

# UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

Bringing Molecular/Cellular Grade Ultrapure  
Water to Billeaud and Wharton Biology  
Laboratories

---

Title

**Sophie Plouviez, Ivan Moberly**

---

Name of Submitter  
*(Faculty or Staff Only)*

**Department of Biology**

---

Organization

Title: Bringing Molecular/Cellular Grade Ultrapure Water to Billeaud and Wharton Biology Laboratories Date: 06/30/2022  
Name (Contact Person): Sophie Plouviez  
Address: Room 108-c Department of Biology 410 St Mary Blvd, Lafayette, 70503  
Phone Number: 337-230-5698 Email: sophie.plouviez@louisiana.edu  
Department/College/Org: Department of Biology/College of Science/2710

**ABSTRACT (250 words or less):**

The Department of Biology has approximately 900 undergraduate majors. All Biology majors, as well as students who do a minor in Biology, take laboratory courses in the fields of molecular and cellular biology. These courses run experiments (DNA, RNA, Proteins, Cells) that requires water free of any chemicals, ions, bacteria, or enzymes. Ultrapure molecular/cellular grade water is free of these contaminants that will cause experiments to fail or give unwanted/wrong results.

The Department of Biology does not have an ultrapure molecular/cellular grade water system for Biology classrooms, forcing instructors to either purchase this expensive water, or use inadequately purified water. This results in student frustration, waste of money, and decreased student learning experience.

This grant aims to bring ultrapure molecular/cellular grade water to Biology laboratories in both Wharton Hall and Billeaud Hall through the purchase and installation of one centrally located system per each of the buildings. More than 1070 students spread across a dozen different Biology lab courses would benefit from these systems each year. The ultrapure water systems will provide students with contamination-free water necessary for their molecular and cellular experience. It will limit failed experiment, increase student learning, and better train students for their future career goals.

**A. Purpose of grant and impact to student body as a whole**

***The purpose of this grant is to bring ultrapure molecular/cellular grade water to our Biology lab courses.***

Water purity is essential in Biology. Different levels of water purity are appropriate for different uses and experiments. Tap water can be deionized to provide water suitable for washing glassware. Additional filtrations are needed to remove fine particles of organic and inorganic compounds to provide ultrapure water needed for applications such as Spectrophotometry or HPLC. Spectrophotometry is used in freshman labs (BIOL112) and Ecotoxicology (BIOL407), while HPLC is used in Plant Physiology lab (BIOL409). Dissolved chlorine in non-ultrapure water can bleach immunohistochemistry staining on slides (BIOL231, 443) Ionic instability and dissolved organic compounds in non-ultrapure water affect protein solubility and protein interactions, altering enzymatic reactions. Altered enzymatic activity along with dissolved gasses affect biochemical reaction rates and can lead to failed DNA/RNA/cell experiments (e.g., BIOL112, 202, 231, 263, 264, 328, 424, 426, 443, 444, 458). After removing fine particles, special filters also need to be added to remove bacteria, enzymes, and endotoxins to provide to provide ultrapure molecular/cellular grade water suitable for all DNA/RNA/cell experiments (e.g., BIOL112, 202, 231, 263, 264, 328, 424, 426, 443, 444, 458).

*The Biology department currently does not have any ultrapure water filtration system for their Biology courses.* Lab instructors must purchase lab-grade water. However, because of the high cost of molecular-grade water (\$78 per liter), they are often forced to use cheaper and inadequate water purity for the experiment at task. Contaminants of inadequate water purity put too many results at risk and cause failed experiments, with associated frustration and reduced student learning.

***Bringing ultrapure molecular/cellular grade water to Biology will impact > 1070 students per year.***

Courses that will benefit from an ultrapure molecular/cellular grade water are listed in Table 1. Please note that other courses not listed in this table (BIOL407, BIOL409) would also benefit from the proposed system through ultrapure water (without the additional removal of enzyme/bacteria).

**Table 1. Courses needing ultrapure molecular/cellular grade water**

Course #	Course title	Students impacted per year	Classroom used
<b>Billeaud Hall</b>			
BIOL112	Fundamental of Biology 1 lab	570	BLD115
BIOL231	Fundamentals of Cell and Molecular Biology Lab	240	BLD110
<b>Wharton Hall</b>			
BIOL202	Introduction to Scientific Research	15-20	VLW416
BIOL263	General Microbiology Lab	35	VLW406
BIOL264	Microbiology Lab	135	VLW406
BIOL328	Microbiology Physiology & Genetics Lab	15-18 <sup>1</sup>	VLW406
BIOL424	Neurobiology Lab	15	VLW411
BIOL426	Developmental Biology Lab	15-20 <sup>2</sup>	VLW416
BIOL443	Immunobiology Lab	20	VLW416
BIOL444	Advanced Molecular Techniques	15 <sup>3</sup>	VLW416
BIOL458	Advanced Cell Biology Lab	20	VLW416
<b>Total number of students impacted per year:</b>		<b>&gt;1070</b>	

<sup>1</sup> Expected number of students. Newly offered course starting spring 2023, mandatory for Biology students with a microbiology concentration.

<sup>2</sup> Expected number of students. BIOL426 has not been offered for years, but a new faculty has now been hired to teach this course, starting spring 2023.

