Chemical

Products and Technologies for the Evolving Semiconductor Industry

Feature shrinks and other new developments in integrated circuit (IC) technology have had a considerable impact on the semiconductor industry. These advances have resulted in an unprecedented demand for consumer electronics. It is this demand that has become the most recent driver in the ever-evolving business model, dictating shorter product life cycles and faster time-to-market. Semiconductor manufacturers and suppliers must respond by being more flexible and more focused on costs, cycle times, and new technology.

State-of-the-art semiconductor manufacturers choose filtration and purification products based primarily on their process-enabling features and on their quality. These are important considerations for state-of-the-industry, high-volume IC manufacturers as well. But, with technology advancing at lightning speed and stiff cost competition, production fabs are finding that they must evaluate a filtration technology primarily on its ability to reduce costs and increase productivity.

It might seem that these differing priorities create an either-or situation—either quality and process improvement or cost reduction and greater productivity. Pall Corporation proves this is not so by providing filtration products that, individually, can satisfy all of these requirements. We offer chemical filters of very high quality, with outstanding capabilities, at competitive prices. Our investment in product development continues to yield new filter materials and purification technologies to benefit semiconductor manufacturers.

Support of New and Expanding Markets

With the growth and diversification of the microelectronics industry, new technologies and markets have emerged. This trend is continuing at an accelerated pace. Pall offers a variety of innovative purification and filtration technologies and products for the benefit of new or expanding markets and applications.

These include:

- **integrated circuits** (semiconductors, compound semiconductors, strained silicon, MEMS/microsystems and nanotechnology devices)
- **data storage** (thin film rigid disks/TFRDs for hard drives, read heads and hybrid drives)
- **flat panel displays** (LCDs, plasma and emissive polymers such as OLEDs)
- **photovoltaics**

Our Filters Score High on the Four Attributes

The chemical filtration and purification products that Pall develops and manufactures are the result of decades of experience serving the semiconductor and related industries. Pall provides application-specific products that are key to our customers' success. We accomplish this by focusing on four attributes of filter performance: particle retention, permeability, purity and robustness. Performance in these areas gauges how well a product will meet application requirements.

Particle Retention

The basic function of chemical filters is to remove random defect-causing particles. This can be difficult in the sometimes severe and often aggressive fluid environment in which these filters are used. Chemical filters must perform reliably, precisely, accurately, and without failure.

The critical particle size for many etch and clean chemicals is approaching the 10 nanometer level and below. The metrology available to measure particles in this size range is either very limited or nonexistent. To verify the retention claims of its chemical filters, Pall Corporation uses a variety of qualification tests. These include state-of-the-art particle counters, challenge tests in actual chemicals under typical operating conditions, and proprietary methods using unique nanometer-sized marker particles and measuring technology.

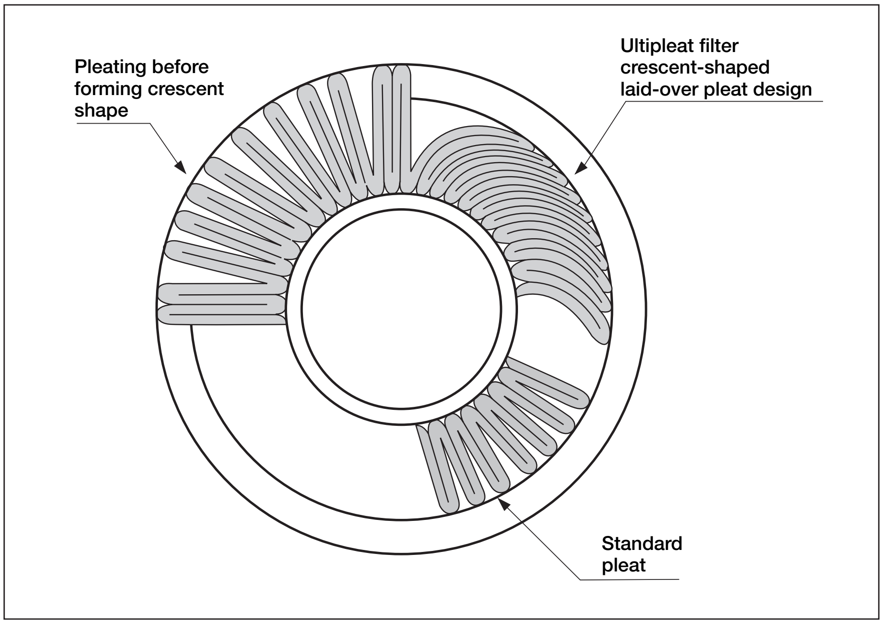
Pall filter media must meet stringent requirements for various properties that contribute to particle removal and retention in the intended application. Media may be tested to determine bubble point, forward diffusion and pore size distribution, and may undergo challenges of monosized spheres. To determine the true performance capabilities of our chemical filters, we typically rate them by testing under real process chemical application conditions in a lab setting. State-of-the-art online particle counters, using specifically designed sampling systems, allow real-time assessment of the retention characteristics of a given filter. This provides a more accurate prediction of the filter's in-fab performance.

