

International Scheme to Evaluate Household Water Treatment Technologies

VF100 Home Filter and VF200 Pre-Filter

Product evaluation report

| | |
|---------------------------------------|--|
| WHO performance classification | Targeted protection (bacteria and protozoa only) One-star (★) |
| Manufacturer | Village Water Filters, Inc 2146 Division Ave S Grand Rapids, MI 49507 United States www.villagewaterfilters.org |
| Evaluation procedure | Abbreviated laboratory test: seal integrity verification |
| WHO report issue date | Round III, 2020 |
| WHO reference | 24/1/2020-R3-22b |

Summary of evaluation

This report summarizes the evaluation results of a combined membrane ultrafiltration and activated carbon filter system known by the tradenames 'VF100 Home Filter' and 'VF200 Pre-Filter', under Round III of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). Evaluation of the VF100 Home Filter plus VF200 Pre-Filter comprised a desk review of existing data and an abbreviated laboratory test aimed at evaluating the system's seal integrity. The laboratory test followed the requirements of the WHO protocol for filtration technologies, and investigated the ability of the filtration system to reduce bacteria and viruses. Reduction of protozoa was assigned based on the mean bacterial reduction achieved. Based on the evaluation results, the combined VF100 Home Filter and VF200 Pre-Filter system meets WHO performance criteria and is classified as providing *Targeted protection* against bacteria and protozoa only (★).

1. Background

Evaluation under the Scheme is based on performance criteria set out in *Evaluating Household Water Treatment Options: Health-based targets and microbiological performance specifications* (WHO, 2011). The criteria were determined by applying quantitative microbial risk assessment methods outlined in the *WHO Guidelines for Drinking-water Quality* (2017) and set out log₁₀ reduction targets against bacteria, viruses and protozoa, as shown in the table below.

Table 1. WHO performance criteria for household water treatment technologies

| Performance classification | Bacteria (log ₁₀ reduction required) | Viruses (log ₁₀ reduction required) | Protozoa (log ₁₀ reduction required) | Interpretation (with correct and consistent use) |
|----------------------------|---|---|--|---|
| ★ ★ ★ | ≥ 4 | ≥ 5 | ≥ 4 | Comprehensive protection |
| ★ ★ | ≥ 2 | ≥ 3 | ≥ 2 | |
| ★ | Meets at least 2-star (★ ★) criteria for two classes of pathogens | | | Targeted protection |
| — | Fails to meet criteria for 1-star (★) | | | Little or no protection |

Product description

The VF100 Home Filter is a hollow-fibre membrane ultrafiltration device. The filter can be plumbed to a pressurized water supply, or connected to a raw water reservoir outlet such as a bucket or water tank and operated by gravity flow. The VF100 can be used as a stand-alone or can be attached to a reticulated carbon foam filter, the VF200 Pre-Filter. The VF200 Pre-Filter is infused with silver. The full product description, illustrations and use instructions can be found on the manufacturer website: www.villagewaterfilters.org.

2. Evaluation approach

This report summarizes the evaluation of the combined VF100 Home Filter and VF200 Pre-Filter system. The evaluation of the individual VF100 Home Filter is summarized in a separate report. Evaluation of the VF100 Home Filter and VF200 Pre-Filter was in two components: a desk review of existing data, and an abbreviated laboratory test aimed at evaluating the seal integrity.

Review of existing data: Products that have been tested by a laboratory meeting the criteria outlined in the Scheme Procedure for Evaluation and using an evaluation approach that closely follows the Scheme Harmonized Testing Protocol: Technology Non-Specific V 3.0 (WHO, 2020) may be eligible for an abbreviated evaluation based on a desk review of the existing data and a partial laboratory test. The VF100 Home Filter was deemed eligible for such an abbreviated evaluation for the reasons outlined below:

- **Testing facility:** The test reports submitted were from a laboratory accredited to International Organization for Standardization (ISO), that is experienced in performance evaluation of water treatment technologies.
- **Test procedure:** The test procedure was based on the requirements of the United States Environmental Protection Agency (US EPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (1987) and the NSF/ANSI P231 Guide Standard and Protocol for Testing Microbiological Water Purifiers. The requirements of these protocols are similar to those of the Scheme.
- **Test organisms:** The surrogates and organisms used in the test were: microspheres, as surrogates for *Cryptosporidium* protozoan cysts; and *Raoultella terrigena*, representing the bacterial group; and enteroviruses.

