



Guide to water filters with the C1 Common Interface

Second edition, April 2016

The Springboard Initiative

PATH's platform helps companies offer better water filters to poor consumers

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About PATH's Springboard Initiative

PATH aimed to raise the level of competition in the water-filter category. To do so we encouraged and guided companies' market-entry efforts by validating demand and making it much easier for any company to design or source *water filters consumers want to buy and love to use*. Indeed, purchase and consistent-use drive health impact. They also directly underpin scalability and sustainability.

PATH knows big problems require multi-faceted solutions that engage commercial partners. First we crafted the technical and commercial essentials for market entry. Then we provided these at no-cost to companies big and small so they can offer better water filters to poor consumers.

To learn more about the Springboard Initiative, please visit our [resource page](#) or consult our [fact sheet](#).

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About this guide

This guide provides an overview of water-filter products that feature the PATH-developed C1 Common Interface, a common-connection point and platform solution to promote product interchangeability, standardization, and market efficiency. Cartridges from one manufacturer can be used in water filters from another.

The products and manufacturers profiled in this guide represent a new ecosystem of water-filter products produced by PATH's Springboard Initiative to help companies offer better water filters to poor consumers. An overview of the initiative and the practical improvements these products represent is provided on the next page.

This guide is primarily intended for professionals who seek balanced, introductory-level information on available water-filter products appropriate for low- and/or lower-middle income consumers in developing countries. It is not comprehensive and covers only products with the C1 Common Interface. The information presented is appropriate for commercial, public-sector, or nonprofit organizations interested in wholesale quantities.

PATH encourages prospective purchasers to contact manufacturers for more information, and, if interested, to obtain sample units and evaluate locally prior to placing substantial orders. PATH receives no revenue from sale of these products or from the manufacturers.

We hope you find this guide a helpful resource.



Photos: Top to bottom, left to right: PATH/Greg Zwisler, PATH/Greg Zwisler, PATH

A new ecosystem of water filters

Nearly two billion people still lack access to safe drinking water. But now change is happening. Thousands of people are enjoying safe water from a new generation of water filters that deliver higher levels of user-experience, performance, and affordability.

PATH's [Springboard Initiative](#) has produced a new ecosystem of interchangeable water-filter products from a range of companies and given impetus to investments by two multinational companies.

The water filters in the Springboard ecosystem significantly improve on previously available filters (see chart).

- *Low cost.* Filters cost just pennies per person per day.
- *High user-acceptability.* Typically, over 80 percent of users would recommend the filters to a friend after three months of use.
- *Good water quality.* Filters meet World Health Organization (WHO) guidelines (WHO, 2011).

- *Breakthrough ceramic cartridges.* These include one with a user-friendly flow rate over 2x to 3x faster than normal and another with bacteria reduction over 100x normal.
- *Robust supply base,* with multiple manufacturers and factories in China, the United States, and India.
- *Strong distribution prospects* via multinationals' global networks and partnerships with local companies and NGOs.

PATH aimed to improve competition in the water-filter category. To do so we encouraged companies' market-entry efforts by validating demand and making it much easier for any company to design or source *water filters that consumers want to buy and love to use.* For example, we created the first user-centered [design guidelines](#) for the product category from 600 hours of in-home observations and research with over 10,000 consumers. We provided these assets at no cost to companies so they can offer better water filters to low-income consumers.

