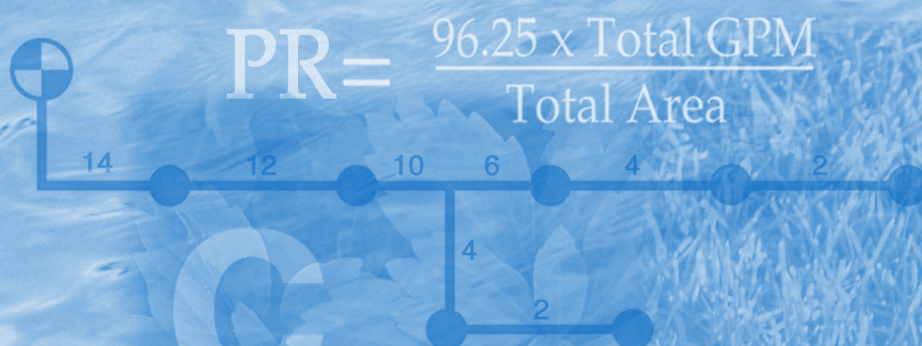


THE HANDBOOK OF TECHNICAL IRRIGATION INFORMATION

A Complete Reference Source for the Professional



$$PR = \frac{96.25 \times \text{Total GPM}}{\text{Total Area}}$$

$$F_f = \frac{P_o \times P_v}{L_c}$$

$$DU = 100 \times \left(\frac{48 \div 3}{243 \div 12} \right)$$

point B

Rise

point A

Run

Produced by

Hunter®
The Irrigation Innovators

Preface

Hunter's Handbook of Technical Irrigation Information is designed to be used as a reference guide for all professionals whose livelihood takes them into the realm of irrigation. Contractors, architects, designers and engineers alike are now able to benefit from the wide spectrum of information that has been gathered from numerous sources into a single document between the covers of this handbook.

Until the completion of the Handbook of Technical Irrigation Information there has not been a single, all-encompassing, up-to-date and reliable source of technical irrigation information. We sincerely hope that the publishing of this guide has helped fill this void and we hope that anything and everything you should ever need to know about the subject can be found herein.

For additional information on subjects within the field of irrigation, Hunter has developed a wide assortment of literature. Please call the Hunter Industries Customer Service Department at 760-744-5240 to obtain the materials to meet your particular needs. And for more information regarding any questions related to irrigation, call our Design And Technical Assistance (DATA) line at 1-800-733-2823 or visit our website at www.HunterIndustries.com

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FORMULAS

Slope

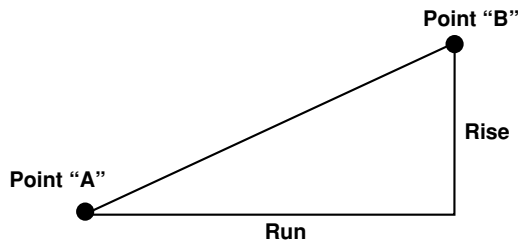
Slope, as used in irrigation, is a measure of the incline of an area. It can be described as 1) a percent, formula "A", 2) a degree, formulas "B" and "C", or 3) a ratio, formula "D". The greater the incline, the greater the tendency for runoff.

- A) The percent of slope can be determined by dividing the net change in elevation between two points (Rise) by the horizontal distance between those two points (Run).

$$S = \frac{\text{Rise}}{\text{Run}}$$

Where:

S = the percent of slope
Rise = the net elevation change in elevation between two points
Run = the horizontal distance between the two points



Note: The units for Rise and Run can be any unit of linear measure, but they must be the same for both the Rise and Run.

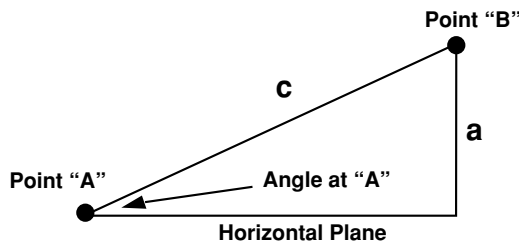
Example:

What is the slope for a bank 40 ft. wide (run) on which the elevation at the top (point "B") is 20 ft. higher than the toe of the slope (point "A")

$$S = \frac{20}{40} \quad S = 0.50 \text{ or } 50\%$$

- B) The degree of slope describes a slope as the angle of the slope (at "A") from the horizontal plane. This method is useful when taking field measurements as "c" represents the measured distance up a slope and "a" equals the elevation change.

$$\sin A = a/c$$



Where:

A = the angle
a = the height of the right triangle
c = the length of the hypotenuse of a right triangle

Example:

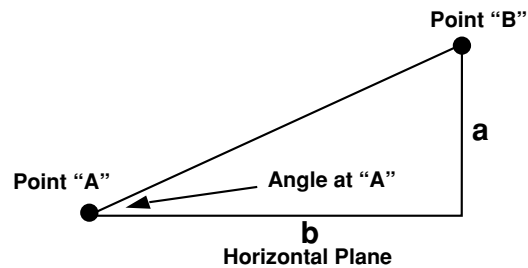
$$\begin{aligned} a &= 20 \text{ feet} \\ c &= 44.72 \text{ feet} \end{aligned}$$

$$\sin A = \frac{20}{44.72} \quad \sin A = 0.4472 \quad A = 26^\circ 34'$$

Slope (continued)

- C) The degree of slope describes a slope as the angle of the slope (at "A") from the horizontal plane. This method is useful when determining the slope from plot plans that include elevation. In this diagram "b" represents the horizontal distance between point "A" and "B" and "a" equals the elevation change between point "A" and "B."

$$\tan A = a/b$$



Where:

A = the angle
a = the height of the right triangle
b = the horizontal distance

Example:

a = 20.0 feet
b = 40.0 feet

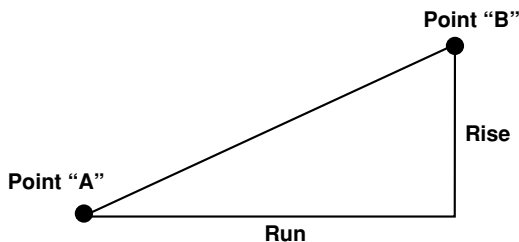
$$\tan A = \frac{20.0}{40.0}$$

$$\tan A = 0.4472$$

$$A = 26^\circ 34'$$

- D) Describing a slope as a ratio such as 2:1, 1:1 or 4:1, indicates the number of feet of run for every one foot of rise. For instance a 2:1 slope indicates there would be two feet of horizontal distance for every one foot change of elevation. A 1:1 would change one foot of elevation for every one foot of horizontal run. This can be calculated by dividing the amount of elevation change by the horizontal distance over which this change occurred.

$$Sr = \frac{\text{Run}}{\text{Rise}} : 1$$



Where:

Sr = the slope ratio
Rise = the net elevation change between two points
Run = the horizontal distance between the two points

Note: the units for Rise and Run can be any unit of linear measure, but they must be the same for both the Rise and Run.

Example:

A slope on a project is 20 feet high (rise) over a distance of 40 feet (run). What is the slope ratio?

$$Sr = \frac{\text{Run}}{\text{Rise}} : 1$$

$$Sr = \frac{40}{20} : 1$$

$$Sr = 2 : 1$$

Note: See pages 57, 58 & 59 for more information on slopes.

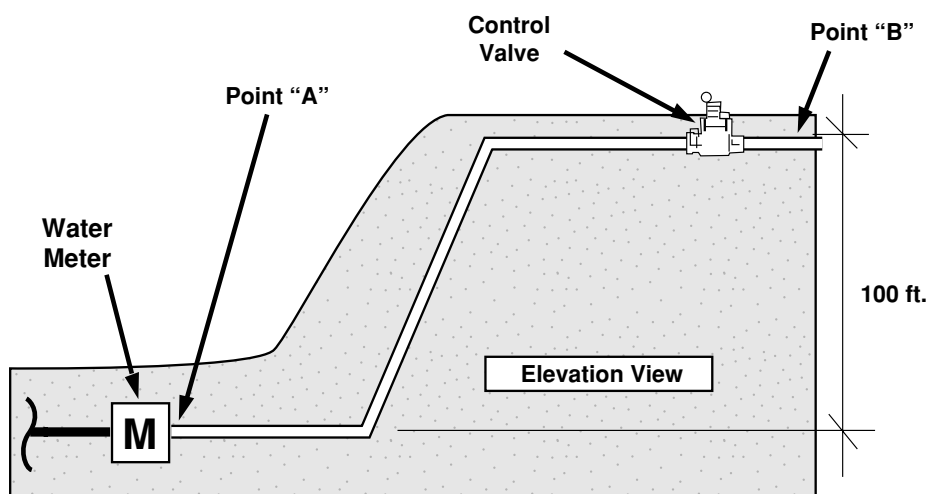
Dynamic Pressure Determination

Dynamic pressure is the pressure when water is flowing in the system. Dynamic pressure in a system can be determined by flow tests, using pressure gauges or by calculation if information on pipe types and sizes, valves, meters or other appurtenances are known. The dynamic pressure can be calculated at a given point in the system by starting with a known dynamic pressure at some point, adjusting for elevation change and subtracting friction losses in pipe, fittings, valves, meters, etc. as shown below:

$$\text{Dynamic Pressure} = (\text{PSI}_{\text{dynamic}} \pm h_e \text{ elevation}) - h_f \text{ pipe} - h_f \text{ fittings} - h_f \text{ valves}$$

Where:

- $\text{PSI}_{\text{dynamic}}$ = the known dynamic pressure at a given point in psi
 $h_e \text{ elevation}$ = pressure change due to elevation in psi
 $h_f \text{ pipe}$ = the psi loss due to “friction” losses in the pipe
 $h_f \text{ fittings}$ = the psi loss due to “friction” losses in fittings
 $h_f \text{ valves}$ = the psi loss due to “friction” losses in valves, meters or other appurtenances between the source and the given point in the system



Example:

In the diagram above the dynamic pressure at point “A” is 90 psi. The pipe is 2 inch class 315 PVC, 200 ft. from point “A” to point “B” with a flow rate of 50 gpm. According to the manufacturer, the control valve will lose 6.0 psi at 50 gpm.

90.00	psi at point “A”
- 43.30	psi loss due to elevation gain (100 ft. x 0.433 psi per ft.)
46.70	psi at point “B”
- 3.86	psi friction loss in pipe (1.93 psi loss per 100 ft. x 200 ft. / 100)
42.84	Subtotal
- 0.39	psi friction loss in fittings (estimate, 10% of friction loss in pipe)
42.45	Subtotal
- 6.00	psi loss in valve - from manufacturer data
36.45	psi dynamic pressure at point “B”

Friction Factor Pipe Sizing

This Friction Factor is used to determine the maximum flow in gallons per minute through any section of lateral line pipe while not exceeding a predetermined pressure loss (pressure variation). In order to minimize uneven distribution, sprinklers should operate with pressure variation between sprinklers of not more than ± 10 to $\pm 20\%$ of the desired sprinkler operating pressure.

$$F_f = \frac{P_o \times P_v}{L_c}$$

Where:

- F_f = Friction Factor, the allowable pressure loss per 100 feet of pipe, in psi
- P_o = sprinkler operating pressure in psi
- P_v = Pressure Variation allowed between the valve and the last sprinkler on the circuit being sized, usually 10% or 20% of the desired sprinkler operating pressure
- L_c = Critical Length of pipe from control valve to farthest head in hundreds of feet

Example:

- A) You must determine the amount of pressure variation you can allow between the valve and the last sprinkler head. This is usually 10% to 20% of the operating pressure of the sprinklers on that particular section. For this example we will use 10% (0.10) variation.

If a control valve operates a group of sprinklers which require 30 psi to operate (operating pressure = P_o) the 10% pressure variation (pressure variation = P_v) would allow a total variation of 3.0 psi from the valve to the farthest head. ($.10 \times 30 \text{ psi} = 3.0 \text{ psi}$)

- B) Determine the Critical Length (L_c)

Next you must determine the distance the water travels from the control valve to the farthest head. That is not necessarily the total length of pipe in the section but just the length of the pipe through which the water flows from the valve to the the farthest head. Divide this number by 100 to determine the hundreds of feet from the valve to the farthest head. This is called the Critical Length and represents the hundreds of feet of pipe in which you can afford to lose the pressure you determined was acceptable for pressure variation in step "A" above.

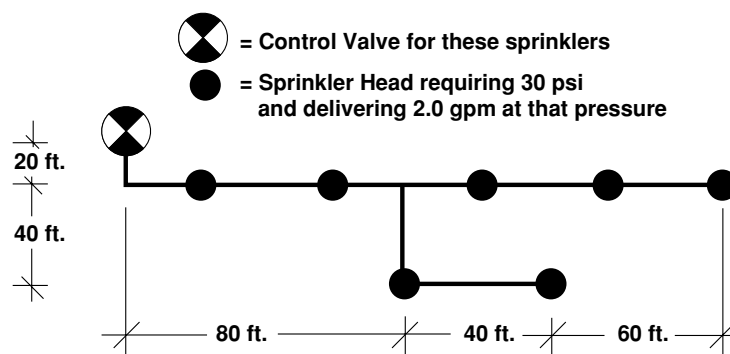


Fig.1

In this diagram you must decide the path the water flows from the valve to the farthest head and calculate that distance in feet. The water flow path is shown below (Fig. 2) and is represented by the pipe with the check pattern. Notice the distance of the branch line is NOT included in the distance. This is because the water flowing to the farthest head does not travel down that length of pipe and therefore any pressure losses occurring in the branch does not affect the pressure in the Critical Length.

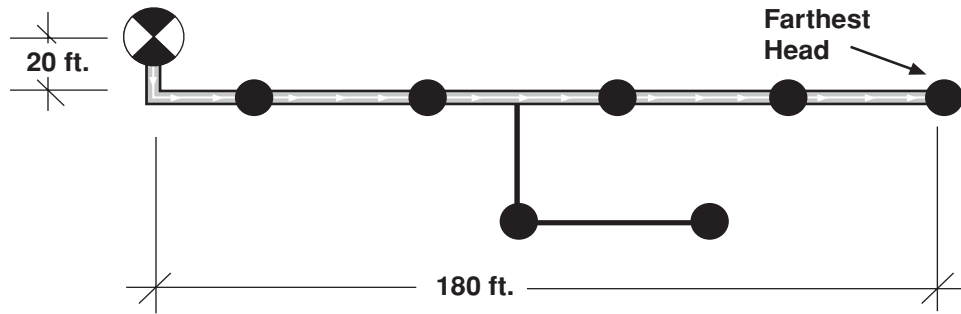


Fig. 2

In Fig. 2 the water traveling from the valve to the farthest head must pass through 200 feet of pipe. This divided by 100 gives a Critical Length (L_c) in hundreds of feet, of 2.0.

- C) Determine the rate at which you can lose pressure in the pipe. This is called the Friction Factor (F_f) which is the allowable psi loss per one hundred feet of pipe. We can determine this allowable rate of loss by dividing the allowable pressure loss (in psi) by the critical length (in hundreds of feet) by using the formula below.

The sprinklers mentioned above (Fig. 1) require 30 psi to operate and a distance from the valve to the farthest head of 200 feet. Using the formula below we can determine the Friction Factor.

$$F_f = \frac{P_o \times P_v}{L_c}$$

$$F_f = \frac{30 \times 0.10}{200/100}$$

$$F_f = \frac{3}{2}$$

$$F_f = 1.5 \text{ allowable psi loss per 100 feet of pipe.}$$

The Friction Factor indicates that the pipe is to be sized so that no section of pipe exceeds a pressure loss of 1.5 psi per 100 ft. This insures that over the 200 feet from the valve to the farthest head the total psi loss will not exceed the 3.0 psi allowable loss (10% of the sprinkler operating pressure). The Friction Factor can be used like a budget. It gives us a guideline by which we can size the pipe without having excessive pressure loss in any section.

For the lateral pipes (those downstream of the control valve) use Class 315 PVC for $\frac{1}{2}$ inch pipe and Class 200 PVC for all larger sizes. Although this requirement for Class 315 and Class 200 is not mandatory and may vary on many larger installations, it is typical for landscape projects from residential through medium commercial projects in the South and Western United States.

At this point turn to the Friction Factor Short Cut charts in the Tables section, page 53. Find the Chart for the Friction Factor closest to the one calculated for your sprinkler system section. (In this case there is a chart for a Friction Factor of 1.5 psi allowable loss per 100 ft. When there is no chart for the exact Friction Factor calculated, round off the Friction Factor to the nearest chart value.)

Figure 3 represents a portion of the Friction Factor Short Cut chart from page 64. The chart in the appendix should look like Fig. 3 shown below.

Friction Factor	1.50 Max. GPM
½" Cl. 315 PV	2.8
¾" Cl. 200 PVC	5.7
1" Cl. 200 PVC	10.8
1¼" Cl. 200 PVC	19.9
1½" Cl. 200 PVC	28.5
2" Cl. 200 PVC	51.1
2½" Cl. 200 PVC	84.3
3" Cl. 200 PVC	141.4

Fig. 3

The “Max. gpm” listed in the chart represent the maximum gpm that each pipe type/size can sustain without exceeding a 1.5 psi loss per 100 ft.

Using the maximum flow rates in the chart as guides the lateral line pipes can be sized with the assurance the total psi loss from the control valve to the farthest sprinkler will not exceed 10% of the sprinkler operating pressure (3.0 psi).

First determine the quantity of water in gpm passing through each section of pipe. A section may need to be sized differently if there is any change in the gpm so it is important to determine the flows carefully. The diagram below (figure 4) lists the gpm flowing through each section of pipe. Notice the section labeled “10” gpm. The 10 gpm is the flow to all sprinkler heads beyond that point and includes both the straight run as well as the branch line.

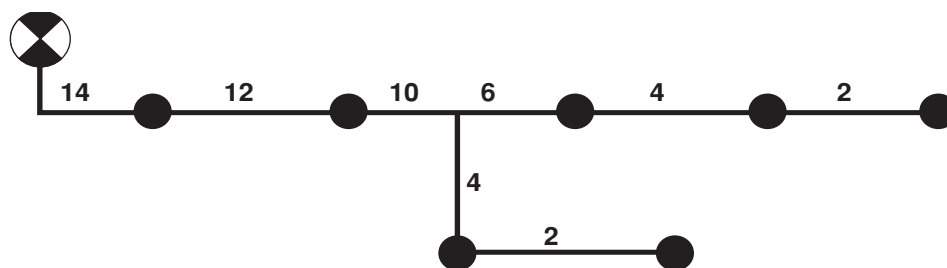


Fig. 4

Using the chart (Fig. 3) as a guide, sizes can be assigned to each pipe section.

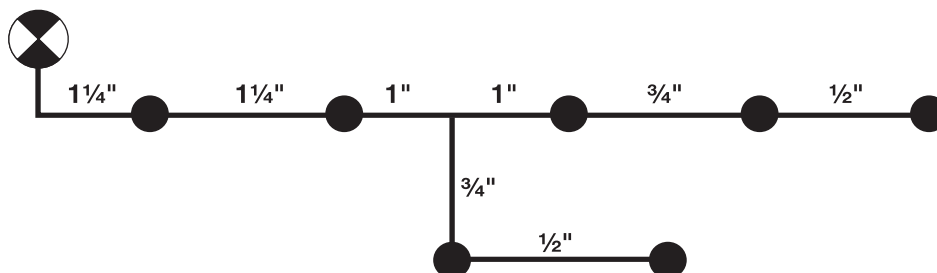


Fig. 5

Note that in the section with 6 gpm we used the 1" pipe. The chart allows up to 5.7 gpm in the ¾" pipe and some designers may choose to use the ¾" instead of the 1". It is acceptable to use ¾" pipe even though it exceeds the allowable loss (the Friction Factor), because pressure is conserved in some sections where the flow is below the maximum allowable.

Friction Loss in Pipe

The Hazen-Williams equation can be expressed as follows and is the most commonly used formula for calculating pressure loss in PVC pipe.

$$h_f = 0.00090194 \left(\frac{100}{C} \right)^{1.852} \frac{Q^{1.852}}{d^{4.866}} L$$

Where:

- h_f = head loss due to friction in pounds per square inch (psi)
- C = Hazen Williams coefficient for roughness of the inside of the pipe
- Q = flow in gallons per minute (gpm)
- d = inside diameter of pipe in inches
- L = length of pipe in feet

Example:

A 2-inch class 200 PVC pipe (I.D. = 2.149") 500 ft. in length will deliver 50 GPM to an irrigation system. Compute the friction loss in the pipeline.

$$h_f = 0.00090194 \left(\frac{100}{150} \right)^{1.852} \left(\frac{50^{1.852}}{2.149^{4.866}} \right) 500$$

$$h_f = 7.208 \text{ psi}$$

Static Pressure Determination

Static pressure is the measure of pressure when the water is at rest. This pressure is determined by the weight of a column of water resting on one square inch and expressed as the pounds per square inch (psi). The weight of a column of water one foot high will create 0.433 pounds of pressure over every square inch. Static pressure can be determined as follows:

$$P_s = A \pm 0.433 H$$

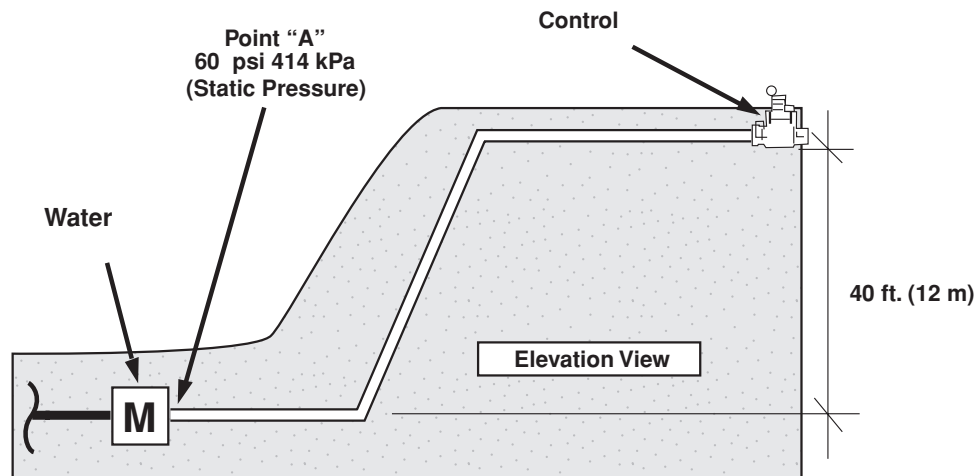
Where:

P_s = static pressure at a given point in the system, in pounds per square inch (psi)

A = static pressure at starting point in psi

0.433 = a constant representing the weight of water in a column one foot high as expressed in pounds per square inch

H = the net vertical change in elevation from the surface of the water to the given point in the system in feet, increase in elevation, uphill, results in psi loss (-0.433) downhill results psi gain (+0.433)



Example:

Determine the static pressure at the entrance to the control valve if the static pressure at the meter is 60 psi. (Note: If change in elevation is downhill, the elevation change (H) would be a positive.)

$$P_s = 60 - (0.433 \times 40)$$

$$P_s = 42.68 \text{ psi}$$

For static pressure in metric units use:

$$P_s = A - 9.79 H$$

$$P_s = 414 - (9.79 \times 12)$$

$$P_s = 296.52 \text{ kPa}$$

Where:

P_s = static pressure at a given point in the system, in kiloPascals (kPa)

A = static pressure at starting point in kPa

9.79 = a constant representing the weight of water in a column one meter high as expressed in kiloPascals

H = the net vertical change in elevation from the surface of the water to the given point in the system in meters

Velocity Head

The velocity head is the pressure required to move the water through the system.

$$H_v = V^2 / 2g$$

Where:

$$\begin{aligned} H_v &= \text{velocity head, the energy required to move the water at the intended velocity, in feet} \\ V &= \text{water velocity, in feet per second} \\ g &= \text{acceleration due to gravity (32.2)} \end{aligned}$$

Example:

What is the Velocity Head required to move 50 GPM through a 2 in. Class 315 PVC pipe?

$$H_v = (4.98)^2 / 64.4$$

$$H_v = 0.39 \text{ ft.}$$

Velocity of Flow

The velocity of flow is a calculation of the speed of water moving in a closed pipe system.

$$V = 0.408 \frac{Q}{d^2}$$

Where:

$$\begin{aligned} V &= \text{flow velocity in feet per second (fps)} \\ Q &= \text{flow in gallons per minute (gpm)} \\ d &= \text{inside diameter of pipe in inches} \\ 0.408 &= \text{constant used to convert units into feet per second} \end{aligned}$$

Example:

What is the velocity of flow for a 1 in. class 200 PVC pipe (1.189 inch I.D.) with a flow rate of 10 gpm?

$$V = 0.408 \frac{10}{(1.189)^2}$$

$$V = 2.89 \text{ fps}$$

Water Hammer

This formula is used to estimate the total surge pressure developed when there is a sudden reduction or cessation in the velocity of flow. This is typical when a control valve closes.

$$P_t = P_o + \frac{(V \times L \times 0.07)}{t}$$

Where:

- P_t = the total pressure developed, in psi
- P_o = the operating pressure at the time of valve closing, in psi
- V = velocity at the time the reduction in velocity occurred, in feet per second
- L = Length of straight pipe between source and point where reduction in velocity occurred, this would be the longest section, in feet (straight pipe means no tee or ell fittings)
- t = seconds during which the velocity was reduced, for example, a valve that closes in a half second would have a value for “t” of 0.5
- 0.07 = constant used to convert velocity, length and time into pressure

Example:

An electric remote control valve has a hydraulic closure time of 0.8 seconds. The main line leading to the valve is 450 ft. long with a velocity of 4.2 fps. The system is operating at 65 psi at the time of valve closure. What is the total surge pressure?

$$P_t = 65 + \frac{(4.2 \times 450 \times 0.07)}{0.8}$$

$$P_t = 65 + \frac{132.3}{0.8}$$

$$P_t = 230.38 \text{ psi}$$

AB 325, California Calculation of Estimated Applied Water Use (EWU)

This formula is used to calculate the estimated amount of water used in one hydrozone of a landscape (the hydrozone may be one control valve or several with similar water requirements). All hydrozones would be added together to determine the Estimated Applied Water Use (EWU) for an entire project. The EWU must be less than the Maximum Applied Water Allowance (MAWA), as shown in the next formula, in order to receive project approval. The use of this formula was mandated by California State assembly bill 325.

$$EWU = \frac{Et_o \times PF \times HA \times 0.62}{IE}$$

Where:

- EWU = the estimated water use in gallons per day
- Et_o = potential daily evapotranspiration for the worst case scenario, in inches per day
- PF = Plant Factor (Crop Coefficient), percent in decimal form
- HA = hydrozone area in square feet
- IE = Irrigation Efficiency or Distribution Uniformity, percent in decimal form
- 0.62 = constant for conversion of units to gallons per day

Example:

You want to determine the EWU for a rectangular lawn area with the following characteristics

- the estimated worst case Et_o is 0.40 inches per day
- for the warm season turf you are using, the crop coefficient has been determined to be 60% (0.60)
- 380 ft. long by 260 ft. wide (98,800 sq. ft.)
- the system efficiency has been estimated at 75% (0.75)

$$EWU = \frac{0.40 \times 0.60 \times 98,800 \times 0.62}{0.75}$$

$$EWU = \frac{14,701.44}{0.75}$$

$$EWU = 19,601.92 \text{ gallons per day}$$

AB 325, California Calculation of Maximum Applied Water Allowance (MAWA)

The Maximum Applied Water Allowance (MAWA) is used to determine the amount of water a project will be allowed to use for landscape purposes. This amount determines the limit for projected water use (EWU). Projects must be designed with an Estimated Applied Water Use (EWU) less than the limit allowed in the MAWA calculation. The use of this formula was mandated by California State assembly bill 325.

$$\text{MAWA} = \text{Et}_o \times \text{LA} \times 0.496$$

Where:

- MAWA = Maximum Applied Water Allowance in gallons per day
- Et_o = potential daily evapotranspiration for the worst case scenario, in inches per day
- LA = landscaped area in square feet
- 0.496 = constant to convert area and evapotranspiration to gallons and then multiplied by 0.8 as required by the model ordinance

Example:

You want to determine the MAWA for the project containing the lawn area mentioned in the example with formula 1 above.

