

ENGINEERING INFORMATION

Velocity Head and Friction Loss in Feet per 100 Feet of Pipe



Engineering Information

| 1" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 1 | 0.4 | --- | 0.1 | 0.4 | --- | 0.1 | --- | --- | --- |
| 2 | 0.7 | --- | 0.4 | 0.7 | --- | 0.4 | 0.7 | --- | 0.4 |
| 3 | 1.2 | --- | 0.8 | 1.2 | --- | 0.7 | 1.2 | --- | 0.8 |
| 4 | 1.5 | --- | 1.3 | 1.5 | --- | 1.0 | 1.5 | --- | 1.3 |
| 5 | 1.9 | 0.1 | 1.9 | 1.9 | 0.1 | 1.6 | 1.9 | 0.1 | 1.9 |
| 6 | 2.3 | 0.1 | 2.7 | 2.2 | 0.1 | 2.2 | 2.2 | 0.1 | 2.7 |
| 7 | 2.6 | 0.1 | 3.6 | 2.6 | 0.1 | 2.9 | 2.6 | 0.1 | 3.6 |
| 8 | 3.0 | 0.1 | 4.6 | 3.0 | 0.1 | 3.7 | 3.0 | 0.1 | 4.7 |
| 9 | 3.4 | 0.2 | 5.8 | 3.4 | 0.2 | 4.6 | 3.4 | 0.2 | 5.8 |
| 10 | 3.8 | 0.2 | 6.9 | 3.8 | 0.2 | 5.5 | 3.8 | 0.2 | 7.0 |
| 12 | 4.5 | 0.3 | 9.6 | 4.5 | 0.3 | 7.7 | 4.5 | 0.3 | 9.8 |
| 14 | 5.2 | 0.4 | 12.8 | 5.2 | 0.4 | 10.4 | 5.2 | 0.4 | 13.1 |
| 16 | 5.9 | 0.5 | 16.5 | 5.9 | 0.5 | 13.4 | 5.9 | 0.5 | 16.8 |
| 18 | 6.7 | 0.7 | 20.6 | 6.7 | 0.7 | 16.5 | 6.7 | 0.7 | 20.8 |
| 20 | 7.4 | 0.9 | 25.1 | 7.4 | 0.9 | 19.7 | 7.4 | 0.9 | 25.1 |
| 22 | 8.2 | 1.1 | 30.2 | 8.2 | 1.0 | 23.9 | 8.2 | 1.1 | 30.1 |
| 24 | 8.9 | 1.2 | 35.6 | 8.9 | 1.2 | 28.1 | 8.9 | 1.2 | 35.6 |
| 26 | 9.7 | 1.5 | 41.6 | 9.7 | 1.5 | 32.2 | 9.7 | 1.5 | 41.3 |
| 28 | 10.4 | 1.7 | 47.9 | 10.4 | 1.7 | 37.9 | 10.4 | 1.7 | 47.2 |
| 30 | 11.1 | 1.9 | 54.6 | 11.1 | 1.9 | 41.8 | 11.1 | 1.9 | 53.4 |
| 32 | 11.9 | 2.2 | 61.8 | 11.9 | 2.2 | 47.0 | 11.9 | 2.2 | 60.5 |
| 34 | 12.6 | 2.5 | 69.4 | 12.6 | 2.5 | 53.0 | 12.6 | 2.5 | 67.8 |
| 36 | 13.4 | 2.8 | 77.4 | 13.4 | 2.8 | 58.8 | 13.4 | 2.8 | 75.0 |
| 38 | 14.1 | 3.0 | 86.0 | 14.1 | 3.1 | 65.0 | 14.1 | 3.0 | 83.0 |
| 40 | 14.8 | 3.4 | 95.0 | 14.8 | 3.4 | 71.4 | 14.8 | 3.4 | 91.1 |
| 42 | | | | | | | | | |
| 44 | | | | | | | | | |
| 46 | | | | | | | | | |
| 48 | | | | | | | | | |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |
| 70 | | | | | | | | | |
| 75 | | | | | | | | | |
| 80 | | | | | | | | | |
| 85 | | | | | | | | | |
| 90 | | | | | | | | | |
| 95 | | | | | | | | | |
| 100 | | | | | | | | | |

| 1 1/4" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 2 | 0.4 | --- | 0.1 | 0.4 | --- | 0.1 | 0.5 | --- | 0.2 |
| 3 | 0.6 | --- | 0.2 | 0.6 | --- | 0.2 | 0.7 | --- | 0.3 |
| 4 | 0.9 | --- | 0.3 | 0.9 | --- | 0.3 | 1.0 | --- | 0.5 |
| 5 | 1.1 | --- | 0.5 | 1.1 | --- | 0.4 | 1.2 | --- | 0.7 |
| 6 | 1.3 | --- | 0.7 | 1.3 | --- | 0.6 | 1.5 | --- | 1.0 |
| 7 | 1.5 | --- | 0.9 | 1.5 | --- | 0.7 | 1.7 | --- | 1.4 |
| 8 | 1.7 | --- | 1.2 | 1.7 | --- | 1.0 | 2.0 | 0.1 | 1.7 |
| 9 | 1.9 | 0.1 | 1.5 | 1.9 | 0.1 | 1.2 | 2.2 | 0.1 | 2.2 |
| 10 | 2.2 | 0.1 | 1.8 | 2.2 | 0.1 | 1.4 | 2.5 | 0.1 | 2.6 |
| 12 | 2.6 | 0.1 | 2.5 | 2.6 | 0.1 | 2.0 | 2.9 | 0.1 | 3.7 |
| 14 | 3.0 | 0.1 | 3.3 | 3.0 | 0.1 | 2.7 | 3.4 | 0.2 | 4.8 |
| 16 | 3.4 | 0.2 | 4.2 | 3.4 | 0.2 | 3.5 | 3.9 | 0.2 | 6.4 |
| 18 | 3.9 | 0.2 | 5.2 | 3.9 | 0.2 | 4.3 | 4.4 | 0.3 | 7.9 |
| 20 | 4.3 | 0.3 | 6.3 | 4.3 | 0.3 | 5.2 | 4.9 | 0.4 | 9.4 |
| 22 | 4.7 | 0.3 | 7.6 | 4.7 | 0.3 | 6.0 | 5.5 | 0.5 | 11.4 |
| 24 | 5.2 | 0.4 | 8.9 | 5.2 | 0.4 | 7.1 | 5.9 | 0.5 | 13.4 |
| 26 | 5.6 | 0.5 | 10.4 | 5.6 | 0.5 | 8.3 | 6.4 | 0.6 | 15.5 |
| 28 | 6.0 | 0.6 | 11.9 | 6.0 | 0.6 | 9.5 | 6.9 | 0.7 | 17.6 |
| 30 | 6.4 | 0.6 | 13.6 | 6.4 | 0.6 | 10.8 | 7.3 | 0.8 | 19.9 |
| 32 | 6.9 | 0.7 | 15.3 | 6.9 | 0.7 | 12.4 | 7.9 | 1.0 | 22.5 |
| 34 | 7.3 | 0.8 | 17.2 | 7.3 | 0.8 | 13.9 | 8.3 | 1.1 | 25.2 |
| 36 | 7.7 | 0.9 | 19.2 | 7.7 | 0.9 | 15.5 | 8.9 | 1.2 | 28.0 |
| 38 | 8.2 | 1.0 | 21.3 | 8.2 | 1.0 | 17.1 | 9.3 | 1.3 | 31.0 |
| 40 | 8.6 | 1.1 | 23.5 | 8.6 | 1.1 | 18.8 | 9.8 | 1.5 | 34.0 |
| 42 | 9.0 | 1.3 | 25.8 | 9.0 | 1.3 | 20.6 | 10.3 | 1.7 | 37.4 |
| 44 | 9.4 | 1.4 | 28.2 | 9.4 | 1.4 | 22.5 | 10.8 | 1.8 | 40.9 |
| 46 | 9.9 | 1.5 | 30.7 | 9.9 | 1.5 | 24.5 | 11.3 | 2.0 | 44.4 |
| 48 | 10.3 | 1.7 | 33.3 | 10.3 | 1.7 | 26.4 | 11.8 | 2.1 | 48.0 |
| 50 | 10.7 | 1.8 | 36.0 | 10.7 | 1.8 | 28.2 | 12.2 | 2.3 | 51.4 |
| 55 | 11.8 | 2.2 | 43.2 | 11.8 | 2.2 | 33.8 | 13.5 | 2.8 | 61.5 |
| 60 | 12.9 | 2.6 | 51.0 | 12.9 | 2.6 | 40.0 | 14.7 | 3.4 | 72.1 |
| 65 | 13.9 | 3.0 | 59.6 | 13.9 | 3.0 | 46.7 | 15.9 | 3.9 | 84.0 |
| 70 | 15.0 | 3.5 | 68.8 | 15.0 | 3.5 | 53.1 | 17.1 | 4.5 | 96.0 |
| 75 | 16.1 | 4.0 | 78.7 | 16.1 | 4.0 | 60.6 | 18.3 | 5.2 | 108.0 |
| 80 | 17.2 | 4.6 | 89.2 | 17.2 | 4.6 | 68.2 | 19.6 | 6.0 | 123.0 |
| 85 | 18.2 | 5.2 | 100.2 | 18.2 | 5.2 | 77.0 | 20.8 | 6.7 | 130.0 |
| 90 | 19.3 | 5.8 | 112.0 | 19.3 | 5.8 | 84.6 | 22.0 | 7.5 | 153.0 |
| 95 | 20.4 | 6.5 | 124.0 | 21.4 | 6.5 | 92.2 | 23.2 | 8.4 | 169.0 |
| 100 | 21.5 | 7.2 | 138.0 | 21.5 | 7.2 | 102.0 | 24.4 | 9.2 | 186.0 |
| 110 | | | | | | | | | |

