



Public Health  
England

# **Assessment of the Efficacy of Hydrogen Peroxide Vapour (HPV) Generated by the Specialist Hygiene Solutions Prototype HPV Unit**

**Report No. 16/030 C**

**Commercial in Confidence**

## Commercial in Confidence

On the 1st April 2013 HPA became Public Health England (PHE), the new logo for PHE contains the Royal Coat of Arms. Please be aware that the use of the Royal Coat of Arms is highly restricted and cannot be copied. Please do not put the PHE logo on your website. Any reference to PHE needs to be approved by us before it can be used.

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## About Public Health England

We work with national and local government, industry and the NHS to protect and improve the nation's health and support healthier choices. We address inequalities by focusing on removing barriers to good health.

We were established on 1 April 2013 to bring together public health specialists from more than 70 organisations into a single public health service.

## About Biosafety Investigation Unit

The Biosafety Investigation Unit at Porton Down has been carrying out independent evaluations of infection control interventions in laboratories, health care, containment, workplace and domestic settings for over twenty years. Our expertise is in air and water microbiology applied to nosocomial, pharmaceutical and containment situations. We have developed and offer standard techniques for the determination of the efficacy of filters and air disinfection units, the performance of safety cabinets, sealed centrifuges rotors and air samplers. We are also able to assess liquid and gaseous disinfectants and the microbial air quality of healthcare facilities, workplaces and other environments.

The Biosafety Investigation Unit provides specialist bespoke research, testing and evaluation services for commercial customers that delivers independent analysis and reports. However as a public sector body we are not able to endorse any particular products or recommend them for use by the NHS or others.

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## Executive summary

A study was carried out to investigate whether levels of Hydrogen Peroxide Vapour (HPV) generated from the Specialist Hygiene Solutions Prototype HPV unit (supplied by Specialist Hygiene Solutions UK Ltd.) inactivated spores of *Bacillus atrophaeus* (NCTC 10073) inoculated and dried onto stainless steel discs.

# Introduction

Gaseous disinfection has been routinely used in microbiology laboratories for many years. There are two main reasons for its use. Firstly, it is used to ensure the inactivation of potentially harmful bacteria and viruses on surfaces in order to prevent the exposure of laboratory and maintenance staff to infectious agents. It is also used to ensure a clean working environment to reduce the chances of contamination of the working area with background agents.

Over the last few decades the problems of diseases caused by environmental microbial contamination has been highlighted in scientific and social media. Therefore rapid, safe methods of decontaminating inhabited areas could help to reduce these levels of infection.

Hydrogen Peroxide Vapour is a relatively new gaseous form of disinfection but is high in popularity due to its natural decay to oxygen and water. A number of systems are available which have been specifically designed to carry out large-scale decontamination including laboratories, cleanrooms and hospital wards. The Specialist Hygiene Solutions Prototype HPV unit involves the use of Deproxin fluid, a 7% concentration formulation of hydrogen peroxide with silver. The Prototype HPV unit uses high frequency ultrasonics (1.8mhz) to create droplets of hydrogen peroxide solution. These droplets are entrained in a regulated air flow which forces and distributes it around the treatment space. Temperature and relative humidity parameters are monitored within the space and control the generation and injection of hydrogen peroxide vapour to ensure the dwell phase does not exceed 'dew point'. At the end of the treatment phase, the main Prototype HPV unit operates a deactivation fan, passing the air in the treatment space through a packed bed reactor of impregnated carbon to catalytically reduce the hydrogen peroxide vapour to water and oxygen.

This study has investigated the efficacy of HPV as a gaseous disinfectant against spores of the micro-organism *Bacillus atropheus* (NCTC 10073), dried on metal carriers. The study was carried out in a 21 m<sup>3</sup> room at PHE, Porton Down.

## Materials and Method

### Room set-up

The Specialist Hygiene Solutions Prototype HPV unit was set-up in the 21 m<sup>3</sup> environmental room (dimension 4 m x 2.3 m x 2.3 m) at PHE, Porton Down. The room is fitted with a filtered extract and supply ventilation system which was active whilst the operator was in the room. The ventilation system was not operated during the testing. The equipment was installed by Specialist Hygiene Solutions' staff and PHE staff were trained on its use.

### Hydrogen Peroxide Vapour Generation

The Specialist Hygiene Solutions Prototype HPV unit used to generate the HPV and was operated to the following parameters.

Parameters*	
Injection Delta	Peak RH of 97%
Dwell Time	30 minutes
Aeration Time	60 minutes
H2O2 volume	7%

\*Information supplied by Specialist Hygiene Solutions UK Ltd., no printed read out provided.

The experiment was carried out during 2016 at PHE, Porton Down.

### Micro-organism

#### *Bacillus atrophaeus* (NCTC 10073)

The *B. atrophaeus* spores ( $6.45 \times 10^8$  colony forming units (cfu) per ml) which had been thoroughly washed in distilled water were suspended in distilled water. The suspension was prepared from batches previously prepared by the HPA Production Division.

## Methodology Used

Nine Biological Indicators (BIs) were prepared by drying 10 µl of the microbial suspension onto the surface of sterilised stainless steel discs of 1 cm diameter. The micro-organisms were dried on the discs at 37°C for 1 hour.

