ZetaPlus® 40Q Purifier Cartridges

Superior removal of trace metals from high purity chemicals

Cuno Incorporated

Zeta Plus 40Q purifiers are high capacity purifiers designed to remove metallic ion contaminants from high purity chemicals such as resins, photoresists, and solvents in a single pass. The purifier contains ion exchange groups that have been bonded within a porous depth media structure. This proprietary construction enhances surface area for the ion exchange groups assuring metallic contaminant removal to single digit ppb levels.

Zeta Plus 40Q Vs Ion Exchange Columns

Ion exchange columns, a process step commonly used to remove trace metal ions from high purity chemicals are often the limiting factor in reducing the manufacturing cycle. Ion exchange columns are comprised of resin beads, which typically have a particle size distribution ranging between 0.3 mm and 1.2 mm in diameter, and are packed into a column. When the resin beads are packed into the column they cause a high differential pressure as the highly viscous fluid flows down through the column. Because a finite space exists between ion exchange resin beads, void or interstitial volume is formed. When a high purity chemical is introduced to the ion exchange column, the fluid will take the path of least resistance through the column, which is commonly referred to as “channeling”. To minimize the channeling effect, the ion exchange column is operated at a very low flow rate which in turn increases the contact or “residence time” with the fluid. Residence is described as the period of time when the fluid and functional sites of the ion exchange resin are in contact. Even with low flow rates and long residence times, ion exchange columns typically cannot reduce the trace metal content to the required specification levels in a single pass. One reason for this is that the ion exchange resin beads have a relatively low surface area to volume ratio and another reason is that a large

Applications	
Resins	Acetone
Solvents	DI Water
Recirculation Baths	IPA
I Line Photoresists	Plating Solutions
G Line Photoresists	Post CMP Clean
Ancillary Chemicals	Water Reclaim

Features	Benefits
■ Zeta Plus 40Q Metal Ion Removal Media	■ Removes trace metals to single digit ppb levels ■ Superior metal removal capacity, lower cost-of-ownership ■ Shorter residence time than an Ion Exchange Column
■ Graded Density Construction	■ Large surface area increases contact time between the fluid and reactive sites of the purifier ■ Increased purifier lifetime
■ High Flow Rates	■ Increased throughputs as compared to ion exchange columns
■ Wide Range of Configurations	■ Allows for the same purification media to be used during laboratory, pilot, and full production scale-up ■ Low hold-up volume disk filters allow material suppliers to perform testing in a rapid and cost-effective manner ■ Purification media can be customized to the specific application
■ Low Cartridge Extractables	■ No leaching of contaminants into the process fluid
■ Quality Manufacturing	■ ISO Certified Facility ■ Repeatable and reliable performance

void volume exists between each resin bead. When these two factors are combined the process fluid is not able to fully access the ion exchange sites thereby resulting in a less efficient means of purification. For this reason, it is often necessary to run the ion exchange column in re-circulation mode until the required parts-per-billion levels for trace metals is achieved. This is particularly true with high viscosity chemicals. While this technology is effective at reducing trace metal and ionic contaminants it lacks the throughput that material suppliers require.

CUNO has developed a chemically modified purifier that is capable of removing metallic or ionic contaminants from photoresists, resins, solvents, and ancillary chemicals while improving flow and throughput. This is accomplished by maximizing purification surface area, which reduces the potential for channeling and increases the contact time between the chemical and reactive sites of the purifier. This increase in purification surface area is achieved by using the patented* Zeta Plus 40Q metal ion removal media.

Superior Metals Removal Capacity Provided by Zeta Plus 40Q

Zeta Plus 40Q Purifiers contain multiple ion exchange groups that reduce trace metals such as Na, Fe, K, and Ca to single digit parts per billion levels in single pass or recirculation mode applications. Unlike competitive purifiers that only contain ion exchange technologies on the surface of the media, Zeta Plus 40Q Purifiers are able to purify ionic contaminants throughout the entire depth of the media. This patented design provides a more efficient means of purification per surface area while increasing flow and lifetime. Tables 1, 2, and 3 show the metal removal performance of Zeta Plus 40Q purifier in propylene glycol monomethyl ether acetate (PGMEA), propylene glycol monomethyl ether (PGME), and ethyl cellosolve acetate (ECA). Metals removal was quantified using a graphite furnace atomic absorption spectrometer.

