BioPak® point-of-use ultrafilter

Final purification step at the ultrapure water point-of-delivery provides pyrogen- and nuclease-free water at a high flow rate when you need it.

The BioPak® unit is a disposable ultrafiltration cartridge typically used in cell culture, biochemistry or molecular biology applications. It can be installed at the outlet of Type I water purification systems such as the Milli-Q®, Direct-Q®, Simplicity® or Synergy® systems, to produce pyrogen- and nuclease-free ultrapure water for a period of up to three months.
The cartridge is composed of polysulfone hollow fibers in a white ABS housing. The BioPak® ultrafiltration membrane is designed to optimize the rejection of pyrogens, nucleases and bacteria, while maintaining a high flow rate and minimizing the release of ionic and organic materials.

Key benefits

- Direct connection to all EMD Millipore Type I water systems
- Pyrogen-free water (< 0.001 EU / mL) production
- RNase-free water (< 0.01 ng / mL) and DNase-free water (< 4 pg / µL) production
- Safe method that eliminates the need to treat water with DEPC
- Bacteria-free water (< 1 cfu / mL) production
- Warranty of results within specifications for a minimum of 90 days usage
- Maintenance-free

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PYROGEN REMOVAL

The most common pyrogens are endotoxins, *i.e.*, lipopolysaccharides (LPS) from the walls of Gramnegative bacteria. The LPS have two major parts: a hydrophilic polysaccharide chain with antigenic regions and a hydrophobic lipid group. As the polysaccharide chain is variable in length, the LPS molecular weight ranges from 3,000 to 25,000 Dalton. In ultrapure water, the LPS sub-units aggregate to form higher molecular weight structures that can be removed by ultrafiltration membranes with cut off below 20,000 Dalton.

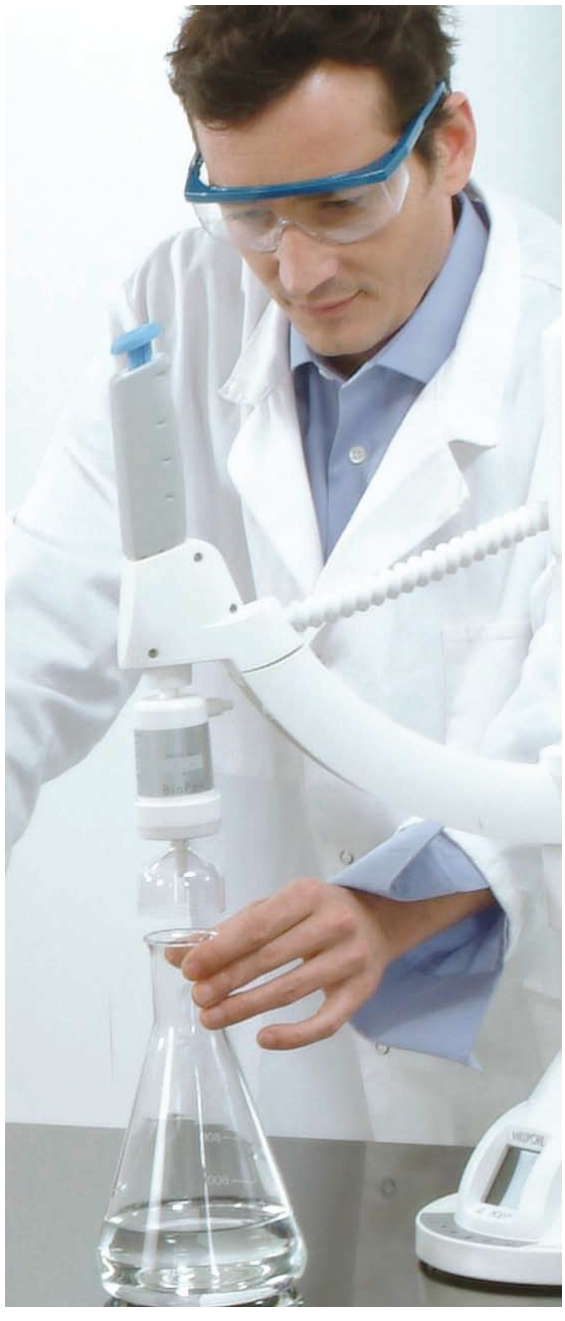
Pyrogens are known to affect cell culture and biochemistry experiments in numerous ways. It has been demonstrated that their interaction with cell membranes causes morphological changes and damage, as well as the secretion of specific substances such as tumor necrosis factor, cytokines or enzymes. Pyrogens also affect the cell division process (enhancing or reducing it) depending on the nature of the cell line. The presence of pyrogens also may affect analytical techniques such as electrophoresis.

