

## Friction Loss in Fittings

### Equivalent length of Pipe, feet

| Size Fittings               | ½"  | ¾"  | 1"  | 1½" | 2"   | 3"   | 4"   | 6"   | 8"   | 10"  | 12"  |
|-----------------------------|-----|-----|-----|-----|------|------|------|------|------|------|------|
| Type Fittings               |     |     |     |     |      |      |      |      |      |      |      |
| 90° Standard Elbow          | 1.6 | 2.1 | 2.6 | 4.0 | 5.5  | 7.7  | 10.1 | 15.2 | 20.0 | 25.1 | 29.8 |
| 45° Standard Elbow          | 0.8 | 1.1 | 1.4 | 2.1 | 2.8  | 4.1  | 5.4  | 8.1  | 10.6 | 13.4 | 15.9 |
| 90° Long Radius Elbow       | 1.0 | 1.4 | 1.7 | 2.7 | 4.3  | 6.3  | 8.3  | 12.5 | 16.5 | 20.7 | 24.7 |
| 90° Street Elbow            | 2.6 | 3.4 | 4.4 | 6.7 | 8.6  | 12.8 | 16.8 | 25.3 | 33.3 | 41.8 | 49.7 |
| 45° Street Elbow            | 1.3 | 1.8 | 2.3 | 3.0 | 4.5  | 6.6  | 8.7  | 13.1 | 17.3 | 21.7 | 25.9 |
| Square Corner Elbow         | 3.0 | 3.9 | 5.0 | 7.6 | 9.8  | 14.6 | 19.1 | 28.8 | 37.9 | 47.6 | 56.7 |
| Standard—with flow thru run | 1.0 | 1.4 | 1.7 | 2.7 | 4.3  | 6.3  | 8.3  | 12.5 | 16.5 | 20.7 | 24.7 |
| Tee—with flow thru Branch   | 4.0 | 5.1 | 6.0 | 8.1 | 12.0 | 16.3 | 22.1 | 32.2 | 39.9 | 50.1 | 59.7 |

## Friction Loss in Fittings Valves

As an aid, liquid sizing constants (Cv values) are shown for valves. These values are defined as the flow rate through the valve required to produce a pressure drop of 1 psi. To determine the pressure drop for a given GPM the following formula may be used.

$$\Delta P = (G^2)(SG)/Cv^2$$

where:

AP = pressure drop

G = Flow in GPM

SG = Specific Gravity of the liquid (water = 1.0)

Cv = Flow Coefficient

Example: Find the pressure drop across a ½" Ball valve with a water flow rate of 10 GPM.

$$\Delta P = (G^2)(SG)/Cv^2 \quad P = (10)(10)(1)/(22)(22) \quad P = .206$$

| Size | Cv Ball valve (TU) | Cv Diaphragm Valve |
|------|--------------------|--------------------|
| ½"   | 22                 | 6.5                |
| ¾"   | 55                 | 9.5                |
| 1"   | 112                | 12.3               |
| 1½"  | 285                | 29.2               |
| 2"   | 540                | 53.7               |

