LifeStraw®

PEAK SERIES

Performance & Test Reports

TABLE OF CONTENTS

LifeStraw products have a history of use in some of the harshest conditions around the world, from refugee camps to natural disasters to extreme back-country, our products have to work because lives depend on them. Our testing and transparency is unparalleled, as is our commitment to social impact and environmental sustainability.

WHAT SETS LIFESTRAW APART

1. Tough and Minimalist: Our products are made with minimal spare parts and are used in the toughest conditions around the world.

2. LifeStraw is the only water filter brand that owns and operates its own fully equipped ISO certified water laboratory

3. 4-step quality control including microbiological testing over every single batch of filters.

4. We give back: We provide a year of safe water to a child in need for every LifeStraw product sold.

5. Transparent testing: We share all internal and external lab reports publicly, on our website.

6. Optimal flow rates: Optimized to operate off of human sucking & last longer in sandy & silty conditions.

7. Sustainable packaging: All packaging is free of plastic and is fully recyclable or compostable

8. It's all about the 9s: We report log removal (99.999999%) data for all of our microbiological claims.

HOW WE TEST OUR PRODUCTS

LifeStraw's testing and transparency is unparalleled and we use the most trusted performance criteria based on protocols established by the World Health Organization, the US EPA, NSF International and the Water Quality Association.

ALL LIFESTRAW PRODUCTS REMOVE:

- LOG 8 (99.999999%) for Bacteria
- LOG 5 (99.999%) for parasites/amoebas/cysts
- LOG 5 (99.999%) for microplastics
- BPA FREE
- FDA Food Grade Materials

4 STEP QUALITY CONTROL

LifeStraw puts 100% of its filters through a rigorous quality control process.

STEP 1: Resistance test at high pressure.
STEP 2: Bubble test to confirm pore size.
STEP 3: Particle test to ensure nothing the size of bacteria or larger can pass through the filters.
STEP 4: We send a sample from every batch for full Bacteria and Protozoa log removal tests.

MICROBIOLOGICAL TESTING – HOW ITS DONE

The only accepted scientific evaluation of microbiological filtration performance is log values (the number of 9s in 99.999999%). PERIOD. All internationally accepted protocols from ANSI, WQA, NSF International, the US EPA, and the World Health Organization evaluate performance through log removal testing. None of these bodies will certify anyone based on pore size; it is ACTUAL PERFORMANCE that matters. LifeStraw products exceed all log-based performance standards.

LifeStraw is the only water filter brand that owns and operates its own fully equipped ISO certified water laboratory capable of performing cutting age tests on microbiological performance longevity, turbidity and other performance indicators. LifeStraw also tests all products through external internationally recognized labs.

LIFESTRAW PEAK SERIES PERSONAL WATER FILTER STRAW

PERFORMANCE DATA

LifeStraw water filters are rigorously tested by independent labs and our own ISO certified lab to meet protocols established by the US Environmental Protection Agency (EPA) and NSF International/ANSI.
The LifeStraw Peak Series Water Filter straw features membrane microfiltration technology with pore size of 0.2 micron to meet NSF/ANSI P231 standard for the removal of bacteria and parasites. The membrane microfilter lasts up to 1,000 gallons (4,000 liters).