For these reasons, it is good laboratory practice to remove pyrogens from all solutions used in cell culture and other biochemical applications. Experiments performed in EMD Millipore R&D laboratories have demonstrated that the BioPak® ultrafiltration cartridge can be used for at least 90 days to treat Milli-Q® ultrapure water and obtain product water with a pyrogen level below 0.001 EU/mL.

NUCLEASE REMOVAL

Challenge tests performed in EMD Millipore R&D laboratories have demonstrated that the BioPak® cartridge allows easy production of ultrapure water that is both RNase-free (< 0.01 ng/mL) and DNase-free (< 4 pg/µL).

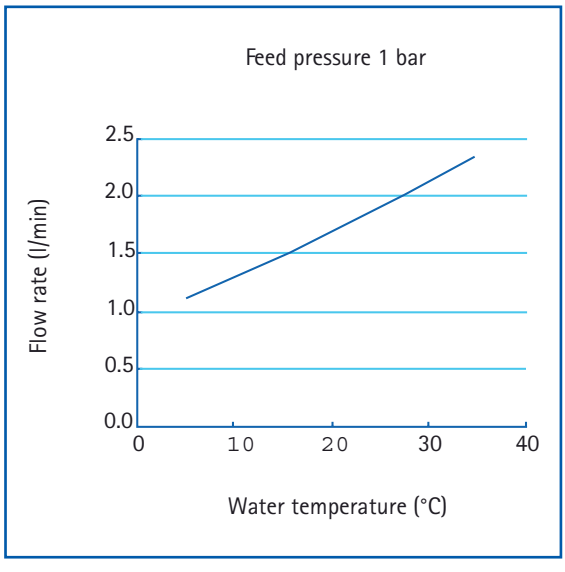
Previous experiments also have shown that ultrafiltration with a properly validated device is just as efficient as diethylpyrocarbonate (DEPC) for RNase removal from ultrapure water without the negative aspects of DEPC treatment: lengthy treatment time and contamination of the treated water by CO_2 and ethanol.



BACTERIA-FREE WATER PRODUCTION

The validation protocol provided proof that the BioPak® ultrafiltration cartridge enables delivery of bacteria-free (< 1 cfu/mL) water, when used according to instructions with the filter outlet located in a clean environment.

BIOPAK® ULTRA FILTRATION CARTRIDGE FLOW RATE



PRODUCT WATER SPECIFICATIONS

Pyrogen Level (EU/mL)	< 0.001
RNases* (ng/mL)	< 0.01
DNases* (pg/µL)	< 4
Bacteria* (cfu/mL)	< 1

* When used according to instructions with the filter outlet located in a clean environment

HIGH FLOW RATE

The large ultrafiltration membrane surface of the BioPak® cartridge makes it possible to produce pyrogen-free ultrapure water without compromising the flow rate, as shown by the graph opposite.

The user can obtain ultrapure water on demand just before solution preparation, minimizing risks of recontamination.

CERTIFICATE OF QUALITY

Each BioPak® unit has been individually tested for efficiency and flow rate and is delivered with a Certificate of Quality.

ORDERING INFORMATION

Description	Catalogue No.
BioPak® Ultrafiltration Cartridge (1/pk), validated for pyrogen- and nucleasefree water production, delivered with a self-adhesive label (with space to note installation and replacement dates), Certificate of Quality and multilingual User manual.	CDUFBI001

Lit. No. PB1006ENUS 01/12.

LC-Pak® Point-of-use Polisher

C18 Reverse phase silica

Key Benefits

- The LC-Pak® cartridge is easily connected to the outlet of all EMD Millipore Type I water systems (Milli-Q®, Direct-Q®, Synergy® and Simplicity®)
- Final purification step uses efficient C18 reverse phase silica technology to provide fresh ultrapure water with low traces of organics-at high flow rate, when you need it
- Delivers a minimum of 500 L of organic-free ultrapure water
- Designed to answer the demands of UPLC, LC-MS and LC-MS/MS analytical techniques used for organic trace and ultra-trace analysis
- Validated for the production of water whose quality equals or exceeds the specifications of bottled water for LC-MS
- Each LC-Pak cartridge is delivered with a Certificate of Quality

Recent advances in analytical techniques such as UPLC, LC-MS, LC-MS / MS have considerably improved the sensitivity of organic and biochemical molecule detection. As a result, these techniques now require improved water quality for the production of mobile phase, buffers, blanks, standards preparation, sample dilution, glassware rinsing or extraction.