## Carrying Capacity and Friction Loss for Schedule 40 Thermoplastic

| Pipe | 1/2 in.                  |                    |                                   | 3/4 in.                  |                    |                                   | 1 in.                    |                    |                                   | 1 1/2 in.                |                    |                                   | 2 in.                    |                    |                                   | 3 in.                    |                    |                                   |
|------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|
|      | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch |
| 1    | 1.13                     | 2.08               | 0.90                              | 0.63                     | 0.51               | 0.22                              |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |
| 2    | 2.26                     | 4.16               | 1.80                              | 1.26                     | 1.02               | 0.44                              | 0.77                     | 0.55               | 0.24                              | 0.33                     | 0.07               | 0.03                              |                          |                    |                                   |                          |                    |                                   |
| 5    | 5.64                     | 23.44              | 10.15                             | 3.16                     | 5.73               | 2.48                              | 1.93                     | 1.72               | 0.75                              | 0.81                     | 0.22               | 0.09                              | 0.49                     | 0.066              | 0.029                             | 0.22                     | 0.015              | 0.007                             |
| 7    | 7.90                     | 43.06              | 13.64                             | 4.43                     | 10.52              | 4.56                              | 2.72                     | 3.17               | 1.37                              | 1.13                     | 0.38               | 0.17                              | 0.69                     | 0.11               | 0.048                             | 0.31                     | 0.021              | 0.009                             |
| 10   | 11.28                    | 82.02              | 35.51                             | 6.32                     | 20.04              | 8.68                              | 3.86                     | 6.02               | 2.61                              | 1.62                     | 0.72               | 0.31                              | 0.98                     | 0.21               | 0.091                             | 0.44                     | 0.03               | 0.013                             |
| 15   |                          | 4 in.              |                                   | 9.48                     | 42.48              | 18.39                             | 5.79                     | 12.77              | 5.53                              | 2.42                     | 1.53               | 0.66                              | 1.46                     | 0.45               | 0.19                              | 0.66                     | 0.07               | 0.030                             |
| 20   | 0.51                     | 0.03               | 0.013                             | 12.65                    | 72.34              | 31.32                             | 7.72                     | 21.75              | 9.42                              | 3.23                     | 2.61               | 1.13                              | 1.95                     | 0.76               | 0.33                              | 0.88                     | 0.11               | 0.048                             |
| 25   | 0.64                     | 0.04               | 0.017                             |                          |                    |                                   | 9.65                     | 32.88              | 14.22                             | 4.04                     | 3.95               | 1.71                              | 2.44                     | 1.15               | 0.50                              | 1.10                     | 0.17               | 0.074                             |
| 30   | 0.77                     | 0.06               | 0.026                             |                          |                    |                                   | 11.58                    | 46.08              | 19.95                             | 4.85                     | 5.53               | 2.39                              | 2.93                     | 1.62               | 0.70                              | 1.33                     | 0.23               | 0.10                              |
| 35   | 0.89                     | 0.08               | 0.035                             |                          |                    |                                   |                          |                    |                                   | 5.66                     | 7.36               | 3.19                              | 3.41                     | 2.15               | 0.93                              | 1.55                     | 0.31               | 0.13                              |
| 40   | 1.02                     | 0.11               | 0.048                             |                          |                    |                                   |                          |                    |                                   | 6.47                     | 9.43               | 4.08                              | 3.90                     | 2.75               | 1.19                              | 1.77                     | 0.40               | 0.17                              |
| 45   | 1.15                     | 0.13               | 0.056                             |                          | 6 in.              |                                   |                          |                    |                                   | 7.27                     | 11.73              | 5.08                              | 4.39                     | 3.43               | 1.49                              | 1.99                     | 0.50               | 0.22                              |
| 50   | 1.28                     | 0.16               | 0.069                             | 0.56                     | 0.02               | 0.009                             |                          |                    |                                   | 8.08                     | 14.25              | 6.17                              | 4.88                     | 4.16               | 1.80                              | 2.21                     | 0.60               | 0.26                              |
| 60   | 1.53                     | 0.22               | 0.095                             | 0.67                     | 0.03               | 0.013                             |                          |                    |                                   | 9.70                     | 19.96              | 8.65                              | 5.85                     | 5.84               | 2.53                              | 2.65                     | 0.85               | 0.37                              |
| 70   | 1.79                     | 0.30               | 0.13                              | 0.79                     | 0.04               | 0.017                             |                          |                    |                                   |                          |                    |                                   | 6.83                     | 7.76               | 3.36                              | 3.09                     | 1.13               | 0.49                              |
| 75   | 1.92                     | 0.34               | 0.15                              | 0.84                     | 0.05               | 0.022                             |                          |                    |                                   |                          |                    |                                   | 7.32                     | 8.82               | 3.82                              | 3.31                     | 1.28               | 0.55                              |
| 80   | 2.05                     | 0.38               | 0.16                              | 0.90                     | 0.05               | 0.022                             |                          |                    |                                   |                          |                    |                                   | 7.80                     | 9.94               | 4.30                              | 3.53                     | 1.44               | 0.62                              |