- the estimated worst case Et_o is 0.40 inches per day
- 380 ft. long by 260 ft. wide (98,800 sq. ft.)

$$\text{MAWA} = 0.40 \times 98,800 \times 0.496$$

$$\text{MAWA} = 19,601.92 \text{ gallons per day}$$

Maximum System Capacity Requirement

The following formula is to be used to determine the gallons per minute (gpm) necessary for peak water demand periods. While an area might survive for short periods with less water by utilizing soil moisture reserves, extended periods of drought would require the maximum system capacity. The formulas below (#10, #11, #12) are a guide and it should be remembered the answer is no better than the factors that go into the formula (e.g. Reference Evapotranspiration Rate, Area, Distribution Uniformity, etc.).

Maximum System Capacity Requirement - GPM per Hydrozone(s)

This formula is used to determine the maximum water required, in GPM, from the source based on the hydrozone's characteristics.

$$\text{GPM} = \frac{0.0104 \times \text{Et}_o \times \text{Area} \times \text{K}_c}{\text{DU} \times \text{Hrs. Available}}$$

Variable Value Ranges:

GPM	= gallons per minute required
Et _o	= peak daily evapotranspiration for the worst case scenario in inches
Area	= area to be irrigated in square feet
K _c	= Crop Coefficient - use 1.0 if actual crop coefficient is not known
DU	= distribution uniformity or irrigation efficiency
Hrs. Available	= hours available for irrigation each day in the worst case
0.0104	= constant for conversion of area, flow and inches per day, etc. into common units

Example:

A park has been designed with 450,000 sq. ft. of turf, and all areas must be irrigated between 10 p.m. and 6 a.m. The crop coefficient is 60% (0.6) with an average peak evapotranspiration rate of 0.35 inches per day. The system distribution uniformity has been estimated to be 65%. What will be the maximum gpm required for the park?

$$\text{GPM} = \frac{0.0104 \times 0.35 \times 450,000 \times 0.60}{0.65 \times 8}$$

$$\text{GPM} = 189$$

Maximum System Capacity Requirement - Total Area For Given GPM

This formula may be used to determine the area that can be irrigated if you know the gallons per minute of the water supply.

$$\text{Area} = \frac{\text{GPM} \times \text{DU} \times \text{Hrs. Available}}{0.0104 \times \text{Et}_o \times K_c}$$

Where:

Area	= area to be irrigated in square feet
GPM	= gallons per minute available from the water supply
DU	= Distribution Uniformity or Irrigation Efficiency
Hrs. Available	= hours available for irrigation on the "Worst Case" day
Et _o	= peak daily evapotranspiration for the worst case scenario
K _c	= Crop Coefficient - use 1.0 if actual crop coefficient is not known
0.0104	= constant for conversion of area, flow and inches per day etc. into common units

Example:

A developer has a well on the site of a proposed golf course. The well will produce 350 gpm. The course will be designed with a distribution uniformity of 75%, and a watering window of 12 hours. The peak evapotranspiration rate in her area is 0.30 inches per day and the turf has a crop coefficient of 80% (0.80). How large an area can she water with the existing well?

$$\text{Area} = \frac{350 \times 0.75 \times 12}{0.0104 \times 0.30 \times 0.80}$$

$$\text{Area} = 1,262,019 \text{ sq. ft. (approximately 29 acres)}$$

Maximum System Capacity Requirement - Total Area For Given Gallons Per Day

This formula may be used to determine the area that can be irrigated if you know the gallons available per day. This is the case in some water rationing systems or where a well capacity is the limiting factor.

$$\text{Area} = \frac{\text{DU} \times \text{Gallons}}{0.62333 \times \text{Et}_o \times \text{K}_c}$$

Where:

- Area = area to be irrigated in square feet
- DU = Distribution Uniformity or Irrigation Efficiency
- Gallons = gallons available from the water supply on the “Worst Case” day
- Et_o = evapotranspiration for the worst case scenario
- K_c = Crop Coefficient - use 1.0 if actual crop coefficient is not known
- 0.62333 = constant for conversion of area, flow and inches per day, etc. into common units

Example:

The city has developed guidelines that allot a commercial project 36,000 gallons of water per day during an extended drought. The area being watered has a distribution uniformity of 60%, an average evapotranspiration rate of 0.22 inches per day and an average crop coefficient of 70% (0.70). How much of their project can be sustained with the city’s water allotment?

$$\text{Area} = \frac{0.60 \times 36,000}{0.62333 \times 0.22 \times 0.70}$$

$$\text{Area} = 225,017 \text{ sq. ft. (approximately 5.2 acres)}$$

Brake Horsepower

This formula determines the amount of power required at the pump shaft based on the pump efficiency. It does not take into account any losses in the engine or electric motor.

$$\text{BHP} = \frac{Q \times h}{3960 \times E_f}$$

Where:

- BHP = brake horsepower (1 HP = 550 ft-lbs/sec)
- Q = pump discharge in gallons per minute (gpm)
- h = total dynamic head in feet
- 3960 = constant for conversion of units to brake horsepower
- E_f = pump efficiency (decimal)

Example:

A pump with an efficiency of 85% is pumping 500 gpm with a total dynamic head of 230 ft. What is the brake horsepower required to drive the pump?

$$\text{BHP} = \frac{500 \times 230}{3960 \times 0.85}$$

$$\text{BHP} = 34.17$$

Horsepower Required in Pumping Water

This formula is used to determine the brake horsepower requirements.

$$\text{BHP} = \frac{\text{ft} \times \text{GPM}}{3960 \times E_f}$$

Where:

- BHP = Brake Horsepower
- ft = the number of feet the water is lifted from the surface of the water source to the discharge point
- GPM = the gallons per minute being pumped
- 3960 = constant for conversion to horsepower
- E_f = pump efficiency (decimal)

Example:

A pump system is needed to pump 500 GPM from a river 70 ft. up to a golf course water reservoir. What is the minimum horsepower required to pump this water? This pump is rated at 75% efficient.

$$\text{HP} = \frac{70 \times 500}{3960 \times .75}$$

$$\text{HP} = 11.78 \approx 12$$

Brake horsepower is the power required at the pump shaft required to drive the pump.

Net Positive Suction Head Available

The Net Positive Suction Head available is the absolute pressure available at the pump impeller. The Net Positive Suction Head Available (NPSHA) must exceed the Net Positive Suction Head Requirement (NPSHR) or cavitation will cause damage to the pump impeller. The NPSHR is determined by the pump manufacturer and is dependent upon pump design and operating conditions.

$$\text{NPSHA} = (H_o - H_v) - H_s - h_f$$

Where:

- H_o = atmospheric pressure in feet of water
- H_v = saturation vapor pressure in feet of water
- H_s = vertical height of the impeller eye above the water surface in feet
- h_f = pressure loss due to friction in the suction (intake) line in feet of head
(pressure losses in psi must be multiplied by 2.31 to convert to feet)

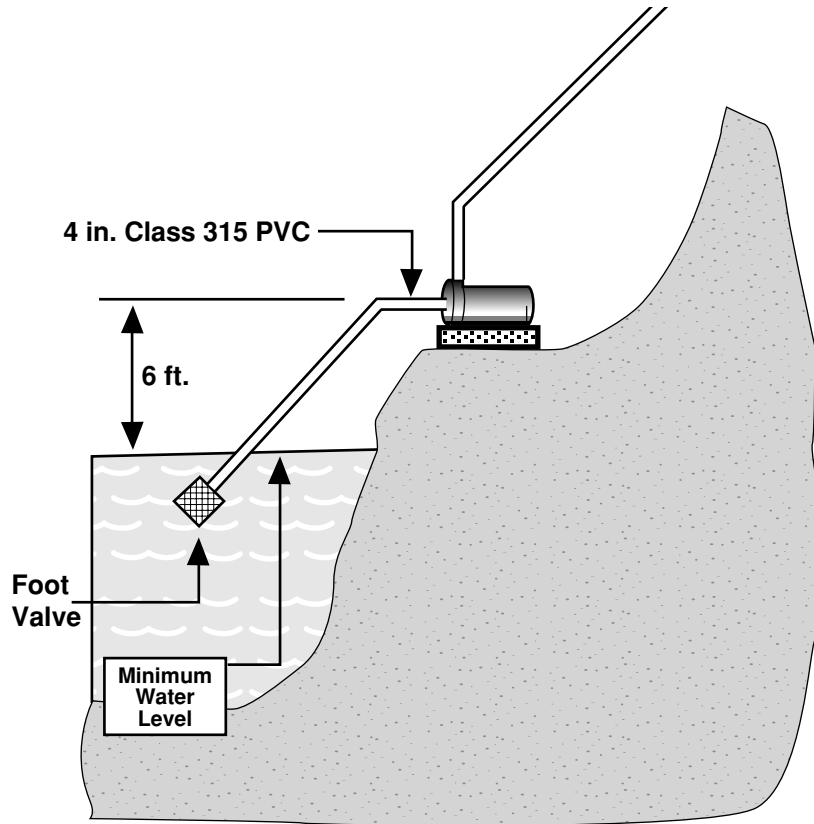
$(H_o - H_v)$ For a Range of Temperatures and Elevations

Water Temp. Degrees F°	Elevation Above Sea Level (ft)						
	0	1000	2000	3000	4000	5000	6000
40	33.7	32.5	31.4	30.3	29.2	28.1	27.0
50	33.6	32.4	31.3	30.2	29.1	28.0	26.9
60	33.4	32.2	31.1	30.0	28.9	27.8	26.7
70	33.2	32.0	30.9	29.8	28.7	27.6	26.5
80	32.8	31.6	31.5	29.4	28.3	27.2	26.1
90	32.4	31.2	30.1	29.0	27.9	26.8	25.7
100	31.8	30.6	29.5	28.4	27.3	26.2	25.1
110	31.1	29.9	28.8	27.7	26.6	25.5	24.4
120	30.1	28.9	27.8	26.7	25.6	24.5	23.4
130	28.9	27.7	26.6	25.5	24.5	23.3	22.2
140	27.3	26.1	25.0	23.9	22.8	21.7	20.6
150	25.4	24.2	23.1	22.0	20.9	19.8	18.7

Net Positive Suction Head Available (continued)

Example:

Using the diagram below and the chart on page 19 determine the Net Positive Suction Head Available. The pump is located 3000 ft. above sea level, the water temperature is 60° F. The intake line is 20 ft. long and the flow rate is 100 gpm. The pressure loss through the foot valve is 1.5 psi and the pressure loss through the fittings is is estimated at 0.5 psi.



$$\begin{aligned}\text{NPSHA} &= 30 - 6 - (1.5 \times 2.31) - (0.31 \times 0.2 \times 2.31) - (0.5 \times 2.31) \\ \text{NPSHA} &= 19.24 \text{ ft. of head}\end{aligned}$$

The Net Positive Suction Head Available (NPSHA) can be calculated by the formula above while the Net Positive Suction Head Required (NPSHR) varies from one pump model to another and can be found with the pump performance curves provided by the manufacturer. For any given pumping situation and pump model, the NPSHA must exceed the pump's NPSHR in order for the pump to operate properly and avoid cavitation.

Total Dynamic Head

Total Dynamic Head is the amount of pressure that one pump must generate or be available for proper sprinkler system operation. It represents the total of all pressure losses and requirements including: 1) pressure change due to elevation, 2) sprinkler operating pressure, 3) friction loss in pipes, fittings and valves and 4) the pressure required to move the water.

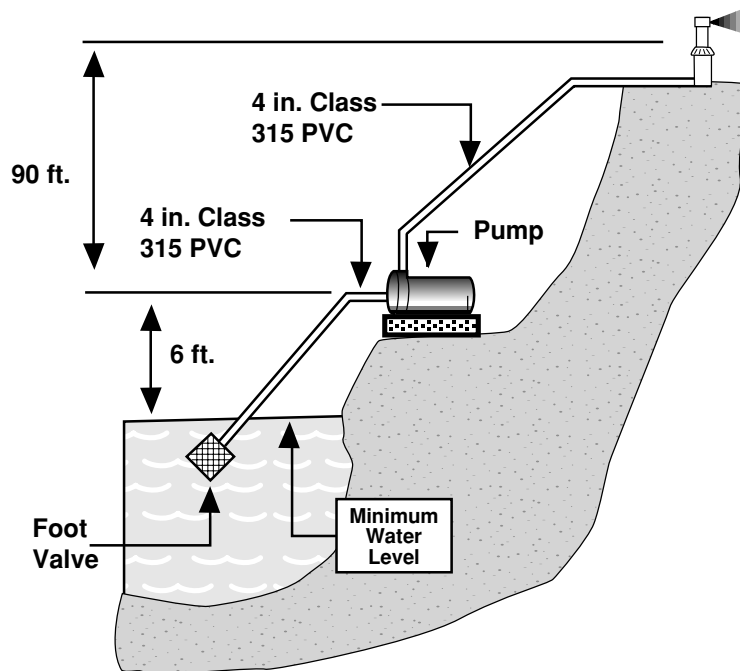
$$TDH = H_s + H_p + h_f + H_v$$

Where:

- TDH = Total Dynamic Head is the maximum pressure the pump will be required to generate.
- H_s = Static Head, the vertical distance in feet from the surface of the water source to the point of discharge, in feet.
- H_p = Pressure Head, the pressure required at the discharge (sprinkler, emitter or discharge pipe) in feet. (If sprinkler psi is used it must be multiplied by 2.31 to convert to feet.)
- h_f = Friction Head, the pressure lost due to friction in pipe, valves and fittings from the water intake to the discharge point, in feet. (If pressure loss is calculated in psi, it must be multiplied by 2.31 to convert to feet.)
- H_v = Velocity Head, the energy required to move the water at the intended velocity (see velocity head) in feet. Because this is an insignificant loss in Total Dynamic Head, it is sometimes ignored in these calculations.

Example:

Determine the Total Dynamic Head where the sprinkler operating pressure is 50 psi, the maximum flow is 150 gpm, the intake line is 35 ft. long and the discharge line is 450 ft. The pressure loss in the foot valve at that flow rate is given by the manufacturer to be 1 psi. In this sample problem we ignore the pressure loss in fittings.



$$TDH = H_s + H_p + H_f + H_v$$

$$TDH = (90 + 6) + (50 \times 2.31) + [(35 + 450) \times \left(\frac{0.66}{100} \right) \times 2.31] + (1 \times 2.31) + \frac{4.16^2}{64.4}$$

$$TDH = 221.47 \text{ ft.}$$

Water Horsepower Requirements

This formula, also called Theoretical Horsepower, is used to calculate the amount of power required to pump a given volume of water at a specified head.

$$\text{WHP} = \frac{\text{GPM} \times \text{TDH}}{3960}$$

Where:

- WHP = horsepower output required
- GPM = gallons per minute flow from the pump
- TDH = Total Dynamic Head in feet of head
- 3960 = constant used to convert flow and head into horsepower

Example:

What is the water horsepower requirement to pump 200 gpm at 350 ft. of head?

$$\text{WHP} = \frac{200 \times 350}{3960}$$

$$\text{WHP} = 17.7$$

Coefficient of Uniformity

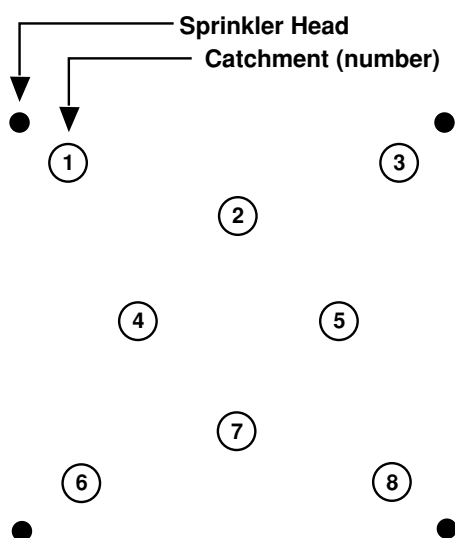
This formula is used to measure the variability of water distribution over a given area. It is calculated by using a series of catchments and comparing the average (mean) catchment and the deviation from that average. This formula was developed by J.E. Christiansen.

$$C_u = 100 \left(1.0 - \frac{\sum x}{mn} \right)$$

Where:

- C_u = Uniformity Coefficient
- x = the deviation of individual observations or catchments
- $\sum x$ = the sum of the deviations of individual observations from the mean value, m
- m = mean value of all observations in the distribution
- n = number of observations in the distribution
- 100 = constant for conversion to percent

Example:



Catchment #	Catchment Quantity (ml)	Deviation From Mean (mean = 46.75 ml)
1	48	1.25
2	51	4.25
3	44	2.75
4	41	5.75
5	45	1.75
6	44	2.75
7	50	3.25
8	51	4.25
Total		26.00

Note: catchment may be expressed in any convenient unit (i.e. milliliters, ounces, etc.), as long as all catchments are measured in the same units.

In a landscape area, eight catchments are placed between sprinklers and the above observations recorded. What is the Coefficient of Uniformity?

$$C_u = 100 \left(1.0 - \frac{26.00}{46.75 \times 8} \right)$$

$$C_u = 93.0$$

Distribution Uniformity

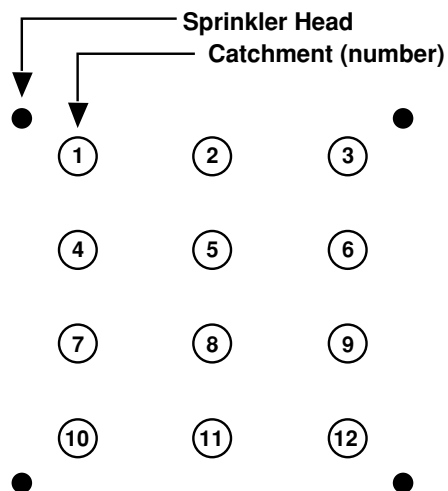
This formula is one of several that are titled Distribution Uniformity. It is used to estimate the variation in water application between sprinklers resulting from pressure variation, improper nozzle selection or lack of maintenance.

$$DU = 100 \times \left(\frac{MQ1}{M} \right)$$

Where:

- DU = Distribution Uniformity expressed as a percent
- MQ1 = mean of observations in lowest 25% of the distribution
- M = mean of distribution
- 100 = constant for conversion to percent

Example:



Catchment #	Quantity after 15 minutes in milliliters
1	13*
2	18*
3	22
4	17*
5	19
6	23
7	19
8	21
9	22
10	23
11	24
12	22
Total	243
*Lowest 1/4 = 48	

Note: catchment may be measured in any units (inches, ounces, millimeters, etc.).

$$DU = 100 \times \left(\frac{48 \div 3}{243 \div 12} \right)$$

$$DU = 100 \times \left(\frac{16}{20.25} \right)$$

$$DU = 100 \times 0.79$$

$$DU = 79\%$$

Precipitation Rate

Two formulas are shown below, the first is most useful when comparing precipitation rates between different types of sprinklers or calculating precipitation rates on areas with a single type of sprinkler and uniform head and row spacing. The second method is better suited to areas where sprinkler head flows or spacing varies. Metric versions are shown in parenthesis.

Precipitation Rate - Method #1 - Individual Head Method

$$PR = \frac{34650 \times \text{GPM (for any arc)}}{\text{Degrees Arc} \times \text{Head Spacing} \times \text{Row Spacing}}$$

$$\left(PR = \frac{\text{m}^3/\text{hr (for any arc)} \times 360,000}{\text{Degrees of arc} \times \text{Head spacing (m)} \times \text{Row Spacing (m)}} = \text{mm/hr} \right)$$

$$\left(PR = \frac{1/\text{min (for any arc)} \times 21,600}{\text{Degrees of arc} \times \text{Head spacing (m)} \times \text{Row Spacing (m)}} = \text{mm/hr} \right)$$

Where:

PR	=	precipitation rate in inches per hour
GPM	=	flow for a given sprinkler of any arc, in gallons per minute
Degrees Arc	=	the arc of the given sprinkler in degrees
Head Spacing	=	the space between the heads in a row, in feet
Row Spacing	=	the space between rows of heads, in feet
34650	=	constant for conversion of area and flow into common units

Example:

What is the precipitation rate for a 270 degree sprinkler with 6.8 gpm spaced at 28' by 30'?

$$PR = \frac{34,650 \times 6.8}{270 \times 28 \times 30}$$

$$PR = 1.04 \text{ in./hr.}$$

Precipitation Rate - Method #2 - Total Area Method

$$PR = \frac{96.25 \times \text{Total GPM}}{\text{Total Area}}$$

$$\left(PR = \frac{\text{Total m}^3/\text{hr} \times 1,000}{\text{Total Area (m}^2\text{)}} = \text{mm/hr} \right) \quad \left(PR = \frac{\text{Total 1/min} \times 60}{\text{Total Area (m}^2\text{)}} = \text{mm/hr} \right)$$

Where:

PR	=	precipitation rate in inches per hour
Total GPM	=	total flow from all sprinklers in the given area in gallons per minute
Total Area	=	the given irrigated area in square feet
96.25	=	constant for conversion of area and flow into common units

Example:

What is the average precipitation rate for a section of turf 325' by 80' if the total flow from all sprinklers in the area is 112 gpm.

$$PR = \frac{96.25 \times 112}{(325 \times 80)}$$

$$PR = 0.41 \text{ in./hr.}$$

Precipitation Rate - Minimum Rate Required

This formula is used to determine the minimum precipitation rate than can be used to deliver the required water during the peak period of water usage.

$$\text{Minimum PR} = \frac{\text{ET} \times \text{Total Acres}}{\text{Hours Avail.} \times \text{Acre per Section} \times \text{Valves} \times \text{Efficiency}}$$

Where:

Minimum PR	= minimum required precipitation rate in inches per hour
ET	= amount of water to be applied in inches per day, including crop coefficient
Total Acres	= the area to be irrigated in acres
Hours Avail.	= hours available for irrigation each day
Acres per Section	= average area covered by one control valve in acres
Valves	= number of valves operating at one time
Efficiency	= system operating efficiency in decimal equivalent of percent

Example:

What is the minimum precipitation rate that will deliver 0.28 inches of water to 15 acres under the following conditions:

- during a 12 hour period
- the average section is 0.40 acres (17,424 sq. ft.)
- there will be two valves operating at one time
- the system efficiency is 75%

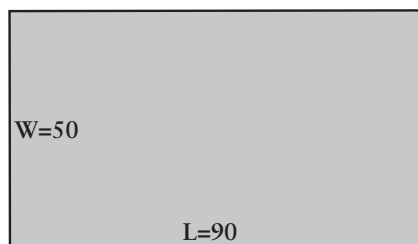
$$\frac{0.28 \times 15}{12 \times 0.40 \times 2 \times .75}$$

= 0.58 in./hr. minimum precipitation rate required

How to Calculate Areas

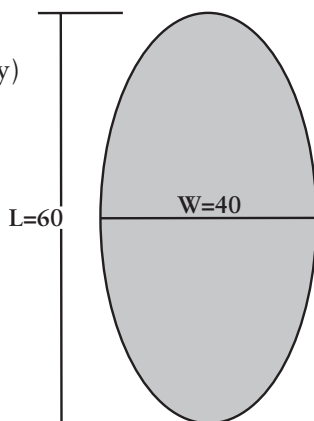
Square or rectangle

Area = L x W
 L = length
 W = width
 A = 90 ft x 50 ft
 = 4,500 sq ft



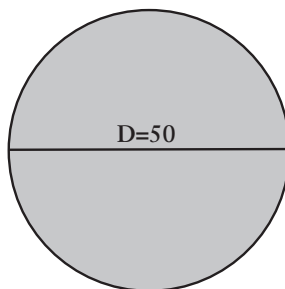
Ovals or egg shapes (within 5 percent accuracy)

Area = 0.8 L x W
 L = length
 W = width at midpoint
 Area = 0.8 x 60 x 40 ft
 = 1,920 sq ft



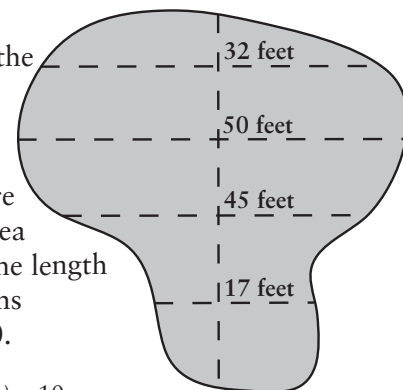
Circle (within 5 percent accuracy)

Area = 0.8 D²
 D = diameter
 Area = 0.8 x 50 ft x 50 ft
 = 2,000s sq ft



Irregular shapes

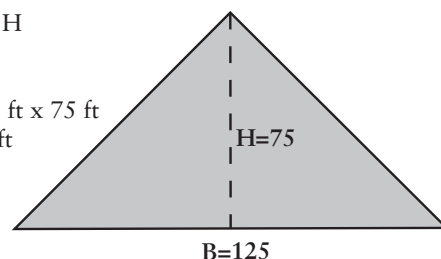
Find the length of the longest line across the area. Every 10 ft along the length line, measure the width of the area at right angles to the length line. Total all widths and multiply by 10.