Seal integrity evaluation: Evaluation of the seal integrity followed the requirements of the WHO protocol for WHO Scheme *Testing Protocol for Filtration Technologies V 3.2*. This abbreviated testing procedure allows for verification of the product's sealing mechanisms that prevent untreated water from bypassing the filtration media.

A product-specific test plan was developed based on the manufacturer's instructions for use; the WHO Scheme *Harmonized Testing Protocol: Technology Non-Specific V 3.0* (WHO, 2020); and the Testing Protocol for Filtration Technologies V 3.2. Testing was conducted at a WHO-designated laboratory, NSF International, in the United States.

Test organisms: The seal integrity test evaluated the performance of the VF100 Home Filter in removing bacteria and viruses. The test organisms were *Escherichia coli* (*E. coli*), and coliphages MS-2 and phiX-174. Based on the available evidence on filtration primarily by size exclusion on the removal of protozoan cysts, testing against this microbial group was not conducted (WHO, 2019). The protozoan reduction is assigned based on the mean bacterial reduction observed.

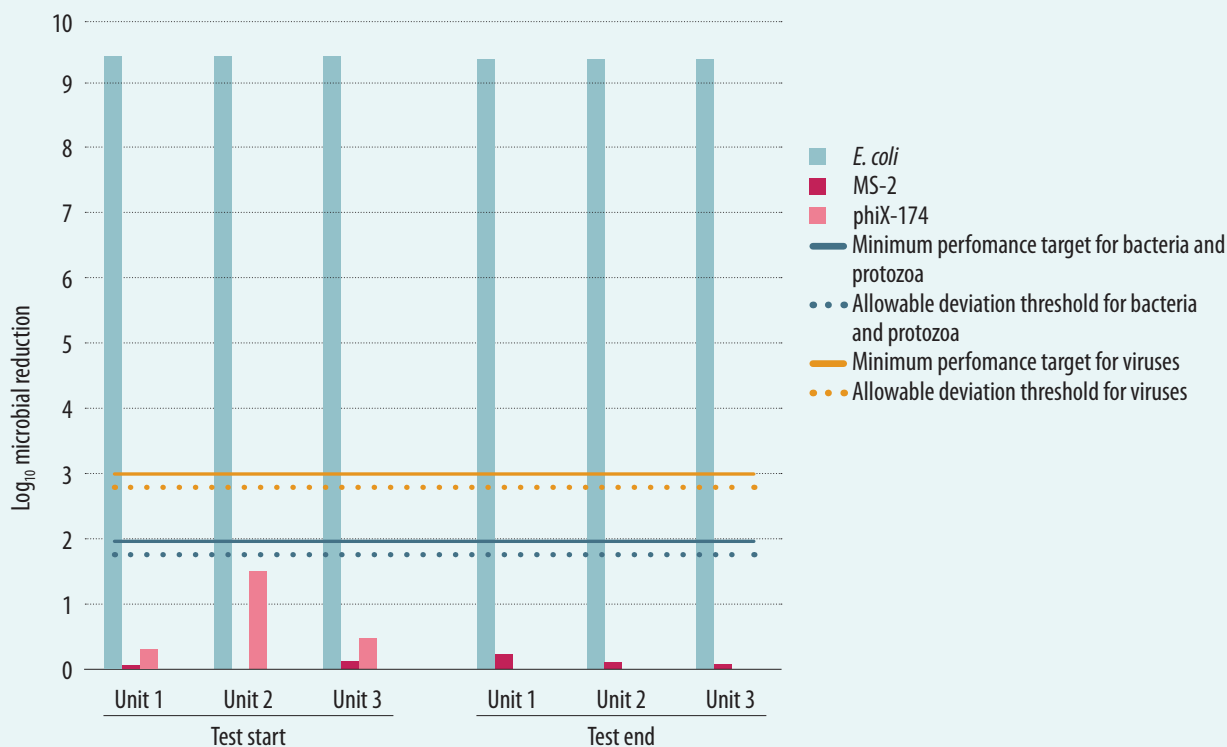
Test waters: The product was tested in General Test Water (GTW), simulating high quality groundwater. Testing in Challenge Test Water (CTW) was not conducted. Refer to the filtration technology test protocol for details on physico-chemical characteristics of the test water.

