

TABLE 1. LOSSES FROM HORIZONTAL BARE IRON STEAM PIPES

From 100 lineal feet of pipe per month of 30 days with steam in pipes 24 hours per day. Coal at \$4.00 per ton of 2000 lb.

| Pipe<br>Size | GAGE PRESSURE TEMPERATURES |              |                                                                         |       |                 |              |                                                                         |       |                  |              |                                                                         |       |                 |              |                                                                         |        |       |        |         |       |       |
|--------------|----------------------------|--------------|-------------------------------------------------------------------------|-------|-----------------|--------------|-------------------------------------------------------------------------|-------|------------------|--------------|-------------------------------------------------------------------------|-------|-----------------|--------------|-------------------------------------------------------------------------|--------|-------|--------|---------|-------|-------|
|              | Hot Water                  |              |                                                                         |       |                 | 10 Lbs.      |                                                                         |       |                  |              | 80 Lbs.                                                                 |       | 120 Lbs.        |              |                                                                         |        |       |        |         |       |       |
|              | 170 Deg. Fahr.             |              | 150 Deg. Fahr.                                                          |       | 180 Deg. Fahr.  |              | 210 Deg. Fahr.                                                          |       | 239.4 Deg. Fahr. |              | 324 Deg. Fahr.                                                          |       | 330 Deg. Fahr.  |              |                                                                         |        |       |        |         |       |       |
|              | Dollars<br>Loss            | Lbs.<br>Coal | B.t.u.<br>per<br>Lineal<br>Ft. per<br>Deg.<br>Fahr.<br>Diff.<br>per Hr. |       | Dollars<br>Loss | Lbs.<br>Coal | B.t.u.<br>per<br>Lineal<br>Ft. per<br>Deg.<br>Fahr.<br>Diff.<br>per Hr. |       | Dollars<br>Loss  | Lbs.<br>Coal | B.t.u.<br>per<br>Lineal<br>Ft. per<br>Deg.<br>Fahr.<br>Diff.<br>per Hr. |       | Dollars<br>Loss | Lbs.<br>Coal | B.t.u.<br>per<br>Lineal<br>Ft. per<br>Deg.<br>Fahr.<br>Diff.<br>per Hr. |        |       |        |         |       |       |
| 1/2"         | 0.53                       | 215          | 0.543                                                                   | 0.90  | 0.90            | 363          | 0.573                                                                   | 1.32  | 526              | 1.77         | 707                                                                     | 0.638 | 2.24            | 897          | 3.92                                                                    | 1566   | 0.779 | 4.51   | 1805    | 2190  | 0.990 |
| 3/4"         | 0.65                       | 261          | 0.660                                                                   | 1.09  | 1.31            | 437          | 0.690                                                                   | 1.58  | 633              | 2.11         | 845                                                                     | 0.762 | 2.70            | 1083         | 4.74                                                                    | 1895   | 0.943 | 5.28   | 2190    | 0.990 |       |
| 1"           | 0.78                       | 313          | 0.791                                                                   | 1.31  | 1.52            | 525          | 0.829                                                                   | 1.91  | 763              | 2.55         | 1020                                                                    | 0.920 | 3.26            | 1305         | 5.72                                                                    | 2290   | 1.14  | 6.25   | 2601    | 1.18  |       |
| 1 1/4"       | 0.97                       | 388          | 0.979                                                                   | 1.61  | 1.82            | 646          | 1.02                                                                    | 2.36  | 947              | 3.07         | 1275                                                                    | 1.10  | 4.00            | 1610         | 7.14                                                                    | 2860   | 1.42  | 8.18   | 3280    | 1.48  |       |
| 1 1/2"       | 1.08                       | 432          | 1.09                                                                    | 1.82  | 2.03            | 728          | 1.15                                                                    | 2.65  | 1060             | 3.37         | 1430                                                                    | 1.29  | 4.54            | 1818         | 7.98                                                                    | 3190   | 1.58  | 9.28   | 3710    | 1.67  |       |
| 2"           | 1.32                       | 530          | 1.34                                                                    | 2.21  | 2.42            | 886          | 1.40                                                                    | 3.24  | 1297             | 3.97         | 1750                                                                    | 1.57  | 5.36            | 2142         | 9.78                                                                    | 3910   | 1.94  | 11.37  | 4549    | 2.03  |       |
| 2 1/2"       | 1.56                       | 625          | 1.58                                                                    | 2.64  | 2.85            | 1056         | 1.67                                                                    | 3.86  | 1545             | 4.58         | 2075                                                                    | 1.87  | 6.65            | 2660         | 11.66                                                                   | 4660   | 2.32  | 13.68  | 5459    | 2.46  |       |
