

Beam GmbH  
 Illertalstraße 3  
 DE-89281 Altenstadt

Hamburg, 14/05/2015

## Expert Opinion

### Removal of bacteria from PVC surfaces with the steam cleaner **BlueEvolution S** on the basis of the practice-like 4-field-test (as per 06/2013)

The steam cleaner **BlueEvolution S** was tested based on the publication of the VAH (Verbund für angewandte Hygiene) "Überprüfung der Wirksamkeit der Kombination von einem spezifizierten Wischtuch und einem Desinfektionsmittel im praxisnahen 4-Felder-Test" in Hygiene und Medizin (edition: 06/2013) on the removal of bacteria from surfaces. In this process, four test fields with the measurement of 5 x 5 cm were drawn on a PVC tile (20 x 50 cm). The first field was contaminated with a mixture of the test bacteria *Staphylococcus aureus*, sheep erythrocytes and bovine albumin. The test was carried out based on the above mentioned method as it was a steam cleaner instead of a disinfectant applied via wipes.

The cleaning process is based on water vapor with a temperature between 140 and 160 °C, an additional optional removal of the dirt with hot water as well as, if needed, the mechanical exposure through different brush heads at the steam nozzle. The removed residual dirt are vacuumed by the cleaner and transported via a hose to the waste water tank. Tap water is used for the steam generation.

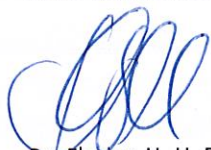
For the application the brush head was pulled over the contaminated tiles three times with a constant speed. Thereby, the removal rate on the first field as well as the carryover to the other fields were tested by using the superheated steam and vacuum function.

According to the test report no. L15/0214.1 dated 11/05/2015 of Dr. Brill + Partner GmbH the following results were determined:

Application	Field and reduction/ residual microbial count	
	Field 1 [log-Steps]	Field 2-f [CFU/25 cm <sup>2</sup> ]
Three times within 15 seconds (for all 4 fields), superheated steam	2.89 ± 0.15	3176.67 ± 2281.03

Through this type of application the microbial count was reduced by a similar size like under perfect conditions with a conventional cleaning process with folding bracket and wipe cover by using commercial professional cleaning agents. The microbial carryover was also similar.

Hence, the device reached a very good cleaning condition in terms of removal of bacteria from a PVC surface. No other biocidal or other chemical substances such as surfactants are used, which may remain on the surface by using conventional methods. A surface cleaned with the steam cleaner BlueEvolution S is treated perfectly for a disinfection process afterwards as no residual substances of a cleaning process or any other dirt could affect the success of the disinfection process.



Dr. Florian H. H. Brill



## Test Report NO. L15/0214.1

### Efficacy of **BlueEvolution S** at surface disinfection under dirty conditions (screening according to the practice-like 4-field-test as per 06/2013)

In accordance with your order we tested the steam cleaner **BlueEvolution S** for its activity in the surface test according to the 4-field-test under dirty conditions.

#### 1 General Information und Material

##### 1.1 Client

Client: beam GmbH, Mr. Robert Wiedemann, Illertalstraße 3, DE-89281 Altenstadt, Germany

Date of order: 13/04/2015

##### 1.2 Identification of Test Laboratory

Location: Dr. Brill + Partner GmbH · Institut für Hygiene und Mikrobiologie, Stiegstück 34, 22339 Hamburg

Study manager: Dipl.-Biol. Henrik Gabriel

Scientific assistant: Dipl.-Biol. Dr. rer. nat. Jan-Hendrik Klock

Laboratory technician: Carmela Jänicke

##### 1.3 Table of Content

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##### 1.4 Identification of Sample