Permeability

The permeability of a chemical filter is determined by the ease with which the chemical fluid flows through it. Bath turnover rates in batch applications and in some chemical delivery systems continue to increase. Typical flow rates in SPM are expected to increase up to 40 L/min. Less viscous chemicals used for cleans are expected to increase to as high as 50 L/min. While flow requirements are increasing, filter permeability is decreasing. This is because of the higher resistance resulting from the ever-smaller pores needed to remove smaller nanometer-sized particles.

To improve the flow rate of its pleated filters, Pall developed a unique technology–the Ultipleat® filter design. This proprietary laid-over pleat design increases effective filter surface area with support layers that enhance the fluid dynamics of the filter. An additional benefit of the design is that it protects the pleat if the filter is subjected to pulsation conditions.

Ultipleat Technology — Cross Section of Ultipleat Filter Cartridge



We also use our proprietary highly asymmetric morphology technology to increase the flow rate and particle-retention capabilities of our chemical filters. This technology combines high permeability and finer particle retention capabilities together in one filter, without reliance on application-dependent affinity charges.

Pall Corporation continues to advance surface modification technology for hydrophobic fluoropolymer filters rated at 50 nm and below that are used in aqueous chemistries. These advances are of particular benefit when the chemistries being filtered contain hydrogen peroxide, ozone, or other microbubble-generating chemicals. Molecular surface tailoring (MST) and applied surface layer kinetics (SLK) are PTFE membrane surface modifications. They improve membrane filter wettability of UltiKleen™ Excellar filters and reduce the likelihood that the pores will dewet in aqueous chemical applications. These proprietary techniques do not add any liquid chemicals to the membrane that could increase impurity levels or compromise chemical resistance. For aggressive and adverse applications such as hot sulfuric and peroxide mix (SPM) applications, we have developed a more robust PTFE membrane and filter assembly design that improves fluid flow and reduces potential damage to the filter, thereby extending service life.

In other cases, where flow rates and pump size remain constant, high permeability filters are required to accommodate ever-finer retention levels. Pall offers filters in new sizes and designs that provide higher flows and longer service life without increasing the footprint size of the filtration system. The Pall Ultipleat® UPK and UltiKleen-G series filters are among these.

Purity

In chemical applications, purity involves both the filter material and the process fluid. Contamination of process chemicals from all sources, particularly metal ions, must remain within limits measured in parts per trillion (ppt) or atoms / cm^2 of wafer surface. Ship-to control limits are currently being standardized to reduce variability of incoming chemicals and materials.

All components that contact the process chemicals, including pumps, valves, piping, and filters, are sources of contamination. Pall has developed a proprietary filter post cleaning method, called the Me-Kleen℠ process, which is effective in reducing metal extractables to the lowest possible level. We continue to improve this process, in addition to offering cleaning options for reduced levels of TOC.

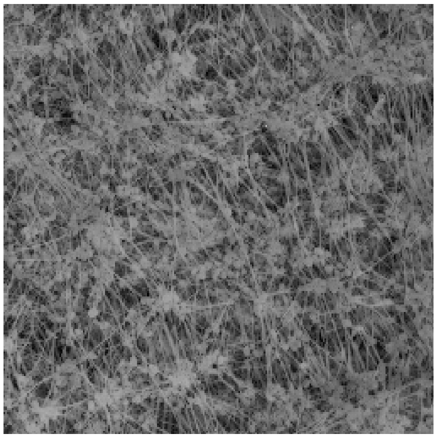
More chemical applications depend on purifiers to further reduce ionic contamination in the process fluid. Pall offers a variety of proprietary technologies for filtration and high-capacity ionic contamination removal from critical process chemicals. Among them is Pall's unique IonKleen™ purifier membrane surface modification technology that provides high ionic removal capacity.

Robustness

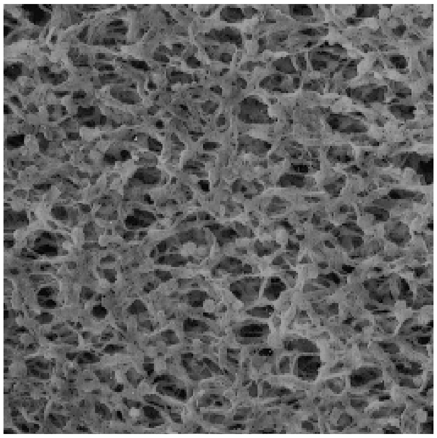
The aggressive nature of semiconductor process chemicals requires that all components of a filter device, including the filter medium, cartridge supporting materials and hardware, seals, and pressure vessel materials, be resistant to attack under the specified operating conditions. Damage to the filter device by the chemical, or harm to the chemical fluid properties, is unacceptable. Pall's material science experts carefully match the fluid properties with the best available material choices to provide the optimum filtration performance possible.

