



# UNIVERSITY OF MAINE

Department of Biochemistry, Microbiology and Molecular Biology

5735 Hitchner Hall  
Orono, Maine 04469-5735  
207/581-2810  
207/581-2815  
FAX 207/581-2801

## Testing of Steri-Pen, a Hand-held Ultraviolet Water Treatment Device using MS2 Coliphage

### 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)



## Test Procedure

Sterile tap water samples (450ml) 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). 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

### Combined Cold Start Results 9/19, Start Results

Test	control MS2 phage titer	cold MS2 phage titer	log reduction	% kill
T3(9/19)	4.60E+09	2.72E+04	5.23	99.999
T4(9/19)	6.90E+09	1.63E+05	4.63	99.998
T1(10/10)	3.00E+08	8.00E+04	3.57	99.973
T2(10/10)	3.20E+08	8.10E+04	3.60	99.975
T3(10/10)	3.10E+08	1.80E+05	3.24	99.942
average			3.64	99.977

## Conclusion

This testing indicates that Hydro-Photon's Steri-Pen is an extremely effective anti microbial water treatment device. With an average of -3.64 log reduction (99.98%) of coliphage MS2 in the 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  
University of Maine  
Orono, Maine  
November 1, 2000

## Literature Cited

1. L.M. Prescott, J.P. Hartley, and D.A. Klein. 1999. Microbiology. 4th edition. WCB McGraw Hill, Boston, p132.
2. Wilson, B.R.P.F. Roessler, E. Van Dellen, M. Abbaszadegan and C.P. Gerba. Coliphage MS2 as a UV Water Disinfection Efficacy Test Surrogate for Bacterial and Viral Pathogens. University of Arizona, Tucson, AZ
3. U.S.E.P.A. - Task Force Report, 1987. Guide Standard and Protocol for Testing Microbiological Water Purifiers. United States Environmental Protection Agency, Registration Division, Office of Pesticide Programs and Criteria and Standards Division, Office of Drinking Water, Washington, DC
4. Johnson, S. 1989. A virus study using chloramine disinfection. In: American Water Works Water Quality Technology Conference Proceedings. November 13-17, 1998, St. Louis, Missouri. pp.75-96.