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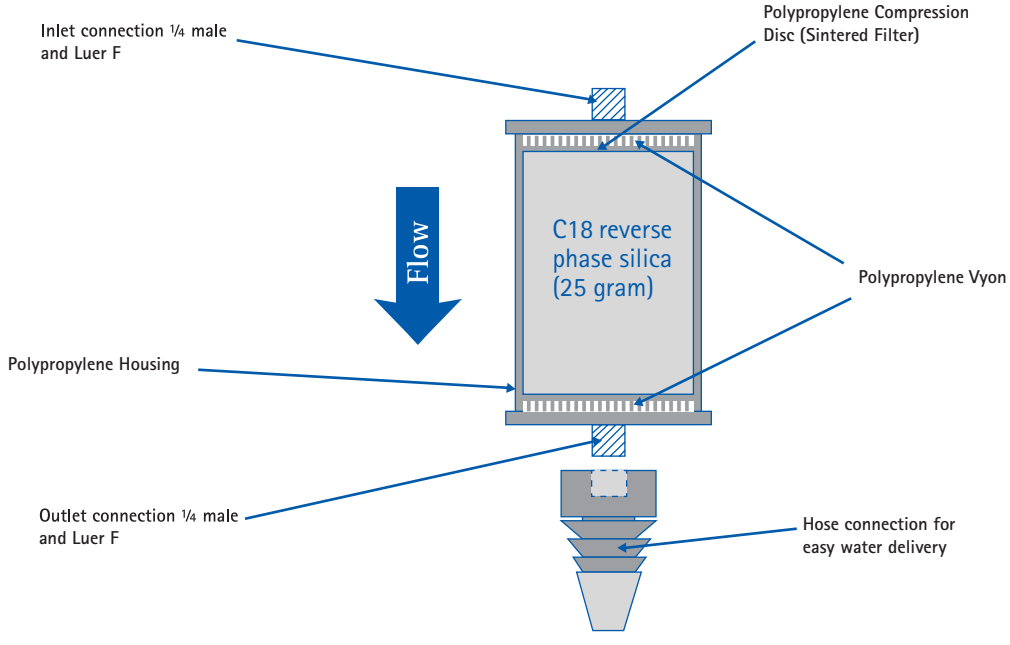
Although fresh Milli-Q® water has proved adequate for most procedures involving these techniques until recently, there is now a growing need for higher water quality in some advanced applications.

To answer this emerging need, EMD Millipore has developed a new POD-Pak® designed to produce ultrapure water with an organics contamination level below most water sources available today, at a fraction of the cost.

The LC-Pak® cartridge can be connected to the outlet of existing and new EMD Millipore Type I water systems (Milli-Q®, Direct-Q®, Synergy® and Simplicity®) to produce water with a TOC level below 5 ppb and deliver at least 500 L of ultrapure water with minimum trace organic contamination. The LC-Pak® cartridge uses the well-known reversed-phase silica purification media to remove traces of neutral organics.

LC-PAK® CARTRIDGE DESIGN

The LC-Pak® is designed to provide scientists with the certitude that the ultrapure water that they are using in critical organic molecules analysis at trace and ultra-trace levels will be adequate.



The granular C18 reverse phase silica in the polypropylene housing is tightly packed by a compression disc to avoid any channeling effect. This ensures that the water passing through the LC-Pak® will be in close contact with the C18 chains binding organic molecules by hydrophobic interactions.

When required, the LC-Pak® outlet can be connected to a 0.22 µm in-line filter.

LC-PAK® CARTRIDGE OPERATION

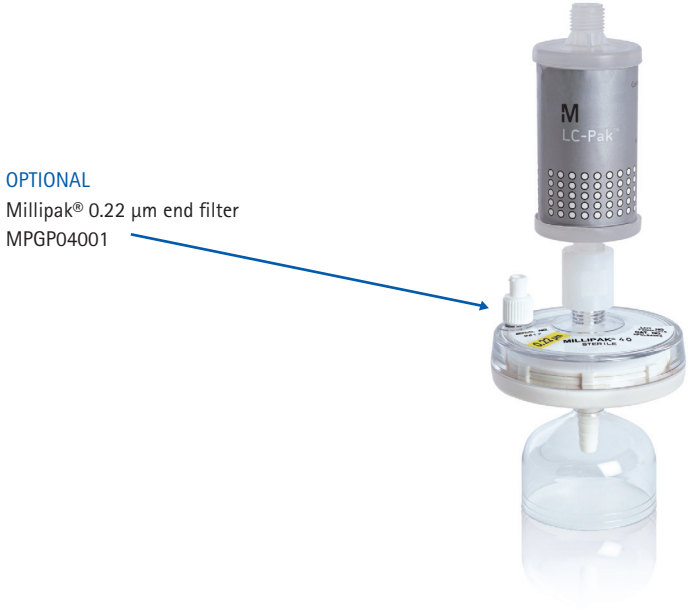
The LC-Pak® is easy to use: simply flush it with 50 mL methanol to properly wet the pores of the C18 reverse phase purification media, connect the LC-Pak® to the outlet of the EMD Millipore ultrapure water system and flush with ultrapure water for 10 minutes. You are now ready to deliver at least 500 L of ultrapure water with low trace organic.