Materials of Choice

Pall's technical leadership in material science development has produced a variety of filter media, including those constructed of PTFE, polyarylsulfone, nylon, PVDF, polyethylene, and polysulfone, enabling the best selection for each application. Pall's new highly asymmetric polyarylsulfone membrane demonstrates how an engineered polymer medium can be used to improve filtration performance while lowering operational costs in typical HF filtration applications.



PTFE medium shown at 3000X magnification



PVDF medium shown at 3000X magnification

Electronics-Grade Quality

Pall electronics-grade (E-Grade) high-purity chemical filters are manufactured and assembled in a controlled environment. All materials used must meet stringent quality control requirements. Every E-Grade filter is checked at multiple manufacturing stages and undergoes 100% final integrity testing to ensure uniformity of product and reproducibility from one manufacturing lot to the next.

Filtration Products Compatibility

The compatibility data presented in the following Filtration Products Compatibility Guide is for general reference only. Because so many factors can affect the chemical resistance of a given product, you should pretest under your own operating conditions, observing applicable safety practices such as those given on the Material Safety Data Sheet for each chemical. In addition to consulting the guide for general compatibility information about materials, it is important to reference the individual housing rating for the various categories of fluids. For example, the PP Megaplast™ housing only has a water rating and is not recommended for chemicals. For questions about compatibility for specific applications, please contact Pall Microelectronics.

Filtration Products Compatibility Guide

E Excellent
G Good at Ambient Temperatures
LR Limited Recommendation
NR Not Recommended

Please contact Pall Microelectronics for specific recommendations.

	Filter Cartridges									Housings				O-Rings					
Acids	**Profile® II / Ultipleat® Depth**	**Ultipleat® P-Nylon**	**Emflon®**	**P Emflon®**	**Fluorodyne®**	**Ulti-Etch**	**UltiKleen™ / Fluoryte™**	**Ultipleat® SP DR Ultipleat® Mega-Etch**	**PE-Kleen**	**316L SS**	**Polypropylene**	**PFA**	**PVDF**	**Viton[2] A**	**Buna-N**	**FEP/Viton**	**Silicone**	**EPR**	**Kalrez[2]**
Acetic Acid (10%)	G	NR	E	E	E	E	E	G	G	E	E	E	E	G	G	E	G	G	E
Acetic Acid, glacial	LR	NR	E	LR	E	E	E	G	G	E	LR	E	E	NR	G	E	G	G	E
Hydrochloric Acid (conc.)	G	NR	E	E	E	E	E	G	G	NR	LR	E	E	G	NR	E	NR	NR	E
Hydrofluoric Acid (49%)	G	NR	E	E	E	E	E	LR	G	NR	LR	E	E	G	NR	E	NR	NR	E
Hydrofluoric Acid (dilute)	G	NR	E	E	E	E	E	G	G	NR	G	E	E	G	NR	E	NR	LR	E
Hydrogen Peroxide (30%)	LR	NR	G	G	G	G	E	NR	NR	G	LR	E	G	G	NR	E	LR	LR	E
Nitric Acid (conc.)	NR	NR	NR	NR	NR	NR	E	NR	NR	G	LR	E	G	G	NR	E	LR	LR	E
Phosphoric Adic (conc.)	LR	NR	G	G	G	G	E	LR	LR	LR	LR	E	G	G	NR	E	NR	G	E
Sulfuric Acid (conc.)	NR	NR	NR	LR	LR	NR	E	NR	NR	NR	NR	E	G	G	NR	E	NR	NR	E
Bases																			
Ammonium Fluoride (40%)	LR	G	G	E	E	E	E	G	G	NR	LR	E	E	G	G	E	NR	G	E
Ammonium Hydroxide (conc.)	G	LR	E	G	NR[1]	NR[1]	E	G	G	LR	G	E	NR[1]	LR	NR	E	G	G	E
Potassium Hydroxide (conc.)	G	LR	E	G	NR[1]	NR[1]	E	G	G	LR	G	E	NR[1]	LR	LR	E	NR	G	E
Sodium Hydroxide (conc.)	G	LR	E	G	NR[1]	NR[1]	E	G	G	LR	G	E	NR[1]	LR	LR	E	NR	G	E
Tetramethyl Ammonium Hydroxide (TMAH) (5%)	G	LR	E	G	NR[1]	NR[1]	E	G	G	LR	G	E	NR[1]	LR	NR	E	LR	LR	E
Alcohols																			
Butanol	E	E	E	E	E	E	E	LR	G	LR	G	E	NR[1]	LR	NR	E	LR	LR	E
Ethanol	E	E	E	E	E	E	E	LR	G	E	E	E	E	G	LR	E	G	G	E
Ethylene Glycol	E	E	E	E	E	E	E	LR	G	E	G	E	E	G	G	E	G	G	E
Glycerol	E	E	E	E	E	E	E	LR	G	E	E	E	E	G	G	E	G	G	E
Isobutanol	E	E	E	E	E	E	E	LR	G	E	E	E	E	G	G	E	G	G	E
Isopropanol (IPA)	E	E	E	E	E	E	E	LR	G	E	E	E	E	G	G	E	G	G	E
Methanol	E	E	E	E	E	E	E	LR	G	E	E	E	E	LR	G	E	G	G	E
Propylene Glycol	G	G	G	G	G	G	E	LR	G	E	G	E	E	G	G	E	G	G	E

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[1] Not recommended for concentrated solutions.

