

Table 10.... Capacity and Sizing Table—Second Story  
For Warm Air and Return Air Stack, Branch, and Registers

| Equiv. Length of Fittings and Registers             | Horizontal Lengths<br>Furnace to Register                    |                                                                      | Second Story<br>Room Heat Loss—Btu/h                                 |                                                                        |                                                                           |                                                                            |                                                                              |                                                                              |                                                                              |                                                                              |
|-----------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|                                                     | Ducts*                                                       | Insulated<br>Attic Ducts                                             | Col. d                                                               | Col. e                                                                 | Col. f                                                                    | Col. g                                                                     | Col. h                                                                       | Col. i                                                                       | Col. j                                                                       | Col. k                                                                       |
| Up to 70 Eq Ft                                      | Up to 7<br>8-12<br>13-17<br>18-25<br>26-35<br>36-45<br>46-55 | Up to 5<br>6-9<br>10-13<br>14-18<br>19-25<br>26-35<br>36-45<br>46-55 | 6,300<br>5,700<br>5,200<br>4,800<br>4,100<br>3,500<br>3,100<br>2,800 | 10,900<br>10,000<br>9,200<br>8,500<br>7,300<br>6,400<br>5,600<br>5,000 | 14,000<br>13,000<br>12,100<br>11,400<br>10,000<br>8,800<br>7,800<br>6,800 | 17,000<br>15,900<br>14,900<br>13,900<br>12,400<br>11,100<br>9,900<br>8,900 | 21,800<br>20,000<br>18,400<br>17,000<br>14,600<br>12,800<br>11,200<br>10,000 | 28,000<br>26,000<br>24,200<br>22,400<br>20,000<br>17,600<br>15,600<br>13,600 | 36,000<br>33,000<br>30,000<br>27,000<br>24,000<br>21,000<br>18,000<br>15,000 | 44,000<br>40,000<br>36,000<br>32,000<br>28,000<br>24,000<br>20,000<br>16,000 |
| 71 to 100 Eq Ft                                     | Up to 7<br>8-12<br>13-17<br>18-25<br>26-35<br>36-45<br>46-55 | Up to 5<br>6-9<br>10-13<br>14-18<br>19-25<br>26-35<br>36-45<br>46-55 | 5,000<br>4,600<br>4,300<br>4,000<br>3,400<br>3,000<br>2,700<br>2,300 | 9,000<br>8,200<br>7,600<br>7,100<br>6,200<br>5,400<br>4,700<br>4,200   | 11,900<br>11,000<br>10,300<br>9,600<br>8,400<br>7,500<br>6,700<br>6,000   | 14,800<br>13,900<br>13,000<br>12,200<br>10,800<br>9,600<br>8,500<br>7,500  | 18,000<br>16,400<br>15,200<br>14,200<br>12,400<br>10,800<br>9,400<br>8,400   | 23,000<br>22,000<br>20,600<br>19,200<br>16,800<br>15,000<br>13,400<br>12,000 | 30,000<br>28,000<br>26,000<br>24,000<br>21,000<br>18,000<br>15,000<br>12,000 | 38,000<br>35,000<br>32,000<br>29,000<br>26,000<br>23,000<br>20,000<br>17,000 |
| 101 to 130 Eq Ft                                    | Up to 7<br>8-12<br>13-17<br>18-25<br>26-35<br>36-45<br>46-55 | Up to 5<br>6-9<br>10-13<br>14-18<br>19-25<br>26-35<br>36-45<br>46-55 | 4,300<br>3,900<br>3,700<br>3,500<br>3,000<br>2,600<br>2,400<br>2,000 | 7,700<br>7,200<br>6,700<br>6,200<br>5,400<br>4,700<br>4,100<br>3,600   | 10,400<br>9,700<br>9,000<br>8,400<br>7,400<br>6,500<br>5,800<br>5,000     | 13,000<br>12,100<br>11,300<br>10,600<br>9,400<br>8,300<br>7,400<br>6,500   | 15,400<br>14,400<br>13,600<br>12,800<br>11,200<br>9,800<br>8,600<br>7,200    | 21,700<br>19,400<br>18,000<br>16,800<br>14,800<br>13,000<br>11,600<br>10,000 | 28,200<br>26,000<br>24,000<br>22,000<br>19,000<br>16,800<br>14,800<br>12,800 | 36,200<br>33,000<br>30,000<br>27,000<br>24,000<br>21,000<br>18,000<br>15,000 |
| 131 to 165 Eq Ft                                    | Up to 7<br>8-12<br>13-17<br>18-25<br>26-35<br>36-45<br>46-55 | Up to 5<br>6-9<br>10-13<br>14-18<br>19-25<br>26-35<br>36-45<br>46-55 | 3,800<br>3,500<br>3,200<br>3,000<br>2,700<br>2,300<br>2,000<br>1,800 | 6,800<br>6,300<br>5,800<br>5,500<br>4,800<br>4,200<br>3,400<br>3,300   | 9,100<br>8,400<br>7,900<br>7,400<br>6,300<br>5,700<br>4,500<br>4,300      | 11,400<br>10,500<br>9,800<br>9,200<br>8,000<br>7,200<br>5,800<br>5,400     | 14,000<br>12,600<br>11,600<br>11,000<br>9,600<br>8,400<br>6,800<br>6,600     | 18,300<br>16,800<br>15,800<br>14,800<br>12,800<br>11,400<br>9,400<br>8,600   | 24,500<br>22,000<br>20,000<br>18,800<br>16,800<br>15,000<br>12,800<br>12,000 | 32,500<br>29,000<br>26,000<br>24,000<br>21,000<br>18,000<br>15,000<br>13,000 |
| 166 to 200 Eq Ft                                    | Up to 7<br>8-12<br>13-17<br>18-25<br>26-35<br>36-45<br>46-55 | Up to 5<br>6-9<br>10-13<br>14-18<br>19-25<br>26-35<br>36-45<br>46-55 | 3,500<br>3,200<br>2,900<br>2,700<br>2,500<br>2,100<br>1,800<br>1,500 | 6,100<br>5,700<br>5,300<br>5,000<br>4,400<br>3,900<br>3,400<br>3,000   | 8,200<br>7,600<br>7,100<br>6,700<br>5,700<br>5,100<br>4,500<br>4,000      | 10,300<br>9,500<br>8,900<br>8,300<br>7,400<br>6,500<br>5,800<br>5,000      | 12,200<br>11,400<br>10,600<br>10,000<br>8,800<br>7,800<br>6,800<br>6,000     | 16,400<br>15,200<br>14,200<br>13,400<br>11,600<br>10,200<br>8,800<br>7,800   | 22,000<br>20,000<br>18,800<br>17,800<br>15,800<br>14,000<br>12,200<br>10,800 | 29,000<br>26,000<br>24,000<br>22,000<br>19,000<br>16,800<br>14,800<br>13,000 |
| Combination Number                                  |                                                              |                                                                      | 41                                                                   | 42                                                                     | 43                                                                        | 44                                                                         | 45                                                                           | 46                                                                           | 47                                                                           |                                                                              |
