

Testing of Steri-Pen, a Hand-held Ultraviolet  
Water Treatment Device using MS2 Coliphage  
In a 32 oz. (1 Liter) Nalgene® Bottle

Introduction

Hydro-Photon, Inc. of Blue Hill, ME contracted with the University of Maine Department of Microbiology and Biochemistry to test Steri-Pen, a hand-held ultraviolet water treatment device. Steri-Pen is designed for batch treatment of up to 16 oz. of water. The device uses a germicidal ultraviolet lamp with a peak output at 254 nanometers.

While it's size and mode of operation are novel, Hydro-Photon's device employs the same basic principles as large "flow through" ultraviolet water treatment systems. During UV exposure, a microbe's DNA absorbs ultraviolet energy in the germicidal range - nominally between 245 and 270 nanometers. This energy absorption causes formation of dimers which disrupt the basic structure of the DNA which, in turn, inhibits the DNA's replication and function (1).

MS2 coliphage is a bacteria virus that infects *E.coli* ATCC 15597. The MS2 coliphage was chosen as the test organism because of it's linear response and high resistance to UV disinfection (2). "A 99.5% (-2.3 log) reduction of coliphage MS2 was found to be equivalent or greater than a 99.9999% reduction of the bacterial and a 99.99% reduction in the viral pathogens.(2)" "For water purifiers, the U.S. E.P.A. Guide Standard and Protocol for Testing Microbiological Water Purifiers requires a 99.9999%, a 99.99% and a 99.9% removal/inactivation of bacteria, viruses, and protozoan cysts, respectively (2,3)

The Steri-Pen was shown to exceed the U.S.E.P.A.'s minimum guide lines for water treatment in 16 oz of water.(5) Thirty Two ounce (approx. 1 L) Nalgene® bottles are commonly used as personal water containers. The effectiveness of Steri-Pen in treating this increased volume of water in a Nalgene® container must be determined.

### Test Procedure

Sterile tap water samples in 1L Nalgene bottles were spiked with stock MS2 coliphage to give a final concentration of approximately  $3 \times 10^8$  PFU (plaque forming units)/ml. The stock MS2 coliphage was grown and assayed using the methods described by Johnson. (4)

The Steri-Pen was activated and submerged in the water and moved in a stirring motion for the duration of the preprogrammed time (designated as a cold start). Due to the large volume(1L) of the Nalgene® bottle a second treatment was done immediately following the first treatment.

The phage titer of the treated water was determined using the double agar overlay method. ( 4). The host *E.coli* ATCC 15597 was prepared as described by Johnson.(4)

### Test Results

	Control	treated	log reduction	% kill
Test 1	$5.9 \times 10^6$	$3.6 \times 10^3$	3.21	99.939
Test 2	$4.6 \times 10^6$	$3.0 \times 10^3$	3.19	99.935
Test 3	$5.5 \times 10^6$	$3.3 \times 10^3$	3.22	99.940
Average	$5.3 \times 10^6$	$3.3 \times 10^3$	3.20	99.938

## Conclusion

This testing indicates that Hydro-Photon's Steri-Pen is an effective anti microbial water treatment device even when treating volume of water up the one liter in Nalgene® bottles. With an average of -3.20 log reduction (99.938%) of coliphage MS2 in the one liter water samples. Steri-Pen's performance indicates that it should substantially exceed the U.S. E.P.A.'s minimum guidelines of 99.9999%, a 99.99% and a 99.9% removal/inactivation of bacteria, viruses, and protozoan cysts, respectively (2,3).

Anne Hanson

*Anne L. Hanson*  
University of Maine

Orono, Maine

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## Literature Cited

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