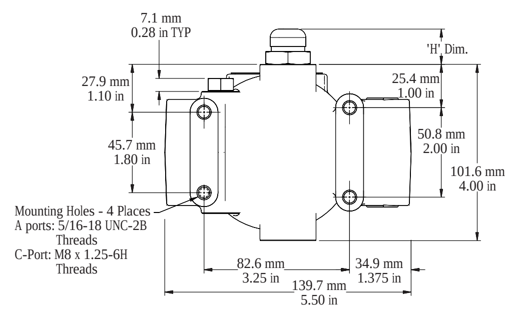
* Use only if 'R'Indicator is selected from Table 1

UR219 Series Filters
Technical Information

RETURN LINE FILTERS
('C' option housing shown)



Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' Option Element Removal Clearance mm (in)	'H' Option Element Removal Clearance mm (in)	Empty Weights kg (lb)
04	246 (9.72)	260 (10.3)	130 (5)	64 (2.5)	2.5 (5.6)
08	348 (13.72)	362 (14.3)	230 (9)	64 (2.5)	3.1 (6.8)
13	483 (19.02)	496 (19.6)	370 (14.5)	64 (2.5)	3.6 (7.9)
20	653 (25.72)	667 (26.3)	530 (21)	64 (2.5)	3.9 (8.5)



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IMUR219ENb Printed in the UK. July 2009

Pall Corporation

UR319

UR319 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size 1½", 2" and 2½"

UR319

RETURN LINE FILTERS

UR319 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 760 L/min (200 US gpm)
- Pressures to 41 bard (600 psid)
- Port size 1½", 2" and 2½"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  41 bard (600 psid)
- Rated Fatigue Pressure:
  41 bard (600 psid)
  10^6 cycles per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  145 bard (2100 psid)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Materials of Construction:
  Tube: Carbon steel
  Head and Cover: Ductile Cast Iron

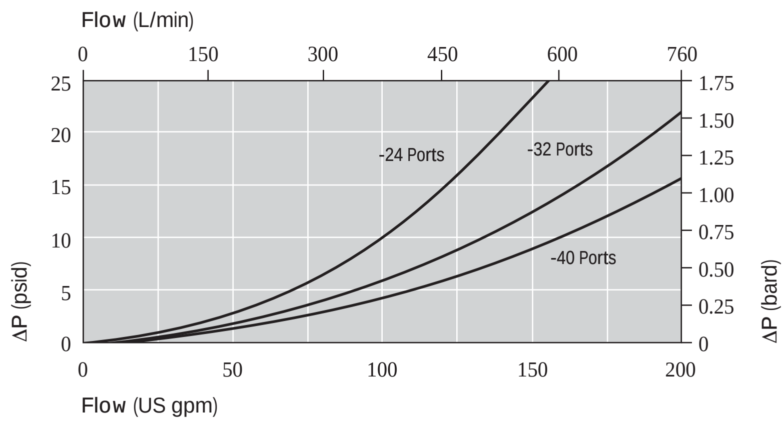
Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UR319 Series 20" length housing with F24 (1½" SAE) split flange ports using AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.48 x 1.2/0.9) bard (housing)

+ ((300 x 0.72/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.64 bard (housing) + 0.45 bard (element)

= 1.09 bard (15.8 psid)

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 319 [Table 1] [Table 2] ++ [Table 3] Z [Table 4] 1 YR85

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The suffix '1' at the end of the Housing P/N designates 1 indicator port fitted with a plug.

Seal Kit P/N:

UR 319 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Orientation Options

Code	Port
C	Cap service (tube up)
H	Head service (tube down)

Table 2: Housing Port Options

Code	Port
A24	1½" SAE J514 straight thread
A32	2" SAE J514 straight thread
C24	1½" BSP ISO 228 threads
C32	2" BSP ISO 228 threads
D24	1½" Flange J518C code 61 with ½"-13 UNC holding bolts
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts
D40	2½" Flange J518C code 61 with ½"-13 UNC holding bolts
F24	1½" ISO 6162 split flange with M12 x 1.75 holding bolts
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts
F40	2½" ISO 6162 split flange with M12 x 1.75 holding bolts

Table 3: Housing Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Table 4: Housing Bypass Valve Options

Code	Valve
A	1.7 bard - 25 psid Use 084 code indicator only
C	4.5 bard - 65 psid bypass valve with resevse flow Use 091 code indicator only
G	4.5 bard - 65 psid Use 091 code indicator only
N	Non-Bypass Use 091 code indicator only

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

RC [Table 1] [Table 2] Z [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' type blanking plug (P/N HC9000A104Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Indicator Pressure Setting Option*

Code	Valve
084	For 'A' Valve Option - Housings (1.1 bard - 16 psid)
091	For 'C', 'G' and 'N' Valve Options - Housings (3.5 bard - 50 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

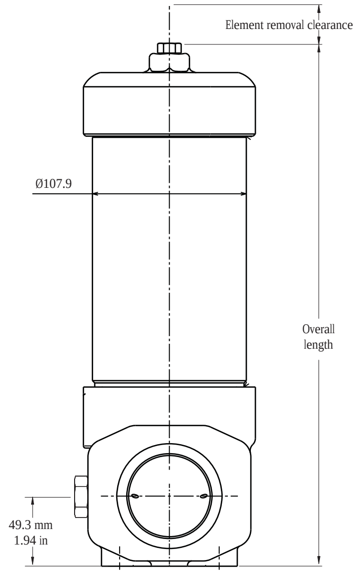
UR319

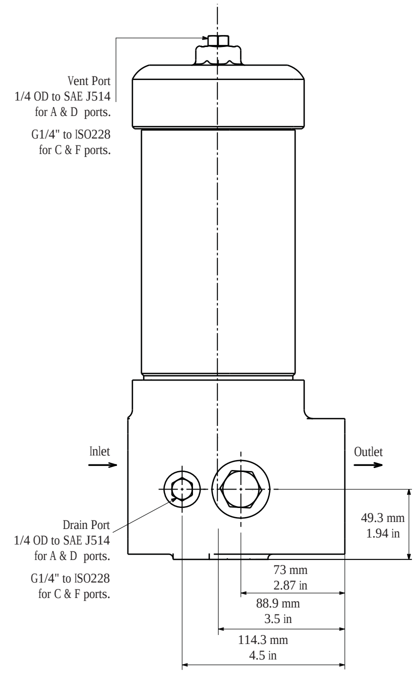
RETURN LINE FILTERS

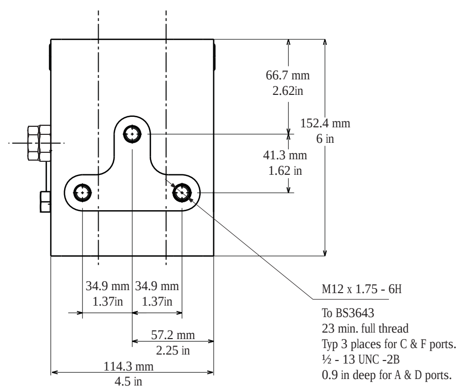
('C' option housing shown)

UR319 Series Filters

Technical Information







'C' and 'H' Housings with 'G' option valve

Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' and 'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	424 (16.69)	437 (17.22)	230 (9)	18 (40)
13	559 (21.99)	572 (22.52)	370 (14.5)	21 (46)
20	729 (28.69)	742 (29.22)	530 (21)	23 (51)
40	1237 (48.69)	1250 (49.22)	1040 (41)	30 (66)

'C' and 'H' Housings with 'C' option valve

Length Code	'C' Option Overall Length mm (in)	'H' Option Overall Length mm (in)	'C' and 'H' Option Element Removal Clearance mm (in)	Empty Weight kg (lb)
08	511 (20.13)	525 (20.66)	230 (9)	20 (45)
13	646 (25.43)	659 (25.96)	370 (14.5)	23 (51)
20	816 (32.13)	829 (32.66)	530 (21)	25 (56)
40	1324 (52.13)	1337 (52.66)	1040 (41)	32 (71)

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IMUR319ENd Printed in the UK. December 2009

Pall Corporation

UR619

UR619 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size 1½", 2" and 2½"

UR619

RETURN LINE FILTERS

UR619 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 835 L/min (220 US gpm)
- Pressures to 28 bard (400 psid)
- Port size 1½", 2" and 2½"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  28 bard (400 psid)
- Rated Fatigue Pressure:
  23 bard (330 psid)
  10^6 cycles per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  145 bard (2100 psid)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Materials of Construction:
  Head and tube: Aluminum alloy
  Cover: Ductile Iron

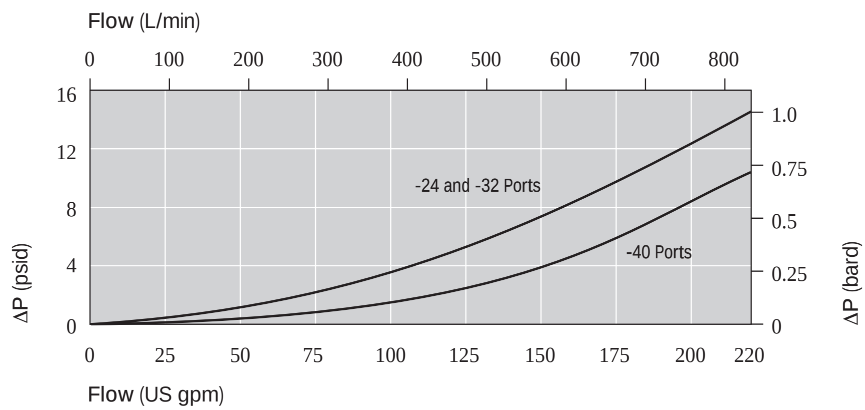
Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity..



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

619 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
20	1.31 (0.072)	0.56 (0.030)	0.43 (0.023)	0.31 (0.017)	0.19 (0.011)
40	0.70 (0.038)	0.30 (0.016)	0.23 (0.013)	0.17 (0.009)	0.10 (0.006)

Sample ΔP calculation

UR619 Series 40" length housing with C32 (2" BSP) threaded ports using AN grade media. Operating conditions 500 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.41 x 1.2/0.9) bard (housing)

+ ((500 x 0.23/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.55 bard (housing) + 0.24 bard (element)

= 0.79 bard (11.5 psid)

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 619 C ☐ (Table 1) **++** ☐ (Table 2) **Z** ☐ (Table 3) **1**

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.
The suffix '1' at the end of the Housing P/N designates 1 indicator port fitted with a plug.

Mounting Bracket P/N:

HA8300-BRKT-1

1 bracket and associated hardware
Order 2 mounting brackets for 20" length housing.
Order 3 mounting brackets for 40" length housing.

Seal Kit P/N:

UR 619 SK Z

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A24	1½" SAE J514 straight thread
D24	1½" Flange J518C code 61 with ½"-13 UNC holding bolts
A32	2" SAE J514 straight thread
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts
D40	2½" Flange J518C code 61 with ½"-13 UNC holding bolts
C24	1½" BSP ISO 228 threads
F24	1½" ISO 6162 split flange with M12 x 1.75 holding bolts
C32	2" BSP ISO 228 threads
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts
F40	2½" ISO 6162 split flange with M12 x 1.75 holding bolts

Table 2: Housing Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Table 3: Housing Bypass Valve Options

Code	Valve
A	1.7 bard - 25 psid
G	4.5 bard - 65 psid
N	Non-Bypass

Section 2

Element P/N:

UE 619 ☐ (Table 1) ☐ (Table 2) **Z**

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC ☐ (Table 1) ☐ (Table 2) **Z** ☐ (Table 3) ☐ (Table 4)

Note: If no differential pressure indicator is selected, 'B' Type blanking plug (P/N HA9000-P8-Kit Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Indicator Pressure Setting Option*

Code	Valve
084	For 'A' Valve Option - Housings (1.1 bard - 16 psid)
091	For 'G' and 'N' Valve Options - Housings (3.5 bard - 50 psid

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

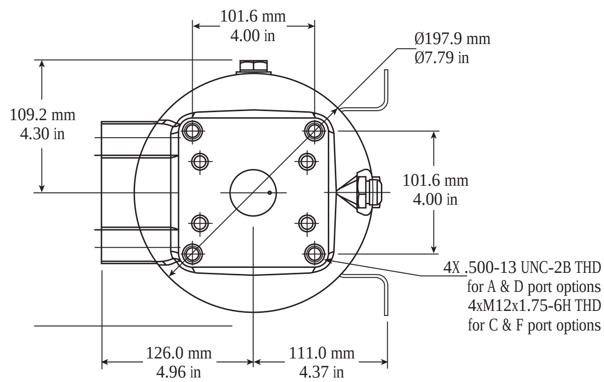
Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

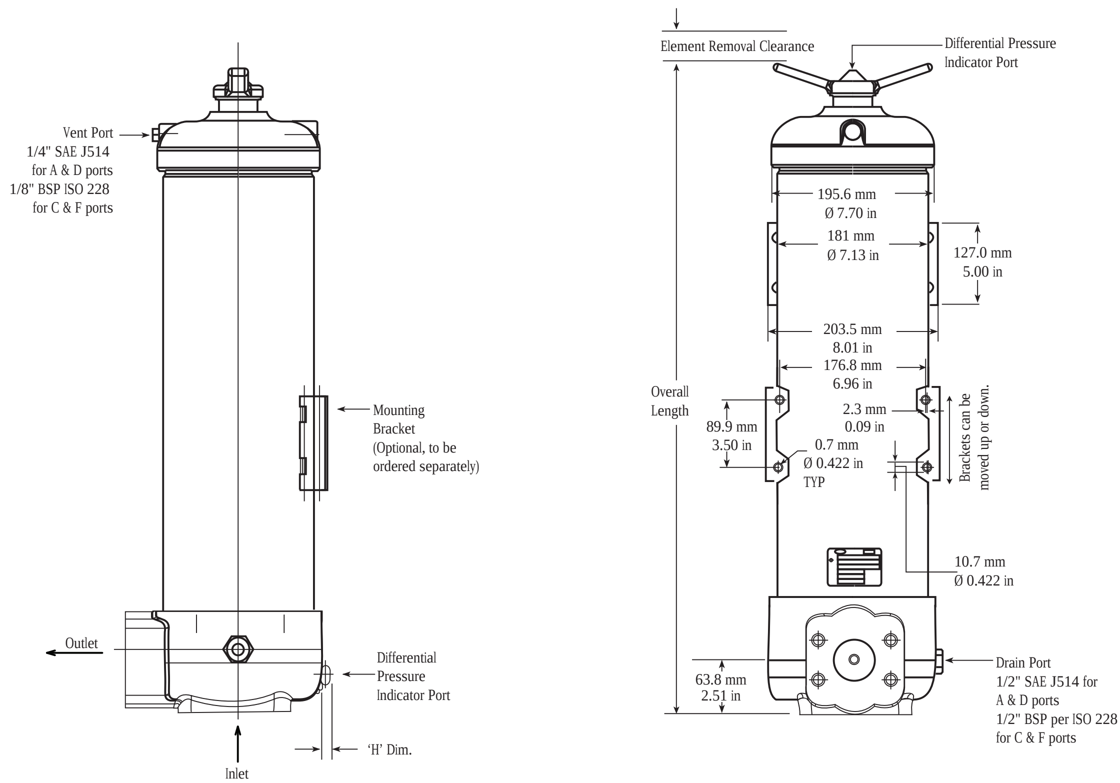
* Use only if 'R'Indicator is selected from Table 1

UR619 Series Filters

Technical Information



Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)	Empty Weight kg (lb)
20	762 (30)	443 (17.5)	26 (58)
40	1270 (50)	951 (37.5)	36 (80)



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IMUR619ENc Printed in the UK. July 2009

PALL Pall Corporation

UR629

UR629 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size 3" and 4"

Filtration. Separation. Solution.SM

IMUR629ENb

UR629

RETURN LINE FILTERS

UR629 Series Filters

Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 1500 L/min (400 US gpm)
- Pressures to 28 bar (400 psi)
- Port size 3" and 4"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  28 bar (400 psi)
- Rated Fatigue Pressure:
  23 bar (330 psi)
  10^6 cycles per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  145 bar (2100 psi)
- Temperature Range:
  Fluorocarbon Seals: -29˚C to 120˚C (-20˚F to 250˚F)
  60˚C (140˚F) maximum in HWCF or water glycol fluids
  Contact sales for other fluid group suitability
- Materials of Construction:
  Head, tube, manifold and check valve: Aluminum alloy
  Cover: Ductile Iron

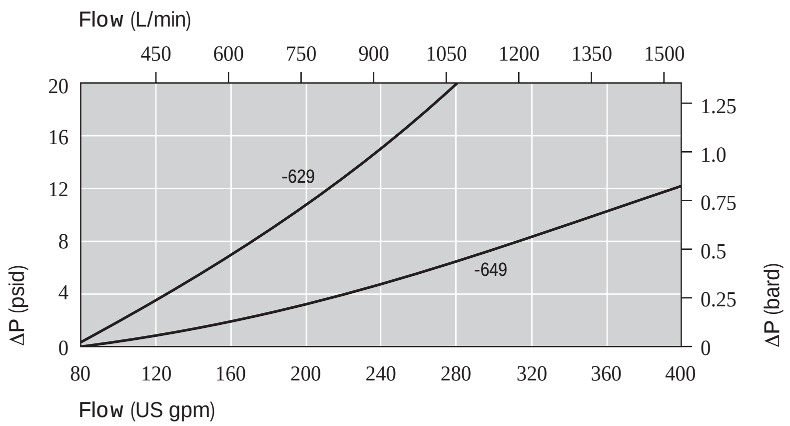
Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design.

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

619 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
20	1.31 (0.072)	0.56 (0.030)	0.43 (0.023)	0.31 (0.017)	0.19 (0.011)
40	0.70 (0.038)	0.30 (0.016)	0.23 (0.013)	0.17 (0.009)	0.10 (0.006)

Sample ΔP calculation

UR629 Series 20" length housing with F48 (3" SAE) split flange ports using AN grade media. Operating conditions 600 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.48 x 1.2/0.9) bard (housing)

+ ((600 x 0.43/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.64 bard (housing) + 0.54 bard (element)

= 1.18 bard (17.1 psid)

UR629 Series Filters
Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 6 [Table 1] 9 C [Table 2] ++ [Table 3] Z [Table 4] 9

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The number '9' at the end of the Housing P/N designates 2 indicator ports per filter tower, one fitted with a plastic shipping plug and the other with a blanking plug.

Seal Kit P/N:

UR 619 SK Z

*Other seal material options are available; Contact Pall.

Table 1: Number of Housing Options

Code	Port
2	2 housings (1 per side)
4	4 housings (2 per side)
6	6 housings (3 per side)
8	8 housings (4 per side)

Table 2: Housing Port Options

Code	Port
D48	3" Flange J518C code 61 with 5/8"-11 UNC holding bolts
D64	4" Flange J518C code 61 with 5/8"-11 UNC holding bolts
F48	3" ISO 6162 split flange with M16 x 2.00 holding bolts
F64	4" ISO 6162 split flange with M16 x 2.00 holding bolts

Table 3: Housing Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Table 4: Housing Bypass Valve Options

Code	Valve
A	1.7 bard - 25 psid
G	4.5 bard - 65 psid
N	Non-Bypass

Section 2

Element P/N:

UE 619 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	ß$_{x(c)}$ ≥1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered for each filter tower)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on each filter tower

RC [Table 1] [Table 2] Z [Table 3] [Table 4]

Note: A differential pressure indicator or a 'B' Type blanking plug (P/N HA9000-P8-Kit Z) must be ordered separately for each filter tower on the housing and fitted to replace the plastic shipping plug. For typical installations, only 2 indicators are required - only one housing per side requires an indicator. Replace other shipping plugs with blanking plugs.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other indicator options are available; contact Pall.