| Stacks*: No. (in paren.) and Size                   | (1) 10x3 1/4                                                 | (1) 10x3 1/4                                                         | (1) 12x3 1/4                                                         | (1) 14x3 1/4                                                           | (2) 10x3 1/4                                                              | (2) 12x3 1/4                                                               | (2) 14x3 1/4                                                                 | (2) 16x3 1/4                                                                 | (2) 18x3 1/4                                                                 | (2) 20x3 1/4                                                                 |
| Rectangular Branch Size                             | 3x8                                                          | 4x8                                                                  | 5x8                                                                  | 6x8                                                                    | 8x8                                                                       | 10x8                                                                       | 12x8                                                                         | 14x8                                                                         | 16x8                                                                         | 18x8                                                                         |
| Round Branch Size (Diam)                            | 5                                                            | 6                                                                    | 7                                                                    | 8                                                                      | 9                                                                         | 10                                                                         | 12                                                                           | 14                                                                           | 16                                                                           | 18                                                                           |
| Number of Joist Spaces and Minimum Depth—Return Air | 1 at 3                                                       | 1 at 3                                                               | 1 at 4                                                               | 1 at 5                                                                 | 1 at 6 or 2 at 3                                                          | 1 at 7 or 2 at 4                                                           | 1 at 8 or 2 at 5                                                             | 1 at 9 or 2 at 6                                                             | 1 at 10 or 2 at 7                                                            | 1 at 11 or 2 at 8                                                            |
| Registers: Low Wall, High Wall or Baseboard:        | 10x6                                                         | 10x6                                                                 | 12x6                                                                 | 14x6                                                                   | (2)10x6 or (1) 24x6                                                       | (2)12x6 or (1) 30x6                                                        | (2)14x6 or (1) 36x6                                                          | (2)16x6 or (1) 42x6                                                          | (2)18x6 or (1) 48x6                                                          | (2)20x6 or (1) 54x6                                                          |
| Registers: Floor, Warm Air                          | 8x10                                                         | 8x10                                                                 | 9x12                                                                 | 9x12 or longer                                                         | 10x12                                                                     | 12x14                                                                      | 14x16                                                                        | 16x18                                                                        | 18x20                                                                        | 20x22                                                                        |
| Registers: Floor, Return Air                        | 6x10 or 4x14                                                 | 6x10 or 4x14                                                         | 6x12 or 6x14                                                         | 6x14                                                                   | 6x30                                                                      | 6x30                                                                       | 8x30                                                                         | 8x30                                                                         | 8x30                                                                         | 8x30                                                                         |
| Trunk Duct Increase, Inches                         | 1                                                            | 2                                                                    | 3                                                                    | 4                                                                      | 5                                                                         | 7                                                                          | 12                                                                           |                                                                              |                                                                              |                                                                              |

