

# HEATING VENTILATING AIR CONDITIONING GUIDE 1939

TABLE 4. HEAT LOSS FROM HORIZONTAL TARNISHED COPPER PIPE

Expressed in Btu per hour per linear foot per degree Fahrenheit between the pipe and surrounding still air at 70 F

| NOMINAL<br>PIPE<br>SIZE<br>(INCHES) | HOT WATER (Type K Copper Tube) |       |       |       | STEAM (Standard Pipe Size Pipe) |                    |                     |
|-------------------------------------|--------------------------------|-------|-------|-------|---------------------------------|--------------------|---------------------|
|                                     | 120 F                          | 150 F | 180 F | 210 F | 227.1 F<br>(5 Lb)               | 297.7 F<br>(50 Lb) | 337.9 F<br>(100 Lb) |
|                                     | TEMPERATURE DIFFERENCE         |       |       |       |                                 |                    |                     |
|                                     | 50 F                           | 80 F  | 110 F | 140 F | 157.1 F                         | 227.7 F            | 267.9 F             |
| 1/2                                 | 0.250                          | 0.287 | 0.300 | 0.321 | 0.433                           | 0.500              | 0.530               |
| 3/4                                 | 0.340                          | 0.381 | 0.409 | 0.429 | 0.533                           | 0.543              | 0.654               |
| 1                                   | 0.440                          | 0.475 | 0.509 | 0.536 | 0.636                           | 0.746              | 0.803               |
| 1 1/4                               | 0.500                          | 0.559 | 0.618 | 0.622 | 0.764                           | 0.878              | 0.934               |
| 1 1/2                               | 0.580                          | 0.656 | 0.710 | 0.750 | 0.904                           | 1.053              | 1.120               |
| 2                                   | 0.730                          | 0.825 | 0.890 | 0.957 | 1.101                           | 1.273              | 1.364               |
| 2 1/2                               | 0.880                          | 1.000 | 1.091 | 1.143 | 1.305                           | 1.490              | 1.605               |
| 3                                   | 1.040                          | 1.175 | 1.272 | 1.343 | 1.560                           | 1.800              | 1.940               |
| 3 1/2                               | 1.180                          | 1.350 | 1.454 | 1.535 | 1.750                           | 2.020              | 2.170               |
| 4                                   | 1.460                          | 1.500 | 1.635 | 1.715 | 1.941                           | 2.240              | 2.430               |
| 4 1/2                               | 1.600                          | 1.812 | 1.980 | 2.071 | 2.131                           | 2.465              | 2.650               |
| 5                                   | 1.840                          | 2.125 | 2.270 | 2.430 | 2.387                           | 2.770              | 2.990               |
| 6                                   | 2.400                          | 2.685 | 2.910 | 3.110 | 2.740                           | 3.210              | 3.440               |
| 8                                   |                                |       |       |       | 3.310                           | 4.050              | 4.370               |

linear foot of pipe. Table 5 gives these areas for various standard pipe sizes, and Table 6 for copper tubing, while Table 7 gives the area in square feet for flanges and fittings for various standard pipe sizes.

Very often, when pipes are insulated, flanges and fittings are left bare due to the belief that the losses from these parts are not large. However, the fact that a pair of 8 in. standard flanges having an area of 2.41 sq ft

TABLE 5. RADIATING SURFACE PER LINEAR FOOT OF PIPE

| NOMINAL<br>PIPE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) | NOMINAL<br>PIPE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) | NOMINAL<br>PIPE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) |
|----------------------------------|-------------------------|----------------------------------|-------------------------|----------------------------------|-------------------------|
| 1/2                              | 0.22                    | 2                                | 0.622                   | 5                                | 1.456                   |
| 3/4                              | 0.275                   | 2 1/2                            | 0.753                   | 6                                | 1.734                   |
| 1                                | 0.344                   | 3                                | 0.917                   | 8                                | 2.257                   |
| 1 1/4                            | 0.435                   | 3 1/2                            | 1.047                   | 10                               | 2.817                   |
| 1 1/2                            | 0.498                   | 4                                | 1.178                   | 12                               | 3.338                   |

TABLE 6. RADIATING SURFACE PER LINEAR FOOT OF COPPER TUBING

| TUBE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) | TUBE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) | TUBE SIZE<br>(INCHES) | SURFACE AREA<br>(Sq Ft) |
|-----------------------|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
| 1/2                   | 0.164                   | 2                     | 0.556                   | 5                     | 1.342                   |
| 3/4                   | 0.229                   | 2 1/2                 | 0.687                   | 6                     | 1.604                   |
| 1                     | 0.295                   | 3                     | 0.818                   | 8                     | 2.128                   |
| 1 1/4                 | 0.360                   | 3 1/2                 | 0.949                   | ..                    | .....                   |
| 1 1/2                 | 0.426                   | 4                     | 1.080                   | ..                    | .....                   |