[2] Viton and Kalrez are trademarks of E. I. du Pont de Nemours and Company.

Filtration Products Compatibility Guide, cont’d.

E	Excellent
G	Good at Ambient Temperatures
LR	Limited Recommendation
NR	Not Recommended

Please contact Pall Microelectronics for specific recommendations.

	Filter Cartridges									Housings				O-Rings					
	Profile® II / Ultipleat® Depth	Ultipleat® P-Nylon	Emflon®	P Emflon®	Fluorodyne®	Ulti-Etch	UltiKleen™ / Fluoryte™	Ultipleat® SP DR Ultipleat® Mega-Etch	PE-Kleen	316L SS	Polypropylene	PFA	PVDF	Viton[2] A	Buna-N	FEP/Viton	Silicone	EPR	Kalrez[2]
Esters																			
Butyl Acetate	LR	E	G	E	NR	NR	E	LR	G	G	LR	E	NR	NR	NR	E	NR	LR	E
Cellusolve Acetate	LR	E	G	E	NR	NR	E	LR	G	G	LR	E	NR	NR	NR	E	NR	LR	E
Ethyl Acetate	LR	E	G	E	NR	NR	E	LR	G	G	LR	E	NR	NR	NR	E	NR	LR	E
Ethyl Lactate	LR	E	G	E	NR	NR	E	LR	G	G	LR	E	NR	NR	NR	E	NR	LR	E
Halogenated Hydrocarbons																			
Carbon Tetrachloride	NR	LR	G[3]	LR	LR	LR	E	NR	NR	G	NR	E	E	G	NR	E	NR	NR	G
Freon TF	NR	LR	G[3]	LR	LR	LR	E	NR	NR	G	NR	E	E	G	NR	E	NR	NR	NR
Methylene Chloride	NR	NR	G[3]	LR	LR	LR	E	NR	NR	G	NR	E	E	H	NR	E	NR	NR	G
Tetrachloroethylene (Perchloroethylene)	NR	LR	G[3]	LR	LR	LR	E	NR	NR	G	NR	E	E	G	NR	E	NR	NR	G
Trichloroethane	NR	LR	G[3]	LR	LR	LR	E	NR	NR	G	NR	E	E	G	NR	E	NR	NR	G
Trichloroethylene	NR	NR	G[3]	NR	LR	LR	E	NR	NR	G	NR	E	E	G	NR	E	NR	NR	G
Hydrocarbons																			
Cyclohexane	LR	LR	LR	LR	LR	LR	E	LR	LR	G	NR	E	E	G	G	E	NR	NR	E
Hexane	LR	LR	LR	LR	LR	LR	E	LR	LR	G	NR	E	E	G	G	E	NR	NR	E
Pentane	NR	LR	LR	LR	LR	LR	E	LR	LR	G	NR	E	E	G	G	E	NR	NR	E
Petroleum Ether	LR	LR	LR	LR	LR	LR	E	NR	NR	G	NR	E	G	G	G	E	NR	NR	E
Toluene	NR	LR	NR	LR	LR	LR	E	NR	NR	G	NR	E	G	G	NR	E	NR	NR	G
Xylene	NR	LR	NR	LR	LR	LR	E	NR	NR	G	NR	E	G	G	NR	E	NR	NR	G
Ketones																			
Acetone	G	G	G	G	NR	NR	E	NR	LR	G	G	E	NR	NR	NR	E	NR	G	E
Cyclohexanone	G	G	G	G	NR	NR	E	NR	LR	G	G	E	NR	NR	NR	E	NR	G	E
Methyl Ethyl Ketone (MEK)	LR	G	G	G	NR	NR	E	NR	LR	G	LR	E	NR	NR	NR	E	NR	G	E
Methyl Isobutyl Ketone (MIBK)	LR	G	G	G	NR	NR	E	NR	LR	G	LR	E	NR	NR	NR	E	NR	LR	E

[3] Good rating for pre-extracted elements; otherwise, LR rating.

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Filtration Products Compatibility Guide, cont'd.