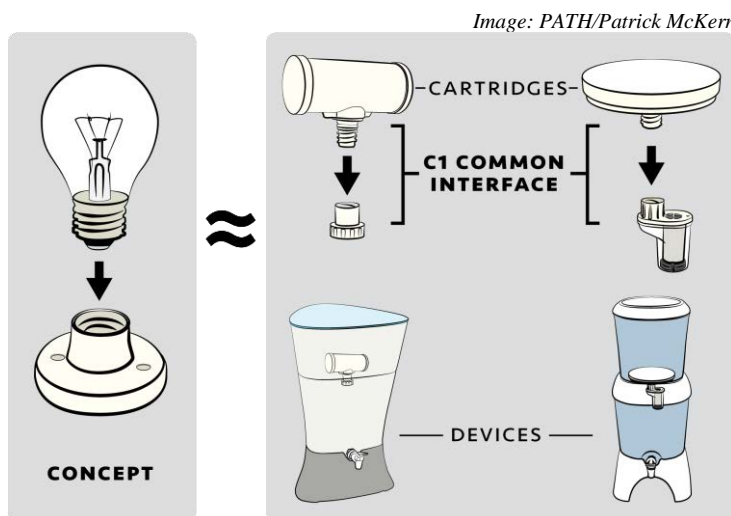
SUCCESS FACTORS	EXISTING PRODUCTS		NEW SPRINGBOARD ECOSYSTEM			
	Various models Previous commercial filters	NGO filter	2011 Redesign of NGO filter	2012 Products premiere C1 Common Interface	2015 Multinationals launch with C1 Common Interface	2016
Cost	Red	Green	Green	Green	Green	Green
User experience	Red	Green	Green	Green	Green	Green
Field performance	Yellow	Green	Green	Green	Green	Green
Desirability	Green	Red	Green	Green	Green	Green
Lab performance	Green	Yellow	Yellow	Green	Green	Green
Distribution	Green	Red	Yellow	Yellow	Green	Green

Chart key: dark green = highly appropriate; medium green = appropriate; yellow = limitations; red = significant limitations.

Manufacturers and the C1 Common Interface





Filter products in the Springboard ecosystem are interchangeable thanks to manufacturers' support for the C1 Common Interface. This interface supports use of cartridges with devices in much the same way a light bulb can be screwed into a socket—so different brands of products can work together (see illustration).

Benefits of the C1 Common Interface include improved choice for consumers and brands. The interface allows for easy attachment of upper and/or lower cartridges and includes built-in safeguards to prevent errors such as upside-down cartridge installation. The detailed specification for the PATH-developed C1 Common Interface is available online under a no-cost license. Current manufacturers are listed below.



Overview of manufacturers that produce water-filter products with the C1 Common Interface

PATH applauds these companies for their commitment to offer better water filters to poor consumers.

Manufacturers	Imerys SA	Kohler Co.	PureEasy Ltd.	Ningbo Clean Ltd.
Head office location	Paris, France	Kohler, Wisconsin, USA	Guangzhou, China	Ningbo, China
Year founded	1880	1873	2006	1997
Employees	16,000	33,000	49	50
Worldwide facilities	over 50 countries	over 30 countries	China	China
Annual revenues, corporate details	€4.1 billion, 2015; trades as IMTP:PA	privately held	privately held	privately held
Primary business	industrial minerals	plumbing fixtures	water filters	treatment fixtures
Corporate logo, reproduced for identification purposes only				
Water-filter products C1 Common Interface				
First launched	April 2016	November 2015	November 2012	November 2012
Cartridges*	yes, distributes globally	yes, distributes globally	yes, for export sales	--
Devices*	yes, distributes globally	yes, distributes globally	yes, for export sales	yes, for export sales
*Terms: a water filter consists of "cartridge(s)" fitted inside of a "device" that contains and stores water.				
Product information: see the <i>Devices</i> and <i>Cartridges</i> sections of this guide.				
Contact details for manufacturers: see the <i>Devices</i> section of this guide.				

Devices

Overview of devices

Manufacturer	Imerys	Kohler	PureEasy	Ningbo Clean
Year introduced	2016	2015	2012	2012
				
Device model	Imerys Pure20 / ImerPure	Kohler Clarity	HF521 Gravity Water Filter	KL258
Size and capacity	medium	large	medium	medium
Treatment chamber	7 liters	11 liters	7 liters	8 liters
Safe storage chamber	8 liters	12 liters	8 liters	9 liters
Assembled dimensions (cm)	25.3x25.3x58.8	35x35x55.3	25x25x60	28x28x58
C1 Common Interface: compliance to specifications	compliant	partial	compliant	compliant
Common-connection point support	yes	yes	yes	yes
Flow-rate and future-cartridge support	yes	no	yes	yes
Safety features	yes	no	yes	yes
Design reflects many of PATH's other guidelines	yes	yes	yes	yes
Durability (plastic type)	excellent	excellent	excellent	see next page
Price/unit, USD, ex-works	illustrative only	inquire for pricing	illustrative only	illustrative only
1,000+ units/year	\$11 ^{.50}		\$12 ^{.50}	\$10 ^{.00}
10,000+ units/year	\$10 ^{.20}		\$12 ^{.00}	\$9 ^{.00}
100,000+ units/year	\$9 ^{.80}		\$11 ^{.50}	inquire
Supply chain and brand				
Factory location	Gujarat, India	Arkansas, USA	Guangzhou, China	Ningbo, China
Distribution network	global	global	export available	export available
Unit weight-in-box	2.3 kg	2.8 kg	2.1 kg	2.4 kg
Units/40-ft container, retail boxed	2,100	1,008 (2,240 bulk pack)	2,016	~2,000
Other brand support	yes, per buyer	inquire	yes, per buyer	yes, per buyer
Cartridges shipped with; not included in pricing, see <i>Cartridges</i> section.	Imerys ImerPure CF, or ImerPure Carb	Kohler Clarity ceramic cartridge	PureEasy PE55136, or PE55136AG	source separately, see <i>Cartridges</i> section