| 1½" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 10 | 1.6 | --- | 0.8 | 1.6 | --- | 0.7 | 1.8 | 0.1 | 1.2 |
| 12 | 1.9 | 0.1 | 1.2 | 1.9 | 0.1 | 0.9 | 2.1 | 0.1 | 1.6 |
| 14 | 2.2 | 0.1 | 1.5 | 2.2 | 0.1 | 1.3 | 2.5 | 0.1 | 2.2 |
| 16 | 2.5 | 0.1 | 2.0 | 2.5 | 0.1 | 1.6 | 2.8 | 0.1 | 2.8 |
| 18 | 2.8 | 0.1 | 2.4 | 2.8 | 0.1 | 2.0 | 3.1 | 0.2 | 3.5 |
| 20 | 3.2 | 0.2 | 2.9 | 3.2 | 0.2 | 2.4 | 3.5 | 0.2 | 4.2 |
| 22 | 3.5 | 0.2 | 3.5 | 3.5 | 0.2 | 2.8 | 3.9 | 0.2 | 5.0 |
| 24 | 3.8 | 0.2 | 4.1 | 3.8 | 0.2 | 3.2 | 4.2 | 0.3 | 5.8 |
| 26 | 4.1 | 0.3 | 4.8 | 4.1 | 0.3 | 3.8 | 4.6 | 0.3 | 6.7 |
| 28 | 4.4 | 0.3 | 5.5 | 4.4 | 0.3 | 4.5 | 4.9 | 0.4 | 7.8 |
| 30 | 4.7 | 0.3 | 6.3 | 4.7 | 0.4 | 5.2 | 5.3 | 0.4 | 8.8 |
| 32 | 5.0 | 0.4 | 7.1 | 5.0 | 0.4 | 5.8 | 5.6 | 0.5 | 10.0 |
| 34 | 5.4 | 0.4 | 7.9 | 5.4 | 0.5 | 6.6 | 6.0 | 0.6 | 11.2 |
| 36 | 5.7 | 0.5 | 8.8 | 5.7 | 0.5 | 7.3 | 6.3 | 0.6 | 12.5 |
| 38 | 6.0 | 0.6 | 9.8 | 6.0 | 0.6 | 8.1 | 6.7 | 0.7 | 13.7 |
| 40 | 6.3 | 0.6 | 10.8 | 6.3 | 0.6 | 8.8 | 7.0 | 0.8 | 15.0 |
| 42 | 6.6 | 0.7 | 11.8 | 6.6 | 0.7 | 9.7 | 7.4 | 0.8 | 16.5 |
| 44 | 6.9 | 0.7 | 12.9 | 7.0 | 0.8 | 10.6 | 7.7 | 0.9 | 18.0 |
| 46 | 7.3 | 0.8 | 14.0 | 7.3 | 0.8 | 11.4 | 8.1 | 1.0 | 19.5 |
| 48 | 7.6 | 0.9 | 15.2 | 7.5 | 0.9 | 12.4 | 8.4 | 1.1 | 21.1 |
| 50 | 7.9 | 1.0 | 16.4 | 7.9 | 1.0 | 13.3 | 8.8 | 1.2 | 22.7 |
| 55 | 8.7 | 1.2 | 19.7 | 8.7 | 1.2 | 16.0 | 9.6 | 1.4 | 27.2 |
| 60 | 9.5 | 1.4 | 23.2 | 9.4 | 1.4 | 18.6 | 10.5 | 1.7 | 31.8 |
| 65 | 10.2 | 1.6 | 27.1 | 10.2 | 1.6 | 21.6 | 11.4 | 2.0 | 36.8 |
| 70 | 11.0 | 1.9 | 31.3 | 11.0 | 1.9 | 24.9 | 12.3 | 2.4 | 42.4 |
| 75 | 11.8 | 2.2 | 35.8 | 11.8 | 2.2 | 28.2 | 13.1 | 2.7 | 48.1 |
| 80 | 12.6 | 2.5 | 40.5 | 12.7 | 2.5 | 32.0 | 14.0 | 3.0 | 54.2 |
| 85 | 13.4 | 2.8 | 45.6 | 13.4 | 2.8 | 35.3 | 14.9 | 3.5 | 60.5 |
| 90 | 14.2 | 3.1 | 51.0 | 14.2 | 3.1 | 39.5 | 15.8 | 3.9 | 67.3 |
| 95 | 15.0 | 3.5 | 56.5 | 15.0 | 3.5 | 43.7 | 16.6 | 4.3 | 74.3 |
| 100 | 15.8 | 3.9 | 62.2 | 15.7 | 3.9 | 47.9 | 17.5 | 4.8 | 82.0 |
| 110 | 17.3 | 4.7 | 74.5 | 17.3 | 4.7 | 57.3 | 19.3 | 5.8 | 97.5 |
| 120 | 18.9 | 5.6 | 88.3 | 18.9 | 5.5 | 67.2 | 21.0 | 6.9 | 115.0 |
| 130 | 20.5 | 6.5 | 103.0 | 20.5 | 6.5 | 78.0 | 22.8 | 8.1 | 133.0 |
| 140 | 22.1 | 7.6 | 119.0 | 22.0 | 7.5 | 89.3 | | | |
| 150 | 23.6 | 8.7 | 137.0 | | | | | | |
| 160 | 25.2 | 9.9 | 156.0 | | | | | | |
| 170 | 26.8 | 11.2 | 175.0 | | | | | | |
| 180 | 28.4 | 12.5 | 196.0 | | | | | | |
| 190 | 29.9 | 13.9 | 218.0 | | | | | | |

| 2" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 20 | 1.9 | 0.1 | 0.9 | 1.9 | 0.1 | 0.9 | 2.0 | 0.1 | 1.1 |
| 22 | 2.1 | 0.1 | 1.0 | 2.1 | 0.1 | 1.1 | 2.2 | 0.1 | 1.3 |
| 24 | 2.3 | 0.1 | 1.2 | 2.3 | 0.1 | 1.2 | 2.4 | 0.1 | 1.5 |
| 26 | 2.5 | 0.1 | 1.4 | 2.5 | 0.1 | 1.4 | 2.6 | 0.1 | 1.8 |
| 28 | 2.7 | 0.1 | 1.6 | 2.7 | 0.1 | 1.6 | 2.8 | 0.1 | 2.0 |
| 30 | 2.9 | 0.1 | 1.8 | 2.9 | 0.1 | 1.8 | 3.0 | 0.1 | 2.3 |
| 35 | 3.4 | 0.2 | 2.4 | 3.4 | 0.2 | 2.4 | 3.5 | 0.2 | 3.1 |
| 40 | 3.8 | 0.2 | 3.1 | 3.8 | 0.2 | 3.1 | 4.1 | 0.3 | 4.0 |
| 45 | 4.3 | 0.3 | 3.9 | 4.3 | 0.3 | 3.9 | 4.6 | 0.3 | 5.0 |
| 50 | 4.8 | 0.4 | 4.7 | 4.8 | 0.4 | 4.7 | 5.1 | 0.4 | 6.0 |
| 55 | 5.3 | 0.4 | 5.6 | 5.3 | 0.4 | 5.6 | 5.6 | 0.5 | 7.1 |
| 60 | 5.7 | 0.5 | 6.6 | 5.7 | 0.5 | 6.5 | 6.1 | 0.6 | 8.4 |
| 65 | 6.2 | 0.6 | 7.7 | 6.2 | 0.6 | 7.6 | 6.6 | 0.7 | 9.7 |
| 70 | 6.7 | 0.7 | 8.9 | 6.7 | 0.7 | 8.6 | 7.1 | 0.8 | 11.2 |
| 75 | 7.2 | 0.8 | 10.1 | 7.2 | 0.8 | 9.8 | 7.6 | 0.9 | 12.6 |
| 80 | 7.7 | 0.9 | 11.4 | 7.7 | 0.9 | 11.1 | 8.1 | 1.0 | 14.3 |
| 85 | 8.1 | 1.0 | 12.8 | 8.1 | 1.0 | 12.5 | 8.6 | 1.2 | 16.0 |
| 90 | 8.6 | 1.2 | 14.2 | 8.6 | 1.2 | 13.8 | 9.1 | 1.3 | 17.8 |
| 95 | 9.1 | 1.3 | 15.8 | 9.1 | 1.3 | 15.3 | 9.6 | 1.4 | 19.6 |
| 100 | 9.6 | 1.4 | 17.4 | 9.6 | 1.4 | 16.8 | 10.1 | 1.6 | 21.6 |
| 110 | 10.5 | 1.7 | 20.9 | 10.5 | 1.7 | 20.2 | 11.1 | 1.9 | 25.8 |
| 120 | 11.5 | 2.1 | 24.7 | 11.5 | 2.1 | 23.5 | 12.1 | 2.3 | 30.4 |
| 130 | 12.4 | 2.4 | 28.8 | 12.4 | 2.4 | 27.3 | 13.1 | 2.7 | 35.1 |
| 140 | 13.4 | 2.8 | 33.2 | 13.4 | 2.8 | 31.5 | 14.2 | 3.2 | 40.3 |
| 150 | 14.3 | 3.2 | 38.0 | 14.3 | 3.2 | 35.7 | 15.2 | 3.6 | 45.8 |
| 160 | 15.3 | 3.6 | 43.0 | 15.3 | 3.6 | 40.4 | 16.2 | 4.1 | 51.5 |
| 170 | 16.3 | 4.1 | 48.4 | 16.3 | 4.1 | 45.1 | 17.2 | 4.6 | 57.7 |
| 180 | 17.2 | 4.6 | 54.1 | 17.2 | 4.6 | 50.3 | 18.2 | 5.1 | 64.1 |
| 190 | 18.2 | 5.1 | 60.1 | 18.2 | 5.1 | 55.5 | 19.2 | 5.7 | 70.7 |
| 200 | 19.1 | 5.7 | 66.3 | 19.1 | 5.7 | 60.6 | 20.2 | 6.3 | 77.9 |
| 220 | 21.0 | 6.9 | 80.0 | 21.0 | 6.9 | 72.4 | 22.2 | 7.7 | 93.1 |
| 240 | 22.9 | 8.2 | 95.0 | 22.9 | 8.2 | 85.5 | 24.3 | 9.2 | 110.0 |
| 260 | 24.9 | 9.6 | 111.0 | 24.9 | 9.6 | 99.2 | 26.3 | 10.7 | 127.0 |
| 280 | 26.8 | 11.1 | 128.0 | | | | 28.3 | 12.4 | 145.0 |
| 300 | 28.7 | 12.8 | 146.0 | | | | 30.4 | 14.4 | 165.0 |
| 320 | 30.6 | 14.5 | 166.0 | | | | | | |
| 340 | 32.5 | 16.4 | 187.0 | | | | | | |
| 360 | 34.4 | 18.4 | 209.0 | | | | | | |
| 380 | 36.3 | 20.5 | 233.0 | | | | | | |
| 400 | 38.2 | 22.7 | 258.0 | | | | | | |