FEATURES + PERFORMANCE	NSF/USEPA REMOVAL REQUIREMENT	LS PEAK STRAW REMOVAL PERFORMANCE	EXTERNAL LAB CERTIFICATION
Bacteria NSF P231/US EPA Brucella melitensis Campylobacter jejuni Francisella tularensis Pseudomonas aeruginosa Shigella Staphylococcus aureus Vibrio cholerae (Cholera) Vibrio parahaemolyticus Yersinia enterocolitica Yersinia pestis Enteropathogenic Escherichia coli (E. coli) Haemophilus influenzae Klebsiella pneumoniae Legionella pneumophila Mycobacterium tuberculosis Mycoplasma pneumoniae Burkholderia pseudomallei Salmonella enterica Salmonella typhi (Typhoid) Streptococcus pneumoniae Streptococcus pyogenes	**min. 99.9999% reduction**	**min. 99.999999% reduction**	**Aquadiagnostics/IAPMO India** *(WQA Accredited)*
Parasites NSF P231/NSF 53 Ascaris lumbricoides Cryptosporidium spp. Entamoeba histolytica Giardia intestinalis Naegleria gruberi Schistosoma mansoni Taenia saginata	**min. 99.9% reduction**	**min. 99.999% reduction**	**Aquadiagnostics/IAPMO India** *(WQA Accredited)*
Microplastics *(as small as 1um)*	**NSF standard under development**	**min. 99.999% reduction**	**Aquadiagnostics/IAPMO India** *(WQA Accredited)*

Study Report

PHÒNG THÍ NGHIỆM NƯỚC
Water Laboratory

Performance on Longevity of LifeStraw Peak Straw

(testing on mass production products)

Study Number: LSP.20.2003.1

Attention to: Jean Luc Madier	Date of issuance: 7 June 2022
Issued by: Chung Quang Nguyen	Approved by: Le Thu Cao

Overview

LifeStraw (LS) Peak Straw is the water filter product applying Microfiltration (MF) membrane technology for households/outdoor activities to remove the microorganisms in water.

In this study, the longevity (filtration lifetime) of LS Peak Straw was evaluated, and microbiological removal efficacy was tested along the longevity test. The filtration lifetime of product was tested following US EPA (1) and NSF P231 (2) protocols.

Longevity of LS Peak Straw reached 4000L under NSF P231 test conditions. At the beginning, average flowrate of LS Peak Straw was about 2100ml/min then decreased slowly over the filtrated volume. The samples which were backwashed (BW) by blowing air could maintain flowrate well till 4000L point. At the end of its lifetime, the average flowrate was still around 500ml/min. Flowrate of the samples which were BW by using the syringe was better than that of the samples BW by blowing air, average flowrate was still around 1000ml/min at the end of its lifetime (4000L point).

All tested samples could remove bacteria at higher than 8log reduction and remove protozoa at higher than 5log reduction till 4000L point. The turbidity of filtrated water was lower than 0.5NTU at all sampling points of all tested samples, and it was 0.1 NTU in average. The quality of the filtered water exceeded requirements of WHO (3)/US EPA/NSF P231 on bacteria removal (≥log6), protozoa removal (≥log4), and turbidity removal (≤0.5 NTU).

References

1) US EPA Guide Standard and Protocol for Testing Microbiological Water Purifiers. April 1987.

2) NSF Protocol P231, Microbiological Water Purifiers. February 2003.

ilac-MRA BUREAU OF ACCREDITATION VIETNAM VILAS 751

VESTERGAARD® IMPACTING PEOPLE

3) WHO (2011). Evaluating household water treatment options: Health-based targets and microbiological performance standards, Geneva, World Health Organization.

4) WL.SOP.056.v1. SOP for Normal Aging Procedure of LS Peak Straw.

Procedure/ Testing methods

Following US EPA/ NSF P231 protocols, 6 replicates of LS Peak Straw were aged with general test water, the samples were divided into 2 groups (3 replicates in each group) applying 2 different backwash methods – blowing air at 0.15bar (mimic human blowing) and using the syringe 40ml (will be included in cleaning kit). At the beginning and after each 500L of longevity, samples were tested with challenge test water to evaluate the microbial removal efficacy (E.coli and protozoa) of the product.

Operating the product during testing was done following WL.SOP.056.v1.

Testing water conditions were prepared and controlled following US EPA (1), NSF P231 (2).

Monthly cleaning was applied for all tested samples for every 100L point, following WL.SOP.056.v1.