\* Uninsulated ducts in heated spaces and insulated ducts in unheated spaces.  
 † Note: For return air a 14x3 1/4 in. stud space may be used instead of 10x14 in. stack. Where 12x3 1/4 in. or 14x3 1/4 in. stack is required, a 14x3 1/4 in. stud space may be used only when inside of stud space is smooth and without protruding plaster keys. The number of joist spaces for combinations 41 is based on 2x10 joists. One space may be used with 2x10 joists.  
 The limiting factor for a duct combination is the stack capacity.

Table 11.... Selection of Bonnet Temperature, Register Temperature and Register Delivery (CFM)\*  
 (For Buildings Having a Heat Loss between 120,000 and 350,000 Btu/hr.)  
 Register Delivery Volume in CFM per 1000 Btu per Hr.

| Temp. of<br>Bonnet °F | Linear Distance from Bonnet to Register, in Feet |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----------------------|--------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                       | 10                                               | 20   | 30   | 40   | 50   | 60   | 70   | 80   | 90   | 100  | 110  | 120  | 130  | 140  | 150  | 160  | 170  | 180  | 190  | 200  | 210  | 220  | 230  | 240  |      |
| 110<br>22.1*          | 108*                                             | 107  | 106  | 104  | 103  | 102  | 101  | 100  | 99   | 98   | 97   | 96   | 95   | 94   | 93   | 92   | 91   | 90   | 89   | 88   | 87   | 86   | 85   | 84   | 83   |
|                       | 23.1*                                            | 23.6 | 24.2 | 25.4 | 26.0 | 26.6 | 27.3 | 28.0 | 28.8 | 29.6 | 30.5 | 31.5 | 32.3 | 33.3 | 34.6 | 35.9 | 37.3 | 38.6 | 39.9 | 41.3 | 42.7 | 44.1 | 45.5 | 46.9 | 48.3 |
| 120<br>18.4           | 118                                              | 116  | 114  | 112  | 111  | 109  | 108  | 106  | 105  | 103  | 102  | 101  | 100  | 99   | 98   | 97   | 96   | 95   | 94   | 93   | 92   | 91   | 90   | 89   | 88   |
|                       | 19.0                                             | 19.6 | 20.3 | 21.1 | 21.6 | 22.5 | 23.1 | 24.2 | 24.8 | 26.0 | 26.6 | 27.3 | 28.0 | 28.8 | 29.6 | 30.5 | 31.5 | 32.3 | 33.3 | 34.6 | 35.9 | 37.3 | 38.6 | 39.9 | 41.3 |
| 130<br>15.9           | 128                                              | 126  | 123  | 121  | 119  | 117  | 115  | 113  | 111  | 110  | 108  | 107  | 105  | 104  | 103  | 102  | 101  | 99   | 98   | 97   | 96   | 95   | 94   | 93   | 92   |
|                       | 16.4                                             | 16.9 | 17.6 | 18.1 | 18.7 | 19.3 | 20.0 | 20.7 | 21.6 | 22.1 | 23.1 | 23.6 | 24.8 | 25.4 | 26.0 | 26.6 | 27.3 | 28.0 | 28.8 | 29.6 | 30.5 | 31.5 | 32.3 | 33.3 | 34.6 |
| 140<br>14.0           | 137                                              | 134  | 131  | 129  | 126  | 124  | 122  | 120  | 118  | 116  | 114  | 112  | 110  | 109  | 107  | 106  | 105  | 103  | 102  | 101  | 100  | 99   | 98   | 97   | 96   |
|                       | 14.6                                             | 15.1 | 15.7 | 16.2 | 16.9 | 17.3 | 17.9 | 18.4 | 19.0 | 19.6 | 20.3 | 21.1 | 22.1 | 22.5 | 23.6 | 24.2 | 24.8 | 25.4 | 26.0 | 26.6 | 27.3 | 28.0 | 28.8 | 29.6 | 30.5 |
