Industrial filtration

# Zeta Plus 40Q purifier cartridges

## Superior removal of trace metals from high purity chemicals

Thermo Scientific™ Zeta Plus™ 40Q Purifier Cartridges 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 construction enhances surface area for the ion exchange groups assuring metallic contaminant removal to single digit ppb levels.



### Zeta Plus 40Q purifier cartridge 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 0.011 in (0.3 mm) and 0.047 in (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.

## Features & benefits

**Zeta Plus 40Q metal ion removal media**

- Reduces trace metals to single digit ppb levels
- Superior metal removal capacity, lower cost-of-ownership

**Graded density construction**

- Large surface area increases contact time between the fluid and reactive sites of the purifier
- Increases 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 9001:2008 registered Quality Management System
- Repeatable and reliable performance

## Applications

- Resins
- Solvents
- Recirculation baths
- I line photoresists
- G line photoresists
- Acetone
- IPA

**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.

**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. |

**Table 4: Extractable metals content of Thermo Scientific™ Zeta Plus™ 40Q Purifier Cartridge 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. |

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 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.

During the manufacturing process, molecules carrying a positive charge are chemically bonded to the filter matrix permanently forming an interconnected filtration structure with positively charged electrokinetic capture sites. The resulting porous depth filter is a tortuous network of charge-enhanced flow channels capable of removing bacteria, particulate, cellular debris and submicronic contaminants to a level which mechanical screening alone cannot achieve.

Thermo Fisher Scientific 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 Zeta Plus 40Q purifier cartridge metal ion removal media.

## Superior metals removal capacity provided by Zeta Plus 40Q purifier cartridge

Zeta Plus 40Q purifier cartridges 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 purifier cartridges are able to purify ionic contaminants throughout the entire depth of the media. This 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 cartridge 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.

## Zeta Plus 40Q purifier cartridge 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).

## Zeta Plus 40Q purifier cartridge scale-up

For laboratory and pilot scale testing, Thermo Fisher offers low hold-up volume Zeta Plus 40Q purifier disks (47 mm) 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 cartridge 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 cartridge is offered in cartridge diameter sizes of 8 in (203 mm), 12 in (304 mm), and 16 in (406 mm) providing up to 34.7 ft.$^2$ (3.2 m$^2$) of surface area in a single cartridge. Zeta Plus housings can vertically accommodate 1, 2, 3, or 4 Zeta Plus 40Q purifier cartridges, allowing the end user to tailor the filtration system to their required flow rate.

## Zeta Plus 40Q purifier cartridge 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. Thermo Fisher recommends ≤0.25 gpm (0.95 lpm) flow rate per 1 ft.$^2$ (0.09 m$^2$) of Zeta Plus 40Q purifier cartridge media for a 1 cps fluid and ≤0.1 gpm (0.38 lpm) flow rate per 1 ft.$^2$ (0.09 m$^2$) of Zeta Plus 40Q purifier cartridge 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**

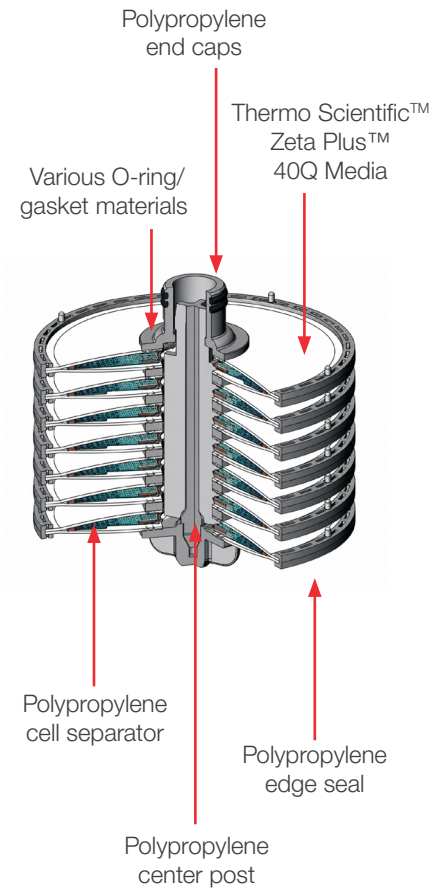
| Catalog number | Max flow rate: 1 cps fluids | | Max flow rate: 10–100 cps fluids | |
|---|---|---|---|---|
| | GPM | LPM | GPM | LPM |
| **Z8F** - 8 in (203 mm), 2 cell | 0.20 | 0.76 | 0.08 | 0.30 |
| **45167** - 8 in (203 mm), 7 cell | 0.75 | 2.85 | 0.30 | 1.14 |
| **45244-01** - 12 in (305 mm), 9 cell | 2.3 | 8.5 | 0.9 | 3.4 |
| **45245-01** - 12 in (305 mm), 16 cell | 4.0 | 15.1 | 1.6 | 6.1 |
| **Z16P** - 16 in (406 mm), 14 cell | 9.3 | 35.0 | 3.7 | 14.0 |

