

UNIVERSAL LIGHT SOURCE, INC.
 1553 FOLSOM ST.
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| ORGANISM | Germicidal Kill Rates | | | | | | | | | | | | | | | | | | | | |
|---|-------------------------------|--|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| | UV TO KILL IN MW-SECS/CM*2 | TIME IN SEC FOR "QUICK KILL" - (99.9% DESTRUCTION) | | | | | | | | | | | | | | | | | | | |
| | | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
| REQUIRED MW/CM*2 @ 1M | | | | | | | | | | | | | | | | | | | | | |
| Bacillus anthracis | 8700 | 1740 | 870 | 580 | 435 | 348 | 290 | 249 | 218 | 193 | 174 | 158 | 145 | 134 | 124 | 116 | 109 | 102 | 97 | 92 | 87 |
| S. enteritidis | 7600 | 1520 | 760 | 507 | 380 | 304 | 253 | 217 | 190 | 169 | 152 | 138 | 127 | 117 | 109 | 101 | 95 | 89 | 84 | 80 | 76 |
| B. Megatherium sp. (veg.) | 2500 | 500 | 250 | 167 | 125 | 100 | 83 | 71 | 63 | 56 | 50 | 45 | 42 | 38 | 36 | 33 | 31 | 29 | 28 | 26 | 25 |
| B. Megatherium sp. (spores) | 5200 | 1040 | 520 | 347 | 260 | 208 | 173 | 149 | 130 | 116 | 104 | 95 | 87 | 80 | 74 | 69 | 65 | 61 | 58 | 55 | 52 |
| B. paratyphosus | 6100 | 1220 | 610 | 407 | 305 | 244 | 203 | 174 | 153 | 136 | 122 | 111 | 102 | 94 | 87 | 81 | 76 | 72 | 68 | 64 | 61 |
| B. subtilis | 11000 | 2200 | 1100 | 733 | 550 | 440 | 367 | 314 | 275 | 244 | 220 | 200 | 183 | 169 | 157 | 147 | 138 | 129 | 122 | 116 | 110 |
| B. subtilis spores | 22000 | 4400 | 2200 | 1467 | 1100 | 880 | 733 | 629 | 550 | 489 | 440 | 400 | 367 | 338 | 314 | 293 | 275 | 259 | 244 | 232 | 220 |
| Clostridium tetani | 22000 | 4400 | 2200 | 1467 | 1100 | 880 | 733 | 629 | 550 | 489 | 440 | 400 | 367 | 338 | 314 | 293 | 275 | 259 | 244 | 232 | 220 |
| Corynebacterium diptheriae | 6500 | 1300 | 650 | 433 | 325 | 260 | 217 | 186 | 163 | 144 | 130 | 118 | 108 | 100 | 93 | 87 | 81 | 76 | 72 | 68 | 65 |
| Eberthella typosa | 4100 | 820 | 410 | 273 | 205 | 164 | 137 | 117 | 103 | 91 | 82 | 75 | 68 | 63 | 59 | 55 | 51 | 48 | 46 | 43 | 41 |
| Escherichia coli | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Micrococcus cadidus | 12300 | 2460 | 1230 | 820 | 615 | 492 | 410 | 351 | 308 | 273 | 246 | 224 | 205 | 189 | 176 | 164 | 154 | 145 | 137 | 129 | 123 |
| Micrococcus sphaeroides | 15400 | 3080 | 1540 | 1027 | 770 | 616 | 513 | 440 | 385 | 342 | 308 | 280 | 257 | 237 | 220 | 205 | 193 | 181 | 171 | 162 | 154 |
| Mycobacterium tuberculosis | 10000 | 2000 | 1000 | 667 | 500 | 400 | 333 | 286 | 250 | 222 | 200 | 182 | 167 | 154 | 143 | 133 | 125 | 118 | 111 | 105 | 100 |
| Neisseria catarrhalis | 8500 | 1700 | 850 | 567 | 425 | 340 | 283 | 243 | 213 | 189 | 170 | 155 | 142 | 131 | 121 | 113 | 106 | 100 | 94 | 89 | 85 |
| Phytomonas tumefaciens | 8500 | 1700 | 850 | 567 | 425 | 340 | 283 | 243 | 213 | 189 | 170 | 155 | 142 | 131 | 121 | 113 | 106 | 100 | 94 | 89 | 85 |
| Proteus vulgaris | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Pseudomonas aeruginosa | 10500 | 2100 | 1050 | 700 | 525 | 420 | 350 | 300 | 263 | 233 | 210 | 191 | 175 | 162 | 150 | 140 | 131 | 124 | 117 | 111 | 105 |
| Pseudomonas fluorescens | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| S. typhimurium | 15200 | 3040 | 1520 | 1013 | 760 | 608 | 507 | 434 | 380 | 338 | 304 | 276 | 253 | 234 | 217 | 203 | 190 | 179 | 169 | 160 | 152 |
| Salmonella typhosa - Typhoid fever | 4100 | 820 | 410 | 273 | 205 | 164 | 137 | 117 | 103 | 91 | 82 | 75 | 68 | 63 | 59 | 55 | 51 | 48 | 46 | 43 | 41 |
| Salmonella paratyphi - Enteric fever | 6100 | 1220 | 610 | 407 | 305 | 244 | 203 | 174 | 153 | 136 | 122 | 111 | 102 | 94 | 87 | 81 | 76 | 72 | 68 | 64 | 61 |
| Sarcina lutea | 26400 | 5280 | 2640 | 1760 | 1320 | 1056 | 880 | 754 | 660 | 587 | 528 | 480 | 440 | 406 | 377 | 352 | 330 | 311 | 293 | 278 | 264 |
| Sarratia marcescens | 6160 | 1232 | 616 | 411 | 308 | 246 | 205 | 176 | 154 | 137 | 123 | 112 | 103 | 95 | 88 | 82 | 77 | 72 | 68 | 65 | 62 |
| Shigella dysenteriae - Dysentery | 4200 | 840 | 420 | 280 | 210 | 168 | 140 | 120 | 105 | 93 | 84 | 76 | 70 | 65 | 60 | 56 | 53 | 49 | 47 | 44 | 42 |
| Shigella flexneri - Dysentery | 3400 | 680 | 340 | 227 | 170 | 136 | 113 | 97 | 85 | 76 | 68 | 62 | 57 | 52 | 49 | 45 | 43 | 40 | 38 | 36 | 34 |
| Shigella paradyserteriae | 3400 | 680 | 340 | 227 | 170 | 136 | 113 | 97 | 85 | 76 | 68 | 62 | 57 | 52 | 49 | 45 | 43 | 40 | 38 | 36 | 34 |
| Spirillum rubrum | 6160 | 1232 | 616 | 411 | 308 | 246 | 205 | 176 | 154 | 137 | 123 | 112 | 103 | 95 | 88 | 82 | 77 | 72 | 68 | 65 | 62 |
| Staphylococcus albus | 5720 | 1144 | 572 | 381 | 286 | 229 | 191 | 163 | 143 | 127 | 114 | 104 | 95 | 88 | 82 | 76 | 72 | 67 | 64 | 60 | 57 |