Velocity Head and Friction Loss in Feet per 100 Feet of Pipe



Engineering Information

| 2½" | | | | | | | | | |
|-----------|---------------------------|--------------------|------------------------------|------------------------|--------------------|------------------------------|----------------------|--------------------|------------------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' |
| 20 | 1.3 | --- | 0.4 | 1.3 | --- | 0.3 | 1.3 | --- | 0.4 |
| 22 | 1.5 | --- | 0.4 | 1.5 | --- | 0.4 | 1.5 | --- | 0.4 |
| 24 | 1.6 | --- | 0.5 | 1.6 | --- | 0.4 | 1.6 | --- | 0.5 |
| 26 | 1.7 | --- | 0.6 | 1.7 | --- | 0.5 | 1.7 | --- | 0.6 |
| 28 | 1.9 | 0.1 | 0.7 | 1.9 | 0.1 | 0.5 | 1.9 | 0.1 | 0.7 |
| 30 | 2.0 | 0.1 | 0.8 | 2.0 | 0.1 | 0.6 | 2.0 | 0.1 | 0.8 |
| 35 | 2.4 | 0.1 | 1.0 | 2.4 | 0.1 | 0.8 | 2.3 | 0.1 | 1.1 |
| 40 | 2.7 | 0.1 | 1.3 | 2.7 | 0.1 | 1.0 | 2.6 | 0.1 | 1.4 |
| 45 | 3.0 | 0.1 | 1.6 | 3.0 | 0.1 | 1.3 | 3.0 | 0.1 | 1.7 |
| 50 | 3.4 | 0.2 | 1.9 | 3.4 | 0.2 | 1.6 | 3.3 | 0.2 | 2.1 |
| 55 | 3.7 | 0.2 | 2.3 | 3.7 | 0.2 | 1.9 | 3.6 | 0.2 | 2.5 |
| 60 | 4.0 | 0.3 | 2.7 | 4.0 | 0.3 | 2.2 | 3.9 | 0.3 | 2.9 |
| 65 | 4.4 | 0.3 | 3.2 | 4.4 | 0.3 | 2.5 | 4.3 | 0.3 | 3.5 |
| 70 | 4.7 | 0.3 | 3.6 | 4.7 | 0.3 | 2.9 | 4.6 | 0.3 | 3.9 |
| 75 | 5.0 | 0.4 | 4.1 | 5.0 | 0.4 | 3.3 | 4.9 | 0.4 | 4.4 |
| 80 | 5.4 | 0.4 | 4.7 | 5.4 | 0.4 | 3.7 | 5.3 | 0.4 | 5.0 |
| 85 | 5.7 | 0.5 | 5.2 | 5.7 | 0.5 | 4.2 | 5.6 | 0.5 | 5.6 |
| 90 | 6.0 | 0.6 | 5.8 | 6.0 | 0.6 | 4.6 | 5.9 | 0.6 | 6.2 |
| 95 | 6.4 | 0.6 | 6.5 | 6.4 | 0.6 | 5.1 | 6.3 | 0.6 | 6.9 |
| 100 | 6.7 | 0.7 | 7.1 | 6.7 | 0.7 | 5.6 | 6.6 | 0.7 | 7.5 |
| 110 | 7.4 | 0.8 | 8.5 | 7.4 | 0.8 | 6.8 | 7.2 | 0.8 | 8.9 |
| 120 | 8.0 | 1.0 | 10.0 | 8.0 | 1.0 | 7.9 | 7.9 | 1.0 | 10.5 |
| 130 | 8.7 | 1.2 | 11.7 | 8.7 | 1.2 | 8.8 | 8.5 | 1.1 | 12.1 |
| 140 | 9.4 | 1.4 | 13.5 | 9.4 | 1.4 | 10.5 | 9.2 | 1.3 | 13.9 |
| 150 | 10.1 | 1.6 | 15.4 | 10.1 | 1.6 | 12.0 | 9.8 | 1.5 | 15.8 |
| 160 | 10.7 | 1.8 | 17.4 | 10.7 | 1.8 | 13.6 | 10.5 | 1.7 | 17.8 |
| 170 | 11.4 | 2.0 | 19.6 | 11.4 | 2.0 | 16.0 | 11.1 | 1.9 | 20.0 |
| 180 | 12.1 | 2.3 | 21.9 | 12.1 | 2.3 | 16.8 | 11.8 | 2.2 | 22.2 |
| 190 | 12.7 | 2.5 | 24.2 | 12.7 | 2.5 | 18.6 | 12.5 | 2.4 | 24.5 |
| 200 | 13.4 | 2.8 | 26.7 | 13.4 | 2.8 | 20.3 | 13.1 | 2.7 | 27.0 |
| 220 | 14.7 | 3.4 | 32.2 | 14.7 | 3.4 | 24.9 | 14.4 | 3.2 | 32.2 |
| 240 | 16.1 | 4.0 | 38.1 | 16.1 | 4.0 | 28.7 | 15.7 | 3.8 | 37.9 |
| 260 | 17.4 | 4.7 | 44.5 | 17.4 | 4.7 | 33.0 | 17.1 | 4.5 | 43.9 |
| 280 | 18.8 | 5.5 | 51.3 | 18.8 | 5.5 | 38.1 | 18.4 | 5.3 | 50.2 |
| 300 | 20.1 | 6.3 | 58.5 | 20.1 | 6.3 | 43.2 | 19.7 | 6.0 | 57.6 |
| 350 | 23.5 | 8.6 | 79.2 | 23.5 | 8.6 | 56.0 | 23.0 | 8.2 | 76.0 |
| 400 | 26.8 | 11.2 | 103.0 | 26.8 | 11.2 | 73.3 | 26.2 | 10.7 | 97.0 |
| 450 | 30.2 | 14.1 | 130.0 | | | | 29.5 | 13.5 | 120.0 |
| 500 | 33.5 | 17.4 | 160.0 | | | | 32.8 | 16.7 | 147.0 |
| 550 | 36.9 | 21.1 | 193.0 | | | | | | |

| 3" | | | | | | | | | |
|-----------|---------------------------|--------------------|------------------------------|------------------------|--------------------|------------------------------|----------------------|--------------------|------------------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' | Vel. Ft./ Sec. | Vel. Hd. Ft. | Head Loss Ft./ 100' |
| 50 | 2.2 | 0.1 | 0.7 | 2.2 | 0.1 | 0.7 | 2.3 | 0.1 | 0.9 |
| 60 | 2.6 | 0.1 | 0.9 | 2.6 | 0.1 | 0.9 | 2.8 | 0.1 | 1.2 |
| 70 | 3.0 | 0.1 | 1.2 | 3.0 | 0.1 | 1.2 | 3.2 | 0.2 | 1.6 |
| 80 | 3.5 | 0.2 | 1.6 | 3.5 | 0.2 | 1.5 | 3.7 | 0.2 | 2.1 |
| 90 | 3.9 | 0.2 | 2.0 | 3.9 | 0.2 | 1.9 | 4.1 | 0.3 | 2.6 |
| 100 | 4.3 | 0.3 | 2.4 | 4.3 | 0.3 | 2.3 | 4.6 | 0.3 | 3.2 |
| 110 | 4.8 | 0.4 | 2.9 | 4.8 | 0.4 | 2.8 | 5.1 | 0.4 | 3.8 |
| 120 | 5.2 | 0.4 | 3.4 | 5.2 | 0.4 | 3.3 | 5.5 | 0.5 | 4.4 |
| 130 | 5.6 | 0.5 | 3.9 | 5.6 | 0.5 | 3.8 | 6.0 | 0.6 | 5.1 |
| 140 | 6.1 | 0.6 | 4.5 | 6.1 | 0.6 | 4.3 | 6.4 | 0.6 | 5.9 |
| 150 | 6.5 | 0.7 | 5.1 | 6.5 | 0.7 | 4.9 | 6.9 | 0.7 | 6.7 |
| 160 | 6.9 | 0.7 | 5.8 | 6.9 | 0.7 | 5.5 | 7.3 | 0.8 | 7.6 |
| 170 | 7.4 | 0.8 | 6.5 | 7.4 | 0.8 | 6.3 | 7.8 | 0.9 | 8.3 |
| 180 | 7.8 | 0.9 | 7.3 | 7.8 | 0.9 | 6.6 | 8.3 | 1.1 | 9.4 |
| 190 | 8.3 | 1.1 | 8.1 | 8.3 | 1.1 | 7.3 | 8.7 | 1.2 | 10.4 |
| 200 | 8.7 | 1.2 | 8.9 | 8.7 | 1.2 | 8.4 | 9.2 | 1.3 | 11.4 |
| 220 | 9.6 | 1.4 | 10.7 | 9.6 | 1.4 | 10.0 | 10.1 | 1.6 | 13.6 |
| 240 | 10.4 | 1.7 | 12.6 | 10.4 | 1.7 | 11.8 | 11.0 | 1.9 | 16.0 |
| 260 | 11.3 | 2.0 | 14.7 | 11.3 | 2.0 | 13.7 | 11.9 | 2.2 | 18.5 |
| 280 | 12.2 | 2.3 | 16.9 | 12.2 | 2.3 | 15.7 | 12.8 | 2.5 | 21.3 |
| 300 | 13.0 | 2.6 | 19.2 | 13.0 | 2.6 | 17.9 | 13.7 | 2.9 | 24.2 |
| 320 | 13.9 | 3.0 | 22.0 | 13.9 | 3.0 | 20.1 | 14.7 | 3.4 | 27.2 |
| 340 | 14.8 | 3.4 | 24.8 | 14.8 | 3.4 | 22.5 | 15.6 | 3.8 | 30.4 |
| 360 | 15.6 | 3.8 | 27.7 | 15.6 | 3.8 | 24.9 | 16.5 | 4.2 | 33.8 |
| 380 | 16.5 | 4.2 | 30.7 | 16.5 | 4.2 | 27.7 | 17.4 | 4.7 | 37.4 |
| 400 | 17.4 | 4.7 | 33.9 | 17.4 | 4.7 | 30.6 | 18.3 | 5.2 | 41.2 |
| 420 | 18.2 | 5.2 | 37.3 | 18.2 | 5.2 | 33.2 | 19.2 | 5.7 | 45.0 |
| 440 | 19.1 | 5.7 | 40.9 | 19.1 | 5.7 | 36.3 | 20.1 | 6.3 | 49.1 |
| 460 | 20.0 | 6.2 | 44.6 | 20.0 | 6.2 | 39.5 | 21.1 | 6.9 | 53.4 |
| 480 | 20.8 | 6.7 | 48.5 | 20.8 | 6.7 | 42.8 | 22.0 | 7.5 | 57.9 |
| 500 | 21.7 | 7.3 | 52.5 | 21.7 | 7.3 | 46.1 | 22.9 | 8.1 | 62.1 |
| 550 | 23.9 | 8.9 | 63.2 | 23.9 | 8.9 | 55 | 25.2 | 9.9 | 74.1 |
| 600 | 26.0 | 10.5 | 74.8 | 26.0 | 10.5 | 64.4 | 27.5 | 11.7 | 87.0 |
| 650 | 28.2 | 12.4 | 87.5 | | | | 29.8 | 13.8 | 101.0 |
| 700 | 30.4 | 14.3 | 101.0 | | | | 32.1 | 16.0 | 116.0 |
| 750 | 32.5 | 16.5 | 116.0 | | | | 34.4 | 18.4 | 132.0 |
| 800 | 34.7 | 18.7 | 131.0 | | | | 36.6 | 20.8 | 148.0 |
| 850 | 36.9 | 21.1 | 148.0 | | | | | | |
| 900 | 39.1 | 23.7 | 165.0 | | | | | | |
| 950 | 41.2 | 26.4 | 184.0 | | | | | | |