Results and discussions

1. Longevity performance

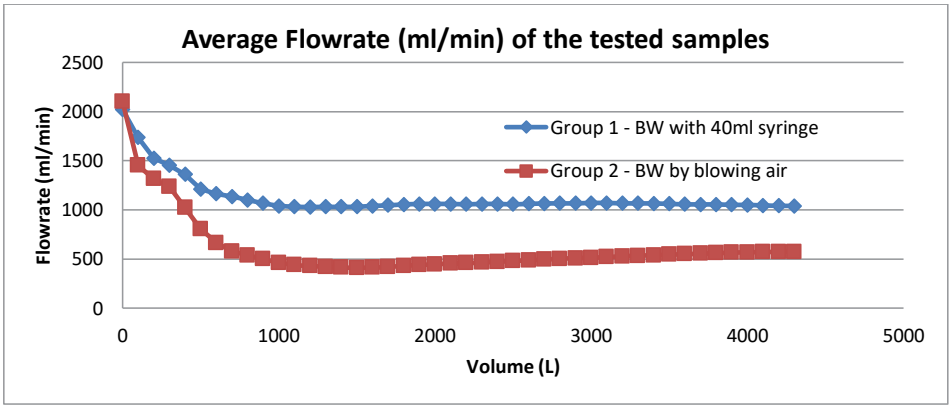

Figure 1: **Flowrate of the tested samples in each group of LS Peak Straw**

- Longevity of all tested samples of LS Peak Straw samples reached 4000L.
- Flowrate of LS Peak Straw samples was high at the beginning, it was around 2100ml/min (around 126L/h).
- The samples which were backwashed by blowing air could maintained flowrate well. The average flowrate of these samples reduced slowly from 2100ml/min to 500ml/min over the aging time in the first 1000L, after that point the average flowrate of these samples was maintained around 500ml/min till end of target lifetime of 4000L.

- On the group of samples which were backwashed by using the syringe 40ml, the flowrate was maintained better to compare with the sample BW by blowing air: the average flowrate of the samples in this group was about 2000ml/min – similar with the samples BW by blowing air, but it was reduced more slowly, at 1000L point, the average flowrate of these samples was still about 1000ml/min (2 times higher than that of samples BW by blowing air), and this flowrate was maintained around 1000ml/min till 4000L point.
- Using the syringe for BW had better effective in maintaining flowrate of Peak Straw product to compare with blowing air method.
- Turbidity of effluent water was about 0.1NTU in average, and lower than 0.5NTU at all sampling points of all tested samples (table 1 below). This result met NSF 53 and USEPA requirements on turbidity of effluent water.

Table 1: **Summary of turbidity of effluent water of LS Peak Straw samples**

	Turbidity of effluent water					
	Sample BW by using syringe			Sample BW by blowing air		
	LS.21.613.62	LS.21.613.63	LS.21.613.64	LS.21.613.65	LS.21.613.66	LS.21.613.68
Average	**0.06**	**0.06**	**0.09**	**0.06**	**0.06**	**0.06**
Min	0.04	0.04	0.03	0.04	0.04	0.04
Max	0.12	0.12	0.33	0.19	0.12	0.11

2. Microbial removal efficacy

- LS Peak Straw uses hollow fiber microfiltration technology which can remove microorganisms bigger than its pore size of 0.2µm, thus, it can remove *E.coli* bacteria (ca. 0.5x2µm) and protozoa cysts (minimum 3µm).
- The removal of protozoa was only tested for 1 sample as representation at the end of target lifetime - 4000L point (as 3 micron microspheres surrogate). Removal of *E.coli* (the smaller tested organisms) guaranteed removal of protozoa.
- The test result was showed in table 2 below.

Table 2: **Summary of microorganism log reduction of LS Peak Straw samples**

		Log Reduction of E.coli and Microspheres at challenging points									
Challenging point		**Beginning point**	**500L**	**1000L**	**1500L**	**2000L**	**2500L**	**3000L**	**3500L**	**Final point (4000L)**	
Samples		E.coli	E.coli	E.coli	E.coli	E.coli	E.coli	E.coli	E.coli	E.coli	Spheres
Sample BW by using syringe	LS.21.613.62	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.7	
	LS.21.613.63	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.3	>5.3
	LS.21.613.64	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.7	
Sample BW by blowing air	LS.21.613.65	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.7	>5.3
	LS.21.613.66	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.7	
	LS.21.613.68	>8.9	>8.5	>8.8	>8.4	>8.8	>8.7	>8.6	>8.9	>8.7	

(*) Protozoa cysts were tested with 3µm microspheres surrogate as alternative.