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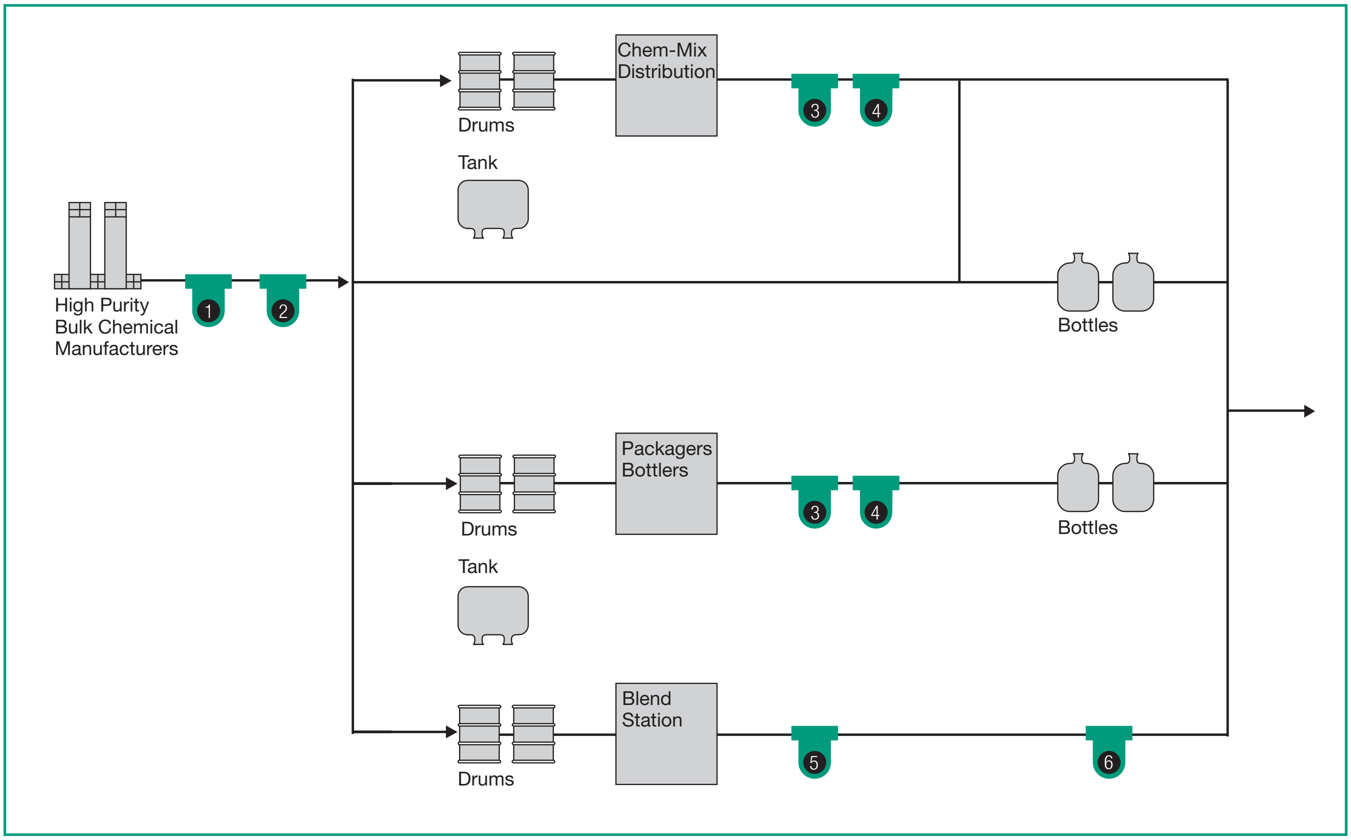
	Filter Cartridges									Housings				O-Rings					
	Profile® II / Ultipleat® Depth	**Ultipleat® P-Nylon**	**Emflon®**	**P Emflon®**	**Fluorodyne®**	**Ulti-Etch**	**UltiKleen™ / Fluoryte™**	**Ultipleat® SP DR Ultipleat® Mega-Etch**	**PE-Kleen**	**316L SS**	**Polypropylene**	**PFA**	**PVDF**	**Viton[2] A**	**Buna-N**	**FEP/Viton**	**Silicone**	**EPR**	**Kalrez[2]**
Miscellaneous																			
Dimethylsulfoxide (DMSO)	LR	G	G	G	NR	NR	E	G	G	G	LR	E	NR	NR	NR	E	NR	NR	E
Hexamethyldisilazane (HMDS)	LR	LR	G	LR	LR	LR	E	G	G	G	NR	E	LR	NR	NR	E	NR	NR	E
EGMEA	LR	G	G	G	G	G	E	LR	G	G	NR	E	G	NR	NR	E	NR	NR	E
Silicone Oils	G	G	G	G	G	G	E	G	G	G	G	E	E	G	G	E	NR	G	E
PGMEA	LR	G	G	E	G	G	E	LR	G	G	NR	E	G	NR	NR	E	NR	NR	E
Etchants/Strippers																			
Aqua Regia; HNO_3:HCl	NR	NR	NR	NR	NR	NR	E	NR	NR	NR	NR	E	LR	NR	NR	E	NR	NR	E
BOE; NH_4F:HF	G	NR	G	G	E	E	E	G	G	NR	G	E	E	G	NR	E	NR	NR	E
NOE; Ethylene Glycol/ NH_4F:H_2O:Surfactant	G	G	E	E	E	E	E	G	G	NR	G	E	E	G	G	E	NR	G	E
Mixed Acid Etch; (HNO_3<20%) HNO_3:HF:CH_3CO_2H	LR	NR	LR	NR	LR	LR	E	NR	NR	LR	NR	E	E	LR	NR	E	NR	NR	E
Chrom Phos H_2O:H_3PO_4: CRO_3 (32:1:0.1)	LR	NR	G	G	G	G	E	NR	NR	LR	NR	E	E	LR	NR	E	NR	NR	E
P-Etch; (3:5:92); HNO_3:HF:DI H_2O	LR	NR	G	NR	G	G	E	NR	NR	G	LR	E	G	G	NR	E	NR	NR	E
Piranha; H_2SO_4:H_2O_2	NR	NR	NR	NR	NR	NR	E	NR	NR	NR	NR	E	LR	NR	NR	E	NR	NR	E
RCA Etch; (75:15:5:5) H_3PO_4:CH_3CO_2:H:HNO_3: DI H_2O	NR	NR	G	NR	G	G	E	NR	NR	LR	LR	E	G	G	NR	E	NR	NR	E
SC1 (RCA Clean) NH_4OH:H_2O_2:DI H_2O	NR	NR	LR	LR	NR	NR	E	LR	LR	LR	NR	E	G	LR	NR	E	NR	NR	E
SC2; HCl:H_2O_2:DI H_2O	NR	NR	NR	LR	NR	NR	E	LR	LR	LR	NR	E	G	LR	NR	E	NR	NR	E

