1717 Arlingate Lane
Columbus, OH, 43228

Telephone: (614) 279-8090
Facsimile: (614) 279-4642
www.intertek.com

Non-Standardized Test Report For:

Survivor Filter, a division of Zakaib Holdings Limited

Model: Survivor Filter ™ Triple Absolute Filtration to 0.05 Microns, and
Survivor Filter ™ PRO 0.01 Micron Water Purifier
Project No. G102092758

REVISION TABLE

Date / Project Number	Engineer / Reviewer	Pages	Comments
06/20/2018 – G102092758	N. Unger L. Moomaw	7	Corrected percentage from 99.9% to 99.999% reflecting 5 log reduction per client request.

Signature on File
N. Unger
Engineer

Signature on File
J. Senediak
Reviewer

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Objective

The primary objective of this evaluation is to provide test data showing the amount of bacteria, virus, removed from a water matrix by the Survivor Filter and Survivor Filter Pro.

Overview

A challenge suspension of known concentration will be prepared and introduced into the system. The suspension will be run through the filter and then analyzed for remaining concentrations.

Separate and new filters are to be used for the bacteria, virus, and heavy metals.

Detection will be as follows:

I. Bacteria
   a. Collection and enumeration technique derived from the Standard Total Coliform Membrane Filter Procedure in accordance with APHA's *Standard Methods for the Examination of Water and Wastewater.* This procedure is commonly used for NSF/ANSI certification standards for food equipment.

II. Virus
   a. Collection and enumeration technique derived from the Standard Total Coliform Membrane Filter Procedure in accordance with APHA's *Standard Methods for the Examination of Water and Wastewater.* This procedure is commonly used for NSF/ANSI certification standards for food equipment.

III. Heavy Metals
   a. The Elemental analysis of the Lead, Mercury and Cadmium will follow the IEC 62321 Elemental analysis procedure. This procedure is commonly used for RoHS analysis of various materials.

Procedural

I. Bacterial Analysis

a. Challenge Suspension Preparation
   1. *E. coli*, (ATCC 11229) and *S. aureus* (ATCC 6538) bacteria obtained from ATCC
   2. Stock cultures rehydrated with Tryptic Soy Broth (TSB) and incubated at 36 ± 1 °C (97 ± 1 °F) for approximately 24 hours
   3. The suspension will be diluted with phosphate buffer solution (PBS) to yield a concentration of 1 to $5x10^6$ cfu/mL of each organism

b. Test
   1. 100 mL of the challenge suspension is filtered through the Survivor unit
   2. Samples will be serial diluted and will be plated on both MacConkey's agar and Mannitol Salts agar, inverted, and incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h
      i. Serial dilution plating will be performed in duplicate
   3. Plates are to be enumerated after the incubation period and results expressed as the number of CFU/mL
      i. Only plates within the range of 20-300 cfu will be reported

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4. Control Samples to be performed as follows:
    i. Negative control: PBS will be filtered through unit and enumerated
    ii. Positive control: Serial dilution of the bacterial suspension will be performed using PBS and aseptically processed using the membrane filter technique
5. Steps (b)1-3 are repeated for Survivor Filter Pro Model

II. Viral Analysis

a. Challenge Suspension Preparation
    1. Phi X174 (#124425) to be obtained from Carolina Biosciences
    2. Sample to be enumerated via serial dilution to confirm concentration
    3. A dilution of the stock suspension will be made so that the density of viral particles is approximately 1 to $5x10^6$ plaque forming units (PFU) per mL

b. Test Procedure
    1. 100 mL of the challenge suspension is filtered through the Survivor unit
    2. Samples will be serial diluted will be plated on nutrient agar utilizing the agar overlay technique, inverted, and incubated at 36 ± 1 °C (97 ± 1 °F) for 24 h
        i. Serial dilution plating will be performed in duplicate
    3. Plates are to be enumerated after the incubation period and results expressed as the number of PFU/mL
        i. Only plates within the range of 20-300 PFU will be reported
    4. Control Samples to be performed as follows:
        i. Negative control: PBS will be filtered through unit and enumerated
        ii. Positive control: Serial dilution of the viral suspension will be performed using PBS and aseptically processed using the membrane filter technique
    5. Steps (b)1-3 are repeated for Survivor Filter Pro Model

Parameters

A digital hygrometer will be used to ensure the temperature range stayed within that specified in the procedure above.

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Hypothesis

The hypothesis for the microbiological portion is that the percent reduction is measurable outside the tolerance of the method, which is 8%. This tolerance is based on the within laboratory precision of the standard plate count test that accounts for a within-analyst variation of 8% (AATCC 100-2012).

Sample Acquisition

Sample will be submitted by the client for evaluation.