<sup>3</sup> Course offered every other year

### *Improper water filtration affects molecular experiments (DNA, RNA, proteins)*

DNases present in non-molecular grade water degrade DNA. Any lab courses using DNA should use ultrapure molecular-grade water. For examples, DNA extraction experiment (BIOL112, BIOL231, BIOL202, BIOL444), and DNA amplification (BIOL231, BIOL202, BIOL444) should be performed using ultrapure molecular-grade water to prevent unwanted degradation. Next Generation Sequencing library preparation performed in Advanced Molecular Techniques (BIOL444) to sequence mitochondrial genomes are highly sensitive to DNA quality and quantity. DNA degradation, caused by the presence of DNase in the water, can lead to a failed library. Reagent costs and supplies for making a NGS library are high (>\$1500 per 24 samples). If a library fails, it is not possible to redo the experiment, disappointing students as their sample cannot be used for genome sequencing.

In Immunology labs (BIOL443), students extract RNA and perform quantitative real-time PCR to determine gene expression based on RNA quantification. RNases present in non-molecular grade water can degrade their extracted RNA and result in wrong quantification of RNA content (and gene expression) or failed quantitative PCR.

Proteinases present in non-molecular grade water degrades proteins. In Fundamentals of Cell and Molecular Biology (BIOL231), students perform protein quantification of two types of milk, and extraction and quantification of extra myosin light chains from fish muscle. The ultrapure molecular/cellular grade water is needed for protein extraction and purification, protein labeling with antibodies, protein electrophoresis, Western blotting, and protein mass spectrometry. Protein labelling is also performed in Immunology labs (BIOL443).

### *Improper water filtration can also affect cell culture.*

Contamination by bacteria can affect the pH of cell media. Contamination by endotoxin disturbs cell growth and function, which can affect cloning efficiency and cause the production of unwanted recombinant proteins. Current lab courses using cell cultures includes Fundamental of Cell and Molecular Biology (BIOL231), Microbiology labs (BIOL263, BIOL264, BIOL328), Neurobiology lab (BIOL424), Advanced Cell Biology (BIOL458) labs as well as upcoming developmental biology lab (BIOL426, new faculty hired to start in January 2023). All these courses need access to ultrapure molecular/cellular grade water to ensure proper cell survival, growth and function in physiology buffers. It is also used for immunostaining and neural tracing studies in Neurobiology lab (BIOL424).

### ***Two smaller systems, rather than one bigger system, are requested to increase access and maintain safety.***

Biology lab courses are spread across 2 buildings: Billeaud Hall and Wharton Hall. Ultrapure water is needed in courses organized in both buildings. Purchasing a single big system creates safety concerns of crossing St Mary Blvd with glassware. To prevent this safety issue, we are requesting the purchase of 2 smaller, cheaper systems: one in Billeaud Hall, and one in Wharton Hall. Each smaller system produces enough ultrapure water a day for their respective building (up to 12L a day per each system). Each system will be placed in a central location so all courses can get ultrapure water without disturbing other classrooms. A different system will be used for each room based on need and current access to deionized water.

***The Billeaud Hall ultrapure Synergy system will be hosted in BLD114.*** This room serves as a prep room for all sections of freshman labs. It has a door to BLD115, where all BIOL112 freshman labs are held and another door that opens into the hallway, for easy access by any other courses, without disturbing on going classes.

BLD114 prep room has a deionised water (DI) system. While DI water is not suitable for molecular and cellular experiment, ultrapure water systems need fewer filters (***Synergypak 2 Polishing Cartridge***) to achieve the needed purity when DI water is fed into the system. Fewer filters will translate in cheaper maintenance cost and increased longevity. The additional requested ***Biopak system*** finishes purifying the ultrapure water into molecular/cellular grade. The Synergy Ultrapure Water system was chosen for BLD114 because it requires pre-filtered water as input. It can dispense 1.5L of ultrapure molecular/cellular water per min.

***The Wharton Hall ultrapure Direct Q 3V system will be hosted in VLW417.*** This room serves as media prep and autoclave room. The central location and proximity to all Wharton Biology classroom makes it ideal for the ultrapure system. This room does not have a DI water system. Tap water will need to be fed into the ultrapure system. For this reason, a Direct Q 3V system was chosen for VLW417.

The Direct Q 3V system functions as both a Reverse Osmosis (RO) water tank and ultrapure system. Tap water is first filtered into RO water (using ***Smart Pack Purification***) and stored into a 6-liters reservoir. This RO water is suitable for application needing pure water but where ultrapure water is unnecessary, such as washing glassware. The system can filter up to 50 liters of tap water into RO water per day. The RO water from the 6-liters reservoir can then, on demand, be further filtered into ultrapure water suitable for molecular and cellular labs. With a dispense rate of 0.8 liter per min. We currently do not have any access to ultrapure water for lab courses in Wharton Hall.

Note that, glassware used in microbiology labs (BIOL263, 264, 328) is being washed and sterilized in VLW417 by students taking Media Prep course (BIOL400). BIOL400 students are currently using distilled water they must transport across the room to their wash/sink station using a carboy container. Access to RO water directly at their station without the need for transport will facilitate the task, especially if a student has a disability or injury preventing them from carrying heavy objects. Because Direct Q 3V system can provide both RO water, ultrapure water, and molecular/cellular grade water (with the addition of the requested ***Biopak filter***), it is also a great tool to teach students the importance of choosing the appropriate water depending on usage.

