EP Lighting, Inc.

Germicidal Effects of UV-Kleen™

Following times are calculated based on the 1 meter measurement of 1345uW/cm^2 irradiance at 253.7nm. The times are in seconds.

UV-Kleen™ on Coronavirus

Microbe	D90 Dose mJ/cm$_2$	Time (sec) to 90% kill at 2 inch	Time (sec) to 90% kill at 3ft	Source
Coronavirus	0.66	0.017	0.49	Walker 2007[a]
Berne virus (Coronaviridae)	0.72	0.018	0.54	Weiss 1986
SARS-CoV-2 (Italy-INMI1)	1.23	0.032	0.91	Bianco 2020
Murine Coronavirus (MHV)	1.5	0.038	1.12	Hirano 1978
SARS Coronavirus (Frankfurt 1)	1.64	0.042	1.22	Eickmann 2020
Canine Coronavirus (CCV)	2.85	0.073	2.12	Saknimit 1988[b]
Murine Coronavirus (MHV)	2.85	0.073	2.12	Saknimit 1988[b]
SARS Coronavirus (CoV-P9)	4	0.103	2.97	Duan 2003[c]
SARS-CoV-2 (SARS-CoV-2/Hu/DP/Kng/19-027)	4.17	0.107	3.10	Inagaki 2020
Murine Coronavirus (MHV)	10.3	0.264	7.66	Liu 2003
SARS Coronavirus (Hanoi)	13.39	0.343	9.96	Kariwa 2004[d]
SARS Coronavirus (Urbani)	241	6.179	179.18	Darnell 2004
Average	23.7	0.608	17.62	
Average excluding outliers	4.7	0.121	3.49	
Average for SARS-CoV-2	2.7	**0.07**	**2.00**	

UV-Kleen™ on Virus

VIRUS	HOST	Reference	Time to disinfect 99% at 3ft
PRD-1 (Phage)	*S. typhimurium* Lt2	Meng and Gerba 1996	12.79
B40-8 (Phage)	*B. Fragilis*	Sommer et al. 2001	12.64
B40-8 (Phage)	*B. fragilis* HSP-40	Sommer et al 1998	13.38
MS2 (Phage)	*Salmonella typhimurium* WG49	Nieuwstad and Havelaar 1994	26.02

MS2 DSM 5694 (Phage)	*E. coli* NCIB 9481	Wiedenmann et al. 1993	11.90
MS2 ATCC 15977-B1 (Phage)	*E. coli* ATCC 15977–B1	Wilson et al. 1992	25.28
MS2 NCIMB	*Salmonella typhimurium* WG49	Tree et al. 1997	22.38
MS2 (Phage)	*E. coli* K-12 Hfr	Sommer et al. 1998	26.77
MS2 (Phage)	*E. coli* CR63	Rauth 1965	25.13
MS2 (Phage)	*E. coli* 15977	Meng and Gerba 1996	21.26
MS2 (Phage)	*E. coli* ATCC 15597	Oppenheimer et al. 1993	29.74
MS2 (Phage)	*E. coli* C3000	Batch et al. 2004	31.23
MS2 (Phage)	*E. coli* ATCC 15597	Lazarova and Savoye 2004	31.23
MS2 (Phage)	*E. coli* HS(pFamp)R	Thompson et al. 2003	33.46
MS2 (Phage)	*E. coli* C3000	Linden et al. 2002a	31.23
MS2 (Phage)	*E. coli* K-12	Sommer et al. 2001	26.77
MS2 (Phage)	*E. coli* NCIMB 9481	Tree et al. 2005	10.41
PHI X 174 (Phage)	*E. coli* WG5	Sommer et al. 1998	3.94
PHI X 174 (Phage)	*E. coli* C3000	Battigelli et al. 1993	3.12
PHI X 174 (Phage)	*E. coli* ATCC15597	Oppenheimer et al. 1993	5.95
PHI X 174 (Phage)	*E. coli* WG 5	Sommer et al. 2001	3.72
PHI X 174 (Phage)	*E. coli* ATCC 13706	Giese and Darby 2000	2.60
Calicivirus canine	*MDCK cell line*	Husman et al. 2004	11.15
Calicivirus feline	*CRFK cell line*	Husman et al. 2004	11.90
Calicivirus feline	*CRFK cell line*	Tree et al. 2005	6.69
Adenovirus type 2	*A549 cell line*	Thurston-Enriquez et al. 2003	33.46
Adenovirus type 2	*Human lung cell line*	Shin et al. 2005	40.89
Adenovirus type 2	*PLC / PRF / 5 cell line*	Ballester and Malley 2004	57.99
Adenovirus type 15	*A549 cell line (ATCC CCL-185)*	Thompson et al. 2003	59.48
Poliovirus Type 1 LSc2ab ()	*MA104 cell*	Chang et al. 1985	8.18
Poliovirus Type 1 LSc2ab	*BGM cell*	Wilson et al. 1992	8.18
Poliovirus 1	*BGM cell line*	Tree et al. 2005	8.18
Poliovirus 1	*CaCo2 cell-line (ATCC HTB37)*	Thompson et al. 2003	12.64
Poliovirus 1	*BGM cell line*	Gerba et al. 2002	11.52
Poliovirus Type Mahoney	*Monkey kidney cell line Vero*		5.20