This page expands on device-related topics from the preceding chart titled *Overview of devices*. The topic headings in this section are keyed to headings in the left column of the chart.

Size and capacity

Users often state a preference for larger devices. However, these can take up more space in small homes and may cost more. The medium-sized PureEasy device has demonstrated excellent user-acceptability in the field.

The actual capacity of these devices' treatment chambers is about one-half liter less than listed, due to the space used by treatment cartridges.

C1 Common Interface

Common-connection point support. Any C1-compatible cartridge will attach.

Flow-rate and future-cartridge support. A minimum height of the upper chamber helps flow rate; it also ensures sufficient water pressure and space for future cartridges.

Safety features. One feature prevents upside-down cartridge installation, while another prevents leak-through of untreated water when a user removes a cartridge.

Design

All of the devices follow PATH's [Design Guidelines](#) to at least a significant degree. While the Kohler device varies most given its partial compliance with the C1 Common Interface specification, it is still a valuable addition to the Springboard ecosystem of water-filter products.

Durability

Most of the devices use polypropylene throughout for its durability. The Ningbo Clean device uses a more transparent type of plastic that fractures more easily, but the company indicates they could adapt their mold to polypropylene for a larger order.

Price

Contact manufacturers for current pricing, availability of samples, and product details. Ex-works pricing excludes any costs incurred after an item leaves the factory.

Supply chain and branding

International shipping rates for standard containers can be surprisingly affordable. The greater costs and complexity may come with customs clearance and transport inland. Use a reputable importer. Imerys or Kohler may be able to facilitate matters through their global logistics vendors and networks. Many of the manufacturers will apply the customer's own brand if desired.

Manufacturer contact details

Imerys: ImerPure@imerys.com; www.imerys.com, ImerPure-specific website expected mid-2016.





Kohler: WaSH@kohler.com; www.clarity.kohler.com.

Ningbo Clean: clean3@nbclean.com; www.nbclean.com.

PureEasy: sales@pureeasy.com; www.pureeasy.com.

Cartridges

Overview of cartridges

Manufacturer	Imerys	Imerys	PureEasy	PureEasy
Year introduced	April 2016	April 2016	November 2012	November 2012
				