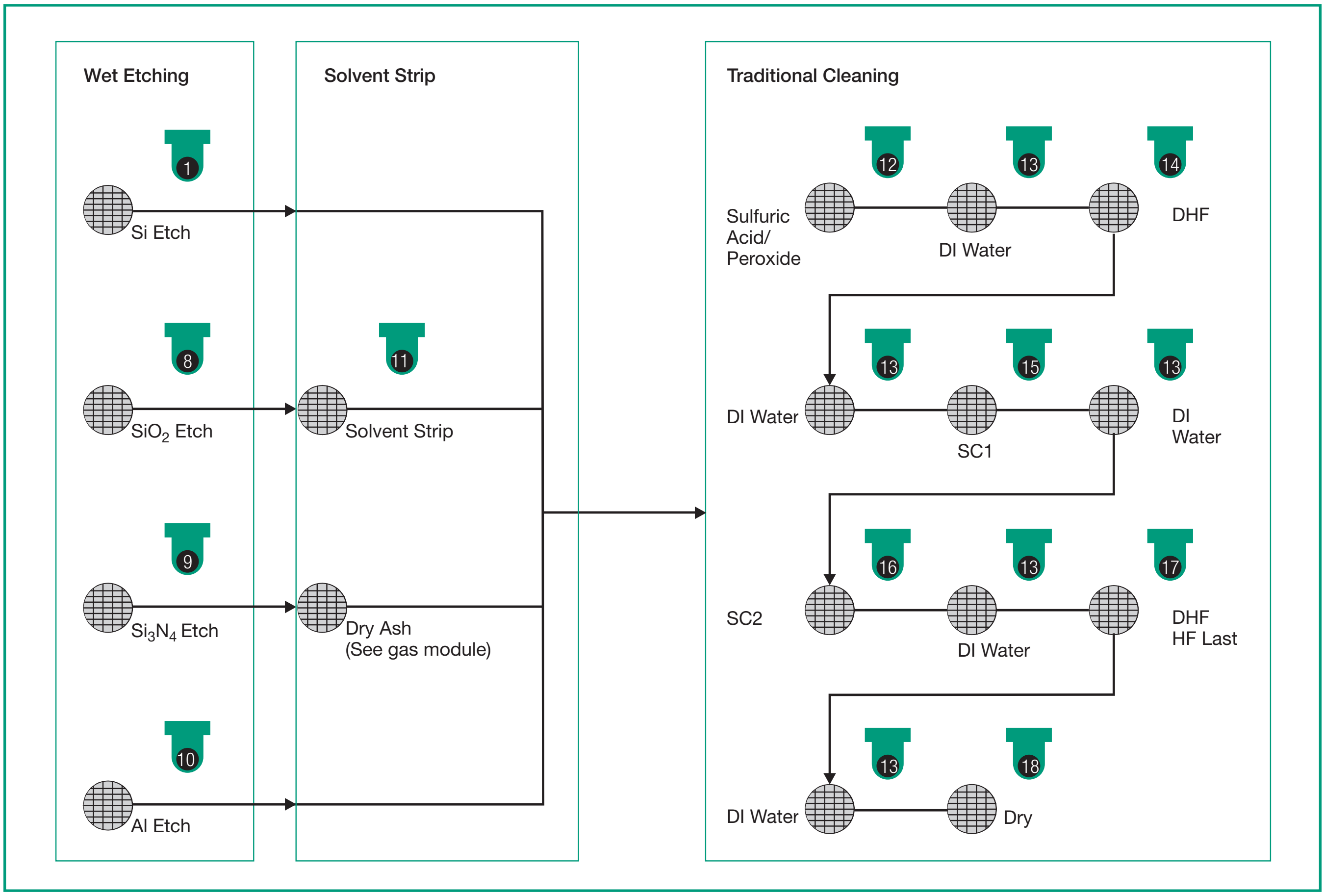
Bulk Chemical Flow Schematic



Chemical Filter Recommendations

Application	Diagram Number	Primary Filter Recommendation	Need to Prewet	Alternative Filter Recommendation	Need to Prewet
Hot acids	1 - 6	Prewet UltiKleen™ S	No	Prewet Fluoryte™ HF	No
Ambient concentrated acids	1 - 6	UltiKleen®-CDS	Yes	Fluoryte HF	Yes
Ambient dilute acids	1 - 6	Prewet UltiKleen-CDS	No	Ultipleat® ME	No
Bulk photoresist/ARC's	1 - 6	Ultipleat P-Nylon	No	PE Kleen	No
Developer (TMAH < 3%)	1 - 6	Ultipleat P-Nylon	No	PE Kleen	Yes
Solvents	1 - 6	Ultipleat P-Nylon	No	PE Kleen	Some
Hot strippers	1 - 6	UltiKleen Series	No	Fluoryte HF	No

Process Flow Schematic



Chemical Filter Recommendations (cont'd)

Application	Diagram Number	Primary Filter Recommendation	Need to Prewet	Alternative Filter Recommendation	Need to Prewet
Wet Etch					
Si etch HF/HNO_3/acetic acid	7	P Emflon®	Yes	UltiKleen®-CDS	Yes
SiO_2 etch BOE/BHF-HF/NH_4F **SiO_2 etch** ambient recir. ⅛ H.P. pump w/surfactant	8	Ultipleat® SP DR	No	Ultipleat ME	No
SiO_2 etch ambient recir. ⅛-½ H.P. pump	8	Ulti-Etch	No	Ultipleat ME	No
SiO_2 etch low recir. rate w/surficant	8	Ultipleat® SP DR	No	Ultipleat ME	No
SiO_2 etch low recir. rate w/o surficant	8	Ulti-Etch	No	Ultipleat ME	Yes
Si_3N_4 etch hot up to 170˚C H_2PO_4	9	Prewet UltiKleen-S Kleen-Change®	No	Prewet UltiKleen-CDS Kleen-Change	No
Al etch Warm H_3PO_4/HNO_3/acetic	10	Prewet UltiKleen-S	No	Prewet Fluoryte HF	No

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Chemical Filter Recommendations