***A Biopak filter needs to be added onto both the Synergy and the Direct Q 3V systems to provide bacteria-free, enzyme-free, and endotoxin-free water.*** Ultrapure water provided by the Synergy and Direct Q 3V systems are free of ions, inorganic and organic contaminants. However, they still contain bacteria, RNases, DNases, and endotoxin (pyrogens) that need to be removed prior to molecular or cellular experiment. The add-on Biopak filter provides this final filtration to provide the needed ultrapure molecular/cellular grade water.

## **B. Projected lifetime of enhancement**

The projected lifetime of the systems is over 10 years, with appropriate maintenance and changes of filters. In addition to the initial filters, we already budgeted replacement filters for each of the system in this grant (see budget supplies: quantity = 2).

**C. Person responsible for:**

**Implementation:** Dr Sophie Plouviez

**Installation:** Coordinated by Dr Plouviez with Millipore

**Maintenance:** Dr Plouviez and Mr. Moberly perform routine maintenance, such as changing filters when needed, will be performed by Dr Plouviez and Mr. Moberly. Both the Synergy and the Direct Q 3V systems are under a 1-year warranty.

**Operation:** Faculty of the Department of Biology, Teaching Assistant. Lab students of BIOL400, BIOL444 and BIOL410 independent studies will also operate the system as part of their training on using equipment and choosing the appropriate water for their experiment.

**Training:** Faculty of the Biology Department

## Budget Proposal

---

<b>1.</b>	<b>Equipment</b>	<b>\$9,774.54</b>	
	Synergy® UV Kit US		\$4,892.10
	PRESS REGULATOR W/GAUGE		\$266.34
	Direct-Q® 3 UV Kit US		\$4,616.10
<b>2.</b>	<b>Software</b>	<b>\$0</b>	
<b>3.</b>	<b>Supplies</b>	<b>\$3,001.88</b>	
	For the Synergy system:		
	Synergypak 2 Polishing Cartridge	\$387.66	QTY2 \$775.32
	Biopak Final Filter, Nuclease & Endotoxin Free Water	\$269.09	QTY2 \$538.18
	For the Direct-Q 3UV system:		
	Smart Pack Purification Pack for Direct-Q 3	\$575.10	QTY2 \$1,150.20
	Biopak Final Filter, Nuclease & Endotoxin Free Water	\$269.09	QTY2 \$538.18
<b>4.</b>	<b>Maintenance</b>	<b>\$0</b>	
<b>5.</b>	<b>Personnel</b>	<b>\$0</b>	
<b>6.</b>	<b>Other</b>	<b>\$1,412</b>	
	Installation of Synergy system by MilliQSigma:	\$270.00 (travel) + \$436 (install)	
	Installation of Direct-Q® 3 UVsystem by MilliQSigma:	\$270.00 (travel) + \$436 (install)	
<b>TOTAL:</b>		<b>\$14,188.42</b>	

### Previous funded STEP projects

Fall 2021: Virtual Cadaver Dissection Table and Wireless Access Improvement for The Anatomy & Physiology Teaching Laboratory: \$82,485.76

PI: Brandon Waltz, CoPI: Michael Fulbright, William Schmidt, Sophie Plouviez, Sherry Krayesky-Self

Spring 2021: Idea Board & Audio Visual (AV) Equipment for Undergraduate Teaching Laboratories in the Department of Biology: \$31,878.70

PI: Sophie Plouviez, CoPIs: Sherry Krayesky-Self, William Schmidt, Ritwij Kulkarni

Fall 2017: *Upgrading a Molecular Biology Teaching Lab*: \$29,392.20

PI: Yi-Hong Wang, CoPI: Sophie Plouviez

University of Louisiana at Lafayette  
 Dr. Sophie Plouviez  
 Biology  
 410 E St Mary Blvd  
 PO Box 43602  
 Lafayette, LA 70503  
 UNITED STATES  
 +13372305698

**Quotation**

Catalogue Number	Description	Qty	Unit List Price (USD/\$)	Unit Net Price (USD/\$)	Total Net Price (USD/\$)
1. ZFMQ000PR	PRESS REGULATOR W/GAUGE	1	386.00	266.34	266.34
2. SYNSVHFUS	Synergy® UV Kit US	1	7,090.00	4,892.10	4,892.10
3. SYPK0SIX2	Synergypak 2 Polishing Cartridge	2	546.00	387.66	775.32
4. CDUFBI001	Biopak Final Filter, Nuclease & Endotoxin Free Water	2	379.00	269.09	538.18
5. ZWAAZONE1	TRAVEL ZONE 1	1	319.00	270.00	270.00
6. ZWAL1INST	SMT INSTALLATION	1	532.00	436.00	436.00
				<b>Total (USD/\$)</b>	<b>7,177.94</b>

Please ensure that you add our Quote Reference (R-5693302.1) to your official order to guarantee that your goods are shipped at the agreed price.

