

TABLE 15. APPLICATION FACTORS/TO APPLY TO TABLES 13, 14 AND 16 TO OBTAIN INSTANTANEOUS RATES OF HEAT GAIN FOR VARIOUS TYPES OF SINGLE FLAT GLASS AND COMBINATIONS OF TWO SHEETS OF FLAT GLASS SPACED AT  $\frac{1}{4}$  IN.

| GLASS <sup>a</sup>             | NORMAL INCIDENCE TRANSMITTANCE | FACTOR TO APPLY TO TABLE 13 | FACTOR TO APPLY TO TABLE 14 |
|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| Single Common Window           | 0.87                           | 1.00                        | $1.0(X) + 0.0(Y)^d$         |
| Single Regular Plate           | 0.77                           | 0.87                        | $1.0(X) + 0.25(Y)$          |
| Single Heat Absorbing Plate    | 0.41                           | 0.46 <sup>b</sup>           | $1.0(X) + 1.00(Y)$          |
| Double Common Window           | 0.76                           | 0.85                        | $0.6(X) + 0.10(Y)$          |
| Double Regular Plate           | 0.60                           | 0.66 <sup>b</sup>           | $0.6(X) + 0.55(Y)$          |
| Heat Absorbing Plate Outdoors} | 0.35                           | 0.37 <sup>b</sup>           | $0.6(X) + 0.75(Y)$          |
| Regular Plate Indoors          |                                |                             |                             |

<sup>a</sup> Common window glass  $\frac{1}{4}$  in. thick. Plate glass  $\frac{1}{4}$  in. thick.  
<sup>b</sup> For better precision, increase factors 10 percent when glass is in the shade.  
<sup>c</sup> X values are Table 14 values. <sup>d</sup> Y values are Table 16 values.

TABLE 16. HEAT ABSORBED IN GLASS. VALUES OF Y TO BE USED WITH FACTORS IN TABLE 15 AND TABLE 17 IN THE DETERMINATION OF INSTANTANEOUS RATES OF HEAT GAIN DUE TO CONVECTION AND RADIATION FOR VARIOUS TYPES OF SINGLE GLASS AND COMBINATIONS OF TWO SHEETS OF GLASS SPACED AT  $\frac{1}{4}$  IN.

For Clear Atmospheres and 18 Deg Declination, North (August 1)

|          |          | VALUES OF Y IN BTU PER (HR) (SQ FT) <sup>a</sup> |    |    |    |    |    |    |    |        |
|----------|----------|--------------------------------------------------|----|----|----|----|----|----|----|--------|
| SUN TIME |          | N                                                | NE | E  | SE | S  | SW | W  | NW | HORIZ. |
| 5 a.m.   |          | 0                                                | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0      |
| 6        |          | 4                                                | 16 | 18 | 9  | 1  | 1  | 2  | 1  | 3      |
| 7        |          | 2                                                | 24 | 30 | 20 | 2  | 2  | 2  | 2  | 11     |
| 8        |          | 2                                                | 22 | 33 | 25 | 2  | 2  | 3  | 3  | 21     |
| 9        |          | 2                                                | 16 | 30 | 29 | 8  | 3  | 3  | 3  | 32     |
| 10       |          | 3                                                | 5  | 25 | 27 | 14 | 3  | 3  | 3  | 37     |
| 11       | 40       | 3                                                | 3  | 12 | 21 | 18 | 3  | 3  | 3  | 42     |
| 12       | DEGREES  | 3                                                | 3  | 3  | 15 | 19 | 12 | 3  | 3  | 45     |
| 1 p.m.   | NORTH    | 3                                                | 3  | 3  | 3  | 19 | 22 | 10 | 3  | 44     |
| 2        | LATITUDE | 3                                                | 3  | 3  | 3  | 16 | 27 | 24 | 4  | 41     |
| 3        |          | 3                                                | 3  | 3  | 3  | 10 | 30 | 31 | 15 | 35     |
| 4        |          | 3                                                | 3  | 3  | 3  | 4  | 29 | 36 | 23 | 28     |
| 5        |          | 2                                                | 2  | 2  | 2  | 2  | 23 | 34 | 27 | 17     |
| 6        |          | 4                                                | 1  | 1  | 1  | 1  | 14 | 24 | 21 | 6      |
| 7        |          | 0                                                | 0  | 0  | 0  | 0  | 2  | 3  | 3  | 1      |