- The results showed that, microorganism removal efficacy of all LS Peak Straw samples was higher than 8.4 log reduction of *E.coli*, and 5.3 log reduction of 3 micron microspheres.
- LS Peak Straw product exceeded the requirements of WHO (3)/US EPA/NSF P231 on bacteria removal (≥log6), protozoa removal (≥log4).

Summary/ Conclusions

Longevity of LS Peak Straw reached 4000L under NSF P231 test conditions.

LS Peak Straw worked well till 4000L. At the beginning, average flowrate of LS Peak Straw was about 2100ml/min then decreased slowly over the filtrated volume.

BW by blowing frequently could help to maintain flowrate the LS Peak Straw quite well, till 4000L point, average flowrate of these samples was still around 500ml/min.

However, if using the syringe for BW, flowrate could be maintained better, till 4000L point, average flowrate of these samples was still around 1000ml/min.

The LS Peak Straw samples could remove *E.coli* at higher than 8.5 log reduction, and microspheres at 5.2 log reduction at all challenging points. This result met the requirement of NSF P231/ NSF 53, USEPA, WHO in bacterial removal efficacy (6log reduction) and protozoa removal efficacy (4log reduction).

Turbidity of efluent water was about 0.1NTU in average, lower than 0.5NTU at all sampling points of all tested samples. This result met NSF 53 and USEPA requirements on turbidity of effluent water.

IAPMO INDIA PRIVATE LIMITED
LABORATORY
No.43, PMR Tower, 3rd Floor, Above SBI, Beretena Agrahara,
Near Hosa Road Junction, Hosur Main Road,
Bangalore - 560 100 Karnataka INDIA
Ph: + 91 7349604940
GSTIN: 29AABCI8589C1Z7
http://www.iapmoindia.org

TEST REPORT

Report No: IAPMOILAB/PRTR/19426G/22-23 **Date: 24.06.2022**

CUSTOMER DETAILS	SAMPLE DETAILS	TEST DETAILS
Name & Address : **Mrs. Le Thu Cao Vestergaard Frandsen Inc 333, W Ostend St. Suite 300 Baltimore, MD 21230, USA**	**Sample received: 30.05.2022** **Sample code no: AWRTCL/19426G/22-23** **Sample Description: LS Peak straw filter** **Sample Quantity for Testing: 1 No.** **Submitted by : Vestergaard Frandsen Inc. USA** **Date of Analysis started:22.06.2022** **Date of Analysis Completed:24.06.2022** **Subcontract : Not Applicable** **Sample condition when received : Intact**	**Method:** Microplastic reduction (as 1 micron plastic spheres _ - black dyed microspheres.

EXCUTEIVE SUMMARY: Tested samples of LS Peak Straw performed well by reducing microplastic (as 1 micron poly styrene black dyed microspheres) to > 5.82 log at tested flow rate.

Table – 1 : 1 Micron Microsphere Reduction by LifeStraw Peak Straw filter: 12 Liter Filtration

Sample Code	Customer Code No	Parameter	Influent water concentration microspheres/Liter	Effluent water concentration microspheres/Liter	% Reduction (log)
AWRTCL/ 19426G/22-23	LS Peak Straw	1 micron microsphere s reduction	1.04×10^8 microspheres/L (8.02 log)	<160 microspheres/L (2.20 log)	>99.9998 (>5.82 log)