| 90   | 2.30                     | 0.47               | 0.20                              | 1.01                     | 0.06               | 0.026                             |                          |                    |                                   |                          |                    |                                   | 8.78                     | 12.37              | 5.36                              | 3.98                     | 1.80               | 0.78                              |
| 100  | 2.56                     | 0.58               | 0.25                              | 1.12                     | 0.08               | 0.035                             | 0.65                     | 0.03               | 0.012                             |                          |                    |                                   | 9.75                     | 15.03              | 6.51                              | 4.42                     | 2.18               | 0.94                              |
| 125  | 3.20                     | 0.88               | 0.38                              | 1.41                     | 0.12               | 0.052                             | 0.81                     | 0.035              | 0.015                             |                          |                    |                                   |                          |                    |                                   | 5.52                     | 3.31               | 1.43                              |
| 150  | 3.84                     | 1.22               | 0.53                              | 1.69                     | 0.16               | 0.069                             | 0.97                     | 0.04               | 0.017                             |                          | 10 in.             |                                   |                          |                    |                                   | 6.63                     | 4.63               | 2.00                              |
| 175  | 4.48                     | 1.63               | 0.71                              | 1.97                     | 0.22               | 0.096                             | 1.14                     | 0.055              | 0.024                             |                          |                    |                                   |                          |                    |                                   | 7.73                     | 6.16               | 2.67                              |
| 200  | 5.11                     | 2.08               | 0.90                              | 2.25                     | 0.28               | 0.12                              | 1.30                     | 0.07               | 0.030                             | 0.82                     | 0.027              | 0.012                             |                          |                    |                                   | 8.83                     | 7.88               | 3.41                              |
| 250  | 6.40                     | 3.15               | 1.36                              | 2.81                     | 0.43               | 0.19                              | 1.63                     | 0.11               | 0.048                             | 1.03                     | 0.035              | 0.015                             |                          | 12 in.             |                                   | 11.04                    | 11.93              | 5.17                              |
| 300  | 7.67                     | 4.41               | 1.91                              | 3.37                     | 0.60               | 0.26                              | 1.94                     | 0.16               | 0.069                             | 1.23                     | 0.05               | 0.022                             |                          |                    |                                   |                          |                    |                                   |
| 350  | 8.95                     | 5.87               | 2.55                              | 3.94                     | 0.79               | 0.34                              | 2.27                     | 0.21               | 0.091                             | 1.44                     | 0.065              | 0.028                             | 1.01                     | 0.027              | 0.012                             |                          |                    |                                   |
| 400  | 10.23                    | 7.52               | 3.26                              | 4.49                     | 1.01               | 0.44                              | 2.59                     | 0.27               | 0.12                              | 1.64                     | 0.09               | 0.039                             | 1.16                     | 0.040              | 0.017                             |                          |                    |                                   |
| 450  |                          |                    |                                   | 5.06                     | 1.26               | 0.55                              | 2.92                     | 0.33               | 0.14                              | 1.85                     | 0.11               | 0.048                             | 1.30                     | 0.05               | 0.022                             |                          |                    |                                   |
| 500  |                          |                    |                                   | 5.62                     | 1.53               | 0.66                              | 3.24                     | 0.40               | 0.17                              | 2.05                     | 0.13               | 0.056                             | 1.45                     | 0.060              | 0.026                             |                          |                    |                                   |
| 750  |                          |                    |                                   | 8.43                     | 3.50               | 1.41                              | 4.86                     | 0.85               | 0.37                              | 3.08                     | 0.28               | 0.12                              | 2.17                     | 0.12               | 0.052                             |                          |                    |                                   |
| 1000 |                          |                    |                                   | 11.24                    | 5.54               | 2.40                              | 6.48                     | 1.45               | 0.63                              | 4.11                     | 0.48               | 0.21                              | 2.89                     | 0.20               | 0.087                             |                          |                    |                                   |
| 1250 |                          |                    |                                   |                          |                    |                                   | 8.11                     | 2.20               | 0.95                              | 5.14                     | 0.73               | 0.32                              | 3.62                     | 0.31               | 0.13                              |                          |                    |                                   |
| 1500 |                          |                    |                                   |                          |                    |                                   | 9.72                     | 3.07               | 1.33                              | 6.16                     | 1.01               | 0.44                              | 4.34                     | 0.43               | 0.19                              |                          |                    |                                   |
| 2000 |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 8.21                     | 1.72               | 0.74                              | 5.78                     | 0.73               | 0.32                              |                          |                    |                                   |
| 2500 |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 10.27                    | 2.61               | 1.13                              | 7.23                     | 1.11               | 0.49                              |                          |                    |                                   |
| 3000 |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 8.68                     | 1.55               | 0.67                              |                          |                    |                                   |
| 3500 |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 10.12                    | 2.07               | 0.90                              |                          |                    |                                   |
| 4000 |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 11.07                    | 2.66               | 1.15                              |                          |                    |                                   |

