TABLE 2. HEAT-CARRYING CAPACITY OF STANDARD BLACK PIPES WITH TEMPERATURE DROP OF 20 DEG[a]

*Nominal Pipe Sizes ⅜ in. to 12 in., and Friction 4 to 800 milinches per foot (A = Capacity, Mbh. B = Velocity, inches per second) (One milinch equals 0.001 in.)*

| Milinch Friction Loss per Foot of Pipe | | Nominal Pipe Size, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ⅜ | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 3½ | 4 | 5 | 6 | 8 | 10 | 12 |
| 4 | A | 0.75 | 1.35 | 2.85 | 5.4 | 11.3 | 17.0 | 33.0 | 53.1 | 95 | 141 | 197 | 363 | 596 | 1250 | 2320 | 3730 |
| | B | 1.5 | 1.7 | 2.1 | 2.4 | 2.9 | 3.2 | 3.8 | 4.3 | 5.0 | 5.5 | 6.0 | 7.0 | 7.9 | 9.6 | 11 | 12 |
| 6 | A | 0.9 | 1.7 | 3.6 | 6.75 | 14.0 | 21.2 | 41.3 | 66.4 | 119 | 176 | 248 | 456 | 748 | 1570 | 2920 | 4690 |
| | B | 1.8 | 2.1 | 2.6 | 3.0 | 3.6 | 4.0 | 4.7 | 5.3 | 6.2 | 6.9 | 7.5 | 8.8 | 10 | 12 | 14 | 16 |
| 8 | A | 1.05 | 2.0 | 4.2 | 7.9 | 16.4 | 24.8 | 48.4 | 77.9 | 140 | 207 | 291 | 535 | 879 | 1850 | 3440 | 5520 |
| | B | 2.1 | 2.5 | 3.0 | 3.5 | 4.2 | 4.7 | 5.6 | 6.3 | 7.3 | 8.0 | 8.8 | 10 | 12 | 14 | 17 | 19 |
| 10 | A | 1.2 | 2.2 | 4.7 | 8.9 | 18.6 | 28.0 | 54.7 | 88.1 | 158 | 234 | 329 | 605 | 997 | 2100 | 3910 | 6270 |
| | B | 2.4 | 2.8 | 3.4 | 4.0 | 4.8 | 5.3 | 6.3 | 7.1 | 8.2 | 9.1 | 9.9 | 12 | 13 | 16 | 19 | 27 |
| 12 | A | 1.35 | 2.45 | 5.2 | 9.8 | 20.5 | 31.0 | 60.4 | 97.4 | 175 | 259 | 364 | 671 | 1100 | 2320 | 4330 | 6950 |
| | B | 2.7 | 3.1 | 3.7 | 4.4 | 5.3 | 5.9 | 6.9 | 7.3 | 9.1 | 10 | 11 | 13 | 15 | 18 | 21 | 24 |
| 14 | A | 1.45 | 2.65 | 5.65 | 10.7 | 22.3 | 33.7 | 65.8 | 106 | 190 | 282 | 397 | 731 | 1200 | 2530 | 4730 | 7590 |
| | B | 2.9 | 3.4 | 4.1 | 4.8 | 5.7 | 6.4 | 7.6 | 8.5 | 9.9 | 11 | 12 | 14 | 16 | 20 | 23 | 26 |
| 16 | A | 1.55 | 2.85 | 6.05 | 11.5 | 24.0 | 36.3 | 70.8 | 114 | 205 | 303 | 428 | 787 | 1300 | 2730 | 5100 | 8190 |
| | B | 3.1 | 3.6 | 4.4 | 5.1 | 6.2 | 6.9 | 8.1 | 9.7 | 11 | 12 | 13 | 15 | 17 | 21 | 25 | 28 |
| 20 | A | 1.75 | 3.25 | 6.85 | 13.0 | 27.1 | 41.0 | 80.0 | 129 | 232 | 344 | 484 | 892 | 1470 | 3100 | 5790 | 9300 |
| | B | 3.5 | 4.1 | 4.9 | 5.8 | 7.0 | 7.7 | 9.2 | 10 | 12 | 13 | 15 | 17 | 20 | 24 | 28 | 32 |
| 25 | A | 2.0 | 3.65 | 7.75 | 14.7 | 30.6 | 46.3 | 90.5 | 146 | 263 | 389 | 548 | 1010 | 1670 | 3510 | 6570 | 10560 |
| | B | 4.0 | 4.6 | 5.6 | 6.5 | 7.9 | 8.8 | 10 | 12 | 14 | 15 | 17 | 19 | 22 | 27 | 32 | 36 |
| 30 | A | 2.2 | 4.0 | 8.55 | 16.2 | 33.8 | 51.2 | 100 | 162 | 290 | 430 | 607 | 1120 | 1850 | 3900 | 7280 | 11710 |
| | B | 4.4 | 5.1 | 6.1 | 7.2 | 8.7 | 9.7 | 11 | 13 | 15 | 17 | 13 | 22 | 25 | 30 | 35 | 40 |
| 35 | A | 2.35 | 4.4 | 9.2 | 17.6 | 36.8 | 55.7 | 109 | 176 | 316 | 469 | 661 | 1220 | 2010 | 4250 | 7940 | 12780 |
| | B | 4.7 | 5.5 | 6.7 | 7.9 | 9.5 | 11 | 13 | 14 | 16 | 18 | 20 | 23 | 27 | 33 | 39 | 44 |