Table 1 - Single Pass Metals Removal from PGMEA/PGME (30/70 Mixture)

Metal	Detection Limit (ppb)	Influent Level (ppb)	Effluent Level (ppb)
Al	0.2	10	< D.L.*
Ca	0.2	15	< D.L.
Cr	0.2	10	< D.L.
Cu	0.2	9	< D.L.
Fe	0.2	9	< D.L.
K	0.2	8	< D.L.
Mg	0.2	8	< D.L.
Mn	0.2	11	< D.L.
Na	0.2	9	1.6
Ni	0.2	8	< D.L.
Pb	0.2	10	< D.L.
Zn	0.2	7	< D.L.
* Detection Limit			

* US Patent 6,103,122

Table 2 - Single Pass Metals Removal from PGMEA

Metal	Detection Limit (ppb)	Influent Level (ppb)	Effluent Level (ppb)
Ca	<10	1160	< D.L.
Fe	<10	838	< D.L.
Na	<10	902	< D.L.

Table 3 - Single Pass Metals Removal from ECA

Metal	Detection Limit (ppb)	Influent Level (ppb)	Effluent Level (ppb)
Ca	<10	590	< D.L.
Fe	<10	230	< D.L.
Na	<10	850	< D.L.

Zeta Plus 40Q Extractables

The purifier's clean materials of construction ensure that ionic, organic, and metallic contaminants are not being added back into the process chemical. Ionic, organic, and metallic contaminants can extract from other filter materials, which may change the photo-speed, viscosity, or molecular weight of the chemical. A static soak test was performed to determine the amount of contaminants extracted from the solvent PGMEA. After a 24-hour static soak, extractables were quantified using a graphite furnace atomic absorption spectrometer (Table 4).

Table 4. - Extractable Metals Content of Zeta Plus 40Q in PGMEA

Metal	Detection Limit (ppb)	Effluent Level (ppb)
Ca	4.0	< D.L.
Cr	2.0	< D.L.
Cu	1.0	< D.L.
Fe	5.0	< D.L.
K	1.0	< D.L.
Na	5.0	< D.L.

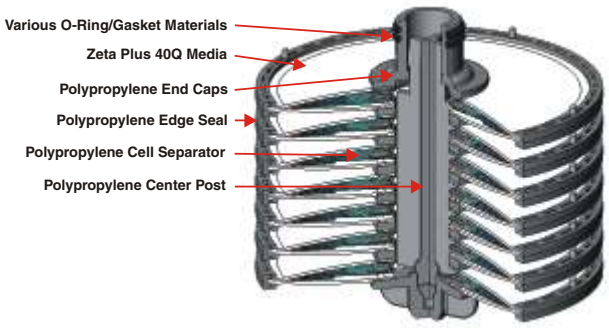
Zeta Plus 40Q Purifier Scale-Up

For laboratory and pilot scale testing, CUNO offers low hold-up volume Zeta Plus 40Q purifier disks (47mm, 90mm, 142mm) and housings to allow end users to assess parameters such as material compatibility, photo-speed, and trace metals removal in a rapid and cost effective manner. The compact size allows for easy replacement and installation of purification media while reducing the waste of expensive chemicals. Zeta Plus 40Q purifier disks contain the same filter media as full size Zeta Plus 40Q purifier cartridges, ensuring repeatable and reliable performance throughout

laboratory, pilot, and full production testing. This makes the scale-up process simple, linear, and predictable.

In full scale production, Zeta Plus 40Q purifier is offered in cartridge diameter sizes of 8", 12", and 16" providing up to 37 ft^2 (3.44 m^2) of surface area in a single cartridge. Zeta Plus Housings can vertically accommodate 1, 2, 3, or 4 Zeta Plus 40Q cartridges, allowing the end user to tailor the filtration system to their required flow rate.

Figure 1. - Zeta Plus 40Q Construction



Zeta Plus 40Q Purifier Lifetime

The lifetime of the purifier will vary based on the ionic contamination loading in the fluid, the batch or bath size, and the desired metal effluent specification. As a result, the purifier should be sized based on the desired flow rate for the application. CUNO recommends ≤ 0.25 gpm (0.95 lpm) flow rate per 1 ft^2 (0.09 m^2) of Zeta Plus 40Q media for a 1cps fluid and ≤ 0.1 gpm (0.38 lpm) flow rate per 1 ft^2 (0.09m^2) of Zeta Plus 40Q media for 10 to 100 cps fluids. For fluids greater than 100 cps, consult the factory. Table 5 provides the recommended flow rate for each Zeta Plus 40Q purifier cartridge available.