Independent variables: Gallons per minute and nominal pipe size O.D.

Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth.

**Carrying Capacity and Friction Loss for Schedule 80 Thermoplastic Pipe**

| Gallons Per Minute | ½ in.                    |                    |                                   | ¾ in.                    |                    |                                   | 1 in.                    |                    |                                   | 1½ in.                   |                    |                                   | 2 in.                    |                    |                                   | 3 in.                    |                    |                                   |
|--------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|
|                    | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch |
| 1                  | 1.48                     | 4.02               | 1.74                              | 0.74                     | 0.86               | 0.37                              |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |
| 2                  | 2.95                     | 8.03               | 3.48                              | 1.57                     | 1.72               | 0.74                              | 0.94                     | 0.88               | 0.38                              | 0.38                     | 0.10               | 0.041                             |                          |                    |                                   |                          |                    |                                   |
| 5                  | 7.39                     | 45.23              | 19.59                             | 3.92                     | 9.67               | 4.19                              | 2.34                     | 2.75               | 1.19                              | 0.94                     | 0.30               | 0.126                             | 0.56                     | 0.10               | 0.04                              | 0.25                     | 0.02               | 0.009                             |
| 7                  | 10.34                    | 83.07              | 35.97                             | 5.49                     | 17.76              | 7.69                              | 3.28                     | 5.04               | 2.19                              | 1.32                     | 0.55               | 0.24                              | 0.78                     | 0.15               | 0.065                             | 0.35                     | 0.028              | 0.012                             |
| 10                 |                          |                    |                                   | 7.84                     | 33.84              | 14.65                             | 4.68                     | 9.61               | 4.16                              | 1.88                     | 1.04               | 0.45                              | 1.12                     | 0.29               | 0.13                              | 0.50                     | 0.04               | 0.017                             |
| 15                 |                          | 4 in.              |                                   | 11.76                    | 71.70              | 31.05                             | 7.01                     | 20.36              | 8.82                              | 2.81                     | 2.20               | 0.95                              | 1.68                     | 0.62               | 0.27                              | 0.75                     | 0.09               | 0.039                             |
| 20                 | 0.57                     | 0.04               | 0.017                             |                          |                    |                                   | 9.35                     | 34.68              | 15.02                             | 3.75                     | 3.75               | 1.62                              | 2.23                     | 1.06               | 0.46                              | 1.00                     | 0.15               | 0.065                             |
| 25                 | 0.72                     | 0.06               | 0.026                             |                          |                    |                                   | 11.69                    | 52.43              | 22.70                             | 4.69                     | 5.67               | 2.46                              | 2.79                     | 1.60               | 0.69                              | 1.25                     | 0.22               | 0.095                             |
| 30                 | 0.86                     | 0.08               | 0.035                             |                          |                    |                                   | 14.03                    | 73.48              | 31.82                             | 5.63                     | 7.95               | 3.44                              | 3.35                     | 2.25               | 0.97                              | 1.49                     | 0.31               | 0.13                              |
| 35                 | 1.00                     | 0.11               | 0.048                             |                          |                    |                                   |                          |                    |                                   | 6.57                     | 10.58              | 4.58                              | 3.91                     | 2.99               | 1.29                              | 1.74                     | 0.42               | 0.18                              |
| 40                 | 1.15                     | 0.14               | 0.061                             |                          |                    |                                   |                          |                    |                                   | 7.50                     | 13.55              | 5.87                              | 4.47                     | 3.83               | 1.66                              | 1.99                     | 0.54               | 0.23                              |
| 45                 | 1.29                     | 0.17               | 0.074                             |                          | 6 in.              |                                   |                          |                    |                                   | 8.44                     | 16.85              | 7.30                              | 5.03                     | 4.76               | 2.07                              | 2.24                     | 0.67               | 0.29                              |
| 50                 | 1.43                     | 0.21               | 0.091                             | 0.63                     | 0.03               | 0.013                             |                          |                    |                                   | 9.38                     | 20.48              | 8.87                              | 5.58                     | 5.79               | 2.51                              | 2.49                     | 0.81               | 0.35                              |
| 60                 | 1.72                     | 0.30               | 0.13                              | 0.75                     | 0.04               | 0.017                             |                          |                    |                                   | 11.26                    | 28.70              | 12.43                             | 6.70                     | 8.12               | 3.52                              | 2.99                     | 1.14               | 0.49                              |
| 70                 | 2.01                     | 0.39               | 0.17                              | 0.88                     | 0.05               | 0.022                             |                          |                    |                                   |                          |                    |                                   | 7.82                     | 10.80              | 4.68                              | 3.49                     | 1.51               | 0.65                              |
| 75                 | 2.15                     | 0.45               | 0.19                              | 0.94                     | 0.06               | 0.026                             |                          |                    |                                   |                          |                    |                                   | 8.38                     | 12.27              | 5.31                              | 3.74                     | 1.72               | 0.74                              |
| 80                 | 2.29                     | 0.50               | 0.22                              | 1.00                     | 0.07               | 0.030                             |                          | 8 in.              |                                   |                          |                    |                                   | 8.93                     | 13.83              | 5.99                              | 3.99                     | 1.94               | 0.84                              |