Table 2: Indicator Pressure Setting Option*

Code	Valve
084	For 'A' Valve Option - Housings (1.1 bard - 16 psid)
091	For 'G' and 'N' Valve Options - Housings (3.5 bard - 50 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

Table 4: 'R' Indicator Options

Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

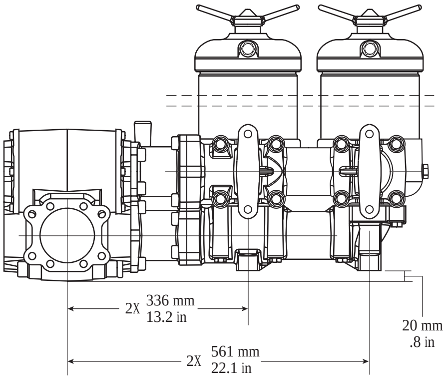
* Use only if 'R'Indicator is selected from Table 1

UR629

RETURN LINE FILTERS

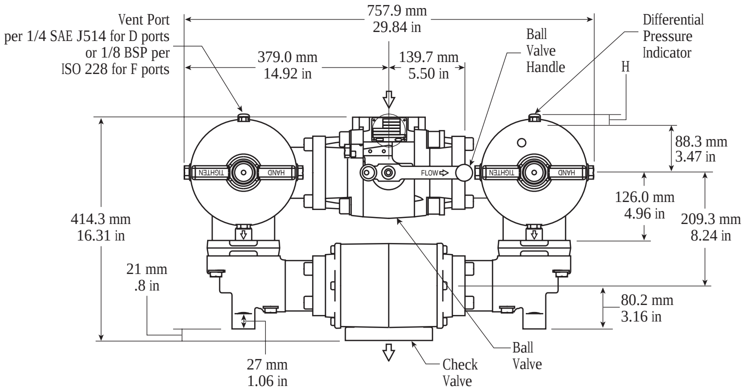
UR629 Series Filters

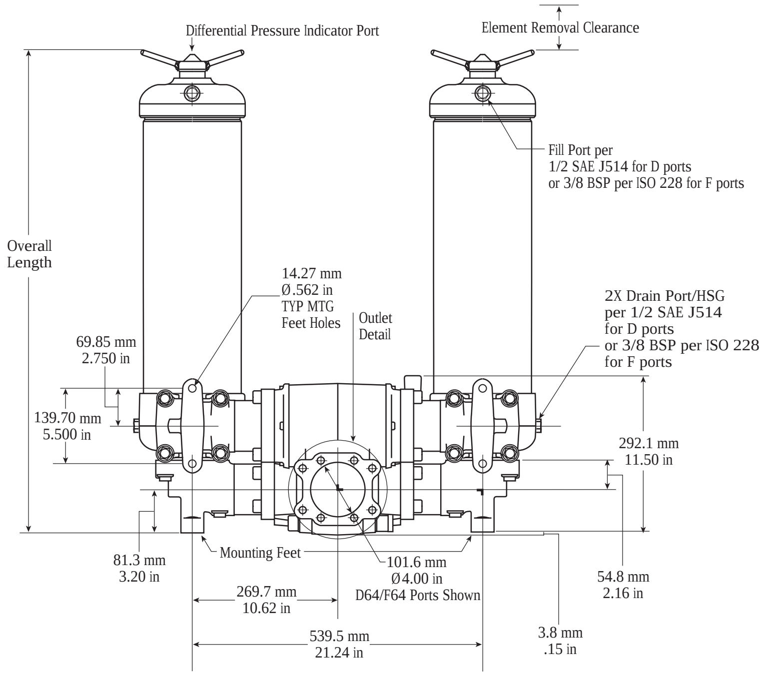
Technical Information



649 Duplex Mounting Dimensions

Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)	Empty Weight kg (lb)
20	897.1 (35.32)	442.7 (17.43)	88.9 (196)
40	1405.1 (55.32)	950.7 (37.43)	112.5 (248)





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Pall Corporation

UR699

UR699 Series Filters

ULTIPLEAT® SRT RETURN LINE FILTERS

Port Size 2", 2½" and 3"

UR699

RETURN LINE FILTERS

UR699 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 835 L/min (220 US gpm)
- Pressures to 28 bard (400 psid)
- Port size 2", 2½" and 3"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  28 bard (400 psid)
- Rated Fatigue Pressure:
  23 bard (330 psid) 10^6 cycles
  per NFPA T2.06.01R2-2001
- Typical Burst Pressure:
  145 bard (2100 psid)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF
  or water glycol fluids
- Materials of Construction:
  Tube: Aluminum alloy
  Head and Cover: Ductile Iron

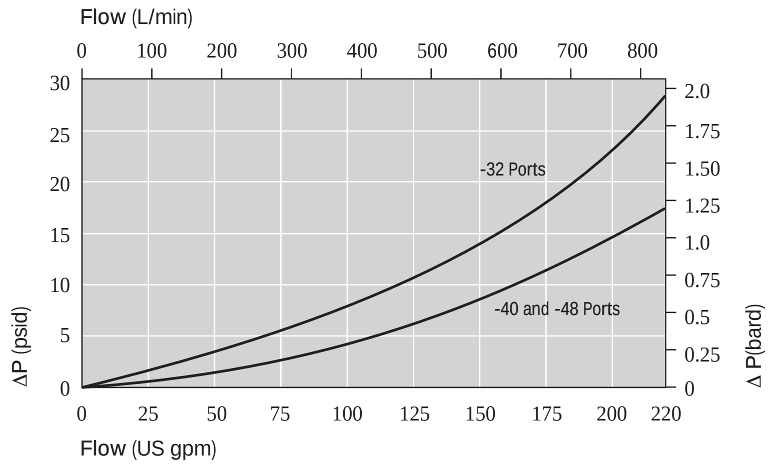
Filter Housing

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

619 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
20	1.31 (0.072)	0.56 (0.030)	0.43 (0.023)	0.31 (0.017)	0.19 (0.011)
40	0.70 (0.038)	0.30 (0.016)	0.23 (0.013)	0.17 (0.009)	0.10 (0.006)

Sample ΔP calculation

UR699 Series 20" length housing with F32 (2" SAE) split flange ports using AN grade media. Operating conditions 300 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP
= ΔP housing + ΔP element
= (0.41 x 1.2/0.9) bard (housing)
+ ((300 x 0.43/1000) x 50/32 x 1.2/0.9) bard (element)
= 0.55 bard (housing) + 0.27 bard (element)
= 0.82 bard (11.9 psid)

UR699 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UR 699 C [Table 1] ++ [Table 2] Z [Table 3] 1

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall. The suffix '1' at the end of the Housing P/N designates 1 indicator port on the filter housing head fitted with a plug.

Seal Kit P/N:

UR 699 SK Z

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A32	2" SAE J514 straight thread
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts
D40	2½" Flange J518C code 61 with ½"-13 UNC holding bolts
D48	3" Flange J518C code 61 with ⁵/₈"-11 UNC holding bolts
C32	2" BSP ISO 228 threads
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts
F40	2½" ISO 6162 split flange with M12 x 1.75 holding bolts
F48	3" ISO 6162 split flange with M16 x 2.00 holding bolts

Table 2: Housing Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Table 3: Housing Bypass Valve Options

Code	Valve
A	1.7 bard - 25 psid
G	4.5 bard - 65 psid
N	Non-Bypass

Section 2

Element P/N:

UE 619 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	ß$_{x(c)}$ ≥1000 based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
20	20
40	40

* Nominal length

Section 3 (At least one Differential Pressure Indicator or 'B' type blanking plug must be ordered)

Differential Pressure Indicator P/N:

Note: Two Differential Pressure Indicators can be fitted on this housing

RC [Table 1] [Table 2] Z [Table 3] [Table 4]

Note: If no differential pressure indicator is selected, 'B' Type blanking plug (P/N HA9000-P8-Kit Z) must be ordered separately and fitted to replace the plastic shipping plug.

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Differential Pressure Indicator Options*

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" leads	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)
861CZ	'R' type Electrical switch (SPDT) and neon light indicator with DIN43650 connector and cap	89mm (3.50in)
771BZ	'S' type Electrical switch (SPDT) with 3-pin MS connector	57mm (2.24in)

* Other options available on application.

Table 2: Indicator Pressure Setting Option*

Code	Valve
084	For 'A' Valve Option - Housings (1.1 bard - 16 psid)
091	For 'G' and 'N' Valve Options - Housings (3.5 bard - 50 psid)

* Other setting options are available; contact Pall.

Table 3: 'M' & 'R'-Type Indicator Codes*

Code	Option
YM	'M' option
YR	'R' option

* Use only if 'R' or 'M' Indicator is selected from Table 1

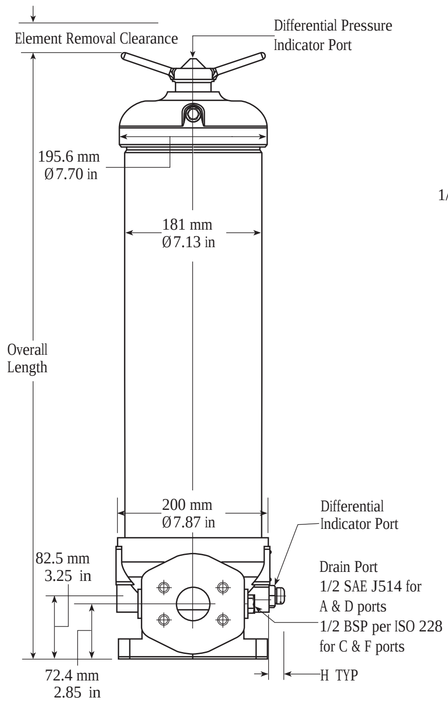
Table 4: 'R' Indicator Options

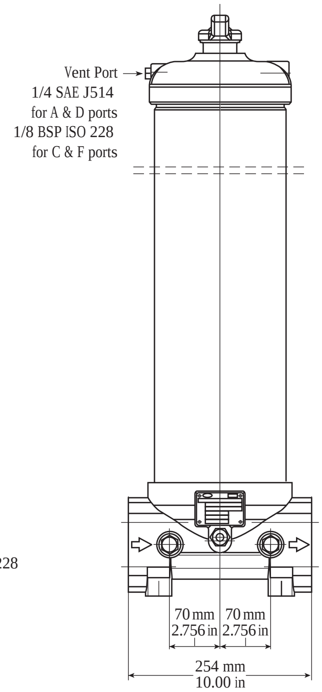
Code	Option
110AC	110V AC
220AC	220V AC
24DC	24V DC

* Use only if 'R'Indicator is selected from Table 1

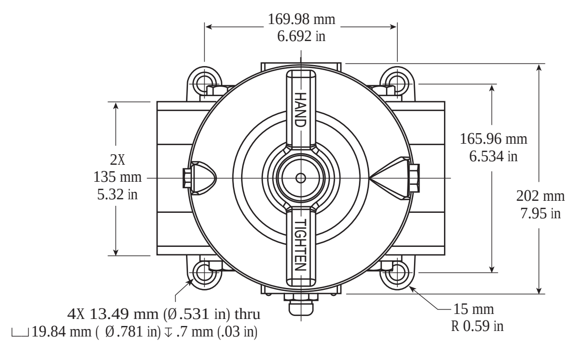
UR699 Series Filters

Technical Information





Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)	Empty Weight kg (lb)
20	762 (30)	443 (17.5)	26 (58)
40	1270 (50)	951 (37.5)	36 (80)



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IMUR699ENc Printed in the UK. July 2009

Pall Corporation

UT279

UT279 Series Filters

ULTIPLEAT® SRT IN-TANK FILTERS

Port Size ¾",1" and 1¼"

UT279

IN-TANK FILTERS

UT279 Series Filters

Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 265 L/min (70 US gpm)
- Pressures to 10 bard (150 psid)
- Port size ¾", 1" and 1¼"

Notes and Specifications

Filter Housing

- **Maximum Working Pressure:** 10 bard (150 psid)
- **Fluid Compatibility:** Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- **Temperature Range:** Fluorocarbon Seals: -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)

  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- **Materials of Construction:** Aluminum alloy head, glass-filled polyamide cover, steel shell and diffuser

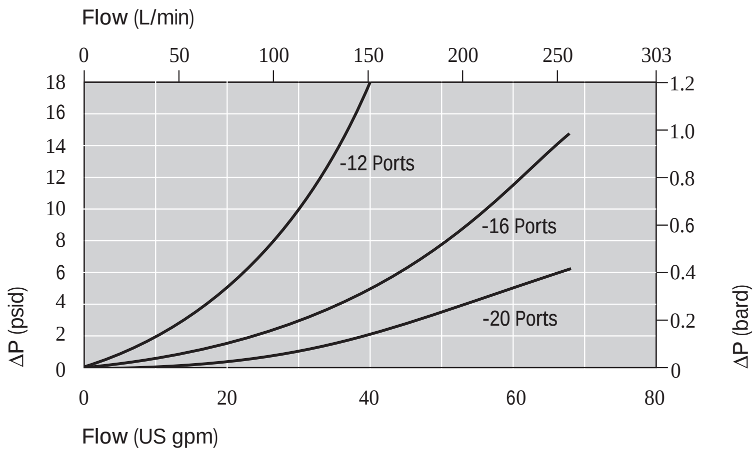
Filter Element

- **Filter Element Burst Pressure:** 10 bard (150 psid)
- **Ultipleat SRT Element Construction:** Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity.



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

299 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
04	20.07 (1.102)	8.51 (0.467)	5.72 (0.314)	3.55 (0.195)	2.69 (0.148)
08	9.93 (0.545)	4.21 (0.231)	2.83 (0.155)	1.76 (0.096)	1.33 (0.073)
13	5.95 (0.327)	2.52 (0.139)	1.70 (0.093)	1.05 (0.058)	0.80 (0.044)
20	3.95 (0.217)	1.68 (0.092)	1.13 (0.062)	0.70 (0.038)	0.53 (0.029)

Sample ΔP calculation

UT279 Series 8" length housing with C16 (1" BSP) threaded ports using AN grade media. Operating conditions 50 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.04 x 1.2/0.9) bard (housing)

+ ((50 x 2.83/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.05 bard (housing) + 0.29 bard (element)

= 0.34 bard (4.9 psid)

UT279 Series Filters

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UT 279 [Table 1] ++ [Table 2] Z [Table 3] [Table 4] B B

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

The first letter 'B' in the Housing p/n designates the breather. The letter 'B' at the end of the housing p/n designates one gauge port, fitted with a blanking plug.

Seal Kit P/N:

UT 279 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A12	¾" SAE J514 straight thread
A16	1" SAE J514 straight thread
A20	1¼" SAE J514 straight thread
C12	¾" BSP ISO 228 threads
C16	1" BSP ISO 228 threads
C20	1¼" BSP ISO 228 threads

Table 2: Housing Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Table 3: Bypass Valve Options

Code	Valve
A	1.7 bard (25 psid) with shroud
G	4.5 bard (65 psid) with shroud

Table 4: Secondary Port Options

Code	Port
N	No secondary port
S	½" port. 'A' or 'C' style depending on primary port style.

Section 2

Element P/N:

UE 299 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$ß_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
04	4
08	8
13	13
20	20

* Nominal length

Section 3

Gauge/Switch P/N: See Table 1

Replacement Breather Element P/N: HC229BR

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Gauge / Switch Options

Part No	Rating	Indicator	'H' Dim
9004D370-11	0-10 bard (150 psid)	'A' type Pressure Gauge	32mm (1.3 in)
9004D370-34	0-10 bard (150 psid)	'G' type Pressure Gauge	32mm (1.3 in)
HC0379-11	1.1 bard (16 psid)	Electrical absolute pressure switch 24VDC	54mm (2.1 in)
HCA132-35	3.5 bard (50 psid)		
HC0380-11	1.1 bard (16 psid)	Electrical absolute pressure switch 220VAC with 3 (15") flying leads	55mm (2.2 in)
HC0380-35	3.5 bard (50 psid)		

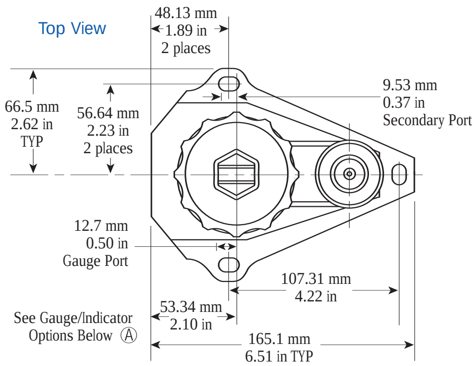
Note: Use 1.1 bard (16 psid) rating for A valve options
Use 3.5 bard (50 psid) rating for G, 3 and 7 valve options

UT279

IN-TANK FILTERS

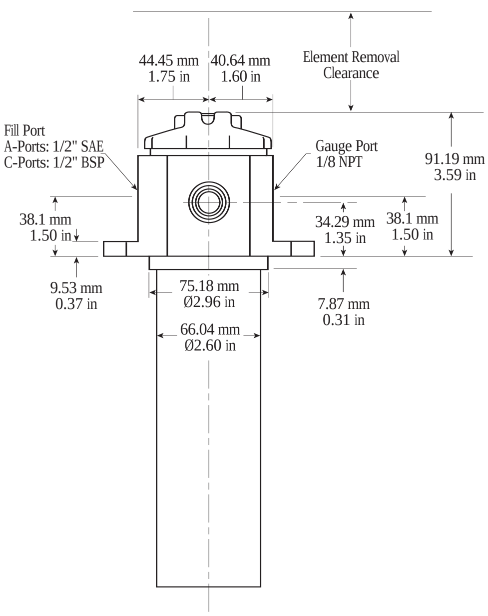
UT279 Series Filters
Technical Information

Top View

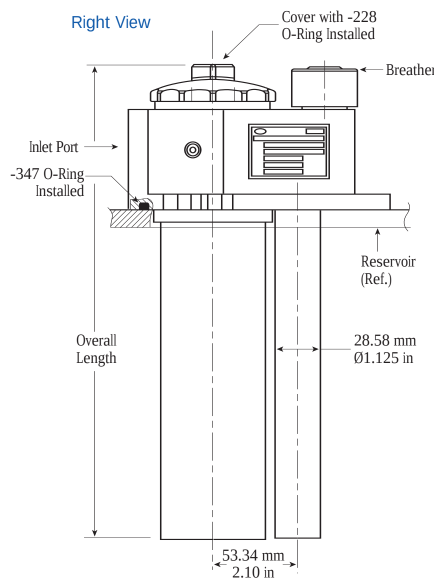


Length Code	Overall Length mm (in)	Element Removal Clearance mm (in)	Empty Weight kg (lb)
04	196 (7.7)	111 (4.4)	1.4 (3.0)
08	297 (11.7)	213 (8.4)	1.6 (3.5)
13	432 (17.0)	356 (14.0)	1.9 (4.2)
20	602 (23.7)	518 (20.4)	2.3 (5.1)

Front View

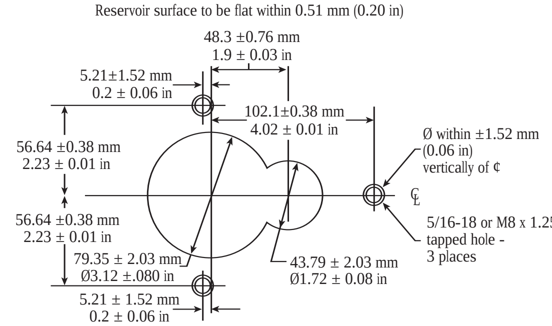


Right View

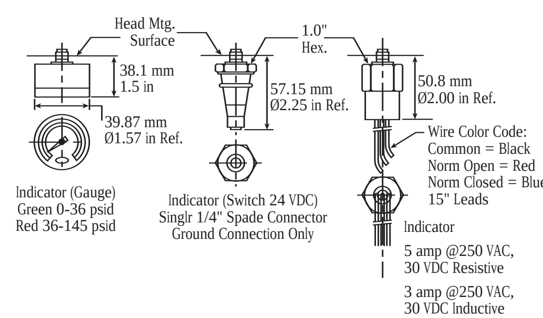


Reservoir Mounting Detail

Reservoir surface to be flat within 0.51 mm (0.20 in)



Ⓐ Gauge/Indicator Layout



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IMUT279ENb Printed in the UK. July 2009

Pall Corporation

UT319

UT319 Series Filters

ULTIPLEAT® SRT IN-TANK FILTERS

Port Size 1½", 2" and 2½"

Filtration. Separation. Solution.SM

IMUT319ENa

UT319 Series Filters
Technical Information

Features

- Patented Ultipleat (laid-over pleat) filter medium pack
- Coreless, cageless element configuration
- Pall Stress-Resistant Technology (SRT) Media
- In-to-out filter element flow path
- Flows to 760 L/min (200 US gpm)
- Pressures to 10 bard (150 psid)
- Port size 1½", 2" and 2½"

Notes and Specifications

Filter Housing

- Maximum Working Pressure:
  10 bard (150 psid)
- Fluid Compatibility:
  Compatible with all petroleum oils, water glycols, water-oil emulsions and most synthetic hydraulic and lubrication fluids
- Temperature Range:
  Fluorocarbon Seals:
  -29 ˚C to 120 ˚C (-20 ˚F to 250 ˚F)
  60 ˚C (140 ˚F) maximum in HWCF or water glycol fluids
- Materials of Construction:
  Die cast aluminum alloy head, and cover, steel shell. Use YR85 option for cast iron head and cover

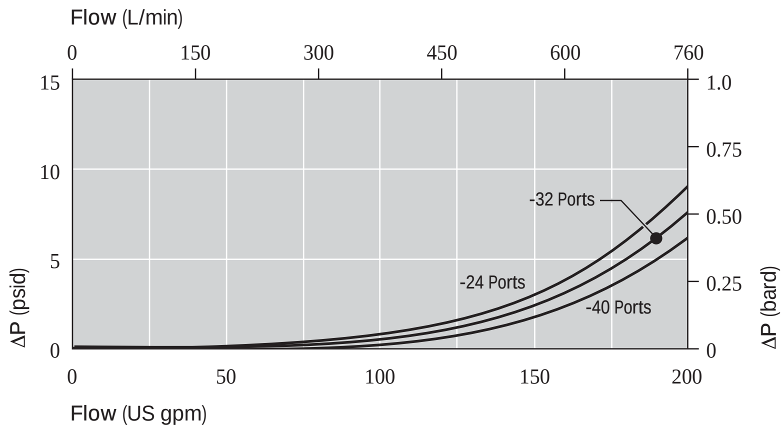
Filter Element

- Filter Element Burst Pressure:
  10 bard (150 psid)
- Ultipleat SRT Element Construction:
  Inorganic fibers impregnated and bonded with epoxy resins. Polymer endcaps. Anti-static media design

The equipment has been assessed in accordance with the guidelines laid down in The European Pressure Directive 97/23/EC and has been classified within Sound Engineering Practice S.E.P. Suitable for use with Group 2 fluids only. Consult Sales for other fluid gas group suitability.