Area = (A + B + C, etc.) x 10
 = (32 ft + 50 ft + 45 ft + 17 ft) x 10
 = 144 x 10
 = 1,440 sq ft

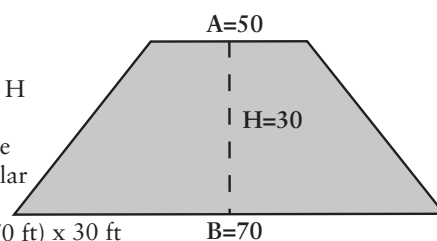
Triangle

Area = 0.5 x B x H
 B = base
 H = height
 Area = 0.5 x 125 ft x 75 ft
 = 4,687 sq ft



Trapezoid

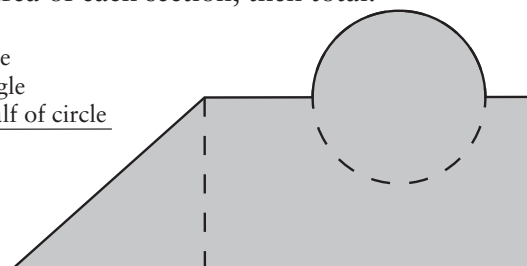
Area = 0.5 x (A + B) x H
 A = one parallel side
 B = second parallel side
 H = height perpendicular to parallel sides
 Area = 0.5 x (50 ft + 70 ft) x 30 ft
 = 0.5 x 120 ft x 30 ft
 = 1,800 sq ft



Unusual shapes

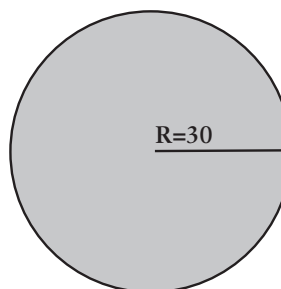
Divide the area into sections of regular geometric shapes, calculate the area of each section, then total:

Area of triangle
 + Area of rectangle
 + Area of one-half of circle
 = Total area



Circle

Area = πr^2
 $\pi = 3.14$
 R = radius
 Area = 3.14 x (30 ft x 30 ft)
 = 2,826 sq ft



Scheduling Coefficient

A scheduling coefficient is used to measure the uniformity of water distribution by relating the lowest precipitation rate for any contiguous region within an irrigated area to the overall precipitation rate of the entire area.

$$SC = \frac{PR}{LPR}$$

Where:

- SC = Scheduling Coefficient, 1.0 would be perfect uniformity
- PR = Precipitation Rate
- LPR = Lowest Precipitation Rate in the irrigated area

Example:

In a catchment test, collectors are placed at two foot intervals. The average precipitation rate is calculated to be 1.6 in./hr. The lowest precipitation rate of all catchments was 0.8 in./hr. What is the Scheduling Coefficient?

$$SC = \frac{1.6}{0.8}$$

$$SC = 2.0$$

Irrigation Frequency

The Irrigation Frequency Formula calculates the maximum interval allowed between irrigation cycles. This irrigation interval is dependent on soil type, root zone depth and water lost by evapotranspiration of a specific crop.

The frequency, or "Set Days To Water", is calculated using the following formula

$$F = \frac{AWHC \times RZ \times MAD}{Et_o \times K_c}$$

Where:

- F = Irrigation frequency
- AWHC = Available Water Holding Capacity is the moisture level in the soil which is above the plant's permanent wilting point, and below the soil's field capacity, in inches per foot
- RZ = root zone, in feet
- MAD = Management Allowable Depletion of water from the AWHC percent. MAD of 30-50% will sustain a healthy landscape.
- Et_o = reference evapotranspiration rate, in inches per day
- K_c = crop coefficient, decimal

Example:

A zone in your system is irrigating established warm season turf which is growing in a sandy loam on a slight slope with an available water holding capacity of 1" per foot of soil. The root depth of the turf is 9". The average precipitation rate is 0.49 inches/hour. The system is located in San Marcos, CA where the daily moisture loss (ET_o) to be replenished is 0.20 inches. The crop coefficient (K_c) is set at 70%. The allowable water depletion will be 50%.

$$F = \frac{1.0" \times 0.75' \times 50\%}{0.20" \times 0.70} = \frac{1.0 \times 0.75 \times 0.50}{0.20 \times 0.70} = 2.68 = 2 \text{ days}$$

Sprinkler Run Time

The sprinkler run time formula calculates the number of minutes required to apply enough water to replace the water lost by evapotranspiration for a specific crop irrigated with a system at a particular precipitation rate and efficiency.

The "run time" is calculated using the following formula.

$$T = \frac{60 \times D \times Et_o \times K_c}{PR \times IE}$$

Where:

- T = sprinkler run time in minutes
- 60 = constant for conversion of area, flow, inches per hour and inches per day into common units
- D = watering frequency in days
- Et_o = reference evapotranspiration rate, in inches per day
- K_c = crop coefficient, decimal
- PR = precipitation rate of the area, in inches per hour
- IE = application efficiency of the system, percent

Example:

Determine the sprinkler run time for an athletic field with a daily Et_o of 0.15 inches and a crop coefficient for the warm season turf of 0.70. The watering schedule is set for every three days. The sprinkler precipitation rate is 0.50 in./hr. with an application efficiency of 75%.

$$T = \frac{60 \times 3 \times 0.15" \times .70}{0.50" \times 75\%} = \frac{60 \times 3 \times 0.15 \times .70}{0.50 \times 0.75}$$

$$T = 50 \text{ minutes every 3 days}$$

CONVERSIONS

Variables and Units

SYMBOL	DEFINITION	ENGLISH UNITS	SI UNITS
a	Cross-sectional area of pipe flow	in. ²	mm ²
A _r	Area of land	ft. ² acres	m ² , ha
A _e	Area of land	ft. ²	m ²
AW	Available soil water	in.	cm
BP	Barometric pressure	ft	m
C	Hazen-Willimas friction coefficient	none	none
C _u	Christiansen's coefficient of uniformity	%	%
d	Inside diameter of a pipe	in.	mm
d _v	Difference between an observed value and the mean value	in. ³	mL
D _t	Diameter of throw of sprinkler	ft.	m
DU	Distribution uniformity	%	%
E	Elevation of a point	ft.	m
EA	Application Efficiency	%	%
ET _c	Crop Evapotranspiration	in./day	mm/day
ET _o	Reference Evapotranspiration	in./day	mm/day
H	Energy head, usually sum of elevation and pressure	ft.	m
I	Electrical current	amps	A
ID	Inside diameter of pipe	in.	mm
h _f	Energy loss due to friction	ft./ft.	m/m
K _c	Crop Coefficient	%	%
kPa	Kilopascals	psi	bars
k _s	Constant used to compute sprinkler spacing	none	none
L	Spacing between lateral lines	ft.	m
MAD	Management allowed depletion	none	none
MC	Maximum coverage for single row sprinklers	ft.	m
n	Number of observations in a uniformity test	none	none
NPSHA	Net positive suction head available	ft.	m
NPSHR	Net positive suction head required	ft.	m
OD	Outside diameter of pipe	in.	mm
P	Pressure of water	lb./in. ² (psi)	kPa, bars
Pal	Allowable loss in pressure	lb./in. ² (psi)	kPa, bars
Pav	Average pressure in a zone	lb./in. ² (psi)	kPa, bars
PET	Potential evapotranspiration	in./day	mm/day
PSI	Pounds per square inch		
PR	Precipitation rate	in./h	mm/h
PL	Pressure losses due to friction	ft.	m
Po	Sprinkler operating pressure	psi	kPa, bars
Pv	Pressure Variation	%	%
P _s	Static Pressure	psi	kPa, bars
Q	Flow of water in a pipe or from a sprinkler	gal/min	L/s
q _e	Flow of water	gal/min	1/min., m ³ /hr
R	Electrical resistance	ohms	
Rt	Radius of throw of sprinkler	ft.	m
RAW	Readily available water	in.	mm
S	Sprinkler spacing	ft.	m
SC	Scheduling coefficient	ratio	ratio
SD	Scalloped distance	ft.	m
t	Time of application or other timed events	h	h
TDH	Total dynamic head	ft.	m
v	Average velocity of water in a pipe	ft/s (fps)	m/s
V _o	Electrical voltage	volts	V
VP	Vapor pressure of water	ft.	m
X	Mean of all values in C _u eq.		
X _{LQ}	Mean of the lower one-fourth of the application values, D _u eq.		
z	Change in elevation between two points	ft.	m

Hunter Industries Conversion Table

Note: Conversions listed in this manual are not exact. Refer to sources such as *Handbook of Chemistry and Physics* and *C.R.C. Standard Math Tables* by the Chemical Rubber Company, *Scientific Tables* by Ciba-Geigy Ltd., *Websters Desk Encyclopedia* by Griesewood and Dempsey, *Field Geologists Manual* by the Australian Institute of Mining and Metallurgy, *Conversion Factors* by Forney's Inc., *Conversions* by Cahn Instruments and *Technical Reference Handbook* by E.P. Rasis for more detailed conversions and specifications.

Convert From	Into	Multiply By
Area		
acres	hectares or sq. hectometer - - - - -	0.4047
	sq. feet - - - - -	43,560
	sq. meters - - - - -	4,047
	sq. miles - - - - -	0.0015625
	sq. yards - - - - -	4,840
	sq. inches - - - - -	6,272,640
hectares	acres - - - - -	2.471
	sq. cm. - - - - -	100,000,000
	sq. feet - - - - -	107,629
	sq. meters - - - - -	10,000
	sq. miles - - - - -	0.00386
square centimeters	acres - - - - -	2.4702×10^{-8}
	sq. feet - - - - -	0.001076
	sq. inches - - - - -	0.155
	sq. millimeters - - - - -	100
	sq. miles - - - - -	3.861×10^{-11}
	sq. yards - - - - -	0.0001196
square feet	acres - - - - -	2.2957×10^{-5}
	sq. centimeters - - - - -	929.03
	sq. inches - - - - -	144
	sq. meters - - - - -	0.0929
	sq. miles - - - - -	3.58701×10^{-8}
	sq. millimeters - - - - -	9.29×10^4
	sq. yards - - - - -	0.1111
square inches	acres - - - - -	1.594×10^{-7}
	sq. centimeters - - - - -	6.4516
	sq. feet - - - - -	0.00694
	sq. meters - - - - -	0.000645
	sq. miles - - - - -	2.491×10^{-10}
	sq. millimeters - - - - -	645.16
square kilometers	acres - - - - -	247.105
	sq. centimeters - - - - -	1.0×10^{10}
	sq. feet - - - - -	1.07639×10^7
	sq. inches - - - - -	1.550003×10^9
	sq. meters - - - - -	1.0×10^6
	sq. miles - - - - -	0.3861
	sq. yards - - - - -	1.196×10^6
square meters	acres - - - - -	0.000247
	hectares - - - - -	0.0001
	sq. centimeters - - - - -	10,000
	sq. feet - - - - -	10.7639
	sq. inches - - - - -	1,550.003
	sq. kilometers - - - - -	1.0×10^{-6}
	sq. miles - - - - -	3.86×10^{-7}
	sq. millimeters - - - - -	1×10^6
	sq. yards - - - - -	1.195961

Convert From	Into	Multiply By
Area (continued)		
square miles	acres - - - - -	640
	hectares - - - - -	258.999
	sq. feet - - - - -	2.78783×10^7
	sq. kilometers - - - - -	2.58999
	sq. meters - - - - -	258,999
square millimeters	sq. yards - - - - -	3,098,000 (3.098×10^6)
	sq. centimeters - - - - -	0.01
	sq. feet - - - - -	1.076×10^{-5}
	sq. inches - - - - -	0.00155
	sq. meters - - - - -	1.0×10^{-6}
square yards	acres - - - - -	0.000207
	hectares - - - - -	8.3613×10^{-5}
	sq. centimeters - - - - -	8,361.27
	sq. feet - - - - -	9
	sq. inches - - - - -	1296
	sq. meters - - - - -	0.8361
	sq. miles - - - - -	3.228×10^{-7}
Concentration		
kilograms/hectare	pounds/acre - - - - -	0.8924
part per million	grams/liter - - - - -	0.001
	milligrams/liter - - - - -	1
	ounces/ton (short) - - - - -	0.0292
	percent - - - - -	0.0001
	pounds/millions gallons - - - - -	8.345
pounds per cu. foot	grams/cu. centimeter - - - - -	0.016018
	kilograms/cu. meter - - - - -	16.018
	pounds/cu. inch - - - - -	5.787×10^{-4}
	pounds/cu. yard - - - - -	27
Flow		
cu. feet per minute	acre/feet/hr - - - - -	0.00138
	acre-feet/min - - - - -	2.2956×10^{-5}
	cu. meters/sec - - - - -	0.00047195
	gallons (US)/min - - - - -	7.48052
	liters/sec - - - - -	0.47193
cu. feet per second	acre-inches/hr - - - - -	0.99173
	cu. meters/sec - - - - -	0.02832
	gallons (US)/min - - - - -	448.83
	liters/min - - - - -	1,698.96
	liters/sec - - - - -	28.316
	millions gallons (US)/day - - - - -	0.64632
gallons (US) per day	cu. feet/hour - - - - -	0.00557
gallons (British) per hour	cu. meters/minute - - - - -	7.5768×10^{-5}
gallons (US) per hour	acre-feet/hour - - - - -	3.0689×10^{-6}
	cu. feet/hour - - - - -	0.13368
	cu. meters/minute - - - - -	6.309×10^{-5}
	gallons/minute - - - - -	0.0166667
	liters/hour - - - - -	3.7853
gallons (US) per minute	acre-feet/day - - - - -	0.0044192
	cu. feet/hour - - - - -	8.0208
	cu. feet/second - - - - -	0.002228
	cu. meters/hour - - - - -	0.2268
	cu. meters/second - - - - -	0.000063
	gallons (US)/hour - - - - -	60
	liters/minute - - - - -	3.7853
	liters/second - - - - -	0.06308

Convert From	Into	Multiply By
Flow (continued)		
liters per minute	cu. feet/minute	0.0353
	cu. feet/second	0.000588
	gallons/minute	0.26418
	gallons/second	0.004403
liters per second	cu. feet/minute	2.1189
	cu. feet/second	0.0353
	cu. yards/minute	0.07848
liters per second-square meter	gallons/minute-sq. foot	1.4726
millions of gallons per day	acre feet/day	3.0689
	acre inches/day	36.8266
	acre inches/hour	1.53444
	cu. feet/hour	5,570.023
	cu. feet/minute	92.834
	cu. feet/second	1.547
	gallons/hour	41,666.667
	gallons/minute	694.4444
pounds of water per minute	cu. feet/second	.000267
Length		
centimeters	feet	0.03281
	inches	0.3937
	meters	0.01
	microns	10,000
	miles (statute)	6.2137×10^{-6}
	millimeters	10
	mils	393.7
	picas (printers)	2.371
	points (printers)	28.4528
	yards	0.01094
feet	centimeters	30.48
	inches	12
	kilometers	3.048×10^{-4}
	meters	0.3048
	microns	304,800
	miles (statute)	0.000189
	millimeters	304.8
	yards	0.333333
inches	centimeters	2.54
	feet	0.08333
	meters	0.0254
	microns	25,400
	miles	1.578×10^{-5}
	millimeters	25.4
	mils	1,000
	yards	0.0278
kilometers	centimeters	100,000
	feet	3,280.84
	inches	39,370
	miles	0.62137
	millimeters	10^6
	yards	1,093.61
meters	centimeters	100
	fathoms	0.54681
	feet	3.28084
	furlongs	0.00497
	inches	39.3701
	kilometers	0.001
	miles	0.000621

Convert From	Into	Multiply By
Length (continued)		
microns	millimeters - - - - -	1,000
	mils - - - - -	39,370.08
	yards - - - - -	1.0936
	centimeters - - - - -	0.0001
	feet - - - - -	3.2808×10^{-6}
	inches - - - - -	3.937×10^{-5}
miles (statute)	meters - - - - -	1×10^{-6}
	millimeters - - - - -	0.001
	centimeters - - - - -	160,934
	feet - - - - -	5,280
	furlongs - - - - -	8
	inches - - - - -	63,360
millimeters	kilometers - - - - -	1.609344
	light years - - - - -	1.701×10^{-12}
	meters - - - - -	1,609.344
	yards - - - - -	1,760
	centimeters - - - - -	0.1
	feet - - - - -	0.00328
mils	inches - - - - -	0.03937
	meters - - - - -	0.001
	mils - - - - -	39.37
	yards - - - - -	1.094×10^{-3}
	centimeters - - - - -	2.54×10^{-3}
	feet - - - - -	8.333×10^{-5}
yards	inches - - - - -	0.001
	kilometer - - - - -	2.54×10^{-8}
	yards - - - - -	2.778×10^{-5}
	centimeters - - - - -	91.44
	cubits - - - - -	2
	fathoms - - - - -	0.5
feet	feet - - - - -	3
	furlongs - - - - -	0.004545
	inches - - - - -	36
	kilometers - - - - -	9.144×10^{-4}
	meters - - - - -	0.9144
	miles - - - - -	5.682×10^{-4}
meters	millimeters - - - - -	914.4
	centimeters - - - - -	100
	feet - - - - -	3.2808
	yards - - - - -	1.0936
	miles - - - - -	1.609344×10^{-3}
	kilometers - - - - -	1,000
Light Intensity		
foot-candles	foot-lamberts - - - - -	1
	lumens/sq. foot - - - - -	1
	lumens/sq. meter - - - - -	10.7639
	lux - - - - -	10.7639
lumens	candle power - - - - -	0.07958
	watt - - - - -	0.0015
lumens per square foot	foot-candles - - - - -	1
	foot-lamberts - - - - -	1
	lumens/sq. meter - - - - -	10.7639
lumens per square meter	foot-candles - - - - -	0.0929
	lumens/sq. foot - - - - -	0.0929
lux	foot-candles - - - - -	0.0929
	lumens/sq. meter - - - - -	1

Convert From	Into	Multiply By
Power		
BTU	foot-pounds - - - - -	777.649
	horsepower-hours - - - - -	0.00039
	kilowatt-hrs - - - - -	0.00029287
	kilowatt-hrs. (international) - - - - -	0.00029283
	joules - - - - -	1,054.35
	joules (international) - - - - -	1,054.18
	therms - - - - -	0.00001
BTU per hour	horsepower/hours - - - - -	0.00039
	kilowatts - - - - -	0.00029
	watts - - - - -	0.29287
BTU per minute	foot-pounds/second - - - - -	12.96
	horsepower - - - - -	0.02356
	kilowatts - - - - -	0.01757
	watts - - - - -	17.5725
foot-pounds	horsepower-hours - - - - -	5.05×10^{-7}
	kilowatt-hours - - - - -	3.766×10^{-7}
horsepower (mechanical)	Btu/minute - - - - -	42.436
	ft.-pounds/min - - - - -	33,000
	ft.-pounds/second - - - - -	550
	horsepower (electric) - - - - -	0.9996
	horsepower (metric) - - - - -	1.0139
	horsepower (water) - - - - -	0.99954
	kg-calories/minute - - - - -	10.68
	kilowatts - - - - -	0.7457
	watts - - - - -	745.7
	Btu/hour - - - - -	3414.4
kilowatts	foot-pounds/hour - - - - -	2,655,000
	horsepower - - - - -	1.341
	horsepower (boiler) - - - - -	0.1019
	horsepower (electric) - - - - -	1.34
	horsepower (metric) - - - - -	1.3596
	kilowatts (international) - - - - -	0.99983
	Btu - - - - -	3414.4
kilowatt-hours	horsepower-hours - - - - -	1.341
	foot-pounds - - - - -	2,655,000
	kilogram-meters - - - - -	367,098
watts	Btu/hour - - - - -	3.4144
	horsepower - - - - -	0.00134
	horsepower (electric) - - - - -	0.00134
	horsepower (metric) - - - - -	0.0013596
	kilowatts - - - - -	0.001
	watts (international) - - - - -	0.9998

Pressure

atmosphere	bars - - - - -	1.01325
	cm. of mercury @ 0° C - - - - -	76
	cm. of water @ 4° C - - - - -	1,033.26
	dynes/sq. cm - - - - -	1,013,250
	ft. of water @ 39.2° F - - - - -	33.8995
	in. of mercury @ 32° F - - - - -	29.9213
	kg./sq. cm - - - - -	1.0332
	kg./sq. meter - - - - -	10,332
	meters of water @ 4° C - - - - -	10.3326
	mm of mercury @ 0° C - - - - -	760
	pounds/sq. in - - - - -	14.696

Convert From	Into	Multiply By
Pressure (continued)		
bars	atmospheres - - - - -	0.98692
	cm. of mercury @ 0° C - - - - -	75.0062
	dynes/sq. cm - - - - -	1,000,000
	ft. water @ 60° F - - - - -	33.4883
	in. of mercury @ 32° F - - - - -	29.53
	pounds/sq. foot - - - - -	2,089
dynes per square centimeter	pounds/sq. in - - - - -	14.5038
	atmospheres - - - - -	9.869 x 10 ⁻⁷
	bars - - - - -	1 x 10 ⁻⁶
	centimeters of mercury @ 0° C - - - - -	7.500617 x 10 ⁻⁵
	centimeters of water @ 4° C - - - - -	0.00101975
	inches of mercury @ 32° F - - - - -	2.953 x 10 ⁻⁵
feet of water @ 4° C	inches of water @ 4° C - - - - -	0.000401
	pounds /sq. inch - - - - -	1.45 x 10 ⁻⁵
	atmospheres - - - - -	0.0295
	cm. of mercury @0° C - - - - -	2.2419
	dynes/sq. centimeter - - - - -	29,889.80
	grams/sq. centimeter - - - - -	30.479
inches of mercury @ 32° F	inches of mercury @ 32° F - - - - -	0.8826
	kilograms/sq. meter - - - - -	304.79
	pounds/sq. inch - - - - -	0.433501
	atmospheres - - - - -	0.03342
	bars - - - - -	0.03386
	dynes/sq. centimeter - - - - -	33,864
inches of water @ 4° C	ft. of air @ 1 atm, 60° F - - - - -	926.2
	ft. of water @ 39.2° F - - - - -	1.1329
	grams/sq. centimeter - - - - -	34.532
	kilograms/sq. meter - - - - -	345.32
	millimeters of mercury @ 60° F - - - - -	25.4
	ounces/sq. inch - - - - -	7.858
inches of water @ 4° C	pounds/sq. inch - - - - -	70.7264
	atmospheres - - - - -	0.002458
	dynes/sq. centimeter - - - - -	2,490.80
	inches of mercury @ 32° F - - - - -	0.07355
	kilograms/sq. centimeter - - - - -	0.00254
	kilograms/sq. meter - - - - -	25.399
kilograms per cu. meter	ounces/sq. foot - - - - -	83.235
	ounces/sq. inch - - - - -	0.57802
	pounds/sq. foot - - - - -	5.20218
	pounds/sq. inch - - - - -	0.03613
	grams/cu centimeter - - - - -	0.001
	pounds/cu. foot - - - - -	0.0624
kilograms per sq. centimeter	atmospheres - - - - -	0.967
	bars - - - - -	0.98066
	centimeters of mercury @ 0° C - - - - -	73.556
	dynes/sq. centimeter - - - - -	98,066
	feet of water @ 39.2° F - - - - -	32.809
	inches of mercury @ 32° F - - - - -	28.959
kilograms per sq. meter	pounds/sq. foot - - - - -	2,048
	pounds/sq. inch - - - - -	14.22
	atmospheres - - - - -	9.678 x 10 ⁻⁵
	bars - - - - -	9.8066 x 10 ⁻⁵
	dynes/sq. centimeter - - - - -	98.066
	feet of water @ 39.2° F - - - - -	0.00328
	inches of mercury @ 32° F - - - - -	0.0029
	kilopascals - - - - -	9.80665 x 10 ⁻³
	millimeters of mercury @ 0° C - - - - -	0.07356
	pascals - - - - -	9.8066
	pounds/sq. foot - - - - -	0.20482
	pounds/sq. inch - - - - -	0.00142
	pounds/sq. yard - - - - -	1.8433

Convert From	Into	Multiply By
Pressure (continued)		
kiloPascals (kPa)	bars - - - - -	0.01
	feet of water - - - - -	0.33458
	kilograms/sq. centimeter - - - - -	0.0102
	kilograms/sq. meter - - - - -	101.97
	meters of head - - - - -	0.1021
	pounds/sq. inch - - - - -	0.14503
	centimeters of mercury @ 0° C - - - - -	0.75
	centimeters of water @ 4° C - - - - -	10.197
	dynes/sq. centimeter - - - - -	10,000
	grams/sq. centimeter - - - - -	10.197
	inches of mercury @ 32° F - - - - -	0.2953
	inches of water @ 39.2° F - - - - -	4.014788
	pounds/sq. foot - - - - -	20.88
	millimeter of mercury @ 0° C - - - - -	7.5
millibars	atmospheres - - - - -	0.000987
	bars - - - - -	0.001
	dynes/sq. centimeter - - - - -	1,000
	inches of mercury @ 32° F - - - - -	0.0295
	pounds/sq. foot - - - - -	2.0885
Newtons	dynes - - - - -	100,000
	pounds - - - - -	0.2248089
Pascal	Newton/sq. meter - - - - -	1
	pounds/sq. inch - - - - -	0.000145
pounds per square inch	atmospheres - - - - -	0.06805
	bars - - - - -	0.06895
	centimeters of mercury @ 0° C - - - - -	5.17149
	centimeters of water @ 4° C - - - - -	70.3089
	dynes/sq. centimeter - - - - -	68,947
	feet of water - - - - -	2.307
	grams/sq. centimeter - - - - -	70.307
	inches of mercury @ 32° F - - - - -	2.036
	inches of water @ 39.2° F - - - - -	27.681
	kilograms/sq. centimeter - - - - -	0.07031
	kilopascals (kPa) - - - - -	6.895
	pounds/sq. foot - - - - -	144
	millimeters of mercury @ 0° C - - - - -	51.715
Pressure Loss		
bars per 100 meters	kilopascals/100 meters - - - - -	100.004
	meters/100 meters - - - - -	10.211
	psi/100 feet - - - - -	4.421
kilopascals (kPa) per 100 meters	bars/100 meters - - - - -	0.010
	meters/100 meters - - - - -	0.1021
	psi/100 feet - - - - -	0.0442
meters per 100 meters	bars/100 meters - - - - -	0.0979
	kilopascals/100 meters - - - - -	9.79
	psi/100 feet - - - - -	0.433
pounds per sq. inch (psi) per 100 feet.	bars/100 meters - - - - -	0.226
	kilopascals/100 meters - - - - -	22.621
	meters/100 meters - - - - -	2.31
Temperature		
Centigrade	Fahrenheit - - - - -	(°C x 1.8) + 32
Fahrenheit	Centigrade - - - - -	(°F - 32) / 1.8