| 90                 | 2.58                     | 0.63               | 0.27                              | 1.13                     | 0.08               | 0.035                             |                          |                    |                                   |                          |                    |                                   | 10.05                    | 17.20              | 7.45                              | 4.48                     | 2.41               | 1.04                              |
| 100                | 2.87                     | 0.76               | 0.33                              | 1.25                     | 0.10               | 0.043                             |                          |                    |                                   |                          |                    |                                   | 11.17                    | 20.90              | 9.05                              | 4.98                     | 2.93               | 1.27                              |
| 125                | 3.59                     | 1.16               | 0.50                              | 1.57                     | 0.16               | 0.068                             | 0.90                     | 0.045              | 0.019                             |                          |                    |                                   |                          |                    |                                   | 6.23                     | 4.43               | 1.92                              |
| 150                | 4.30                     | 1.61               | 0.70                              | 1.88                     | 0.22               | 0.095                             | 1.07                     | 0.05               | 0.022                             |                          | 10 in.             |                                   |                          |                    |                                   | 7.47                     | 6.20               | 2.68                              |
| 175                | 5.02                     | 2.15               | 0.93                              | 2.20                     | 0.29               | 0.12                              | 1.25                     | 0.07               | 0.033                             |                          |                    |                                   |                          |                    |                                   | 8.72                     | 8.26               | 3.58                              |
| 200                | 5.73                     | 2.75               | 1.19                              | 2.51                     | 0.37               | 0.16                              | 1.43                     | 0.09               | 0.039                             | 0.90                     | 0.036              | 0.015                             |                          |                    |                                   | 9.97                     | 10.57              | 4.58                              |
| 250                | 7.16                     | 4.16               | 1.81                              | 3.14                     | 0.56               | 0.24                              | 1.79                     | 0.14               | 0.061                             | 1.14                     | 0.045              | 0.02                              |                          | 12 in.             |                                   | 12.46                    | 16.00              | 6.93                              |
| 300                | 8.60                     | 5.83               | 2.52                              | 3.76                     | 0.78               | 0.34                              | 2.14                     | 0.20               | 0.087                             | 1.36                     | 0.07               | 0.03                              |                          |                    |                                   |                          |                    |                                   |
| 350                | 10.03                    | 7.76               | 3.36                              | 4.39                     | 1.04               | 0.45                              | 2.50                     | 0.27               | 0.12                              | 1.59                     | 0.085              | 0.037                             | 1.12                     | 0.037              | 0.016                             |                          |                    |                                   |
| 400                | 11.47                    | 9.93               | 4.30                              | 5.02                     | 1.33               | 0.58                              | 2.86                     | 0.34               | 0.15                              | 1.81                     | 0.11               | 0.048                             | 1.28                     | 0.05               | 0.022                             |                          |                    |                                   |
| 450                |                          |                    |                                   | 5.64                     | 1.65               | 0.71                              | 3.21                     | 0.42               | 0.18                              | 2.04                     | 0.14               | 0.061                             | 1.44                     | 0.06               | 0.026                             |                          |                    |                                   |
| 500                |                          |                    |                                   | 6.27                     | 2.00               | 0.87                              | 3.57                     | 0.51               | 0.22                              | 2.27                     | 0.17               | 0.074                             | 1.60                     | 0.07               | 0.030                             |                          |                    |                                   |
| 750                |                          |                    |                                   | 9.40                     | 4.25               | 1.84                              | 5.36                     | 1.08               | 0.47                              | 3.40                     | 0.36               | 0.16                              | 2.40                     | 0.15               | 0.065                             |                          |                    |                                   |
| 1000               |                          |                    |                                   | 12.54                    | 7.23               | 3.13                              | 7.14                     | 1.84               | 0.80                              | 4.54                     | 0.61               | 0.26                              | 3.20                     | 0.26               | 0.11                              |                          |                    |                                   |
| 1250               |                          |                    |                                   |                          |                    |                                   | 8.93                     | 2.78               | 1.20                              | 5.67                     | 0.92               | 0.40                              | 4.01                     | 0.40               | 0.17                              |                          |                    |                                   |
| 1500               |                          |                    |                                   |                          |                    |                                   | 10.71                    | 3.89               | 1.68                              | 6.80                     | 1.29               | 0.56                              | 4.81                     | 0.55               | 0.24                              |                          |                    |                                   |
| 2000               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 9.07                     | 2.19               | 0.95                              | 6.41                     | 0.94               | 0.41                              |                          |                    |                                   |
| 2500               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 11.34                    | 3.33               | 1.44                              | 8.01                     | 1.42               | 0.62                              |                          |                    |                                   |
| 3000               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 9.61                     | 1.99               | 0.86                              |                          |                    |                                   |
| 3500               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 11.21                    | 2.65               | 1.15                              |                          |                    |                                   |
| 4000               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 12.82                    | 3.41               | 1.48                              |                          |                    |                                   |