Cartridge model	ImerPure CF	ImerPure Carb (with carbon)	PE55136	PE55136AG (with silver)
Treatment —primary, drives health benefits	ceramic	ceramic	ceramic	ceramic
Secondary, if any	--	granular activated carbon, in a layer under ceramic	--	silver, mixed into ceramic
Flow rate: when used with non-cloudy water	~8 liters/hour	~7 liters/hour	~2 liters/hour	~2 liters/hour
If used with cloudy input water	evaluate locally; see next page.	evaluate locally; see next page.	evaluate locally; see next page.	evaluate locally; see next page.
Water quality: cartridge meets WHO guidelines	yes	yes	yes	yes
Bacteria reduction, in lab testing (average)	~99.99% (n=6)	~99.99% (n=6)	~99.9999% (n=4)	~99.99999% (n=4)
Estimated service life,* non-cloudy input water	~6–12 months or ~2,500–5,000 liters	~6–12 months or ~2,500–5,000 liters	~6–12 months or ~2,500–5,000 liters	~6–12 months or ~2,500–5,000 liters
If used with cloudy input water	evaluate locally; see next page.	evaluate locally; see next page.	evaluate locally; see next page.	evaluate locally; see next page.
Est. life of secondary treatment	--	3–4 months of use (carbon)	--	3–6 months of use (silver)
Premature breakage risks, related notes	field data pending	field data pending	occasional, T-join; uninstall gently	occasional, T-join; uninstall gently
C1 Common Interface	compliant	compliant	compliant	compliant
Price/ea., USD, ex-works	illustrative only	illustrative only	illustrative only	illustrative only
1,000+ units/year	\$3 ^{.50}	\$3 ^{.75}	\$3 ^{.30}	\$3 ^{.50}
10,000+ units/year	\$3 ^{.00}	\$3 ^{.25}	\$3 ^{.10}	\$3 ^{.30}
100,000+ units/year	\$2 ^{.50}	\$2 ^{.75}	\$2 ^{.90}	\$3 ^{.10}
Supply chain; see more details in <i>Devices</i> section				
Factory location	Gujarat, India	Gujarat, India	Guangzhou, China	Guangzhou, China
Box for one unit, dimensions	195x195x55 mm	195x195x55mm	153x108x68 mm	153x108x68 mm
Case (60 units)	55x60x50 cm	55x60x50 cm	37x35x47 cm	37x35x47 cm
Units/40-ft container	over 22,000	over 22,000	over 22,000	over 22,000
*Values shown are preliminary estimates. Actual experience may vary. See also discussion of use with cloudy water on next page. Note: Kohler Clarity's C1-compliant ceramic cartridges also meet WHO guidelines; contact Kohler for details.				

This page expands on cartridge-related topics from the preceding chart titled *Overview of cartridges*. The topic headings in this section are keyed to headings in the left column of the chart.

Treatment

Ceramic filtration offers several advantages: a solid research base demonstrating positive health impact; a long history of use in developing countries; a long life leading to fewer replacement cycles; and relatively low cost compared to alternatives. Usually ceramic filtration also improves water aesthetics, such as taste and clarity.

Granular activated carbon can further enhance water aesthetics and remove some chemical pollutants. However, it usually loses its effect after a few months of use.

Silver, in colloidal form as a coating on a ceramic cartridge, or, often preferably, impregnated in the ceramic itself, can inhibit growth of bacteria through or within the ceramic. However, it often loses its effect after a few months of use.

Flow rate

Users generally prefer higher flow rates. At about eight liters per hour, the new ImerPure cartridges from Imerys represent a major breakthrough with a flow rate over 2x to 3x that provided by other ceramic cartridges that meet WHO performance guidelines.

Water quality

All of the ceramic cartridges listed in this document meet WHO's interim performance

guidelines for water filters. The PureEasy cartridges are notable for their class-leading bacterial removal, with performance over 100x that provided by normal gravity-fed ceramic cartridges (for lab-test details, see the *Details* section on page 9). To place bacteria-reduction figures in perspective, note that even consistent users of older filters with bacteria reduction averaging around 90 to 96 percent were shown to experience fully 50 percent fewer diarrhea episodes than non-users, in a randomized-controlled study (Brown, 2008).

Use with cloudy input water

Cloudy input water challenges ceramic filtration and, indeed, most to all low-cost filtration systems. Cloudy water increases the frequency which users must clean the ceramic cartridge to maintain flow, leading to a reduction in cartridge lifespan. Sometimes users can mitigate this by allowing water to settle before treatment or pre-filtering with a cloth. Much depends on local soil characteristics, so local evaluation with a few sample units is recommended. Relatedly, of the 1.8 billion people without access to safe drinking water, only about 10 to 15 percent rely on surface-water sources that present such issues (i.e., lakes and streams).

Price

Contact manufacturers for current pricing, availability of samples, and product details. See *Devices* section for contact details.

Supply chain and branding

See *Devices* section for additional information on these topics.

More in the pipeline


To broaden the market for Springboard filters, supply competing brands, and thereby drive economies of scale at the ecosystem level, PATH invested in early-stage research and development (R&D) on bromine-based technology for optional second-stage cartridges. Aimed at both lower- and lower-middle-income consumers, these cartridges can enhance the (already strong) performance of the primary, ceramic cartridges in Springboard filters. Imerys has conducted R&D and is currently field-testing various prototypes. The company plans commercial launch of the ImerPure Vir cartridge by 2017 (see details at right).

