



Solar Position and Insolation Values for 24° North Latitude

| BTUH/ft² Total Insolation on Surface <sup>a</sup> |                      |      |                |       |                     |        |  |      |      |      |     |    |
|---|----------------------|------|----------------|-------|---------------------|--------|--|------|------|------|-----|----|
| Date  | Solar Time           |      | Solar Position |       | Normal <sup>b</sup> | Horiz. | South Facing Surface Angle with Horiz. |      |      |      |     |    |
|   | a.m.                 | p.m. | Alt.           | Azm.  |                     |        | 14                                     | 24   | 34   | 44   | 90  |    |
| April 21  | 6                    | 6    | 4.7            | 100.6 | 40                  | 7      | 5                                      | 4    | 4    | 3    | 2   |    |
|   | 7                    | 5    | 18.3           | 94.9  | 203                 | 83     | 77                                     | 70   | 62   | 51   | 10  |    |
|   | 8                    | 4    | 32.0           | 89.0  | 256                 | 160    | 157                                    | 149  | 137  | 122  | 16  |    |
|   | 9                    | 3    | 45.6           | 81.9  | 280                 | 227    | 227                                    | 220  | 206  | 186  | 46  |    |
|   | 10                   | 2    | 59.0           | 71.8  | 292                 | 278    | 282                                    | 275  | 259  | 237  | 61  |    |
|   | 11                   | 1    | 71.1           | 51.6  | 298                 | 310    | 316                                    | 309  | 293  | 269  | 74  |    |
|   | 12                   |      | 77.6           | 0.0   | 299                 | 321    | 328                                    | 321  | 305  | 280  | 79  |    |
|   | Surface daily totals |      |                |       |                     | 2454   | 2458                                   | 2374 | 2228 | 2016 | 488 |    |
|   | May 21               | 6    | 6              | 8.0   | 108.4               | 86     | 22                                     | 15   | 10   | 9    | 9   | 5  |
|   |                      | 7    | 5              | 21.2  | 103.2               | 203    | 98                                     | 85   | 73   | 59   | 44  | 12 |
|   |                      | 8    | 4              | 34.6  | 98.5                | 248    | 171                                    | 159  | 145  | 127  | 106 | 15 |
|   |                      | 9    | 3              | 48.3  | 93.6                | 269    | 233                                    | 224  | 210  | 190  | 165 | 16 |
| 10  |                      | 2    | 62.0           | 87.7  | 280                 | 281    | 275                                    | 261  | 239  | 211  | 22  |    |
| 11  |                      | 1    | 75.5           | 76.9  | 286                 | 311    | 307                                    | 293  | 270  | 240  | 34  |    |
| 12  |                      |      | 86.0           | 0.0   | 288                 | 322    | 317                                    | 304  | 281  | 250  | 37  |    |
| Surface daily totals                              |                      |      |                |       | 2556                | 2447   | 2286                                   | 2072 | 1800 | 246  |     |    |