| 4" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 100 | 2.5 | 0.1 | 0.6 | 2.5 | 0.1 | 0.6 | 2.6 | 0.1 | 0.8 |
| 110 | 2.8 | 0.1 | 0.7 | 2.8 | 0.1 | 0.7 | 2.9 | 0.1 | 1.0 |
| 120 | 3.0 | 0.1 | 0.9 | 3.0 | 0.1 | 0.8 | 3.2 | 0.1 | 1.2 |
| 130 | 3.3 | 0.2 | 1.0 | 3.3 | 0.2 | 0.9 | 3.4 | 0.2 | 1.3 |
| 140 | 3.5 | 0.2 | 1.2 | 3.5 | 0.2 | 1.1 | 3.7 | 0.2 | 1.5 |
| 150 | 3.8 | 0.2 | 1.3 | 3.8 | 0.2 | 1.2 | 4.0 | 0.3 | 1.7 |
| 160 | 4.0 | 0.3 | 1.5 | 4.0 | 0.3 | 1.4 | 4.2 | 0.3 | 1.9 |
| 170 | 4.3 | 0.3 | 1.7 | 4.3 | 0.3 | 1.5 | 4.5 | 0.3 | 2.2 |
| 180 | 4.5 | 0.3 | 1.9 | 4.5 | 0.3 | 1.7 | 4.7 | 0.4 | 2.4 |
| 190 | 4.8 | 0.4 | 2.1 | 4.8 | 0.4 | 1.9 | 5.0 | 0.4 | 2.7 |
| 200 | 5.0 | 0.4 | 2.3 | 5.0 | 0.4 | 2.1 | 5.3 | 0.4 | 2.9 |
| 220 | 5.5 | 0.5 | 2.7 | 5.5 | 0.5 | 2.4 | 5.8 | 0.5 | 3.5 |
| 240 | 6.1 | 0.6 | 3.2 | 6.1 | 0.6 | 2.9 | 6.3 | 0.6 | 4.1 |
| 260 | 6.6 | 0.7 | 3.7 | 6.6 | 0.7 | 3.3 | 6.9 | 0.7 | 4.8 |
| 280 | 7.1 | 0.8 | 4.3 | 7.1 | 0.8 | 3.9 | 7.4 | 0.9 | 5.5 |
| 300 | 7.6 | 0.9 | 4.9 | 7.6 | 0.9 | 4.4 | 7.9 | 1.0 | 6.2 |
| 320 | 8.1 | 1.0 | 5.5 | 8.1 | 1.0 | 4.9 | 8.4 | 1.1 | 7.0 |
| 340 | 8.6 | 1.1 | 6.2 | 8.6 | 1.1 | 5.5 | 9.0 | 1.3 | 7.8 |
| 360 | 9.1 | 1.3 | 6.9 | 9.1 | 1.3 | 6.2 | 9.5 | 1.4 | 8.7 |
| 380 | 9.6 | 1.4 | 7.7 | 9.6 | 1.4 | 6.6 | 10.0 | 1.6 | 9.7 |
| 400 | 10.1 | 1.6 | 8.5 | 10.1 | 1.6 | 7.5 | 10.5 | 1.7 | 10.6 |
| 420 | 10.6 | 1.7 | 9.3 | 10.6 | 1.7 | 8.3 | 11.1 | 1.9 | 11.6 |
| 440 | 11.1 | 1.9 | 10.2 | 11.1 | 1.9 | 9.0 | 11.6 | 2.1 | 12.6 |
| 460 | 11.6 | 2.1 | 11.1 | 11.6 | 2.1 | 9.8 | 12.1 | 2.3 | 13.7 |
| 480 | 12.1 | 2.3 | 12.0 | 12.1 | 2.3 | 10.6 | 12.6 | 2.5 | 14.8 |
| 500 | 12.6 | 2.5 | 13.0 | 12.6 | 2.5 | 11.3 | 13.2 | 2.7 | 15.9 |
| 550 | 13.9 | 3.0 | 15.7 | 13.9 | 3.0 | 13.5 | 14.5 | 3.3 | 19.1 |
| 600 | 15.1 | 3.6 | 18.6 | 15.1 | 3.6 | 15.8 | 15.8 | 3.9 | 22.4 |
| 650 | 16.4 | 4.2 | 21.7 | 16.4 | 4.2 | 18.3 | 17.1 | 4.5 | 26.0 |
| 700 | 17.6 | 4.8 | 25.0 | 17.6 | 4.8 | 21.1 | 18.4 | 5.3 | 29.9 |
| 750 | 18.9 | 5.6 | 28.6 | 18.9 | 5.6 | 24.0 | 19.8 | 6.1 | 33.8 |
| 800 | 20.2 | 6.3 | 32.4 | 20.2 | 6.3 | 26.8 | 21.1 | 6.9 | 38.1 |
| 850 | 21.4 | 7.1 | 36.5 | 21.4 | 7.1 | 30.1 | 22.4 | 7.8 | 42.6 |
| 900 | 22.7 | 8.0 | 40.8 | 22.7 | 8.0 | 33.4 | 23.7 | 8.7 | 47.3 |
| 950 | 23.9 | 8.9 | 45.3 | | | | 25.0 | 9.7 | 52.3 |
| 1000 | 25.2 | 9.9 | 50.2 | | | | 26.4 | 10.8 | 57.6 |
| 1100 | 27.7 | 11.9 | 60.2 | | | | 29.0 | 13.1 | 68.7 |
| 1200 | 30.2 | 14.2 | 72.0 | | | | 31.6 | 15.5 | 81.0 |
| 1300 | 32.8 | 16.7 | 84.3 | | | | 34.2 | 18.2 | 93.5 |
| 1400 | 35.3 | 19.3 | 97.6 | | | | 36.9 | 21.1 | 108.0 |

| 5" | | | | | | | | | |
|--------|------------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------|--------------|--------------------|
| US GPM | IRON/STEEL Schedule 40 | | | PLASTIC Schedule 40 | | | COPPER Type M | | |
| | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' | Vel. Ft./Sec. | Vel. Hd. Ft. | Head Loss Ft./100' |
| 200 | 3.2 | 0.2 | 0.7 | | | | 3.4 | 0.2 | 1.0 |
| 220 | 3.5 | 0.2 | 0.9 | | | | 3.7 | 0.2 | 1.2 |
| 240 | 3.9 | 0.2 | 1.0 | | | | 4.1 | 0.3 | 1.4 |
| 260 | 4.2 | 0.3 | 1.2 | | | | 4.4 | 0.3 | 1.6 |
| 280 | 4.5 | 0.3 | 1.4 | | | | 4.7 | 0.3 | 1.9 |
| 300 | 4.8 | 0.4 | 1.6 | | | | 5.1 | 0.4 | 2.1 |
| 320 | 5.2 | 0.4 | 1.8 | | | | 5.4 | 0.5 | 2.5 |
| 340 | 5.5 | 0.5 | 2.0 | | | | 5.7 | 0.5 | 2.8 |
| 360 | 5.8 | 0.5 | 2.2 | | | | 6.1 | 0.6 | 3.1 |
| 380 | 6.0 | 0.6 | 2.5 | | | | 6.4 | 0.6 | 3.3 |
| 400 | 6.4 | 0.6 | 2.7 | | | | 6.8 | 0.7 | 3.6 |
| 420 | 6.8 | 0.7 | 3.0 | | | | 7.1 | 0.8 | 4.0 |
| 440 | 7.0 | 0.8 | 3.3 | | | | 7.4 | 0.9 | 4.5 |
| 460 | 7.4 | 0.9 | 3.6 | | | | 7.8 | 0.9 | 4.8 |
| 480 | 7.7 | 0.9 | 3.9 | | | | 8.1 | 1.0 | 5.2 |
| 500 | 8.0 | 1.0 | 4.2 | | | | 8.5 | 1.1 | 5.5 |
| 550 | 8.8 | 1.2 | 5.0 | | | | 9.3 | 1.3 | 6.6 |
| 600 | 9.6 | 1.4 | 5.9 | | | | 10.1 | 1.6 | 7.7 |
| 650 | 10.4 | 1.7 | 6.9 | | | | 11.0 | 1.9 | 8.9 |
| 700 | 11.2 | 2.0 | 7.9 | | | | 11.8 | 2.2 | 10.2 |
| 750 | 12.0 | 2.3 | 9.0 | | | | 12.7 | 2.5 | 11.6 |
| 800 | 12.8 | 2.6 | 10.3 | | | | 13.5 | 2.8 | 13.1 |
| 850 | 13.6 | 2.9 | 11.5 | | | | 14.4 | 3.2 | 14.7 |
| 900 | 14.4 | 3.3 | 12.9 | | | | 15.2 | 3.6 | 16.3 |
| 950 | 15.2 | 3.6 | 14.3 | | | | 16.1 | 4.0 | 18.0 |
| 1000 | 16.0 | 4.0 | 15.8 | | | | 16.9 | 4.4 | 19.8 |
| 1100 | 17.6 | 4.8 | 19.0 | | | | 18.6 | 5.4 | 23.6 |
| 1200 | 19.2 | 5.8 | 22.5 | | | | 20.3 | 6.4 | 27.7 |
| 1300 | 20.8 | 6.8 | 26.3 | | | | 22.0 | 7.5 | 32.1 |
| 1400 | 22.5 | 7.8 | 30.4 | | | | 23.7 | 8.7 | 36.8 |
| 1500 | 24.1 | 9.0 | 34.8 | | | | 25.4 | 10.1 | 41.8 |
| 1600 | 25.7 | 10.2 | 39.5 | | | | 27.0 | 11.3 | 47.2 |
| 1700 | 27.3 | 11.6 | 44.5 | | | | 28.7 | 12.8 | 53.0 |
| 1800 | 28.8 | 12.9 | 49.7 | | | | 30.4 | 14.4 | 58.7 |
| 1900 | 30.5 | 14.4 | 55.2 | | | | 32.1 | 16.0 | 64.9 |
| 2000 | 32.1 | 16.0 | 61.0 | | | | 33.8 | 17.7 | 71.2 |
| 2100 | 33.7 | 17.6 | 67.1 | | | | 35.5 | 19.6 | 78.1 |
| 2200 | 35.3 | 19.3 | 73.5 | | | | 37.2 | 21.5 | 85.0 |
| 2300 | 36.9 | 21.1 | 80.1 | | | | 38.8 | 23.4 | 92.4 |
| 2400 | 38.5 | 23.0 | 87.0 | | | | 40.5 | 25.5 | 99.8 |