Application	Diagram Number	Primary Filter Recommendation	Need to Prewet	Alternative Filter Recommendation	Need to Prewet
Solvent Strip					
Solvent Strip Hydroxyl/amine, NMP, glycol/amine, NAP/amine, solvent, amine/solvent, amine/NH_4F/solvent, HAS, TMAH, H_2O, NMP/sulfane/amine/catechol, DGMEE/NMP/TEG, NMP/solvent/amine/catechol	11	PE Kleen (up to 60°C) UltiKleen-S (above 60°C)	No	P Emflon (up to 60°C) Fluoryte HF (above 60°C)	No
Solvent Strip Glycol NH_4F based	11	UltiKleen-CDS	No	Fluorodyne® (up to 70°C)	No
				Fluoryte HF (above 70°C)	Yes
Solvent Strip DMSO/amine based, EL/2 pentanone, EL MEK	11	Emflon (up to 60°C)	No	P Emflon (up to 60°C)	No
		UltiKleen-CDS (above 60°C)	Yes	Fluoryte HF (above 60°C)	Yes
Traditional Cleaning					
Sulfuric Acid/Peroxide up to 150°C H_2SO_4/H_2O_2	12	UltiKleen Excellar Kleen-Change® Assembly	No	L-Style Kleen-Change Assembly	No
UPW Rinse	13	Posidyne®	No	VaraFine™	No
DHF 0.5%	14	Ultipleat SP DR	No	Ultipleat ME	No
SC1 up to 90°C $NH_4OH/H_2O_2/H_2O$	15	UltiKleen™ Excellar	No	Prewet UltiKleen-S	No
SC2 up to 90°C $HCl/H_2O_2/H_2O$	16	UltiKleen Excellar	No	Prewet UltiKleen-S	No
DHF (HF last)	17	UltiKleen-S	Yes	Ultipleat SP DR	No
Dry (IPA drying)	18	Mini Kleen-Change	N/A	IonKleen™	N/A

Prewetting Procedures

UltiKleen™-S, UltiKleen-CDS, P Emflon®, Fluoryte™ and Emflon filters and assemblies require prewetting for the filtration of most acids and aqueous-based liquids in order to achieve good flow rates. Prewetting is not essential for solvents and liquids with surface tensions below approximately 30 dynes/cm^2. Recommended prewetting procedures follow.