Sample #	Description	Serial #	Model	Date	Condition
COL1508141358 -001	Survivor Filter	X000M99LWN	Survivor Filter TM Model L600	7/20/2015	New
Sample #	**Description**	**Serial #**	**Model**	**Date**	**Condition**
COL1508141358 -002	Survivor Filter Pro	X000P3MQJV	Survivor Filter TM PRO Model L610	7/20/2015	New

Equipment List

Item	Equipment Type	Intertek Asset No.	Calibration Due
1	Micropipette	CE 1141	03/11/16
2	Thermofisher Heracell Incubator	CE 2381	For Reference Only
3	Balance	CE 1182	11/3/15
4	Autoclave	CE 2376	Verify before use
5	Graduated Cylinder	CE 2264	Initial Calibration Only
7	Centrifuge	CE 2382	For Reference Only
8	Filtration System	CE 2031	Initial Calibration Only
9	Refrigerator	CE 1157	05/05/16
10	10-100 µL Pipette	CE2315	12/01/15
11	100-1000 µL Pipette	CE2234	03/30/16
12	1-5 ml Pipette	CE2228	03/30/16
13	Analytical Balance	CE2235	09/16/15
14	ICP	CE2100	Verify Before Use

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Testing to be conducted at: Intertek Testing Laboratory
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Raw Microbiological Test Data

Test Parameter		Result[1]	Units
Organism	Bacterial Species	Escherichia coli	--
	ATCC No.	11229	--
	Challenge Concentration	4.45×10^6	CFU/mL
Survivor Filter ™ Triple Absolute Filtration to 0.05 Microns	Serial Dilution Replicate 1	<1	CFU/mL
	Serial Dilution Replicate 2	<1	CFU/mL
	Average	**<1**	**CFU/mL**
Survivor Filter ™ PRO 0.01 Micron Water Purifier	Serial Dilution Replicate 1	<1	CFU/mL
	Serial Dilution Replicate 2	<1	CFU/mL
	Average	**<1**	**CFU/mL**

[1]Results imported from Intertek Report Number 102092758COL-002

Test Parameter		Result[1]	Units
Organism	Bacterial Species	Staphylococcus aureus	--
	ATCC No.	ATCC 6538	--
	Challenge Concentration	4.96×10^6	CFU/mL
Survivor Filter ™ Triple Absolute Filtration to 0.05 Microns	Serial Dilution Replicate 1	<1	CFU/mL
	Serial Dilution Replicate 2	<1	CFU/mL
	Average	**<1**	**CFU/mL**
Survivor Filter ™ PRO 0.01 Micron Water Purifier	Serial Dilution Replicate 1	<1	CFU/mL
	Serial Dilution Replicate 2	<1	CFU/mL
	Average	**<1**	**CFU/mL**

[1]Results imported from Intertek Report Number 102092758COL-002

Test Parameter		Result[1]	Units
Organism	Viral Species	Phi X174	--
	ATCC No.	13706-B1	--
	Challenge Concentration	5.0×10^6	PFU/mL
Survivor Filter ™ Triple Absolute Filtration to 0.05 Microns	Serial Dilution Replicate 1	740	PFU/mL
	Serial Dilution Replicate 2	810	PFU/mL
	Average	**775**	**PFU/mL**
Survivor Filter ™ PRO 0.01 Micron Water Purifier	Serial Dilution Replicate 1	<1	PFU/mL
	Serial Dilution Replicate 2	<1	PFU/mL
	Average	**<1**	**PFU/mL**

[1]Results imported from Intertek Report Number 102092758COL-002

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Percent Reduction Calculations

Percent reduction calculated as follows-

$$\text{Percent Reduction} = \frac{(A-B) \times 100}{A}$$

Where:
A is the number organism concentration before running through the filter. B is the number organism concentration after running through the filter.

Percent Reduction Values -Microbiological

	Bacterial Challenge[1]		Viral Challenge[1]
Unit Type	**E.coli**	**S.aureus**	**Phi-X174**
Survivor Filter ™ Triple Absolute Filtration to 0.05 Microns	>99.999%	>99.999%	99.999%

[1]Results imported from Intertek Report Number 102092758COL-002

	Bacterial Challenge[1]		Viral Challenge[1]
Unit Type	**E.coli**	**S.aureus**	**Phi-X174**
Survivor Filter ™ PRO 0.01 Micron Water Purifier	>99.999%	>99.999%	>99.999%

[1]Results imported from Intertek Report Number 102092758COL-002

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Percent Reduction Values -Chemical

Conclusion

The microbiological hypothesis has been accepted since the plate count values were well outside the 8% measurement of uncertainty of the microbiological test method.