Bill Reems  
 Application Specialist Lab Water Solutions  
 MilliporeSigma  
 bill.reems@milliporesigma.com



University of Louisiana at Lafayette  
 Dr. Sophie Plouviez  
 Biology  
 410 E St Mary Blvd  
 PO Box 43602  
 Lafayette, LA 70503  
 UNITED STATES  
 +13372305698

**Quotation**

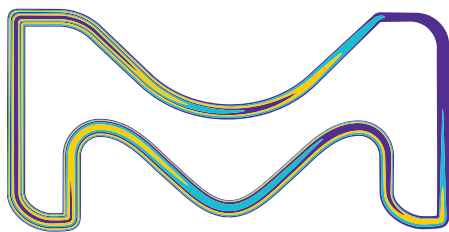
Catalogue Number	Description	Qty	Unit List Price (USD/\$)	Unit Net Price (USD/\$)	Total Net Price (USD/\$)
1. ZRQSV3US	Direct-Q® 3 UV Kit US	1	6,690.00	4,616.10	4,616.10
2. SPR00SIA1	Smart Pack Purification Pack for Direct-Q 3	2	810.00	575.10	1,150.20
3. CDUFBI001	Biopak Final Filter, Nuclease & Endotoxin Free Water	2	379.00	269.09	538.18
4. ZWAAZONE1	TRAVEL ZONE 1	1	319.00	270.00	270.00
5. ZWAL1INST	SMT INSTALLATION	1	532.00	436.00	436.00
				<b>Total (USD/\$)</b>	<b>7,010.48</b>

Please ensure that you add our Quote Reference (R-5693284.1) to your official order to guarantee that your goods are shipped at the agreed price.

Bill Reems  
 Application Specialist Lab Water Solutions  
 MilliporeSigma  
 bill.reems@milliporesigma.com

# Synergy® Water Purification Systems

Ultrapure water at your point of use - with easy and convenient dispense!



The life science business of Merck KGaA, Darmstadt, Germany operates as MilliporeSigma in the U.S. and Canada.

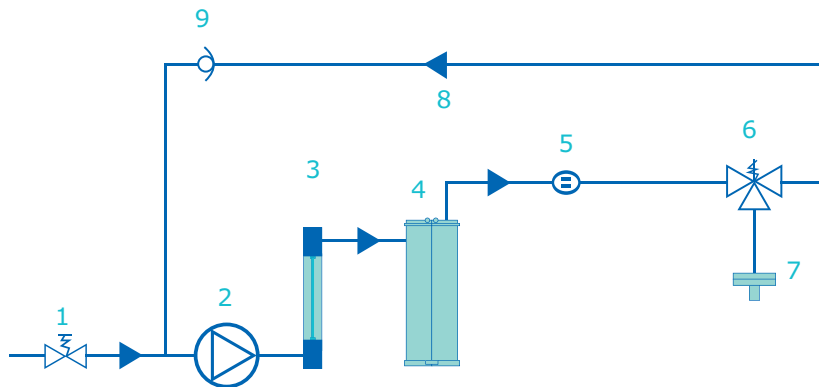
**Milli-Q®**  
Lab Water Solutions

# Ultrapure water at your point of use - with easy and convenient dispense!

Your water purification needs	Our solution: The Synergy® range of water purification systems
Ultrapure water easily accessible wherever you need it in your lab	With the <b>Synergy®</b> range of water purification systems, you benefit from a choice of ultrapure water dispensing possibilities. The innovative, space-saving <b>Remote dispenser</b> offers you water delivery solutions to best fit the way you work, with <b>easy and convenient remote delivery</b> up to two meters away from your water production unit.
Point-of-use system to supply ultrapure water	Synergy® water purification systems produce <b>ultrapure water</b> using feed water from an existing pretreated pure water supply (such as a RiOs™ system).
Compact design for the most efficient use of your lab space	A <b>small footprint</b> makes it <b>easy to install</b> the Synergy® systems wherever you want to – on or under the bench-integrated or on the wall.
Flow rates adapted to your ultrapure water needs	Systems in the Synergy® range can dispense <b>more than 1.5 L/min water</b> .
High quality water to meet the requirements of your most critical applications	Options such as a <b>UV lamp</b> and a range of <b>Application Pak point-of-use polishers</b> are available to fine-tune your ultrapure water.
Easily accessible information on system operation	The <b>user-friendly display</b> provides system status at a glance; the concise <b>Quick Reference Guide</b> is a handy guide for daily operation.
Simple, low-level self-maintenance	<b>SynergyPak®</b> purification cartridges enable easy and rapid replacement.

## Synergy® Systems Water Purification Pathway

1. Inlet Solenoid Valve
2. Booster Pump
3. Photooxidation UV lamp
4. SynergyPak® 1, 2 or 3
5. Product Resistivity Cell
6. Point-of-Use (POU) Solenoid Valve
7. Final Filter
8. Recirculation Loop
9. Check Valve



# Choose the solution that's right for you

## Easy installation

Installing the Synergy® system is so easy you can do it yourself. Just connect the system to a pretreated water supply (e.g., from a RiOs™ system), plug it in, and insert the SynergyPak® purification cartridges. Then, if you have chosen the system with a [Remote dispenser](#), follow the simple setup procedure — and your system is ready to use!