Name of product: **BlueEvolution S**

Product description: Steam cleaner with different nozzles and brush heads

Are of use: Cleaning of surfaces e.g. floors, glass and mirror surfaces

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Cleaning process:	Water vapor with a temperature of min. 140 °C with extraction, supplementary if needed hot water with a temperature of min. 70 °C, additional brush heads for increasing the mechanical exposure
Manufacturer:	beam GmbH, DE-89281 Altenstadt, Germany
Date of delivery:	15/04/2015
Storage conditions:	room temperature and darkness
Recommended water quality:	tap water

### 1.5 Test Conditions

Test period:	15/04/2015 – 20/04/2015
Carrier:	PVC tiles (4-field-test)
Product settings:	steam level 3
Exposure times:	10 + 20 seconds
Test temperature:	20°C ± 1°C
Organic load:	dirty (0.3 % sheep erythrocytes + 0.3 % bovine albumin)
Neutralizer:	30 g/L polysorbate 80, 30 g/L saponin, 1 g/L histidine, 1 g/L cysteine in 0.2 mol N <sub>2</sub> HPO <sub>4</sub> buffer (TSHC)
Identification of test strains:	<i>Staphylococcus aureus</i> ATCC 6538

## 2 Methods

The tests were carried out on based on the publication of the VAH (Verbund für angewandte Hygiene) "Überprüfung der Wirksamkeit der Kombination von einem spezifizierten Wischtuch und einem Desinfektionsmittel im praxisnahen 4-Felder-Test" in Hygiene und Medizin (edition: 06/2013).

The test was carried out based on the above mentioned method as it was a steam cleaner instead of a disinfectant applied via wipes. The cleaning process is based on water vapor with a temperature between 140 and 160 °C, an additional optional removal of the dirty with hot water as well as, if needed, the mechanical exposure through different brush heads at the steam nozzle. The removed residual dirt is vacuumed by the cleaner and transported via a hose to the waste water tank. Tap water is used for the steam generation.

For the application the brush head was pulled over the contaminated tiles three times with a constant speed. Thereby, two passages were done with superheated steam and a third passage was done with additional water and vacuum.

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### 3 Results

The results of the tests are shown in tables 1 - 3. These are summarized in table a.

**Table a** Mean log-reduction and carryover achieved by the steam cleaner **BlueEvolution S** against *S. aureus* under dirty conditions

Application	Field and reduction/residual microbial count	
	Field 1 [log-Steps]	Field 2-f [CFU/25 cm <sup>2</sup> ]
One time within 10 seconds (for all 4 fields), superheated steam	1.19 ± 0.35	1425.56 ± 936.81
Three times within 15 seconds (for all 4 fields), superheated steam	2.89 ± 0.15	3176.67 ± 2281.03
Two times within 20 seconds (for all 4 fields), steam with hot water	2.67 ± 0.64	4317.78 ± 2755.33

### 4 Conclusion

In comparison to a classical cleaning process with folding bracket and wipe cover the system achieved a comparable reduction of the test bacteria by a three times application within 15 seconds with superheated steam without hot water. Concerning the carryover the device was similar.

Hamburg, 11/05/2015

Dipl.-Biol. Henrik Gabriel  
Study Manager

Dipl.-Biol. Dr. rer. nat. Florian H. H. Brill  
Managing Director

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Table 1: Validation, Controls and Evaluation (4-fieldtest according to VAH 06-2013)

Test product:	<b>BlueEvolution S</b>	Test strain:	<i>Staphylococcus aureus</i>
Exposure time:	<b>10 seconds</b>	Test temperature:	20°C ± 1°C
Passage:	1	Carrier:	PVC-tiles
Application:	steam, without hot water	Organic load:	dirty