| 3"           | 1.86                       | 744          | 1.88                                                                    | 3.15  | 3.36            | 1260         | 1.99                                                                    | 4.56  | 1824             | 5.10         | 2480                                                                    | 2.21  | 8.24            | 3292         | 14.46                                                                   | 5350   | 2.76  | 16.36  | 6545    | 2.90  |       |
| 3 1/2"       | 2.11                       | 843          | 2.13                                                                    | 3.54  | 3.75            | 1418         | 2.24                                                                    | 5.18  | 2080             | 6.12         | 2860                                                                    | 2.51  | 9.39            | 3750         | 16.87                                                                   | 5910   | 3.16  | 18.51  | 7323    | 3.30  |       |
| 4"           | 2.33                       | 934          | 2.36                                                                    | 3.95  | 4.16            | 1580         | 2.50                                                                    | 5.78  | 2303             | 6.95         | 3280                                                                    | 2.80  | 10.52           | 4180         | 19.48                                                                   | 6600   | 3.45  | 20.50  | 8030    | 3.70  |       |
| 4 1/2"       | 2.57                       | 1030         | 2.60                                                                    | 4.35  | 4.56            | 1740         | 2.75                                                                    | 6.35  | 2590             | 7.93         | 3750                                                                    | 3.08  | 10.94           | 4370         | 21.25                                                                   | 7200   | 3.73  | 22.62  | 8925    | 4.07  |       |
| 5"           | 2.84                       | 1135         | 2.87                                                                    | 4.71  | 4.92            | 1920         | 3.02                                                                    | 6.95  | 2980             | 9.38         | 4450                                                                    | 3.31  | 11.97           | 4790         | 23.42                                                                   | 7930   | 4.07  | 24.60  | 9850    | 4.45  |       |
| 6"           | 3.13                       | 1242         | 3.16                                                                    | 5.02  | 5.23            | 2120         | 3.28                                                                    | 7.53  | 3370             | 11.10        | 4950                                                                    | 3.54  | 14.21           | 5650         | 25.30                                                                   | 10.11  | 4.82  | 29.30  | 11.720  | 5.29  |       |
| 7"           | 3.43                       | 1352         | 3.39                                                                    | 5.36  | 5.57            | 2340         | 3.55                                                                    | 8.14  | 3760             | 12.70        | 5980                                                                    | 3.78  | 16.18           | 6470         | 28.20                                                                   | 11.640 | 5.78  | 33.70  | 13.480  | 6.09  |       |
| 8"           | 3.73                       | 1463         | 3.70                                                                    | 5.70  | 5.91            | 2570         | 3.82                                                                    | 8.76  | 4150             | 14.25        | 6700                                                                    | 4.01  | 18.25           | 7300         | 32.60                                                                   | 13.030 | 6.21  | 37.65  | 15.050  | 6.84  |       |
| 9"           | 4.03                       | 1574         | 4.00                                                                    | 6.04  | 6.25            | 2800         | 4.09                                                                    | 9.38  | 4540             | 15.80        | 7500                                                                    | 4.24  | 20.35           | 8130         | 36.07                                                                   | 14.500 | 6.75  | 42.10  | 16.840  | 7.60  |       |
| 10"          | 4.33                       | 1685         | 4.30                                                                    | 6.38  | 6.59            | 3030         | 4.36                                                                    | 10.00 | 4930             | 17.35        | 8300                                                                    | 4.47  | 22.45           | 8820         | 39.40                                                                   | 16.100 | 7.21  | 46.50  | 18.690  | 8.44  |       |
| 11"          | 4.63                       | 1796         | 4.60                                                                    | 6.72  | 6.93            | 3260         | 4.63                                                                    | 10.62 | 5320             | 18.90        | 9100                                                                    | 4.69  | 24.54           | 9510         | 42.90                                                                   | 17.600 | 7.75  | 50.90  | 20.540  | 9.28  |       |
| 12"          | 4.93                       | 1907         | 4.90                                                                    | 7.06  | 7.27            | 3490         | 4.90                                                                    | 11.24 | 5710             | 20.45        | 9900                                                                    | 4.91  | 26.64           | 10200        | 46.40                                                                   | 19.100 | 8.29  | 55.40  | 22.420  | 10.00 |       |