Convert From	Into	Multiply By
Velocity		
cu. meters/minute	gallons (British)/min - - - - -	219.969
	gallons (US)/min - - - - -	264.172
	liters/min - - - - -	1000
feet per minute	centimeters/second - - - - -	0.508
	kilometers/hour - - - - -	0.018288
	kilometers/minute - - - - -	0.000348
	meters/minute - - - - -	0.3048
	meters/second - - - - -	0.00508
	miles/hour - - - - -	0.011364
feet per second	centimeters/second - - - - -	30.48
	kilometers/hour - - - - -	1.09728
	kilometers/minute - - - - -	0.01829
	meters/minute - - - - -	18.288
	meters/second - - - - -	0.3048
	miles/hour - - - - -	0.681818
feet per (second x second)	centimeters/(second x second) - - - - -	30.48
	kilometers/(hr x second) - - - - -	1.0973
	meters/(second x second) - - - - -	0.3048
gravity constant	cm/(sec. x sec.) - - - - -	980.6
	ft./(sec. x sec.) - - - - -	32.17
inches per hour	centimeters/hour - - - - -	2.54
	feet/hour - - - - -	0.0833
	miles/hour - - - - -	1.5783 x 10 ⁻⁵
inches per minute	centimeters/hour - - - - -	152.4
	feet/hour - - - - -	5
	feet/second - - - - -	0.0013889
	miles/hour - - - - -	0.000947
kilometers per hour	centimeters/second - - - - -	27.778
	feet/hour - - - - -	3,280.84
	feet/minute - - - - -	54.6807
	meters/second - - - - -	0.2778
	miles/hour - - - - -	0.62137
meters per hour	feet/hour - - - - -	3.2808
	feet/minute - - - - -	0.05468
	knots - - - - -	0.00054
	miles/hour - - - - -	0.000621
meters per minute	centimeters/second - - - - -	1.66667
	feet/minute - - - - -	3.2808
	feet/second - - - - -	0.05468
	kilometers/hour - - - - -	0.06
	miles/hour - - - - -	0.03728
meters per second	feet/minute - - - - -	196.85
	feet/second - - - - -	3.2818
	kilometers/hour - - - - -	3.6
	miles/hour - - - - -	2.2369
	miles/minute - - - - -	0.03728
miles her hour	centimeters/second - - - - -	44.704
	feet/hour - - - - -	5,280
	feet/minute - - - - -	88
	feet/second - - - - -	1.4667
	kilometers/hour - - - - -	1.6094
	kilometers/minute - - - - -	0.0268
	knots (international) - - - - -	0.86897
	meters/minute - - - - -	26.822
	miles/minute - - - - -	0.01667

Convert From	Into	Multiply By
Volume		
acre-feet	cu. feet - - - - -	43,560
	cu. meters - - - - -	1,233.482
	cu. yards - - - - -	1,613.33
	gallons (US) - - - - -	325,900
	liters - - - - -	1,233,455.5
acre inches	cu. feet - - - - -	3,630
	cu. meters - - - - -	102.79033
	gallons (US) - - - - -	27,154.29
bushels (British)	bushels (US) - - - - -	1.03206
	cu. feet - - - - -	1.28435
	gallons (British) - - - - -	8
	liters - - - - -	36.3677
bushels (US)	bushels (British) - - - - -	0.96894
	cu. feet - - - - -	1.24446
	gallons (US dry) - - - - -	8
	gallons (US liquid) - - - - -	9.30918
cu. centimeters	cu. feet - - - - -	3.5315×10^{-5}
	cu. inches - - - - -	0.06102
	cu. meters - - - - -	1×10^{-6}
	gallons (British) - - - - -	0.00022
	gallons (US dry) - - - - -	0.00023
	gallons (US liquid) - - - - -	0.00026
	liters - - - - -	0.001
	ounces (British liquid) - - - - -	0.03519
	ounces (US liquid) - - - - -	0.03381
	acre-feet - - - - -	2.296×10^{-5}
cu. feet	cu. centimeters - - - - -	28,316.8
	cu. inches - - - - -	1,728
	cu. meters - - - - -	0.02832
	gallons (US dry) - - - - -	6.42851
	gallons (US liquid) - - - - -	7.48052
	liters - - - - -	28.316
	ounces (British fluid) - - - - -	996.614
	ounces (US fluid) - - - - -	957.506
	pints (US dry) - - - - -	51.4281
	pints (US liquid) - - - - -	59.8442
	quarts (US dry) - - - - -	25.714
	quarts (US liquid) - - - - -	29.922
cu. feet of water @ 60° F	pounds of water - - - - -	63.367
cu. inches	cu. centimeters - - - - -	16.3871
	cu. meters - - - - -	1.639×10^{-5}
	cu. yards - - - - -	2.143×10^{-5}
	gallons (US dry) - - - - -	0.00372
	gallons (US liquid) - - - - -	0.00433
	liters - - - - -	0.01639
	milliliters - - - - -	16.3866
	ounces (British liquid) - - - - -	0.57674
	ounces (US liquid) - - - - -	0.55411
	quarts (US dry) - - - - -	0.01488
	quarts (US liquid) - - - - -	0.01732
	acre-feet - - - - -	0.00081
cu. meters	cu. centimeters - - - - -	1,000,000
	cu. feet - - - - -	35.3147
	cu. inches - - - - -	61,023.70
	cu. yards - - - - -	1.30795
	gallons (British) - - - - -	219.969
	gallons (US liquid) - - - - -	264.172
	liters - - - - -	1,000
	quarts (US liquid) - - - - -	1,056.69
	cu. feet - - - - -	27
	cu. yards - - - - -	

Convert From	Into	Multiply By
Volume (continued)		
	cu. meters - - - - -	0.76455
	gallons (British) - - - - -	168.179
	gallons (US dry) - - - - -	173.569
	gallons (US liquid) - - - - -	201.974
	liters - - - - -	764.533
cup	gallons - - - - -	0.0625
	pints - - - - -	0.5
	milliliters - - - - -	284.13
	quarts - - - - -	0.25
	tablespoons - - - - -	16
	teaspoons - - - - -	48
gallons (British)	barrels (British) - - - - -	0.0277
	bushels - - - - -	0.125
	cu. centimeters - - - - -	4,546.09
	cu. feet - - - - -	0.1605
	cu. inches - - - - -	277.419
	gallons (US liquid) - - - - -	1.2009
	liters - - - - -	4.546
	ounces (British liquid) - - - - -	160
	ounces (US liquid) - - - - -	153.721
	pounds of water @ 62° F - - - - -	10
gallons (US dry)	barrels (US dry) - - - - -	0.038096
	barrels (US liquid) - - - - -	0.03694
	cu. centimeters - - - - -	4,404.88
	cu. feet - - - - -	0.15556
	gallons (US liquid) - - - - -	1.163647
	liters - - - - -	4.4048
gallons (US liquid)	acre-feet - - - - -	3.0688 x 10 ⁻⁶
	barrels (US liquid) - - - - -	0.031746
	barrels (US petroleum) - - - - -	0.023809
	cu. centimeters - - - - -	3,785.41
	cu. feet - - - - -	0.13368
	cu. inches - - - - -	231
	cu. meters - - - - -	0.00378
	cu. yards - - - - -	0.00495
	gallons (British) - - - - -	0.83267
	gallons (US dry) - - - - -	0.85937
	gallons (US wine) - - - - -	1
	liters - - - - -	3.7853
	ounces (US liquid) - - - - -	128
	pints (US liquid) - - - - -	8
	quarts (US liquid) - - - - -	4
gallons (US) of water @ 4° C	pounds of water - - - - -	8.34517
gallons (US) of water @ 60° F	pounds of water - - - - -	8.32823
liters	bushels (British) - - - - -	0.0275
	bushels (US) - - - - -	0.02838
	cu. centimeters - - - - -	1,000
	cu. feet - - - - -	0.03532
	cu. inches - - - - -	61.002
	cu. meters - - - - -	0.001
	cu. yards - - - - -	0.001308
	gallons (British) - - - - -	0.21998
	gallons (US dry) - - - - -	0.22703
	gallons (US liquid) - - - - -	0.26418
	ounces (British fluid) - - - - -	35.196
	ounces (US fluid) - - - - -	33.81497
	pints (British) - - - - -	1.7598
	pints (US dry) - - - - -	1.8162
	pints (US liquid) - - - - -	2.1134
	quarts (British) - - - - -	0.8799

Convert From	Into	Multiply By
Volume (continued)		
liters	quarts (US dry) - - - - -	0.9081
	quarts (US liquid) - - - - -	1.0567
ounces (US liquid)	cu. centimeters - - - - -	29.5737
	cu. inches - - - - -	1.80469
	cups - - - - -	0.1698
	cu. meters - - - - -	2.9574 x 10 ⁻⁵
	drops - - - - -	360.14
	gallons (US liquid) - - - - -	0.00781
	liters - - - - -	0.02957
	milliliters - - - - -	29.57
	quarts (US liquid) - - - - -	0.0312
	teaspoons - - - - -	6
	tablespoons - - - - -	2
pint (US liquid)	cu. centimeters - - - - -	473.176
	cu. feet - - - - -	0.01671
	cu. inches - - - - -	28.875
	cups - - - - -	2
	fifths - - - - -	0.625
	gallons (US liquid) - - - - -	0.125
	liters - - - - -	0.473176
	millimeters - - - - -	473.163
	ounces (US liquid) - - - - -	16
	quarts (US liquid) - - - - -	0.5
	teaspoons - - - - -	96
	tablespoons - - - - -	32
quarts (US liquid)	cu. centimeters - - - - -	946.353
	cu. feet - - - - -	0.0334
	cu. inches - - - - -	57.75
	cu. meters - - - - -	0.464 x 10 ⁻⁴
	cu. yards - - - - -	0.001238
	fifth - - - - -	1.25
	gallons (US liquid) - - - - -	.25
	liters - - - - -	0.9463
	magnums - - - - -	0.5
	ounces (US liquid) - - - - -	32
	pints (US liquid) - - - - -	2
	quarts (British) - - - - -	0.859367
	shots - - - - -	32
tablespoons	cups - - - - -	0.0625
	drops - - - - -	180
	ounces (US liquid) - - - - -	0.5
	quarts - - - - -	0.01562
	teaspoons - - - - -	3
teaspoons	cups - - - - -	0.02083
	drops - - - - -	60
	ounces (US liquid) - - - - -	0.1666

Convert From	Into	Multiply By
Volume (continued)		
teaspoons	pinch - - - - -	3 to 4
	pints - - - - -	0.01042
	quarts - - - - -	0.00521
	tablespoons - - - - -	0.3333
Weight		
dynes	kilograms - - - - -	1.02×10^{-6}
	pounds - - - - -	2.248×10^{-6}
grams	dynes - - - - -	980.66
	ounces - - - - -	0.03527
	pounds - - - - -	0.0022046
kilograms	drams - - - - -	564.38
	dynes - - - - -	980,665
	grams - - - - -	1,000
	ounces - - - - -	35.27396
	pounds - - - - -	2.20462
	tons (short) - - - - -	0.001102
milligrams	grams - - - - -	0.001
	ounces - - - - -	3.527×10^{-5}
	pounds - - - - -	2.205×10^{-6}
ounces	grams - - - - -	28.349
	kilograms - - - - -	0.02835
	pounds - - - - -	0.0625
	tons (metric) - - - - -	2.835×10^{-5}
	tons (short) - - - - -	3.125×10^{-5}
pounds	drams - - - - -	256
	dynes - - - - -	444,800
	grains - - - - -	7,000
	grams - - - - -	453.59
	kilograms - - - - -	0.4536
	ounces - - - - -	16
	tons (long) - - - - -	0.0004464
	tons (metric) - - - - -	0.0004536
	tons (short) - - - - -	0.0005
pounds of water	cu. feet - - - - -	0.01602
	cu. inches - - - - -	27.68
	gallons - - - - -	0.1198
	liters - - - - -	0.4545
tons (metric)	dynes - - - - -	9.807×10^8
	kilograms - - - - -	1,000
	ounces - - - - -	35,273.95
	pounds - - - - -	2,204.62
	tons (short) - - - - -	1.1023
tons (short)	dynes - - - - -	8.8964×10^8
	kilograms - - - - -	907.18
	ounces - - - - -	32,000
	pounds - - - - -	2,000
	tons (long) - - - - -	0.89286
	tons (metric) - - - - -	0.90718

Decimal and Metric Equivalents of Common Fractions

Fractions of an Inch	Decimals of an Inch	Millimeters	Fractions of an Inch	Decimals of an Inch	Millimeters
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	17/32	0.523125	13.494
3/64	0.046875	1.191	35/64	0.546875	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.078125	1.984	37/64	0.578125	14.684
3/32	0.09375	2.381	19/32	0.59375	15.081
7/64	0.109375	2.778	39/64	0.609375	15.478
1/8	0.125	3.175	5/8	0.625	15.875
9/64	0.140625	3.572	41/64	0.640625	16.272
5/32	0.15625	3.969	21/32	0.65625	16.669
11/64	0.171875	4.366	43/64	0.671875	17.066
3/16	0.1875	4.763	11/16	0.6875	17.463
13/64	0.203125	5.159	45/64	0.703125	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.234375	5.953	47/64	0.734375	18.653
1/4	0.250	6.350	3/4	0.750	19.050
17/64	0.265625	6.747	49/64	0.765625	19.447
9/32	0.28125	7.144	15/32	0.78125	19.844
19/64	0.296875	7.541	51/64	0.796875	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.34375	8.731	17/32	0.84375	21.431
23/64	0.359375	9.128	55/64	0.859375	21.828
3/8	0.375	9.525	7/8	0.875	22.225
25/64	0.390625	9.922	57/64	0.890625	22.622
13/32	0.40625	10.319	29/32	.090625	23.019
27/64	0.421875	10.716	59/64	0.921875	23.416
7/16	0.4375	11.113	15/16	0.9375	23.813
29/64	0.453125	11.509	61/64	0.953125	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.500	12.700	1	1.000	25.400

TABLES

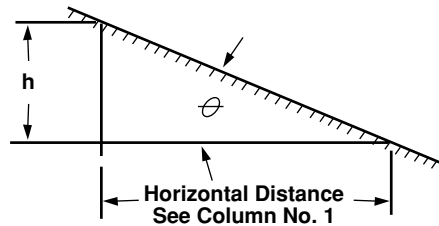
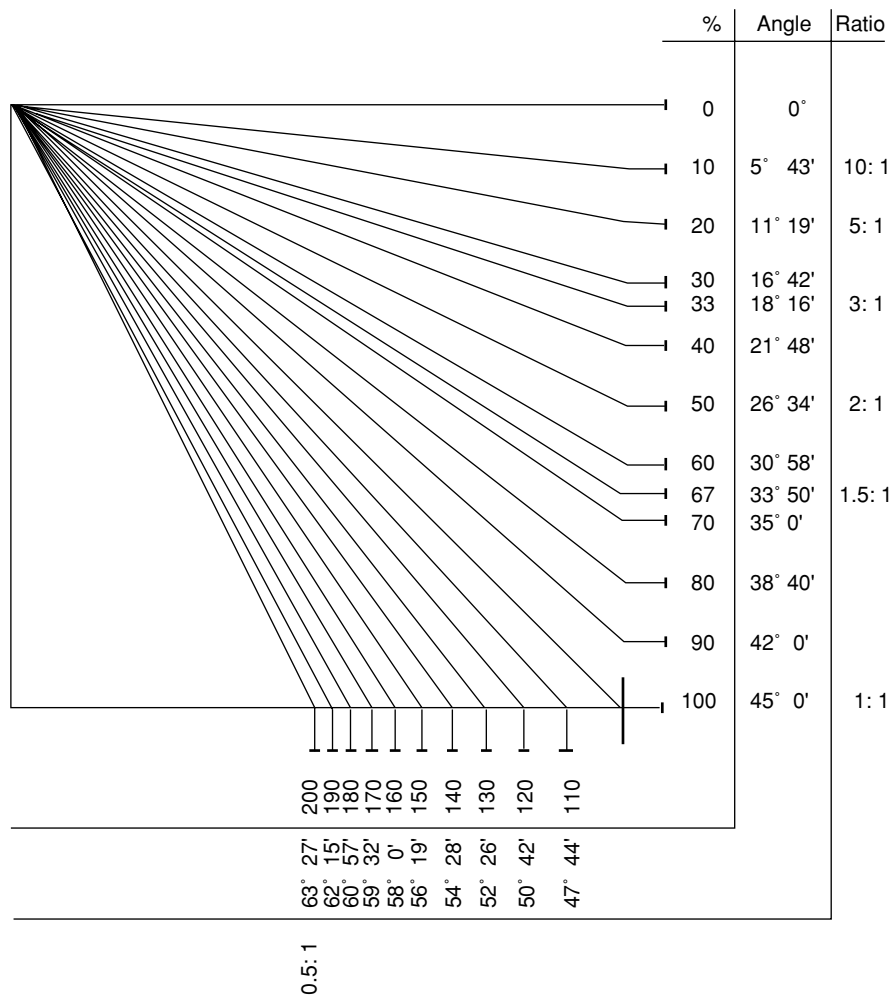
Slope Comparison

Amount of Rise in 100' of Run	Percent Slope	Slope Ratio	Slope Angle Degrees	Plan to Slope Factor *
5	5	20:1	2° 52'	1.001
10	10	10:1	5° 43'	1.005
14	14		7° 58'	1.010
15	15		8° 32'	1.011
17	17		9° 39'	1.014
20	20	5:1	11° 19'	1.020
25	25	4:1	14° 2'	1.031
30	30		16° 42'	1.044
33	33	3:1	18° 16'	1.053
35	35		19° 17'	1.059
40	40	2.5:1	21° 48'	1.077
45	45		24° 14'	1.097
50	50	2:1	26° 34'	1.118
55	55		28° 49'	1.141
60	60		30° 58'	1.166
65	65	1.5:1	33° 1'	1.193
70	70		35° 0'	1.221
75	75		36° 52'	1.250
80	80		38° 40'	1.281
85	85		40° 22'	1.312
90	90		41° 59'	1.345
95	95		43° 32'	1.379
100	100	1:1	45° 0'	1.414
105	105		46° 24'	1.450
110	110		47° 44'	1.487
115	115		48° 59'	1.524
120	120		50° 12'	1.562
125	125	0.8:1	51° 20'	1.601
130	130		52° 26'	1.640
135	135		53° 28'	1.680
140	140		54° 28'	1.720
145	145		55° 24'	1.761
150	150	0.67:1	56° 19'	1.803

* Plan to Slope Factor: to convert from a plan dimension (horizontal measure) to actual slope distance, multiply by this factor. For example: plan indicates a 2:1 (50%) slope measuring 100 feet from the top to the toe of the slope on the plan. The actual distance from the top to the toe of the slope is 100 feet x 1.118 = 111.8 feet.

Plan to Slope Factor: to convert from an actual soil measurement, divide by this factor. For example: soil measurement is 12 feet, and the slope ratio is 1.5:1, the actual distance on the plan will be $12 \div 1.193 = 10$ feet.

Slope Reference Chart Percent, Angle and Ratio



h = vertical rise in feet

Percent of grade or slope: Equals vertical rise in feet per 100' of horizontal distance

= Angle of slope: Angle of inclination with respect to horizontal plane (ie) $\tan = h/\text{horizontal distance}$

Ratio of slope = $\frac{\text{horizontal distance}}{h}$

Maximum Precipitation Rates for Slopes

The maximum precipitation values listed below are those suggested by the United States Department of Agriculture. The values are average and may vary with respect to actual soil condition and condition of ground cover.

Maximum Precipitation Rates: Inches per Hour								
SOIL TEXTURE	0 to 5% slope		5 to 8% slope		8 to 12% slope		12% + slope	
	Cover	Bare	Cover	Bare	Cover	Bare	Cover	Bare
Coarse sandy soils	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50
Coarse sandy soils over compact subsoils	1.75	1.50	1.25	1.00	1.00	0.75	0.75	0.40
Light sandy loams uniform	1.75	1.00	1.25	0.80	1.00	0.60	0.75	0.40
Light sandy loams over compact subsoils	1.25	0.75	1.00	0.50	0.75	0.40	0.50	0.30
Uniform silt loams	1.00	0.50	0.80	0.40	0.60	0.30	0.40	0.20
Silt loams over compact subsoil	0.60	0.30	0.50	0.25	0.40	0.15	0.30	0.10
Heavy clay or clay loam	0.20	0.15	0.15	0.10	0.12	0.08	0.10	0.06

Using the “Water Supply Requirements” Table

The “Water Supply Requirements” table (page 61) provides a quick estimate of the gallons per minute (GPM) required to irrigate one acre at 70% efficiency for a variety of potential evapotranspiration (PET) rates for varying hours of operation. This can be used to estimate the water needs of large areas for water service meter size or pump station requirement.

How to Use the Table

- 1) Determine the approximate PET for the project. This should be the peak ET_o and should include a crop coefficient. For example if the peak ET_o were 0.34 in./day and the irrigated area was a warm season turf grass with a crop coefficient of 60% (0.60) the PET would be 0.20 in./day ($0.34 \times 0.60 = 0.20$).

Find the PET Average in in./day in the second column from the left.

Example: 0.20 inches/day

- 2) Read across to the column under the “Average Hours of Operation/Day”

Example: 12

- 3) Under the column for 12 Average Hours of Operation/Day, the “Minimum GPM per Acre” represents the minimum number of gallons per minute required to deliver 0.20 inches of water per day for one acre using an irrigation system with 70% efficiency.

Example: 10.8 gpm minimum per acre required at peak demand.

- 4) Multiply the minimum gpm per acre times the number of acres in the project, If the project being designed had a total of 20 acres.

Example: $20 \times 10.8 = 216$ gpm

Water Supply Requirements

			Available Hours of Operation per Day						
			24	20	16	12	10	8	6
PET Average in./mo.in./day		Gal. per acre/day	Minimum GPM per acre	Minimum GPM per acre	Minimum GPM per acre	Minimum GPM per acre	Minimum GPM per acre	Minimum GPM per acre	Minimum GPM per acre
0.30	0.01	388	0.3	0.3	0.4	0.5	0.6	0.8	1.1
0.60	0.02	776	0.5	0.6	0.8	1.1	1.3	1.6	2.2
0.90	0.03	1164	0.8	1.0	1.2	1.6	1.9	2.4	3.2
1.20	0.04	1552	1.1	1.3	1.6	2.2	2.6	3.2	4.3
1.50	0.05	1940	1.3	1.6	2.0	2.7	3.2	4.0	5.4
1.80	0.06	2328	1.6	1.9	2.4	3.2	3.9	4.8	6.5
2.10	0.07	2715	1.9	2.3	2.8	3.8	4.5	5.7	7.5
2.40	0.08	3103	2.2	2.6	3.2	4.3	5.2	6.5	8.6
2.70	0.09	3491	2.4	2.9	3.6	4.8	5.8	7.3	9.7
3.00	0.10	3879	2.7	3.2	4.0	5.4	6.5	8.1	10.8
3.30	0.11	4267	3.0	3.6	4.4	5.9	7.1	8.9	11.9
3.60	0.12	4655	3.2	3.9	4.8	6.5	7.8	9.7	12.9
3.90	0.13	5043	3.5	4.2	5.3	7.0	8.4	10.5	14.0
4.20	0.14	5431	3.8	4.5	5.7	7.5	9.1	11.3	15.1
4.50	0.15	5819	4.0	4.8	6.1	8.1	9.7	12.1	16.2
4.80	0.16	6207	4.3	5.2	6.5	8.6	10.3	12.9	17.2
5.10	0.17	6595	4.6	5.5	6.9	9.2	11.0	13.7	18.3
5.40	0.18	6983	4.8	5.8	7.3	9.7	11.6	14.5	19.4
5.70	0.19	7370	5.1	6.1	7.7	10.2	12.3	15.4	20.5
6.00	0.20	7758	5.4	6.5	8.1	10.8	12.9	16.2	21.6
6.30	0.21	8146	5.7	6.8	8.5	11.3	13.6	17.0	22.6
6.60	0.22	8534	5.9	7.1	8.9	11.9	14.2	17.8	23.7
6.90	0.23	8922	6.2	7.4	9.3	12.4	14.9	18.6	24.8
7.20	0.24	9310	6.5	7.8	9.7	12.9	15.5	19.4	25.9
7.50	0.25	9698	6.7	8.1	10.1	13.5	16.2	20.2	26.9
7.80	0.26	10086	7.0	8.4	10.5	14.0	16.8	21.0	28.0
8.40	0.28	10862	7.5	9.1	11.3	15.1	18.1	22.6	30.2
9.00	0.30	11638	8.1	9.7	12.1	16.2	19.4	24.2	32.3
9.60	0.32	12413	8.6	10.3	12.9	17.2	20.7	25.9	34.5
10.20	0.34	13189	9.2	11.0	13.7	18.3	22.0	27.5	36.6
10.80	0.36	13965	9.7	11.6	14.5	19.4	23.3	29.1	38.8
11.40	0.38	14741	10.2	12.3	15.4	20.5	24.6	30.7	40.9
12.00	0.40	15517	10.8	12.9	16.2	21.6	25.9	32.3	43.1
12.60	0.42	16293	11.3	13.6	17.0	22.6	27.2	33.9	45.3
13.20	0.44	17068	11.9	14.2	17.8	23.7	28.4	35.6	47.4

***Note:** Required GPM assumes a 70% system efficiency.

Friction Factor Short Cuts

The Friction Factor Method of sizing lateral line pipe is based on the premise that the operating pressure of all heads on a circuit should not vary by more than 10% to 20% of their designed operating pressure. This will provide the most uniform application of water.

The following is a simplified way to determine the maximum flow (gpm) allowed in lateral lines using the Friction Factor pipe sizing method. The example is based on lateral lines of Class 315 PVC for ½" and Class 200 PVC for ¾" - 3". Additional charts for lateral lines of Class 160 PVC and Polyethylene are on pages 66-69.

Determination of appropriate pipe size is dependent upon 1) the sprinkler operating pressure, psi, 2) the acceptable pressure variation between sprinklers on the circuit 10% to 20% and 3) the distance from the valve to the farthest sprinkler head on the circuit (note: in some cases this distance can be the distance between the first and last sprinklers on a circuit).