| 40 | A | 2.55 | 4.7 | 10.0 | 18.9 | 39.6 | 59.9 | 117 | 189 | 341 | 505 | 712 | 1320 | 2170 | 4580 | 8570 | 13780 |
| | B | 5.1 | 5.9 | 7.2 | 8.4 | 10 | 11 | 13 | 15 | 18 | 20 | 22 | 25 | 29 | 35 | 42 | 47 |
| 50 | A | 2.85 | 5.3 | 11.3 | 21.4 | 44.7 | 67.7 | 133 | 214 | 386 | 572 | 807 | 1490 | 2460 | 5190 | 9720 | 15650 |
| | B | 5.7 | 6.7 | 8.1 | 9.5 | 12 | 13 | 15 | 17 | 20 | 22 | 24 | 29 | 33 | 40 | 47 | 54 |
| 60 | A | 3.15 | 5.85 | 12.4 | 23.6 | 49.4 | 74.9 | 147 | 238 | 427 | 633 | 893 | 1650 | 2730 | 5760 | 10780 | 17360 |
| | B | 6.3 | 7.4 | 8.9 | 11 | 13 | 14 | 17 | 19 | 22 | 25 | 27 | 32 | 36 | 44 | 52 | 60 |
| 70 | A | 3.45 | 6.35 | 13.5 | 25.7 | 53.8 | 81.4 | 160 | 258 | 465 | 690 | 973 | 1800 | 2970 | 6280 | 11760 | 18950 |
| | B | 6.9 | 8.0 | 9.7 | 11 | 14 | 15 | 18 | 21 | 24 | 27 | 29 | 35 | 40 | 48 | 57 | 65 |
| 80 | A | 3.7 | 6.8 | 14.5 | 27.6 | 57.9 | 87.6 | 172 | 278 | 500 | 743 | 1050 | 1940 | 3200 | 6770 | 12690 | 20440 |
| | B | 7.4 | 8.6 | 10 | 12 | 15 | 17 | 20 | 22 | 26 | 29 | 32 | 37 | 43 | 52 | 62 | 70 |
| 100 | A | 4.15 | 7.7 | 16.4 | 31.1 | 65.4 | 99.0 | 194 | 314 | 566 | 840 | 1190 | 2200 | 3630 | 7680 | 14400 | 23200 |
| | B | 8.3 | 9.7 | 12 | 14 | 17 | 19 | 22 | 25 | 30 | 33 | 36 | 42 | 48 | 59 | 70 | 80 |
| 150 | A | 5.2 | 9.6 | 20.4 | 38.8 | 81.6 | 124 | 243 | 393 | 709 | 1050 | 1490 | 2760 | 4560 | 9650 | 18120 | 29220 |
| | B | 10 | 12 | 15 | 17 | 21 | 23 | 28 | 32 | 37 | 41 | 45 | 53 | 61 | 74 | 88 | 101 |
| 200 | A | 6.05 | 11.2 | 23.9 | 45.4 | 95.5 | 145 | 285 | 461 | 832 | 1240 | 1750 | 3240 | 5360 | 11350 | 21320 | 34400 |
| | B | 12 | 14 | 17 | 20 | 25 | 27 | 33 | 37 | 43 | 48 | 53 | 62 | 71 | 87 | 104 | 118 |
| 300 | A | 7.5 | 13.9 | 29.7 | 56.6 | 119 | 181 | 356 | 577 | 1040 | 1550 | 2190 | 4060 | 6730 | 14270 | 26830 | 43300 |
| | B | 15 | 18 | 21 | 25 | 31 | 34 | 41 | 46 | 54 | 60 | 66 | 78 | 90 | 116 | 131 | 149 |
| 400 | A | 8.75 | 16.2 | 34.7 | 66.2 | 140 | 212 | 417 | 676 | 1220 | 1820 | 2570 | 4780 | 7910 | 16790 | 31580 | 51000 |
| | B | 18 | 21 | 26 | 30 | 36 | 40 | 48 | 54 | 64 | 71 | 78 | 92 | 105 | 129 | 154 | 175 |
| 500 | A | 9.85 | 18.3 | 39.2 | 74.8 | 158 | 239 | 471 | 765 | 1380 | 2060 | 2910 | 5410 | 8970 | 19040 | 35840 | 57880 |
| | B | 20 | 23 | 29 | 33 | 41 | 45 | 54 | 62 | 72 | 80 | 88 | 104 | 119 | 147 | 174 | 199 |
| 600 | A | 10.9 | 20.2 | 43.2 | 82.5 | 174 | 264 | 521 | 846 | 1530 | 2280 | 3220 | 5990 | 9930 | 21100 | 39740 | 64210 |
| | B | 22 | 26 | 32 | 37 | 45 | 50 | 60 | 68 | 80 | 89 | 97 | 115 | 132 | 162 | 193 | 221 |
| 800 | A | 12.7 | 23.6 | 50.5 | 96.5 | 204 | 310 | 610 | 992 | 1790 | 2670 | 3780 | 7030 | 11670 | 24820 | 46780 | 75620 |
| | B | 25 | 30 | 37 | 43 | 52 | 59 | 70 | 80 | 94 | 104 | 114 | 135 | 155 | 191 | 228 | 260 |