| 14"          | 5.53                       | 2167         | 5.50                                                                    | 7.70  | 7.91            | 3950         | 5.46                                                                    | 12.68 | 6500             | 23.00        | 11300                                                                   | 5.34  | 28.90           | 11560        | 50.90                                                                   | 20.800 | 10.34 | 60.50  | 24.200  | 10.90 |       |
| 16"          | 6.13                       | 2427         | 6.10                                                                    | 8.34  | 8.55            | 4410         | 6.02                                                                    | 14.10 | 7290             | 25.55        | 12500                                                                   | 5.77  | 31.20           | 12320        | 54.40                                                                   | 22.300 | 11.70 | 68.40  | 27.320  | 12.34 |       |
| 18"          | 6.73                       | 2687         | 6.70                                                                    | 8.98  | 9.19            | 4870         | 6.62                                                                    | 15.60 | 8080             | 27.10        | 13700                                                                   | 6.19  | 33.50           | 13080        | 58.76                                                                   | 23.800 | 13.00 | 76.50  | 30.570  | 13.80 |       |
|              | 7.33                       | 2947         | 7.30                                                                    | 9.62  | 9.83            | 5330         | 7.22                                                                    | 16.60 | 8870             | 28.65        | 15000                                                                   | 6.61  | 35.80           | 13840        | 63.20                                                                   | 25.300 | 14.30 | 84.60  | 33.720  | 15.24 |       |
|              | 7.93                       | 3207         | 7.90                                                                    | 10.26 | 10.47           | 5790         | 7.82                                                                    | 18.10 | 9660             | 30.20        | 16200                                                                   | 7.03  | 38.10           | 14600        | 67.70                                                                   | 26.800 | 15.60 | 92.70  | 36.870  | 16.68 |       |
|              | 8.53                       | 3467         | 8.50                                                                    | 10.90 | 11.11           | 6250         | 8.42                                                                    | 19.60 | 10450            | 31.75        | 17400                                                                   | 7.45  | 40.40           | 15360        | 72.20                                                                   | 28.300 | 16.90 | 100.80 | 39.970  | 18.12 |       |
|              | 9.13                       | 3727         | 9.10                                                                    | 11.54 | 11.75           | 6710         | 9.02                                                                    | 21.10 | 11240            | 33.30        | 18600                                                                   | 7.87  | 42.70           | 16120        | 76.70                                                                   | 29.800 | 18.20 | 108.90 | 43.070  | 19.56 |       |
|              | 9.73                       | 3987         | 9.70                                                                    | 12.18 | 12.39           | 7170         | 9.62                                                                    | 22.60 | 12030            | 34.85        | 19800                                                                   | 8.29  | 45.00           | 16880        | 81.20                                                                   | 31.300 | 19.50 | 117.00 | 46.170  | 21.00 |       |
|              | 10.33                      | 4247         | 10.30                                                                   | 12.82 | 13.03           | 7630         | 10.22                                                                   | 24.10 | 12820            | 36.40        | 21000                                                                   | 8.71  | 47.30           | 17640        | 85.70                                                                   | 32.800 | 20.80 | 125.10 | 49.270  | 22.44 |       |
|              | 10.93                      | 4507         | 10.90                                                                   | 13.46 | 13.67           | 8090         | 10.82                                                                   | 25.60 | 13610            | 37.95        | 22200                                                                   | 9.13  | 49.60           | 18400        | 90.20                                                                   | 34.300 | 22.10 | 133.20 | 52.370  | 23.88 |       |
|              | 11.53                      | 4767         | 11.50                                                                   | 14.10 | 14.31           | 8550         | 11.42                                                                   | 27.10 | 14400            | 39.50        | 23400                                                                   | 9.55  | 51.90           | 19160        | 94.70                                                                   | 35.800 | 23.40 | 141.30 | 55.470  | 25.32 |       |
|              | 12.13                      | 5027         | 12.10                                                                   | 14.74 | 14.95           | 9010         | 12.02                                                                   | 28.60 | 15190            | 41.05        | 24600                                                                   | 9.97  | 54.20           | 20000        | 99.20                                                                   | 37.300 | 24.70 | 149.40 | 58.570  | 26.76 |       |