## Optimized lab space

The Synergy® system's small footprint will allow you to find a space for it anywhere in your laboratory, either on or under the benchtop, or wall-installed. You choose the best location for your Synergy® system.

## High ultrapure flow rates to match your requirements

With high flow rates above 1.5 L/min, the systems provide ultrapure water on demand in the volumes required to satisfy critical applications. When not in use, your Synergy® system will recirculate water in order to maintain water quality, so that you do not have to wait when sourcing ultrapure water. For your convenience, and to save time, you can also set the system to automatically deliver your selected volume of ultrapure water on demand.

The high quality ultrapure water produced by Synergy® systems is suitable for applications such as production of mobile phase for chromatographic separations; preparation of blanks and standard solutions for spectrophotometry; spectroscopy or other analytical techniques; and preparation of buffers for biochemical and molecular biology experiments.



# Fine-tune your water quality

## Point-of-use ultrapure water

For laboratories with an existing access to pure water, Synergy® systems provide a solution to point-of-use ultrapure water needs. The high quality ultrapure water produced by Synergy® systems is suitable for applications such as HPLC mobile phase preparation and sample dilution; buffer and cell culture media preparation; preparation of chemical solutions used with titrators, spectrophotometers, and electrophoresis systems.

## Organic-sensitive applications

If you work with organic-sensitive applications such as HPLC, LC, GC or TOC analyses, the Synergy® UV system contains a built-in photooxidation UV lamp to reduce TOC to less than 5 ppb. Water with low TOC provides important benefits to HPLC users such as higher sensitivity and longer column lifetime. The same UV lamp also destroys bacteria.

## Application Pak point-of-use polishers

Our range of Application Pak polishers makes it possible to fine-tune your ultrapure water quality to match your research. Are your applications sensitive to bacteria, particulates, pyrogens, nucleases, endocrine disruptors or volatile organic compounds? If so, just choose the appropriate final polisher from our range of Application Paks to provide optimal water quality for your requirements.

Please visit [EMDmillipore.com/labwater](http://EMDmillipore.com/labwater) for more information.



# Stay focused on your work

## Versatile remote dispenser

Designed to fit perfectly into your lab environment, the versatile Remote dispenser can be placed up to two meters from your Synergy® water purification unit. Select the free-standing or wall-installed model according to your needs — their ergonomics will make either one a welcome addition to your lab, giving you the freedom to focus on your research, while dispensing ultrapure water exactly where you need it. Alternatively, Synergy® systems are also available with an integrated dispenser for use on the benchtop.



# We offer more than water

## Just the information you need

The intuitive color graphic display shows key system parameters at a glance, enabling easy water quality and maintenance warning monitoring; the screen rotates for easy viewing wherever the system is located. Additional information on system operation and maintenance is provided by the Quick Reference Guide and User Manual stored on the water production unit.



## User-friendly maintenance

The SynergyPak® purification cartridges integrate all the main purification technologies. The Synergy® system will automatically tell you when it's time to change the SynergyPak®, and "plug-and-use" design makes this easy to do in just a couple of minutes!

## Milli-Q® Service Plans

To optimize the performance and lifetime of your water purification system, we offer a complete portfolio of service plans ranging from a single annual checkup to a full system cover. For more information, please check with your applications specialist or visit our website: [EMDmillipore.com/labwater](http://EMDmillipore.com/labwater)





# Specifications

## Ultrapure (Type I) Product Water Quality

Parameter	Value
Resistivity	18.2 M $\Omega$ ·cm @ 25 °C
Instant flow rate (with Application Pak final filter)	> 1.5 L/min
TOC (Synergy® system)	< 10 ppb
TOC (Synergy® UV system)	< 5 ppb
Particulates (size > 0.22 $\mu$ m) <sup>1</sup>	< 1 particulate/mL
Bacteria (Synergy® system) <sup>1</sup>	< 0.1 cfu/mL
Bacteria (Synergy® UV system) <sup>1</sup>	< 0.01 cfu/mL
Endotoxin (pyrogens) <sup>2</sup>	< 0.001 EU/mL
RNases <sup>2</sup>	< 0.01 ng/mL
DNases <sup>2</sup>	< 4 pg/ $\mu$ L

These values (validated with Elix® feed water) are typical and may vary depending on the nature and concentration of contaminants in the feed water.

<sup>1</sup> With Millipak® filter or with Biopak® ultrafiltration cartridge as final polisher

<sup>2</sup> Only with Biopak® polisher

Feed water for use with Synergy® systems should be pretreated Type 2 (e.g. Elix®, DI water) or Type 3 (e.g. RiOs™, distilled water) grade water delivered at 0.3 bar maximum pressure.