**Table 6: Product specifications**

| Catalog number | Nominal diameter | | Height | | Media surface area | |
|---|---|---|---|---|---|---|
| | in | mm | in | mm | ft$^2$ | m$^2$ |
| **Z8F** - 8 in (203 mm), 2 cell | 8 | 203 | 3-15/32 | 88 | 0.7 | 0.065 |
| **45167** - 8 in (203 mm), 7 cell | 8 | 203 | 6-5/8 | 168 | 2.5 | 0.23 |
| **45244-01** - 12 in (305 mm), 9 cell | 12 | 273 | 7-9/16 | 192 | 9.2 | 0.90 |
| **45245-01** - 12 in (305 mm), 16 cell | 12 | 273 | 10-3/4 | 273 | 16.4 | 1.5 |
| **Z16P** - 16 in (406 mm), 14 cell | 16 | 406 | 10-3/4 | 273 | 34.7 | 3.2 |
| Maximum operating temperature | | | 176°F (80°C) | | | |
| Maximum differential pressure | | | 35 psid @ 176°F (2.4 bar @ 80°C) | | | |



**Figure 1: Thermo Scientific™ Zeta Plus™ 40Q Purifier Cartridge construction**



## Zeta Plus 40Q purifier cartridges ordering guide

| Thermo Scientific™ Zeta Plus™ Filter | Configuration | 2-123 O-ring material | Packaging | Media grade |
|---|---|---|---|---|
| **Z8F**<br>8 in (203 mm), 2 cell SOE cartridge | A2NP<br>C2NP | B – Fluorocarbon<br>C – EPR<br>K – PTFE encapsulated fluorocarbon | 2 | 40Q |

| Thermo Scientific™ Zeta Plus™ 40Q Purifier disk | |
|---|---|
| 47 mm disk | B0204-40Q |

| Configuration | 2-123 O-ring material | Media grade |
|---|---|---|
| **45167** - 8 in (203 mm), 7 cell SOE cartridge | 03 – Fluorocarbon<br>09 – PTFE encapsulated fluorocarbon | 40Q |

| Configuration | DOE gasket material | Media grade |
|---|---|---|
| **45244-01** - 12 in (305 mm), 9 cell | E – PTFE | 40Q |
| **Z16P** - 16 in (406 mm), 14 cell | C – EPR<br>E – PTFE | 40Q |

**PLEASE NOTE: The ordering guide above is for reference only. Not all combinations are available.**
**Please consult with your Thermo Fisher representative to determine the appropriate part number for your application.**

**Intended Use:** Zeta Plus 40Q products are intended for use in industrial, chemical, and electronics filtration applications of aqueous and non-aqueous fluids in accordance with the product instructions, specifications and where materials of construction are compatible

Since there are many factors that can affect a product's use, the customer and user remain responsible for determining whether the Thermo Scientific product is suitable and appropriate for the user's specific application, including user risk assessments and evaluation of the Thermo Scientific product in the user's application.

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Zeta Plus 40Q products are not for use in food contact applications.

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