|              | 12.73                      | 5287         | 12.70                                                                   | 15.38 | 15.59           | 9470         | 12.62                                                                   | 30.10 | 15980            | 42.60        | 25800                                                                   | 10.39 | 56.50           | 20840        | 103.70                                                                  | 38.800 | 26.00 | 157.50 | 61.670  | 28.20 |       |
|              | 13.33                      | 5547         | 13.30                                                                   | 16.02 | 16.23           | 9930         | 13.22                                                                   | 31.60 | 16770            | 44.15        | 27000                                                                   | 10.81 | 58.80           | 21680        | 108.20                                                                  | 40.300 | 27.30 | 165.60 | 64.770  | 29.64 |       |
|              | 13.93                      | 5807         | 13.90                                                                   | 16.66 | 16.87           | 10390        | 13.82                                                                   | 33.10 | 17560            | 45.70        | 28200                                                                   | 11.23 | 61.10           | 22520        | 112.70                                                                  | 41.800 | 28.60 | 173.70 | 67.870  | 31.08 |       |
|              | 14.53                      | 6067         | 14.50                                                                   | 17.30 | 17.51           | 10850        | 14.42                                                                   | 34.60 | 18350            | 47.25        | 29400                                                                   | 11.65 | 63.40           | 23360        | 117.20                                                                  | 43.300 | 29.90 | 181.80 | 70.970  | 32.52 |       |
|              | 15.13                      | 6327         | 15.10                                                                   | 17.94 | 18.15           | 11310        | 15.02                                                                   | 36.10 | 19140            | 48.80        | 30600                                                                   | 12.07 | 65.70           | 24200        | 121.70                                                                  | 44.800 | 31.20 | 189.90 | 74.070  | 33.96 |       |
|              | 15.73                      | 6587         | 15.70                                                                   | 18.58 | 18.79           | 11770        | 15.62                                                                   | 37.60 | 19930            | 50.35        | 31800                                                                   | 12.49 | 68.00           | 25040        | 126.20                                                                  | 46.300 | 32.50 | 198.00 | 77.170  | 35.40 |       |
|              | 16.33                      | 6847         | 16.30                                                                   | 19.22 | 19.43           | 12230        | 16.22                                                                   | 39.10 | 20720            | 51.90        | 33000                                                                   | 12.91 | 70.30           | 25880        | 130.70                                                                  | 47.800 | 33.80 | 206.10 | 80.270  | 36.84 |       |
|              | 16.93                      | 7107         | 16.90                                                                   | 19.86 | 20.07           | 12690        | 16.82                                                                   | 40.60 | 21510            | 53.45        | 34200                                                                   | 13.33 | 72.60           | 26720        | 135.20                                                                  | 49.300 | 35.10 | 214.20 | 83.370  | 38.28 |       |
|              | 17.53                      | 7367         | 17.50                                                                   | 20.50 | 20.71           | 13150        | 17.42                                                                   | 42.10 | 22300            | 55.00        | 35400                                                                   | 13.75 | 74.90           | 27560        | 139.70                                                                  | 50.800 | 36.40 | 222.30 | 86.470  | 39.72 |       |
|              | 18.13                      | 7627         | 18.10                                                                   | 21.14 | 21.35           | 13610        | 18.02                                                                   | 43.60 | 23090            | 56.55        | 36600                                                                   | 14.17 | 77.20           | 28400        | 144.20                                                                  | 52.300 | 37.70 | 230.40 | 89.570  | 41.16 |       |
|              | 18.73                      | 7887         | 18.70                                                                   | 21.78 | 21.99           | 14070        | 18.62                                                                   | 45.10 | 23880            | 58.10        | 37800                                                                   | 14.59 | 79.50           | 29240        | 148.70                                                                  | 53.800 | 39.00 | 238.50 | 92.670  | 42.60 |       |
|              | 19.33                      | 8147         | 19.30                                                                   | 22.42 | 22.63           | 14530        | 19.22                                                                   | 46.60 | 24670            | 59.65        | 39000                                                                   | 15.01 | 81.80           | 30080        | 153.20                                                                  | 55.300 | 40.30 | 246.60 | 95.770  | 44.04 |       |
|              | 19.93                      | 8407         | 19.90                                                                   | 23.06 | 23.27           | 14990        | 19.82                                                                   | 48.10 | 25460            | 61.20        | 40200                                                                   | 15.43 | 84.10           | 30920        | 157.70                                                                  | 56.800 | 41.60 | 254.70 | 98.870  | 45.48 |       |