Test procedure: Three sample units each of the VF100 Home Filter and VF200 Pre-Filter were provided by the manufacturer for the test, and were operated according to the manufacturer’s use instructions. The test units were each connected to three five-gallon buckets with a gravity filtration installation kit provided by the manufacturer. Batches of water were processed in 10 L volumes. The test duration was one day, with two microbial challenge points. This resulted in a total of six sample points per test organism: 3 units × 2 challenge points × 1 test water. Pretreatment and posttreatment water grab samples were analyzed using methods identified in the product-specific test plan. As the carbon pre-filter is infused with silver, post-treatment silver residual samples were collected.

3. Results

The figure below presents the results of the bacterial and viral testing for the three units in GTW at the start and end of the test. Test water characteristics were within specifications.

Performance across test units¹



The combined VF100 Home Filter and VF200 Pre-Filter system achieved mean log₁₀ reductions of 9.39 for *E. coli*; 0.11 for MS-2; and 0.38 for phiX-174.

4. Interpretation and application of results

Performance is classified in three ascending tiers: ★ (one-star); ★★ (two-star); and ★★★ (three-star), as shown in the table outlining performance criteria. Both three- and two-star products provide Comprehensive

¹ The maximum microbial reduction that can be demonstrated is limited by the pretreatment challenge concentration delivered. For each organism tested, the pretreatment concentration must be sufficient to allow for the demonstration of the performance targets in the table showing the performance criteria. Due to the complexity of using viable organisms, there may be variation in these pretreatment concentrations above what is sufficient, which may lead to demonstrated reductions reported that far exceed the performance targets. However, the emphasis is on whether the performance target has been met and not the extent by which the target was exceeded.




protection against all three microbial groups. One-star products meet performance targets for only two of the three microbial groups, providing *Targeted protection*.

Each production unit should consistently meet or exceed the performance target for each microbial group in both test waters (GTW and CTW). However, a maximum deviation of $0.2 \log_{10}$ is acceptable for 25% of sample points at the two-star performance tier and $0.4 \log_{10}$ at the three-star performance tier¹. This means that for classification as a two-star product, up to three of the 12 sample points can achieve a minimum reduction of $1.8 \log_{10}$ for bacteria or protozoan cysts (instead of $2 \log_{10}$) or $2.8 \log_{10}$ for viruses (instead of $3 \log_{10}$). Each phage is treated separately for evaluating acceptable allowance, and the overall claim for viruses is based on the lower performing phage.

Performance classification

The combined VF100 Home Filter and VF200 Pre-Filter system fully met the performance target for bacteria. For the protozoan reduction, a value of $9 \log_{10}$ is assigned, based on the mean bacterial reduction. The minimum performance target for viruses was not met. As such, the VF100 Home Filter is classified as providing *Targeted protection* (★) against bacteria and protozoa only.

Considerations for product selection

| | | |
|--|---|---|
|  | Microbial conditions | Use where contaminant of concern is known to be bacterial / protozoan microbes |
|  | Physico-chemical water characteristics | Can be used to treat turbid water |
|  | Product information and labelling | Check that the product is appropriately labelled and has clear instructions for use |

References

Evaluating household water treatment options: health-based targets and microbiological performance specifications. Geneva: World Health Organization; 2011 (http://www.who.int/water_sanitation_health/publications/household_water/en/).

Guidelines for drinking-water quality, fourth edition incorporating first addendum. Geneva: World Health Organization; 2017 (http://www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4-including-1st-addendum/en/).

Harmonized Testing Protocol: Technology non-specific version 2.0. Geneva: World Health Organization; 2019 (http://www.who.int/water_sanitation_health/water-quality/household/household-water-treatment-scheme-resources/en/).

Filtration Technology Testing Protocol: version 3.2. Geneva: World Health Organization; 2020 (http://www.who.int/water_sanitation_health/water-quality/household/household-water-treatment-scheme-resources/en/).

¹ These cut-off values were determined using QMRA modelling and selecting ranges that still resulted in appreciable health gains within a specific performance tier

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ISBN 978-92-4-000774-1 (electronic version)

ISBN 978-92-4-000775-8 (print version)

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