Table 5. - Recommended Flow Rate per Cartridge Configuration

Catalog Number	Maximum Flow Rate for 1 cps fluids		Maximum Flow Rate for 10 to 100 cps fluids	
	GPM	LPM	GPM	LPM
Z8F (8" – 2 cell)	0.20	0.76	0.08	0.30
45167 (8" – 7 cell)	0.75	2.85	0.30	1.14
45109 (8" – 8 cell)	0.85	3.23	0.34	1.29
45244-01 (12" – 9 cell)	2.3	8.5	0.9	3.4
45237 -01 (12" – 12 cell)	3.0	11.3	1.2	4.5
45245-01 (12" – 16 cell)	4.0	15.1	1.6	6.1
Z16P (16" – 14 cell)	9.3	35.0	3.7	14.0

Product Specifications

Catalog Number	Nominal Diameter		Height		Media Surface Area	
	In.	mm	In.	mm	Ft^2	m^2
Z8F (8" – 2 cell)	8	203	3 15/32	88	0.8	0.07
45167 (8" – 7 cell)	8	203	6 5/8	168	3.0	0.28
45109 (8" – 8 cell)	8	203	6 9/16	166	3.4	0.32
45244-01 (12" – 9 cell)	12	273	7 9/16	192	9.0	0.84
45237 -01 (12" – 12 cell)	12	273	10 3/4	273	12.0	1.1
45245-01 (12" – 16 cell)	12	273	10 3/4	273	16.0	1.5
Z16P (16" – 14 cell)	16	406	10 3/4	273	37.0	3.4
Maximum Operating Temperature	176º F (80º C)					
Maximum Differential Pressure	35 psid @ 176º F (2.4 bar @ 80º C)					

Zeta Plus 40Q Purifier Cartridge Ordering Guide

Zeta Plus	Configuration	2-123 O-Ring Material	Packaging	Grade
Z8F (8" – 2 cell) SOE Cartridge	A2NP	A - Silicone B - Fluorocarbon C - EPR D - Nitrile K - TEV	2	40Q

Configuration	2-123 O-Ring Material	Grade
45167 (8" – 7 cell) SOE Cartridge	01 – Nitrile 02 – EPR 03 – Fluorocarbon 04 – Silicone 09 – TEV	40Q

Configuration	DOE Gasket Material	Grade
45109 (8" – 8 cell) DOE Cartridge	11 – Nitrile 13 – Fluorocarbon 14 – EPR 22 – Silicone 23 – PTFE	40Q

Configuration	DOE Gasket Material	Grade
45244-01 (12" – 9 cell) 45237-01 (12" – 12 cell) 45245-01 (12" – 16 cell)	A - Silicone B - Fluorocarbon C - EPR D - Nitrile E - PTFE	40Q

Configuration	DOE Gasket Material	Grade
Z16P (16" – 14 cell)	A - Silicone B - Fluorocarbon C - EPR D - Nitrile E - PTFE	40Q

Zeta Plus 40Q Purifier Disk Ordering Guide

47mm Disk	B0204-40Q
90mm Disk	B0406-40Q
142mm Disk	B0611-40Q

WARRANTY

Seller warrants its equipment against defects in workmanship and material for a period of 12 months from date of shipment from the factory under normal use and service and otherwise when such equipment is used in accordance with instructions furnished by Seller and for purposes disclosed in writing at the time of purchase, if any. Any unauthorized alteration or modification of the equipment by Buyer will void this warranty. Seller's liability under this warranty shall be limited to the replacement or repair, F.O.B. point of manufacture, of any defective equipment or part which, having been returned to the factory, transportation charges prepaid, has been inspected and determined by the Seller to be defective. THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, AS TO DESCRIPTION, QUALITY, MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR ANY OTHER MATTER. Under no circumstances shall Seller be liable to Buyer or any third party for any loss of profits or other direct or indirect costs, expenses, losses or consequential damages arising out of or as a result of any defects in or failure of its products or any part or parts thereof or arising out of or as a result of parts or components incorporated in Seller's equipment but not supplied by the Seller.

Service Worldwide

Visit us at www.cuno.com for more information
about CUNO Products or the location of your local sales office

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