Independent variables: Gallons per minute and nominal pipe size O.D.

Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe, interior smooth.

**Carrying Capacity and Friction Loss for 200 psi and SDR 21 Thermoplastic Pipe**

| Gallons Per Minute | ½ in.                    |                    |                                   | ¾ in.                    |                    |                                   | 1 in.                    |                    |                                   | 1½ in.                   |                    |                                   | 2 in.                    |                    |                                   | 3 in.                    |                    |                                   |
|--------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|--------------------------|--------------------|-----------------------------------|
|                    | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch | Velocity Feet per Second | Friction Head Feet | Friction Loss lbs per Square Inch |
| 1                  | 0.84                     | 1.00               | 0.44                              | 0.50                     | 0.28               | 0.12                              |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |
| 2                  | 1.67                     | 2.00               | 0.87                              | 0.99                     | 0.56               | 0.24                              | 0.60                     | 0.30               | 0.13                              | 0.29                     | 0.05               | 0.022                             | 0.18                     | 0.023              | 0.010                             |                          |                    |                                   |
| 5                  | 4.17                     | 11.25              | 4.87                              | 2.47                     | 3.14               | 1.36                              | 1.50                     | 0.93               | 0.41                              | 0.71                     | 0.15               | 0.065                             | 0.45                     | 0.06               | 0.025                             | 0.20                     | 0.015              | 0.006                             |
| 7                  | 5.84                     | 20.66              | 8.95                              | 3.46                     | 5.76               | 2.49                              | 2.09                     | 1.70               | 0.74                              | 0.99                     | 0.28               | 0.12                              | 0.63                     | 0.081              | 0.035                             | 0.29                     | 0.021              | 0.009                             |
| 10                 | 8.34                     | 39.34              | 17.03                             | 4.94                     | 10.96              | 4.75                              | 2.99                     | 3.24               | 1.40                              | 1.41                     | 0.52               | 0.23                              | 0.90                     | 0.17               | 0.074                             | 0.41                     | 0.03               | 0.013                             |
| 15                 | 4 in.                    |                    |                                   | 7.40                     | 23.23              | 10.06                             | 4.49                     | 6.86               | 2.97                              | 2.12                     | 1.11               | 0.48                              | 1.35                     | 0.37               | 0.16                              | 0.62                     | 0.06               | 0.026                             |
| 20                 | 0.50                     | 0.03               | 0.013                             | 9.87                     | 39.57              | 17.13                             | 5.98                     | 11.68              | 5.06                              | 2.83                     | 1.89               | 0.82                              | 1.80                     | 0.63               | 0.27                              | 0.83                     | 0.09               | 0.039                             |
| 25                 | 0.62                     | 0.04               | 0.017                             |                          |                    |                                   | 7.48                     | 17.66              | 7.65                              | 3.54                     | 2.85               | 1.23                              | 2.25                     | 0.95               | 0.41                              | 1.03                     | 0.14               | 0.061                             |
| 30                 | 0.75                     | 0.06               | 0.026                             |                          |                    |                                   | 8.97                     | 24.76              | 10.72                             | 4.24                     | 4.00               | 1.73                              | 2.71                     | 1.34               | 0.58                              | 1.24                     | 0.20               | 0.087                             |
| 35                 | 0.87                     | 0.08               | 0.035                             |                          |                    |                                   | 10.47                    | 32.94              | 14.26                             | 4.95                     | 5.32               | 2.30                              | 3.16                     | 1.78               | 0.77                              | 1.45                     | 0.27               | 0.12                              |
| 40                 | 1.00                     | 0.10               | 0.043                             |                          |                    |                                   |                          |                    |                                   | 5.66                     | 6.81               | 2.95                              | 3.61                     | 2.27               | 0.98                              | 1.65                     | 0.34               | 0.15                              |