Pressure Drop Information

Housing pressure drop using fluid with 0.9 S.G.
Housing pressure drop is directly proportional to specific gravity..



Element Pressure Drop

Multiply actual flow rate times factor in table below to determine pressure drop with fluid at 32 cSt (150 SUS), 0.9 S.G. Correct for other fluids by multiplying new viscosity in cSt/32 (SUS/150) x new S.G./0.9. Note: factors are per 1000 L/min and per 1 US gpm.

319 Series Filter Elements — bard/1000 L/min (psid/US gpm)

Length Code	AZ	AP	AN	AS	AT
08	5.52 (0.302)	2.30 (0.126)	1.82 (0.100)	1.32 (0.072)	0.82 (0.045)
13	3.31 (0.182)	1.38 (0.076)	1.09 (0.060)	0.79 (0.043)	0.49 (0.027)
20	2.18 (0.120)	0.91 (0.050)	0.72 (0.040)	0.52 (0.029)	0.33 (0.018)
40	1.10 (0.060)	0.46 (0.025)	0.36 (0.020)	0.26 (0.014)	0.16 (0.009)

Sample ΔP calculation

UT319 Series 13" length housing with F24 (1 1/2"SAE) split flange ports using AN grade media. Operating conditions 200 L/min flow rate using a hydraulic fluid of 50 cSt and specific gravity (s.g.) 1.2.

Total Filter ΔP

= ΔP housing + ΔP element

= (0.05 x 1.2/0.9) bard (housing

+ ((200 x 1.09/1000) x 50/32 x 1.2/0.9) bard (element)

= 0.07 bard (housing) + 0.45 bard (element)

= 0.52 bard (7.6 psid)

Ordering Information

For new installations, select one complete part number from each section below

Section 1

Housing P/N:

Note: Pall Ultipleat SRT filter housings are supplied without filter elements or warning devices fitted. Never operate the filter unless a filter element is fitted and all warning device ports are sealed.

UT 319 [Table 1] ++ [Table 2] Z [Table 3] [Table 4] BN B [Table 5]

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

'BNB' at the end of the Housing P/N designates 1 gauge port, and one indicator port, both fitted with plugs.

Seal Kit P/N:

UT 319 SKZ

*Other seal material options are available; Contact Pall.

Table 1: Housing Port Options

Code	Port
A24	1½" SAE J514 straight thread
D24	1½" Flange J518C code 61 with ½"-13 UNC holding bolts
A32	2" SAE J514 straight thread
D32	2" Flange J518C code 61 with ½"-13 UNC holding bolts
A40	2½" SAE J514 straight thread
D40	2½" Flange J518C code 61 with ½"-13 UNC holding bolts
C24	1½" BSP ISO 228 threads
F24	1½" ISO 6162 split flange with M12 x 1.75 holding bolts
C32	2" BSP ISO 228 threads
F32	2" ISO 6162 split flange with M12 x 1.75 holding bolts

Table 2: Housing Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Table 3: Bypass Valve Options

Code	Valve
A	1.7 bard (25 psid) with shroud
G	4.5 bard (65 psid) with shroud
3	4.5 bard (65 psid) with cannister, no ABFV
7	4.5 bard (65 psid) with cannister & ABFV

Table 4: Secondary Port Options

Code	Port
N	No secondary port
S	1¼" port (same style as primary port)

Table 5: Head Material

Code	Material
OMIT	Cast aluminum alloy (standard)
YR85	Cast iron

Section 2

Element P/N:

UE 319 [Table 1] [Table 2] Z

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Table 1: Filter Element Options

Code	$\beta_{x(c)} \geq 1000$ based on ISO 16889	CST Rating*
AZ	3	08/04/01
AP	5	12/07/02
AN	7	15/11/04
AS	12	16/13/04
AT	22	17/15/08

* CST: Cyclic Stabilization Test to determine filter rating under stress conditions, based on SAE ARP4205

Table 2: Filter Element Length Options

Code	Length (in)*
08	8
13	13
20	20
40	40

* Nominal length

Section 3

Differential Pressure Indicator P/N:

RC [Table 2] [Table 3] Z [Table 4]

Note: Z indicates fluorocarbon seals are standard. Other options are available; contact Pall.

Gauge/Switch P/N: See Table 1

Table 1: Gauge / Switch Options

Part No	Rating	Indicator	'H' Dim
1373772	-	'B' option ⅛" blanking plug	3mm (0.1in)
9004D370-11	0-10 bard (150 psid)	'A' type Pressure Gauge	32mm (1.3in)
9004D370-34	0-10 bard (150 psid)	'G' type Pressure Gauge	32mm (1.3in)
HC0379-11	1.1 bard (16 psid)	Electrical absolute pressure switch 24VDC	54mm (2.1in)
HCA132-35	3.5 bard (50 psid)		
HC0618-11	1.1 bard (16 psid)	Electrical absolute pressure switch 220VAC with Hirschmann connector	83mm (3.25in)
HC0618-35	3.5 bard (50 psid)		
HC0380-11	1.1 bard (16 psid)	Electrical absolute pressure switch 220VAC with 3 (15") flying leads	55mm (2.2in)
HC0380-35	3.5 bard (50 psid)		

Note: Use 1.1 bar rating for A valve options
Use 3.5 bar rating for G, 3 and 7 valve options

Table 2: Differential Pressure Indicator Options

Code	Indicator	'H' Dim.
778NZ	'P' type Visual indicator with thermal lockout	21mm (0.83in)
860MZ	'D' type Visual indicator with no thermal lockout	21mm (0.83in)
861CZ	'L' type Electrical switch (SPDT) with 6" lead	38mm (1.50in)
861CZ	'M' type Electrical switch (SPDT) with DIN43650 connector and matching cap	78mm (3.07in)

* Other options available on application.

Table 3: Indicator Pressure Setting Options*

Code	Pressure Setting
084	For 'A' Valve Option Housings (1.1 bard - 16 psid)
091	For 'G', '3' and '7' Valve Option Housings (3.5 bard - 50 psid)

* Other setting options are available; contact Pall.

Table 4: 'M' Type Indicator Code*

Code	Option
YM	'M' option

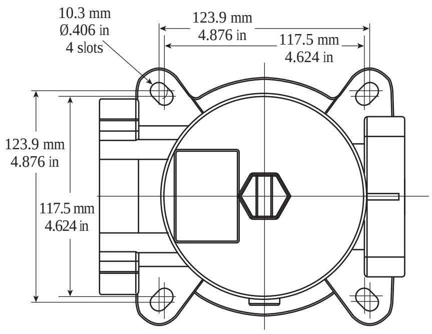
* Use only if 'M' Indicator is selected from Table 8

UT319

IN-TANK FILTERS

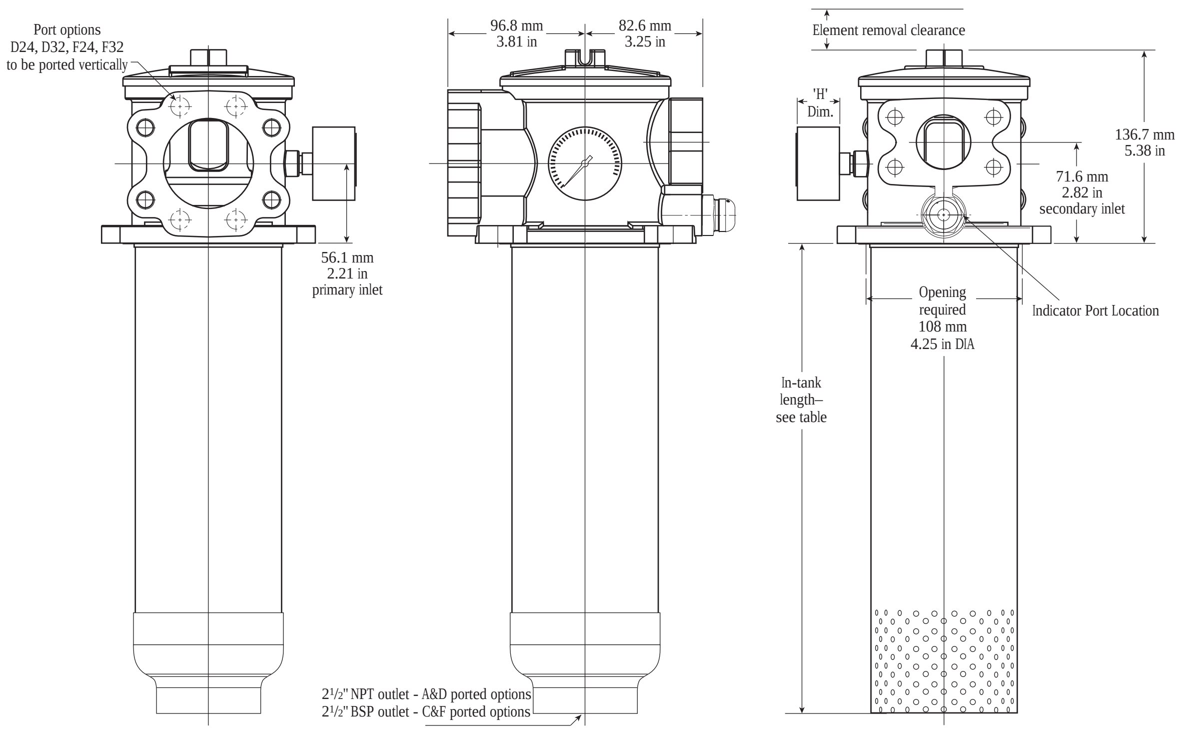
UT319 Series Filters

Technical Information



Top view (Scale: 3:4)
(Indicators/gauges removed)

Length Code	In-tank Length mm (in) 'C' Option	'S' Option	Element Removal Clearance mm (in)
08	337 (13.25)	295 (11.62)	229 (9)
13	464 (18.25)	422 (16.62)	361 (14.2)
20	641 (25.25)	600 (23.62)	533 (21)
40	1149 (45.25)	1108 (43.62)	1041 (41)



Left view
Cannister option shown

Front view

Right view
Shrouded option shown

PALL® Pall Corporation

Pall Industrial Manufacturing

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IMUT319ENa Printed in the UK. July 2009

Water Sensor Calibration and Repair Services

Utilization of sensor information to minimization unscheduled downtime is important for today's Industrial applications.

Real time estimation of water content in non-aqueous hydraulic and lubricating systems is critical for determining when intervention is required. The Pall family of water sensors provide "real time" measurement of dissolved water content and enables the user to take immediate action towards minimizing water induced component damage and fluid degradation. Data acquired from the water sensor often triggers plant operators to mobilize personnel and equipment to mitigate water "upsets" which have occurred in the system.

ISO 9000 guidelines and internal plant protocols are found to be the main drivers for increased demand of water sensor calibration services. In response to this increased demand Pall Corporation has developed a suite of easily obtainable water sensor services to meet the needs of our customers.

Products covered: WS03, 04, 05, 06, 07, 08, 10

Ordering Instructions
Contact your local Pall Corporation representative for return authorization instructions.

Water Sensor Services Offering

Part number	Description
SERVICE-WS RECAL	Sensor Calibration (includes calibration certificate)
SERVICE-WS REPAIR	Assess and Repair Faults
SERVICE-WS LOAD CONST	Assess sensor, quote repair costs
SERVICE-WS NEW CONST	Determining New PPM Constants

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Please contact Pall Corporation for product applicability to specific National legislation and/or Regional Regulatory requirements for water and food contact use.

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Pall Corporation

NEW: Pall WS08 Series Water Sensor

For measurement of dissolved water content in oils

Features

- A sensing probe immersed in the fluid to directly monitor dissolved water content and temperature
- Water content expressed as % saturation or PPM and temperature in °C or °F
- High temperature sensing
- Simple to operate
- Robust modular housing and sensing probe designs
- Available with or without display
- Included PC configuration software with RS232 communication cable
- Two relay outputs standard (except if RS485 output is ordered)
- Optional RS485 output (not available with relay outputs)
- Two freely scaleable and selectable analogue outputs, 4-20 mA, 0-5 V or 0-10 V (factory default setting is 4-20 mA)
- Simple and flexible installation

The Pall WS08 Series water sensor provides precise and reliable measurement of dissolved water content in industrial process fluids. It is ideal for in-line monitoring of moisture in hydraulic, lubrication and insulation oils, contributing to the predictive maintenance of plant and machinery.

Specifically designed for harsh industrial environments the WS08 Water Sensor features a modular housing concept and simple on-site adjustment.

Simple Installation

The Water Sensor enclosure is designed in modular form for safe and convenient installation. The base section allows location and electrical wiring of the sensor to be carried out before the microprocessor, sensor probe and display sections are fitted. Each section of the enclosure fits securely to achieve an IP65 NEMA 4 moisture protection rating.

Pall WS08 Water Sensor.

Water content measurement in oil

Similar to the measurement of humidity in air, the water content in oil can be described either as the relative % saturation or as an absolute value of the total oil mass, expressed in ppm (parts per million).

% Saturation or PPM Output

The sensor measures dissolved water concentration as a percentage of the water saturation level (% saturation) of the fluid at the measurement temperature. This allows the user to monitor changes and trends in water concentration with time. The % saturation can be converted to water concentration in PPM by programming the unit with constants that are specific to the fluid; contact Pall Corporation for details and the protocol.

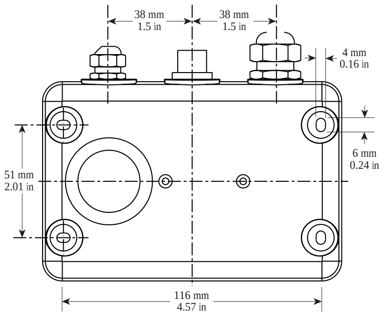
The sensing probe can be fitted directly into the fluid system or via a ball valve. Once permanently installed, the ball valve allows mounting and removal of the probe without having to drain the system.

Sensor probe shown fitted into ball valve

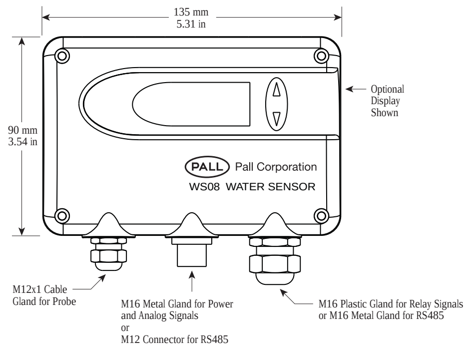
Specifications

Supply Voltage	8-35 VDC 12-30 VAC
Temperature	
Sensing Probe	-40 °C to 180 °C (-40°F to 356 °F)
Housing with display	-20 °C to 50 °C (-4°F to 122 °F)
Housing without display	-40 ºC to 60 ºC (-40ºF to 140 ºF)
Fluid Compatibility	Petroleum based and synthetic fluids. The water sensor is not to be used in water based fluids or aerospace phosphate ester hydraulic fluids.
Pressure	20 bar (290 psi) maximum
Probe Connector	½" NPT (male) or ½" BSPP (male)
Probe Cable Length	2 m (6.6 ft) Longer cable lengths available
Accuracy Humidity Sensor	± 2 % 0 to 90 % RH and ± 3 % 90 to 100 % Traceable to international standards, administered by NIST, PTB, BEV
Accuracy Temperature Sensor	Pt 1000 (Tolerance Class A, DIN EN60751)
Enclosure	IP 65: NEMA 4
Weight	0.43 kg (0.95 lb)
Signal Output	RS232 Serial (RS485 optional), 0-5 V, 0-10 V or 4-20 mA
Alarms	Settable water and temperature alarms using configuration software (included) and customer's PC
Outputs	Freely selectable and scaleable 0 – 5 V Load Current <1 mA 0 – 10 V Load Current <1 mA 4 – 20 mA Load <500 Ohm 0- 20 mA Load <500 Ohm
PC Configuration Software	Included
Systems requirement	Windows 98 or later, serial interface
Calibration Services	Available from Pall; contact your local representative

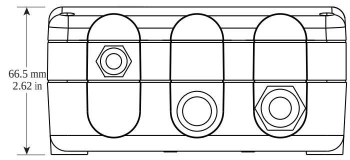
Rear View



Front View



Bottom View



Ordering Information

Water Sensor P/N: WS08 ☐ S ☐ ☐ ☐ ☐

Table 1 — Table 2 — Table 3 — Table 4 — Table 5

Spare Parts and Accessories

Display and housing cover:	WS08D05-KIT
RS232 Interface cable, 3 meter:	WS08CA
Ball valve set (C08 option):	WSPV-KIT
Ball valve set (B08 option):	WSPV-KIT-NPT
Sealing Element 1 (o-ring):	HA050308

Table 1: Display Options

Code	Display Options
None	Without display
D	With display

Table 2: Relay Options

Code	Relay Options
None	Without relay (Non Stock Special Order)
R	With relay (Standard Stock item)
B	With RS485 (Note: No relays fitted)

Table 3: Probe Options

Code	Probe Options
B08	½" NPT connector ½
C08	½" BSPP connector

Table 4: Probe Length

Code	Probe Length
None	100 mm probe length
L	200 mm probe length (includes ball valve)

Table 5: Cable Length

Code	Length
NONE	2 m (6.6 ft) Standard
05	5 m (16.4 ft)
10	10 m (32.8 ft)

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IMWS08EN Printed in the UK. February 2008.

Pall Corporation

New: Pall WS09 Series Water Sensor

For measurement of water content in oil

The Pall WS09 Series portable water sensor is an ideal, low-cost method for measuring dissolved water content in hydraulic, lubricating and insulating fluids.

Specifically designed for use in industrial environments, readings are shown on an LCD display and can be used as a key component in the predictive maintenance of plant and machinery.

Features

- A sensing probe directly immersed in the fluid to monitor dissolved water content and temperature
- Water content output in % saturation or PPM
- Temperature in °C or °F
- ‘Plug and play’ connectivity
- Simple to operate and calibrate
- Robust housing and sensing probe designs.

The Effect of Water in Oil

Water contamination in fluids can cause numerous problems such as additive depletion, oil oxidation, corrosion, reduced lubricating film thickness, microbial growth, and reduction of dielectric strength. These costly problems can be averted with continuous monitoring of oil water content so that timely action can be implemented. Hydraulic, lubricating and insulating fluids should be operated without the presence of free water and with dissolved water levels at 50 % saturation or considerably lower in the case of insulating oils.

Water content measurement in oil

PPM

The common industry practice has been to report water content in oil in terms of parts per million (PPM). Most fluids can tolerate a certain degree of water contamination, but at what level is it considered excessive? 200 PPM of water in a phosphate ester based oil would be excellent. However, the same amount would be catastrophic in a transformer oil.