LC-PAK® CARTRIDGE SPECIFICATIONS

The LC-Pak® cartridge was extensively validated to ensure that the water quality at the outlet matches the most demanding requirements.

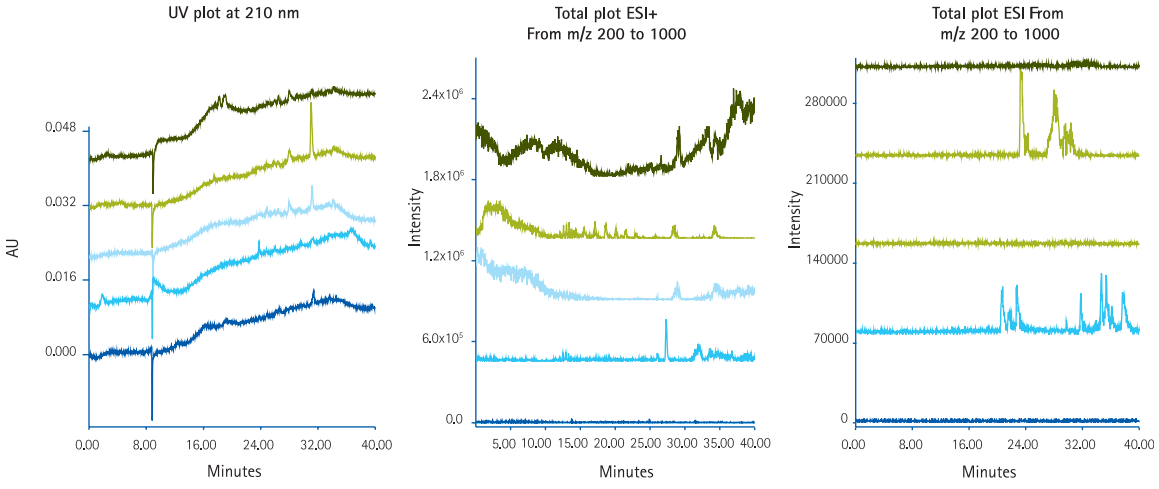
Parameter	Specification of LC-Pak® ultrapure water	Comments
HPLC Gradient Test - Absorbance of highest eluted peak	ZRXQ003 WW*	Concentration of 60 mL water at 1 mL/min prior to elution
HPLC Gradient Test - Absorbance of highest eluted peak	At 210 nm < 0.006 AU At 254 nm < 0.002 AU	No water preconcentration
Optical properties: absorbance in UV range	UV 200 nm < 0.05 AU UV 205 nm < 0.01 AU UV 210 nm < 0.01 AU UV 254 nm < 0.005 AU	
Fluorescence as quinine	At 254 nm < 1 ppb At 365 nm < 1 ppb	
Compliance with suitability for LC/MS: Reserpine test	No peak higher than 10 ppb Reserpine at 609 m/z in ESI +	
Residue after evaporation	< 0.0001 % w/w	Test performed as specified in ISO 3696 procedure

An LC-Pak® validation guide is available should you wish to review the details of the validation report.



COMPARISON OF LC-PAK® AND SOME LC-MS BOTTLED WATER

In order to verify that fresh ultrapure water produced by a Milli-Q® system and an LC-Pak® cartridge matched or exceeded the quality of commercially available bottled water for LC-MS applications, different 60 mL water samples were pre-concentrated on a C18 reverse phase chromatography column, then eluted and an lyzed by LC-MS (PDA, single quadrupole). Examples of the results obtained are shown below.



Bottled water F for LC-MS
Bottled water J for LC-MS
Bottled water R for LC-MS
Bottled water B for LC-MS
Milli-Q® Integral with LC-Pak®

EQUIPMENT

The equipment used throughout the experiment was from Waters® Corporation, Milford, MA, U.S.A.

- LC system: Alliance® 2695
- Pre-column Column: C18 X-Terra®; 3 µm, 4.6 x 30 mm
- Column: C18 Atlantis; 3 µm, 2.1 x 150 mm
- Detectors: PDA Model 2996
- Mass detector ZQ 2000™
- Elution solvents: Water to be tested, Acetonitrile HPLC grade (J.T. Baker)
- Computer for data acquisition and system control equipped with Empower® software

Detailed analytical conditions available upon request: internal procedure No. 00084229SO.
The entire study, including details of analytical procedures, is provided in the LC-Pak® cartridge Validation Guide.