| Staphylococcus aureus | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Streptococcus hemolyticus | 5500 | 1100 | 550 | 367 | 275 | 220 | 183 | 157 | 138 | 122 | 110 | 100 | 92 | 85 | 79 | 73 | 69 | 65 | 61 | 58 | 55 |
| Streptococcus lactis | 8800 | 1760 | 880 | 587 | 440 | 352 | 293 | 251 | 220 | 196 | 176 | 160 | 147 | 135 | 126 | 117 | 110 | 104 | 98 | 93 | 88 |
| Streptococcus viridans | 3800 | 760 | 380 | 253 | 190 | 152 | 127 | 109 | 95 | 84 | 76 | 69 | 63 | 58 | 54 | 51 | 48 | 45 | 42 | 40 | 38 |
| Vibrio comma - Cholera | 6500 | 1300 | 650 | 433 | 325 | 260 | 217 | 186 | 163 | 144 | 130 | 118 | 108 | 100 | 93 | 87 | 81 | 76 | 72 | 68 | 65 |
| Leptospira canicola - Infectious jaundice | 6000 | 1200 | 600 | 400 | 300 | 240 | 200 | 171 | 150 | 133 | 120 | 109 | 100 | 92 | 86 | 80 | 75 | 71 | 67 | 63 | 60 |
| YEASTS | | | | | | | | | | | | | | | | | | | | | |
| Saccharomyces ellipsoideus | 13200 | 2640 | 1320 | 880 | 660 | 528 | 440 | 377 | 330 | 293 | 264 | 240 | 220 | 203 | 189 | 176 | 165 | 155 | 147 | 139 | 132 |
| Saccharomyces sp. | 17600 | 3520 | 1760 | 1173 | 880 | 704 | 587 | 503 | 440 | 391 | 352 | 320 | 293 | 271 | 251 | 235 | 220 | 207 | 196 | 185 | 176 |
| Saccharomyces cerevisiae | 13200 | 2640 | 1320 | 880 | 660 | 528 | 440 | 377 | 330 | 293 | 264 | 240 | 220 | 203 | 189 | 176 | 165 | 155 | 147 | 139 | 132 |
| Brewer's yeast | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Baker's yeast | 8800 | 1760 | 880 | 587 | 440 | 352 | 293 | 251 | 220 | 196 | 176 | 160 | 147 | 135 | 126 | 117 | 110 | 104 | 98 | 93 | 88 |
| Common yeast cake | 13200 | 2640 | 1320 | 880 | 660 | 528 | 440 | 377 | 330 | 293 | 264 | 240 | 220 | 203 | 189 | 176 | 165 | 155 | 147 | 139 | 132 |
| MOLD SPORES | | | | | | | | | | | | | | | | | | | | | |
| Penicillium roqueforti GREEN | 26400 | 5280 | 2640 | 1760 | 1320 | 1056 | 880 | 754 | 660 | 587 | 528 | 480 | 440 | 406 | 377 | 352 | 330 | 311 | 293 | 278 | 264 |
| Penicillium expansum OLIVE | 22000 | 4400 | 2200 | 1467 | 1100 | 880 | 733 | 629 | 550 | 489 | 440 | 400 | 367 | 338 | 314 | 293 | 275 | 259 | 244 | 232 | 220 |
| Penicillium digitatum OLIVE | 88000 | 17600 | 8800 | 5867 | 4400 | 3520 | 2933 | 2514 | 2200 | 1956 | 1760 | 1600 | 1467 | 1354 | 1257 | 1173 | 1100 | 1035 | 978 | 926 | 880 |
| Aspergillus glaucus BLUISH GREEN | 88000 | 17600 | 8800 | 5867 | 4400 | 3520 | 2933 | 2514 | 2200 | 1956 | 1760 | 1600 | 1467 | 1354 | 1257 | 1173 | 1100 | 1035 | 978 | 926 | 880 |
| Aspergillus flavus YELLOWISH GREEN | 99000 | 19800 | 9900 | 6600 | 4950 | 3960 | 3300 | 2829 | 2475 | 2200 | 1980 | 1800 | 1650 | 1523 | 1414 | 1320 | 1238 | 1165 | 1100 | 1042 | 990 |
| Aspergillus niger BLACK | 330000 | 66000 | 33000 | 22000 | 16500 | 13200 | 11000 | 9429 | 8250 | 7333 | 6600 | 6000 | 5500 | 5077 | 4714 | 4400 | 4125 | 3882 | 3667 | 3474 | 3300 |
| Rhizopus nigricans BLACK | 220000 | 44000 | 22000 | 14667 | 11000 | 8800 | 7333 | 6286 | 5500 | 4889 | 4400 | 4000 | 3667 | 3385 | 3143 | 2933 | 2750 | 2588 | 2444 | 2316 | 2200 |
| Mucor racemosus A WHITE GRAY | 35200 | 7040 | 3520 | 2347 | 1760 | 1408 | 1173 | 1006 | 880 | 782 | 704 | 640 | 587 | 542 | 503 | 469 | 440 | 414 | 391 | 371 | 352 |
| Mucor racemosus B WHITE GRAY | 35200 | 7040 | 3520 | 2347 | 1760 | 1408 | 1173 | 1006 | 880 | 782 | 704 | 640 | 587 | 542 | 503 | 469 | 440 | 414 | 391 | 371 | 352 |
| Oospora lactis WHITE | 11000 | 2200 | 1100 | 733 | 550 | 440 | 367 | 314 | 275 | 244 | 220 | 200 | 183 | 169 | 157 | 147 | 138 | 129 | 122 | 116 | 110 |
| VIRUS | | | | | | | | | | | | | | | | | | | | | |
| Bacteriophage (E. coli) | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Infectious hepatitis | 8000 | 1600 | 800 | 533 | 400 | 320 | 267 | 229 | 200 | 178 | 160 | 145 | 133 | 123 | 114 | 107 | 100 | 94 | 89 | 84 | 80 |
| Influenza | 6600 | 1320 | 660 | 440 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 | 83 | 78 | 73 | 69 | 66 |
| Poliovirus - Poliomyelitis | 6000 | 1200 | 600 | 400 | 300 | 240 | 200 | 171 | 150 | 133 | 120 | 109 | 100 | 92 | 86 | 80 | 75 | 71 | 67 | 63 | 60 |
| Tobacco mosaic | 440000 | 88000 | 44000 | 29333 | 22000 | 17600 | 14667 | 12571 | 11000 | 9778 | 8800 | 8000 | 7333 | 6769 | 6286 | 5867 | 5500 | 5176 | 4889 | 4632 | 4400 |
| PROTOZOA | | | | | | | | | | | | | | | | | | | | | |
| Paramecium | 20000 | 4000 | 2000 | 13333 | 10000 | 8000 | 6667 | 5714 | 5000 | 4444 | 4000 | 3636 | 3333 | 3077 | 2857 | 2667 | 2500 | 2353 | 2222 | 2105 | 2000 |
| Nematode eggs | 92000 | 18400 | 9200 | 6133 | 4600 | 3680 | 3067 | 2629 | 2300 | 2044 | 1840 | 1673 | 1533 | 1415 | 1314 | 1227 | 1150 | 1082 | 1022 | 968 | 920 |
| Chlorella vulgaris (algae) | 22000 | 4400 | 2200 | 1467 | 1100 | 880 | 733 | 629 | 550 | 489 | 440 | 400 | 367 | 338 | 314 | 293 | 275 | 259 | 244 | 232 | 220 |