The Friction Factor is the allowable psi loss per 100 feet of pipe. With the Friction Factor, pipe can be sized to avoid excessive pressure losses. The friction factor is calculated by the following formula:

$$\text{Friction Factor} = \frac{\text{Sprinkler Operating Pressure} \times \text{Allowable \% of psi Variation}}{\text{Critical Length (from valve to farthest head) in 100's of feet}}$$

$$F_f = \frac{P_o \times P_v}{L_c}$$

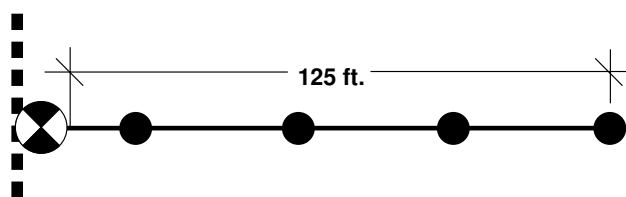
1) Determine the Friction Factor

Example:



Electric Remote Control Valve

Full Circle Sprinkler 2.0 gpm at 35 psi



Sprinkler operating pressure = 35 psi
Allowable pressure loss = 10%
Critical Length = 125 feet

$$\text{Friction Factor} = \frac{35 \times 0.10}{125 / 100}$$

$$\text{Friction Factor} = \frac{3.5}{1.25}$$

Friction Factor = 2.8 allowable psi loss from valve to farthest head

Round off the Friction Factor to the nearest ¼ psi.

Example: 2.8 is rounded off to 2.75

This represents an allowable rate of psi loss from the valve to the farthest head of 2.75 psi per 100 feet of pipe.

- 2) Find the Short Cut chart on the following pages that matches the Friction Factor above (2.75 psi loss per 100 ft.).

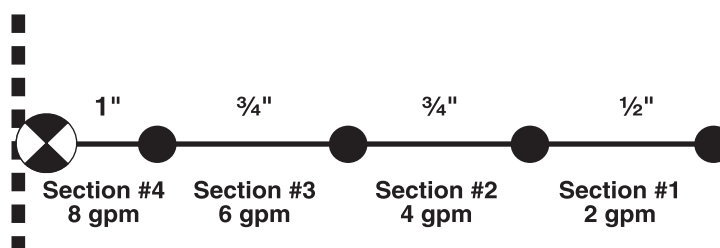
Example:

Friction Factor	2.75
	Max. GPM
½" Cl. 315 PVC	3.9
¾" Cl. 200 PVC	7.8
1" Cl. 200 PVC	15.0
1¼" Cl. 200 PVC	27.6
1½" Cl. 200 PVC	39.5
2" Cl. 200 PVC	70.9
2½" Cl. 200 PVC	117.0
3" Cl. 200 PVC	196.1

The "Max. GPM" represents the maximum gpm that can flow through the various sizes of lateral line pipe without exceeding the 2.75 psi allowable loss per 100 ft.

- 3) Starting with the pipe sections farthest from the valve determine the flow in each section and find the smallest pipe that can carry that flow.

Example:



Pipe section #1 = 2 gpm, lateral line pipe should be ½" Cl. 315 PVC
 Pipe section #2 = 4 gpm, lateral line pipe should be ¾" Cl. 200 PVC
 Pipe section #3 = 6 gpm, lateral line pipe should be ¾" Cl. 200 PVC
 Pipe section #4 = 8 gpm, lateral line pipe should be 1" Cl. 200 PVC

Friction Factor Short Cuts for Class 200 PVC*

Maximum GPM for Various Friction Factors

Friction Factor	0.25 Max. GPM	0.50 Max. GPM	0.75 Max. GPM	1 Max. GPM	1.25 Max. GPM	1.50 Max. GPM	1.75 Max. GPM	2 Max. GPM
½" Cl. 315 PVC	1.1	1.6	2.0	2.3	2.6	2.8	3.1	3.3
¾" Cl. 200 PVC	2.1	3.1	3.9	4.5	5.1	5.7	6.1	6.6
1" Cl. 200 PVC	4.1	6.0	7.4	8.7	9.8	10.8	11.7	12.6
1¼" Cl. 200 PVC	7.6	11.0	13.7	16.0	18.1	19.9	21.7	23.3
1½" Cl. 200 PVC	10.8	15.7	19.6	22.9	25.8	28.5	30.9	33.2
2" Cl. 200 PVC	19.4	28.2	35.1	41.0	46.3	51.1	55.5	59.7
2½" Cl. 200 PVC	32.1	46.6	58.0	67.8	76.4	84.3	91.7	98.5
3" Cl. 200 PVC	53.7	78.1	97.2	113.6	128.1	141.4	153.7	165.1

Friction Factor	2.25 Max. GPM	2.50 Max. GPM	2.75 Max. GPM	3 Max. GPM	3.25 Max. GPM	3.50 Max. GPM	3.75 Max. GPM	4 Max. GPM
½" Cl. 315 PVC	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.8
¾" Cl. 200 PVC	7.0	7.5	7.8	8.2	8.6	8.9	9.3	9.6
1" Cl. 200 PVC	13.4	14.2	15.0	15.7	16.4	17.0	17.7	18.3
1¼" Cl. 200 PVC	24.8	26.3	27.6	29.0	30.3	31.5	32.7	33.8
1½" Cl. 200 PVC	35.4	37.5	39.5	41.4	43.2	45.0	46.7	48.3
2" Cl. 200 PVC	63.6	67.3	70.9	74.3	77.5	80.7	83.8	86.7
2½" Cl. 200 PVC	105.0	111.1	117.0	122.6	128.1	133.3	138.3	143.2
3" Cl. 200 PVC	176.0	186.3	196.1	205.6	214.6	223.4	231.9	240.1

Friction Factor	4.25 Max. GPM	4.50 Max. GPM	4.75 Max. GPM	5 Max. GPM	5.25 Max. GPM	5.50 Max. GPM	5.75 Max. GPM	6 Max. GPM
½" Cl. 315 PVC	5.0	5.1	5.3	5.5	5.6	5.7	5.9	6.0
¾" Cl. 200 PVC	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0
1" Cl. 200 PVC	18.9	19.5	20.1	20.7	21.2	21.8	22.3	22.8
1¼" Cl. 200 PVC	35.0	36.1	37.1	38.2	39.2	40.2	41.2	42.1
1½" Cl. 200 PVC	49.9	51.5	53.0	54.5	56.0	57.4	58.8	60.2
2" Cl. 200 PVC	89.6	92.4	95.2	97.9	100.5	103.0	105.5	108.0
2½" Cl. 200 PVC	148.0	152.7	157.2	161.6	165.9	170.1	174.3	178.3
3" Cl. 200 PVC	248.1	255.9	263.4	270.8	278.1	285.1	292.1	298.9

Friction Factor	6.25 Max. GPM	6.50 Max. GPM	6.75 Max. GPM	7 Max. GPM	7.25 Max. GPM	7.50 Max. GPM	7.75 Max. GPM	8 Max. GPM
½" Cl. 315 PVC	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.0
¾" Cl. 200 PVC	12.2	12.5	12.7	13.0	13.2	13.5	13.7	14.0
1" Cl. 200 PVC	23.3	23.8	24.3	24.8	25.3	25.7	26.2	26.6
1¼" Cl. 200 PVC	43.1	44.0	44.9	45.8	46.7	47.5	48.4	49.2
1½" Cl. 200 PVC	61.5	62.8	64.1	65.4	66.6	67.9	69.1	70.3
2" Cl. 200 PVC	110.4	112.7	115.1	117.4	119.6	121.8	124.0	126.1
2½" Cl. 200 PVC	182.3	186.2	190.0	193.8	197.5	201.1	204.7	208.3
3" Cl. 200 PVC	305.5	312.1	318.5	324.8	331.0	337.1	343.2	349.1

***Note:** ½" is Class 315 PVC because wall thickness must be at least 0.060" and Class 200 SDR is 21 which would result in a wall thickness in ½" of less than 0.060".

Friction Factor Short Cuts for Class 200 PVC*

Maximum GPM for Various Friction Factors

Friction Factor	8.25 Max. GPM	8.50 Max. GPM	8.75 Max. GPM	9 Max. GPM	9.25 Max. GPM	9.50 Max. GPM	9.75 Max. GPM	10 Max. GPM
½" Cl. 315 PVC	7.1	7.3	7.4	7.5	7.6	7.7	7.8	7.9
¾" Cl. 200 PVC	14.2	14.4	14.7	14.9	15.1	15.3	15.5	15.8
1" Cl. 200 PVC	27.1	27.5	28.0	28.4	28.8	29.2	29.6	30.0
1¼" Cl. 200 PVC	50.0	50.8	51.7	52.4	53.2	54.0	54.8	55.5
1½" Cl. 200 PVC	71.4	72.6	73.7	74.9	76.0	77.1	78.2	79.3
2" Cl. 200 PVC	128.2	130.3	132.4	134.4	136.4	138.4	140.3	142.3
2½" Cl. 200 PVC	211.8	215.2	218.6	221.9	225.3	228.5	231.8	234.9
3" Cl. 200 PVC	354.9	360.7	366.4	372.0	377.6	383.0	388.4	393.8

Friction Factor	10.25 Max. GPM	10.50 Max. GPM	10.75 Max. GPM	11 Max. GPM	11.25 Max. GPM	11.50 Max. GPM	11.75 Max. GPM	12 Max. GPM
½" Cl. 315 PVC	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
¾" Cl. 200 PVC	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4
1" Cl. 200 PVC	30.4	30.8	31.2	31.6	32.0	32.4	32.8	33.2
1¼" Cl. 200 PVC	56.3	57.0	57.7	58.4	59.2	59.9	60.6	61.3
1½" Cl. 200 PVC	80.3	81.4	82.4	83.4	84.5	85.5	86.5	87.5
2" Cl. 200 PVC	144.2	146.1	147.9	149.8	151.6	153.4	155.2	157.0
2½" Cl. 200 PVC	238.1	241.2	244.3	247.3	250.4	253.4	256.3	259.2
3" Cl. 200 PVC	399.1	404.3	409.5	414.6	419.6	424.7	429.6	434.5

Friction Factor	12.25 Max. GPM	12.50 Max. GPM	12.75 Max. GPM	13 Max. GPM	13.25 Max. GPM	13.50 Max. GPM	13.75 Max. GPM	14 Max. GPM
½" Cl. 315 PVC	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5
¾" Cl. 200 PVC	17.6	17.8	18.0	18.2	18.3	18.5	18.7	18.9
1" Cl. 200 PVC	33.5	33.9	34.3	34.6	35.0	35.3	35.7	36.0
1¼" Cl. 200 PVC	61.9	62.6	63.3	64.0	64.6	65.3	65.9	66.6
1½" Cl. 200 PVC	88.4	89.4	90.4	91.3	92.3	93.2	94.1	95.0
2" Cl. 200 PVC	158.8	160.5	162.2	163.9	165.6	167.3	169.0	170.6
2½" Cl. 200 PVC	262.1	265.0	267.9	270.7	273.5	276.3	279.0	281.7
3" Cl. 200 PVC	439.4	444.2	449.0	453.7	458.4	463.1	467.7	472.2

Friction Factor	14.25 Max. GPM	14.50 Max. GPM	14.75 Max. GPM	15 Max. GPM	15.25 Max. GPM	15.50 Max. GPM	15.75 Max. GPM	16 Max. GPM
½" Cl. 315 PVC	9.6	9.7	9.8	9.9	10.0	10.0	10.1	10.2
¾" Cl. 200 PVC	19.1	19.3	19.4	19.6	19.8	20.0	20.1	20.3
1" Cl. 200 PVC	36.4	36.7	37.1	37.4	37.7	38.1	38.4	38.7
1¼" Cl. 200 PVC	67.2	67.8	68.5	69.1	69.7	70.3	70.9	71.6
1½" Cl. 200 PVC	96.0	96.9	97.8	98.7	99.5	100.4	101.3	102.2
2" Cl. 200 PVC	172.3	173.9	175.5	177.1	178.7	180.3	181.8	183.4
2½" Cl. 200 PVC	284.5	287.1	289.8	292.4	295.1	297.7	300.2	302.8
3" Cl. 200 PVC	476.8	481.3	485.7	490.2	494.6	498.9	503.3	507.6

***Note:** ½" is Class 315 PVC because wall thickness must be at least 0.060" and Class 200 SDR is 21 which would result in a wall thickness in ½" of less than 0.060".

Friction Factor Short Cuts for Class 160 PVC*

Maximum GPM for Various Friction Factors

Friction Factor	0.25 Max. GPM	0.50 Max. GPM	0.75 Max. GPM	1 Max. GPM	1.25 Max. GPM	1.50 Max. GPM	1.75 Max. GPM	2 Max. GPM
½" Cl. 315 PVC	1.1	1.6	2.0	2.3	2.6	2.8	3.1	3.3
¾" Cl. 200 PVC	2.1	3.1	3.9	4.5	5.1	5.7	6.1	6.6
1" Cl. 160 PVC	4.2	6.0	7.5	8.8	9.9	10.9	11.9	12.8
1¼" Cl. 160 PVC	8.0	11.6	14.4	16.9	19.0	21.0	22.8	24.5
1½" Cl. 160 PVC	11.4	16.6	20.6	24.1	27.1	30.0	32.6	35.0
2" Cl. 160 PVC	20.5	29.8	37.1	43.3	48.8	53.9	58.6	62.9
2½" Cl. 160 PVC	33.8	49.2	61.2	71.5	80.7	89.0	96.8	104.0
3" Cl. 160 PVC	56.6	82.3	102.5	119.7	135.0	149.0	161.9	174.1

Friction Factor	2.25 Max. GPM	2.50 Max. GPM	2.75 Max. GPM	3 Max. GPM	3.25 Max. GPM	3.50 Max. GPM	3.75 Max. GPM	4 Max. GPM
½" Cl. 315 PVC	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.8
¾" Cl. 200 PVC	7.0	7.5	7.8	8.2	8.6	8.9	9.3	9.6
1" Cl. 160 PVC	13.6	14.4	15.2	15.9	16.6	17.3	17.9	18.6
1¼" Cl. 160 PVC	26.1	27.7	29.1	30.5	31.9	33.2	34.4	35.7
1½" Cl. 160 PVC	37.3	39.5	41.6	43.6	45.5	47.3	49.1	50.9
2" Cl. 160 PVC	67.1	71.0	74.7	78.3	81.8	85.1	88.4	91.5
2½" Cl. 160 PVC	110.8	117.3	123.5	129.4	135.2	140.7	146.0	151.2
3" Cl. 160 PVC	185.5	196.3	206.7	216.7	226.2	235.5	244.4	253.1

Friction Factor	4.25 Max. GPM	4.50 Max. GPM	4.75 Max. GPM	5 Max. GPM	5.25 Max. GPM	5.50 Max. GPM	5.75 Max. GPM	6 Max. GPM
½" Cl. 315 PVC	5.0	5.1	5.3	5.5	5.6	5.7	5.9	6.0
¾" Cl. 200 PVC	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0
1" Cl. 160 PVC	19.2	19.8	20.4	20.9	21.5	22.0	22.6	23.1
1¼" Cl. 160 PVC	36.8	38.0	39.1	40.2	41.3	42.3	43.4	44.4
1½" Cl. 160 PVC	52.6	54.2	55.8	57.4	58.9	60.4	61.9	63.3
2" Cl. 160 PVC	94.5	97.5	100.4	103.2	106.0	108.7	111.3	113.9
2½" Cl. 160 PVC	156.2	161.1	165.9	170.6	175.1	179.6	183.9	188.2
3" Cl. 160 PVC	261.5	269.7	277.7	285.5	293.1	300.5	307.8	315.0

Friction Factor	6.25 Max. GPM	6.50 Max. GPM	6.75 Max. GPM	7 Max. GPM	7.25 Max. GPM	7.50 Max. GPM	7.75 Max. GPM	8 Max. GPM
½" Cl. 315 PVC	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.0
¾" Cl. 200 PVC	12.2	12.5	12.7	13.0	13.2	13.5	13.7	14.0
1" Cl. 160 PVC	23.6	24.1	24.6	25.1	25.6	26.1	26.5	27.0
1¼" Cl. 160 PVC	45.4	46.3	47.3	48.2	49.2	50.1	51.0	51.8
1½" Cl. 160 PVC	64.7	66.1	67.5	68.8	70.1	71.4	72.7	74.0
2" Cl. 160 PVC	116.4	118.9	121.4	123.8	126.1	128.5	130.8	133.0
2½" Cl. 160 PVC	182.4	196.5	200.6	204.5	208.4	212.3	216.1	219.8
3" Cl. 160 PVC	322.0	328.9	335.7	342.3	348.9	355.3	361.7	367.9

***Note:** ½" is Class 315 PVC and ¾" is Cl 200 PVC because wall thickness must be at least 0.060" and Class 160 SDR is 26 which would result in a wall thicknesses in ½" an ¾" of less than 0.060".

Friction Factor Short Cuts for Class 160 PVC*

Maximum GPM for Various Friction Factors

Friction Factor	8.25 Max. GPM	8.50 Max. GPM	8.75 Max. GPM	9 Max. GPM	9.25 Max. GPM	9.50 Max. GPM	9.75 Max. GPM	10 Max. GPM
½" Cl. 315 PVC	7.1	7.3	7.4	7.5	7.6	7.7	7.8	7.9
¾" Cl. 200 PVC	14.2	14.4	14.7	14.9	15.1	15.3	15.5	15.8
1" Cl. 160 PVC	27.4	27.9	28.3	28.8	29.2	29.6	30.0	30.4
1¼" Cl. 160 PVC	52.7	53.6	54.4	55.2	56.1	56.9	57.7	58.5
1½" Cl. 160 PVC	75.2	76.4	77.6	78.8	80.0	81.2	82.3	83.4
2" Cl. 160 PVC	135.3	137.5	139.6	141.8	143.9	146.0	148.0	150.1
2½" Cl. 160 PVC	223.5	227.1	230.7	234.3	237.8	241.2	244.6	248.0
3" Cl. 160 PVC	374.1	380.2	386.2	392.1	397.9	403.7	409.4	415.1

Friction Factor	10.25 Max. GPM	10.50 Max. GPM	10.75 Max. GPM	11 Max. GPM	11.25 Max. GPM	11.50 Max. GPM	11.75 Max. GPM	12 Max. GPM
½" Cl. 315 PVC	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7
¾" Cl. 200 PVC	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4
1" Cl. 160 PVC	30.9	31.3	31.7	32.1	32.4	32.8	33.2	33.6
1¼" Cl. 160 PVC	59.3	60.0	60.8	61.6	62.3	63.1	63.8	64.5
1½" Cl. 160 PVC	84.6	85.7	86.8	87.8	88.9	90.0	91.0	92.1
2" Cl. 160 PVC	152.1	154.1	156.0	158.0	159.9	161.8	163.7	165.6
2½" Cl. 160 PVC	251.3	254.6	257.8	261.1	264.3	267.4	270.5	273.6
3" Cl. 160 PVC	420.6	426.1	431.6	437.0	442.3	447.6	452.8	458.0

Friction Factor	12.25 Max. GPM	12.50 Max. GPM	12.75 Max. GPM	13 Max. GPM	13.25 Max. GPM	13.50 Max. GPM	13.75 Max. GPM	14 Max. GPM
½" Cl. 315 PVC	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5
¾" Cl. 200 PVC	17.6	17.8	18.0	18.2	18.3	18.5	18.7	18.9
1" Cl. 160 PVC	34.0	34.3	34.7	35.1	35.4	35.8	36.2	36.5
1¼" Cl. 160 PVC	65.2	66.0	66.7	67.4	68.1	68.8	69.4	70.1
1½" Cl. 160 PVC	93.1	94.1	95.1	96.1	97.1	98.1	99.1	100.1
2" Cl. 160 PVC	167.4	169.3	171.1	172.9	174.7	176.5	178.2	180.0
2½" Cl. 160 PVC	276.7	279.7	282.7	285.7	288.7	291.6	294.5	297.4
3" Cl. 160 PVC	463.1	468.2	473.2	478.2	483.2	488.1	492.9	497.7

Friction Factor	14.25 Max. GPM	14.50 Max. GPM	14.75 Max. GPM	15 Max. GPM	15.25 Max. GPM	15.50 Max. GPM	15.75 Max. GPM	16 Max. GPM
½" Cl. 315 PVC	9.6	9.7	9.8	9.9	10.0	10.0	10.1	10.2
¾" Cl. 200 PVC	19.1	19.3	19.4	19.6	19.8	20.0	20.1	20.3
1" Cl. 160 PVC	36.9	37.2	37.6	37.9	38.2	38.6	38.9	39.2
1¼" Cl. 160 PVC	70.8	71.5	72.1	72.8	73.4	74.1	74.7	75.4
1½" Cl. 160 PVC	101.0	102.0	102.9	103.9	104.8	105.7	106.6	107.5
2" Cl. 160 PVC	181.7	183.4	185.1	186.8	188.5	190.1	191.8	193.4
2½" Cl. 160 PVC	300.2	303.1	305.9	308.7	311.4	314.2	316.9	319.6
3" Cl. 160 PVC	502.5	507.3	512.0	516.6	521.3	525.9	530.4	535.0

*Note: ½" is Class 315 PVC and ¾" is Cl 200 PVC because wall thickness must be at least 0.060" and Class 160 SDR is 26 which would result in a wall thickness in ½" an ¾" of less than 0.060".

Friction Factor Short Cuts for Polyethylene (PE) - SDR-7 (IPS) Pressure Rated Tube

Maximum GPM for Various Friction Factors

Friction Factor	0.25 Max. GPM	0.50 Max. GPM	0.75 Max. GPM	1 Max. GPM	1.25 Max. GPM	1.50 Max. GPM	1.75 Max. GPM	2 Max. GPM
½" SDR-Poly	0.7	1.0	1.3	1.5	1.7	1.8	2.0	2.1
¾" SDR-Poly	1.5	2.1	2.6	3.1	3.5	3.8	4.2	4.5
1" SDR-Poly	2.8	4.0	5.0	5.8	6.6	7.2	7.9	8.5
1¼" SDR-Poly	5.7	8.2	10.2	12.0	13.5	14.9	16.2	17.4
1½" SDR-Poly	8.5	12.3	15.4	17.9	20.2	22.3	24.3	26.1
2" SDR-Poly	16.4	23.8	29.6	34.6	39.0	43.0	46.8	50.3
2½" SDR-Poly	26.1	37.9	47.2	55.2	62.2	68.7	74.6	80.2
3" SDR-Poly	46.2	67.1	83.6	97.6	110.1	121.5	132.0	141.9

Friction Factor	2.25 Max. GPM	2.50 Max. GPM	2.75 Max. GPM	3 Max. GPM	3.25 Max. GPM	3.50 Max. GPM	3.75 Max. GPM	4 Max. GPM
½" SDR-Poly	2.3	2.4	2.5	2.7	2.8	2.9	3.0	3.1
¾" SDR-Poly	4.8	5.1	5.3	5.6	5.8	6.1	6.3	6.5
1" SDR-Poly	9.0	9.5	10.0	10.5	11.0	11.4	11.9	12.3
1¼" SDR-Poly	18.5	19.6	20.7	21.6	22.6	23.5	24.4	25.3
1½" SDR-Poly	27.8	29.4	31.0	32.5	33.9	35.3	36.6	37.9
2" SDR-Poly	53.6	56.7	59.7	62.6	65.3	68.0	70.6	73.1
2½" SDR-Poly	85.5	90.5	95.2	99.8	104.2	108.5	112.6	116.6
3" SDR-Poly	151.2	160.1	168.5	176.6	185.5	192.0	199.3	206.3

Friction Factor	4.25 Max. GPM	4.50 Max. GPM	4.75 Max. GPM	5 Max. GPM	5.25 Max. GPM	5.50 Max. GPM	5.75 Max. GPM	6 Max. GPM
½" SDR-Poly	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
¾" SDR-Poly	6.7	7.0	7.2	7.4	7.6	7.7	7.9	8.1
1" SDR-Poly	12.7	13.1	13.5	13.9	14.2	14.6	15.0	15.3
1¼" SDR-Poly	26.1	26.9	27.7	28.5	29.3	30.0	30.8	31.5
1½" SDR-Poly	39.2	40.4	41.6	42.8	43.9	45.0	46.1	47.2
2" SDR-Poly	75.5	77.9	80.2	82.5	84.7	86.8	88.9	91.0
2½" SDR-Poly	120.5	124.3	127.9	131.6	135.0	138.5	141.8	145.1
3" SDR-Poly	213.2	219.9	226.4	232.7	239.0	245.0	251.0	256.8

Friction Factor	6.25 Max. GPM	6.50 Max. GPM	6.75 Max. GPM	7 Max. GPM	7.25 Max. GPM	7.50 Max. GPM	7.75 Max. GPM	8 Max. GPM
½" SDR-Poly	4.0	4.0	4.1	4.2	4.3	4.4	4.5	4.5
¾" SDR-Poly	8.3	8.5	8.7	8.8	9.0	9.2	9.3	9.5
1" SDR-Poly	15.7	16.0	16.3	16.6	17.0	17.3	17.6	17.9
1¼" SDR-Poly	32.2	32.9	33.5	34.2	34.9	35.5	36.1	36.8
1½" SDR-Poly	48.2	49.3	50.3	51.3	52.3	53.2	54.2	55.1
2" SDR-Poly	93.0	95.0	97.0	98.9	100.8	102.6	104.5	106.3
2½" SDR-Poly	148.4	151.5	154.7	157.7	160.8	163.7	166.6	169.5
3" SDR-Poly	262.5	268.2	273.7	279.1	284.5	289.7	294.9	300.0

Friction Factor Short Cuts for Polyethylene (PE) - SDR-7 (IPS) Pressure Rated Tube

Maximum GPM for Various Friction Factors

Friction Factor	8.25 Max. GPM	8.50 Max. GPM	8.75 Max. GPM	9 Max. GPM	9.25 Max. GPM	9.50 Max. GPM	9.75 Max. GPM	10 Max. GPM
½" SDR-Poly	4.6	4.7	4.8	4.8	4.9	5.0	5.0	5.1
¾" SDR-Poly	9.6	9.8	10.0	10.1	10.3	10.4	10.6	10.7
1" SDR-Poly	18.2	18.5	18.8	19.1	19.3	19.6	19.9	20.2
1¼" SDR-Poly	37.4	38.0	38.6	39.2	39.8	40.3	40.9	41.5
1½" SDR-Poly	56.0	57.0	57.9	58.7	59.6	60.5	61.3	62.2
2" SDR-Poly	108.1	109.8	111.5	113.3	114.9	116.6	118.3	119.9
2½" SDR-Poly	172.4	175.2	177.9	180.7	183.4	186.0	188.6	191.2
3" SDR-Poly	305.0	310.0	314.9	319.7	324.4	329.1	333.8	338.4