% Saturation

An alternative way to report water content is as a percentage of the water saturation level of the fluid for a given temperature. One advantage of this method is that it provides a better measure of how close the water content is to the water saturation level of the oil and hence, the formation of free water in the fluid. The WS09 water sensor reports the presence of dissolved water in oil in the range of 0 % to 100 % of saturation. If an oil is cloudy due to free water contamination at the measurement temperature, the WS09 Water Sensor will display 100 % saturation, until steps are taken to bring the water content below the saturation point.

The % saturation can be converted to water concentration in PPM by programming the unit with constants that are specific to the fluid; contact Pall Corporation for details.

Simple use

Specifically designed for industrial environments the WS09 Water Sensor features a thumb-wheel for simple on-site adjustment and calibration, and interchangeable sensor options.

Applications

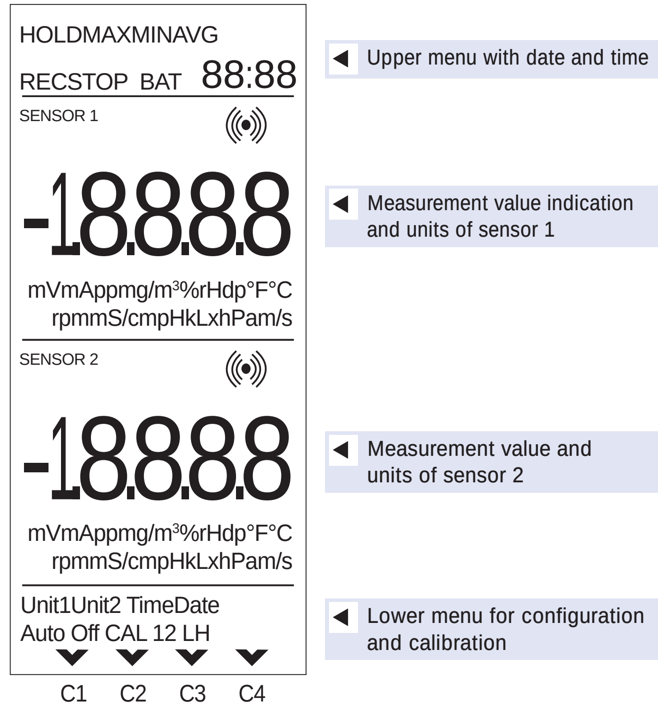
There are numerous applications for the WS09 Water sensor, including:

- Primary Metals
  - Rod Mill High Speed Lube Systems
  - Cold Mill Tandem Mill
  - Tilt Furnace HPU's
- Power Generation
  - Gear Box Lube Oil
  - Turbine Lube Oil
  - Transformer Oil
- Pulp and Paper
  - Dryer Section Lube Systems
  - Wet End Lube Systems
  - Press Section Hyd/Lube Systems
  - Powerhouse - Steam Turbine Lube Systems
- Marine
  - Main propulsion lubrication
  - Hydraulic active fin stabilization
- Industrial In-plant
- Automotive
- Offshore / Petrochemicals

Specification

Dimensions	85mm W X 145mm L X 37mm D (3.3" W X 5.7" L X 1.5" D)
Supply Voltage	4X 1.5V Alkali-Manganese Battery IEC LR6 AA.
Battery Life	200 Hours
Temperature	
Sensing Probe Tip	-40 °C to 120 °C (-40°F to 248 °F)
Grip of Sensing Probe	0 °C to 50 °C (32°F to 122 °F)
Hand Held Display	0 ºC to 50 ºC (32ºF to 122 ºF)
Fluid Compatibility	Petroleum based and synthetic fluids. The water sensor is not to be used in water based fluids or aerospace phosphate ester hydraulic fluids.
Probe Cable Length	2 m (6.6 ft)
Accuracy Saturation	± 2 % 0 to 90 % RH and ± 3 % 90 to 100 % Traceable to international standards, administered by NIST, PTB, BEV
Accuracy Temperature	± 0.2°C (±0.36°F) at 20°C (68°F) ± 0.7°C (±0.9°F) at -40°C (-40°F) ± 0.7°C (±0.9°F) at 100°C (248°F)
Enclosure / Protection	ABS /IP 40
Weight	0.43 kg (0.95 lb)
CE Compatibility	EN61000-6-4, EN61000-6-2, EN55011, EN61000-4-2, EN61000-4-3
Display	Liquid Crystal Display, 90 X 50mm (3.5" X 2"), Illuminated
Calibration Services	Available from Pall; contact your local representative

The display



Ordering Information

Water Sensor (handheld unit and probe) with case:	WS09DS
Water sensor, case and optional calibration kit:	WS09DSC
Probe only:	WS09S
Callibration kit:	WS09CALK
Callibration salts only:	WS09CALS
Connecting cable:	WS09CABLE

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IMWS09EN Printed in UK. January 2010

Pall Corporation

NEW: Pall WS10 Series Water Sensor

For measurement of water content in oil

The Pall WS10 Series water sensor is an ideal, low-cost, in-line, monitoring solution for measuring dissolved water content in hydraulic, lubricating and insulating fluids. Specifically designed for use in harsh and often remote industrial environments, readings are transmitted continuously to the user's control systems as a key component in the predictive maintenance of plant and machinery.

Pall WS10 Water Sensor.

Features

- A sensing probe directly immersed in the fluid to monitor dissolved water content and temperature
- Water content output in % saturation
- Temperature in °C or °F
- High pressure option up to 100 bar (1450 psi)
- Simple and flexible installation, simple to operate
- Robust all in-one modular housing and sensing probe design
- Two analogue outputs, 4 - 20 mA, for connections to existing SCADA and DCS systems

The Effect of Water in Oil

Water contamination in fluids can cause numerous problems such as additive depletion, oil oxidation, corrosion, reduced lubricating film thickness, microbial growth, and reduction of dielectric strength. These costly problems can be averted with continuous monitoring of oil water content so that timely action can be implemented.

Hydraulic, lubricating and insulating fluids should be operated without the presence of free water and with dissolved water levels at 50 % saturation or considerably lower in the case of insulating oils.

Water content measurement in oil

PPM

The common industry practice has been to report water content in oil in terms of parts per million (PPM). Most fluids can tolerate a certain degree of water contamination, but at what level is it considered excessive? 200 PPM of water in a phosphate ester based oil would be excellent. However, the same amount would be catastrophic in a transformer oil.

% Saturation

An alternate way to report water content is as a percentage of the water saturation level of the fluid for a given temperature. One advantage of this method is that it provides a better measure of how close the water content is to the water saturation level of the oil and hence, the formation of free water in the fluid. The WS10 water sensor reports the presence of dissolved water in oil in the range of 0 % to 100 % of saturation. If an oil is cloudy due to free water contamination at the measurement temperature, the WS10 Water Sensor will display 100 % saturation, until steps are taken to bring the water content below the saturation point.

Simple Installation

The Water Sensor enclosure is designed in modular form for safe and convenient installation. The M12 connector allows for electrical wiring of the Water Sensor for power and sensor output. Each section of the enclosure fits securely to achieve at least IP65 (NEMA 4) moisture protection rating.

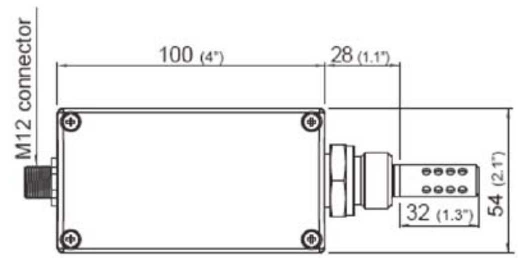
Applications

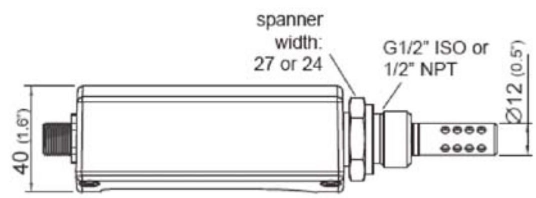
There are numerous applications for the WS10 Water sensor, including:

- Primary Metals
  Rod Mill High Speed Lube Systems
  Cold Mill Tandem Mill
  Tilt Furnace HPU's
- Power Generation
  Wind Turbine Gear Box Lube
  Main Turbine Lube Oil
  Transformer Oil
- Pulp and Paper
  Dryer Section Lube Systems
  Wet End Lube Systems
  Press Section Hyd/Lube Systems
  Powerhouse - Steam Turbine Lube Systems
- Marine
  Main propulsion lubrication
  Hydraulic active fin stabilization
- Industrial In-plant
- Automotive
- Offshore / Petrochemicals

Specifications

Supply Voltage	21-28 VDC (requires ≥ 200 mA))
Working Temperature Range	
Sensing Probe	- 40 °C to 125 °C (-40 °F to 275 °F)
Electronics	- 40 °C to 80 °C (-40 °F to 176 °F)
Fluid Compatibility	Petroleum based and synthetic fluids. The water sensor is not to be used in water based fluids or aerospace phosphate ester hydraulic fluids.
Pressure Range	
Standard Model	Up to 20 bar (290 psi)
High Pressure Model	Up to 100 bar (1450 psi)
Probe Connector	1/2" NPT (male) or 1/2" BSPP (male)
Electrical Connector	M12 - included in scope of supply
Accuracy	
Humidity Sensor	± 2 % 0 to 90 % RH and ± 3 % 90 to 100 % Traceable to international standards, administered by NIST, PTB, BEV
Temperature Sensor	Pt 1000 (Tolerance Class A, DIN EN60751)
Enclosure	IP65 (NEMA 4)
Weight	0.43 kg (0.95 lb)
Calibration Services	Available from Pall; contact your local representative
Outputs	4-20 mA Load < 500 Ohm OUT 1 = 0 to 100 % RH OUT 2 = -25 to 125 °C (-13 to 257 °F)





Ordering Information

Water Sensor P/N: WS10 S ☐ Table 1 ☐ Table 2

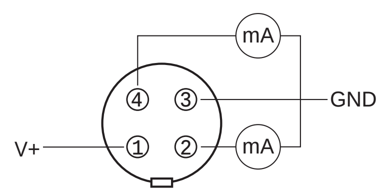
Table 1: Relay Options

Code	Probe Options
B08	½ NPT connector
C08	½ BSPP connector

Table 2: Probe Options

Code	Pressure Options
None	20 bar (290 psi) Standard
H	100 bar (1450 psi) High Pressure

M12 Connector Configuration (IEC 61076-2-101)



PIN 1 V+
PIN 2 OUT1 (4 -20mA)
PIN 3 GND
PIN 4 OUT2 (4 -20mA)

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Power Generation

Case Study

American Electric Power Generates Results with Pall

D.C. Cook Plant Deploys Pall Ultipor® Media for Reliable Fuel Pool Filtration

Overview

American Electric Power (AEP) owns and operates more than 60 generating stations in the United States, with a capacity of more than 35,000 megawatts. While the size of the operation is significant, it's the efficiency -- and the resulting reliability and operational economies -- that has earned AEP its reputation as a pioneering, innovative, and dependable power producer.

AEP's D.C. Cook Nuclear Plant is located in Bridgman, MI -- 650 acres on the shoreline of Lake Michigan that reflect AEP's philosophy of safety and performance. Cook Unit 1 is one of the leading nuclear power generators in the United States.

The Challenge: Cleaning the Fuel Pool

For fuel pool filtration, the D.C. Cook plant had been relying on a competitor's 5-micron nominal cartridges but found them to be the cause of rising dose rates on the refueling floor. To combat this hazardous situation, the nuclear plant decided to modernize its filtration capabilities.

The Solution: Pall Ultipor® GF Plus

After evaluating several options, the company chose Pall's Ultipor® GF Plus media in a direct retrofit cartridge to filter D.C. Cook's fuel pool. Pall Ultipor GF Plus media has been specifically designed for use in the nuclear industry. It's manufactured in removal ratings ranging from 40µ down to 0.1µ.

Because of its unique, positively charged media, the Pall cartridge delivers a higher dirt-holding capacity and lower clean differential pressure than competitors' cartridges.

Additionally, the Ultipor GF Plus element allows for easier and quicker changeouts, further reducing exposure for plant personnel. As plants use finer and finer filtration, they actually capture more radioactive particulate. Adhering to Pall's recommended graduated filter replacement program, D.C. Cook initiated the project with 6µ filters and is now down to 1µ.

Pall has retrofitted numerous fuel pools, including Utilities Service Alliance plants representing more than 13,000MW of power generation. Exelon, Entergy and Duke, the nations three largest nuclear generators, also use Pall products in their fuel pool. Offering several direct replacements for fuel pool retrofits, Pall has the products to help your plant run safely and efficiently.

About Pall Ultipor® GF Plus

Pall Ultipor® GF Plus filter cartridges are made with highly efficient glass fiber filter media pleated into low pressure drop modular filter elements, and feature:

- High-area pleated medium
- Low differential pressures
- Absolute particle rated in liquids
- High-capacity for long life
- Fixed pores to prevent unloading

Power Generation

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Power Generation

Filtration Products and Services for Nuclear Power Generation

Customized Total Fluid Management for the Nuclear Power Industry

*Filtration. Separation. Solution.*SM

Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.

We can provide a complete analysis of the systems in your plant and recommend the correct Pall filtration and separation technologies and products to improve efficiency. Pall offers real and lasting solutions, not just quick fixes. With today's sophisticated nuclear plants, a high level of technical proficiency is required to properly inspect, diagnose, and make recommendations for your systems. Pall Corporation can provide the expertise necessary to ensure that your plant operates at peak performance.

About Pall Corporation

Our company is committed to upholding the high standards we have set for product quality and service excellence for over 50 years.

Established more than a half-century ago, Pall Corporation has grown to be the largest and most diverse filtration, separations, and purification company in the world. Our global presence is far-reaching, and our product portfolio and technical expertise are extensive. Pall offers advanced filtration solutions for the removal of contaminants from water and hydraulic fluids in nuclear power plants. We have been a dependable source of filters and media designed to ensure outstanding reliability, long service life, and top efficiency. Our credentials include: ISO 9001-2000; ASME Section VIII, Div. 1; National Board of Boiler & Pressure Vessel Inspectors “R” Certificate of Authorization; American Society of Mechanical Engineers “U” Certificate of Authorization; NSF 53 and NSF 61 certification for water systems; and UL508A and CSA22.2 for electrical systems.

Pall offers a variety of services for all phases of system operation, from start-up to decommissioning. We design and install new systems including vessels, piping, valves, and controls, as well as retrofits into existing systems. These services are provided locally, with intensive, broad-based assistance from Pall's worldwide technical support network. Located in over 30 countries, our staff of engineers and scientists are technical experts who help determine how Pall products and technologies can best be applied to benefit you. As part of your customized Total Fluid Management solution, products, processes, and services are recommended to optimize your system and help you gain the edge in this increasingly competitive marketplace.

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation equipment and services to yield the highest process efficiency at the lowest cost. Pall's TFM program offers a wide range of filtration products, advanced technologies, and technical services. The Power Generation Group offers its customers an exclusive TFM program unique to Pall Corporation. This package provides filtration products and diagnostic, consulting, and on-site support services tailored specifically for customers in the nuclear power industry.

How can a Total Fluid Management approach benefit you?

- Reduces your operating costs and increases your process efficiency. Pall offers unsurpassed engineered products and services to help you cost effectively meet your purification goals.
- Gives you access to an extensive, multidisciplinary team of experts including engineers, physicists, chemists, biochemists, and microbiologists. Utilize the global technical support network of the world's leader in filtration, separation, and purification solutions.
- Offers you the benefits of Pall's advanced technology. Our teams of technical specialists are well versed in all areas of filtration, separations, and purification including microfiltration, ultrafiltration, nanofiltration, reverse osmosis, and phase separation.
- Enables you to redeploy your resources. With your system in the competent hands of Pall staff, you can put your resources where they are most needed.
- Introduces you to Pall's comprehensive services program. Our Total Fluid Management program offers a full range of services to help you meet your filtration, separations, and purification requirements.

Filters that meet your requirements

Select from a wide variety of disposable and backwashable filter products to meet all your filtration needs.

Pall filters are engineered and manufactured to meet stringent quality requirements and are rigorously tested before leaving our manufacturing plants. When you choose Pall, you can be assured that you are buying high-quality, dependable, and cost-effective filter products from the company that has set the standard for nuclear filtration for over 30 years.

Our products for nuclear applications include:

- Pall Aria™ filtration systems,
- Ultipor® III hydraulic filters,
- Pall Hydro-Guard® backwashable filters (HGPPB and HGPPB-R),
- Ultipleat® High Flow filters,
- PMM® and Rigimesh® sintered metal elements,
- Ultipor® GF Plus filters,
- over 160 different types of nuclear cartridges.

As part of our TFM program, we will conduct a detailed analysis of your filtration processes and recommend the correct Pall products for your system and application. This service provides you with a customized solution for optimizing the efficiency of your system and lowering operating costs.

There are many benefits to using Pall filtration products:

- absolute rating (ß 5000) for reliable, repeatable performance,
- long service life,
- high dirt-holding capacity,
- matrix bonding to prevent media migration,
- positive sealing to eliminate fluid bypass,
- direct replacements with no modification of equipment required,
- strict quality control.

* Microza is a trademark of Asahi Kasei Corporation.

Media

Pall's varied selection of filter media makes your customized filtration solution possible. We provide innovative disposable and backwashable media in a wide range of micron removal ratings. These materials are developed, designed, and manufactured under the strictest quality controls and have proven their exceptional performance, reliability, and consistency.

Control Rod Drive filters using Pall's Rigimesh media are used throughout the BWR fleet.

The following Pall media are most commonly used for nuclear applications:

- Microza* medium: mechanically strong, oxidant-resistant hollow fiber available in MF and UF grades,
- Ultipor III medium: inert, inorganic fibers securely bonded into a fixed, tapered pore structure,
- Rigimesh medium: extremely strong, highly permeable, sintered stainless steel woven wire mesh,
- PMM medium: thin, porous metal membrane constructed of very fine stainless steel, powder, and Rigimesh sintered together to produce an absolute-rated medium,
- Ultipor GF Plus medium: resin-bonded glass fibers supported by upstream and downstream polymeric substrates.

Elements

Pall's disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radwaste, fewer changeouts, and added protection for equipment and personnel.

Plant water treatment

You can rely on Pall water treatment technologies for successful purification and reuse of water within your plant.

Plant water treatment is the most recent addition to Pall's TFM program. We provide effective filtration products for the treatment of make-up water, drinking water, and wastewater within your plant.

Make-up water

The quality of your make-up water is critical to the operation and maintenance of your steam generator and condensate systems. Pall Aria water treatment systems consistently provide high-quality effluent, regardless of the water source.

Pall Aria systems offer the following advantages:

- fully automatic,
- self-regenerable,
- remotely monitored,
- use Microza hollow fiber microfiltration and ultrafiltration membranes,
- superior control of metallics, bacteria, and colloidal and particulate silica.

Pall Aria water treatment system is compact and flexible and produces high quality treated water

These advanced features can improve your reverse osmosis (RO) operation, reduce your chemical costs for precipitation, coagulation, and RO membrane regeneration, and lower your water treatment costs.

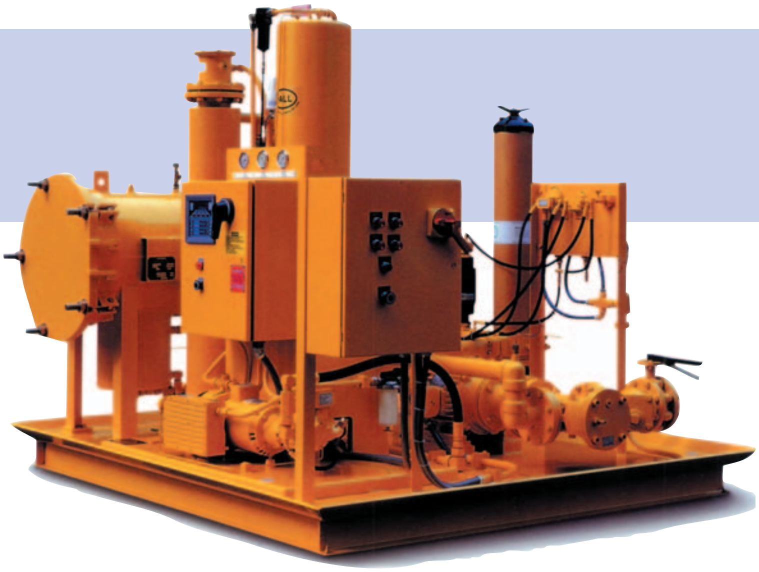
Drinking water

At power plants throughout the world, Pall Aria microfiltration systems have been preferred for drinking water treatment. Through the safe and cost-effective reduction of disease-causing organisms, Pall Aria systems can provide your plant with drinking water that meets strict quality standards.