Equivalent Length (Feet) of Straight Pipe for Pipe Fittings

(Based on Hydraulic Institute Pipe Friction Manual)

Engineering Information

| | PIPE FITTINGS | PIPE DIAMETER | | | | | | | | | |
|--|---|---------------|----|----|----|----|----|----|-----|-----|-----|
| | | 3/4 | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 4 | 5 | 6 |
|  | SCREWED RETURN BEND OR REGULAR SCREWED ELBOW | 4 | 6 | 6 | 7 | 9 | 9 | 11 | 14 | - | - |
|  | LONG RADIUS SCREWED ELBOW | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | - | - |
|  | REGULAR SCREWED 45° ELBOW | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | - | - |
|  | SCREWED T-LINE FLOW | 2 | 3 | 5 | 6 | 8 | 10 | 13 | 18 | - | - |
|  | SCREWED T-BRANCH FLOW | 5 | 7 | 8 | 10 | 12 | 14 | 17 | 22 | - | - |
|  | SCREWED INCREASER (1 PIPE SIZE) | 1 | 3 | 1 | 3 | 2 | 4 | 10 | - | - | - |
|  | SCREWED GATE VALVE | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | - | - |
|  | SCREWED GLOB VALVE | 27 | 32 | 41 | 45 | 60 | 66 | 84 | 112 | - | - |
|  | SCREWED COUPLINGS & UNIONS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - |
|  | SCREWED SWING CHECK VALVE | 9 | 11 | 13 | 15 | 19 | 23 | 28 | 40 | - | - |
|  | SCREWED ANGLE VALVE | 16 | 16 | 18 | 18 | 18 | 18 | 20 | 20 | - | - |
|  | INWARD PROJECTING PIPE OR SUDDEN INCREASE | 3 | 4 | 5 | 6 | 9 | 11 | 14 | 20 | 26 | 33 |
|  | REDUCERS | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 7 |
|  | FOOT VALVE | - | 3 | 4 | 5 | 7 | 9 | 11 | 16 | 21 | 26 |
|  | BELL MOUTHED INLET | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 |
|  | SQUARE EDGED INLET | 1 | 2 | 3 | 3 | 4 | 5 | 7 | 10 | 13 | 16 |
|  | REGULAR FLANGED RETURN BEND OR REGULAR FLANGED ELBOW | - | 2 | 2 | 3 | 3 | 4 | 5 | 6 | 8 | 9 |
|  | LONG RADIUS FLANGED RETD. BEND OR LONG RADIUS FLANGED ELBOW | - | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 6 |
|  | LONG RADIUS FLANGED 45° ELBOW | - | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 5 |
|  | FLANGED T-LINE FLOW | - | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 |
|  | FLANGED T-BRANCH FLOW | - | 4 | 5 | 6 | 7 | 8 | 10 | 14 | 16 | 19 |
|  | FLANGED INCREASER | - | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  | FLANGED GATE VALVE | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 |
|  | FLANGED GLOBE VALVE | - | 45 | 57 | 63 | 74 | 83 | 98 | 120 | 156 | 192 |
|  | FLANGED SWING CHECK VALVE | - | 7 | 10 | 13 | 18 | 22 | 28 | 40 | 53 | 65 |
|  | FLANGED ANGLE VALVE | - | 16 | 18 | 18 | 21 | 23 | 30 | 39 | 53 | 65 |
|  | BASKET STRAINER | - | - | 10 | 11 | 13 | 14 | 17 | 22 | 25 | 28 |

| PROPERTIES OF WATER | | | | | | | |
|---------------------|-------------------------|-----------|--|----------|-------------------------|-----------|--|
| Temp. °F | Absolute Vapor Pressure | | Specific Gravity (Water at 39.2°F = 1.000) | Temp. °F | Absolute Vapor Pressure | | Specific Gravity (Water at 39.2°F = 1.000) |
| | Psi | Ft. Water | | | Psi | Ft. Water | |
| 60 | 0.26 | 0.59 | 0.999 | 205 | 12.77 | 30.6 | 0.961 |
| 70 | 0.36 | 0.89 | 0.998 | 206 | 13.03 | 31.2 | 0.960 |
| 80 | 0.51 | 1.2 | 0.997 | 207 | 13.30 | 32.0 | 0.960 |
| 85 | 0.60 | 1.4 | 0.996 | 208 | 13.57 | 32.6 | 0.960 |
| 90 | 0.70 | 1.6 | 0.995 | 209 | 13.84 | 33.2 | 0.959 |
| 100 | 0.95 | 2.2 | 0.993 | 210 | 14.12 | 33.9 | 0.959 |
| 110 | 1.27 | 3.0 | 0.991 | 211 | 14.41 | 34.6 | 0.958 |
| 120 | 1.69 | 3.9 | 0.989 | 212 | 14.70 | 35.4 | 0.958 |
| 130 | 2.22 | 5.0 | 0.986 | 213 | 14.99 | 36.2 | 0.957 |
| 140 | 2.89 | 6.8 | 0.983 | 214 | 15.29 | 37.0 | 0.957 |
| 150 | 3.72 | 8.8 | 0.981 | 215 | 15.59 | 37.7 | 0.957 |
| 151 | 3.81 | 9.0 | 0.981 | 216 | 15.90 | 38.4 | 0.956 |
| 152 | 3.90 | 9.2 | 0.980 | 217 | 16.22 | 39.2 | 0.956 |
| 153 | 4.00 | 9.4 | 0.980 | 218 | 16.54 | 40.0 | 0.956 |
| 154 | 4.10 | 9.7 | 0.979 | 219 | 16.86 | 40.8 | 0.955 |
| 155 | 4.20 | 9.9 | 0.979 | 220 | 17.19 | 41.6 | 0.955 |
| 156 | 4.31 | 10.1 | 0.979 | 221 | 17.52 | 42.5 | 0.955 |
| 157 | 4.41 | 10.4 | 0.978 | 222 | 17.86 | 43.3 | 0.954 |
| 158 | 4.52 | 10.7 | 0.978 | 223 | 18.21 | 44.2 | 0.954 |
| 159 | 4.63 | 10.9 | 0.978 | 224 | 18.56 | 45.0 | 0.953 |
| 160 | 4.74 | 11.2 | 0.977 | 225 | 18.92 | 45.9 | 0.953 |
| 161 | 4.85 | 11.5 | 0.977 | 226 | 19.28 | 46.8 | 0.953 |
| 162 | 4.97 | 11.7 | 0.977 | 227 | 19.65 | 47.7 | 0.952 |
| 163 | 5.09 | 12.0 | 0.976 | 228 | 20.02 | 48.6 | 0.952 |
| 164 | 5.21 | 12.3 | 0.976 | 229 | 20.04 | 49.5 | 0.951 |
| 165 | 5.33 | 12.6 | 0.976 | 230 | 20.78 | 50.5 | 0.951 |
| 166 | 5.46 | 12.9 | 0.975 | 231 | 21.17 | 51.4 | 0.951 |
| 167 | 5.59 | 13.3 | 0.975 | 232 | 21.57 | 52.5 | 0.950 |
| 168 | 5.72 | 13.6 | 0.974 | 233 | 21.97 | 53.5 | 0.950 |
| 169 | 5.85 | 13.9 | 0.974 | 234 | 22.38 | 54.5 | 0.950 |
| 170 | 5.99 | 14.2 | 0.974 | 235 | 22.80 | 55.5 | 0.949 |
| 171 | 6.13 | 14.5 | 0.973 | 236 | 23.22 | 56.6 | 0.949 |
| 172 | 6.27 | 14.9 | 0.973 | 237 | 23.65 | 57.8 | 0.948 |
| 173 | 6.42 | 15.2 | 0.973 | 238 | 24.09 | 58.8 | 0.948 |
| 174 | 6.56 | 15.6 | 0.972 | 239 | 24.53 | 59.8 | 0.948 |
| 175 | 6.71 | 15.9 | 0.972 | 240 | 24.97 | 61.0 | 0.947 |
| 176 | 6.87 | 16.3 | 0.972 | 241 | 25.43 | 62.1 | 0.947 |
| 177 | 7.02 | 16.7 | 0.971 | 242 | 25.89 | 63.3 | 0.946 |
| 178 | 7.18 | 17.1 | 0.971 | 243 | 26.36 | 64.5 | 0.946 |
| 179 | 7.34 | 17.4 | 0.971 | 244 | 26.83 | 65.6 | 0.946 |
| 180 | 7.51 | 17.8 | 0.970 | 245 | 27.31 | 66.8 | 0.945 |
| 181 | 7.68 | 18.3 | 0.970 | 250 | 29.83 | 73.2 | 0.943 |
| 182 | 7.85 | 18.7 | 0.970 | 260 | 35.44 | 87.4 | 0.938 |
| 183 | 8.02 | 19.1 | 0.969 | 270 | 41.87 | 103.6 | 0.933 |
| 184 | 8.20 | 19.5 | 0.969 | 280 | 49.22 | 122.8 | 0.927 |
| 185 | 8.38 | 20.0 | 0.969 | 290 | 57.57 | 144.0 | 0.923 |
| 186 | 8.57 | 20.4 | 0.968 | 300 | 67.0 | 168.6 | 0.918 |
| 187 | 8.76 | 20.9 | 0.968 | 310 | 77.7 | 197.0 | 0.913 |
| 188 | 8.95 | 21.4 | 0.967 | 320 | 89.7 | 228.4 | 0.908 |
| 189 | 9.14 | 21.8 | 0.967 | 330 | 103.0 | 264.0 | 0.902 |
| 190 | 9.34 | 22.3 | 0.966 | 340 | 118.0 | 305.0 | 0.896 |
| 191 | 9.54 | 22.8 | 0.966 | 350 | 134.6 | 349.0 | 0.891 |
| 192 | 9.75 | 23.3 | 0.965 | 360 | 153.0 | 399.0 | 0.886 |
| 193 | 9.96 | 23.8 | 0.965 | 380 | 195.8 | 517.7 | 0.874 |
| 194 | 10.17 | 24.3 | 0.965 | 400 | 247.3 | 663.9 | 0.861 |
| 195 | 10.38 | 24.9 | 0.964 | 420 | 308.8 | 842.4 | 0.847 |
| 196 | 10.60 | 25.4 | 0.964 | 440 | 381.6 | 1058.5 | 0.833 |
| 197 | 10.83 | 25.9 | 0.963 | 460 | 466.9 | 1318.0 | 0.818 |
| 198 | 11.06 | 26.6 | 0.963 | 480 | 566.1 | 1630.5 | 0.802 |
| 199 | 11.29 | 27.1 | 0.963 | 500 | 680.8 | 2000.1 | 0.786 |
| 200 | 11.53 | 27.6 | 0.963 | 520 | 812.4 | 2445.5 | 0.767 |
| 201 | 11.77 | 28.2 | 0.962 | 540 | 962.5 | 2980.4 | 0.746 |
| 202 | 12.01 | 28.8 | 0.962 | | | | |
| 203 | 12.26 | 29.4 | 0.962 | | | | |
| 204 | 12.51 | 30.0 | 0.961 | | | | |