| 150<br>12.6           | 147                                              | 143  | 140  | 137  | 134  | 131  | 129  | 127  | 124  | 122  | 120  | 118  | 116  | 114  | 112  | 110  | 109  | 107  | 106  | 105  | 103  | 102  | 101  | 100  | 99   |
|                       | 12.9                                             | 13.5 | 14.0 | 14.6 | 15.1 | 15.7 | 16.2 | 16.9 | 17.3 | 17.8 | 18.4 | 19.0 | 19.6 | 20.3 | 21.1 | 22.1 | 22.5 | 23.6 | 24.2 | 24.8 | 25.4 | 26.0 | 26.6 | 27.3 | 28.0 |
| 160<br>11.4           | 156                                              | 152  | 149  | 145  | 142  | 139  | 136  | 133  | 130  | 128  | 126  | 123  | 121  | 119  | 117  | 115  | 113  | 112  | 110  | 108  | 107  | 106  | 104  | 103  | 102  |
|                       | 11.8                                             | 12.3 | 12.7 | 13.2 | 13.7 | 14.2 | 14.8 | 15.3 | 15.9 | 16.4 | 16.9 | 17.6 | 18.1 | 18.7 | 19.3 | 20.0 | 20.7 | 21.6 | 22.1 | 23.1 | 23.6 | 24.8 | 25.4 | 26.0 | 26.6 |
| 170<br>10.5           | 166                                              | 161  | 157  | 153  | 150  | 146  | 143  | 140  | 137  | 134  | 131  | 128  | 126  | 124  | 122  | 120  | 118  | 116  | 114  | 112  | 110  | 109  | 107  | 106  | 104  |
|                       | 10.8                                             | 11.3 | 11.7 | 12.2 | 12.6 | 13.1 | 13.6 | 14.0 | 14.6 | 15.1 | 15.7 | 16.2 | 16.9 | 17.3 | 17.8 | 18.4 | 19.0 | 19.6 | 20.3 | 21.1 | 22.1 | 22.5 | 23.6 | 24.2 | 24.8 |
| 180<br>9.7            | 175                                              | 170  | 166  | 161  | 157  | 153  | 150  | 146  | 143  | 140  | 137  | 135  | 131  | 128  | 126  | 124  | 122  | 120  | 118  | 116  | 115  | 113  | 111  | 110  | 109  |
|                       | 10.0                                             | 10.5 | 10.8 | 11.3 | 11.7 | 12.2 | 12.6 | 13.1 | 13.6 | 14.0 | 14.6 | 14.9 | 15.7 | 16.4 | 16.9 | 17.3 | 17.9 | 18.4 | 19.0 | 19.6 | 20.0 | 20.7 | 21.6 | 22.1 | 22.5 |
| 190<br>9.1            | 184                                              | 179  | 174  | 169  | 165  | 160  | 156  | 153  | 149  | 145  | 142  | 139  | 136  | 133  | 130  | 128  | 126  | 124  | 121  | 119  | 117  | 115  | 113  | 112  | 111  |
|                       | 9.4                                              | 9.8  | 10.1 | 10.6 | 10.9 | 11.4 | 11.8 | 12.2 | 12.7 | 13.2 | 13.7 | 14.2 | 14.7 | 15.3 | 15.9 | 16.4 | 16.9 | 17.3 | 17.8 | 18.1 | 18.7 | 19.3 | 20.0 | 20.7 | 21.1 |
| 200<br>8.6            | 193                                              | 187  | 182  | 176  | 171  | 167  | 163  | 158  | 154  | 151  | 147  | 144  | 140  | 138  | 135  | 132  | 129  | 127  | 125  | 122  | 120  | 118  | 116  | 114  | 113  |
|                       | 8.9                                              | 9.2  | 9.6  | 9.9  | 10.4 | 10.7 | 11.1 | 11.6 | 12.1 | 12.4 | 12.9 | 13.4 | 14.0 | 14.4 | 14.9 | 15.5 | 16.2 | 16.6 | 17.2 | 17.9 | 18.4 | 19.0 | 19.6 | 20.3 | 21.1 |