|             |                      |   |      |       |     |     |     |     |     |    |
|-------------|----------------------|---|------|-------|-----|-----|-----|-----|-----|----|
| June 21     | 6                    | 6 | 9.3  | 111.6 | 97  | 29  | 20  | 12  | 11  | 7  |
|             | 7                    | 5 | 22.3 | 106.8 | 201 | 103 | 87  | 73  | 41  | 13 |
|             | 8                    | 4 | 35.5 | 102.6 | 242 | 173 | 158 | 142 | 99  | 16 |
|             | 9                    | 3 | 49.0 | 98.7  | 263 | 234 | 221 | 204 | 155 | 18 |
|             | 10                   | 2 | 62.6 | 95.0  | 274 | 280 | 269 | 253 | 199 | 18 |
|             | 11                   | 1 | 76.3 | 90.8  | 279 | 309 | 300 | 283 | 227 | 19 |
|             | 12                   |   | 89.4 | 0.0   | 281 | 319 | 310 | 294 | 236 | 22 |
|             | Surface daily totals |   |      |       |     |     |     |     |     |    |
|             | 2994                 |   |      |       |     |     |     |     |     |    |
|             | 2574                 |   |      |       |     |     |     |     |     |    |
|             | 2422                 |   |      |       |     |     |     |     |     |    |
|             | 1700                 |   |      |       |     |     |     |     |     |    |
| July 21     | 6                    | 6 | 8.2  | 109.0 | 81  | 23  | 16  | 11  | 9   | 6  |
|             | 7                    | 5 | 21.4 | 103.8 | 195 | 98  | 85  | 73  | 44  | 13 |
|             | 8                    | 4 | 34.8 | 99.2  | 239 | 169 | 157 | 143 | 104 | 16 |
|             | 9                    | 3 | 48.4 | 94.5  | 261 | 231 | 221 | 207 | 161 | 18 |
|             | 10                   | 2 | 62.1 | 89.0  | 272 | 278 | 270 | 256 | 206 | 21 |
|             | 11                   | 1 | 75.7 | 79.2  | 278 | 307 | 302 | 287 | 235 | 32 |
|             | 12                   |   | 86.6 | 0.0   | 280 | 317 | 312 | 298 | 245 | 36 |
|             | Surface daily totals |   |      |       |     |     |     |     |     |    |
|             | 2932                 |   |      |       |     |     |     |     |     |    |
|             | 2526                 |   |      |       |     |     |     |     |     |    |
|             | 2412                 |   |      |       |     |     |     |     |     |    |
|             | 2036                 |   |      |       |     |     |     |     |     |    |
| August 21   | 6                    | 6 | 5.0  | 101.3 | 35  | 7   | 5   | 4   | 4   | 2  |
|             | 7                    | 5 | 18.5 | 95.6  | 186 | 82  | 76  | 69  | 50  | 11 |
|             | 8                    | 4 | 32.2 | 89.7  | 241 | 158 | 154 | 146 | 118 | 16 |
|             | 9                    | 3 | 45.9 | 82.9  | 265 | 223 | 222 | 214 | 181 | 39 |
|             | 10                   | 2 | 59.3 | 73.0  | 278 | 273 | 275 | 268 | 230 | 58 |
|             | 11                   | 1 | 71.6 | 53.2  | 284 | 304 | 309 | 301 | 261 | 71 |
|             | 12                   |   | 78.3 | 0.0   | 286 | 315 | 320 | 313 | 272 | 75 |
|             | Surface daily totals |   |      |       |     |     |     |     |     |    |
|             | 2864                 |   |      |       |     |     |     |     |     |    |
|             | 2408                 |   |      |       |     |     |     |     |     |    |
|             | 2402                 |   |      |       |     |     |     |     |     |    |
|             | 2316                 |   |      |       |     |     |     |     |     |    |
| 2168        |                      |   |      |       |     |     |     |     |     |    |
| 1958        |                      |   |      |       |     |     |     |     |     |    |
| 470         |                      |   |      |       |     |     |     |     |     |    |
| (continued) |                      |   |      |       |     |     |     |     |     |    |