## System Information

Parameter	Value
Dimensions (H x W x D)	54 x 29 x 38 cm (21.3 x 11.4 x 15 in)
Net weight (Synergy® system)	6.7 kg (14.8 lb)
Net weight (Synergy® UV system)	7.2 kg (15.9 lb)
Operating weight (Synergy® system)	9.7 kg (21.4 lb)
Operating weight (Synergy® UV system)	10.2 kg (22.5 lb)
Net weight (Remote dispenser)	2.15 kg (4.8 lb)
Operating weight (Remote dispenser)	2.68 kg (5.91 lb)
Electrical feed voltage	100-250 V +/- 10 %
Electrical feed frequency	50-60 Hz +/- 10 %
Tap (feed) water connection	½" Gaz M
Tap (feed) water pressure	< 0.3 bar

MilliporeSigma  
400 Summit Drive  
Burlington, MA 01803

## [EMDMillipore.com/synergy](https://www.emdmillipore.com/synergy)

To place an order or receive technical assistance in the U.S. and Canada, call toll-free 1-800-645-5476

For other countries across Europe and the world, please visit: [EMDMillipore.com/offices](https://www.emdmillipore.com/offices)

For Technical Service, please visit: [EMDMillipore.com/techservice](https://www.emdmillipore.com/techservice)

© 2019 Merck KGaA, Darmstadt, Germany and/or its affiliates. All Rights Reserved. MilliporeSigma, the vibrant M, Millipore, Milli-Q, Synergy, SynergyPak, Millipak, Biopak and RiOs are trademarks of Merck KGaA, Darmstadt, Germany or its affiliates. All other trademarks are the property of their respective owners. Detailed information on trademarks is available via publicly accessible resources.

Lit. No. PB1552ENUS  
2018-12707  
05/2019

# Direct-Q® 3, 5, 8 Water Purification Systems

Tap to pure and ultrapure water —  
with easy and convenient dispense!



The life science business of  
Merck KGaA, Darmstadt,  
Germany operates as  
MilliporeSigma in the  
U.S. and Canada.

**Milli-Q®**  
Lab Water Solutions

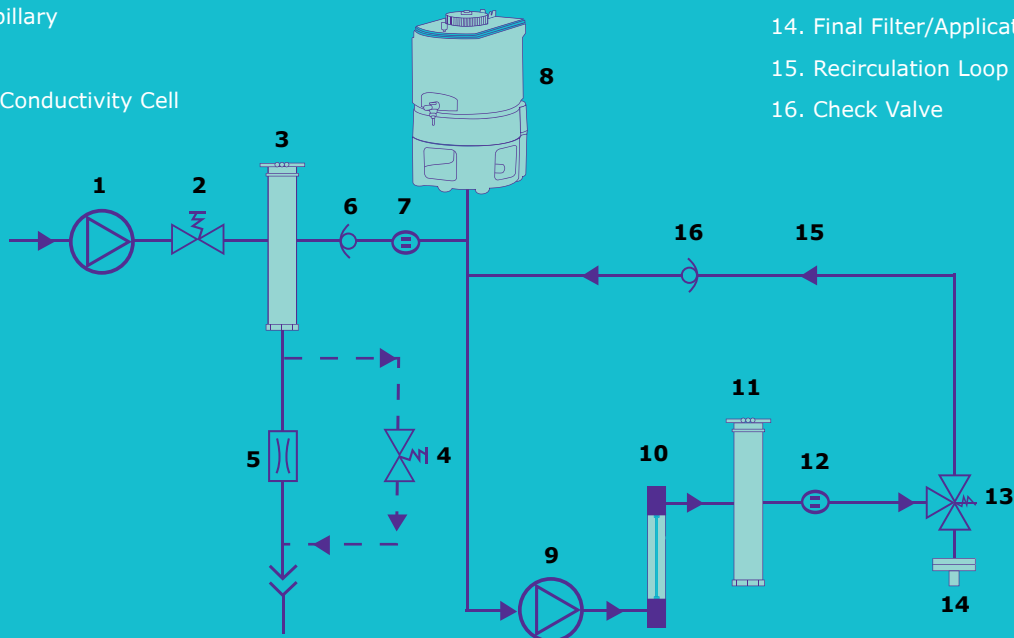


# Tap to pure and ultrapure water — with easy and convenient dispense!

Your water purification needs	Our solution: the Direct-Q® range of water purification systems
High quality water produced directly from tap water	Direct-Q® systems deliver <b>both pure and ultrapure water</b> directly from tap for use with a wide variety of applications in your lab.
Ultrapure water easily accessible wherever you need it in your lab	With the <b>Direct-Q® range</b> of water purification systems, you benefit from a choice of ultrapure water dispensing possibilities. The innovative, space-saving <b>Remote dispenser</b> offers you water delivery solutions to best fit the way you work, with <b>easy and convenient remote delivery</b> up to two meters away from your water production unit.
Compact all-in-one system for the most efficient use of your lab space	The Direct-Q® range includes <b>versatile solutions</b> that can be bench-integrated or bench-/wall-installed.
A choice of adequate storage volumes	Direct-Q® systems come either with an <b>integrated 6-liter reservoir</b> or an <b>external reservoir</b> (30 L or 60 L).
Flow rates adapted to your daily usage	Systems in the Direct-Q® range provide <b>3, 5 or 8 liters of pure water per hour</b> , covering lab needs of 50, 100 and 150 L of pure water per day.
Instant flow rates to match your needs	Direct-Q® systems dispense up to 30 L of <b>ultrapure water per hour</b> .
High quality water to meet the requirements of your most critical applications	Options such as a <b>UV lamp</b> and a range of <b>Application Pak point-of-use polishers</b> are available to fine-tune your ultrapure water.
Easily accessible information on system operation	The <b>user-friendly display</b> provides system status at a glance; the concise <b>Quick Reference Guide</b> is a handy guide for daily operation.
Simple, low-level self-maintenance	<b>All-in-one SmartPak®</b> cartridges enable easy and rapid replacement.