Test suspension (N and N <sub>0</sub> )	N	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} / \lg N$	N <sub>0</sub> =N/20; lg N <sub>0</sub>	7,88 ≤ N <sub>v0</sub> ≤ 8,40 ?
	1,00E-07	168		213	168	213	1,94E+09	7,99	Yes
	1,00E-08	20		25	20	25	9,29		
Control test for drying (D <sub>co</sub> )	T <sub>0</sub>	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	lg T <sub>0</sub>	6,88 ≤ T <sub>0</sub> ≤ 8,40 ?
	1,00E-05	190		191	190	191	9,52E+07	7,98	Yes
	1,00E-06	19		19	19	19			
Control test for drying after t (D <sub>ct</sub> )	T <sub>t</sub>	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	N <sub>0</sub> =N/10; lg N <sub>0</sub>	6,88 ≤ T <sub>t</sub> ≤ 8,40 ?
	1,00E-04	>330		>330	>660	>660	1,63E+07	7,21	Yes
	1,00E-05	34		31	34	31			

**Test field 1 (Reduction)**

Parallels	Dilution	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	N <sub>a</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ )	lg N <sub>a</sub>	lg R
									(lg T <sub>t</sub> = 7,21)
1	1,00E-02	>330		>330	>330	>330	>3,30E+06	> 6,22	≤ 0,99
	1,00E-03	>330		>330	>330	>330			
2	1,00E-02	>330		>330	>330	>330	>3,30E+06	> 6,22	≤ 0,99
	1,00E-03	>330		>330	>330	>330			
3	1,00E-02	>330		>330	>330	>330	4,20E+05	5,62	1,59
	1,00E-03	80		88	80	88			

**Test fields 2-4 (CFU/25 cm<sup>2</sup>)**

Parallels	Dilution	Microbial count on test fields			V <sub>T2to4</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ ) CFU/25 cm <sup>2</sup>	V <sub>T2to4</sub> < 10 KBE/25cm <sup>2</sup>
		V <sub>c</sub> T <sub>2</sub>	V <sub>c</sub> T <sub>3</sub>	V <sub>c</sub> T <sub>4</sub>		
1	1,00E+00	1020	41	435	2493,33	No
2	1,00E+00	415	80	130	1041,67	No
3	1,00E+00	245	112	88	741,67	No

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Table 2: Validation, Controls and Evaluation (4-field-test according to VAH 06-2013)

Test product:	<b>BlueEvolution S</b>	Test strain:	<i>Staphylococcus aureus</i>
Exposure time:	<b>15 seconds</b>	Test temperature:	20°C ± 1°C
Passage:	3	Carrier:	PVC-tiles
Application:	steam, without hot water	Organic load:	dirty

Test suspension (N and N <sub>0</sub> )	N	Microbial count				V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} / \lg N$	N <sub>0</sub> =N/20; lg N <sub>0</sub>	7,88 ≤ N <sub>0</sub> ≤ 8,40 ?	
		1	2	3	4						
	1,00E-07	168		213		168	213	1,94E+09	7,99	Yes	
	1,00E-08	20		25		20	25	9,29			
Control test for drying (D <sub>c0</sub> )	T <sub>0</sub>	Microbial count				V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	lg T <sub>0</sub>	6,88 ≤ T <sub>0</sub> ≤ 8,40 ?	
		1,00E-05	190		191						
		1,00E-06	19		19		19	19			
Control test for drying after t (D <sub>ct</sub> )	T <sub>t</sub>	Microbial count				V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	N <sub>0</sub> =N/10; lg N <sub>0</sub>	6,88 ≤ T <sub>t</sub> ≤ 8,40 ?	
		1,00E-04	180		161						
		1,00E-05	21		16		21	16			

**Test field 1 (Reduction)**

Parallels	Dilution	Microbial count				V <sub>c1</sub>	V <sub>c2</sub>	N <sub>a</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ )	lg N <sub>a</sub>	lg R
		1	2	3	4					(lg T <sub>t</sub> = 6,93)
1	1,00E-02	20		22		20	22	1,05E+04	4,02	2,91
	1,00E-03	1		2		<14	<14			
2	1,00E-02	34		30		34	30	1,60E+04	4,20	2,73
	1,00E-03	2		3		<14	<14			
3	1,00E-02	17		16		17	16	8,25E+03	3,92	3,02
	1,00E-03	2		3		<14	<14			