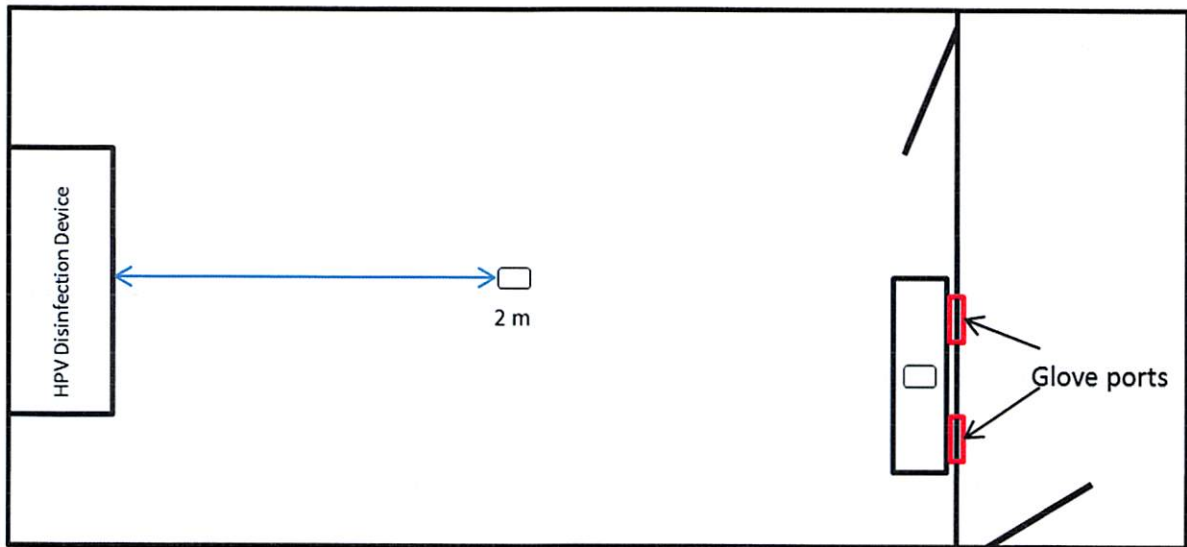
The HPV disinfection device was set up by Hygiene Solutions UK.

The discs were placed in the environmental room either on the table in front of the glove ports or 2 metres away from the disinfection device, at a height of approx. 1 metre off the floor. Three discs were placed at this location (see figure 1).

During the test procedure the room ventilation was turned off and the Specialist Hygiene Solutions Prototype HPV unit was activated. After completion of the cycle the room was vented for a period of 20 minutes before the operator entered and retrieved the samples. Two of the three discs from each location were assayed quantitatively to give a total viable count (TVC) and the remaining disc was assayed qualitatively. The discs that were assayed quantitatively were placed into individual universals containing 5mls Phosphate Buffered Saline (PBS). The universals were agitated using a mixer then serially diluted, plated onto suitable agar plates and incubated to observe any growth. Discs that were assayed qualitatively were placed into individual universals containing nutrient broth and incubated to show positive or negative growth.

Three positive controls were carried out for the test run. The positive controls were prepared by the same method as the test sample discs but they were not exposed to the disinfection cycle.

Figure 1. Diagram of sampling locations



# Results

## Test Conditions

Date	20 <sup>th</sup> September 2016	Challenge Micro-organisms	<i>Bacillus atrophaeus</i> NCTC 10073
Operators	Anna Moy	Suspension Fluid	Sterile Distilled Water
		Concentration	10 <sup>8</sup> cfu/ml (10µl)

## Results

Location	Coupon No.	Colony Forming Units			Average Total cfu	Log Reduction
		N	1ml	Rest		
2m from device	1	0, 0	0	0	<1	>6.44
	2	0, 0	0	0		
	3	Negative				
By glove ports	1	0, 0	0	0	<1	>6.44
	2	0, 0	0	0		
	3	Negative				

## Positive Control

Coupon No.	Colony Forming Units			Average Total cfu
	-2	-3	-4	
1	TNTC , TNTC	52, 58	4, 8	2.79 x 10 <sup>6</sup>
2	TNTC , TNTC	51, 62	15, 4	
3	positive			

### Test Conditions

Date	21 <sup>st</sup> September 2016	Challenge Micro-organisms	<i>Bacillus atrophaeus</i> NCTC 10073
Operators	Anna Moy	Suspension Fluid	Sterile Distilled Water
		Concentration	10 <sup>8</sup> cfu/ml (10µl)

### Results

Location	Coupon No.	Colony Forming Units			Average Total cfu	Log Reduction
		N	1ml	Rest		
2m from device	1	0, 0	0	0	<1	>6.50
	2	0, 0	0	0		
	3	Negative				
By glove ports	1	0, 0	0	0	<1	>6.50
	2	0, 0	0	0		
	3	Negative				

### Positive Control

Coupon No.	Colony Forming Units			Average Total cfu
	-2	-3	-4	
1	TNTC, TNTC	66, 64	5, 7	3.19 x 10 <sup>6</sup>
2	TNTC, TNTC	64, 61	6, 7	
3	positive			

## Test Conditions

Date	22 <sup>nd</sup> September 2016	Challenge Micro-organisms	<i>Bacillus atrophaeus</i> NCTC 10073
Operators	Anna Moy	Suspension Fluid	Sterile Distilled Water
		Concentration	10 <sup>8</sup> cfu/ml (10µl)

## Results

Location	Coupon No.	Colony Forming Units Neat (5ml)	Average Total cfu	Log Reduction
2m from device	1	0	<1	>6.37
	2	0		
	3	Negative		
By glove ports	1	0	<1	>6.37
	2	0		
	3	Negative		

## Positive Control

Coupon No.	Colony Forming Units			Average Total cfu
	-2	-3	-4	
1	TNTC , TNTC	41, 43	3 , 9	2.39 x 10 <sup>6</sup>
2	TNTC , TNTC	54, 53	7 , 7	
3	positive			

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