		Sommer et al. 1989	
Coxsackievirus B5	*Buffalo Green Monkey cell line*	Battigelli et al. 1993	10.19
Coxsackievirus B3	*BGM cell line*	Gerba et al. 2002	11.90
Coxsackievirus B5	*BGM cell line*	Gerba et al. 2002	13.38
Reovirus-3	*Mouse L-60*	Rauth 1965	16.65
Reovirus Type 1 Lang strain		Harris et al. 1987	26.77
Rotavirus SA-11	*Monkey kidney cell line MA 104*	Sommer et al. 1989	11.15
Rotavirus SA-11	*MA-104 cell line*	Battigelli et al. 1993	11.38
Rotavirus SA-11	*MA-104 cell line*	Chang et al. 1985	11.00
Rotavirus SA-11	*MA-104 cell line*	Wilson et al. 1992	14.13
Rotavirus	*MA104 cells*	Caballero et al. 2004	59.48
Hepatitis A HM175	*FRhK-4 cell*	Wilson et al. 1992	10.19
Hepatitis A	*HAV/HFS/GBM*	Wiedenmann et al. 1993	7.29
Hepatitis A HM175	*FRhK-4 cell*	Battigelli et al. 1993	6.10
Echovirus I	*BGM cell line*	Gerba et al. 2002	12.27
Echovirus II	*BGM cell line*	Gerba et al. 2002	10.41

UV-Kleen™ on Bacteria

BACTERIA	Reference	Time in sec to disinfect 99% at 3ft
	Wilson et al. 1992	1.93
Aeromonas salmonicida	Liltved and Landfald 1996	2.01
Campylobacter jejuni ATCC 43429	Wilson et al. 1992	2.53
Citrobacter diversus	Giese and Darby 2000	5.20
Citrobacter freundii	Giese and Darby 2000	6.69
Escherichia coli ATCC 11229	Harris et al. 1987	2.23
Escherichia coli ATCC 11303	Wu et al. 2005	4.46
Escherichia coli ATCC 25922	Sommer et al. 1998	4.83
Escherichia coli C	Otaki et al. 2003	2.23
Escherichia coli O157:H7	Yaun et al. 2003	1.49
Escherichia coli O157:H7 CCUG 29193	Sommer et al. 2000	3.49
Escherichia coli O157:H7 CCUG 29197	Sommer et al. 2000	2.23
Escherichia coli O157:H7 CCUG 29199	Sommer et al. 2000	0.52
Escherichia coli O157:H7 ATCC 43894	Wilson et al. 1992	2.08
Escherichia coli O25:K98:NM	Sommer et al. 2000	5.58
Escherichia coli O26	Tosa and Hirata 1999	5.95
Escherichia coli O50:H7	Sommer et al. 2000	2.23
Escherichia coli O78:H11	Sommer et al. 2000	3.72