ORDERING INFORMATION

Description	Comments
LC-Pak® Cartridge (1/pk) delivered hermetically sealed, with a Certificate of Quality	LCPAK0001
Cartridge installation and Conditioning Kit including the following reusable parts: • Polyethylene ¼ Gaz F-Hose barb connection with O-ring • Polyethylene ¼ G F – ¼ Gaz F connectors for connection to Millipak®	EDSKIT001
Millipak® 0.22 µm end filter	MPGP04001

Lit. No. DS1067ENUS

EDS-Pak® Point-of-Use Polisher

Endocrine disrupter-free water at the ultrapure water point of delivery

Key benefits:

- Point-of-use polisher for use with Milli-Q® and other EMD Millipore Type I water purification systems
- Final purification step provides endocrine disrupter-free ultrapure water at high flow rate—when you need it
- Delivers a minimum of 300 l of EDS-free ultrapure water
- Validated for efficient removal of bisphenol A, diethyl phthalate and di-n-butyl phthalate
- Each EDS-Pak® cartridge is delivered with a Certificate of Quality

Endocrine disrupters

Endocrine disrupters are small, man-made organic chemicals whose structures mimic those of hormones, enabling them to interact with normal endocrine system functions. By sheer coincidence, their key-shaped molecules open the hormonal locks that control proper development and behavior in both humans and animals.[1,2,3]

Today, endocrine disrupters are increasingly present in the environment. Although endocrine disrupters may be only somewhat dangerous for adults, mounting evidence suggests that they can significantly disturb fetal and infant development. As researchers increasingly focus on the effects of these chemicals, there is a need for endocrine-disrupter free water for use in experimental tests. While conventional water purification techniques remove the bulk of organic compounds from ultrapure water, some trace organics still may remain.

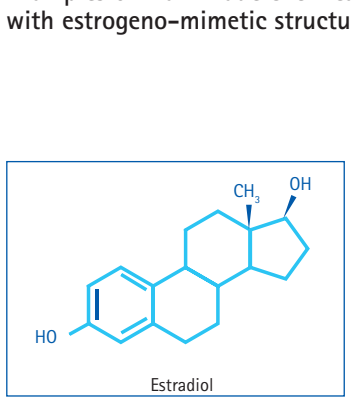
Examples of endocrine disrupters include nonylphenol (a detergent), bisphenol A (a plasticizer), diethylstilbestrol (a growth agent administered to livestock) and DDT (a pesticide).

These man-made chemicals can be found in many products widely used in industrial societies:

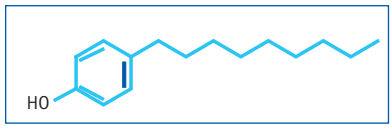
- Bisphenol A is a plasticizer used in reusable water bottles, laptop computer housings, dental sealants and the resins in some food can linings.

- Phthalates are found in a wide variety of products, including vinyl flooring, food packaging, blood-storage bags, intravenous medical tubing, as well as many health and beauty products such as detergents, soaps, shampoos, deodorants, fragrances, hair spray and nail polish. They are often used as a plasticizer in PVC pipes distributing water in buildings.

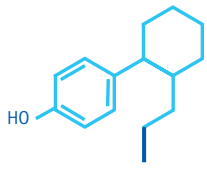
Examples of man-made chemicals with estrogeno-mimetic structure

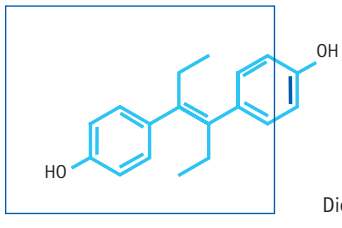


Estradiol

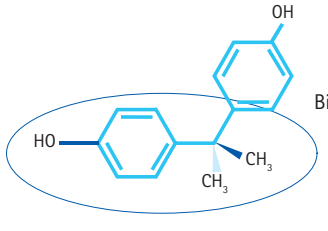


Nonylphenol



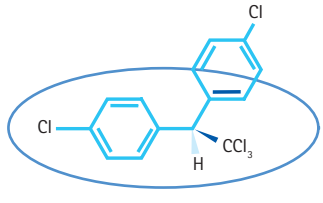


Diethylstilbestrol



Bisphenol A

DDT



EDS-Pak® polisher design

The EDS-Pak® is a disposable point-of-use ultrafiltration cartridge developed by EMD Millipore to meet the needs of researchers who require ultrapure water free of endocrine disrupters (EDS).