| SUN TIME | LATITUDE        | SE | S | SW | SUN TIME | LATITUDE        | SE | S  | SW |
|----------|-----------------|----|---|----|----------|-----------------|----|----|----|
| 5 a.m.   |                 | 0  | 0 | 0  | 5 a.m.   |                 | 2  | 0  | 0  |
| 6        |                 | 7  | 1 | 1  | 6        |                 | 13 | 1  | 1  |
| 7        |                 | 18 | 2 | 2  | 7        |                 | 22 | 2  | 2  |
| 8        |                 | 22 | 2 | 2  | 8        |                 | 28 | 3  | 3  |
| 9        |                 | 24 | 3 | 3  | 9        |                 | 30 | 13 | 3  |
| 10       |                 | 22 | 5 | 3  | 10       | 50 <sup>b</sup> | 31 | 20 | 3  |
| 11       | 30 <sup>b</sup> | 16 | 7 | 3  | 11       | DEGREES         | 27 | 25 | 5  |
| 12       | DEGREES         | 6  | 9 | 4  | 12       | NORTH           | 20 | 27 | 17 |
| 1 p.m.   | LATITUDE        | 3  | 9 | 14 | 1 p.m.   |                 | 9  | 25 | 26 |
| 2        |                 | 3  | 6 | 21 | 2        |                 | 3  | 22 | 32 |
| 3        |                 | 3  | 5 | 27 | 3        |                 | 3  | 16 | 33 |
| 4        |                 | 3  | 3 | 26 | 4        |                 | 2  | 7  | 31 |
| 5        |                 | 2  | 2 | 21 | 5        |                 | 2  | 2  | 26 |
| 6        |                 | 1  | 1 | 11 | 6        |                 | 1  | 1  | 17 |
| 7        |                 | 0  | 0 | 0  | 7        |                 | 0  | 0  | 7  |

<sup>a</sup> Values of Y for 8 and 9 p.m. are zero.

<sup>b</sup> For N, NE, E, W, NW and horizontal use 40 deg North Latitude values.

in Table 15, and added to the first value. All convection and radiation gain values for double glass were computed for a  $\frac{1}{4}$ -in. air space. No great error is involved in cooling load estimates if these are used for double glass with other air spaces.

*Example 9:* Find the total instantaneous heat gain through a single sheet of regular plate glass in a southwest wall at 2 p.m. sun time and 40 deg north latitude on August 1. The maximum dry-bulb temperature for design is 98 F; the atmosphere is clear. The indoor temperature is 80 F.

*Solution:* From Table 13 the heat gain due to transmitted radiation is 148 Btu per (hr) (sq ft) for common window glass; from Table 15, the factor for regular plate glass is 0.87. The coefficient of X in Table 15 is 1.0, while X is found from Table 14 for common window glass for the same hour, orientation and latitude. The coefficient of Y in Table 15 is 0.25, while the Y value is found from Table 16 for a southwest wall at 2:00 p.m. and 40 deg north latitude. The correction for design dry-bulb temperature is found from Table 23 to be 1.0 Btu per (hr) (sq ft) per degree difference from 95 F design temperature. The total instantaneous heat gain is, from Equation 2a,

$$q = 0.87 \times 148 + 1.0 \times 19 + 0.25 \times 27 + 1.0 (98 - 95) \\ = 157.5 \text{ Btu per (hr) (sq ft).}$$

#### Design Tables for Rolled Figured Glass

Tables 17 and 18 give design values of instantaneous rates of heat gain for a number of common patterns of single vertical sheets of rolled figured glass. The tables are for a solar declination of 18 deg, which corresponds to a nominal August 1 day, and are based upon the solar intensity values for a clear atmosphere as given in Table 4. The values are given in terms of corrections to apply to Tables 13 and 14. The heat gain due to transmitted solar radiation is found by multiplying the Table 13 values by the approximate percentages given in Table 18. To obtain instantaneous rates of heat gain by convection and radiation, Table 16 values are multiplied by the appropriate value of Y from Table 17 and then added to the corresponding Table 14 values. The total instantaneous heat gain is the sum of the gain due to transmitted solar radiation and the gain by convection and radiation.

The values given in Tables 17 and 18 are based upon an A.S.H.A.E. research paper<sup>23</sup> to which the reader is directed for additional data. The values in Tables 17 and 18 may be used with fair precision for other patterns of similar transmittance and surface characteristics. For example, the data for hammered glass may be used for glass having shallow, closely-spaced ribs or for glass having small, closely-spaced circular indentations. Because some patterns have distinct orientation properties, no attempt has been made to give values for non-vertical glass.

#### Design Tables for Glass Block Walls

Tables 20 and 21 give design values of instantaneous rates of heat gain for sunlit walls of Type I pattern 8-in. hollow glass block for a solar declination of 18 deg (see Table 19 for description of block patterns). These tables are based upon the solar intensity values for a clear atmosphere as given in Table 4. For solar energy transmittance data the reader is referred to reference 21. Table 20 presents values of transmitted direct and diffuse solar radiation, while Table 21 gives values of instantaneous rates of heat gain by convection and radiation from the wall. The latter values are for an indoor temperature of 80 F and a 95 F maximum dry-bulb temperature, as indicated in the table, and are based upon experimentally-