The most notable benefit of Vir’s bromine treatment is deactivation of viruses. These are too small to be removed through ceramic filtration. The bromine also effectively eliminates any remaining bacteria. The result is safe drinking water that exceeds the most stringent threshold set by WHO guidelines. The Vir cartridge uses novel production chemistry, brominated-resin beads, and special hydraulics to dispense bromine within a factory-adjustable concentration range for ~1,500 to 3,000 liters (per Imerys’ current target).

Use of a secondary treatment cartridge such as the ImerPure Vir can involve trade-offs. For instance, flow rate is reduced versus that for the ImerPure CF/Carb ceramic cartridges used alone. However, the complete system’s flow rate and cost both remain quite competitive versus existing products. Ongoing field testing of prototypes may identify additional trade-offs and benefits.

To function properly, the ImerPure Vir cartridge requires a minimum initial water pressure. This requirement will be satisfied when installed in any fully C1-compliant device, since the C1 Common Interface specification requires a device’s upper chamber be at least a certain minimum height in order to support sufficient system water pressure.

Optional, second-stage cartridge to deactivate viruses (in development)

Manufacturer	Imerys
Launch timeframe	2017
	
Cartridge model	ImerPure Vir
Required first-stage cartridge (refer to <i>Cartridges</i> section)	ImerPure CF or ImerPure Carb, in upper position
Compatible devices include	all C1-compliant devices
Treatment (second-stage cartridge)	bromine, controlled release
Flow rate: when used with non-cloudy water	~4–6 liters/hour system flow rate
If used with cloudy input water	evaluate locally; see page 6.
Water quality: cartridge meets WHO guidelines	yes
Bacteria reduction, in lab testing (average)	>99.99999% (n=3)
Virus reduction, lab testing (average)	>99.999% (n=3)
Protozoa reduction, in lab testing (average)	>99.99% (n=3)
Estimated service life	~3–6 months or ~1,500–3,000 liters
End of life indicator	color change, from red to white
C1 Common Interface	compliant
install location	lower position
Price/ea., USD, ex-works	illustrative only
1,000+ units/year	\$3 ^{.10}
10,000+ units/year	\$3 ^{.20}
100,000+ units/year	\$2 ^{.80}
Supply chain; see more details in <i>Devices</i> section	
Factory location	Gujarat, India

Interest from more companies

The Springboard ecosystem is set to keep growing with continued interest from a diverse range of manufacturers. Such companies include an Indian small-medium enterprise interested to create a water filter especially suited to water issues that affect one region of the country, and one of the largest water-filter manufacturers in Brazil. PATH has issued over seven no-cost licenses to companies to use the C1 Common Interface specification.

Resources

PATH's Springboard Initiative offers an array of additional resources online, via our resource page listed below. These include:

- [Fact sheet](#) on the Springboard Initiative.
- Detailed [Design Guidelines](#) for water filters.
- [Demand validation](#) and [“beta test” filter redesign](#) in Cambodia.
- [No-cost license](#) to the C1 Common Interface specification.
- [Springboard resource page](#): (<http://sites.path.org/water/water/new-water-filters-resources/>).

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Details

Lab tests

All testing, such as for bacteria reduction, was conducted by qualified, independent third-party US laboratories. Performance testing was usually conducted with three or four units provided by a manufacturer, utilizing the US Environmental Protection Agency-issued P231 test protocol often used in this product category. The P231 test includes several measurement points over a period of ten days. For comparability, the results listed for ceramic cartridges are from testing with standardized General Test Water (type) 1 or similar. In the case of the ImerPure ceramic cartridges only (page 6), a faster single-measurement test method was used. For the Vir bromine-prototype cartridge, results listed are from P231 testing of the system with General Test Water (types) 1 and 3. *Performance of cartridges can vary among units within the same manufacturing batch and between different batches, on both flow rate and performance with pathogens.* Manufacturers utilize quality-control processes to help manage variability and may have additional data.

References

1. Brown J, Sobsey MD, Loomis D. Local drinking water filters reduce diarrheal disease in Cambodia: a randomized, controlled trial of the ceramic water purifier. *American Journal of Tropical Medicine and Hygiene*. 2008;79(3):394-400.
2. World Health Organization (WHO). *Evaluating household water treatment options: health-based targets and microbiological performance specifications*. Geneva: WHO; 2011.