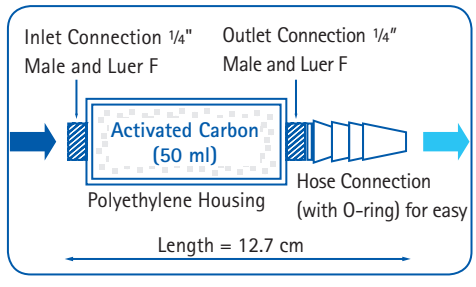
The EDS-Pak® can be installed on all EMD Millipore Type I water purification systems that deliver ultrapure water with TOC < 5 ppb, including the Milli-Q®, Synergy®, Simplicity® and Direct-Q® systems. It is designed to provide at least 300 l of EDS-free ultrapure water before replacement is necessary.

EDS-Pak® polisher operation

The EDS-Pak® cartridge contains a specific type of activated carbon that has been validated for the removal of several endocrine disrupters. The cartridge's housing and connector materials also have been validated for the absence of endocrine disrupters.

Before use, the EDS-Pak® unit must be conditioned with methanol to ensure that all binding surfaces are accessible to endocrine disrupters.*

Following this step, the cartridge should then be flushed with ultrapure water to remove any excess methanol. Once conditioned, the EDS-Pak® unit is warranted to deliver up to 300 l of EDSfree water (see specifi cations below) when fed by ultrapure water with a TOC level < 5 ppb at a fl ow rate between 0.5 – 2 l/min.



EDS-Pak® polisher specifications

The EDS-Pak® has been validated for the effi cient removal of the following endocrine disrupters: bisphenol A, diethyl phthalate, di-n-butyl phthalate and nonylphenol.

EDS tested	Feed (ppb)	Product (ppt)	Volume (l)	Flow (l/min)
Bisphenol A	Up to 4	< DL (5 ppt)	300	0.5 – 2.0
Diethyl phthalate	Up to 1.5	< DL (200 ppt)	300	0.5 – 2.0
Di-n-butyl phthalate	Up to 1.5	< DL (200 ppt)	300	0.5 – 2.0
Nonylphenol	Up to 3.3	< DL (100 ppt)	300	0.5 – 2.0

Each EDS-Pak® cartridge is delivered with a Certificate of Quality showing the analytical results of the Endocrine Disrupter Analysis performed on the cartridge lot.

Ordering information

Description	Catalogue No.
EDS-Pak® Cartridge (1/pk) delivered hermetically sealed, with a Certificate of Quality	EDSPAK001
EDS-Pak® Cartridge installation and Conditioning Kit including the following reusable parts: • Polyethylene 1/4 Gaz F-Hose barb connection with O-ring • Polyethylene 1/4 G F – 1/4 Gaz F connectors for connection to Millipak®	EDSKIT001

***Note: A 50 ml glass syringe is required to condition the EDS-Pak® cartridge with methanol. This syringe is not provided by EMD Millipore.**

Bibliography

1. Huang, Y.W.; Twidwell, D. L.; Elrod, J.C. "Occurrence and Effects of Endocrine Disrupting Chemicals in the Environment," *Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, 7* (4), p. 241-247 (2003).

2. Brevini, T.A.L.; Zanetto, S.B.; Cillo, F. "Effects of Endocrine Disrupters on Developmental and Reproductive Functions," *Current Drug Targets – Immune, Endocrine & Metabolic Disorders*, Volume 5, Number 1, p. 1-10 (2005).

3. Bigsby, R.; Chapin, R. E.; Daston, G. P.; Davis, B.J.; Gorski, J.; Gray, L.E.; Howdeshell, K.L.; Zoeller, R. T. and vom Saal, F. S. "Evaluating the Effects of Endocrine Disrupters on Endocrine Function during Development," *Environmental Health Perspectives 107* (Suppl. 4), p. 613-618 (1999).

Lit No. PB1234ENUS

VOC-Pak™ Point-of-Use Polisher

Final purification step at the ultrapure water point-of-delivery efficiently removes Volatile Organic Compounds (VOCs)

VOCs are industrial contaminants that may cause health safety issues and therefore should be detected in the environment. VOCs are routinely analyzed in water, soil, soil gas and air.
Specifications for VOCs in drinking water have been established by different regulatory agencies in many countries. A table showing the Maximum Allowable Concentration (MAC) for some of the different VOCs monitored in the United States, Europe, Japan and China, as well as by the World Health Organization (WHO), is available on the EMD Millipore web site: www.millipore.com/labwater

Benefits

- The VOC-Pak™ polisher is easily connected to the outlet of all EMD Millipore Type I water purification systems (Milli-Q®, Direct-Q®, Synergy® and Simplicity® systems)
- The final purification step provides VOC-free ultrapure water at high flow rate—when you need it
- Delivers a minimum of 300 l of VOC-free ultrapure water
- Validated for efficient removal of VOCs
- Each VOC-Pak™ cartridge is delivered with a Certificate of Quality