Escherichia coli K-12 IFO3301	Otaki et al. 2003	1.49
Escherichia coli Wild type	Sommer et al. 1998	4.61
Halobacterium elongata ATCC33173	Martin et al. 2000	0.52
Halobacterium salinarum ATCC43214	Martin et al. 2000	11.15
Klebsiella pneumoniae	Giese and Darby 2000	11.15
Klebsiella terrigena ATCC33257	Wilson et al. 1992	4.98
Legionella pneumophila ATCC 43660	Wilson et al. 1992	3.72
Legionella pneumophila ATCC33152	Oguma et al. 2004	2.38
Legionella pneumophila ATCC33152	Oguma et al. 2004	2.83
Pseudomonas stutzeri	Joux et al. 1999	111.52
RB2256	Joux et al. 1999	223.05
Salmonella spp.	Yaun et al. 2003	1.49
Salmonella anatum (from human feces)	Tosa and Hirata 1998	8.92
Salmonella derby (from human feces)	Tosa and Hirata 1998	5.58
Salmonella enteritidis (from human feces)	Tosa and Hirata 1998	5.20
Salmonella infantis (from human feces)	Tosa and Hirata 1998	2.97
Salmonella typhi ATCC 19430	Wilson et al. 1992	3.57
Salmonella typhi ATCC 6539	Chang et al. 1985	3.05
Salmonella typhimurium (from human feces)	Tosa and Hirata 1998	2.60
Salmonella typhimurium (from human feces)	Tosa and Hirata 1998	2.60
Salmonella typhimurium (in act. sludge)	Maya et al. 2003	8.55
Salmonella typhimurium	Joux et al. 1999	74.35
Shigella dysenteriae ATCC29027	Wilson et al. 1992	0.89
Shigella sonnei ATCC9290	Chang et al. 1985	3.64
Staphylococcus aureus ATCC25923	Chang et al. 1985	4.01
Streptococcus faecalis ATCC29212	Chang et al. 1985	6.54
Streptococcus faecalis (secondary effluent)	Harris et al. 1987	4.83
Vibrio anguillarum	Liltved and Landfald 1996	0.89
Vibrio cholerae ATCC25872	Wilson et al. 1992	1.04
Vibrio natriegens	Joux et al. 1999	55.76
Yersinia enterocolitica ATCC27729	Wilson et al. 1992	2.08
Yersinia ruckeri	Liltved and Landfald 1996	1.49

UV-Kleen™ on Protozoa

Protozoa	Reference	Time to disinfect 99% at 3ft
Cryptosporidium hominis	Johnson et al. 2005	4.31
Cryptosporidium parvum, oocysts, tissue culture assay	Shin et al. 2000	1.71
Cryptosporidium parvum	Craik et al. 2001	3.72
Encephalitozoon cuniculi, microsporidia	Marshall et al. 2003	6.69
Encephalitozoon hellem, microsporidia	Marshall et al. 2003	8.92
Encephalitozoon intestinalis, microsporidia	Huffman et al. 2002	2.23
Giardia lamblia	Mofidi et al. 2002	1.49
Giardia lamblia,excystation assay	Rice and Hoff 1981	46.84
Giardia muris, excystation assay	Carlson et al. 1985	81.78
G. muris, cysts, *mouse infectivity assay*	Craik et al. 2000	4.46
Giardia muris	Craik et al. 2000	3.35
Giardia muris	Belosevic et al. 2001	7.43
Giardia muris	Hayes et al. 2003	1.41
Giardia muris	Mofidi et al. 2002	1.49
G. muris, cysts	Amoah et al. 2005	3.72

UV-Kleen™ on Spores

SPORES	Reference	Time to disinfect 99% at 3ft
Bacillus subtilis ATCC6633	Mamane-Gravetz and Linden 2004	26.02
Bacillus subtilis WN626	Marshall et al., 2003	0.67