# CHAPTER 39. PIPING AND DUCT INSULATION

TABLE 7. AREAS OF FLANGED FITTINGS, SQUARE FEET<sup>a</sup>

| NOMINAL<br>PIPE SIZE<br>(INCHES) | FLANGED<br>COUPLING |                | 90 DEG ELL |                | LONG RADIUS<br>ELL |                | TEE      |                | CROSS    |                |
|----------------------------------|---------------------|----------------|------------|----------------|--------------------|----------------|----------|----------------|----------|----------------|
|                                  | Standard            | Extra<br>Heavy | Standard   | Extra<br>Heavy | Standard           | Extra<br>Heavy | Standard | Extra<br>Heavy | Standard | Extra<br>Heavy |
| 1                                | 0.320               | 0.438          | 0.795      | 1.015          | 0.892              | 1.083          | 1.235    | 1.575          | 1.622    | 2.07           |
| 1 1/4                            | 0.383               | 0.510          | 0.957      | 1.098          | 1.084              | 1.340          | 1.481    | 1.925          | 1.943    | 2.53           |
| 1 1/2                            | 0.477               | 0.727          | 1.174      | 1.332          | 1.337              | 1.874          | 1.815    | 2.68           | 2.38     | 3.54           |
| 2                                | 0.672               | 0.848          | 1.65       | 2.01           | 1.84               | 2.16           | 2.54     | 3.09           | 3.32     | 4.06           |
| 2 1/2                            | 0.841               | 1.107          | 2.09       | 2.57           | 2.32               | 2.76           | 3.21     | 4.05           | 4.19     | 5.17           |
| 3                                | 0.945               | 1.484          | 2.38       | 3.49           | 2.68               | 3.74           | 3.66     | 5.33           | 4.77     | 6.95           |
| 3 1/2                            | 1.122               | 1.644          | 2.98       | 3.96           | 3.28               | 4.28           | 4.48     | 6.04           | 5.83     | 7.89           |
| 4                                | 1.344               | 1.914          | 3.53       | 4.64           | 3.96               | 4.99           | 5.41     | 7.07           | 7.03     | 9.24           |
| 4 1/2                            | 1.474               | 2.04           | 3.95       | 5.02           | 4.43               | 5.46           | 6.07     | 7.72           | 7.87     | 10.07          |
| 5                                | 1.622               | 2.18           | 4.44       | 5.47           | 5.00               | 6.02           | 6.81     | 8.52           | 8.82     | 10.97          |
| 6                                | 1.82                | 2.78           | 5.13       | 6.99           | 5.99               | 7.76           | 7.84     | 10.64          | 10.08    | 13.75          |
| 8                                | 2.41                | 3.77           | 6.98       | 9.76           | 8.56               | 11.09          | 10.55    | 14.74          | 13.44    | 18.97          |
| 10                               | 3.43                | 5.20           | 10.18      | 13.58          | 12.35              | 15.60          | 15.41    | 20.41          | 19.58    | 26.26          |
| 12                               | 4.41                | 6.71           | 13.08      | 17.73          | 16.35              | 18.76          | 19.67    | 26.65          | 24.87    | 34.11          |

<sup>a</sup>Including areas of accompanying flanges bolted to the fitting.

would lose, at 100 lb steam pressure, an amount of heat equivalent to more than a ton of coal per year shows the necessity for insulating such surfaces.

## HEAT LOSSES FROM INSULATED PIPES

The conductivities of various materials used for insulating steam and hot water pipes are given in Table 8. In this table the conductivities are given as functions of the mean temperatures or the mean of the inner and outer surface temperatures of the insulations. This method of stating conductivities makes it possible to readily calculate the heat loss through single or compound sections. It should be emphasized that the conductivities given in Table 8 for the various insulations are the average of

TABLE 8. CONDUCTIVITIES (k) OF VARIOUS TYPES OF INSULATING MATERIALS FOR MEDIUM AND HIGH TEMPERATURE PIPES<sup>a</sup>

| TYPES OF INSULATING MATERIALS       | MEAN TEMPERATURE |       |       |       |       |
|-------------------------------------|------------------|-------|-------|-------|-------|
|                                     | 100 F            | 200 F | 300 F | 400 F | 500 F |
| 85 per cent Magnesia Type.....      | 0.425            | 0.465 | 0.505 | 0.550 | 0.590 |
| Corrugated Asbestos Type.....       | 0.530            | 0.650 | 0.770 | 0.890 |       |
| (4 Plies per 1 in. thick)           |                  |       |       |       |       |
| Corrugated Asbestos Type.....       | 0.480            | 0.555 | 0.630 | 0.705 |       |
| (8 Plies per 1 in. thick)           |                  |       |       |       |       |
| Laminated Asbestos Type.....        | 0.360            | 0.415 | 0.470 | 0.525 | 0.585 |
| (30-40 Laminations per 1 in. thick) |                  |       |       |       |       |
| Laminated Asbestos Type.....        | 0.545            | 0.605 | 0.665 | 0.725 | 0.785 |
| (20 Laminations per 1 in. thick)    |                  |       |       |       |       |
| Rock Wool Type.....                 | 0.350            | 0.410 | 0.470 | 0.530 | 0.590 |
| High Temperature Type.....          | 0.515            | 0.545 | 0.575 | 0.605 | 0.635 |
| (Diatomaceous Earth and Asbestos)   |                  |       |       |       |       |
| Brown Asbestos Type.....            | 0.600            | 0.640 | 0.675 | 0.715 | 0.750 |
| (Felted Fibre)                      |                  |       |       |       |       |

<sup>a</sup>R. H. Heilman, *Mechanical Engineering*, Vol. 46 (1924), p. 593.