Friction Factor	10.25 Max. GPM	10.50 Max. GPM	10.75 Max. GPM	11 Max. GPM	11.25 Max. GPM	11.50 Max. GPM	11.75 Max. GPM	12 Max. GPM
½" SDR-Poly	5.2	5.2	5.3	5.4	5.4	5.5	5.6	5.6
¾" SDR-Poly	10.8	11.0	11.1	11.3	11.4	11.5	11.7	11.8
1" SDR-Poly	20.4	20.7	21.0	21.2	21.5	21.8	22.0	22.3
1¼" SDR-Poly	42.0	42.6	43.1	43.7	44.2	44.7	45.2	45.8
1½" SDR-Poly	63.0	63.8	64.7	65.5	66.3	67.1	67.8	68.6
2" SDR-Poly	121.5	123.1	124.7	126.2	127.8	129.3	130.8	132.3
2½" SDR-Poly	193.8	196.3	198.8	201.3	203.8	206.2	208.6	211.0
3" SDR-Poly	342.9	347.4	351.9	356.3	360.6	364.9	369.2	373.4

Friction Factor	12.25 Max. GPM	12.50 Max. GPM	12.75 Max. GPM	13 Max. GPM	13.25 Max. GPM	13.50 Max. GPM	13.75 Max. GPM	14 Max. GPM
½" SDR-Poly	5.7	5.8	5.8	5.9	5.9	6.0	6.1	9.5
¾" SDR-Poly	11.9	12.1	12.2	12.3	12.5	12.6	12.7	18.9
1" SDR-Poly	22.5	22.8	23.0	23.2	23.5	23.7	24.0	36.5
1¼" SDR-Poly	46.3	46.8	47.3	47.8	48.3	48.8	49.3	70.1
1½" SDR-Poly	69.4	70.1	70.9	71.6	72.4	73.1	73.8	100.1
2" SDR-Poly	133.8	135.2	136.7	138.1	139.6	141.0	142.4	180.0
2½" SDR-Poly	213.4	215.7	218.0	220.3	222.6	224.9	227.1	297.4
3" SDR-Poly	377.6	381.7	385.8	389.9	393.9	397.9	401.9	497.7

Friction Factor	14.25 Max. GPM	14.50 Max. GPM	14.75 Max. GPM	15 Max. GPM	15.25 Max. GPM	15.50 Max. GPM	15.75 Max. GPM	16 Max. GPM
½" SDR-Poly	6.2	6.2	6.3	6.4	6.4	6.5	6.5	6.6
¾" SDR-Poly	13.0	13.1	13.2	13.3	13.4	13.6	13.7	13.8
1" SDR-Poly	24.4	24.7	24.9	25.1	25.3	25.6	25.8	26.0
1¼" SDR-Poly	50.2	50.7	51.2	51.6	52.1	52.5	53.0	53.5
1½" SDR-Poly	75.3	76.0	76.7	77.4	78.1	78.8	79.5	80.1
2" SDR-Poly	145.2	146.5	147.9	149.2	150.6	151.9	153.2	154.5
2½" SDR-Poly	231.5	233.7	235.9	238.0	240.2	242.3	244.4	246.5
3" SDR-Poly	409.7	413.6	417.4	421.2	425.0	428.7	432.5	436.2

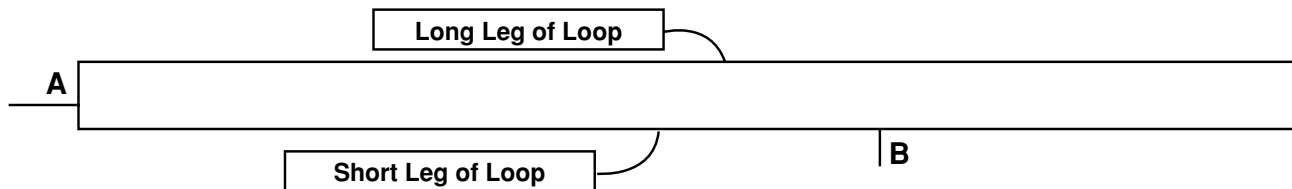
Approximate Flow Rates In Simple Looped Main Lines *

Length Ratio † Long to Short	Flow Rate Short Leg	Flow Rate Long Leg
1 to 1	50.0%	50.0%
2 to 1	59.4%	40.6%
3 to 1	64.4%	35.6%
4 to 1	67.8%	32.2%
5 to 1	70.4%	29.6%
6 to 1	72.4%	27.6%
7 to 1	74.0%	26.0%
8 to 1	75.4%	24.6%
9 to 1	76.6%	23.4%
10 to 1	77.6%	22.4%
12 to 1	79.2%	20.8%
15 to 1	81.2%	18.8%
20 to 1	83.4%	16.6%
25 to 1	85.0%	15.0%
30 to 1	86.2%	13.8%
35 to 1	87.2%	12.8%
40 to 1	88.0%	12.0%
45 to 1	88.6%	11.4%
50 to 1	89.2%	10.8%

* A simple looped main line would have one inlet and one outlet, and all pipe would be the same size. The type of pipe does not affect the flow percentages as long as pipe type and size remain constant.

† The “Length Ratio” is the ratio of the short leg of the loop to the long leg of the loop. To find the “Length Ratio”, divide the length of the long leg by the length of the short leg.

Example: If the long leg is 400 feet and the short leg of the loop is 100 feet, the “Length Ratio” is 4 to 1. With a ratio of 4 to 1, the volume of flow in the short leg would be approximately 67.8% and the volume of flow in the long leg would be approximately 32.2% of the total flow.



Example: The entrance to the loop is at point “A” and the outlet is at point “B”. Point “B” could be thought of as the location of a remote control valve. In the loop above, the longer side of the loop is about twice as long as the shorter side. In using the chart above, the ratio of 2:1 would indicate the flow in the short leg to be approximately 59.4% and the flow in the long leg to be approximately 40.6% of the total flow in the loop. If the total flow to point “B” is 50 gallons, the flow in the short leg would be approximately 29.7 GPM while the flow in the long leg would be approximately 20.3 GPM. Unequal flow rates occur because the pressure losses in each leg of the loop must be equal.

Average Number of Sprinklers per Acre

Square and/or Rectangular Spacing

Spacing in Feet	Heads Per Acre	Spacing in Feet	Heads Per Acre
10 x 10	435.6	30 x 60	24.2
11 x 11	360.0	40 x 40	27.2
12 x 12	302.4	40 x 50	21.8
13 x 13	257.6	40 x 60	18.2
14 x 14	222.3	40 x 80	13.6
15 x 15	193.5	50 x 50	17.4
16 x 16	170.0	50 x 60	14.5
17 x 17	150.8	50 x 70	12.4
18 x 18	134.3	50 x 80	10.9
19 x 19	120.6	60 x 60	12.1
20 x 20	109.0	60 x 70	10.4
20 x 30	72.7	60 x 80	9.1
20 x 40	54.5	70 x 70	8.9
20 x 50	43.5	70 x 80	7.8
20 x 60	36.3	70 x 90	6.9
25 x 25	69.7	80 x 80	6.8
30 x 30	48.4	80 x 90	6.1
30 x 40	36.3	80 x 100	5.5
30 x 50	29.0	100 x 100	4.4

Average Number of Sprinklers per Acre

Equilateral Triangular Spacing

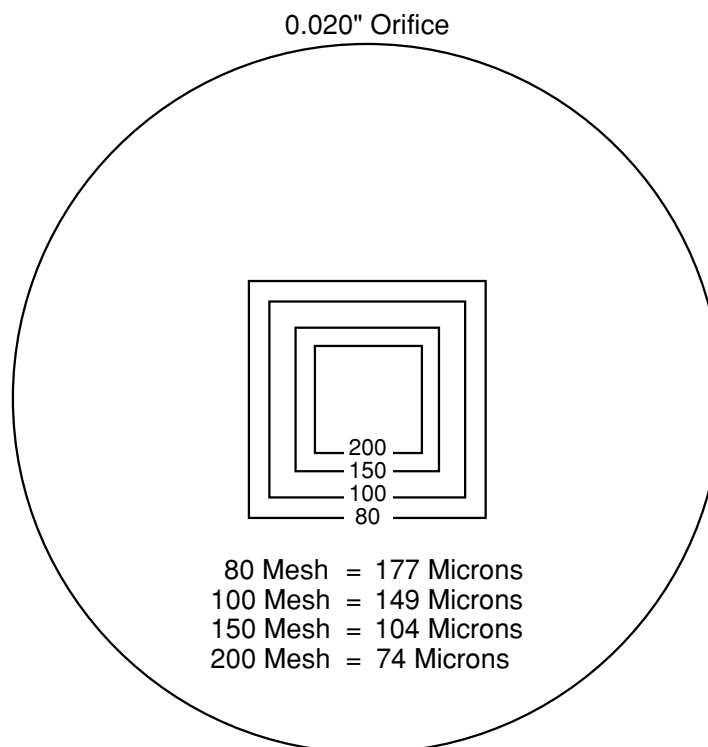
Spacing in Feet	Heads Per Acre	Spacing in Feet	Heads Per Acre
10	504	66	11.5
11	418	68	10.9
12	348	70	10.3
13	296	72	9.7
14	256	74	9.2
15	224	76	8.7
16	196	78	8.3
17	175	80	7.9
18	155	82	7.5
19	140	84	7.1
20	125	86	6.8
21	114	88	6.5
22	105	90	6.2
23	96	92	5.9
24	87	94	5.7
25	80	96	5.5
26	74	98	5.2
27	69	100	5.0
28	64	102	4.8
29	60	104	4.6
30	56	106	4.5
32	49	108	4.3
34	44	110	4.2
36	39	112	4.0
38	35	114	3.9
40	31	116	3.7
42	28.5	118	3.6
44	26.0	120	3.5
46	23.7	122	3.4
48	21.8	124	3.3
50	20.0	126	3.2
52	18.6	128	3.1
54	17.2	130	3.0
56	16.0	132	2.9
58	15.0	134	2.8
60	14.0	136	2.7
62	13.1	138	2.6
64	12.3	140	2.5

The theoretical figures above represent the minimum number of sprinklers required to cover a square acre (208.7' x 208.7') with the most economical placement of sprinklers possible. Actual layouts to match individual field conditions may require additional sprinklers. This table should only be used for estimating purposes.

Screen Filter Mesh Equivalents

Mesh Size	Microns	Inches	mm
4	5205	0.2030	5.16
6	3175	0.125	3.18
8	2487	0.0970	2.46
10	1923	0.0750	1.90
11	1778	0.070	1.78
14	1307	0.0510	1.30
18	1000	0.0394	1.00
20	840	0.0331	0.84
24	813	0.032	0.81
25	710	0.0280	0.71
30	590	0.025	0.59
35	500	0.0197	0.50
40	420	0.0165	0.42
45	350	0.0138	0.35
50	297	0.0117	0.30
60	250	0.0098	0.25
70	210	0.0083	0.21
80	177	0.0070	0.18
100	149	0.0059	0.15
120	125	0.0049	0.12
140	105	0.0041	0.10
170	88	0.0035	0.08
200	74	0.0029	0.07
230	62	0.0024	0.06
270	53	0.0021	0.05
325	44	0.0017	0.04
400	37	0.0015	0.04
550	25	0.0009	0.02
800	15	0.0006	0.01
1250	10	0.0004	0.01

Screen Mesh Sizes Compared to 0.020 inch orifice



Approximate Cost of Pump Operation

Pump Horse Power	Average Kilowatt Hour Input		Approximate Cost of Operation per Hour at Kilowatt Hr. Rate of:																	
			\$.0150		\$.0200		\$.0250		\$.0400		\$.0500		\$.0600		\$.0800		\$.1000		\$.1200	
			Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase
¼	0.305		0.0046		0.0062		0.0078		0.0122		0.0153		0.0183		0.0244		0.0305		0.0366	
⅓	0.408		0.0062		0.0082		0.0103		0.0163		0.0204		0.0245		0.0326		0.0408		0.0490	
½	0.535	0.520	0.0081	0.0078	0.0108	0.0104	0.0135	0.0130	0.0214	0.0208	0.0268	0.0260	0.0321	0.0312	0.0428	0.0416	0.0535	0.0520	0.0642	0.0642
¾	0.760	0.768	0.0114	0.0116	0.0152	0.0154	0.0190	0.0193	0.0304	0.0307	0.0380	0.0384	0.0456	0.0461	0.0608	0.0614	0.0760	0.0768	0.0912	0.0922
1	1.000	0.960	0.0150	0.0144	0.0200	0.0192	0.0250	0.0240	0.0400	0.0384	0.0500	0.0480	0.0600	0.0576	0.0800	0.0768	0.1000	0.0960	0.1200	0.1152
1½	1.500	1.42	0.0225	0.0213	0.0300	0.0284	0.0375	0.0335	0.0600	0.0568	0.0750	0.0710	0.0900	0.0852	0.1200	0.1136	0.1500	0.1420	0.1800	0.1704
2	1.980	1.83	0.0297	0.0275	0.0396	0.0366	0.0495	0.0458	0.0792	0.0732	0.0990	0.0915	0.1188	0.1098	0.1584	0.1464	0.1980	0.1830	0.2376	0.2196
3	2.95	2.70	0.0443	0.0405	0.0590	0.0540	0.0738	0.0675	0.1180	0.1080	0.1475	0.1350	0.1770	0.1620	0.2360	0.2160	0.2950	0.2700	0.3540	0.3240
5	4.65	4.50	0.0698	0.0675	0.0930	0.0900	0.1163	0.1125	0.1860	0.1800	0.2325	0.2250	0.2790	0.2700	0.3720	0.3600	0.4650	0.4500	0.5580	0.5400
7½	6.9	6.75	0.1035	0.1013	0.1380	0.1350	0.1725	0.1688	0.2760	0.2700	0.3450	0.3375	0.4140	0.4050	0.5520	0.5400	0.6900	0.6750	0.8280	0.8100
10	9.3	9.0	0.1395	0.1350	0.1860	0.1800	0.2325	0.2250	0.3720	0.3600	0.4650	0.4500	0.5580	0.5400	0.7440	0.7200	0.9300	0.9000	1.1160	1.0800
15		12.8		0.1920		0.2560		0.3200		0.5120		0.6400		0.7680		1.0240		1.2800		1.5360
20		16.9		0.2535		0.3380		0.4225		0.6760		0.8450		1.0140		1.3520		1.6900		2.0280
25		20.8		0.3120		0.4160		0.5200		0.8320		1.0400		1.2480		1.6640		2.0800		2.4960
30		25.0		0.3750		0.5000		0.6250		1.0000		1.2500		1.5000		2.0000		2.5000		3.0000
40		33.2		0.4980		0.6640		0.8300		1.3280		1.6600		1.9920		2.6560		3.3200		3.9840
50		41.3		0.6195		0.8260		1.0325		1.6520		2.0650		2.4780		3.3040		4.1300		4.9560
60		49.5		0.7425		0.9900		1.2375		1.9800		2.4750		2.9700		3.9600		4.9500		5.9400
75		61.5		0.9225		1.2300		1.5375		2.4600		3.0750		3.6900		4.9200		6.1500		7.3800
100		81.5		1.225		1.6300		2.0375		3.2600		4.0750		4.8900		6.5200		8.1500		9.7800

Note: To calculate approximate cost of operation at a cost factor not listed above, multiply the second column rate of \$.02 per KWH by the actual rate in effect, and then divide by 2.

Example:

the cost of operating a 3 hp single phase pump
at a rate of \$0.07 per KWH would be
 $.0590 \times 7 \div 2 = \0.2065 per hour

These charts are based upon 100% motor efficiencies.
To determine actual cost factors, divide by actual pump and motor efficiency, as indicated above.

Table of Pump Horsepower Requirements (WHP)

(at 100% Pump Efficiency)

HEAD (feet)	PRESSURE (psi)	FLOW - GPM										
		25	50	75	100	150	200	250	300	350	400	500
10	4.33	0.063	0.126	0.189	0.253	0.379	0.505	0.631	0.758	0.884	1.01	1.26
15	6.50	0.095	0.189	0.284	0.379	0.568	0.758	0.947	1.136	1.326	1.52	1.89
20	8.66	0.126	0.253	0.379	0.505	0.758	1.010	1.26	1.52	1.77	2.02	2.53
25	10.83	0.158	0.316	0.473	0.631	0.947	1.26	1.58	1.89	2.21	2.53	3.16
30	12.99	0.189	0.379	0.57	0.76	1.14	1.52	1.89	2.27	2.65	3.03	3.79
35	15.16	0.22	0.44	0.66	0.88	1.33	1.77	2.21	2.65	3.09	3.54	4.42
40	17.32	0.25	0.51	0.76	1.01	1.52	2.02	2.53	3.03	3.54	4.04	5.05
45	19.49	0.28	0.57	0.85	1.14	1.70	2.27	2.84	3.41	3.98	4.55	5.68
50	21.65	0.32	0.63	0.95	1.26	1.89	2.53	3.16	3.79	4.42	5.05	6.31
60	25.98	0.38	0.76	1.14	1.52	2.27	3.03	3.79	4.55	5.30	6.06	7.58
70	30.31	0.44	0.88	1.33	1.77	2.65	3.54	4.42	5.30	6.19	7.07	8.84
80	34.64	0.51	1.01	1.52	2.02	3.03	4.04	5.05	6.06	7.07	8.08	10.10
90	38.97	0.57	1.14	1.70	2.27	3.41	4.55	5.68	6.82	7.95	9.09	11.36
100	43.30	0.63	1.26	1.89	2.53	3.79	5.05	6.31	7.58	8.84	10.10	12.63
120	51.96	0.76	1.52	2.27	3.03	4.55	6.06	7.58	9.09	10.61	12.12	15.15
140	60.62	0.88	1.77	2.65	3.54	5.30	7.07	8.84	10.61	12.37	14.14	17.68
160	69.28	1.01	2.02	3.03	4.04	6.06	8.08	10.10	12.12	14.14	16.16	20.20
180	77.94	1.14	2.27	3.41	4.55	6.82	9.09	11.36	13.64	15.91	18.18	22.73
200	86.60	1.26	2.53	3.79	5.05	7.58	10.10	12.63	15.15	17.68	20.20	25.25
220	95.26	1.39	2.78	4.17	5.56	8.33	11.11	13.89	16.67	19.44	22.22	27.78
240	103.92	1.52	3.03	4.55	6.06	9.09	12.12	15.15	18.18	21.21	24.24	30.30
260	112.58	1.64	3.28	4.92	6.57	9.85	13.13	16.41	19.70	22.98	26.26	32.83
280	121.24	1.77	3.54	5.30	7.07	10.61	14.14	17.68	21.21	24.75	28.28	35.35
300	129.90	1.89	3.79	5.68	7.58	11.36	15.15	18.94	22.73	26.52	30.30	37.88
325	140.73	2.05	4.10	6.16	8.21	12.31	16.41	20.52	24.62	28.72	32.83	41.04
350	151.55	2.21	4.42	6.63	8.84	13.26	17.68	22.10	26.52	30.93	35.35	44.19
375	162.38	2.37	4.73	7.10	9.47	14.20	18.94	23.67	28.41	33.14	37.88	47.35
400	173.20	2.53	5.05	7.58	10.10	15.15	20.20	25.25	30.30	35.35	40.40	50.51
425	184.03	2.68	5.37	8.05	10.73	16.10	21.46	26.83	32.20	37.56	42.93	53.66
450	194.85	2.84	5.68	8.52	11.36	17.05	22.73	28.41	34.09	39.77	45.45	56.82
475	205.68	3.00	6.00	9.00	11.99	17.99	23.99	29.99	35.98	41.98	47.98	59.97
500	216.50	3.16	6.31	9.47	12.63	18.94	25.25	31.57	37.88	44.19	50.50	63.13

Notes: 1. The (WHP) water horsepower requirements charted above have been calculated by either of the following formulas.

$$\text{WHP} = \frac{\text{GPM} \times \text{HEAD (feet)}}{3960}$$

$$\text{WHP} = \frac{\text{GPM} \times \text{PRESSURE (psi)}}{1714}$$

2. The specific brake horsepower requirement is calculated by dividing the WHP above by the actual pump efficiency.

$$\text{BHP} = \frac{\text{WHP}}{\text{efficiency}}$$

Example:

100 gpm at 90 feet of head requires 2.27 horsepower at 100% efficiency. If the pump is 70% efficient, the actual (BHP) required is:

$$\frac{2.27}{0.70} = 3.25 \text{ BHP}$$

Wire Data: Standard Annealed Copper at 20° C

American Wire Gauge	Metric Wire Gauge	Diameter Mils	Diameter mm	Resistance Per mft Ohms	Per km Ohms
1		289.3	7.348	0.9239	0.4065
	7.0		7.000		0.4480
2		257.6	6.543	0.1563	0.5128
	6.0		6.000		0.6098
3		229.4	5.827	0.1971	0.6466
4		204.3	5.189	0.2485	0.8152
	5.0		5.000		0.08781
5		181.9	4.620	0.3134	1.028
	4.5		4.500		1.084
6		162.0	4.115	0.3952	1.297
	4.0		4.000		1.372
7		144.3	3.665	0.4981	1.634
	3.5		3.500		1.792
8		128.5	3.264	0.6281	2.061
	3.0		3.000		2.439
9		114.4	2.906	0.7925	2.600
10		101.9	2.588	0.9988	3.277
	2.5		2.500		3.512
11		90.7	2.30	1.26	4.14
12		80.8	2.05	1.59	5.21
	2.0		2.00		5.49
13		72.0	1.83	2.00	6.56
	1.8		1.80		6.78
14		64.1	1.63	2.52	8.28
	1.6		1.60		8.58
15		57.1	1.45	3.18	10.4
	1.4		1.40		11.2
16		50.8	1.29	4.02	13.2
	1.2		1.20		15.2
17		45.3	1.15	5.05	16.6
18		40.3	1.02	6.39	21.0
	1.0		1.000		22.0
19		35.9	0.912	8.05	26.4
	0.90		0.900		27.1
20		32.0	0.813	10.1	33.2

Table of Voltage Losses for Annealed Copper Wire 25° C (77° F)

(Loss per 1000 feet of wire)

AMPERES	18	16	14	12	10	8	6	4	2
0.1	0.65	0.41	0.26	0.16	0.10	0.06	0.04	0.03	0.02
0.15	0.98	0.61	0.39	0.24	0.15	0.10	0.06	0.04	0.02
0.2	1.30	0.82	0.52	0.32	0.20	0.13	0.08	0.05	0.03
0.25	1.63	1.02	0.65	0.41	0.26	0.16	0.10	0.06	0.04
0.3	1.95	1.23	0.77	0.49	0.31	0.19	0.12	0.08	0.05
0.35	2.28	1.43	0.90	0.57	0.36	0.22	0.14	0.09	0.06
0.4	2.60	1.64	1.03	0.65	0.41	0.26	0.16	0.10	0.06
0.45	2.93	1.84	1.16	0.73	0.46	0.29	0.18	0.11	0.07
0.5	3.26	2.05	1.29	0.81	0.51	0.32	0.20	0.13	0.08
0.6	3.91	2.45	1.55	0.97	0.61	0.38	0.24	0.15	0.10
0.7	4.56	2.86	1.81	1.13	0.71	0.45	0.28	0.18	0.11
0.8	5.21	3.27	2.06	1.30	0.82	0.51	0.32	0.20	0.13
0.9	5.86	3.68	2.32	1.46	0.92	0.58	0.36	0.23	0.14
1.0	6.51	4.09	2.58	1.62	1.02	0.64	0.40	0.25	0.16
1.1	7.16	4.50	2.84	1.78	1.12	0.71	0.44	0.28	0.17
1.2	7.81	4.91	3.10	1.94	1.22	0.77	0.48	0.30	0.19
1.3	8.46	5.32	3.35	2.11	1.33	0.83	0.52	0.33	0.21
1.4	9.11	5.73	3.61	2.27	1.43	0.90	0.56	0.35	0.22
1.5	9.77	6.14	3.87	2.43	1.53	0.96	0.60	0.38	0.24
1.6	10.42	6.54	4.13	2.59	1.63	1.03	0.77	0.40	0.25
1.7	11.07	6.95	4.39	2.75	1.73	1.09	0.69	0.43	0.27
1.8	11.72	7.36	4.64	2.92	1.84	1.15	0.73	0.46	0.29
1.9	12.37	7.77	4.90	3.08	1.94	1.22	0.77	0.48	0.30
2.0	13.02	8.18	5.16	3.24	2.04	1.28	0.81	0.51	0.32
2.1	13.67	8.59	5.42	3.40	2.14	1.35	0.85	0.53	0.33
2.2	14.32	9.00	5.68	3.56	2.24	1.41	0.89	0.56	0.35
2.3	14.97	9.41	5.93	3.73	2.35	1.47	0.93	0.58	0.37
2.4	15.62	9.82	6.19	3.89	2.45	1.54	0.97	0.61	0.38
2.5	16.28	10.23	6.45	4.05	2.55	1.60	1.01	0.63	0.40
2.6	16.93	10.63	6.71	4.21	2.65	1.67	1.05	0.66	0.41
2.7	17.58	11.04	6.97	4.37	2.75	1.73	1.09	0.68	0.43
2.8	18.23	11.45	7.22	4.54	2.86	1.79	1.13	0.71	0.45
2.9	18.88	11.86	7.48	4.70	2.96	1.86	1.17	0.73	0.46
3.0	19.53	12.27	7.74	4.86	3.06	1.92	1.21	0.76	0.48
3.2	20.83	13.09	8.26	5.18	3.26	2.05	1.29	0.81	0.51
3.4	22.13	13.91	8.77	5.51	3.47	2.18	1.37	0.86	0.54
3.6	23.44	14.72	9.29	5.83	3.67	2.31	1.45	0.91	0.57
3.8	24.74	15.54	9.80	6.16	3.88	2.44	1.53	0.96	0.60
4.0	26.04	16.36	10.32	6.48	4.08	2.56	1.61	1.01	0.64
4.2	27.34	17.18	10.84	6.80	4.28	2.69	1.69	1.06	0.67
4.4	28.64	18.00	11.35	7.13	4.49	2.82	1.77	1.11	0.70
4.6	29.95	18.81	11.87	7.45	4.69	2.95	1.85	1.16	0.73
4.8	31.25	19.63	12.38	7.78	4.90	3.08	1.93	1.21	0.76
5.0	32.55	20.45	12.90	8.10	5.10	3.21	2.02	1.27	0.80
5.2	33.85	21.27	13.42	8.42	5.30	3.33	2.10	1.32	0.83
5.4	35.15	22.09	13.93	8.75	5.51	3.46	2.18	1.37	0.86
5.6	36.46	22.90	14.45	9.07	5.71	3.59	2.26	1.42	0.89
5.8	37.76	23.72	14.96	9.40	5.92	3.72	2.34	1.47	0.92
6.0	39.06	24.54	15.48	9.72	6.12	3.85	2.42	1.52	0.95
6.2	40.36	25.36	16.00	10.04	6.32	3.97	2.50	1.57	0.99
6.4	41.66	26.18	16.51	10.37	6.53	4.10	2.58	1.62	1.02
6.6	42.97	26.99	17.03	10.69	6.73	4.23	2.66	1.67	1.05
6.8	44.27	27.81	17.54	11.02	6.94	4.36	2.74	1.72	1.08
7.0	45.57	28.63	18.06	11.34	7.14	4.49	2.82	1.77	1.11

To Use This Chart

To find the voltage loss for a two wire circuit, multiply the loss per 1000 feet figure above by twice the actual wire length expressed in thousands.