Pall module cut-away reveals hollow fiber membrane

Wastewater

Successfully removing the undesirable constituents from wastewater streams is critical for conformance with stringent environmental regulations. Pall offers advanced wastewater management systems that are fully integrated, reliable, flexible, and easy to use. They are designed to optimize each step in the wastewater treatment process. Our Pall Aria microfiltration and ultrafiltration systems, backwash systems, and reverse osmosis systems successfully treat wastewater to meet your requirements, even when they are zero liquid discharge.



Pall's TLC unit protects steam turbine components and the generator seal oil system.

Steam turbine management

Pall offers the filters you need for efficient steam turbine management.

Through our TFM program, Pall provides products and services to improve the reliability, output, and efficiency of your steam turbine. Our total approach to turbine fluid systems optimizes turbine operation and reduces costs. We help ensure that all turbine fluids meet the most recent INPO requirements for steam turbine management.

For the smooth operation of your steam turbine, we recommend filters constructed of Pall's Ultipor and Ultipor SRT℠ medium. Both the Ultipor III filter and the Ultipor Dirt Fuse filter are outstanding products and are the most commonly used filters in steam turbine systems.

Ultipor III filters have numerous advantages, which include:

- maximum removal efficiency,
- long life,
- absolute rated down to 1 micron (β_1>200),
- duplex configuration available for uninterrupted operation,
- fixed, tapered pore structure for superior dirt capacity,
- resistance to flow and pressure spikes,
- tested for integrity and efficiency.

Significant benefits of Ultipor Dirt Fuse filters include:

- 3,000 psid collapse rating,
- filtration down to 3 µm (β_3 > 200),
- nonbypass design for maximum protection,
- superior flow resistance providing low differential pressure.

Steam turbine applications are crucial to reliable plant operations. Our TFM program provides products and services for applications including:

- turbine lube oil,
- electrohydraulic control (EHC),
- hydrogen seal oil.

Pall's Ultipor III cuts down on wear in turbines, reducing bearing wipes and improving start-up success.

EHC fluid treatment

The Pall HRP purifier enhances the operation of your EHC system. It combines anionic and cationic ion exchange with mass transfer dehydration and fine particulate filtration to control acid formation and maintain high volume resistivity. The HRP also reclaims degraded phosphate ester systems by removing metal salt deposits. If your EHC system uses GE or Siemens Westinghouse filters, you can convert to a Pall system by retrofitting your existing filters with our Ultipor III elements.

Turbine lube oil

Your lube oil contamination problems can be resolved by implementing one of Pall's turnkey turbine lube oil systems. Our systems use high-efficiency filtration, coalescence, and mass transfer dehydration to combat contamination from water and solids. Your benefit— consistently clean, dry oil.

Hydrogen seal oil

Particulate and moisture in your hydrogen seal oil system can cause serious generator problems. Our hydrogen seal oil systems prevent these problems by protecting the seals from abrasive wear and preventing water from ingressing into the generator. Pall offers systems proven to maintain seal integrity, protect hydrogen purity, and minimize maintenance of the sealing system. We can convert your existing system by replacing your filter cartridges with Ultipor III elements.

Condensate filtration systems

Using a Pall condensate filtration system can improve the efficiency of your equipment.

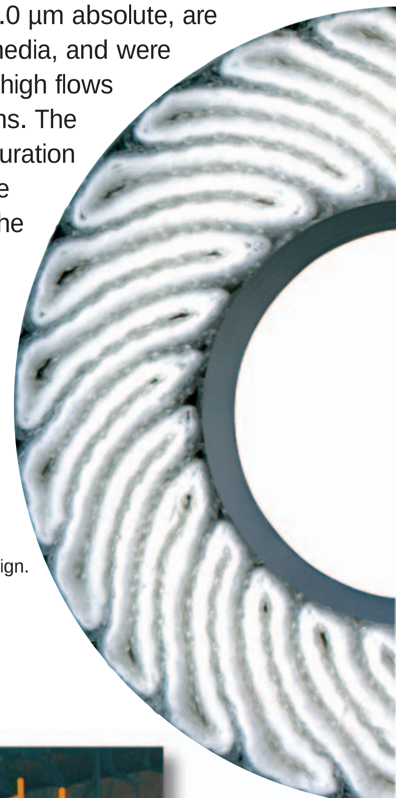
Pall condensate filtration systems can lengthen the life of your equipment and prevent costly delays during start-up. Our backwashable and disposable systems effectively remove corrosion products while preventing resin bleedthrough.

Backwashable systems

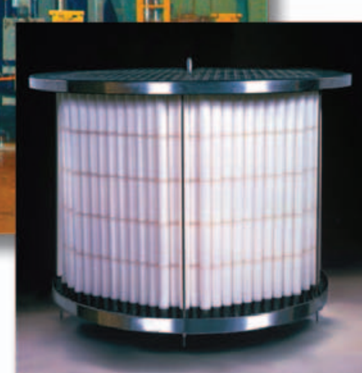
Pall backwashable elements are used around the world in small and large condensate systems to reduce particulate transport, protect steam generators and resin beds, and minimize worker exposure. Pall Hydro-Guard® PPB filters and Hydro-Guard® ColdR filters are designed for systems where filter integrity, element life, and efficiency are critical to maintaining the purity of water. Our backwashable systems can be used with and/or without precoat.

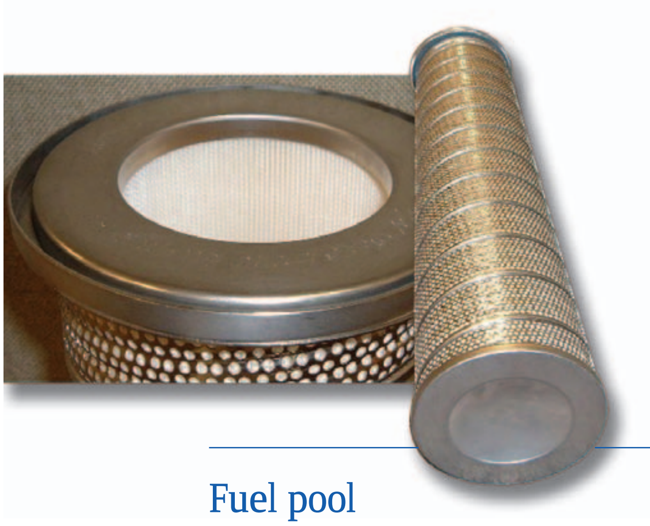
Disposable systems

Pall Ultipleat High Flow filters are frequently used in high-efficiency condensate filtration systems because they are available down to 1.0 µm absolute, are constructed of disposable media, and were designed specifically for the high flows encountered in these systems. The inside-to-outside flow configuration allows retention of particulate matter inside the element. The large diameter of the filter means that fewer filters are needed, and the small footprint lowers installation and filtration costs.



Photograph showing Ultipleat crecent pleat design.





Fuel pool

Minimize worker exposure and reduce operating costs with Pall Ultipor GF Plus® filters.

An optically clear and radiologically clean fuel pool can minimize delays resulting from crud bursts during refueling. Personnel exposure can also be decreased. Saving time and reducing radioactive exposure can cut your operating costs by millions of dollars.

Pall recommends Ultipor GF Plus filters to optimize the visual clarity of your fuel pool. These filters are used in the cleanest nuclear plants around the world to protect against radiation and to reduce waste volumes. They are strongly bonded, migration free, and capable of removing particles far smaller than the rated pore size. Our 140 series filter has the same attributes and is constructed of the same medium as the Ultipor GF Plus filter. This filter is designed to fit directly into existing Tri Nuclear Corp. underwater filter housings, without the need for rework, to keep your fuel pool clean and clear.

Radwaste

Pall filters are effective for the clarification of liquid radwaste having both high and low solids loading.

Radwaste filtration, like fuel pool clarification, can be accomplished using backwashable or disposable systems. Pall radwaste filtration systems provide highly effective decontamination of liquid radwaste. We offer complete backwashable systems that provide continuous, automated, long-term service for small- and large-flow applications. Our disposable systems are equipped with filter elements that are highly permeable and especially sturdy and efficient.

As part of our TFM program, Pall can evaluate your radwaste filtration system and upgrade it by retrofitting competitors' filters or filter assemblies with our products. If, for example, you currently have bag filter assemblies, we can retrofit them with our Marksman™ filter cartridges. Marksman elements have finer micron ratings and have been specifically designed to retrofit bag filter housings.

Reactor Water Cleanup (RWCU)

Replacing septa with Pall porous metal membranes prevents resin leakage and improves reactor water quality.

Spiral welded mesh, wedge wire, and coarse metal elements commonly found in RWCU systems allow significant resin leakage. Pall offers PMM septa and Rigimesh septa as alternatives. These filters prevent leakage without compromising filter efficiency and without the addition of cellulose fiber. In the absence of fiber, ion exchange capacity is improved, and waste costs are reduced. Converting to PMM membranes or Rigimesh membranes can substantially reduce the total time to precoat and to bring your system to full flow.

Laterals and traps

Our laterals and traps are constructed of extremely durable media to prolong the life of your demineralizer system.

Resin laterals and traps constructed of Pall's Rigimesh medium can lower differential pressure, improve resin fragment retention, and increase the service life of your demineralizer. This medium is an extremely strong, highly permeable, sintered stainless steel woven wire mesh available in a range of micron removal ratings. It forms a rigid barrier that withstands high pressure and temperature and is known for its exceptional dirt-holding capacity.

Nuclear Steam Supply System (NSSS)

Submicron absolute-rated filters can reduce radioactive exposure from your Nuclear Steam Supply System.

Exposure of plant personnel to radiation is a serious concern. Absolute-rated Pall Ultipor GF Plus filters effectively remove sources of radioactive exposure. They also reduce overall dose rates during refueling outages.

Our Ultipor GF Plus filters have additional advantages, such as:

- absolute-rated efficiency to ($ß_{0.1}$ > 5000,
- effective removal of submicron particles (including Cobalt 58, Cobalt 60, and iron oxides),
- high dirt-holding capacity,
- high void volumes,
- decreased background radiation levels,
- reduced maintenance and refueling costs.

Chemical and Volume Control System (CVCS)

CVCS filter elements are expected to provide maximum removal of irradiated particulate and eliminate erosive wear of reactor coolant pump (RCP) seal surfaces. Filter elements with submicron ratings are needed to prevent seal surface corrosion. With a submicron removal rating of 0.1µm, the Ultipor GF Plus filter can significantly reduce resin fragments and corrosion products while protecting your deep bed demineralizer. This filter has also been demonstrated to reduce out-of-core radiation levels and prevent fouling of heat transfer equipment.

Our graduated filter replacement program (GFRP) is designed to maximize your cost savings by using coarser filters first, then gradually progressing through a series of continually finer filters as the inventory of particulate in your system is reduced and then maintained at the desired level.

Seal Water Injection (SWI)

Seal water injection (SWI) filters also prevent erosive wear of reactor coolant pump (RCP) seal surfaces. Ultipor GF Plus SWI filters and Seal Water Return (SWR) filters are industry proven to maintain seal leak-off rates by removing submicron particles. The removal of metal oxides and other particulate matter from your seal water ensures adequate cooling of the pump shaft and seal surface protection, thereby reducing the frequency of costly RCP seal replacement.

Quality service to optimize system performance

Pall provides quality service to ensure that your filtration, separation, and purification systems operate efficiently.

At Pall, we are dedicated to providing you with quality service to help maximize the efficiency of your system. Our engineers have a thorough knowledge of the components, design, operation, and maintenance requirements of Pall filtration and separation systems. They are expert troubleshooters who can quickly identify and resolve process inefficiencies. When additional resources are needed to diagnose and solve a problem, they call upon Pall's local and global teams of Scientific and Laboratory Services (SLS) engineers and scientists with their state-of-the-art equipment.

More than 430 SLS engineers and scientists.

Access to 41 SLS laboratories worldwide.

State-of-the-art equipment such as submicron filter test cells, scanning electron microscopes, and mass spectrometers.

High-tech communication tools – software and intranet communication tools for fast, efficient, 24/7 global information sharing.

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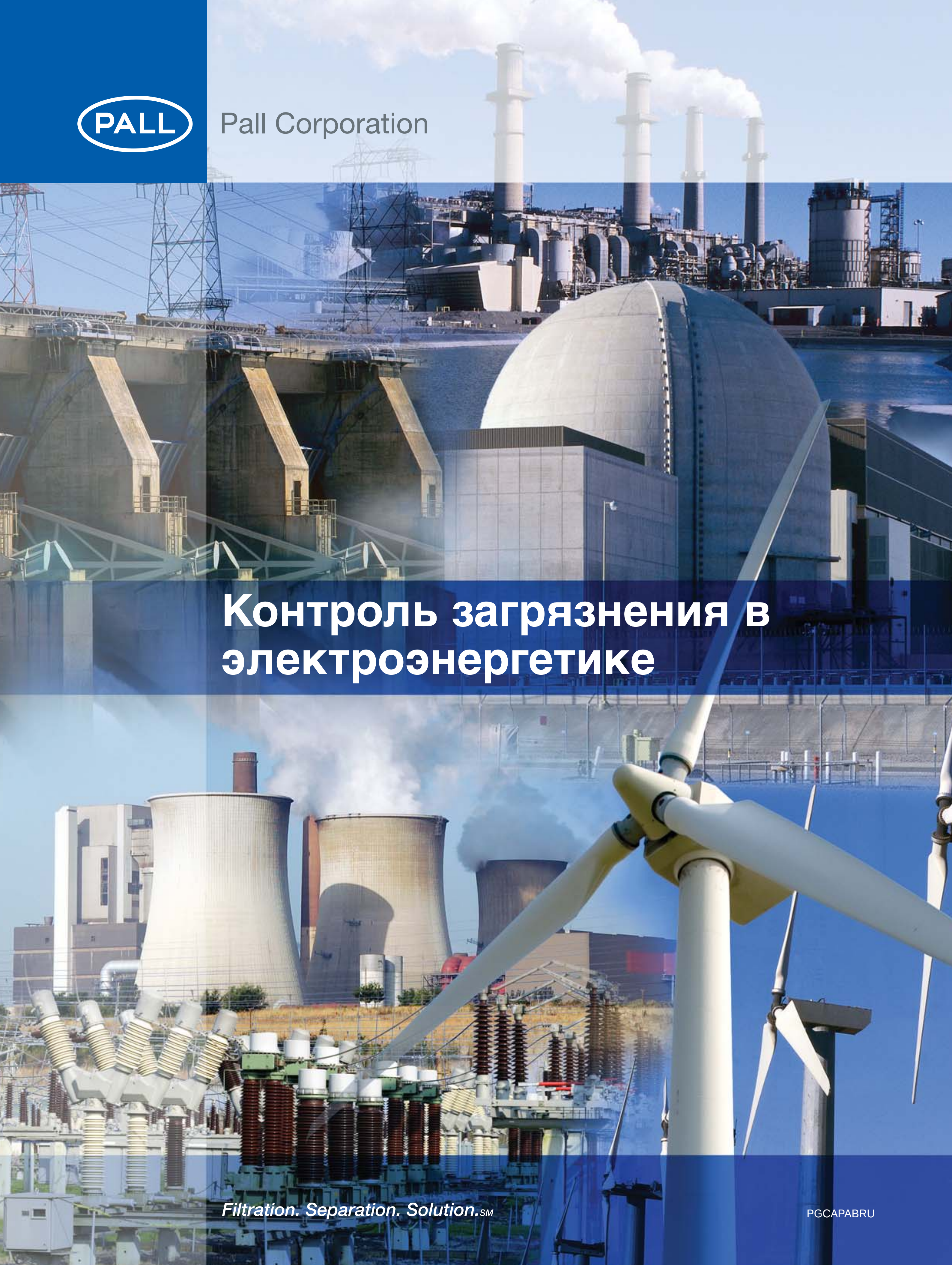


Контроль загрязнения в электроэнергетике

*Filtration. Separation. Solution.*SM

PGCAPABRU

Введение
Pall Power Generation

Pall – Ваш партнер в электроэнергетике

Pall Corporation – международная компания, способная решить комплекс проблем, связанных с загрязнениями, сепарацией и очисткой.

Pall Power Generation - отделение Pall Energy Division - является поставщиком продукции для предприятий электроэнергетики по всему миру. Имея широчайший спектр продукции и услуг, Pall может помочь Вам улучшить качество жидкости и увеличить прибыль путем оптимизации эффективности работы оборудования предприятия.

Электроэнергетика доверяет решениям, предлагаемым Pall

Pall – мировой лидер в области технологии очистки жидкости для электроэнергетики. Передовые научные разработки Pall в области сепарации и высокое качество производства используются для всех типов жидкостей предприятий электроэнергетики, обеспечивая чистоту, безопасность и надежность производства наряду с высокой прибыльностью.

Pall может решить Ваши проблемы, связанные с очисткой, для любых применений: от небольших расходов и простых устройств, до больших расходов и сложных систем; от поставки фильтрующих элементов до поставки полностью автоматизированных систем.

Преимущества научно-технической экспертизы и сервисных услуг Pall

Pall означает намного больше, чем компания, производящая фильтры. Pall специализируется в области оптимизации фильтрационных процессов, используя свои широчайшие возможности, для того, чтобы сделать Вашу деятельность более успешной. Наши знания и опыт позволили создать большой спектр собственных фильтрационных материалов, которые мы можем модифицировать для сепарации, удаления или селективного отбора наиболее сложных загрязнений.

Программа оптимизации фильтрационных процессов «Total Fluid Management»

Pall обладает возможностью осуществлять проектирование, производство, поставку и ввод в эксплуатацию экономичных комплексных систем и осуществлять их обслуживание. Программа оптимизации фильтрационных процессов Pall - «Total Fluid Management» (TMF) - для предприятий электроэнергетики помогает специалистам эксплуатировать, очищать и контролировать качество водных, топливных и масляных ресурсов. Такой подход приводит к уменьшению совокупных эксплуатационных затрат, связанных с жидкостями, эксплуатацией и техобслуживанием чувствительных компонентов. Сочетая производство и консультационные услуги, содействие при вводе в эксплуатацию и промывках оборудования, Pall является идеальным партнером для предприятий электроэнергетики.

С помощью специалистов Pall Вы улучшите качество жидкости и

снизите издержки при оптимизации работы оборудования на предприятии

Контроль загрязнения

Почему так важно заботиться о чистоте жидкости?

Твердые, жидкие и растворенные загрязнения, присутствующие в жидкостях и газах, могут вызывать проблемы при эксплуатации и техническом обслуживании оборудования предприятий электроэнергетики, такого как паровые котлы, турбины или трансформаторы.

Оставленные без контроля такие загрязнения увеличивают эксплуатационные и ремонтные затраты, понижают тепловую эффективность и производительность и создают проблемы предприятиям энергетики при инспекциях по соответствию экологическим стандартам.

Эти проблемы могут быть решены с использованием высокоэффективных, надежных и правильно применяемых фильтрационных и сепарационных технологий.

Применения:

Тепловая энергетика

Энергетические предприятия по всему миру выбирают оборудование Pall, чтобы обеспечить качество конденсата, чистоту смазочного масла и надежность работы системы регулирования турбины. Оборудование Pall уменьшает время простоя за счет осуществления высококачественной промывки систем и очистки масла, используемых технологий и консультации клиентов. Системы Pall для водоподготовки контролируют и поддерживают чистоту подпиточной воды и отработанного пара.

Атомная энергетика

Фильтрационные системы Pall помогают атомным электростанциям со всеми типами реакторов поддерживать низкий уровень радиоактивного загрязнения по всему циклу использования воды. Фильтры Pall уменьшают затраты и увеличивают производительность, защищая систему подачи пара, очищая воду в бассейнах выдержки и осуществляя доочистку конденсата:

- Снижение времени простоя
- Снижение потребления химреагентов
- Повышение безопасности
- Оптимизация производства

Возобновляемые источники энергии

Технологии Pall используются при разработке источников возобновляемой энергии. От фильтрации масла систем смазки гидротурбин до защиты редукторов ветряных электростанций или очистки биогазов, Pall применяет передовые технологии, гарантируя, что все, что связано с экологически чистым производством «зеленой» энергии, всегда будет очищено.

