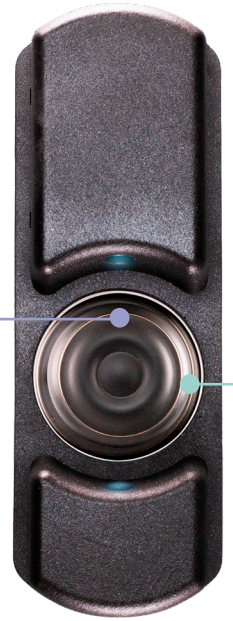
CITRUS

19mW LED Disinfectant Calculations

Point A - Irradiance Calculation		
Irradiance (Ee) =	Ee=Φe/(4πd^2)	
Radiant Flux (Φe)	19	mW
Distance (d)	1.905	cm
Denominator	45.60	(4πd^2)
Irradiance at Point A	416.63	µW/cm^2
Total Irradiance at Point A 30 seconds)	12,498.99	Irradiance * 30sec
Total Irradiance at Point A (60 seconds)	24,997.99	Irradiance * 60sec



Point B - Irradiance Calculation		
Irradiance (Ee) =	Ee=Φe/(4πd^2)	
Radiant Flux	19	mW
Distance	3.81	cm
Denominator	182.41	(4πd^2)
Irradiance at Point B	104.16	µW/cm^2
Total Irradiance at Point B (30 seconds)	3,124.75	Irradiance * 30sec
Total Irradiance at Point B (60 seconds)	6,249.50	Irradiance * 60sec

Function to Determine Kill Percentage	
F(x)	1-e^(-x*2.30258509)
F(y)	log(1-y)=-2.30258509x

Compiled using various sources including, but not limited to:

- *Brickner, Philip & Vincent, Richard & First, Melvin & Nardell, Edward & Murray, Megan & Kaufman, Will. (2003). The application of ultraviolet germicidal irradiation to control transmission of airborne disease: Bioterrorism countermeasure. Public health reports (Washington, D.C. : 1974). 118. 99-114. 10.1016/S0033-3549(04)50225-X.*
- *Bolton, James & Cotton, Christine. (2008). The Ultraviolet Disinfection Handbook.*

Kill Percentage of Various Microbials with Citrus

Bacteria	Point A		Point B	
	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds
Bacillus anthracis - Anthrax	99.0%	99.9%	80.0%	90.0%
Bacillus anthracis spores - Anthrax spores	80.0%	90.0%	25.0%	50.0%
Bacillus magaterium sp. (spores)	99.9%	99.9%	90.0%	99.0%
Bacillus magaterium sp. (veg.)	99.9%	99.9%	99.0%	99.9%
Bacillus paratyphusus	99.9%	99.9%	80.0%	99.0%
Bacillus subtilis spores	90.0%	99.0%	50.0%	80.0%
Bacillus subtilis	99.0%	99.9%	80.0%	90.0%
Clostridium tetani	80.0%	99.0%	50.0%	80.0%
Corynebacterium diphtheriae	99.9%	99.9%	80.0%	90.0%
Ebertelia typhosa	99.9%	99.9%	90.0%	99.0%
Escherichia coli	99.9%	99.9%	90.0%	90.0%
Leptospiracanicola - infectious Jaundice	99.9%	99.9%	80.0%	99.0%
Micrococcus candidus	99.0%	99.9%	80.0%	90.0%
Micrococcus sphaeroides	99.9%	99.9%	99.9%	99.9%
Mycobacterium tuberculosis	99.0%	99.9%	80.0%	90.0%
Neisseria catarrhalis	99.0%	99.9%	80.0%	90.0%
Phytomonas tumefaciens	99.0%	99.9%	80.0%	90.0%
Proteus vulgaris	99.9%	99.9%	90.0%	90.0%
Pseudomonas aeruginosa	99.0%	99.9%	80.0%	90.0%
Pseudomonas fluorescens	99.9%	99.9%	80.0%	90.0%
Salmonella enteritidis	99.9%	99.9%	80.0%	90.0%
Salmonela paratyphi - Enteric fever	99.9%	99.9%	80.0%	99.0%
Salmonella typhosa - Typhoid fever	99.9%	99.9%	90.0%	99.0%
Salmonella typhimurium	90.0%	99.9%	80.0%	80.0%
Sarcina lutea	80.0%	90.0%	50.0%	80.0%
Serratia marcescens	99.9%	99.9%	90.0%	99.0%
Shigella dyseteriae - Dysentery	99.9%	99.9%	90.0%	99.0%
Shigella flexneri - Dysentery	99.9%	99.9%	90.0%	99.9%
Shigella paradysenteriae	99.9%	99.9%	90.0%	99.9%
Spirillum rubrum	99.0%	99.9%	80.0%	99.0%
Staphylococcus albus	99.9%	99.9%	90.0%	99.9%
Staphylococcus aureus	99.9%	99.9%	90.0%	90.0%
Staphylococcus hemolyticus	99.9%	99.9%	90.0%	99.0%
Staphylococcus lactis	99.0%	99.9%	80.0%	90.0%
Streptococcus viridans	99.9%	99.9%	90.0%	99.9%
Vibrio comma - Cholera	99.9%	99.9%	80.0%	90.0%

Kill Percentage of Various Microbials with Citrus				
Viruses	Point A		Point B	
	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds
Bacteriopfage - E. Coli	99.9%	99.9%	90.0%	90.0%
Infectious Hepatitis	99.0%	99.9%	80.0%	90.0%
Influenza	99.9%	99.9%	80.0%	90.0%
Poliovirus - Poliomyelitis	99.9%	99.9%	80.0%	90.0%
Tobacco mosaic	10.0%	25.0%	0.0%	10.0%

Kill Percentage of Various Microbials with Citrus				
Molds	Point A		Point B	
	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds
Aspergillius flavus	50.0%	80.0%	10.0%	25.0%
Aspergillius glaucus	50.0%	80.0%	25.0%	50.0%
Aspergillius niger	25.0%	50.0%	10.0%	10.0%
Mucor racemosus A	80.0%	90.0%	50.0%	80.0%
Mucor racemosus B	80.0%	90.0%	50.0%	80.0%
Oospora lactis	99.0%	99.9%	80.0%	90.0%
Penicillium expansum	80.0%	99.0%	50.0%	80.0%
Penicillium roqueforti	80.0%	90.0%	50.0%	80.0%
Penicillium digitatum	50.0%	80.0%	25.0%	50.0%
Rhisopus nigricans	25.0%	50.0%	10.0%	25.0%

Kill Percentage of Various Microbials with Citrus				
Protozoa	Point A		Point B	
	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds
Chlorella Vulgaris	80.0%	99.0%	50.0%	80.0%
Nematode Eggs	50.0%	80.0%	25.0%	50.0%
Paramecium	90.0%	99.0%	50.0%	80.0%

Kill Percentage of Various Microbials with Citrus				
Yeast	Point A		Point B	
	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds	Kill Factor with Citrus in 30 seconds	Kill Factor with Citrus in 60 seconds
Brewers yeast	99.9%	99.9%	80.0%	90.0%
Common yeast cake	90.0%	99.9%	80.0%	90.0%
Saccharomyces carevisiae	90.0%	99.9%	80.0%	90.0%
Saccharomyces ellipsoideus	90.0%	99.9%	80.0%	90.0%
Saccharomyces spores	90.0%	99.9%	80.0%	80.0%