

# DOSAGE CHART

The degree of inactivation by ultraviolet radiation is directly related to the UV dose applied

## The UV DOSE is the PRODUCT of

*UV intensity or UV energy per unit surface area usually expressed in  $\mu\text{W}/\text{cm}^2$ [UVI]*

*AND*

*Exposure time [T].*

Therefore **DOSE = UVI x T expressed in  $\mu\text{W-s}/\text{cm}^2$**

The UVC exposure dosage needed<sup>1</sup> for each level of reduction for an abridged list of micro-organisms is shown in the table below.

The reduction of micro-organisms is classified using a logarithmic scale. A single log reduction refers to a 90% reduction of organisms. A two log reduction is a 99% reduction of organisms, followed by a three log reduction (99.9%), etc.

## Example

To compute the time needed<sup>2</sup> to inactivate the specific micro-organism divide the UV dosage needed by the UV intensity of the lamp.

**Take the case of VIOLight Saber (Regular), which has intensity of  $1600 \mu\text{W}/\text{cm}^2$  at 6"**

### Time needed for a 99% reduction of Influenza Virus

$$6600 \mu\text{W-s}/\text{cm}^2 / 1600 \mu\text{W}/\text{cm}^2 = 4.125 \text{ secs}$$

<sup>1</sup> A full list of published references where the data is extracted from is also mentioned below the table.

<sup>2</sup> The UV intensity of the lamp is given at a specific distance from the lamp. So, the lamp has to be placed at that distance from the micro-organism for the calculation to be valid.