Flow Rate of Filtration: 800 ml/min, < 160 = Below detection limit

RECOGNIZED BY IAPMO R&T – USA

We under take analytical job for water, food, biocidal resins, detergents & sanitizers and soil. We carry out performance evaluation of drinking water treatment units as per NSF/ANSI specifications. Based on performance we can arrange for certification from IAPMO – USA

Note:
1. The results pertain only to the tested samples and applicable parameters.
2. Samples will be disposed after 15 days from the issue of test certificate unless otherwise specified, in case of bacteriological tests, the samples will be disposed after 7 days itself from the date of issuing the certificate.
3. This report is not to be reproduced either wholly or in parts and cannot be used as evidence in the court of Law and should not be used in any advertising media without prior written permission.
4. In case, any recommendation of contents of this certificate is required please contact our office.

IAPMO INDIA PRIVATE LIMITED
LABORATORY
No.43, PMR Tower, 3rd Floor, Above SBI, Beretena Agrahara,
Near Hosa Road Junction, Hosur Main Road,
Bangalore - 560 100 Karnataka INDIA
Ph: + 91 7349604940
GSTIN: 29AABCI8589C1Z7
http://www.iapmoindia.org

TEST REPORT

TEST WATER COMPOSITION: GTW#1 (General Test water – 1)

Test water Characteristic	Recommended Concentration	Concentration maintained by the Laboratory
pH	6.5 to 8.5	7.50
TDS mg/L	50 – 500	310
TOC mg/L	>1	>1
Turbidity NTU	0.1 to 5.0	1.0
Temperature ^{0}C	20±5 ^{0}C	24

PICTURE OF TEST SETUP

Dr S.MURALIDHARA RAO
Director - Laboratory

00---End of the Test Report –00

RECOGNIZED BY IAPMO R&T – USA

We under take analytical job for water, food, biocidal resins, detergents & sanitizers and soil. We carry out performance evaluation of drinking water treatment units as per NSF/ANSI specifications. Based on performance we can arrange for certification from IAPMO – USA

Note:
1. The results pertain only to the tested samples and applicable parameters.
2. Samples will be disposed after 15 days from the issue of test certificate unless otherwise specified, in case of bacteriological tests, the samples will be disposed after 7 days itself from the date of issuing the certificate.
3. This report is not to be reproduced either wholly or in parts and cannot be used as evidence in the court of Law and should not be used in any advertising media without prior written permission.
4. In case, any recommendation of contents of this certificate is required please contact our office.

Certificate of Analysis

PHÒNG THÍ NGHIỆM NƯỚC/ *Water Laboratory*
ISO/IEC 17025 accredited

Sample Information

Sample	: LifeStraw® Peak series Peak Straw	**Requested by**	: PARA Membranes Ltd.
Quantity	: 5 pcs	**Description**	: QC Finished goods
Date of receipt of test sample (dd/mm/yyyy)			: 13/06/2022

Analysis Result

Parameter			Microbiological log_{10} reduction		Physico-chemical characteristics		Conclusion
			Bacteria (*E.coli*)	Protozoa (3µm spheres surrogate)	Turbidity of effluent water (NTU)	Flow rate (ml/min)	
Reference method			SMEWW 9222I: 2017 (*)	US EPA 05/9205/ EPADWC (Modified) (*)	SMEWW 2130B:2017 (*)	WL.SOP.106	
Specification			Min 8	Min 5	Max 0.5	2500 ± 30%	PASSED
1	15302E2	Mountain Blue	>8.7	>5.2	<0.12	2200	PASSED
2	15302E2		>8.7	-	<0.12	1760	PASSED
3	15302E2		>8.7	-	0.15	1920	PASSED
4	15302E2		>8.7	-	<0.12	1840	PASSED
5	15302E2		>8.7	-	<0.12	2000	PASSED

Note: (*) ISO/IEC 17025 accredited methods

I, the undersigned, hereby declare that the findings provide a true and accurate record of the results obtained on samples as received.

Date and signature

16/06/2022

Cao Thu Le
Water Laboratory Manager

VESTERGAARD®
IMPACTING PEOPLE

LifeStraw®