| ATMOSPHERIC PRESSURE AND BOILING POINT OF WATER AT VARIOUS ALTITUDES | | | | |
|--|--------------------------|----------------------|-------------|------------------|
| Altitude (Feet) | Barometer inches Mercury | Atmospheric Pressure | | Boiling Point °F |
| | | PSIA | (ft. water) | |
| -1000 | 31.0 | 15.2 | 32.5 | 213.8 |
| -500 | 30.5 | 15.0 | 34.6 | 212.9 |
| 0 | 29.9 | 14.7 | 33.9 | 212.0 |
| +500 | 29.4 | 14.4 | 33.3 | 211.1 |
| +1000 | 28.9 | 14.2 | 32.8 | 210.2 |
| +1500 | 28.3 | 13.9 | 32.1 | 209.3 |
| +2000 | 27.8 | 13.7 | 31.5 | 208.4 |
| +2500 | 27.3 | 13.4 | 31.0 | 207.4 |
| +3000 | 26.8 | 13.2 | 30.4 | 206.5 |
| +3500 | 26.3 | 12.9 | 29.8 | 205.6 |
| +4000 | 25.8 | 12.7 | 29.2 | 204.7 |
| +4500 | 25.4 | 12.4 | 28.8 | 203.8 |
| +5000 | 24.9 | 12.2 | 28.2 | 202.9 |
| +5500 | 24.4 | 12.0 | 27.6 | 201.9 |
| +6000 | 24.0 | 11.8 | 27.2 | 201.0 |
| +6500 | 23.5 | 11.5 | 26.7 | 200.1 |
| +7000 | 23.1 | 11.3 | 26.2 | 199.2 |
| +7500 | 22.7 | 11.1 | 25.7 | 198.3 |
| +8000 | 22.2 | 10.9 | 25.2 | 197.4 |
| +8500 | 21.8 | 10.7 | 24.7 | 196.5 |
| +9000 | 21.4 | 10.5 | 24.3 | 195.5 |
| +9500 | 21.0 | 10.3 | 23.8 | 194.6 |
| +10000 | 20.6 | 10.1 | 23.4 | 193.7 |
| +15000 | 16.9 | 8.3 | 19.2 | 184.0 |

| VACUUM CONVERSION DATA | | | | |
|------------------------|-------------|-----------------|---------------|-------|
| Vacuum inches Mercury | Equivalents | | | PSIA |
| | PSIG | Inches of Water | Feet of Water | |
| 30 | 14.7 | 407.70 | 33.90 | 0.00 |
| 29 | 14.21 | 393.60 | 32.80 | .49 |
| 28 | 13.72 | 380.05 | 31.60 | .98 |
| 27 | 13.23 | 366.40 | 30.50 | 1.47 |
| 26 | 12.74 | 352.90 | 29.40 | 1.96 |
| 25 | 12.25 | 339.30 | 28.30 | 2.45 |
| 24 | 11.76 | 325.70 | 27.10 | 2.94 |
| 23 | 11.27 | 312.10 | 26.00 | 3.43 |
| 22 | 10.78 | 298.60 | 24.90 | 3.92 |
| 21 | 10.29 | 285.00 | 23.70 | 4.41 |
| 20 | 9.80 | 271.40 | 22.60 | 4.90 |
| 19 | 9.31 | 257.80 | 21.50 | 5.39 |
| 18 | 8.82 | 244.30 | 20.30 | 5.88 |
| 17 | 8.33 | 230.70 | 19.20 | 6.37 |
| 16 | 7.84 | 217.70 | 18.00 | 6.86 |
| 15 | 7.35 | 203.60 | 17.00 | 7.35 |
| 14 | 6.86 | 190.02 | 15.80 | 7.84 |
| 13 | 6.37 | 176.40 | 14.70 | 8.33 |
| 12 | 5.88 | 162.80 | 13.50 | 8.82 |
| 11 | 5.39 | 149.30 | 12.40 | 9.31 |
| 10 | 4.90 | 135.70 | 11.30 | 9.80 |
| 9 | 4.41 | 122.10 | 10.20 | 10.29 |
| 8 | 3.92 | 108.50 | 9.00 | 10.78 |
| 7 | 3.43 | 95.00 | 7.90 | 11.27 |
| 6 | 2.94 | 81.40 | 6.80 | 11.76 |
| 5 | 2.45 | 67.80 | 5.70 | 12.25 |
| 4 | 1.96 | 54.20 | 4.50 | 12.74 |
| 3 | 1.47 | 40.70 | 3.40 | 13.23 |
| 2 | 0.98 | 27.10 | 2.30 | 13.72 |
| 1 | 0.49 | 13.60 | 1.13 | 14.21 |
| 0 | 0.00 | 0.00 | 0.00 | 14.70 |

Engineering Information

| PRESSURE TO FEET OF HEAD | |
|--------------------------|-----------|
| Lbs. Per Sq. In. | Feet Head |
| 1 | 2.31 |
| 2 | 4.62 |
| 3 | 6.93 |
| 4 | 9.24 |
| 5 | 11.54 |
| 6 | 13.85 |
| 7 | 16.16 |
| 8 | 18.47 |
| 9 | 20.78 |
| 10 | 23.09 |
| 15 | 34.63 |
| 20 | 46.18 |
| 25 | 57.72 |
| 30 | 69.27 |
| 40 | 92.36 |
| 50 | 115.45 |
| 60 | 138.54 |
| 70 | 161.63 |
| 80 | 184.72 |
| 90 | 207.81 |
| 100 | 230.90 |
| 110 | 253.98 |
| 120 | 277.07 |
| 125 | 288.62 |
| 130 | 300.16 |
| 140 | 323.25 |
| 150 | 346.34 |
| 160 | 369.43 |
| 170 | 392.52 |
| 180 | 415.61 |
| 190 | 438.90 |
| 200 | 461.78 |
| 225 | 519.51 |
| 250 | 577.24 |
| 275 | 643.03 |
| 300 | 692.69 |
| 325 | 750.41 |
| 350 | 808.13 |
| 375 | 865.89 |
| 400 | 922.58 |
| 500 | 1154.48 |
| 1000 | 2309.00 |

| FEET OF HEAD TO PRESSURE | |
|--------------------------|-----------------|
| Feet Head | Lbs Per Sq. In. |
| 1 | .43 |
| 2 | .87 |
| 3 | 1.30 |
| 4 | 1.73 |
| 5 | 2.17 |
| 6 | 2.60 |
| 7 | 3.03 |
| 8 | 3.46 |
| 9 | 3.90 |
| 10 | 4.33 |
| 20 | 8.66 |
| 30 | 12.99 |
| 40 | 17.32 |
| 50 | 21.65 |
| 60 | 25.99 |
| 70 | 30.32 |
| 80 | 34.65 |
| 90 | 38.98 |
| 100 | 43.31 |
| 110 | 47.65 |
| 120 | 51.97 |
| 130 | 56.30 |
| 140 | 60.63 |
| 150 | 64.96 |
| 160 | 69.29 |
| 170 | 73.63 |
| 180 | 77.96 |
| 190 | 82.29 |
| 200 | 86.62 |
| 225 | 97.45 |
| 250 | 108.27 |
| 275 | 119.10 |
| 300 | 129.93 |
| 325 | 140.75 |
| 350 | 151.58 |
| 400 | 173.24 |
| 500 | 216.55 |
| 600 | 259.85 |
| 700 | 303.16 |
| 800 | 346.47 |
| 900 | 389.78 |
| 1000 | 433.09 |

Engineering Information

| PRESSURE | | | | | | | |
|-------------|----------|-----------|--------|--------|--------|---------|-----------|
| | In Water | Ft. Water | PSI | In Hg. | MM Hg | Atm | Kg/Sq. Cm |
| In. Water = | 1.0 | 0.083 | 0.0361 | 0.0736 | 1.87 | 0.353 | 0.0025 |
| Ft. Water = | 12.0 | 1.0 | 0.433 | 0.883 | 22.43 | 0.0295 | 0.0304 |
| PSI = | 27.72 | 2.31 | 1.0 | 2.040 | 51.816 | 0.068 | 0.0703 |
| In Hg = | 13.596 | 1.133 | 0.491 | 1.0 | 25.40 | 0.0334 | 0.0345 |
| MM Hg = | 0.535 | 0.0446 | 0.0193 | 0.0394 | 1.0 | 0.00132 | 0.0014 |
| Atm = | 2.829 | 33.947 | 14.7 | 29.921 | 760.0 | 1.0 | 1.0033 |
| Kg/Sq. Cm = | 393.6 | 32.80 | 14.22 | 28.97 | 736.03 | 0.968 | 1.0 |

| VOLUME | | | | | | | |
|--------------------|-----------|-----------|---------|------------------|---------|---------|---------|
| | U.S. Gal. | Imp. Gal. | Cu. Ft. | Lb. Water @ 60°F | Cu. M | Quart | Liter |
| U.S. Gal. = | 1.0 | 0.833 | 0.134 | 8.33 | 0.00379 | 4.0 | 3.785 |
| Imp. Gal. = | 1.2 | 1.0 | 0.161 | 10.0 | 0.00455 | 4.8 | 4.546 |
| Cu. Ft. = | 7.481 | 6.232 | 1.0 | 62.37 | 0.0283 | 29.92 | 28.32 |
| Lb. Water @ 60°F = | 0.12 | 0.10 | 0.016 | 1.0 | 0.00045 | 0.48 | 0.454 |
| Cu. M = | 264.2 | 220.0 | 35.31 | 2,202.9 | 1.0 | 1,057.0 | 1,000.0 |
| Quart = | 0.25 | 0.208 | 0.0334 | 2.086 | 0.00095 | 1.0 | 0.946 |
| Liter = | 0.264 | 0.22 | 0.0353 | 2.204 | 0.001 | 1,057.0 | 1.0 |