**Test fields 2-4 (CFU/25 cm<sup>2</sup>)**

Parallels	Dilution	Microbial count on test fields			V <sub>T2to4</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ ) CFU/25 cm <sup>2</sup>	V <sub>T2to4</sub> <10 KBE/25cm <sup>2</sup>
		V <sub>c</sub> T <sub>2</sub>	V <sub>c</sub> T <sub>3</sub>	V <sub>c</sub> T <sub>4</sub>		
1	1,00E+00	56	87	670	1355,00	No
2	1,00E+00	47	94	3300	5735,00	No
3	1,00E+00	28	26	1410	2440,00	No

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Table 3: Validation, Controls and Evaluation (4-fiel-test according to VAH 06-2013)

Test product:	<b>BlueEvolution S</b>	Test strain:	<i>Staphylococcus aureus</i>
Exposure time:	<b>20 seconds</b>	Test temperature:	20°C ± 1°C
Passage:	2 + 2	Carrier:	PVC-tiles
Application:	steam, with hot water	Organic load:	dirty

Test suspension (N and N <sub>0</sub> )	N	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} / \lg N$	N <sub>0</sub> =N/20; lg N <sub>0</sub>	7,88 ≤ N <sub>v0</sub> ≤ 8,40?	
		1,00E-07	168		213	168	213	1,94E+09	7,99	Yes
	1,00E-08	20		25	20	25	9,29			
Control test for drying (D <sub>c0</sub> )	T <sub>0</sub>	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	lg T <sub>0</sub>	6,88 ≤ T <sub>0</sub> ≤ 8,40?	
		1,00E-05	190		191	190	191	9,52E+07	7,98	Yes
		1,00E-06	19		19	19	19			
Control test for drying after t (D <sub>ct</sub> )	T <sub>t</sub>	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	$\bar{x}_{wm} * 5$	N <sub>0</sub> =N/10; lg N <sub>0</sub>	6,88 ≤ T <sub>t</sub> ≤ 8,40?	
		1,00E-04	190		118	190	118	7,70E+06	6,89	Yes
		1,00E-05	13		16	13	16			

**Test field 1 (Reduction)**

Parallels	Dilution	Microbial count			V <sub>c1</sub>	V <sub>c2</sub>	N <sub>a</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ )	lg N <sub>a</sub>	lg R
				(lg T <sub>t</sub> = 6,89)					
1	1,00E-02	1		3	<14	<14	<7,00E+03	< 3,85	≥ 3,04
	1,00E-03	0		0	<14	<14			
2	1,00E-02	11		12	<14	<14	<7,00E+03	< 3,85	≥ 3,04
	1,00E-03	1		3	<14	<14			
3	1,00E-02	>330		>330	>330	>330	8,75E+04	4,94	1,94
	1,00E-03	16		19	16	19			

**Test fields 2-4 (CFU/25 cm<sup>2</sup>)**

Parallels	Dilution	Microbial count on test fields			V <sub>T2to4</sub> (= $\bar{x}$ or $\bar{x}_{wm} * 5$ ) CFU/25 cm <sup>2</sup>	V <sub>T2to4</sub> <10 KBE/25cm <sup>2</sup>
		V <sub>cT2</sub>	V <sub>cT3</sub>	V <sub>cT4</sub>		
1	1,00E+00	20	3300	980	7166,67	No
2	1,00E+00	52	1580	840	4120,00	No
3	1,00E+00	84	710	206	1666,67	No

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## 5 List of Abbreviations

CFU	=	colony forming units (viable count)
Ko1	=	WSH-control
Ko2	=	control of neutralization
Ko3	=	control of non- toxicity of neutralizer
n.a.	=	not measureable
n.u.	=	not tested
o	=	above the detection limit
RF	=	reduction factor

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