For a single wire, multiply the loss per 1000 feet value, above by the actual wire length in thousands.

Note: Remember, amperages are additive along a wire where current is demanded by more than one appliance.

Note: Voltage losses are calculated from the formula:

Where: $V = IR$
 I = current in amperes
 R = resistance in ohms per 1000 ft
 V = voltage

Reference Chart

Approximate Number of Wires to be Installed in Conduit or Tubing

MAXIMUM NO. OF WIRES IN CONDUIT OR SLEEVING

WIRE SIZE (AWG)	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	WIRE SIZE (AWG)
18	6	12	20	35	49	80	110	175					18
16	5	10	16	30	42	67	97	150					16
14	4	6	10	18	25	40	56	88	120	150			14
12	3	5	7	15	20	33	50	75	102	130	205		12
10	1	3	6	13	16	27	40	63	85	110	170		10
8	1	2	4	6	9	16	25	35	50	65	105	150	8
6	1	1	3	3	5	10	15	22	32	40	63	92	6
4		1	1	2	4	7	10	16	24	30	48	70	4
2		1	1	2	2	5	9	12	18	22	36	54	2
0			1	1	2	3	5	8	12	15	24	36	0
00			1	1	1	2	4	7	10	14	21	31	00
000				1	1	2	3	6	8	11	18	26	000
0000				1	1	1	2	5	7	10	15	22	0000

Estimating Pipe Size

Nominal Pipe Size	Copper Pipe	Galvanized (Sch. 40 Steel)	PVC Pipe
	Approximate String Length in Inches		
½"	2"	2⅝"	2⅝"
⅝"	2¾"	—	—
¾"	2¾"	3⅝"	3⅝"
1"	3½"	4⅞"	4⅞"
1¼"	4⅝"	5⅜"	5⅜"
1½"	5⅞"	6"	6"
2"	6¾"	7⅞"	7⅞"

To determine the nominal size of a pipe, wrap a string around the pipe and compare its length to the chart above.

Operating Pressures for PVC, Polyethylene Pipe and Copper Tube

Pressure Rating (psi) at 73.4° F (23° C)

Nominal Size	Sch 80 PVC*	Sch 40 PVC*	(SDR 13.5) CI 315	(SDR 21) CI 200	(SDR 26) CI 160	(SDR 32.5) CI 125	Sch 40 PE
½"	850	600	315	***	***	***	190
¾"	690	480	315	200	***	***	150
1"	630	450	315	200	160	***	140
1¼"	520	370	315	200	160	***	120
1½"	470	330	315	200	160	***	100
2"	400	280	315	200	160	***	90
2½"	420	300	315	200	160	***	100
3"	370	260	315	200	160	125	80
4"	320	220	315	200	160	125	70
6"	280	180	315	200	160	125	60
8"	250	160	315	200	160	125	++
10"	230	140	315	200	160	125	++
12"	230	130	315	200	160	125	++

Note:

- 1) Pressure ratings are the maximum that should be applied. Surge pressures should be included.
- 2) Pressure ratings must be reduced for temperatures over 23° C (73.4° F)
- 3) These ratings do not apply for threaded pipe. Do not thread Sch 40 pipe
- 4) "****" indicates pipe not listed because wall thickness less than 0.060 minimum
- 5) Burst pressures are generally about 2.5 to 2.8 times the maximum pressure rating
- 6) PVC 1120, 1220 code designations
- 7) Non-threaded pipe
- 8) "*" Sch 80 & Sch 40 pipe rounded to the nearest ten.

Copper Tube

Nominal Size	Type M		Type L		Type K	
	Annealed	Hard Drawn	Annealed	Hard Drawn	Annealed	Hard Drawn
½"	430	760	625	1105	780	1375
¾"	350	610	495	875	750	1315
1"	295	515	440	770	575	1010
1¼"	295	515	385	680	465	820
1½"	290	510	355	630	435	765
2"	300	450	315	555	380	665
2½"	235	410	295	520	355	520
3"	220	385	275	490	340	605
4"	215	380	255	450	315	555
6"	190	335	215	385	305	540
8"	200	350	240	420	325	580
10"	205	355	240	425	330	585
12"	205	360	225	395	330	585

Rated Internal Working Pressure for Copper Tube for Service Temperatures up to 150°F, psi

PVC Schedule 40 and Schedule 80 Pipe & Injection Molded Fittings Suggested Maximum Internal Pressure Ratings

Pressure Rating (psi) at 73.4° F (23° C)

Suggested PVC Pipe & Injection Molded Fittings Internal Pressure Ratings						
Nominal Size	Schedule 40			Schedule 80		
	Pipe	Solvent Cemented Joint	Threaded Joint	Pipe	Solvent Cemented Joint	Threaded Joint
½"	596	358	179	848	509	254
¾"	482	289	144	688	413	206
1"	450	270	135	630	378	189
1¼"	368	221	110	520	312	156
1½"	330	198	99	471	282	141
2"	277	166	83	404	243	121
2½"	304	182	91	425	255	127
3"	263	158	79	375	225	112
3½"	240	144	72	345	207	103
4"	222	133	66	324	194	97
6"	177	106	53	279	167	83
8"	155	93	46	246	148	—
10"	141	150	—	234	200	—
12"	132	150	—	228	200	—

This table is for use as a general guide only. Actual Internal Pressure Ratings may vary widely with field conditions. Elevated operating temperatures will necessitate a devaluation of the above ratings.

Note: Historically, manufactures have assumed that fittings have the same internal pressure rating as pipe. A recent engineering study* by Keller-Bleisner Engineering of Logan, Utah, indicates that while the fittings do meet the minimum burst requirements of pipe, actual operating conditions may require a devaluation of the internal pressure rating for fittings. The devaluation is due to the applied stress loads to the fitting caused by the operating parameters of the system. The maximum internal pressure ratings are admittedly based on limited data but it is most recent study pertaining to fitting internal pressure ratings.

*The above study was funded by Dura, Eslon, LCP, Lasco, Nibco, R&G Sloane, and Spears.

The Affinity Laws

The total dynamic head (TDH) discharge capacity (flow) and brake horsepower (BHP) from a pump are a function of the impeller diameter and rotational speed (RPM). When selecting a pump model it is uncommon to find the exact match of TDH and capacity. The Affinity Laws can be used to determine the appropriate RPM, impeller diameter or brake horsepower (BHP) for a given flow and TDH requirement.

The relationship between pump capacity, TDH, BHP and horsepower for different RPM's and impeller diameters are as follows: the flow varies directly with speed (or impeller diameter), pressure varies as the square of speed (or impeller diameter), and power varies as the square of speed (or impeller diameter), and power varies as the cube of speed (or impeller diameter). A mathematical representation of the Affinity Laws is shown below:

$$\begin{array}{lll} \frac{Q_1}{Q_2} = \left[\frac{N_1}{N_2} \right] & \frac{H_1}{H_2} = \left[\frac{N_1}{N_2} \right]^2 & \frac{BHP_1}{BHP_2} = \left[\frac{N_1}{N_2} \right]^3 \\ \frac{Q_1}{Q_2} = \left[\frac{D_1}{D_2} \right] & \frac{H_1}{H_2} = \left[\frac{D_1}{D_2} \right]^2 & \frac{BHP_1}{BHP_2} = \left[\frac{H_1}{H_2} \right]^3 \end{array}$$

Where:

- Q = Pump Capacity (gpm)
- H = Total Dynamic Head (ft)
- BHP = Brake Horsepower (ft-lb/sec)
- N = Impeller Rotational Velocity (rpm)
- D = Impeller Diameter (inches)

FRICTION LOSS CHARTS

Class 100 IPS U.S. PVC Plastic Pipe

(1120,1220) C=150 SDR 41

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3½" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick		4" 4.280 4.500 0.110	6" 6.30 6.625 0.162	8" 8.20 8.625 0.210	10" 10.266 10.750 0.262	12" 12.128 12.750 0.311	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM		Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
10		0.22 0.00					10
15		0.33 0.01					15
20		0.45 0.01					20
25		0.56 0.00					25
30		0.67 0.01					30
35		0.78 0.03	0.36 0.00				35
40		0.89 0.03	0.41 0.01				40
45		1.00 0.04	0.46 0.01				45
50		1.11 0.05	0.51 0.01				50
55		1.22 0.06	0.57 0.01				55
60		1.34 0.07	0.62 0.01				60
65		1.45 0.08	0.67 0.01				65
70		1.56 0.09	0.72 0.01				70
75		1.67 0.11	0.77 0.02	0.45 0.00			75
80		1.78 0.12	0.82 0.02	0.48 0.01			80
85		1.89 0.13	0.87 0.02	0.52 0.01			85
90		2.00 0.15	0.92 0.02	0.55 0.01			90
95		2.12 0.17	0.98 0.03	0.58 0.01			95
100		2.23 0.18	1.03 0.03	0.61 0.01			100
110		2.45 0.22	1.13 0.03	0.67 0.01			110
120		2.67 0.26	1.23 0.04	0.73 0.01			120
130		2.90 0.30	1.34 0.05	0.79 0.01			130
140		3.12 0.34	1.44 0.05	0.85 0.01	0.54 0.00		140
150		3.34 0.39	1.54 0.06	0.91 0.02	0.58 0.01		150
160		3.56 0.43	1.64 0.07	0.97 0.02	0.62 0.01		160
170		3.79 0.49	1.75 0.07	1.03 0.02	0.66 0.01		170
180		4.01 0.54	1.85 0.08	1.09 0.02	0.70 0.01		180
190		4.23 0.60	1.95 0.09	1.15 0.03	0.74 0.01		190
200		4.45 0.66	2.06 0.10	1.21 0.03	0.77 0.01	0.55 0.00	200
225		5.01 0.82	2.31 0.12	1.36 0.03	0.87 0.01	0.62 0.01	225
250		5.57 0.99	2.57 0.15	1.52 0.04	0.97 0.01	0.69 0.01	250
300		6.68 1.39	3.08 0.21	1.82 0.06	1.16 0.02	0.83 0.01	300
350		7.80 1.85	3.60 0.28	2.12 0.08	1.35 0.03	0.97 0.01	350
400		8.91 2.37	4.11 0.36	2.42 0.10	1.55 0.03	1.11 0.01	400
450		10.02 2.95	4.62 0.45	2.73 0.12	1.74 0.04	1.25 0.02	450
500		11.14 3.59	5.14 0.55	3.03 0.15	1.94 0.05	1.39 0.02	500
550		12.25 4.28	5.65 0.65	3.33 0.18	2.13 0.06	1.53 0.03	550
600		13.36 5.03	6.17 0.77	3.64 0.21	2.32 0.07	1.66 0.03	600
650		14.48 5.83	6.68 0.89	3.94 0.25	2.52 0.08	1.80 0.04	650
700		15.59 6.69	7.19 1.02	4.24 0.28	2.71 0.09	1.94 0.04	700
750		16.70 7.60	7.71 1.16	4.55 0.32	2.90 0.11	2.08 0.05	750
800		17.82 8.57	8.22 1.31	4.85 0.36	3.10 0.12	2.22 0.05	800
850		18.93 9.59	8.73 1.46	5.15 0.40	3.29 0.14	2.36 0.06	850
900			9.25 1.62	5.45 0.45	3.48 0.15	2.50 0.07	900
950			9.76 1.79	5.76 0.50	3.68 0.17	2.64 0.07	950
1000			10.28 1.97	6.06 0.55	3.87 0.18	2.77 0.08	1000
1050			10.79 2.16	6.36 0.60	4.06 0.20	2.91 0.09	1050
1100			11.30 2.35	6.67 0.65	4.26 0.22	3.05 0.10	1100
1150			11.82 2.56	6.97 0.71	4.45 0.24	3.19 0.11	1150
1200			12.33 2.77	7.27 0.77	4.65 0.26	3.33 0.11	1200
1250			12.85 2.98	7.58 0.83	4.84 0.28	3.47 0.12	1250
1300			13.36 3.21	7.88 0.89	5.03 0.30	3.61 0.13	1300
1350			13.87 3.44	8.18 0.95	5.23 0.32	3.74 0.14	1350
1400			14.39 3.68	8.48 1.02	5.42 0.34	3.88 0.15	1400
1450			14.90 3.93	8.79 1.09	5.61 0.37	4.02 0.16	1450
Nominal Size			15.41 4.18	9.09 1.16	5.81 0.39	4.16 0.17	1500
Pipe ID	10.266	12.128	15.93 4.44	9.39 1.23	6.00 0.41	4.30 0.18	1550
Pipe OD	10.750	12.750	16.44 4.71	9.70 1.30	6.19 0.44	4.44 0.19	1600
Wall Thick	0.262	0.311	16.96 4.99	10.00 1.38	6.39 0.46	4.58 0.21	1650
			17.47 5.27	10.30 1.46	6.58 0.49	4.72 0.22	1700
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	17.98 5.56 18.50 5.86 19.01 6.16 19.53 6.48	10.61 1.54 10.91 1.62 11.21 1.71 11.51 1.79 11.82 1.88	6.77 0.52 6.97 0.54 7.16 0.57 7.36 0.60 7.55 0.63	4.85 0.23 4.99 0.24 5.13 0.25 5.27 0.27 5.41 0.28	1750 1800 1850 1900 1950
3500	13.55 1.87	9.71 0.83					
3600	13.94 1.97	9.99 0.87					
3700	14.32 2.07	10.26 0.92		12.12 1.97	7.74 0.66	5.55 0.29	2000
3800	14.71 2.17	10.54 0.97		12.73 2.16	8.13 0.72	5.83 0.32	2100
3900	15.10 2.28	10.82 1.01		13.33 2.35	8.52 0.79	6.10 0.35	2200
4000	15.49 2.39	11.10 1.06		13.94 2.55	8.90 0.86	6.38 0.38	2300
4100	15.87 2.50	11.37 1.11		14.55 2.76	9.29 0.93	6.66 0.41	2400
4200	16.26 2.62	11.65 1.16		15.15 2.98	9.68 1.00	6.93 0.44	2500
4300	16.65 2.73	11.93 1.21		15.76 3.20	10.07 1.08	7.21 0.48	2600
4400	17.03 2.85	12.20 1.27		16.36 3.44	10.45 1.15	7.49 0.51	2700
4500	17.42 2.97	12.48 1.32		16.97 3.68	10.84 1.24	7.77 0.55	2800
4600	17.81 3.10	12.76 1.38		17.58 3.92	11.23 1.32	8.04 0.59	2900

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Class 125 IPS U.S. PVC Plastic Pipe

(1120,1220) C=150 SDR 32.5

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 1" THRU 5"

Nominal Size Pipe ID Pipe OD Wall Thick	1"		1¼"		1½"		2"		2½"		3"		4"		Nominal Size Pipe ID Pipe OD Wall Thick
	1.211 1.315 0.052		1.548 1.660 0.056		1.784 1.900 0.058		2.229 2.375 0.073		2.699 2.875 0.088		3.284 3.500 0.108		4.224 4.500 0.138		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	0.28	0.02	0.17	0.01	0.13	0.00									1
2	0.56	0.06	0.34	0.02	0.26	0.01	0.16	0.00							2
3	0.83	0.13	0.51	0.04	0.38	0.02	0.25	0.01							3
4	1.11	0.22	0.68	0.07	0.51	0.03	0.33	0.01	0.22	0.00					4
5	1.39	0.33	0.85	0.10	0.64	0.05	0.41	0.02	0.28	0.01					5
6	1.67	0.46	1.02	0.14	0.77	0.07	0.49	0.02	0.34	0.01					6
7	1.95	0.62	1.19	0.19	0.90	0.09	0.57	0.03	0.39	0.01	0.26	0.00			7
8	2.23	0.79	1.36	0.24	1.03	0.12	0.66	0.04	0.45	0.02	0.30	0.01			8
9	2.50	0.98	1.53	0.30	1.15	0.15	0.74	0.05	0.50	0.02	0.34	0.01			9
10	2.78	1.19	1.70	0.36	1.28	0.18	0.82	0.06	0.56	0.02	0.38	0.01			10
11	3.06	1.42	1.87	0.43	1.41	0.22	0.90	0.07	0.62	0.03	0.42	0.01			11
12	3.34	1.67	2.04	0.51	1.54	0.25	0.99	0.09	0.67	0.03	0.45	0.01			12
13	3.62	1.94	2.21	0.59	1.67	0.29	1.07	0.10	0.73	0.04	0.49	0.02	0.30	0.00	13
14	3.89	2.22	2.38	0.67	1.79	0.34	1.15	0.11	0.78	0.05	0.53	0.02	0.32	0.01	14
15	4.17	2.53	2.55	0.77	1.92	0.38	1.23	0.13	0.84	0.05	0.57	0.02	0.34	0.01	15
16	4.45	2.85	2.72	0.86	2.05	0.43	1.31	0.15	0.90	0.06	0.61	0.02	0.37	0.01	16
17	4.73	3.19	2.89	0.96	2.18	0.48	1.40	0.16	0.95	0.06	0.64	0.02	0.39	0.01	17
18	5.01	3.54	3.06	1.07	2.31	0.54	1.48	0.18	1.01	0.07	0.68	0.03	0.41	0.01	18
19	5.29	3.91	3.23	1.19	2.44	0.59	1.56	0.20	1.06	0.08	0.72	0.03	0.43	0.01	19
20	5.56	4.31	3.41	1.30	2.56	0.65	1.64	0.22	1.12	0.09	0.76	0.03	0.46	0.01	20
22	6.12	5.14	3.75	1.56	2.82	0.78	1.81	0.26	1.23	0.10	0.83	0.04	0.50	0.01	22
24	6.68	6.03	4.09	1.83	3.08	0.92	1.97	0.31	1.34	0.12	0.91	0.05	0.55	0.01	24
25	6.96	6.51	4.26	1.97	3.20	0.99	2.05	0.33	1.40	0.13	0.95	0.05	0.57	0.01	25
26	7.23	7.00	4.43	2.12	3.33	1.06	2.14	0.36	1.46	0.14	0.98	0.05	0.59	0.02	26
28	7.79	8.03	4.77	2.43	3.59	1.22	2.30	0.41	1.57	0.16	1.06	0.06	0.64	0.02	28
30	8.35	9.12	5.11	2.76	3.85	1.38	2.46	0.47	1.68	0.18	1.13	0.07	0.69	0.02	30
32	8.90	10.28	5.45	3.11	4.10	1.56	2.63	0.53	1.79	0.21	1.21	0.08	0.73	0.02	32
34	9.46	11.50	5.79	3.48	4.36	1.75	2.79	0.59	1.90	0.23	1.29	0.09	0.78	0.03	34
35	9.74	12.14	5.96	3.67	4.49	1.84	2.87	0.62	1.96	0.25	1.32	0.09	0.80	0.03	35
36	10.02	12.79	6.13	3.87	4.62	1.94	2.96	0.66	2.02	0.26	1.36	0.10	0.82	0.03	36
38	10.57	14.13	6.47	4.28	4.87	2.15	3.12	0.73	2.13	0.29	1.44	0.11	0.87	0.03	38
40	11.13	15.54	6.81	4.71	5.13	2.36	3.28	0.80	2.24	0.31	1.51	0.12	0.91	0.04	40
42	11.68	17.01	7.15	5.15	5.38	2.58	3.45	0.87	2.35	0.34	1.59	0.13	0.96	0.04	42
44	12.24	18.54	7.49	5.61	5.64	2.81	3.61	0.95	2.46	0.38	1.66	0.14	1.01	0.04	44
45	12.52	19.33	7.66	5.85	5.77	2.93	3.70	0.99	2.52	0.39	1.70	0.15	1.03	0.04	45
46	12.80	20.13	7.83	6.10	5.90	3.06	3.78	1.03	2.58	0.41	1.74	0.16	1.05	0.05	46
48	13.35	21.78	8.17	6.60	6.15	3.31	3.94	1.12	2.69	0.44	1.82	0.17	1.10	0.05	48
50	13.91	23.49	8.51	7.11	6.41	3.57	4.11	1.21	2.80	0.48	1.89	0.18	1.14	0.05	50
55	15.30	28.03	9.36	8.49	7.05	4.26	4.52	1.44	3.08	0.57	2.08	0.22	1.26	0.06	55
60	16.69	32.93	10.22	9.97	7.69	5.00	4.93	1.69	3.36	0.67	2.27	0.26	1.37	0.08	60
65	18.08	38.19	11.07	11.57	8.33	5.80	5.34	1.96	3.64	0.77	2.46	0.30	1.49	0.09	65
70	19.47	43.81	11.92	13.27	8.97	6.65	5.75	2.25	3.92	0.89	2.65	0.34	1.60	0.10	70
75			12.77	15.07	9.61	7.56	6.16	2.56	4.20	1.01	2.84	0.39	1.72	0.11	75
80			13.62	16.99	10.26	8.52	6.57	2.88	4.48	1.14	3.03	0.44	1.83	0.13	80
85			14.47	19.01	10.90	9.53	6.98	3.22	4.76	1.27	3.22	0.49	1.94	0.14	85
90			15.32	21.13	11.54	10.59	7.39	3.58	5.04	1.41	3.40	0.54	2.06	0.16	90
95			16.17	23.35	12.18	11.71	7.80	3.96	5.32	1.56	3.59	0.60	2.17	0.18	95
100			17.03	25.68	12.82	12.88	8.21	4.36	5.60	1.72	3.78	0.66	2.29	0.19	100
110			18.73	30.64	14.10	15.36	9.03	5.20	6.16	2.05	4.16	0.79	2.52	0.23	110
120					15.38	18.05	9.85	6.11	6.72	2.41	4.54	0.93	2.74	0.27	120
130					16.67	20.93	10.68	7.08	7.28	2.79	4.92	1.07	2.97	0.32	130
140					17.95	24.01	11.50	8.12	7.84	3.20	5.30	1.23	3.20	0.36	140
150					19.23	27.28	12.32	9.23	8.40	3.64	5.67	1.40	3.43	0.41	150
160							13.14	10.40	8.96	4.10	6.05	1.58	3.66	0.46	160
170							13.96	11.64	9.52	4.59	6.43	1.77	3.89	0.52	170
180							14.78	12.94	10.08	5.10	6.81	1.96	4.12	0.58	180
190							15.60	14.30	10.64	5.64	7.19	2.17	4.34	0.64	190
200							16.42	15.73	11.20	6.20	7.57	2.39	4.57	0.70	200
225							18.48	19.56	12.60	7.71	8.51	2.97	5.15	0.87	225
250									14.00	9.37	9.46	3.61	5.72	1.06	250
275									15.40	11.18	10.40	4.30	6.29	1.26	275
300									16.80	13.14	11.35	5.06	6.86	1.49	300
325									18.20	15.23	12.30	5.86	7.43	1.72	325
350									19.60	17.48	13.24	6.73	8.00	1.98	350
375											14.19	7.64	8.58	2.25	375
400											15.13	8.61	9.15	2.53	400
425											16.08	9.64	9.72	2.83	425
450											17.02	10.71	10.29	3.15	450
475											17.97	11.84	10.86	3.48	475
500											18.92	13.02	11.43	3.83	500
550													12.58	4.56	550
600													13.72	5.36	600
650													14.86	6.22	650
700													16.01	7.14	700
750													17.15	8.11	750

Shaded area represents velocities over 5 fps.
Use with caution where water hammer is a concern.