| 45                 | 1.12                     | 0.12               | 0.052                             | 6 in.                    |                    |                                   |                          |                    |                                   | 6.36                     | 8.47               | 3.67                              | 4.06                     | 2.83               | 1.23                              | 1.86                     | 0.42               | 0.18                              |
| 50                 | 1.25                     | 0.15               | 0.065                             | 0.58                     | 0.02               | 0.009                             |                          |                    |                                   | 7.07                     | 10.29              | 4.46                              | 4.51                     | 3.44               | 1.49                              | 2.06                     | 0.51               | 0.22                              |
| 60                 | 1.50                     | 0.21               | 0.091                             | 0.69                     | 0.03               | 0.013                             |                          |                    |                                   | 8.49                     | 14.42              | 6.24                              | 5.41                     | 4.82               | 2.09                              | 2.48                     | 0.72               | 0.31                              |
| 70                 | 1.75                     | 0.28               | 0.12                              | 0.81                     | 0.04               | 0.017                             |                          |                    |                                   | 9.90                     | 19.19              | 8.31                              | 6.31                     | 6.41               | 2.78                              | 2.89                     | 0.96               | 0.42                              |
| 75                 | 1.87                     | 0.32               | 0.14                              | 0.86                     | 0.05               | 0.022                             |                          |                    |                                   | 10.61                    | 21.80              | 9.44                              | 6.76                     | 7.29               | 3.16                              | 3.10                     | 1.09               | 0.47                              |
| 80                 | 2.00                     | 0.36               | 0.16                              | 0.92                     | 0.05               | 0.022                             | 8 in.                    |                    |                                   |                          |                    |                                   | 7.21                     | 8.21               | 3.55                              | 3.30                     | 1.23               | 0.53                              |
| 90                 | 2.25                     | 0.45               | 0.19                              | 1.04                     | 0.07               | 0.030                             |                          |                    |                                   |                          |                    |                                   | 8.12                     | 10.21              | 4.42                              | 3.72                     | 1.52               | 0.66                              |
| 100                | 2.50                     | 0.54               | 0.23                              | 1.15                     | 0.08               | 0.035                             | 0.67                     | 0.03               | 0.012                             |                          |                    |                                   | 9.02                     | 12.41              | 5.37                              | 4.13                     | 1.85               | 0.80                              |
| 125                | 3.13                     | 0.82               | 0.36                              | 1.44                     | 0.125              | 0.054                             | 0.85                     | 0.037              | 0.015                             |                          |                    |                                   |                          |                    |                                   | 5.17                     | 2.81               | 1.22                              |
| 150                | 3.75                     | 1.15               | 0.50                              | 1.73                     | 0.18               | 0.078                             | 1.02                     | 0.05               | 0.022                             | 10 in.                   |                    |                                   |                          |                    |                                   | 6.19                     | 3.93               | 1.70                              |
| 175                | 4.37                     | 1.54               | 0.67                              | 2.02                     | 0.24               | 0.103                             | 1.19                     | 0.065              | 0.028                             |                          |                    |                                   |                          |                    |                                   | 7.23                     | 5.23               | 2.26                              |
| 200                | 4.99                     | 1.96               | 0.85                              | 2.31                     | 0.30               | 0.13                              | 1.36                     | 0.08               | 0.035                             | 0.86                     | 0.027              | 0.012                             |                          |                    |                                   | 8.26                     | 6.69               | 2.90                              |
| 250                | 6.24                     | 2.97               | 1.29                              | 2.89                     | 0.46               | 0.20                              | 1.70                     | 0.125              | 0.054                             | 1.10                     | 0.045              | 0.020                             | 12 in.                   |                    |                                   | 10.33                    | 10.13              | 4.39                              |