# Direct-Q® Systems Water Purification Pathway

1. Booster Pump
2. Inlet Solenoid Valve
3. SmartPak® Part 1 (Pretreatment and RO Cartridge)
4. RO Reject Solenoid Valve
5. RO Reject Capillary
6. Check valve
7. RO Permeate Conductivity Cell
8. Reservoir (Built-in or separate, depending on model)
9. Distribution Pump
10. UV Lamp 185/254 nm (UV Systems)
11. SmartPak® Part 2 (Synthetic Activated Carbon & Ion Exchange Polisher Cartridge)
12. Product Resistivity Cell
13. Point-of-Use (POU) 3-way solenoid valve
14. Final Filter/Application Pak
15. Recirculation Loop
16. Check Valve



## Choose the solution that's right for you

### Easy installation

The Direct-Q® range of systems requires no special installation. You can easily set the system up yourself: just connect the system to your tap water supply, plug it in, and insert the SmartPak® purification cartridges. Then, if your configuration includes the Remote dispenser or a 30- or 60-liter reservoir\*, follow the simple setup procedures — and your system is ready to use!

### Optimized lab space

The compact, all-in-one Direct-Q® water purification unit lets you locate it nearly anywhere in your laboratory, either on or under the benchtop, or wall-installed.

\* Direct-Q® 5 and Direct-Q® 8 systems are designed for use with a 30 L or 60 L external reservoir.



## Flow rates to match your requirements

Choose the solution that best meets your lab's requirements with a Direct-Q® system that provides 3, 5, or 8 liters of pure water per hour, and more than 0.5 L of ultrapure water per minute (> 30 L per hour). When not in use, the Direct-Q® system automatically recirculates water in order to maintain high water quality, so that you do not have to wait when sourcing ultrapure water. For your convenience, and to save time, you can set the system to automatically deliver your selected volume of ultrapure water on demand.

## Choice of storage volumes

With its built-in reservoir, the Direct-Q® 3 system can store 6 L of reverse osmosis (RO) water, while Direct-Q® 5 and 8 models are designed for use with a 30- or 60-liter reservoir. Just choose the storage volume that best meets your daily water volume needs.



## Fine-tune your water quality

### Both pure and ultrapure water

The Direct-Q® range of systems provides you with a convenient and flexible solution for your pure and ultrapure water needs, directly from potable tap water. You'll have access to ultrapure water for your critical applications, and pure water for less critical applications such as general glassware washing or final rinsing — from the same system! The high quality ultrapure water produced by Direct-Q® systems is suitable for applications such as production of mobile phase for chromatographic separations; preparation of blanks and standard solutions for spectrophotometry, spectroscopy or other analytical techniques; and preparation of buffers for biochemical experiments.

### Organic-sensitive applications

Direct-Q® systems are also available with a built-in 185/254 nm UV lamp to reduce the level of organics for critical applications. Water with low TOC provides important benefits to HPLC users such as higher sensitivity and longer column lifetime. The same UV lamp also destroys bacteria.

### Application Pak point-of-use polishers

Our range of Application Pak polishers makes it possible to fine-tune your ultrapure water quality to match your research needs. Are your applications sensitive to bacteria, particulates, pyrogens, nucleases, endocrine disruptors or volatile organic compounds? If so, just choose the appropriate final polisher from our range of Application Paks to provide optimal water quality for your requirements.

Please see [EMDMillipore.com/labwater](http://EMDMillipore.com/labwater) for more information.



# Stay focused on your work

## Versatile remote dispenser

Designed to fit perfectly into your lab environment, the versatile Remote dispenser can be placed up to two meters from your Direct-Q® water purification unit. Select the free-standing or wall-installed model according to your needs — their ergonomics will make either one a welcome addition to your lab, giving you the freedom to focus on your research, while dispensing ultrapure water exactly where you need it. Alternatively, Direct-Q® systems are also available with an integrated dispenser for use on the benchtop.

The design of the bench-installed Direct-Q® systems is also adapted to the height and shape of common laboratory glassware.



## Milli-Q® offers more than water

### Just the information you need

The intuitive color graphic display shows key system parameters at a glance, enabling easy water quality and maintenance warnings monitoring; the screen rotates for easy viewing wherever the system is located. A short Quick Reference Guide is conveniently located in the base of the system for immediate information; the complete User Manual can be stored at the back of the water purification unit.

## User-friendly maintenance

The all-in-one SmartPak® purification cartridges are easily replaced in just a few minutes.