Solar Position and Insolation Values for 24° North Latitude

| BTUH/ft² Total Insolation on Surface <sup>a</sup> |                      |      |                |      |                     |        |  |      |      |      |      |
|---|----------------------|------|----------------|------|---------------------|--------|--|------|------|------|------|
| Date  | Solar Time           |      | Solar Position |      | Normal <sup>b</sup> | Horiz. | South Facing Surface Angle with Horiz. |      |      |      |      |
|   | a.m.                 | p.m. | Alt.           | Azm. |                     |        | 14                                     | 24   | 34   | 44   | 90   |
| September 21                                      | 7                    | 5    | 13.7           | 83.8 | 173                 | 57     | 60                                     | 60   | 59   | 56   | 26   |
|   | 8                    | 4    | 27.2           | 76.8 | 248                 | 136    | 144                                    | 146  | 143  | 136  | 62   |
|   | 9                    | 3    | 40.2           | 67.9 | 278                 | 205    | 218                                    | 221  | 217  | 206  | 93   |
|   | 10                   | 2    | 52.3           | 54.8 | 292                 | 258    | 275                                    | 278  | 273  | 261  | 116  |
|   | 11                   | 1    | 61.9           | 33.4 | 299                 | 291    | 311                                    | 315  | 309  | 295  | 131  |
|   | 12                   |      | 66.0           | 0.0  | 301                 | 302    | 323                                    | 327  | 321  | 306  | 136  |
|   | Surface daily totals |      |                |      |                     | 2194   | 2342                                   | 2366 | 2322 | 2212 | 992  |
| October 21  | 7                    | 5    | 9.1            | 74.1 | 138                 | 32     | 40                                     | 45   | 48   | 50   | 42   |
|   | 8                    | 4    | 22.0           | 66.7 | 247                 | 111    | 129                                    | 139  | 144  | 145  | 99   |
|   | 9                    | 3    | 34.1           | 57.1 | 284                 | 180    | 206                                    | 217  | 223  | 221  | 138  |
|   | 10                   | 2    | 44.7           | 43.8 | 301                 | 234    | 265                                    | 277  | 282  | 279  | 165  |
|   | 11                   | 1    | 52.5           | 24.7 | 309                 | 268    | 301                                    | 315  | 319  | 314  | 182  |
|   | 12                   |      | 55.5           | 0.0  | 311                 | 279    | 314                                    | 328  | 332  | 327  | 188  |
|   | Surface daily totals |      |                |      |                     | 1928   | 2198                                   | 2314 | 2364 | 2346 | 1442 |

|  |                      |   |      |      |      |      |      |      |      |      |      |
|--|----------------------|---|------|------|------|------|------|------|------|------|------|
| November 21  | 7                    | 5 | 4.9  | 65.8 | 67   | 10   | 16   | 20   | 24   | 27   | 29   |
|  | 8                    | 4 | 17.0 | 58.4 | 232  | 82   | 108  | 123  | 135  | 142  | 124  |
|  | 9                    | 3 | 28.0 | 48.9 | 282  | 150  | 186  | 205  | 217  | 224  | 172  |
|  | 10                   | 2 | 37.3 | 36.3 | 303  | 203  | 244  | 265  | 278  | 283  | 204  |
|  | 11                   | 1 | 43.8 | 19.7 | 312  | 236  | 280  | 302  | 316  | 320  | 222  |
|  | 12                   |   | 46.2 | 0.0  | 315  | 247  | 293  | 315  | 328  | 332  | 228  |
|  | Surface daily totals |   |      |      |      |      |      |      |      |      |      |
|  |                      |   |      |      | 2706 | 1610 | 1962 | 2146 | 2268 | 2324 | 1730 |
| December 21  | 7                    | 5 | 3.2  | 62.6 | 30   | 3    | 7    | 9    | 11   | 12   | 14   |
|  | 8                    | 4 | 14.9 | 55.3 | 225  | 71   | 99   | 116  | 129  | 139  | 130  |
|  | 9                    | 3 | 25.5 | 46.0 | 281  | 137  | 176  | 198  | 214  | 223  | 184  |
|  | 10                   | 2 | 34.3 | 33.7 | 304  | 189  | 234  | 258  | 275  | 283  | 217  |
|  | 11                   | 1 | 40.4 | 18.2 | 314  | 221  | 270  | 295  | 312  | 320  | 236  |
|  | 12                   |   | 42.6 | 0.0  | 317  | 232  | 282  | 308  | 325  | 332  | 243  |
|  | Surface daily totals |   |      |      |      |      |      |      |      |      |      |
|  |                      |   |      |      | 2624 | 1474 | 1852 | 2058 | 2204 | 2286 | 1808 |
| <hr/>  |                      |   |      |      |      |      |      |      |      |      |      |
| Source: Kreider, J.F. and Kreith, F., <i>Solar Heating and Cooling</i> , revised 1st edn., Hemisphere Publ. Corp., Washington, DC, 1977. |                      |   |      |      |      |      |      |      |      |      |      |

<sup>a</sup> 1 Btu/h · ft<sup>2</sup> = 3.152 W/m<sup>2</sup>. Ground reflection not included on normal or horizontal surfaces.

<sup>b</sup> Normal insolation does not include diffuse component.