| 300                | 7.49                     | 4.16               | 1.80                              | 3.46                     | 0.63               | 0.27                              | 2.04                     | 0.18               | 0.078                             | 1.31                     | 0.06               | 0.026                             |                          |                    |                                   |                          |                    |                                   |
| 350                | 8.74                     | 5.54               | 2.40                              | 4.04                     | 0.85               | 0.37                              | 2.38                     | 0.24               | 0.103                             | 1.54                     | 0.08               | 0.035                             | 1.08                     | 0.036              | 0.016                             |                          |                    |                                   |
| 400                | 9.99                     | 7.09               | 3.07                              | 4.61                     | 1.08               | 0.47                              | 2.72                     | 0.30               | 0.13                              | 1.75                     | 0.10               | 0.043                             | 1.24                     | 0.04               | 0.017                             |                          |                    |                                   |
| 450                | 11.24                    | 8.82               | 3.82                              | 5.19                     | 1.34               | 0.58                              | 3.06                     | 0.37               | 0.16                              | 1.97                     | 0.13               | 0.056                             | 1.40                     | 0.06               | 0.026                             |                          |                    |                                   |
| 500                | 12.48                    | 10.72              | 4.64                              | 5.76                     | 1.63               | 0.71                              | 3.40                     | 0.45               | 0.19                              | 2.19                     | 0.15               | 0.065                             | 1.55                     | 0.07               | 0.030                             |                          |                    |                                   |
| 750                |                          |                    |                                   | 8.64                     | 3.46               | 1.50                              | 5.10                     | 0.96               | 0.42                              | 3.29                     | 0.33               | 0.14                              | 2.33                     | 0.14               | 0.061                             |                          |                    |                                   |
| 1000               |                          |                    |                                   | 11.53                    | 5.89               | 2.55                              | 6.80                     | 1.63               | 0.64                              | 4.38                     | 0.56               | 0.24                              | 3.11                     | 0.24               | 0.10                              |                          |                    |                                   |
| 1250               |                          |                    |                                   |                          |                    |                                   | 8.50                     | 2.47               | 1.07                              | 5.48                     | 0.85               | 0.37                              | 3.89                     | 0.37               | 0.16                              |                          |                    |                                   |
| 1500               |                          |                    |                                   |                          |                    |                                   | 10.19                    | 3.45               | 1.49                              | 6.57                     | 1.18               | 0.51                              | 4.66                     | 0.51               | 0.22                              |                          |                    |                                   |
| 2000               |                          |                    |                                   |                          |                    |                                   | 13.59                    | 5.87               | 2.54                              | 8.76                     | 2.02               | 0.87                              | 6.22                     | 0.87               | 0.38                              |                          |                    |                                   |
| 2500               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 10.96                    | 3.06               | 1.33                              | 7.77                     | 1.33               | 0.57                              |                          |                    |                                   |
| 3000               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 13.15                    | 4.27               | 1.85                              | 9.33                     | 1.85               | 0.80                              |                          |                    |                                   |
| 3500               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 10.88                    | 2.47               | 1.07                              |                          |                    |                                   |
| 4000               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 12.44                    | 3.17               | 1.37                              |                          |                    |                                   |
| 4500               |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   |                          |                    |                                   | 13.99                    | 3.93               | 1.70                              |                          |                    |                                   |

Independent variables: Gallons per minute and nominal pipe size O.D.  
 Dependent variables: Velocity, friction head and pressure drop per 100 feet of pipe interior smooth.