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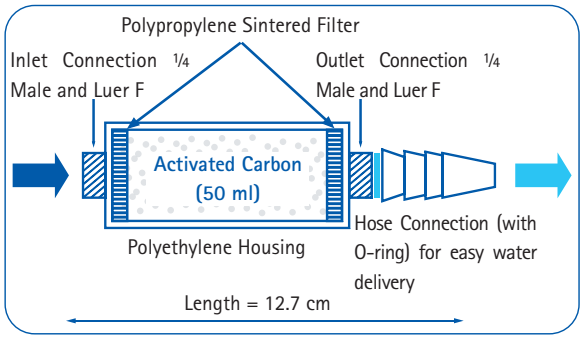
VOC-Pak™ POLISHER DESIGN

The VOC-Pak™ cartridge is designed to assure scientists performing VOC analysis that the ultrapure water they use to rinse glassware, produce standard solutions or dilute samples is VOC-free.



The purification media used to achieve this goal is a specific activated carbon selected after tests performed on media from many suppliers.

Table 1:
Results of the VOC-Pak™ challenge test for a processed volume of 350 l

VOC tested	Challenge (ppb) (*)	Quantification limit (ppb) (**)	Concentration after VOC-Pak™ (ppb) (***)
benzene	0.97	< 0.05	< 0.05
bromodichloromethane	1.56	< 0.05	< 0.05
bromoform	1.58	< 0.50)	< 0.50
carbon tetrachloride	1.06	< 0.05	< 0.05
chlorobenzene	0.94	< 0.05	< 0.05
chloroform	1.07	< 0.05	< 0.05
dibromochloromethane	1.01	< 0.10	< 0.10
1,2-dichlorobenzene	1.01	< 0.05	< 0.05
1,4-dichlorobenzene	1.53	< 0.05	< 0.05
1,2-dichloroethane	1.08	< 0.05	< 0.05
1,1-dichloroethene	0.87	< 0.05	< 0.05
cis-1,2-dichloroethene	0.95	< 0.05	< 0.05
trans-1,2-dichloroethene	1.53	< 0.05	< 0.05
1,2-dichloropropane	0.86	< 0.05	< 0.05
cis-1,3-dichloropropene	0.97	< 0.04	< 0.04
trans-1,3-dichloro-propene	0.91	< 0.05	< 0.05
ethylbenzene	1.09	< 0.05	< 0.05
tetrachloroethene	1.44	< 0.05	< 0.05
toluene	0.96	< 0.10	< 0.10
1,1,1-trichloroethane	0.94	< 0.10	< 0.10
1,1,2-trichloroethane	0.93	< 0.05	< 0.05
trichloroethene	1.02	< 0.05	< 0.05
o-xylene	0.79	< 0.05	< 0.05
m-xylene	1.02	< 0.05	< 0.05
p-xylene	0.94	< 0.05	< 0.05

(*) Challenge = VOC concentration in feed water upstream of VOC-Pak™ cartridge
(**) Quantification limit: limit of quantification of the VOC measured by GC
(***) Concentration of VOC below the VOC-Pak™ cartridge for a feed water concentration of 1 ppb

VOC-Pak™ POLISHER OPERATION

The VOC-Pak™ cartridge is easy to use: simply connect the VOC-Pak™ unit to the outlet of the EMD Millipore ultrapure water system and flush 5 l of water. You are now ready to deliver at least 300 l of VOC-free ultrapure water.

VOC-Pak™ POLISHER SPECIFICATIONS

The VOC-Pak™ cartridge is designed to producewater in which the VOC concentration is below the analytical quantification limit (**) for the VOCs listed in Table 1, provided that the VOC concentration in feed water does not exceed 1 ppb (1 µg/l), and the Total Oxidizable Carbon (TOC) of the ultrapure water entering the VOC-Pak™ cartridge is below 5 ppb.

In order to warrant this water quality, the VOC-Pak™ cartridge was qualified by a challenge test: the VOC-Pak™ cartridge was fed by ultrapure water containing a 1 ppb (1 µg/l) concentration of the VOC to be eliminated.

The concentration of the VOC was measured by Gas Chromatography (GC) downstream of the VOC-Pak™ cartridge after passage of 50, 100, 150, 200, 250, 300 and 350 l in order to determine the breakthrough point of the different VOCs. The results are displayed in Table 1 for a processed volume of 350 l.