Prewetting UltiKleen-S, UltiKleen-CDS, P Emflon, Fluoryte and Emflon Filters and Assemblies

1. Place filter in a 2 liter graduated cylinder containing 1.5 liters of 60/40 isopropanol (IPA)/water. Position the filter so that the open end is facing up.
2. Slowly immerse the filter cartridge into the solvent. Allow filter to remain submerged for 30 minutes.
3. Remove filter, drain the excess solvent, and resubmerge into 1.5 liters of 18 Megohm DI water for 5 minutes.
4. Remove filter, drain the excess solvent, and install in a rinse-up filter housing.
5. Rinse up for 20 minutes at 2 GPM/7.5 lpm (1 GPM/3.75 lpm for 127 mm/5 in filter cartridge) using 18 Megohm DI water.

Note: Prewetting can be best accomplished by vacuum-drawing or pumping the 60/40 IPA/water prewetting solvent through the filter, then soaking the filter for 30 minutes. This is especially recommended for the 0.05 µm filters, which are more difficult to wet because of tighter pores. In the case of concentrated acids, which when introduced into water result in a high heat of mixing, it is strongly recommended that the filter be exposed to dilute acid (< 10%) prior to exposure with the concentrated acid. This prevents localized high temperature excursions.

Prewetting Kleen-Change Assembly

The Kleen-Change assembly is configured as shown in Figure A or B, depending on the assembly style. Mount the T-type Kleen-Change assembly bowl side up. This will allow the fluid to drain from the assembly through the vents.

Note: V1 and V2 should be all-fluoropolymer diaphragm valves. The pump, tubing and piping (upstream of the filter) should be all-fluoropolymer materials as well.

Warning: If an exothermic fluid is mixed with water (e.g. conc. H2SO4), it is strongly recommended that you expose the assembly to the dilute chemical before the concentrated chemical to avoid localized heating.

Figure A:
In-Line Kleen-Change Assembly

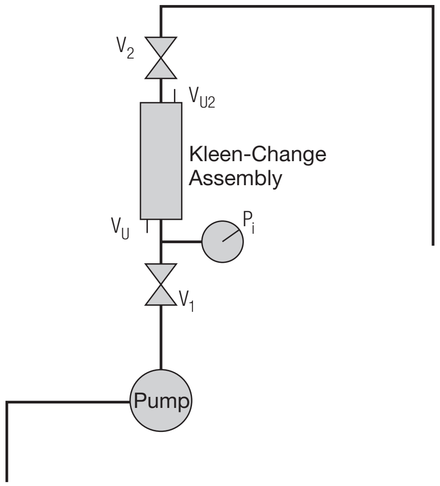
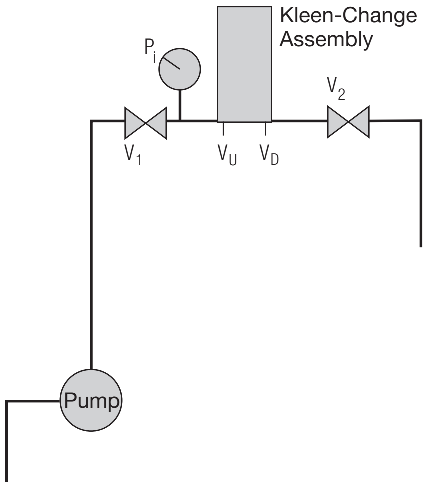


Figure B:
T-Type Kleen-Change Assembly



1. Open the valves upstream and downstream of the assembly (V1 and V2). Ensure that the assembly is vented correctly during the prewetting procedure. The presence of any trapped air in the assembly will cause the membrane to dewet.
2. Flush the assembly with 8 liters of IPA/water (60/40) at a flow of 1 GPM.
3. Terminate the flow of IPA/water and close V1 and V2 completely. Allow the assembly to stand for 30 minutes.

4. Drain the assembly of the IPA/water solution through the upstream vent (VU). For the T-type Kleen-Change assembly, open the valve downstream (V2) of the assembly. For the in-line Kleen-Change assembly, invert the assembly and drain the filter through the upstream vent (VU2) keeping valve V2 open. Invert the in-line assembly back to its original configuration before proceeding to the next step.
5. Open valves V1 and V2 and flush the assembly with 18 Megohm DI water at a flow of 1.5 GPM for 20 minutes.
6. Drain the assembly of the DI water through the upstream vent (VU). For the T-type assembly, open the valve downstream (V2) of the assembly. For the in-line assembly, invert the assembly and drain the filter through the upstream vent (VU2), keeping valve V2 open.
7. The assembly is now ready to install.