## Milli-Q® Services portfolio

To optimize the performance and lifetime of your water purification system, we offer a complete portfolio of Milli-Q® Services ranging from a single annual checkup to full system coverage. For more information, please check with your applications specialist or visit our website:

[EMDMillipore.com/Milli-Qservices](http://EMDMillipore.com/Milli-Qservices)





## Direct-Q® System Specifications

Ultrapure (Type I) Product Water Quality*	Direct-Q® Systems
Resistivity	18.2 MΩ·cm @ 25 °C
Production flow rate Direct-Q® 3	3 L/h @ 25 °C ±15%
Production flow rate Direct-Q® 5	5 L/h @ 25 °C ±15%
Production flow rate Direct-Q® 8	8 L/h @ 25 °C ±15%
Instant flow rate (with Application Pak final filter)	> 0.5 L/min
TOC (w/o 185/254 nm UV lamp)	< 10 ppb
TOC (with 185/254 nm UV lamp)	< 5 ppb
Particulates (size > 0.22 µm)**	< 1 particulate/mL
Bacteria**	< 0.1 cfu/mL
Endotoxin***(pyrogens)	< 0.001 EU/mL
RNases***	< 0.01 ng/mL
DNases***	< 4 pg/µL

\* In regular operating conditions

\*\* With Millipak® Express 20 (0.22 µm) membrane filter or with BioPak® ultrafiltration cartridge as final polisher

\*\*\* Only with BioPak® ultrafiltration cartridge as final polisher

## System Information

Pure (Type III) Product Water Quality*	
Ionic rejection	> 96%
Organic rejection for MW > 200	> 99%
Bacteria and particulates	> 99%

\* In regular operating conditions







## System Information

Dimensions (H × W × D)	540 × 290 × 380 mm (21.3 × 11.4 × 15 in.)
Net weight (Direct-Q® 3 system w/o 185/254 nm UV lamp)	8.1 kg (17.9 lb)
Net weight (Direct-Q® 3 system with 185/254 nm UV lamp)	8.6 kg (19.0 lb)
Net weight (Direct-Q® 5, 8 systems with 185/254 nm UV lamp)	7.6 kg (16.7 lb)
Operating weight (Direct-Q® 3 system w/o 185/254 nm UV lamp)	17.6 kg (38.8 lb)
Operating weight (Direct-Q® 3 system with 185/254 nm UV lamp)	18.2 kg (40.1 lb)
Operating weight (Direct-Q® 5, 8 systems with 185/254 nm UV lamp)	12.2 kg (26.8 lb)
Net weight (Remote dispenser)	2.15 kg (4.8 lb)
Operating weight (Remote dispenser)	2.68 kg (5.91 lb)
Built-in reservoir volume	6 L
Electrical feed voltage	100–250 V ±10%
Electrical feed frequency	50–60 Hz ±10%
Tap (feed) water connection	½" Gaz M
Tap (feed) water pressure	0.5 to 6 bar

## Available System Configurations

### Water Purification Systems

Available Configurations	Direct-Q® 3	Direct-Q® 5	Direct-Q® 8
 UV 185/254 nm	With/Without	With	With
 Remote dispenser	With/Without	With/Without	With/Without
 Built-in 6 L reservoir	With	Without	Without
 30/60 L reservoir*	Option	Required	Required

# Biopak® Polisher

## Ultrafilter for pyrogen-, nuclease- and bacteria-free water at the point of dispense



The Biopak® Polisher is a disposable ultrafiltration cartridge typically used in cell culture, biochemistry or molecular biology applications. It can be installed at the outlet of Milli-Q® water purification 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 (< 1 pg/mL) and DNase-free water (< 5 pg/mL) production
- Safe method that eliminates the need to treat water with DEPC
- Bacteria-free water (< 0.1 CFU/mL) production
- Warranty of results within specifications for a minimum of 90 days usage
- Maintenance-free

## 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® Polisher 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 (< 1 pg/mL) and DNase-free (< 5 pg/mL).

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<sub>2</sub> and ethanol.

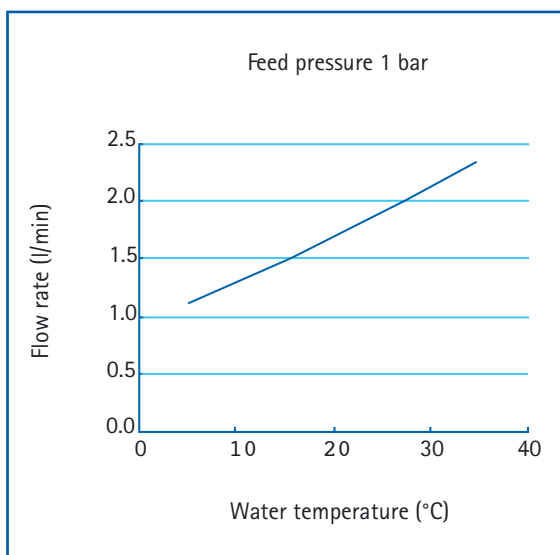




## BACTERIA REMOVAL

The validation protocol provided proof that the Biopak® ultrafiltration cartridge enables delivery of bacteria-free (< 0.1 CFU/mL) water, when used according to instructions with the filter outlet located in a clean environment.

## BIOPAK® POLISHER FLOW RATE



## PRODUCT WATER SPECIFICATIONS

Pyrogen Level (EU/mL)	< 0.001
RNases (pg/mL)	< 1
DNases (pg/mL)	< 5
Bacteria (cfu/mL)	< 0.1

## 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® comes with a certificate of quality stating its performance specifications and lot release criteria.

## ORDERING INFORMATION

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