| LAMP TYPES | |
|----------------------|------------|
| MW/CM*2 @ 1M | LAMP I.D. |
| HOT CATHODE | |
| 1.1 | OZ4S11 |
| 1.1 | G4S11 |
| 5.4 | G4T5 |
| 6.5 | OZ4T5 |
| 7.5 | G4T4/1 |
| 11.0 | G6T5 |
| 13.0 | OZ6T5 |
| 17.0 | G8T5 |
| 19.5 | OZ8T5 |
| 38.0 | G15T8 |
| 54.0 | G25T8 |
| 85.0 | G30T8 |
| SLIMLINE | |
| 55.0 | G10T51/2L |
| 55.0 | G10T51/2H |
| 55.0 | G10T51/2VH |
| 110.0 | G36T6 |
| 120.0 | G36T6L |
| 120.0 | G36T6H |
| 124.0 | G37T6VH |
| 190.0 | G64T5L |
| 208.0 | G64T6L |
| COLD CATHODE* | |
| 16.0 | GCC369N |
| 20.0 - 28.0 | 782L10 |
| 20.0 - 28.0 | 782H10 |
| 23.7 | GCC369H |
| 35.0 - 52.0 | 782L20 |
| 35.0 - 52.0 | 782H20 |
| 46.0 - 73.0 | 782L30 |
| 46.0 - 73.0 | |