\* Register temperature, Fahrenheit. (Use upper value in each group.)

† Register delivery volume in cubic feet per minute per 1000 Btu. (Use lower value in each group.)

‡ Register delivery volume in column 1 are for zero length of duct.

in the structure. The calculation of these losses is explained in Chapter 12.

2. Location of registers and return intakes on floor plan, showing types of registers, with distance from register to opposite wall and deflection of registers desired.

3. Laying out a proposed duct system for both warm air and return air sides of the system, and including details of types of fittings and the actual and equivalent lengths of each branch line from bonnet to register, without sizes. (See Fig. 7, Groups 1 through 6, for equivalent length of fittings.)

4. Determination of bonnet temperature.

If the rating sheet for a furnace-blower unit specifies a fixed value of bonnet temperature, find this temperature in the left-hand column of Table 11. If not specified, use the following procedure: Use Table 11 for buildings having a heat loss between 120,000 and 350,000 Btu per hr. or Table 12 for buildings having a heat loss greater than 350,000 Btu per hr. Select shortest actual length, including vertical risers and read downward in nearest column in Tables 11 or 12 until lower heavy diagonal line is reached, but do not cross line. Run horizontally to first column of table and note bonnet temperature. Also select longest actual length including vertical risers, and read downward in nearest column in Tables 11 or 12 until upper heavy diagonal line is just crossed. Run horizontally to left to obtain value for bonnet temperature in first column. Select as the design bonnet temperature any value between these two limits.

5. Determination of air volume to be delivered through each register and the respective register air temperatures.

Using Tables 11 or 12 and the design bonnet temperature selected, find the values of cfm per 1000 Btu for each duct length, and the corresponding register temperature.

6. Selection of register sizes and pressure losses to produce necessary throw, for the air volumes handled.

Use Tables 13 or 14 to obtain required free area and pressure loss of register.

7. Design of duct system.

A. Warm air branches.

a. Use Table 15 to select maximum bonnet pressure usually required for the trunk carrying the maximum volume of air (cfm). If the maximum bonnet pressure is not high enough to accommodate the pressure loss through the registers, use a higher bonnet pressure. If the register pressure is critically large, it may be necessary to reduce it by either using two registers in place of one, or using smaller deflection angles.

b. Obtain actual duct loss by subtracting total register pressure loss, as determined from Tables 13 or 14, from maximum bonnet pressure.

c. Obtain the pressure drop in each duct per 100 ft using the following equation:

$$\text{Pressure drop per 100 ft} = \frac{\text{Actual Duct Loss} \times 100}{\text{Total Equivalent Length}}$$

d. Determine duct size by means of air friction chart