| POWER | | | | | | |
|-------------|-------|-----------|-------|----------|----------|---------|
| | HP | Metric HP | kW | HP Hr. | kW Hr | BTU |
| HP = | 1.0 | 1.014 | 0.746 | --- | --- | --- |
| Metric HP = | 0.986 | 1.0 | 0.736 | --- | --- | --- |
| Kw = | 1.341 | 1.36 | 1.0 | --- | --- | --- |
| HP Hr. = | --- | --- | --- | 1.0 | 0.746 | 2,545.0 |
| Kw Hr. = | --- | --- | --- | 1.341 | 1.0 | 3,413.0 |
| BTU | --- | --- | --- | 0.000393 | 0.000293 | 1.0 |

| LENGTH | | | | | | | |
|--------|---------|-------|---------|--------|---------|-------|-------|
| | mm | cm | m | in | ft | yd | mi |
| mm = | 1.0 | 0.1 | 0.001 | 0.0394 | 0.00328 | --- | --- |
| cm = | 10.0 | 1.0 | 0.01 | 0.394 | 0.0328 | --- | --- |
| m = | 1,000.0 | 100.0 | 1.0 | 39.37 | 3.281 | 1.094 | --- |
| km = | --- | --- | 1,000.0 | --- | --- | --- | 0.621 |

| AREA | | | | | |
|----------|----------|-------|---------|---------|---------|
| | Sq. cm | Sq. m | Sq. in. | Sq. ft. | Sq. yd. |
| Sq. cm = | 1.0 | --- | 0.155 | --- | --- |
| Sq. m = | 10,000.0 | 1.0 | 1,550.0 | 10.76 | 1.196 |

ABBREVIATIONS

| | |
|----------------------------|------------------------------|
| Atm. = Atmosphere | Kg = Kilogram |
| BTU = British Thermal Unit | KM = Kilometer |
| cm = Centimeter | Kw = Kilowatt |
| Cu. = Cubic | Lb. = Pound |
| Ft. = Foot | m = Meter |
| Gal. = Gallon | Mi. = Mile |
| Hg. = Mercury | ml = Milliliter |
| HP = Horsepower | mm = Millimeter |
| Hr. = Hour | PSI = Pounds per Square inch |
| Imp. = Imperial | Sq. = Square |
| in. = inch | yd. = Yard |

Engineering Information

SPECIFIC GRAVITY

Direct ratio of any liquid's weight to the weight of water at 62°F. Water at 62°F weighs 8.33 lbs per gallon and is designated 1.0 sp. gr.

NOTE: A centrifugal pump develops head, not pressure. All pressure figures should be converted to feet of head taking into consideration the sp. gr.
(Ft. HD - PSI x 2.31 ÷ Sp. Gr.)

VISCOSITY

Property of a liquid that resists any force tending to produce flow.

It is the evidence of cohesion between the particles of a fluid which causes a liquid to offer resistance analogous to friction. An increase in the temperature reduces the viscosity; conversely, a temperature reduction increases the viscosity. Pipe friction loss increases as viscosity increases.

EFFECTS OF VISCOSITY

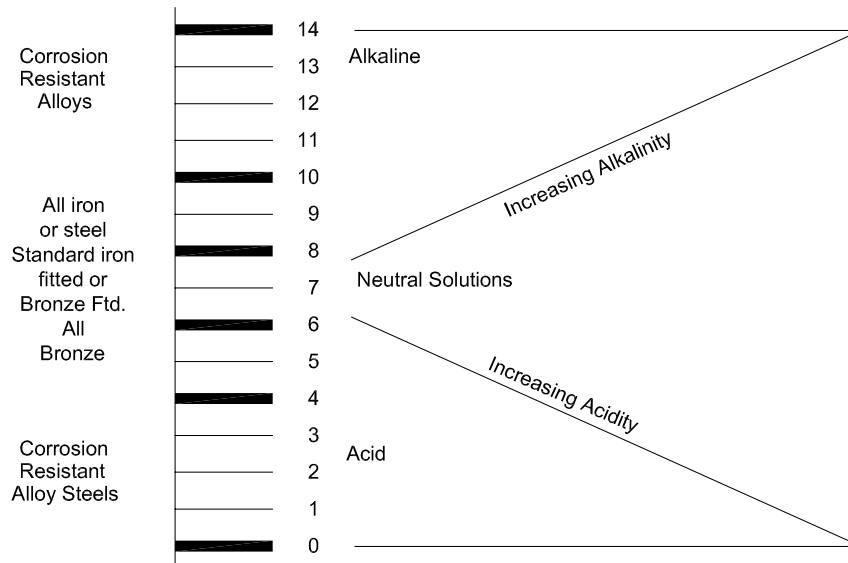
Viscous liquids tend to increase pump HP, reduce efficiency, reduce capacity and head and increase pipe friction.

VISCOSITY - CENTRIFUGAL PUMP PERCENTAGE OF WATER CHARACTERISTICS - APPROXIMATE GUIDE

| Viscosity S.S.U. | Capacity | Head | Efficiency |
|------------------|----------|------|------------|
| 31.5 | 100% | 100% | 100% |
| 500 | 95% | 98% | 80% |
| 1000 | 92% | 97% | 70% |
| 2000 | 89% | 94% | 60% |

NOTE: Viscosities higher than 500 SSU should be referred to manufacture.

pH VALUE Of Solutions - General Guide For Pump Construction



NOTE: There is no substitute for experience in selecting materials for pump construction. Previous experience in handling a particular solution should be the main criterion in determining the optimal construction.

Engineering Information

NPSH combines all the factors limiting the suction side of a pump; internal pump losses, static suction lift, friction losses, vapor pressure and atmospheric conditions. It is important to differentiate between REQUIRED NPSH and AVAILABLE NPSH.

NPSH REQUIRED

REQUIRED NPSH is a factor designed into pump and measurable in the test laboratory by the manufacturer. Testing facilities can determine losses in the suction piping static lift and barometric pressures.

NPSH AVAILABLE (Ft.)

The term for providing sufficient pressure on the suction, at the impeller eye, to prevent "boiling" is known as NPSH AVAILABLE. It is a function of the pumping system and consists of pressure on the liquid at its source, the elevation of the liquid with respect to the impeller centerline, losses in the suction piping and vapor pressure of the liquid. If the available NPSH is not equal to, or greater than that required by the pump, it must be increased. This is usually done by increasing the static head, Hz.

NPSH FORMULAS

Determining NPSH AVAILABLE

$$\text{NPSH} = (\text{Barometer} + \text{Gauge} - \text{Vapor Pressure}) \times (2.31 \div \text{Specific Gravity}) \pm \text{Static Height} - \text{Pipe Loss.}$$

BAROMETER value in pounds per square inch absolute (PSIA) should be lowest likely reading for the area where the pump will be installed. (Use table, page 8 of section 11, to convert barometer reading in inches of mercury to PSIA).

GAUGE PRESSURE (PSIG) is the pressure in pounds per square inch ABOVE atmospheric pressure on the surface of the liquid in the supply vessel.

VAPOR PRESSURE is the value in pounds per square inch absolute (PSIA) at which the liquid will boil at given temperature.

STATIC HEIGHT is the distance in feet between the pump suction centerline and the surface level of the liquid in the supply vessel. If the surface level of the liquid is higher than the pump suction, static height is positive. If the surface level of the liquid is lower than the pump suction, static height is negative.

PIPE LOSS is the friction in feet between the supply vessel and the pump.

MAXIMUM WORKING PRESSURE

DEFINITIONS

WORKING PRESSURE - The maximum pressure of the pumping system.

OPERATING PRESSURE - The pressure added to the pumping system by the pump (total head of the pump).

EXAMPLE:

A pump used for booster service takes liquid from a 50 p.s.i. (335kpa) source and adds 150 p.s.i. (1034kpa). This gives a final discharge pressure of 200 p.s.i. (1379kpa). The system is functioning at 200 p.s.i. (1379kpa) WORKING PRESSURE and the pump is operating at 150 p.s.i. (1034kpa) OPERATING PRESSURE.

OPERATING PRESSURE is a function of the basic hydraulic design considerations of the pump, and is determined by capacity and head requirements at given horsepower loads, as established in catalog ratings of the pump.

MAXIMUM SAFE WORKING PRESSURE is governed by safe and reasonable life expectancy limits of such items as: mechanical shaft seal, stuffing box, gasket design, bolt strength, bursting strength of case and frame castings, etc.

DATA: The following table lists the maximum recommended safe working pressure for BURKS pumps.

| PUMP SERIES | MAX. WORKING PRESSURE | MAX. INLET PRESSURE |
|---------------------------|-----------------------|---------------------|
| G, GA, GB, GN, GV, DF, WG | 200 PSI (1379 KPA) | 100 PSI (690 KPA) |
| WA | 100 PSI (690 KPA) | 40 PSI (276 KPA) |
| WT3, WPT3 | 165 PSI (1138 KPA) | 100 PSI (690 KPA) |
| WT5, WPT5, WST5 | 165 PSI (1138 KPA) | 100 PSI (690 KPA) |
| WT5X, WPT5X, WST5X | 60 PSI (414 KPA) | 15 PSI (103 KPA) |
| CR | 150 PSI (1034 KPA) | 50 PSI (335 KPA) |
| CT, ET, CS, ES | 250 PSI (1724 KPA) | 100 PSI (690 KPA) |
| EC, ED | 200 PSI (1379 KPA) | 50 PSI (335 KPA) |