|              | 20.53                      | 8667         | 20.50                                                                   | 23.70 | 23.91           | 15450        | 20.42                                                                   | 49.60 | 26250            | 62.75        | 41400                                                                   | 15.85 | 86.40           | 31760        | 162.20                                                                  | 58.300 | 42.90 | 262.80 | 101.970 | 46.92 |       |
|              | 21.13                      | 8927         | 21.10                                                                   | 24.34 | 24.55           | 15910        | 21.02                                                                   | 51.10 | 27040            | 64.30        | 42600                                                                   | 16.27 | 88.70           | 32600        | 166.70                                                                  | 59.800 | 44.20 | 270.90 | 105.070 | 48.36 |       |
|              | 21.73                      | 9187         | 21.70                                                                   | 24.98 | 25.19           | 16370        | 21.62                                                                   | 52.60 | 27830            | 65.85        | 43800                                                                   | 16.69 | 91.00           | 33440        | 171.20                                                                  | 61.300 | 45.50 | 279.00 | 108.170 | 49.80 |       |
|              | 22.33                      | 9447         | 22.30                                                                   | 25.62 | 25.83           | 16830        | 22.22                                                                   | 54.10 | 28620            | 67.40        | 45000                                                                   | 17.11 | 93.30           | 34280        | 175.70                                                                  | 62.800 | 46.80 | 287.10 | 111.270 | 51.24 |       |
|              | 22.93                      | 9707         | 22.90                                                                   | 26.26 | 26.47           | 17290        | 22.82                                                                   | 55.60 | 29410            | 68.95        | 46200                                                                   | 17.53 | 95.60           | 35120        | 180.20                                                                  | 64.300 | 48.10 | 295.20 | 114.370 | 52.68 |       |
|              | 23.53                      | 9967         | 23.50                                                                   | 26.90 | 27.11           | 17750        | 23.42                                                                   | 57.10 | 30200            | 70.50        | 47400                                                                   | 17.95 | 97.90           | 35960        | 184.70                                                                  | 65.800 | 49.40 | 303.30 | 117.470 | 54.12 |       |
|              | 24.13                      | 10227        | 24.10                                                                   | 27.54 | 27.75           | 18210        | 24.02                                                                   | 58.60 | 31000            | 72.05        | 48600                                                                   | 18.37 | 100.20          | 36800        | 189.20                                                                  | 67.300 | 50.70 | 311.40 | 120.570 | 55.56 |       |
|              | 24.73                      | 10487        | 24.70                                                                   | 28.18 | 28.39           | 18670        | 24.62                                                                   | 60.10 | 31790            | 73.60        | 49800                                                                   | 18.79 | 102.50          | 37640        | 193.70                                                                  | 68.800 | 52.00 | 319.50 | 123.670 | 57.00 |       |
|              | 25.33                      | 10747        | 25.30                                                                   | 28.82 | 29.03           | 19130        | 25.22                                                                   | 61.60 | 32580            | 75.15        | 51000                                                                   | 19.21 | 104.80          | 38480        | 198.20                                                                  | 70.300 | 53.30 | 327.60 | 126.770 | 58.44 |       |
|              | 25.93                      | 11007        | 25.90                                                                   | 29.46 | 29.67           | 19590        | 25.82                                                                   | 63.10 | 33370            | 76.70        | 52200                                                                   | 19.63 | 107.10          | 39320        | 202.70                                                                  | 71.800 | 54.60 | 335.70 | 129.870 | 59.88 |       |
|              | 26.53                      | 11267        | 26.50                                                                   | 30.10 | 30.31           | 20050        | 26.42                                                                   | 64.60 | 34160            | 78.25        | 53400                                                                   | 20.05 | 109.40          | 40160        | 207.20                                                                  | 73.300 | 55.90 | 343.80 | 132.970 | 61.32 |       |
|              | 27.13                      | 11527        | 27.10                                                                   | 30.74 | 30.95           | 20510        | 27.02                                                                   | 66.10 | 34950            | 79.80        |                                                                         |       |                 |              |                                                                         |        |       |        |         |       |       |