Передача и распределение

Доступность энергии также зависит от надежности и эффективности энергосистемы. Оборудование Pall обеспечивает высокую чистоту изоляционных масел. Установки Pall позволяют осуществлять комплексную очистку трансформаторного масла и осушку изоляции в трансформаторах, работающих под нагрузкой, существенно сокращая затраты на техобслуживание и потери, связанные с простоем оборудования. Фильтры Pall «Ultipor®» WG, удаляя воду и мелкодисперсные загрязнения, защищают контактные устройства, предотвращают разрушение масла в маслонаполненных выключателях и увеличивают межремонтные интервалы.

Pall улучшит контроль загрязнения жидкостей на Вашем предприятии, тем самым оптимизируя работу генерирующего оборудования!

Тепловая энергетика

Высокоэффективная фильтрация, чистое топливо, сокращение выброса вредных веществ, низкое потребление электроэнергии, защита от коррозионного и эрозионного износа при минимальном обслуживании.

Системы подготовки топлива

Обладая большим опытом в нефтегазовой промышленности по всему миру, Pall предоставляет комплексные решения для очистки жидкого и газообразного топлива на энергетических предприятиях. Соединение технологий фильтрации мехпримесей и эффективной коалесценции обеспечивает качество топлива, которое соответствует высоким требованиям нового поколения систем сжигания. Эффективность коалесцеров жидкость/жидкость и жидкость/газ сочетается с легкостью эксплуатации, низкими затратами на обслуживание и продолжительным сроком службы.

Контроль водоподготовки

Системы питательной воды для паровых котлов

Фильтры и мембранные системы Pall, объединенные в комплектную систему водоподготовки, обеспечивают постоянную непрерывную подачу производственной воды с минимальным использованием химикатов, оптимальным качеством и непревзойденной простотой использования и обслуживания. Pall предлагает широчайший ассортимент оборудования для фильтрации воды, включая: микрофильтрацию, ультрафильтрацию, обратный осмос или фильтрующие элементы.

Системы конденсата

Паровые котлы и турбины могут быть оборудованы системами Pall для фильтрации конденсата в виде систем с обратной промывкой или сменными фильтрующими элементами. Чтобы предложить наилучшую защиту от коррозии для систем с любыми расходами и давлением, Pall объединяет знания фильтрационных материалов и инженерные знания систем.

Системы Pall HGCoLD-R и HGPPB с обратной промывкой предлагают::

- Инженерное решение, обеспечивающее длительную экономную эксплуатацию при режиме прямой фильтрации или фильтрации с намывным ионообменным слоем
- Разные фильтрационные материалы и различные тонкости фильтрации, применимые при любых параметрах потока конденсата

Фильтры Pall Ultipleat® High Flow обеспечивают:

- Небольшой габаритный размер даже при фильтрации полного потока
- Запатентованную серповидную геометрию фильтрующего материала
- Высокую эффективность, высокую производительность при тонкости фильтрации от 100 до 1 мкм
- Легкую смену одноразовых фильтрующих элементов.

Фильтрация горячих газов

Дополнительно к оборудованию для очистки жидкостей Pall предлагает оборудование для фильтрации горячих газов, которое отвечает требованиям новейших технологий сжигания и включает керамические элементы для биогазов и газификации угля. Pall также производит оборудование, которое уменьшает выбросы загрязняющих веществ, идя навстречу эффективной, чистой и малозатратной энергетике.

Паровые турбины

Системы смазки

Применение полного спектра продукции Pall для фильтрации и комплексной очистки масла позволяет обеспечить наивысший уровень защиты подшипников и валов от износа и коррозии. Путем эффективного и экономичного удаления влаги, механических примесей и газов из смазочных масел оборудование Pall обеспечивает защиту наиболее нагруженных механизмов и сохранение первоначальных свойств масла.

Масляная система водородных уплотнений

Задача защиты уплотнений от абразивного износа и предотвращения попадания влаги в генератор лежит на системе смазки турбины. Защита от твердых частиц и влаги с помощью Pall TLC помогает поддерживать чистоту водорода и минимизировать затраты на техобслуживание уплотнений.

Система регулирования

Гидравлические системы управления паровых клапанов являются одним из наиболее чувствительных и критичных компонентов паровой турбины. Оборудование Pall соединяет в себе фильтрацию, удаление влаги и ионный обмен для защиты жидкостей, как минеральных, так и синтетических. При надлежащей фильтрации и обработке жидкости клапаны защищены от залипания и эрозии, а гидравлические жидкости защищены от термического разрушения или образования кислот.

Атомная энергетика

Pall предлагает фильтрационные решения, которые отвечают нормативным требованиям и минимизируют радиоактивное воздействие, сокращая Ваши совокупные издержки.

Современный дизайн фильтрационных материалов, опыт применения и непревзойденная эффективность очистки сделали Pall мировым лидером в сфере радиационной безопасности, контроля, обработки радиоактивных отходов и очистки бассейнов выдержки. Оборудование Pall сокращает время простоя, увеличивает эффективность работы и сводит к минимуму риск, а также осуществляет техническую поддержку заказчика по всему миру.

Программа Fine Ratings (тонких рейтингов)

В течение многих лет фильтрационные системы Pall используются на наиболее критичных позициях охлаждающих систем реакторов PWR (реактор под давлением/ ВВЭР). Сегодня наиболее чистые производства используют фильтры Pall со специальным рейтингом для атомной промышленности, чтобы снизить уровень радиации активной зоны и дозу облучения обслуживающего персонала. Программа Fine Ratings - это программа ступенчатого уменьшения тонкости фильтрации до уровня 0,1 мкм с целью последовательной очистки систем охлаждения, обеспечения лучшего функционирования, простоты ремонта и уменьшения облучения.

Фильтрационный материал

Pall поставляет новейшие фильтрующие материалы: одноразовые и с обратной промывкой, с широким диапазоном микронной тонкости фильтрации, разработанные, спроектированные и изготовленные под строгим контролем качества для обеспечения исключительной производительности, надежности и стабильности.

Фильтрующие элементы

Одноразовые фильтрующие элементы Pall, разработанные для атомной энергетики, спроектированы с исключительной целостностью структуры и отлично работают в средах с высоким уровнем радиации и различных значениях pH. Они имеют длительный срок службы, что означает меньшее количество радиоактивных отходов, меньше смен элементов и повышенную защиту оборудования и персонала.

Система контроля химического состава и уплотнения насосов охлаждающей жидкости

Фильтрационная среда Pall Ultipor GF положительно заряжена и имеет тонкость фильтрации вплоть до 0,1 мкм. Это позволяет быстро удалять радиоактивные частицы и обеспечить высочайший уровень безопасности в первом контуре.

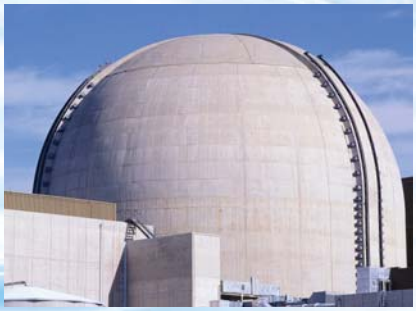
Элементы Pall Ultipor GF Plus фильтруют охлаждающую воду, защищая с непревзойденным качеством, эффективностью и долговечностью уплотнения от износа, а предприятие - от радиационного загрязнения. Фильтры Pall обеспечивают наилучший способ уменьшения уровня радиации активной зоны, облучения персонала и снижения затрат.

Фильтры Pall Ultipor GF Plus также применяются для защиты уплотнений основных насосов охлаждающей жидкости, удаляя мельчайшие твердые частицы. Уменьшение абразивного износа уплотнений, иллюстрируемое значительным сокращением утечек, гарантирует увеличение срока их службы и сокращение затрат на замену.

Системы конденсата атомных станций

Фильтрационные системы Pall с обратной промывкой являются отраслевым эталоном защиты реакторов BWR (кипящий реактор). В режиме с намывным слоем и без него фильтрующие элементы Pall сочетают в себе высокую эффективность, целостность и долговечность. Отличаясь конструкцией системы, не имеющей аналогов, и многолетним опытом эксплуатации, фильтры Pall являются наиболее эффективным способом поддержания чистоты питающей воды, сокращения затрат на ионообменную смолу и защиты парогенераторов.

Металлический пористый материал Pall сочетает большой объем пор с высокой механической и температурной стойкостью вплоть до 315,5°С. Серия фильтров Pall Rigimesh® предлагает наилучшую защиту от уноса ионита и образования отложений при уровне фильтрации от 400 до 18 мкм.



Возобновляемые источники энергии

Фильтры и установки очистки Pall совершенствуют работу всей системы, упорядочивают рабочий режим и снижают затраты на периодическое обслуживание.

Энергия гидроэлектростанций

Надежность выработки электроэнергии на гидроэлектростанциях сильно зависит от надежности, работоспособности и чувствительности механизмов регулирования турбин и систем смазки. Фильтры и установки для комплексной очистки масла Pall улучшают быстродействие системы, сокращают время вывода оборудования на рабочий режим и ремонтные затраты, поддерживая состояние смазочных и гидравлических масел на уровне, соответствующем техническим требованиям. Вместе с оборудованием Pall для контроля и мониторинга, они представляют надежную защиту от перебоев в работе, дорогостоящих затрат на замену масла и замедленного отклика системы.

Удаление мелких частиц и эффективное удаление влаги защищает смазочный слой и компоненты системы. При поддержании чистоты масла лучше, чем 16/14/12 по стандарту ИСО 4406 срок службы роликовых подшипников или подшипников скольжения может быть существенно увеличен.

Фильтрация и контроль влагосодержания –

решение программы «Total Fluid Management»

Фильтры Pall Ultipleat SRT специально разработаны для удаления твердых частиц, сопоставимых с размером зазора, вызывающих усталостный износ подшипников, абразивный износ регулирующих клапанов и ухудшение состояния жидкости. Обладая превосходной устойчивостью к цикличности потока и отсутствием накопления электростатического заряда, фильтрующие элементы Pall Ultipleat SRT превосходно работают при пиковых нагрузках в тяжелейших условиях.

При поддержании содержания воды в масле на уровне ниже уровня насыщения процесс окисления масла, а вместе с ним и коррозия в системах управления и смазки будут остановлены. На гидроэлектростанциях установки Pall для комплексной очистки масла и воздушные фильтры-поглотители влаги Pall поддерживают уровень влагосодержания ниже 30% насыщения и защищают смазочные и гидравлические жидкости от воды.

Энергия ветра

Защита редукторов

Если редуктор испытывает переменные нагрузки и работает в экстремальных условиях при воздействии вибрации, необходимо защитить его системой фильтрации, способной в течение всего времени надежно обеспечивать требуемую чистоту масла. Системы Pall для фильтрации масла в системах смазки ветряных турбин сочетают простоту устройства, легкость обслуживания, небольшой вес с рабочей характеристикой, присущей технологии Ultipleat SRT.

Для обеспечения полного контроля чистоты масло защищается фильтрами-поглотителями влаги Pall от попадания в него воды и загрязнения, и поэтому вы можете удаленно контролировать качество масла с помощью датчиков Pall, определяющих влагосодержание и количество твердых частиц.

Удаленный контроль состояния масла

Возможность раннего обнаружения проблемы с качеством масла является важной составляющей в обеспечении устойчивого функционирования удаленных ветровых электростанций. Загрязнение масла может быть наглядным показателем износа компонента, обнаружение его является ключевым средством перехода к практике профилактической эксплуатации. Благодаря наличию оборудования Pall для удаленного контроля мехзагрязнений и влаги ветряные электростанции никогда не будут без присмотра, как далеко бы они не находились.

Биомасса

Технологии Pall изготовления керамических и металлических фильтров используются для очистки сжигаемого газа при высокотемпературных и химически сложных средах, таких, как процесс газификации, и защищают оборудование после горелок и турбин. Обладая передовыми возможностями для разработки больших фильтрационных газовых систем с обратной продувкой, Pall активно участвует в разработке возобновляемых горючих источников энергии.

Техническая поддержка Pall

Что такое Total Fluid Management?

Программа Total Fluid Management (TMF) – означает внедрение правильно подобранных фильтрационных и сепарационных технологий и услуг в производственный процесс с целью достижения максимальной эффективности при наименьших затратах. Программа TFM подразумевает широкий ассортимент фильтрационных продуктов, передовые технологии и услуги, чтобы сделать производственный процесс более совершенным и увеличить производительность.

Наша глобальная команда ученых и инженеров поддерживает программу TFM

С целью помочь увеличить производительность Вашего предприятия Pall предлагает разнообразные услуги. Мы внедрим программу TFM на вашем предприятии, используя поддержку нашей Научно-лабораторной службы (SLS). Находящиеся более чем в 30-ти странах мира, наши ученые и инженеры осуществляют эту поддержку повсеместно при тесном содействии с всемирной сетью Технической поддержки Pall Corporation. Наши эксперты работают индивидуально с вами, чтобы определить, какие преимущества вы можете получить при использовании оборудования и технологий Pall.

Консультации

Наша система услуг для заказчика это:

Ввод в эксплуатацию и промывка

Pall имеет широкую сеть дистрибьюторов и сервисных центров по всему миру. Pall осуществляет промывки, мониторинг и консультирование во время капитального ремонта, ввода в эксплуатацию турбин или промывки систем. Благодаря продукции Pall, оборудованию для контроля и практическому опыту, наши программы содействия при вводе в эксплуатацию позволяют осуществить его быстрее, дешевле и более эффективно, обеспечив увеличение производительности, маневренность и производственную эффективность.

Сервис

Аудит чистоты

Аудит чистоты может вскрыть проблемы, связанные с загрязнением и его вредными последствиями. У нашей лабораторной службы и инженеров имеется все необходимое мобильное лабораторное и аналитическое оборудование и пилотные установки для проведения у вас требуемых исследований. Путем отбора проб в различных точках технологического процесса мы собираем, оцениваем количественно и идентифицируем твердые и жидкие загрязнения для определения их происхождения и выработки рекомендаций для корректирующих действий. Наши рекомендации направлены на оптимизацию вашего процесса и повышение надежности вашего оборудования при наименьших возможных затратах.

Промывка

Аудит технологического процесса/ Консультирование

Pall предлагает: услуги по выявлению неисправностей, аудит и консультирование для определения возможностей усовершенствования технологического процесса, которые приведут к увеличению производительности. Усовершенствования означают, например, снижение эксплуатационных затрат или затрат на техобслуживание. Аудит включает сбор данных и рассмотрение предложения с последующей подготовкой технического отчета о полученных данных и предложениях по усовершенствованию.

Аренда фильтрационного оборудования

В случае если Вам требуется арендовать оборудование для фильтрации или комплексной очистки, чтобы устранить появившееся в жидкости системы загрязнение, провести полномасштабные пилотные испытания или использовать его в период изготовления основного оборудования, контактируйте с Pall. Благодаря возможности вы можете протестировать оборудование на месте эксплуатации и, возможно, быстро решить существующую проблему.

Аренда фильтрационного оборудования

Газовые турбины и комбинированный цикл

Для всех аспектов эксплуатации электростанций с комбинированным циклом Pall применяет новейшие технологии, обеспечивая снабжение производственного оборудования водой, топливом и смазочными маслами высокого качества. Располагая решениями для подготовки газа с целью сокращения выбросов и воздействия на окружающую среду, Pall является партнером операторов парогазовых установок (ПГУ), следящих за улучшением работы, снижением затрат на топливо и масло, повышением надежности и работоспособности системы.

Топливо

Знания и опыт Pall в области очистки жидкого и газообразного топлива гарантируют, что газовые турбины постоянно защищены от механического и химического воздействия, присутствующих в топливе примесей. Предлагаемое Pall решение соединяет в себе высокоэффективную фильтрацию механических примесей с коалесценцией для удаления влаги или аэрозолей из топлива. Результат – значительное сокращение содержания твердых и гелеобразных примесей, воды и солей в топливе, подаваемом в камеру сгорания.

Производя спектр керамических и металлических фильтрационных систем, Pall является экспертом в подготовке альтернативных видов топлива и отраслевым лидером в системах газификации угля и биомассы. При наличии не имеющего себе равного опыта создания фильтрационных материалов и систем, системы фильтрации горячих газов Pall являются центром некоторых новейших и наиболее многообещающих энергетических проектов.

Liquid / Liquid and Liquid / Gas Coalescers

Oil Mist Eliminator

Защита турбин

Системы смазки и регулирования газовых турбин защищаются масляными фильтрами Pall, независимо от того являются они промышленными или авиационными. Останавливая цепную реакцию износа роликовых подшипников и подшипников скольжения турбины, фильтры Pall защищают турбину от простоя, ремонта и износа подшипников.

Маслоуловители Pall сокращают выбросы масляных паров в атмосферу с помощью коалесцеров жидкость/газ. Их эффективность и низкое гидравлическое сопротивление означают, что резервуары системы могут «дышать» без ограничений и с неощутимыми выбросами масла в атмосферу.

Системы водоснабжения

На электростанциях с комбинированным циклом постоянная подача и качество воды важны как для котлов утилизаторов, так и для газовых турбин. Мембранные системы Pall гарантируют постоянно высокое качество воды, отвечающее наиболее строгим требованиям нового поколения газовых турбин и котлов высокого давления. Широкий ряд ультра- и микрофильтрационных мембран, обратного осмоса, фильтрующих элементов и систем для доочистки позволяет Pall представлять комплексные решения для электростанций с комбинированным циклом. Результатом является более полное горение, лучшее функционирование систем контроля окислов азота, защита котлов от обычной коррозии и коррозии, ускоренной потоком, и уменьшение потребления воды в целом.

Pall Aria System

Ultipleat High Flow Particulate Filters

Технологии контроля загрязнения и мониторинга

Технологии фильтрации и сепарации Pall

Pall разрабатывает и поставляет широкий ассортимент фильтрационных материалов, фильтров и систем для очистки жидкостей и газов от загрязнений.

Эта продукция наряду с сервисными возможностями и технической экспертизой позволяет нам удовлетворить различные требования очистки жидкости во всех процессах энергетической отрасли.

Удаление механических примесей из жидкостей и газов

Pall разрабатывает, производит и продает широчайший спектр оборудования для очистки от механических примесей для разных применений. Фильтры Pall могут удалять мельчайшие твердые частицы из жидких или газовых потоков при большом диапазоне температуры, давления и химического состава. Такие фильтры для механических примесей могут быть изготовлены из стекловолокна, полимеров, метала или керамики. Имея различную форму, размер и микронную тонкость фильтрации, они осуществляют экономичный, эффективный и долговременный контроль на некоторых наиболее критичных применениях в энергетической отрасли.

Ultipleat High Flow/Coreless Filter Elements

HNP006 Oil Purifier

Коалесценция и обезвоживание

Удаление влаги и аэрозолей из масел или топлив является наиболее важным при защите оборудования, такого как горелки и подшипники. Влага и аэрозоли несут химические и твердые загрязнения, которые приводят к образованию отложений, коррозии и деградации жидкости. Результатом может быть неожиданный выход из строя оборудования и высокие затраты на его техобслуживание. Коалесцеры и установки для комплексной очистки масла Pall удаляют нежелательные загрязнения из углеводородов вплоть до уровня их растворимости и даже ниже. Камеры сгорания, инжекторы, подшипники или уплотнения, будут защищены при полном удалении влаги из топлив и масел.

Мембранные технологии

Мембранные технологии наиболее эффективны применительно к процессам водоподготовки. Ассортимент мембранных систем Pall включает микрофильтрацию, ультрафильтрацию и обратный осмос. В микрофильтрационных системах очистки воды Pall Ariaтм, например, используются мембраны в виде полых волокон для получения чистой воды из любого источника. Они удаляют бактерии, железо, марганец, мышьяк и твердые частицы, поставляя воду, которая постоянно соответствует жестким стандартам качества и чистоты. Мембраны Pall используются для получения подпиточной воды, обработки сточных вод и воды, используемой при продувках, также как и для очистки воды для парогенерации газовых турбин.

Мониторинг загрязнения

Мониторинг загрязнения твердыми частицами

Быстрое получение точных и надежных данных о чистоте жидкости для того, чтобы обнаружить нехарактерное загрязнение, является ключевым фактором обеспечения эффективного производственного процесса и сокращения времени простоев.

Надежные решения по мониторингу ...при любых условиях …для любой жидкости

Pall располагает портативными приборами, что решает проблемы контроля, обеспечивая возможность операторам предприятий измерять уровень чистоты даже наиболее проблемных жидкостей достоверно, легко и быстро, и предотвращает нежелательные и дорогостоящие простои оборудования.

Прибор Pall PCM400W может определить степень чистоты практически всех типов жидкостей систем.