| Microorganism                              | Ultraviolet radiation (dose) in µW-s/cm2 needed to inactivate |                          |                            |                             |
|--------------------------------------------|---------------------------------------------------------------|--------------------------|----------------------------|-----------------------------|
| Bacteria                                   | 90%<br>(1 log reduction)                                      | 99%<br>(2 log reduction) | 99.9%<br>(3 log reduction) | 99.99%<br>(4 log reduction) |
| Bacillus anthracis - Anthrax               | 4,520                                                         | 8,700                    | 13,560                     | 18,080                      |
| Bacillus anthracis spores - Anthrax spores | 24,320                                                        | 48,640                   |                            |                             |
| Bacillus magaterium sp. (spores)           | 2,730                                                         | 5,460                    | 8,190                      | 10,920                      |
| Bacillus magaterium sp. (veg.)             | 1,300                                                         | 2,600                    | 3,900                      | 5,200                       |
| Bacillus paratyphus                        | 3,200                                                         | 6,400                    | 9,600                      | 12,800                      |
| Bacillus subtilis spores                   | 11,600                                                        | 23,200                   |                            |                             |
| Bacillus subtilis                          | 5,800                                                         | 11,600                   | 17,400                     | 23,200                      |
| Clostridium tetani                         | 13,000                                                        | 22,000                   |                            |                             |
| Corynebacterium diphtheriae                | 3,370                                                         | 6,510                    | 10,110                     | 13,480                      |
| Ebertelia typhosa                          | 2,140                                                         | 4,100                    | 6,420                      | 8,560                       |
| Escherichia coli                           | 3,000                                                         | 6,600                    | 9,000                      | 12,000                      |
| Leptospiracanicola - infectious Jaundice   | 3,150                                                         | 6,000                    | 9,450                      | 12,600                      |
| Micrococcus candidus                       | 6,050                                                         | 12,300                   | 18,150                     | 24,200                      |
| Micrococcus sphaeroides                    | 1,000                                                         | 2,000                    | 3,000                      | 4,000                       |
| Mycobacterium tuberculosis                 | 6,200                                                         | 12,400                   | 18,600                     | 24,800                      |
| Neisseria catarrhalis                      | 4,400                                                         | 8,500                    | 13,200                     | 17,600                      |
| Phytomonas tumefaciens                     | 4,400                                                         | 8,800                    | 13,200                     | 17,600                      |
| Proteus vulgaris                           | 3,000                                                         | 6,600                    | 9,000                      | 12,000                      |
| Pseudomonas aeruginosa                     | 5,500                                                         | 10,500                   | 16,500                     | 22,000                      |
| Pseudomonas fluorescens                    | 3,500                                                         | 6,600                    | 10,500                     | 14,000                      |
| Salmonella enteritidis                     | 4,000                                                         | 8,000                    | 12,000                     | 16,000                      |
| Salmonella paratyphi - Enteric fever       | 3,200                                                         | 6,400                    | 9,600                      | 12,800                      |
| Salmonella typhosa - Typhoid fever         | 2,150                                                         | 4,300                    | 6,450                      | 8,600                       |
| Salmonella typhimurium                     | 8,000                                                         | 15,200                   | 24,000                     | 32,000                      |
| Sarcina lutea                              | 19,700                                                        | 26,400                   |                            |                             |
| Serratia marcescens                        | 2,420                                                         | 4,840                    | 7,260                      | 9,680                       |
| Shigella dysenteriae - Dysentery           | 2,200                                                         | 4,400                    | 6,600                      | 8,800                       |
| Shigella flexneri - Dysentery              | 1,700                                                         | 3,400                    | 5,100                      | 6,800                       |
| Shigella paradysenteriae                   | 1,680                                                         | 3,300                    | 5,040                      | 6,720                       |
| Spirillum rubrum                           | 4,400                                                         | 8,800                    | 13,200                     | 17,600                      |
| Staphylococcus albus                       | 1,840                                                         | 3,680                    | 5,520                      | 7,360                       |
| Staphylococcus aureus MRSA                 | 2,600                                                         | 5,200                    | 7,800                      | 10,400                      |
| Staphylococcus hemolyticus                 | 2,160                                                         | 4,320                    | 6,480                      | 8,640                       |
| Staphylococcus lactis                      | 6,150                                                         | 12,300                   | 18,450                     | 24,600                      |
| Streptococcus viridans                     | 2,000                                                         | 4,000                    | 6,000                      | 8,000                       |
| Vibrio comma - Cholera                     | 3,375                                                         | 6,750                    | 10,120                     | 13,500                      |
| <b>Molds</b>                               |                                                               |                          |                            |                             |
| Aspergillus flavus                         | 60,000                                                        | 99,000                   |                            |                             |
| Aspergillus glaucus                        | 44,000                                                        | 88,000                   | 1,32,000                   | 1,76,000                    |
| Aspergillus niger                          | 1,32,000                                                      | 2,64,000                 | 3,96,000                   | 5,28,000                    |
| Mucor racemosus A                          | 17,000                                                        | 35,200                   |                            |                             |
| Mucor racemosus B                          | 17,000                                                        | 35,200                   |                            |                             |
| Oospora lactis                             | 5,000                                                         | 10,000                   | 15,000                     | 20,000                      |
| Penicillium expansum                       | 13,000                                                        | 22,000                   |                            |                             |
| Penicillium roqueforti                     | 13,000                                                        | 26,400                   |                            |                             |
| Penicillium digitatum                      | 44,000                                                        | 88,000                   |                            |                             |
| Rhizopus nigricans                         | 1,11,000                                                      | 2,20,000                 |                            |                             |
| <b>Protozoa</b>                            |                                                               |                          |                            |                             |
| Chlorella Vulgaris                         | 13,000                                                        | 26,000                   | 39,000                     | 52,000                      |
| Nematode Eggs                              | 45,000                                                        | 92,000                   |                            |                             |
| Paramecium                                 | 11,000                                                        | 20,000                   |                            |                             |
| <b>Virus</b>                               |                                                               |                          |                            |                             |
| Bacteriophage - E. Coli                    | 2,600                                                         | 6,600                    |                            |                             |
| Infectious Hepatitis                       | 5,800                                                         | 11,600                   | 17,400                     | 23,200                      |
| Influenza                                  | 3,400                                                         | 6,800                    | 10,200                     | 13,600                      |
| Poliovirus - Poliomyelitis                 | 3,150                                                         | 6,600                    |                            |                             |
| Tobacco mosaic                             | 2,40,000                                                      | 4,40,000                 |                            |                             |
| <b>Yeast</b>                               |                                                               |                          |                            |                             |
| Brewers yeast                              | 3,300                                                         | 6,600                    | 9,900                      | 13,200                      |
| Common yeast cake                          | 6,000                                                         | 12,000                   | 18,000                     | 24,000                      |
| Saccharomyces carevisiae                   | 6,000                                                         | 13,200                   |                            |                             |
| Saccharomyces ellipsoideus                 | 6,000                                                         | 13,200                   |                            |                             |
| Saccharomyces spores                       | 8,000                                                         | 16,000                   | 24,000                     | 32,000                      |

Sources:

1. American Air & Water UV Irradiation Dosage Table accessed at <https://www.americanairandwater.com/uv-facts/uv-dosage.htm>
2. UV Sensitivity Review : Fluence (UV Dose) Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa Viruses and Algae BY Adel Haji Malayeri, Madjid Mohseni, Bill Cairns and James R. Bolton
3. Light Sources Inc
4. American Ultraviolet Company
5. UV-Light.co.uk