Boiler Rating & Pump Capacity Required

Engineering Information

| EQUIVALENT BOILER HP | BTU/hr. (1000's) | STREAM Lb/per hr. | EDR RATING Sq., Ft. | Cond. Rate GPM | PUMP Cap. * Reqd. GPM |
|-------------------------|---------------------|----------------------|------------------------|-------------------|--------------------------|
| 20 | 670 | 690 | 2790 | 1.38 | 3 |
| 30 | 1005 | 1035 | 4185 | 2.07 | 6 |
| 40 | 1340 | 1380 | 5580 | 2.76 | 9 |
| 50 | 1675 | 1725 | 6975 | 3.45 | 9 |
| 60 | 2010 | 2070 | 8370 | 4.14 | 12 |
| 70 | 2345 | 2415 | 9765 | 4.38 | 15 |
| 80 | 2680 | 2760 | 11160 | 5.52 | 15 |
| 100 | 3350 | 3450 | 13950 | 6.90 | 22.5 |
| 125 | 4185 | 4313 | 17438 | 8.62 | 22.5 |
| 150 | 5025 | 5175 | 20935 | 10.40 | 30 |
| 200 | 6695 | 6900 | 27915 | 13.80 | 45 |
| 250 | 8370 | 8625 | 34895 | 17.30 | 45 |
| 300 | 10045 | 10350 | 41875 | 20.70 | 60 |
| 350 | 11720 | 12075 | 48825 | 24.20 | 75 |
| 400 | 13390 | 13800 | 55830 | 27.60 | 75 |
| 450 | 15064 | 15520 | 63000 | 31.10 | 97.5 |
| 500 | 16740 | 17250 | 69790 | 34.50 | 97.5 |
| 550 | 18411 | 18975 | 77000 | 37.95 | 120 |
| 600 | 20085 | 20700 | 83750 | 41.40 | 120 |
| 650 | 21759 | 22425 | 91000 | 44.85 | 150 |
| 700 | 23432 | 24150 | 98000 | 48.30 | 150 |
| 750 | 25106 | 25875 | 105000 | 51.75 | 150 |
| 800 | 26780 | 27600 | 112000 | 55.20 | 187.5 |
| 1000 | 33475 | 34500 | 140000 | 69.00 | 200 |

(*) NOTE: Boiler HP x .069 GPM of feed water required to maintain boiler water level at 100% load. Pumps should be selected to provide two to three times the condensate rate shown in the above Table.
Pump capacity listed in the Table are based on an approximate 3 to 1 ratio.

SIZING RECEIVER FOR BOILER FEED PUMPS

Receiver capacity is determined by allowing 1 gal. of gross capacity per boiler HP.*

Maximum working capacity recommended is 75% of gross capacity.

(*) General Service Administration specs.

USEFUL CONVERSION DATA

1 Boiler HP = 34.5 lbs. of water evaporated per hour from and at 212°F.

1 Boiler HP = 33,475 BTUH or 970 BTUH per lb. of water.

1 Boiler HP = 140 sq. ft. EDR

1 BTU is required to raise 1 lb. of water 1°F between 32°F and 212°F

Engineering Information

Capacity, discharge pressure, suction conditions, temperature and duty cycle are determined by the application and/or the installation.

Name, viscosity, abrasiveness, specific gravity, vapor pressure, materials of construction - are properties of, or determined by the liquid to be handled.

The following list of liquids are known to be handled by BURKS pumps. Some liquids require special construction, shaft seals, etc., depending on the liquid, its concentration, temperature, ambient conditions, etc. We have attempted to be accurate in making the list but it is not to be considered infallible.

- Acetone
- Admixtures for concrete - WRDA, Daratard, Darex AEA
- Alcohol
- Ammonia
- Beer
- Carbon Tetrachloride
- Caustics
- Condensate
- Cooking Oil
- Cutting Oil
- Deionized water
- Demineralized water
- Deodorants
- Detergents
- Diesel Fuel
- Dimethyl formamide
- Distilled water
- Electrolytes - EDM machine tools
- Ethylene Glycol - antifreeze
- Freon - with limitations
- Heat transfer fluids (oils) - Dowtherm, Thermanal, Ucon Mobiltherm, Cellutherm and others
- Hexane
- Hydraulic fluid
- Ink
- Insecticides
- Jet fuel
- Kerosene
- Liquid car wax
- Methyl ethyl ketone - MEK
- Mineral Spirits
- Naptha
- Oakite products
- Perchloroethylene
- Rust inhibitors
- Salt brine
- Sea water
- Stoddard solvent
- Tea
- Toluene
- Transformer oil
- Transmission fluid
- Trichloroethane (Clorothene)
- Trichloroethylene
- Water
- Turpentine
- Vegetable oil
- Water soluble oils
- Whiskey
- Xylene, Xylol

Engineering Information

We can generalize by saying BURKS Pumps are sold everywhere. There definitely is a wide range of applications within major industries. We have listed some of the industries and applications below for your consideration as you search for the industrial pump market in your area.

AERONAUTICAL & SPACE INDUSTRY

Wash down
Cooling

AGRICULTURE INDUSTRY

Insecticide - grain processing
Liquid fertilizer
Brooder houses
High pressure cleaning
Weed killers
Irrigation
Commercial farms
Fish farms
Dewatering
Disinfecting

AIR CONDITIONING & REFRIGERATION INDUSTRY

Cooling towers
Circulating
Brine handling
Mist cooling for greenhouses

AUTOMOBILE INDUSTRY

Solvents - transfer & circulating
Anti-freeze
Radiator cleaning
Pressure testing
Flushing
Car wash
Transmission fluid
Liquid car wax

BOATS & BARGES (MARINE)

Fresh water
Wash down
Sanitary system
Bilge
Fire

CHEMICAL INDUSTRY

Soaps
Cleaners
Solvents
Detergents
Agricultural chemicals

CHILLER & HEATER EXCHANGER

Radar, sonar, TV and radio transmitter cooling
TV tube manufacturing - gun cooling
Slicing & sawing blade cooling
Hot water, hot oil, ethylene glycol
Chillers - brine handling
Laser beam cooler
Automobile welding
Deicing

CONCRETE AND PAVING INDUSTRY

Additives (admixture) metering
Wash down - spray pumps
Booster
Circulating

CONSTRUCTION

Heat pump - well source
Dewatering
Solar heating
Condensate return

FOOD PROCESSING INDUSTRY

Can & bottle warmers
Can & bottle washers
Bakeries
Circulating
Dairies
Creameries
Canneries
Bottling
Meat Packing
Seafood processing
Transferring & circulating cooking oil & lard
Boiler feed for sterilizing
Condensate return for cooking kettles-steam jacketing
Soft drink and beverage bottlers
Heat transfer
Brine injection (pickling)
Breweries
Caustic handling

FOUNDRIES

Scrubbers
Spraying

LAUNDRY & DRY CLEANING INDUSTRY

Boiler feed
Condensate return
Transfer
Filtration
Washing machines
Water reclamation
Coin-op laundries
Car wash
Circulating hot & cold water
Perc & solvent pumping
Pressing establishments
Carpet cleaning - hot water spray
Commercial throw rug washing machines
Institutional laundries
Department stores
Alteration shops

LUMBER INDUSTRY

Plywood curing

MACHINE INDUSTRY

EDM (electrical discharge machines) electrolyte
Circulating cutting & cooling oils
Hydraulic press operation
Slicing & sawing blades cooling
Filtering Welding (plasma arc)

MANUFACTURING - GENERAL

Sprinkler systems
Air conditioning
Transfer
Booster
Condensation return
Dewatering
Testing valves, water lines, etc.
Blows the whistle @D.P.Co.

MEAT PACKING

Brine injection - pickling hams
Wash down
Circulation
Booster service

MEDICAL, DENTAL & HOSPITALS & HEALTH SERVICES

Sterilizers
Electric boiler
Nursing homes

MINING INDUSTRY

Dewatering

MUNICIPALITIES

Industrial & Commercial Park Development
Water works
Water treatment facilities
Testing equipment for water mains
Jockey pumps for fire pumps
Deicing ponds, boat areas, etc.

PAPER & PULP INDUSTRY

Paper mills
Coating

PLASTICS & RUBBER INDUSTRY

High transfer in molding - high temperature heating & cooling
Tire recapping
Boiler Feed

PLATING INDUSTRY

Circulation
Dewatering

PRINTING INDUSTRY

Photo engraving
Plate making

RECREATION INDUSTRY

Water falls
Balloon making
Hydraulic motors for animation
Shooting galleries
Ice rinks
Golf courses
Deicing marinas
Ski lodges & lifts
Race tracks
Weed killers (lily pads)

REFINERIES & STORAGE PLANTS

Process
Transfer Cooling - heat exchanger
Loading & unloading

SEWAGE PLANTS

Wash down
Screen cleaning

TEXTILE INDUSTRY

Dyeing, washing

WATER & WASTEWATER TREATMENT

Scrubbers - anti-pollution equipment
Froth spray pumps
Brine circulation
Chlorine injector system
Water reclamation
Water softener regenerating plants
Filtration
Circulating
Booster
Dewatering
Car wash
Aspirators

Pump Specification Sheet



Engineering Information

Date: _____
Name of Firm _____ By _____
Address _____
Reply Attention of _____ Title _____
Date Quotation is Required _____
Number of Pumps Required _____ Estimated Yearly Requirements _____

**THE FOLLOWING OUTLINES THE INFORMATION NECESSARY FOR PROPER PUMP RECOMMENDATION
COPY THIS PAGE AND USE BACK OF SHEET FOR FURTHER DATA AND SKETCHES**

LIQUID:
What is it? _____ pH _____
Specific Gravity _____
Temperature - Max _____ (F/C). Min. _____ (F/C). Oper. _____
Viscosity @ Max. Temp _____ Min. Temp. _____ Oper. Temp. _____
Vapor Pressure @ Max. Temp. _____ Min. Temp. _____ Oper. Temp. _____
Liquid Purity (other liquids - solids, their size & quantity - abrasives or other contaminants - hazardous):

DUTY:
Capacity Required _____ GPM (l/s)
Total Head Required _____ Ft. (m)
NPSH Available _____ Ft. (m)

MOTOR CHARACTERISTICS:
HP _____ Volts _____
Phase _____ Hertz _____
RPM _____ Enclosure _____

INLET (Suction) CONDITIONS:
Static Liquid Level Above/Below Inlet _____ Ft. (m)
Pressure on Supply Liquid _____ PSIG (kpa)
Barometric Pressure (or altitude) _____
Piping Components (Sizes, Lengths, Number and type of fittings, etc. _____

PUMP BEING REPLACED:
Manufacture _____
Type _____
Model _____
Why being replaced? _____

OUTLET (Discharge) CONDITIONS:
Static Liquid Level Above/Below Outlet _____ Ft. (m)
Pressure At Point of Use _____ PSIG (kpa)
Piping Components (Sizes, Lengths, _____
Number and type fittings, etc. _____

ENVIRONMENTAL CONDITIONS:
Dust, Moisture, Fumes _____
Fire Hazards, etc. _____

NOTES: _____

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A Crane Co. Company

PUMPS & SYSTEMS

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