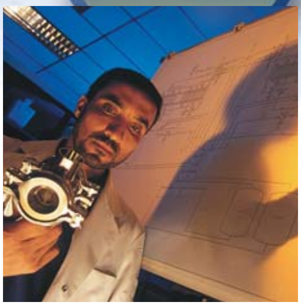
В приборе Pall PCM400W использована технология блокировки сеток, чтобы уйти от проблемы неточных и неверных результатов, появляющихся в случае, если исследуемая жидкость темного цвета, мутная или содержит воду или воздух. В качестве опции прибор может определить температуру жидкости и уровень насыщения водой (зависит от применения).

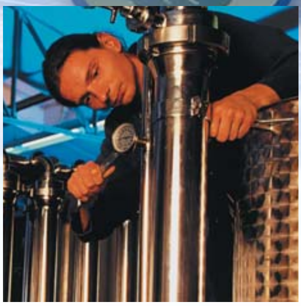
PCM400W

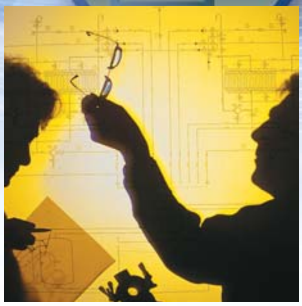
Датчики воды Pall

Масла, по возможности, следует использовать при отсутствии в них свободной или эмульгированной воды.

Датчики воды Pall измеряют содержание воды, растворенной в жидкости, в виде процента насыщения или ppm. Опции изготовления прибора включают: портативный переносной прибор для «мгновенных» измерений и стационарный прибор для проведения постоянных или запланированных по времени измерений.







Исследования и разработки

Сотрудничая с изготовителями оборудования и отдельных компонентов, Pall проектирует на заказ оборудование и системы очистки, которые полностью применимы для промышленной очистки масел и газа. Эта продукция увеличивает срок службы, повышает безопасность и надежность всех технологических систем.

Научно-лабораторная служба

Принципиальным элементом осуществления технической поддержки заказчика является наша Научно-Лабораторная служба (SLS). Проблемы фильтрации, возникающие при эксплуатации, можно анализировать и моделировать в лаборатории. Постоянный мониторинг со стороны специалистов Pall SLS может определить инженерное решение ваших проблем связанных с загрязнениями и сепарацией и, соответственно, рекомендации.

Продажи и техническая поддержка

Группа специалистов отдела продаж и технической поддержки представляет собой группу опытных специалистов, находящихся в Европе, США и Азии наряду дистрибьюторами и представителями по всему миру. Мы осуществляем продажи и сопутствующую техническую поддержку всех заказчиков по всему миру.

Качество

Политика Pall – проектировать и изготавливать продукцию, соответствующую самым высоким существующим стандартам качества, безопасности и надежности. Для реализации этой политики, организационная структура и все осуществляемые процедуры Pall полностью определены системой контроля качества, одобренной в соответствии с ISO 9001:2000.

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Pall Fuels and Chemicals

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Filtration. Separation. Solution.SM

Посетите наш сайт: www.pall.com

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Вследствие развития технологии данные характеристики и процедуры могут изменяться. Поэтому мы рекомендуем пользователям ежегодно проверять продление срока их действия. Номера деталей, перечисленных выше, защищены авторским правом Pall Europe Limited.

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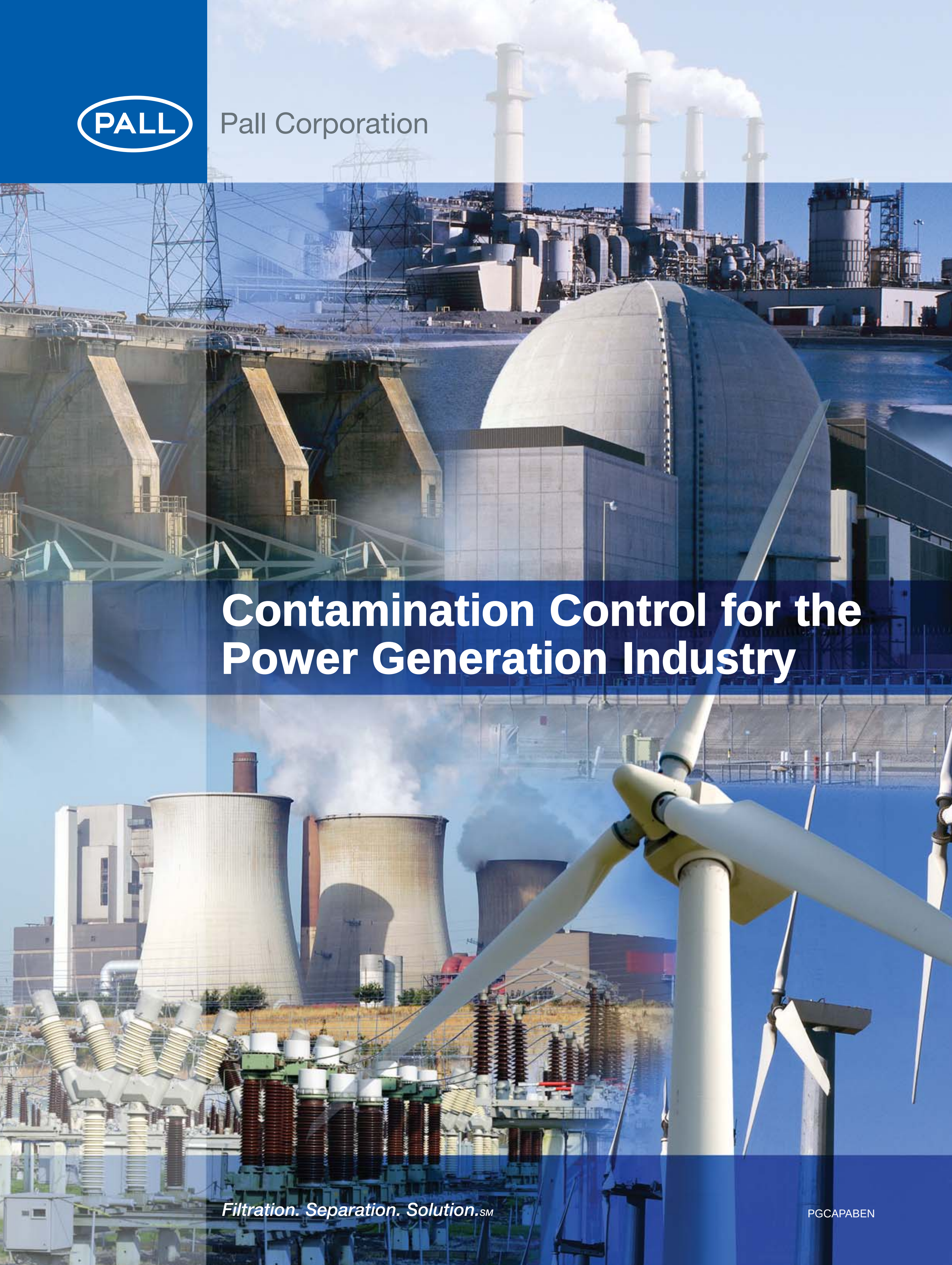
Pall Corporation



Contamination Control for the Power Generation Industry

*Filtration. Separation. Solution.*SM

PGCAPABEN

Introduction to Pall Power Generation

Pall - Your integrated partner in Power Generation

Pall Corporation is a global company solving complex contamination, separation and purification problems.

Pall's Power Generation Group is part of Pall Energy Division and as such serves the power generation market around the world. With a broad line of products and services, Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment.

The power generation industry trusts Pall as a solution provider

Pall is a worldwide leader in fluid purification technologies for the power generation industry. Pall advanced separation science and high quality manufacturing are applied on all fluids throughout the power plant to ensure cleaner, safer, more reliable power with higher profitability.

Pall can solve your purification challenges in any size of application, from small flows and simple installations to large flows and complex systems, from the supply of filter elements to fully-integrated turnkey systems.

Benefit from Pall's expertize and customized services

Pall is much more than a filter company. Pall specializes in fluid management, leveraging our unmatched capabilities to make your operation more successful. Our expertize has enabled us to build a large library of proprietary core materials, which we can modify to separate, remove, or selectively capture the most elusive contaminants.

Total Fluid Management℠

Pall has the ability to design, manufacture, and install economical, integrated systems as well as service them. Pall's Total Fluid Management (TFM) program for power generation plants help plant operators and engineers manage, control and monitor plant water, fuels and oil resources. This approach results in a reduction in total operating costs associated with fluids, operation and maintenance on critical components. Combining products with consulting services, commissioning and flushing assistance, Pall is the ideal partner for the power generation industry.

'Pall can help you improve fluid quality and increase profitability by optimizing the performance of plant equipment'

Contamination Control

Why is it so important to take care of fluid cleanliness?

Solid, liquid and dissolved contaminants present in liquids and gases will cause operating and maintenance problems on power production assets like boilers, turbines or transformers.

Left unchecked, these contaminants increase O&M costs, decrease thermal efficiency and output, and threaten environmental compliance of power plants.

Such issues can be solved by the use of highly effective, reliable and correctly applied filtration and separations technologies.

'Let Pall help you optimize the performance of your generating equipment by improving fluids contamination control!'

Applications:

Fossil Generation

Power plants around the world choose Pall to ensure the quality of their condensate water, the purity of their lubrication oil and the reliability of turbine control system operation. Pall products reduce downtime with unsurpassed flushing and oil treatment capabilities, technologies and on-site assistance. Pall water treatment systems also control and maintain make-up water and waste stream purity.

Nuclear Generation

Pall filtration systems help nuclear plants of all reactor types to maintain low levels of radioactive contamination throughout the water cycle. Pall filters reduce costs and maximize output by protecting the NSSS system, filtering the reactor pool and polishing condensate water:

- Less downtime
- Lower chemical usage
- Improved safety
- Optimal operating efficiency

Renewable Energy

Pall technology takes part in the development of renewable energy sources. From the filtration of hydroelectric turbine control and lubrication oil to the protection of windmill gearboxes or the purification of biomass gases, Pall employs state of the art technology to ensure that greener is always cleaner.

Transmission and Distribution

Energy availability also depends on a reliable and efficient grid. Pall products protect the critical purity of insulating oils. Pall online purifiers allow the online/onload treatment of transformer oil and insulation, dramatically reducing maintenance and downtime costs. By controlling water and fine particulate matter, Pall® Ultipor® WG filters protect LTC contacts, prevent OCB oil degradation and extend maintenance intervals.

Fossil Fuel Generation

Fuel Treatment Systems

With unmatched experience in the oil and gas industry worldwide, Pall brings complete solutions to the treatment of liquid and gas fuel for power plants. Combination of particulate filtration and high efficiency coalescence provide a fuel quality that meets the most stringent specifications of new generation combustion systems. The efficiency of Pall liquid/liquid and liquid/gas coalescers is only matched by their ease of use, low maintenance and long life.

Process Water Management

Water Supply Systems

Pall filters and membrane systems combine into a complete water treatment chain to ensure consistent, uninterrupted process water with minimal chemical usage, optimum quality and an unmatched ease of use and service. With microfiltration, ultrafiltration, reverse osmosis or filter cartridges, Pall offers the widest range of water filtration products.

Condensate Water

Boilers and turbines are protected by Pall condensate filtration systems, either in backwash or disposable configuration. For any system pressure of flowrate, Pall combines media science and system engineering expertize to offer the best protection against corrosion transport.

Pall HGCOld and HGPPB backwash systems offer:

- Engineering expertize to ensure long, economical operation, in demin-precoat or straight filtration mode
- Variety of media ranges and materials to adapt to any condensate flow conditions

Pall Ultipleat® High Flow disposable filters offer:

- Small footprint even for full flow installation
- Proprietary crescent shaped pleat geometry
- High efficiency, high flux filtration at ratings from 100 to 1 micron
- Simple element replacement

'high efficiency filtration, purer fuel, reduced pollutant emissions, low energy consumption, protection from erosive and corrosive wear, with minimal maintenance.'

Hot Gas Filtration

Pall has the full complement of fluid management products for hot gas filtration for the latest combustion technologies including ceramics for biomass and coal gasification, plus products that reduce pollutant emissions driving the movement towards efficient, clean and low cost energy.

Steam Turbines

Lubrication

Pall's full range of oil filtration and oil purification products combine to provide the best possible protection of the bearings and shaft against wear and corrosion. By efficiently and economically removing moisture, particles and gases from lubricating oils, Pall products ensure that critical machinery is protected and that the oil remains in pristine condition.

Hydrogen Seal Oil

The task of protecting seals from abrasive wear, and preventing water from ingressing into the generator falls on the turbine lubrication oil control system. The solid and moisture protection from the Pall TLC helps maintain hydrogen purity and minimize maintenance on the seals.

Control

The hydraulic systems controlling the steam valves are some of the most sensitive and critical components around the steam turbine. Pall products combine filtration, dehydration and ion exchange to protect and even reclaim hydraulic fluids, whether mineral or synthetic. With proper filtration and fluid treatment, critical valves are protected against stiction and erosive wear, and hydraulic fluids are protected against thermal degradation or acid formation.

Nuclear Power

'Pall offers filtration solutions that enable you to meet regulatory requirements and minimize radioactive exposure while reducing your total cost of ownership.'

State-of-the-art media design, application experience and unsurpassed removal efficiencies have made Pall the world standard in nuclear safety, control, radioactive waste treatment and fuel pool clean-up. Pall products shorten outages, increase operating efficiency and minimize exposure with the backing of expert customer support worldwide.

Fine Ratings Programs

For many years, Pall filtration systems have been used in the most sensitive nuclear applications of PWR coolant systems. Today, the cleanest plants use Pall nuclear grade filters to reduce the out of core radiation levels and reduce overall personnel exposure. The fine ratings program is a step by step reduction of filtration level down to 0.1 micron in order to decontaminate the coolant systems progressively, ensuring better operation, easier maintenance and reduced exposure.

Media

Pall provides innovative disposable and back-washable media in a wide range of micron removal ratings, developed, designed and manufactured under the strictest quality controls for exceptional performance, reliability, and consistency.

Elements

Pall's disposable nuclear cartridges are designed with exceptional structural integrity and perform well in environments with high radioactivity and varied pH. They have long service life, which means less radioactive waste, fewer change outs and added protection for equipment and personnel.

CVCS and Coolant Pump Seals

Pall Ultipor GF Plus media is positively charged and rated down to 0.1 micron. These rapidly remove radioactive material and provide the highest level of safety in the primary loop.

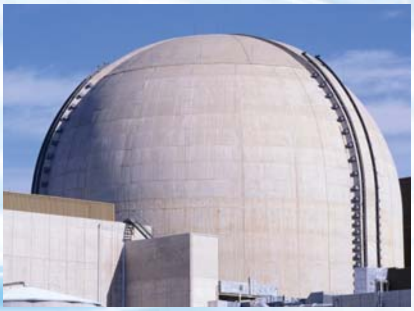
Pall Ultipor GF Plus elements filters the cooling water, protecting against seal wear and plant exposure with unsurpassed integrity, efficiency and durability. Pall filters provide the best way to reduce out of core radiation, personnel exposure and costs.

By removing minute solid particles, Pall Ultipor GF Plus filters are also used to protect the seals of the main coolant pumps. Reduction in abrasive wear of the seal, shown by a drastic reduction in leak rates, ensure longer life and lower seal replacement costs.

Nuclear Condensate Systems

Pall backwashable condensate filtration systems are an industry standard for BWR protection. In precoatable or straight filtration mode, Pall elements combine very high efficiency with strong integrity and durability. Backed by unmatched system design and operation expertize, Pall filters are the most effective way to maintain feed water purity, reduce ion resin consumption and protect the steam generators.

Pall traps and laterals protection feature an all-metallic porous media combining a very high void volume with high mechanical and thermal resistance up to 600F. With removal levels from 400 down to 18 micron, the Pall Rigimesh® line offers the best protection against resin leakage and fouling.



Renewable Energy

Hydroelectric Power

Clean hydroelectric generation depends greatly on the reliability, availability and response of the turbine control mechanisms and lubrication systems. By ensuring that the lubricating and hydraulic oils are maintained in pristine condition, Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs. Combined with Pall analysis capability and monitoring equipment, they form the ultimate protection against component related outages, high oil replacement costs and sluggish system response.

The combination of fine particle control and efficient moisture removal protects the oil films and the components. By consistently maintaining oil cleanliness lower than a ISO 16/14/12 life of roller or journal bearings can be drastically extended.

Filtration and Moisture Control - A Total Fluid Management solution

Pall Ultipleat SRT filters are especially designed to remove clearance size particles known to cause fatigue wear of the bearings, abrasive wear of the governor control valves and fluid degradation. With superior resistance to cyclic flows and no electrostatic discharge, the Pall Ultipleat SRT filter performs at its peak under the toughest of conditions.

When moisture is kept well under the saturation level of the oil, the process of oil oxidation can be stopped and with it, corrosion in the lube and control system. In hydroelectric plants, Pall purifiers and air dessicant breathers maintain moisture levels under 30%RH, and protect lubrication and hydraulic fluids against water ingression.

'Pall filters and purifiers improve system response, shorten ramp-up times and lower maintenance costs.'

Wind Power

Gearbox Protection

When the gearbox faces variable loads, and operates in vibrating and extreme environments, it needs to be protected by a filtration system able to deliver specified cleanliness under stress conditions, at all times, consistently, and reliably. Pall wind turbine lube filtration systems combine design simplicity, ease of service, light weight with the performance of Ultipleat SRT technology.

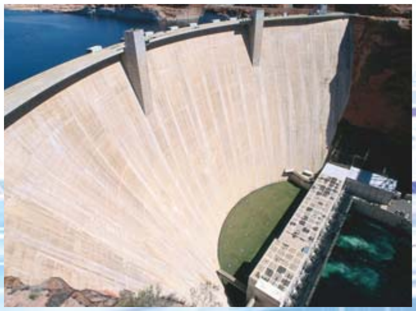
To ensure total cleanliness control, oil is protected against water or dirt ingression by Pall breathers, and its quality can be remotely monitored with Pall moisture and particle sensors.

Remote Monitoring of Oil Condition

The ability to detect oil quality problems early is a critical step in ensuring viability of remote windfarms. Oil contamination can be a strong indicator of component wear, its detection is the key for switching from reactive to predictive maintenance practices. With Pall capability for remote particle and moisture sensing equipment, wind turbines are never left alone, as far as they may be.

Biomass

Pall ceramics and metallic filter technologies are used to purify combustible gas in hot and chemically challenging environments such as in gasification processes and protect burners and turbines downstream. With advanced design capabilities for large blowback gas filter systems, Pall participates actively in the development of renewable combustible sources.



Pall Technology Services

What is Total Fluid Management?

Total Fluid Management (TFM) is the integration of properly selected filtration and separation technologies and services into a production process to yield the highest efficiency at the lowest cost. The Pall TFM program covers a wide range of filtration products, advanced technologies and services to improve system operation and increase productivity.

Our global team of scientists and engineers support TFM

Pall offers a variety of services to help you maximize productivity within your plant. We deliver TFM to you with the support of our global teams of Scientific and Laboratory Services (SLS). Located in more than 30 countries, our scientists and engineers provide these services locally, with broad-based assistance from Pall's worldwide technical support network. Our experts work directly with you to determine how Pall products and technologies can benefit your process.


Consultancy

Our customized system services include:

Commissioning and Flushing

Pall has the most extensive network of distributors and customer service centers in the world. Pall provides flushing, monitoring and consulting during plant overhaul, turbine start-up or system flushes worldwide. With Pall products, monitoring equipment and field expertize, our start-up assistance programs enable users to get back on-line faster, cheaper and more efficiently to maximize output, flexibility and operating profits.


Servicing

Cleanliness Audit

A cleanliness audit can uncover contamination problems and their detrimental effects. Our laboratory staff and field engineers have at your disposal lab-scale and analytical equipment and field pilot-scale units. By sampling at various locations throughout the process, we collect, quantify and identify solid and liquid contaminants to determine their origin and provide you with recommendations for corrective action. Our recommendations are designed to help you optimize your processes and increase the reliability of your equipment at the lowest possible cost.


Flushing Services

Process Audits / Consultancy

Pall offers troubleshooting, audit and consulting services to identify opportunities for process improvements that lead to increased productivity. Improvements are defined, for instance, as the reduction of operating costs or maintenance operations. An audit involves data collection and proposal review, followed by a technical report documenting the findings and suggestions for improvement.