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TO DETERMINE REQUIRED MW/CM^2 FOR OBJECTIVES OF OTHER THAN ONE METER, PROCEED AS FOLLOWS:

- 1) DETERMINE ORGANISM TO BE DESTROYED.
- 2) DETERMINE TOTAL UV ENERGY REQUIRED IN MW SECS/CM^2 TO DESTROY ORGANISM.
- 3) DETERMINE REQUIRED KILL TIME.
- 4) DETERMINE OBJECTIVE DISTANCE (TABLE 1).
- 5) DETERMINE CORRESPONDING INTENSITY FACTOR (TABLE 2).
- 6) TOTAL U.V. LAMP INTENSITY REQUIRED TO DESTROY COLONY IS THEN EQUAL TO:
- 7) DETERMINE LAMP(S) NECESSARY TO GENERATE REQUIRED MW/CM^2.

$$\frac{\text{(REQUIRED ENERGY TO DESTROY (2))}}{\text{(INTENSITY FACTOR (5) * KILL TIME (3))}}$$

| TABLE 1 Objective Distance (in.) | TABLE 2 Intensity Factor |
|-------------------------------------|-----------------------------|
| 2 | 386 |
| 3 | 172 |
| 4 | 96.5 |
| 6 | 42.9 |
| 8 | 24.1 |
| 10 | 15.4 |
| 12 | 10.7 |
| 14 | 7.88 |
| 18 | 4.77 |
| 24 | 2.68 |
| 36 | 1.19 |
| 1m | 1.00 |
| 48 | 0.670 |
| 60 | 0.429 |
| 80 | 0.241 |
| 100 | 0.154 |
| 120 | 0.107 |

Example: To destroy the organism Bacillus Anthracis within 30 seconds at an objective distance of six inches, the formula will read:

$$\frac{8700 \mu\text{W-sec/cm}^2}{(12.9 \times 30)} = \frac{8700}{387} = 22.48 \mu\text{W/cm}^2$$

A lamp whose aggregate output is 22.48μW/cm^2 or greater will answer this requirement.