Q-POD® dispenser fitted with a VOC-Pak™ cartridge

Analysis of the VOCs in ultrapure water was performed according to EMD Millipore procedure 84214SO, using an Eclipse 4660 Purge-and-Trap sample concentrator from OI Corporation™ (College Station, Texas) and a GC-MS system (GC model 6890N and MS model 5975B) from Agilent Technologies®, Inc., Santa Clara, California. A copy of the complete qualification report with description of the analytical procedure is available upon request.

Additionally, each lot of VOC-Pak™ cartridges is analyzed to ensure that the following VOCs (Table 2) are below the analytical quantification limit in water produced by a VOC-Pak™ fed with ultrapure water from a EMD Millipore Milli-Q® system (resistivity at 18.2 MΩ.cm at 25 °C and TOC < 5 ppb).

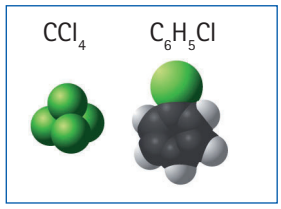
Table 2:

Quantification limits (ppb) of VOCs analyzed in each lot of VOC-Pak™ cartridges

Compound	QL* (ppb)
benzene	< 0.05
bromobenzene	< 0.10
bromochloromethane	< 0.05
bromodichloromethane	< 0.05
bromoform	< 0.50
bromomethane	< 0.20
n-butylbenzene	< 0.05
sec-butylbenzene	< 0.50
tert-butylbenzene	< 0.05
carbon tetrachloride	< 0.05
chlorobenzene	< 0.05
chloroethane	< 1.00
chloroform	< 0.05
2-chlorotoluene	< 0.05
4-chlorotoluene	< 0.10
dibromochloromethane	< 0.10
1,2-dibromo-3-chloropropane (DBCP)	< 0.05
1,2-dibromoethane	< 0.05
dibromomethane	< 0.10
1,2-dichlorobenzene	< 0.05
1,3-dichlorobenzene	< 0.05
1,4-dichlorobenzene	< 0.05
1,1-dichloroethane	< 0.05
1,2-dichloroethane	< 0.05
1,1-dichloroethene	< 0.05
cis-1,2-dichloroethene	< 0.05
trans-1,2-dichloroethene	< 0.05
1,2-dichloropropane	< 0.05
1,3-dichloropropane	< 0.10

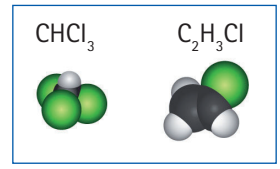
Compound	QL* (ppb)
2,2-dichloropropane	< 0.05
1,1-dichloropropene	< 0.05
cis-1,3-dichloropropene	< 0.05
trans-1,3-dichloropropene	< 0.05
ethylbenzene	< 0.05
hexachlorobutadiene	< 0.05
isopropylbenzene	< 0.05
4-isopropyltoluene	< 0.05
methylene chloride (dichloromethane)	< 0.10
naphtalene	< 0.10
n-propylbenzene	< 0.50
styrene	< 0.10
1,1,1,2-tetrachloroethane	< 0.05
1,1,2,2-tetrachloroethane	< 0.10
tetrachloroethene	< 0.05
toluene	< 0.10
1,2,3-trichlorobenzene	< 0.05
1,2,4-trichlorobenzene	< 0.05
1,1,1-trichloroethane	< 0.10
1,1,2-trichloroethane	< 0.05
trichloroethene	< 0.05
trichloromonofluoromethane	< 0.10
1,2,3-trichloropropane	< 0.05
1,2,4-trimethylbenzene	< 0.05
1,3,5-trimethylbenzene	< 0.10
o-xylene	< 0.05
m-xylene	< 0.05
p-xylene	< 0.05
vinyl chloride	< 0.20

***QL = Quantification Limit – expressed in ppb (µg/l)**



Molecules removed by the VOC-Pak™ cartridge include carbon tetrachloride (CCl_4) and chlorobenzene (C_6H_5Cl).

Milli-Q® water purification system fitted with a VOC-Pak™ cartridge



Molecules removed by the VOC-Pak™ cartridge include chloroform ($CHCl_3$) and vinyl chloride (C_2H_3Cl).

Direct-Q® 3 water purification system with VOC-Pak™ cartridge

Ordering information

Description	Catalogue No.
VOC-Pak™ cartridge (1/pk) delivered hermetically sealed, with a Certificate of Quality	VOCPAK001
Cartridge installation and Conditioning Kit including the following reusable parts: • Polyethylene 1/4 Gaz F-Hose barb connection with O-ring • Polyethylene 1/4 Gaz F – 1/4 Gaz F connectors for connection to Millipak® final filter	EDSKIT001

For more information, please visit our website:
www.millipore.com/labwater

Lit. No. PB1632ENUS 01/12