Filtration Equipment Rental

When you need to rent filtration and purification equipment to conduct spot depollution of system fluids, to conduct large-scale pilot testing or to use while permanent equipment is being manufactured, contact Pall. Our rental services can provide equipment on the spot, so that you can handle upsets promptly.


Filtration Equipment Hire

Combustion Turbines and Combined Cycle

In all aspects of the operation of a combined cycle plant, Pall employs state-of-the-art technology to ensure a consistently high quality supply of water, fuels and lubricating oil to the machines. With gas treatment solutions to reduce emissions and environmental impact, Pall is the complete partner for CCPP operators looking to improve operation, save on fuel and water costs and improve system reliability and availability.

Fuels

Pall's expertize in liquid and gas fuel treatment ensures that combustion turbines are constantly protected from the mechanical and chemical attacks due to fuel impurities. Pall fuel treatment solution combines very efficient particulate filtration with coalescence to remove moisture or aerosols in the fuels. The result is a drastic reduction in the presence of solids, gels, water and salts in the fuels entering the combustion chamber.

Pall is also an expert in the treatment of alternative fuels and is an industry standard for coal and biomass gasification systems, with a range of ceramic and metallic filtration systems. With unmatched experience in materials and system designs, Pall hot gas filtration systems are at the core of some of the newest and most promising power generation designs.

Liquid / Liquid and Liquid / Gas Coalescers

Oil Mist Eliminator

Machine Protection

Whether industrial or aeroderivatives, combustion turbines are protected by Pall oil filters in the lubrication and control systems. By stopping the chain reaction of wear in rolling or journal bearings of the turbine, Pall filters protect the machine against downtime, repairs and bearing wear.

Pall oil mist eliminators reduce emissions of oil vapour to the atmosphere using Pall liquid / gas coalescers. Their efficiency and low resistance to flow means that the system reservoirs can breathe without restriction and with no detectable oil emissions into the plant.

Water Systems

In combined cycle plants, the availability and quality of water is critical for both the heat recovery boilers and the combustion turbine itself. Pall membrane systems ensure consistently pristine water meeting the most stringent purity requirements of new generation combustion turbines and high pressure boilers. With a wide range of ultra and microfiltration membranes, reverse osmosis, cartridge filtration and polishing systems, Pall brings the complete water management solution to combined cycle plants. The result is a cleaner combustion, better operation of Nox control systems, protection of the boiler against corrosion and FAC and reduced water usage overall.

Pall Aria System

Ultipleat High Flow Particulate Filters

Technologies For Contamination Control And Monitoring

Pall filtration and separation technology

Pall designs and supplies a wide range of media, filters, and systems to remove contaminants from liquids and gases.

These products, along with our service capabilities and technical expertize, enable us to fulfill diverse fluid purification requirements throughout all power generation processes.

Ultipleat High Flow/Coreless Filter Elements

Particulate Filtration for Liquids and Gases

Pall designs, manufactures and markets the widest range of solid contamination control products anywhere. Pall filters can remove minute solid particles from liquid or gas streams, across a wide range of temperature, pressure, and chemical conditions. These particulate filters can be made of glass fibres, polymers, metals or ceramics. With various shapes, sizes and micron ratings, they offer economic, efficient and durable contamination control in some of the most critical applications in power plants.

HNP006 Oil Purifier

Coalescence and Dehydration

Removal of moisture and aerosols from oils or fuels is paramount in order to protect machines like combustors or bearings. Moisture and aerosols carry chemical and solid contaminants responsible for deposits, chemical attacks or fluid degradation. Results can be devastating outages and high maintenance costs. Pall coalescers and oil purifiers have what it takes to remove unwanted contaminants from hydrocarbons, down to their solubility levels, and even beyond. Combustion chambers, injectors, bearings or seals all benefit from complete removal of moisture contaminants from fuels and oils.

Membrane Technologies

Membrane Technologies are by far the most effective methods for water processing applications. The Pall range of membrane systems includes microfiltration, ultrafiltration and reverse osmosis membrane technology. Pall Aria™ water treatment systems for example use hollow fiber microfiltration membranes to produce pure water from any water source. They remove bacteria, iron, manganese, arsenic, and other solid particulate to deliver water that consistently measures up to the toughest cleanliness and quality standards.

Pall membranes are used for production of make-up water, recycling of blowdowns and wastewater, as well as water fed protection for combustion turbines.

Contamination Monitoring

Solid Contamination Monitors

Obtaining accurate and reliable fluid cleanliness data quickly in order to detect abnormal contamination is a key factor in ensuring the efficiency of industrial processes and reducing downtime.

Reliable monitoring solutions ...whatever the conditions ...whatever the fluid

Pall have portable devices that resolve detection problems by giving plant operators the ability to measure the cleanliness of even the most troublesome fluids reliably, simply, and quickly, and prevent unnecessary and costly machinery downtime.

The Pall PCM400W Cleanliness Monitor can confirm cleanliness of almost every kind of system fluid.

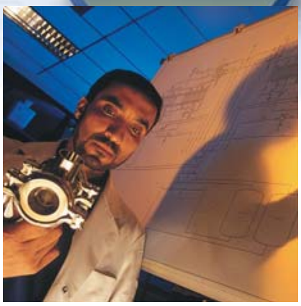
The Pall PCM400W uses multiple mesh blockage technology to address the common problem of inaccurate or unreliable results when monitoring fluids that are dark, cloudy, or contaminated by water or air. Additionally it can read fluid temperature and saturated water content (when appropriate).

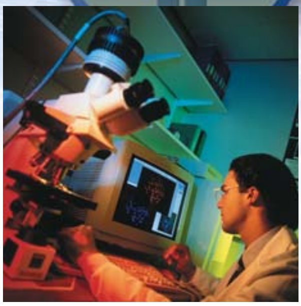
PCM400W

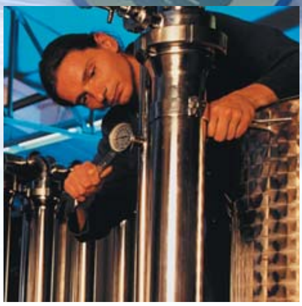
Pall Water Sensors

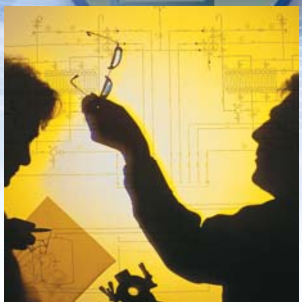
Wherever possible, oils should be operated without the presence of free or emulsified water.

Pall Water Sensors detect water in solution within the fluid, displayed as a percentage saturation or expressed as a parts per million (PPM) reading. Options include the handheld unit for a ‘point-in-time’ reading or the permanent unit which can provide continuous or timed monitoring.









Research and Development

Working with equipment and component manufacturers in these markets, Pall custom designs products and purification systems that are fully integrated into oil and gas industry applications.

These products extend component service life, enhance safety and improve the operating reliability of all processing systems.

Scientific and Laboratory Services

A principal element in Pall's customer support operations is our Scientific and Laboratory Services (SLS) Department. Filtration problems arising in the field can be assessed and simulated in the laboratory. Close monitoring by Pall scientists can determine the engineered solution to your contamination and separation problems and advise accordingly.

Sales and Support

The sales and support team comprises a group of experienced specialists located in Europe, the USA and across Asia with distributors and representatives worldwide. We offer a comprehensive sales and service support to all customers around the world.

Quality

The policy of Pall is to design and manufacture products to the highest and most current standards of quality, safety and reliability. To implement this policy, the organisational structure and the procedures by which Pall operates are fully defined in quality management systems, approved to ISO 9001:2000

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Case Study

Power Generation

Nuclear Power Plants Use Robust Filters to Reduce Operating and Disposal Costs

Overview

As nuclear plant management continues to work diligently to reduce personnel exposure to radiation and to reduce contamination levels, radioactive waste continues to be produced, and must be disposed of. Today, available radioactive disposal sites and disposal space are limited, and disposal costs continue to rise. Hence, it is imperative that the plant operate and manage waste as efficiently as possible.

Pall Corporation's 140 Series filters can help reduce disposal costs at nuclear power plants. They have superior dirt holding capacity, which means that fewer filters are needed to achieve the desired results. When fewer filters are used, plants save on radiation exposure, labor, and radwaste volume.

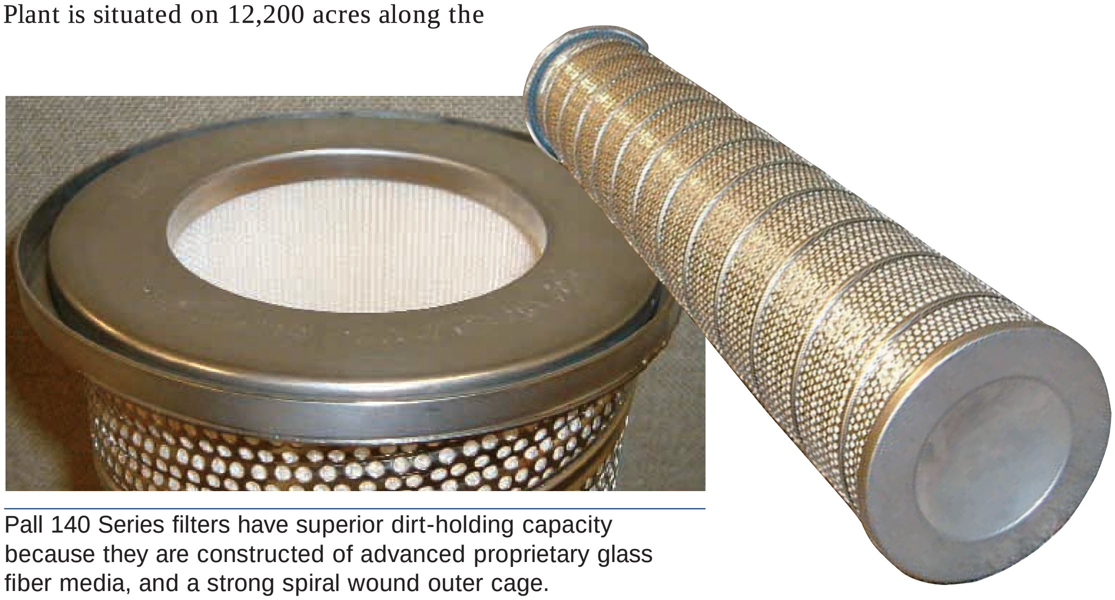
Disposal costs can be further reduced when radwaste is "volume reduced", since fees are partially based on volume. For this reason, Pall specifically designed its 140 Series filters to be easily crushed, sheared, and compacted after use.

The Challenge

The South Texas Project (STP) Nuclear Power Plant is situated on 12,200 acres along the Colorado River, about 90 miles southwest of Houston. It has two of the largest pressurized water reactors (PWR) in the US, each with a capacity of approximately 1,280 MWe, and often generates more electricity than any other nuclear plant in the country.

To keep the fuel pool radiologically clean and free of suspended solids, frequent filter change-outs had to be performed. Frequent change-outs resulted in high radwaste disposal costs, and an increase in the duration of personnel exposure to radiation.

The Diablo Canyon Nuclear Power Plant is located on a 750-acre site in San Luis Obispo County, California. The plant has two Westinghouse 4-loop PWRs, each with a capacity of 1,000 Mwe. To keep disposal costs down, an effort was made to reduce radwaste volume by shearing filters. The filters the plant had been using were designed with an outer screen, which could not be completely cut preventing volume reduction of the filters. This resulted in disposal of the filters whole, which resulted in poor loading of the waste container.



Pall 140 Series filters have superior dirt-holding capacity because they are constructed of advanced proprietary glass fiber media, and a strong spiral wound outer cage.

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The Solution

To keep costs, and radiation exposure, to a minimum, the number of underwater filters used at STP Nuclear Plant needed to be reduced. This necessitated finding a replacement filter with robust filtration characteristics. The replacement filter would also need to retrofit the plant's existing Tri-Nuclear underwater filter housings. The decision was made to switch to Pall 140 Series filters. The superior dirt-holding capacity of these filter cartridges enabled the number of filters used at the plant to be reduced from 92 during the 6th refueling of Unit 1 to 39 during the 7th refueling, a difference of almost 60%. As a result, the cost of disposing of filters decreased.

Diablo Canyon Nuclear Power Plant management decided to replace the existing under water vacuum and spent resin transfer filters with Pall 140 Series filters. These Pall filters easily fit in the plant's Tri-Nuclear underwater vacuum and spent resin transfer filter vessels. Instead of an outer screen, the Pall filters are constructed with a strong spiral wound outer cage. This cage is designed to crush and shear easily.

The Pall 140 Series filters have been instrumental in reducing radwaste at the Diablo Canyon plant. The shearing machine shears the filters efficiently, without jamming. Since sheared filters reduce radwaste volume about 4:1, filter disposal costs at the Diablo Canyon plant have been reduced along with the number of container handling operations and cask shipments.

The Benefits

Switching to Pall's 140 Series filters has provided STP and Diablo Canyon with exceptional benefits. Constructed of advanced proprietary glass fiber media, with high efficiency and exceptional dirt-holding capacity, fewer 140 Series filters are needed to perform the job. The design of Pall's 140 Series filters allows for simple and less expensive radwaste disposal. Easily crushed and placed in high integrity containers, the filters contribute significantly to the reduction of radwaste volumes and disposal costs. These exceptional features translate into cost-saving benefits for Pall customers.

- Fewer filters needed
- Fewer filters to change out-lower labor costs, less radiation exposure
- Lower radwaste volume

PALL® Power Generation

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PGCS7

PALL Industrial Process

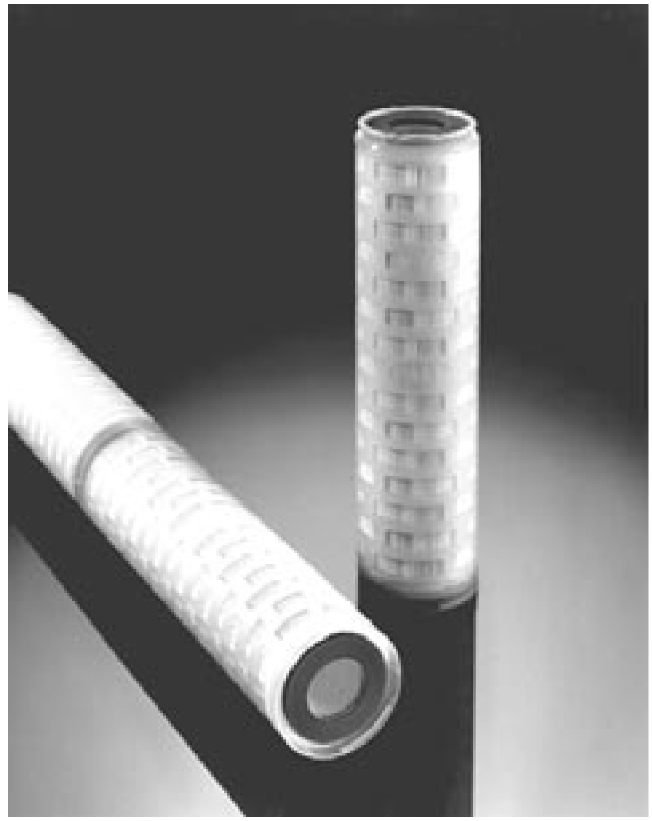
Ultipor GF Plus® Filter Elements

Description

Ultipor GF Plus® filters have a pleated high area construction for long service life. The medium uses a binder resin which coats the glass fibers, imparting a positive zeta potential in aqueous service. The resin also bonds the glass fibers to polyester substrate, producing a rugged composite medium. Applications for such filters are numerous as most suspensions are negatively charged in aqueous solution, including not only particles but bacteria and viruses. Some Ultipor GF Plus filter grades efficiently remove sub-microscopic haze from a wide variety of pharmaceutical, cosmetic, and food products, including colognes and whiskey.

Ultipor GF Plus filters have a fixed pore construction which precludes unloading or media migration.

Ultipor GF Plus elements with polypropylene hardware in a double open-ended UNI CAP configuration are rated to withstand differential pressures of 75 psid of up to 122˚F (50˚C) and 45 psid up to 180˚F (82˚C). When constructed in a single open-ended AB configuration, the element can withstand differential pressures of 80 psid up to 122˚F (50˚C) and 60 psid up to 180˚F (82˚C).



UNI CAP Style Ultipor GF Plus Filter Elements

Ultipor GF Plus Continuous Length UNI CAP Style Filter Elements

Table I. Removal Ratings

Cartridge Grade	Liquid Service(1) Rating in Microns At % Efficiency 99%	99.98%	Aqueous Clean Pressure Drop Per 10″ Module (PSID/GPM)(2)	Typical Aqueous Flow (GPM/10″ Cartridge)
U010Z	0.6**	1	0.17	2-3
U2-20Z*	0.8**	2	0.14	2-3
U030Z	2.0	3	0.10	2-3
U6-40Z*	3.2	6	0.05	3-5
U100Z	6.0	10	0.03	3-5
U200Z	17.0	20	0.02	3-5
U400Z	25.0	40	0.015	4-7

* *These grades are particularly useful as prefilters, in addition to providing absolute removal efficiency.*

** *Extrapolated value.*

(1) *Liquid service ratings are based on a modified OSU F-2 protocol for recording removal efficiency based on particle counting techniques.*

(2) *Pressure drop in PSI per GPM water for a single 10″ module. Multiply this value by the required flow to determine the total aqueous pressure drop. Next, for fluids other than water, multiply by viscosity in centipoise. If this calculated pressure drop is excessive, then divide this value by the number of 10″ modules required to reduce this pressure drop to an acceptable level.*

Table II. Ordering Information

Element Part Number

Double Open Ended Filter PUY ▲ ■ ●

Single Open Ended Filter AB ▲ ■ ◆ ▼

■

Code	Cartridge
	U010Z
	U2-20Z
	U030Z
	U6-40Z
	U100Z
	U200Z
	U400Z

▲

Code	Cartridge Length (Inches)
1	10
2	20
3	30
4	40

◆

Code	End Fittings O-Ring Fitting I.D. (In.)	O-Ring Replacement Size
3, 8	1¼	-222
7	1½	-226

●

Code	Gasket Option
J	Ethylene Propylene (Std)
H13	Buna N
H	Viton A***

***Trademark of E.I. du Pont de Nemours & Co.*

▼

Code	O-Ring Option
H4	Silicone (Std.)
H	Viton A
J	Ethylene Propylene

Housing Information

Housings are available in either polypropylene, carbon steel, or stainless steel with capabilities from 1 to 152, 10” modules per housing.

Refer to brochure SUM 200 for further details.

PALL® Industrial Process

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PALL Power Generation

Ultipor® GF Plus Nuclear Grade Filters

Description

Pall nuclear-grade disposable cartridges use proprietary Pall Ultipor® GF Plus media as a fundamental resource. The medium uses a binder resin which coats the glass fibers, imparting a positive zeta potential in aqueous service. These filters also have an integrally bonded fixed pore structure that produces a rugged composite medium, which resists unloading or media migration.

Applications and Performance

The Ultipor® GF Plus medium is available with ratings as fine as 0.1µm, and is capable of electrostatically stopping even smaller negatively charged particles. Ultipor GF Plus medium's higher void volume enables higher flow rates at lower initial pressure drops, resulting in longer on-stream life. The medium's exceptional dirt-holding capacity and high efficiency also enables plants to reduce the frequency of change-outs.

The nuclear-style disposable filters are available in over 160 different types. Pall-Fit cartridges for direct replacement of other commercially available string-wound cartridge or basket assemblies are also available. These disposable cartridges, designed for irradiated service, are supported by a perforated stainless steel inner core and outer cage. Internal tie rods (or welded cages) connect the top and bottom end caps and reinforce cartridge integrity, even when the element is handled remotely and lifted from the filter vessel.

Pall's disposable nuclear cartridges have set the standard for over 30 years and can be found in many nuclear plant applications around the world including:

- Fuel Pool Filters
- Seal Water Injection/Return
- Reactor Coolant Letdown Pre/Post
- Radwaste Filters
- Chemical Addition Filters
- Recycle Evaporator Filters

Please consult your Pall representative for specifications.

About Pall Ultipor® GF Plus

Pall Ultipor® GF Plus filter cartridges are made with highly efficient glass fiber filter media pleated into low pressure drop modular filter elements, and feature:

- High-area pleated medium
- Low differential pressures
- Particulate rated in liquids
- High-capacity for long life
- Fixed pores to prevent unloading

Power Generation

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