[a]For other temperature drops the pipe capacities may be changed correspondingly. For example, with a temperature drop of 30 deg the capacities shown in this table are to be multiplied by 1.5.



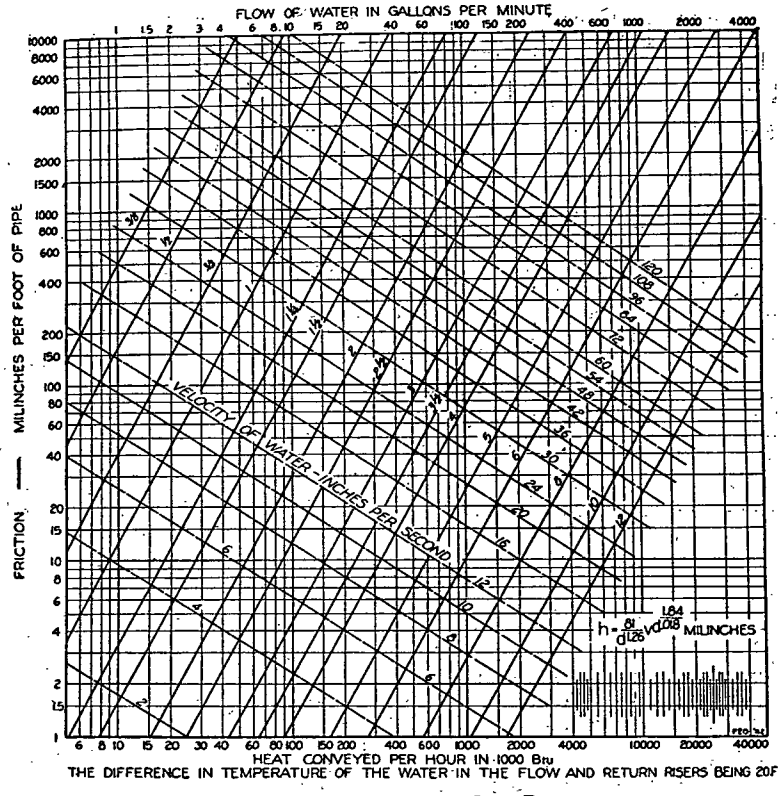



FIG. 3. FRICTION IN BLACK IRON PIPES

To find friction when temperature drop is other than 20 deg, multiply the actual heat conveyed by $\left(\frac{20}{\text{actual temp. drop}}\right)$ and read the corresponding friction.

The friction loss in black iron pipes for a determined weight of water may be obtained from Fig. 2. For the frequently used temperature drop of 20 deg the friction loss may be determined directly from the heat requirement by means of Table 2 or Fig. 3 for black iron pipes, or by means of Table 3 for copper tubing.

Orifices drilled in plates inserted in pipe unions are convenient means for introducing friction, where required to balance various circuits. The friction losses caused by various sizes of orifices are given in Table 4.

## CLASSIFICATION OF SYSTEMS

*Gravity* or *forced* systems of piping may be classified according to piping arrangement and type of circulation as shown in Table 5. Flow and return main piping (gravity systems) for one-pipe, two-pipe direct return, and two-pipe reversed return systems are shown in Figs. 4, 5, and 6 re-