Friction Loss Characteristics

Class 125 IPS U.S. PVC Plastic Pipe

(1120,1220) C=150 SDR 32.5
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 6" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	6"		8"		10"		12"			Nominal Size Pipe ID Pipe OD Wall Thick	8"		10"		12"	
	6.217 6.625 0.204		8.095 8.625 0.265		10.088 10.750 0.331		11.966 12.750 0.392				8.095 8.625 0.265		10.088 10.750 0.331		11.966 12.750 0.392	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS		Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS
40	0.42	0.01								1850	11.52	1.82	7.42	0.62	5.27	0.27
45	0.48	0.01								1900	11.83	1.91	7.62	0.66	5.41	0.29
50	0.53	0.01								1950	12.14	2.01	7.82	0.69	5.56	0.30
55	0.58	0.01								2000	12.45	2.10	8.02	0.72	5.70	0.31
60	0.63	0.01								2050	12.76	2.20	8.22	0.75	5.84	0.33
65	0.69	0.01								2100	13.08	2.30	8.42	0.79	5.98	0.34
70	0.74	0.02								2150	13.39	2.41	8.62	0.82	6.13	0.36
75	0.79	0.02	0.47	0.00						2200	13.70	2.51	8.82	0.86	6.27	0.37
80	0.84	0.02	0.50	0.01						2250	14.01	2.62	9.02	0.90	6.41	0.39
85	0.90	0.02	0.53	0.01						2300	14.32	2.73	9.22	0.93	6.55	0.41
90	0.95	0.02	0.56	0.01						2350	14.63	2.84	9.42	0.97	6.70	0.42
95	1.00	0.03	0.59	0.01						2400	14.94	2.95	9.62	1.01	6.84	0.44
100	1.06	0.03	0.62	0.01						2450	15.25	3.06	9.82	1.05	6.98	0.46
110	1.16	0.04	0.68	0.01						2500	15.57	3.18	10.02	1.09	7.12	0.48
120	1.27	0.04	0.75	0.01						2550	15.88	3.30	10.22	1.13	7.27	0.49
130	1.37	0.05	0.81	0.01	0.52	0.00				2600	16.19	3.42	10.42	1.17	7.41	0.51
140	1.48	0.06	0.87	0.02	0.56	0.01				2650	16.50	3.54	10.62	1.21	7.55	0.53
150	1.58	0.06	0.93	0.02	0.60	0.01				2700	16.81	3.67	10.82	1.26	7.69	0.55
160	1.69	0.07	1.00	0.02	0.64	0.01				2750	17.12	3.80	11.03	1.30	7.84	0.57
170	1.79	0.08	1.06	0.02	0.68	0.01				2800	17.43	3.92	11.23	1.34	7.98	0.59
180	1.90	0.09	1.12	0.02	0.72	0.01				2850	17.74	4.06	11.43	1.39	8.12	0.61
190	2.01	0.10	1.18	0.03	0.76	0.01				2900	18.06	4.19	11.63	1.44	8.26	0.63
200	2.11	0.11	1.25	0.03	0.80	0.01	0.57	0.00		2950	18.37	4.32	11.83	1.48	8.41	0.65
225	2.38	0.13	1.40	0.04	0.90	0.01	0.64	0.01		3000	18.68	4.46	12.03	1.53	8.55	0.67
250	2.64	0.16	1.56	0.04	1.00	0.02	0.71	0.01		3050	18.99	4.60	12.23	1.58	8.69	0.69
275	2.90	0.19	1.71	0.05	1.10	0.02	0.78	0.01		3100	19.30	4.74	12.43	1.62	8.83	0.71
300	3.17	0.23	1.87	0.06	1.20	0.02	0.85	0.01		3150	19.61	4.88	12.63	1.67	8.98	0.73
325	3.43	0.26	2.02	0.07	1.30	0.02	0.93	0.01		3200	19.92	5.03	12.83	1.72	9.12	0.75
350	3.69	0.30	2.18	0.08	1.40	0.03	1.00	0.01		3250			13.03	1.77	9.26	0.77
375	3.96	0.34	2.33	0.09	1.50	0.03	1.07	0.01		3300			13.23	1.82	9.40	0.79
400	4.22	0.39	2.49	0.11	1.60	0.04	1.14	0.02		3350			13.43	1.87	9.55	0.82
425	4.49	0.43	2.65	0.12	1.70	0.04	1.21	0.02		3400			13.63	1.93	9.69	0.84
450	4.75	0.48	2.80	0.13	1.80	0.05	1.28	0.02		3450			13.83	1.98	9.83	0.86
475	5.01	0.53	2.96	0.15	1.90	0.05	1.35	0.02		3500			14.03	2.03	9.97	0.89
500	5.28	0.58	3.11	0.16	2.00	0.06	1.42	0.02		3550			14.23	2.09	10.12	0.91
550	5.81	0.70	3.42	0.19	2.21	0.07	1.57	0.03		3600			14.43	2.14	10.26	0.93
600	6.33	0.82	3.74	0.23	2.41	0.08	1.71	0.03		3700			14.83	2.25	10.54	0.98
650	6.86	0.95	4.05	0.26	2.61	0.09	1.85	0.04		3800			15.23	2.37	10.83	1.03
700	7.39	1.09	4.36	0.30	2.81	0.10	1.99	0.04		3900			15.64	2.48	11.11	1.08
750	7.92	1.24	4.67	0.34	3.01	0.12	2.14	0.05		4000			16.04	2.60	11.40	1.13
800	8.44	1.39	4.98	0.39	3.21	0.13	2.28	0.06		4100			16.44	2.73	11.68	1.19
850	8.97	1.56	5.29	0.43	3.41	0.15	2.42	0.06		4200			16.84	2.85	11.97	1.24
900	9.50	1.73	5.60	0.48	3.61	0.16	2.56	0.07		4300			17.24	2.98	12.25	1.30
1000	10.56	2.11	6.23	0.58	4.01	0.20	2.85	0.09		4400			17.64	3.11	12.54	1.35
1050	11.08	2.31	6.54	0.64	4.21	0.22	2.99	0.10		4500			18.04	3.24	12.82	1.41
1100	11.61	2.51	6.85	0.70	4.41	0.24	3.13	0.10		4600			18.44	3.37	13.11	1.47
1150	12.14	2.73	7.16	0.76	4.61	0.26	3.28	0.11		4700			18.84	3.51	13.39	1.53
1200	12.67	2.95	7.47	0.82	4.81	0.28	3.42	0.12		4800			19.24	3.65	13.68	1.59
1250	13.19	3.18	7.78	0.88	5.01	0.30	3.56	0.13		4900			19.64	3.79	13.96	1.65
1300	13.72	3.42	8.09	0.95	5.21	0.32	3.70	0.14		5000					14.25	1.71
1350	14.25	3.67	8.41	1.02	5.41	0.35	3.85	0.15		5100					14.53	1.78
1400	14.78	3.93	8.72	1.09	5.61	0.37	3.99	0.16		5200					14.82	1.84
1450	15.31	4.19	9.03	1.16	5.81	0.40	4.13	0.17		5300					15.10	1.91
1500	15.83	4.46	9.34	1.24	6.01	0.42	4.27	0.18		5400					15.39	1.98
1550	16.36	4.74	9.65	1.31	6.21	0.45	4.42	0.20		5600					15.96	2.12
1600	16.89	5.03	9.96	1.39	6.41	0.48	4.56	0.21		5800					16.53	2.26
1650	17.42	5.32	10.27	1.47	6.62	0.51	4.70	0.22		6000					17.10	2.40
1700	17.95	5.63	10.58	1.56	6.82	0.53	4.84	0.23		6500					18.52	2.79
1750	18.47	5.94	10.90	1.64	7.02	0.56	4.99	0.25		7000					19.95	3.20
1800	19.00	6.26	11.21	1.73	7.22	0.59	5.13	0.26								

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Class 160 IPS U.S. PVC Plastic Pipe

(1120,1220) C=150 SDR 26

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 1" THRU 5"

Nominal Size Pipe ID Pipe OD Wall Thick	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	Nominal Size Pipe ID Pipe OD Wall Thick
	1.195 1.315 0.060	1.532 1.660 0.064	1.754 1.900 0.073	2.193 2.375 0.091	2.655 2.875 0.110	3.230 3.500 0.135	4.154 4.500 0.173	
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
1	0.29 0.02	0.17 0.01	0.13 0.00					1
2	0.57 0.06	0.35 0.02	0.27 0.01	0.17 0.00				2
3	0.86 0.14	0.52 0.04	0.40 0.02	0.25 0.01				3
4	1.14 0.23	0.70 0.07	0.53 0.04	0.34 0.01	0.23 0.00			4
5	1.43 0.35	0.87 0.11	0.66 0.05	0.42 0.02	0.29 0.01			5
6	1.71 0.49	1.04 0.15	0.80 0.08	0.51 0.03	0.35 0.01	0.23 0.00		6
7	2.00 0.66	1.22 0.20	0.93 0.10	0.59 0.03	0.41 0.01	0.27 0.01		7
8	2.29 0.84	1.39 0.25	1.06 0.13	0.68 0.04	0.46 0.02	0.31 0.01		8
9	2.57 1.05	1.56 0.31	1.19 0.16	0.76 0.05	0.52 0.02	0.35 0.01		9
10	2.86 1.27	1.74 0.38	1.33 0.20	0.85 0.07	0.58 0.03	0.39 0.01		10
11	3.14 1.52	1.91 0.45	1.46 0.23	0.93 0.08	0.64 0.03	0.43 0.01		11
12	3.43 1.78	2.09 0.53	1.59 0.28	1.02 0.09	0.69 0.04	0.47 0.01		12
13	3.71 2.07	2.26 0.62	1.72 0.32	1.10 0.11	0.75 0.04	0.51 0.02	0.31 0.00	13
14	4.00 2.37	2.43 0.71	1.86 0.37	1.19 0.12	0.81 0.05	0.55 0.02	0.33 0.01	14
15	4.29 2.70	2.61 0.80	1.99 0.42	1.27 0.14	0.87 0.06	0.59 0.02	0.35 0.01	15
16	4.57 3.04	2.78 0.91	2.12 0.47	1.36 0.16	0.93 0.06	0.63 0.02	0.38 0.01	16
17	4.86 3.40	2.96 1.01	2.25 0.53	1.44 0.18	0.98 0.07	0.66 0.03	0.40 0.01	17
18	5.14 3.78	3.13 1.13	2.39 0.58	1.53 0.20	1.04 0.08	0.70 0.03	0.43 0.01	18
19	5.43 4.18	3.30 1.25	2.52 0.65	1.60 0.22	1.10 0.09	0.74 0.03	0.45 0.01	19
20	5.71 4.59	3.48 1.37	2.65 0.71	1.70 0.24	1.16 0.09	0.78 0.04	0.47 0.01	20
22	6.29 5.48	3.82 1.64	2.92 0.85	1.87 0.29	1.27 0.11	0.86 0.04	0.52 0.01	22
24	6.86 6.44	4.17 1.92	3.18 0.99	2.04 0.34	1.39 0.13	0.94 0.05	0.57 0.01	24
25	7.14 6.94	4.35 2.07	3.32 1.07	2.12 0.36	1.45 0.14	0.98 0.05	0.59 0.02	25
26	7.43 7.47	4.52 2.23	3.45 1.15	2.21 0.39	1.50 0.15	1.02 0.06	0.61 0.02	26
28	8.00 8.56	4.87 2.56	3.71 1.32	2.38 0.45	1.62 0.18	1.09 0.07	0.66 0.02	28
30	8.57 9.73	5.22 2.91	3.98 1.50	2.55 0.51	1.74 0.20	1.17 0.08	0.71 0.02	30
32	9.14 10.97	5.56 3.27	4.24 1.69	2.71 0.57	1.85 0.23	1.25 0.09	0.76 0.03	32
34	9.71 12.27	5.91 3.66	4.51 1.90	2.88 0.64	1.97 0.25	1.33 0.10	0.80 0.03	34
35	10.00 12.95	6.08 3.87	4.64 2.00	2.97 0.67	2.03 0.27	1.37 0.10	0.83 0.03	35
36	10.29 13.64	6.26 4.07	4.77 2.11	3.05 0.71	2.08 0.28	1.41 0.11	0.85 0.03	36
38	10.86 15.08	6.61 4.50	5.04 2.33	3.22 0.79	2.20 0.31	1.49 0.12	0.90 0.04	38
40	11.43 16.58	6.95 4.95	5.30 2.56	3.39 0.86	2.32 0.34	1.56 0.13	0.95 0.04	40
42	12.00 18.15	7.30 5.42	5.57 2.80	3.56 0.95	2.43 0.37	1.64 0.14	0.99 0.04	42
44	12.57 19.78	7.65 5.91	5.84 3.06	3.73 1.03	2.55 0.41	1.72 0.16	1.04 0.05	44
45	12.86 20.62	7.82 6.16	5.90 3.19	3.82 1.07	2.60 0.42	1.76 0.16	1.06 0.05	45
46	13.14 21.48	8.00 6.41	6.10 3.32	3.90 1.12	2.66 0.44	1.80 0.17	1.09 0.05	46
48	13.71 23.24	8.34 6.94	6.37 3.59	4.07 1.21	2.78 0.48	1.88 0.18	1.13 0.05	48
50	14.29 25.07	8.69 7.48	6.63 3.87	4.24 1.31	2.89 0.52	1.96 0.20	1.18 0.06	50
55	15.71 29.90	9.56 8.93	7.29 4.62	4.67 1.56	3.10 0.61	2.15 0.24	1.30 0.07	55
60	17.14 35.13	10.43 10.49	7.96 5.43	5.09 1.83	3.47 0.72	2.35 0.28	1.42 0.08	60
65	18.57 40.75	11.30 12.16	8.62 6.30	5.51 2.12	3.76 0.84	2.54 0.32	1.54 0.09	65
70		12.17 13.95	9.28 7.22	5.94 2.44	4.05 0.96	2.74 0.37	1.66 0.11	70
75		13.04 15.86	9.95 8.21	6.36 2.77	4.34 1.09	2.93 0.42	1.77 0.12	75
80		13.91 17.87	10.61 9.25	6.79 3.12	4.63 1.23	3.13 0.47	1.89 0.14	80
85		14.78 19.99	11.27 10.35	7.21 3.49	4.92 1.38	3.32 0.53	2.01 0.16	85
90		15.65 22.23	11.94 11.50	7.64 3.88	5.21 1.53	3.52 0.59	2.13 0.17	90
95		16.51 24.57	12.60 12.72	8.06 4.29	5.50 1.69	3.72 0.65	2.25 0.19	95
100		17.38 27.01	13.26 13.98	8.48 4.72	5.79 1.86	3.91 0.72	2.36 0.21	100
110		19.12 32.23	14.59 16.68	9.33 5.63	6.37 2.22	4.30 0.85	2.60 0.25	110
120			15.91 19.60	10.18 6.61	6.95 2.61	4.69 1.00	2.84 0.30	120
130			17.24 22.73	11.03 7.67	7.52 3.02	5.08 1.16	3.07 0.34	130
140			18.57 26.08	11.88 8.79	8.10 3.47	5.47 1.34	3.31 0.39	140
150			19.89 29.63	12.73 9.99	8.68 3.94	5.87 1.52	3.55 0.45	150
160				13.57 11.26	9.26 4.44	6.26 1.71	3.78 0.50	160
170				14.42 12.60	9.84 4.97	6.65 1.91	4.02 0.56	170
180				15.27 14.01	10.42 5.52	7.04 2.13	4.26 0.63	180
190				16.12 15.48	11.00 6.11	7.43 2.35	4.49 0.69	190
200				16.97 17.02	11.58 6.72	7.82 2.59	4.73 0.76	200
225				19.09 21.17	13.02 8.35	8.80 3.22	5.32 0.95	225
250					14.47 10.15	9.78 3.91	5.91 1.15	250
275					15.92 12.11	10.75 4.67	6.50 1.37	275
300					17.36 14.23	11.73 5.48	7.09 1.61	300
325					18.81 16.50	12.71 6.36	7.68 1.87	325
350						13.69 7.29	8.28 2.14	350
375						14.67 8.29	8.87 2.44	375
400						15.64 9.34	9.46 2.75	400
425						16.62 10.45	10.05 3.07	425
450						17.60 11.62	10.64 3.41	450
475						18.58 12.84	11.23 3.77	475
500							11.82 4.15	500

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Friction Loss Characteristics

Class 160 IPS U.S. PVC Plastic Pipe

(1120,1220) C=150 SDR 26

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 6" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	6"	8"	10"	12"		Nominal Size Pipe ID Pipe OD Wall Thick	8"	10"	12"
	6.115 6.625 0.225	7.961 8.625 0.332	9.924 10.750 0.413	11.770 12.750 0.490			7.961 8.625 0.332	9.924 10.750 0.413	11.770 12.750 0.490
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS		Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS
40	0.44 0.01					1850	11.91 1.98	7.66 0.68	5.45 0.29
45	0.49 0.01					1900	12.23 2.08	7.87 0.71	5.60 0.31
50	0.55 0.01					1950	12.55 2.18	8.08 0.75	5.74 0.32
55	0.60 0.01					2000	12.88 2.28	8.29 0.78	5.89 0.34
60	0.65 0.01					2050	13.20 2.39	8.49 0.82	6.04 0.36
65	0.71 0.01					2100	13.52 2.50	8.70 0.85	6.18 0.37
70	0.76 0.02	0.45 0.00				2150	13.84 2.61	8.91 0.89	6.33 0.39
75	0.82 0.02	0.48 0.01				2200	14.16 2.72	9.11 0.93	6.48 0.41
80	0.87 0.02	0.52 0.01				2250	14.48 2.84	9.32 0.97	6.63 0.42
85	0.93 0.02	0.55 0.01				2300	14.81 2.96	9.53 1.01	6.77 0.44
90	0.98 0.03	0.58 0.01				2350	15.13 3.08	9.74 1.05	6.92 0.46
95	1.04 0.03	0.61 0.01				2400	15.45 3.20	9.94 1.09	7.07 0.48
100	1.09 0.03	0.64 0.01				2450	15.77 3.32	10.15 1.14	7.22 0.50
110	1.20 0.04	0.71 0.01				2500	16.09 3.45	10.36 1.18	7.36 0.51
120	1.31 0.04	0.77 0.01				2550	16.42 3.58	10.56 1.22	7.51 0.53
130	1.42 0.05	0.84 0.01	0.54 0.00			2600	16.74 3.71	10.77 1.27	7.66 0.55
140	1.53 0.06	0.90 0.02	0.58 0.01			2650	17.06 3.84	10.98 1.32	7.80 0.57
150	1.64 0.07	0.97 0.02	0.62 0.01			2700	17.38 3.98	11.19 1.36	7.95 0.59
160	1.75 0.08	1.03 0.02	0.66 0.01			2750	17.70 4.12	11.39 1.41	8.10 0.61
170	1.85 0.09	1.09 0.02	0.70 0.01			2800	18.03 4.26	11.60 1.46	8.25 0.64
180	1.96 0.10	1.16 0.03	0.75 0.01			2850	18.35 4.40	11.81 1.51	8.39 0.66
190	2.07 0.11	1.22 0.03	0.79 0.01			2900	18.67 4.54	12.01 1.55	8.54 0.68
200	2.18 0.12	1.29 0.03	0.83 0.01	0.59 0.00		2950	18.99 4.69	12.22 1.60	8.69 0.70
225	2.45 0.14	1.45 0.04	0.93 0.01	0.66 0.01		3000	19.31 4.84	12.43 1.66	8.84 0.72
250	2.73 0.18	1.61 0.05	1.04 0.02	0.74 0.01		3050	19.63 4.99	12.64 1.71	8.98 0.74
275	3.00 0.21	1.77 0.06	1.14 0.02	0.81 0.01		3100	19.96 5.14	12.84 1.76	9.13 0.77
300	3.27 0.25	1.93 0.07	1.24 0.02	0.88 0.01		3150		13.05 1.81	9.28 0.79
325	3.55 0.28	2.09 0.08	1.35 0.03	0.96 0.01		3200		13.26 1.87	9.42 0.81
350	3.82 0.33	2.25 0.09	1.45 0.03	1.03 0.01		3250		13.46 1.92	9.57 0.84
375	4.09 0.37	2.41 0.10	1.55 0.04	1.10 0.02		3300		13.67 1.97	9.72 0.86
400	4.36 0.42	2.58 0.12	1.66 0.04	1.18 0.02		3350		13.88 2.03	9.87 0.89
425	4.64 0.47	2.74 0.13	1.76 0.04	1.25 0.02		3400		14.09 2.09	10.01 0.91
450	4.91 0.52	2.90 0.14	1.86 0.05	1.33 0.02		3450		14.29 2.14	10.16 0.93
475	5.18 0.58	3.06 0.16	1.97 0.05	1.40 0.02		3500		14.50 2.20	10.31 0.96
500	5.46 0.63	3.22 0.18	2.07 0.06	1.47 0.03		3550		14.71 2.26	10.46 0.99
550	6.00 0.75	3.54 0.21	2.28 0.07	1.62 0.03		3600		14.91 2.32	10.60 1.01
600	6.55 0.89	3.86 0.25	2.49 0.08	1.77 0.04		3700		15.33 2.44	10.90 1.06
650	7.09 1.03	4.18 0.28	2.69 0.10	1.91 0.04		3800		15.74 2.56	11.19 1.12
700	7.64 1.18	4.51 0.33	2.90 0.11	2.06 0.05		3900		16.16 2.69	11.49 1.17
750	8.18 1.34	4.83 0.37	3.11 0.13	2.21 0.06		4000		16.57 2.82	11.78 1.23
800	8.73 1.51	5.15 0.42	3.31 0.14	2.36 0.06		4100		16.99 2.95	12.08 1.29
850	9.27 1.69	5.47 0.47	3.52 0.16	2.50 0.07		4200		17.40 3.09	12.37 1.35
900	9.82 1.88	5.79 0.52	3.73 0.18	2.65 0.08		4300		17.81 3.22	12.66 1.41
1000	10.91 2.28	6.44 0.63	4.14 0.22	2.95 0.09		4400		18.23 3.36	12.96 1.47
1050	11.46 2.50	6.76 0.69	4.35 0.24	3.09 0.10		4500		18.64 3.51	13.25 1.53
1100	12.00 2.72	7.08 0.75	4.56 0.26	3.24 0.11		4600		19.06 3.65	13.55 1.59
1150	12.55 2.96	7.40 0.82	4.76 0.28	3.39 0.12		4700		19.47 3.80	13.84 1.66
1200	13.09 3.20	7.73 0.89	4.97 0.30	3.53 0.13		4800		19.89 3.95	14.14 1.72
1250	13.64 3.45	8.05 0.96	5.18 0.33	3.68 0.14		4900			14.43 1.79
1300	14.18 3.71	8.37 1.03	5.39 0.35	3.83 0.15		5000			14.73 1.86
1350	14.73 3.98	8.69 1.10	5.59 0.38	3.98 0.16		5100			15.02 1.93
1400	15.28 4.26	9.01 1.18	5.80 0.40	4.12 0.18		5200			15.31 2.00
1450	15.82 4.54	9.33 1.26	6.01 0.43	4.27 0.19		5300			15.61 2.07
1500	16.37 4.84	9.66 1.34	6.21 0.46	4.42 0.20		5400	Shaded area represents velocities over 5 fps. Use with caution where water hammer is a concern.		15.90 2.14
1550	16.91 5.14	9.98 1.42	6.42 0.49	4.56 0.21		5600			16.49 2.29
1600	17.46 5.45	10.30 1.51	6.63 0.52	4.71 0.23		5800			17.08 2.45
1650	18.00 5.77	10.62 1.60	6.84 0.55	4.86 0.24		6000			17.67 2.60
1700	18.55 6.10	10.94 1.69	7.04 0.58	5.01 0.25		6200			18.26 2.77
1750	19.09 6.44	11.27 1.78	7.25 0.61	5.15 0.27		6400			18.85 2.94
1800	19.64 6.78	11.59 1.88	7.46 0.64	5.30 0.28		6600			19.44 3.11

Shaded area represents velocities over 5 fps. Use with caution where water hammer is a concern.

Friction Loss Characteristics

Class 200 IPS U.S. PVC Plastic Pipe

(1120, 1220) C=150 SDR 21

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ¾" THRU 4"

Nominal Size Pipe ID Pipe OD Wall Thick	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.930 1.050 0.060	1.189 1.315 0.063	1.502 1.660 0.079	1.720 1.900 0.090	2.149 2.375 0.113	2.601 2.875 0.137	3.166 3.500 0.167	4.072 4.500 0.214	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	0.47	0.06	0.29	0.02	0.18	0.01			1
2	0.94	0.22	0.58	0.07	0.36	0.02			2
3	1.42	0.46	0.87	0.14	0.54	0.04			3
4	1.89	0.79	1.15	0.24	0.72	0.08	0.18	0.00	4
5	2.36	1.19	1.44	0.36	0.90	0.12	0.24	0.01	5
6	2.83	1.67	1.73	0.51	1.09	0.16	0.30	0.01	6
7	3.30	2.23	2.02	0.67	1.27	0.22	0.42	0.01	7
8	3.77	2.85	2.31	0.86	1.45	0.28	0.48	0.02	8
9	4.25	3.55	2.60	1.07	1.63	0.34	0.54	0.02	9
10	4.72	4.31	2.89	1.30	1.81	0.42	0.60	0.03	10
12	5.66	6.04	3.46	1.83	2.17	0.59	0.72	0.04	12
14	6.60	8.04	4.04	2.43	2.53	0.78	0.84	0.05	14
15	7.08	9.13	4.33	2.76	2.71	0.89	0.90	0.06	15
16	7.55	10.29	4.62	3.11	2.89	1.00	0.96	0.07	16
18	8.49	12.80	5.19	3.87	3.26	1.24	1.09	0.09	18
20	9.43	15.56	5.77	4.71	3.62	1.51	1.21	0.10	20
22	10.38	18.56	6.35	5.62	3.98	1.80	1.33	0.12	22
24	11.32	21.81	6.93	6.60	4.34	2.12	1.45	0.15	24
25	11.79	23.52	7.22	7.12	4.52	2.28	1.51	0.16	25
26	12.27	25.29	7.50	7.65	4.70	2.45	1.57	0.17	26
28	13.21	29.01	8.08	8.78	5.06	2.82	1.69	0.19	28
30	14.15	32.96	8.66	9.97	5.43	3.20	1.81	0.22	30
32	15.10	37.15	9.24	11.24	5.79	3.61	1.93	0.25	32
34	16.04	41.56	9.81	12.58	6.15	4.03	2.05	0.28	34
35	16.51	43.86	10.10	13.27	6.33	4.26	2.11	0.29	35
36	16.98	46.21	10.39	13.98	6.51	4.48	2.17	0.31	36
38	17.93	51.07	10.97	15.45	6.87	4.96	2.29	0.34	38
40	18.87	56.16	11.54	16.99	7.23	5.45	2.41	0.38	40
42	19.81	61.47	12.12	18.60	7.60	5.97	2.53	0.41	42
44	20.76	67.00	12.70	20.27	7.96	6.50	2.65	0.45	44
45			12.99	21.13	8.14	6.78	2.71	0.47	45
46			13.28	22.01	8.32	7.06	2.77	0.49	46
48			13.85	23.82	8.68	7.64	2.89	0.53	48
50			14.43	25.69	9.04	8.24	3.02	0.57	50
55			15.87	30.65	9.95	9.83	3.32	0.68	55
60			17.32	36.00	10.85	11.55	3.62	0.80	60
65			18.76	41.76	11.76	13.39	3.92	0.93	65
70					12.66	15.36	4.22	1.06	70
75					13.56	17.46	4.52	1.21	75
80					14.47	19.67	4.82	1.36	80
85					15.37	22.01	5.13	1.52	85
90					16.28	24.47	5.43	1.69	90
95					17.18	27.05	5.73	1.87	95
100					18.09	29.74	6.03	2.06	100
110					19.89	35.48	6.63	2.45	110
120					16.55	21.56	7.24	2.88	120
130					17.93	25.00	7.84	3.34	130
140					19.31	28.68	8.44	3.83	140
150							9.05	4.36	150
175							10.55	5.80	175
200							12.06	7.42	200
225							13.57	9.23	225
250							15.08	11.22	250
275							16.58	13.39	275
300							18.09	15.73	300
350							14.25	8.04	350
400							16.28	10.29	400
450							18.32	12.80s	450
500									500
550									550
600									600
700									700
800									800

Shaded area represents velocities over 5 fps.
Use with caution where water hammer is a concern.

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Friction Loss Characteristics

Class 315 IPS PVC Plastic Pipe

(1120,1220) C=150 SDR 13.5
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 3"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.716 0.840 0.062	0.894 1.050 0.078	1.121 1.315 0.097	1.414 1.660 0.123	1.618 1.900 0.141	2.023 2.375 0.176	2.449 2.875 0.213	2.982 3.500 0.259	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	0.80	0.22	0.51	0.07	0.32	0.02	0.20	0.00	1
2	1.59	0.78	1.02	0.27	0.65	0.09	0.41	0.03	2
3	2.39	1.65	1.53	0.56	0.97	0.19	0.61	0.03	3
4	3.18	2.82	2.04	0.96	1.30	0.32	0.82	0.10	4
5	3.97	4.26	2.55	1.45	1.62	0.48	1.02	0.16	5
6	4.77	5.97	3.06	2.03	1.95	0.67	1.22	0.22	6
7	5.57	7.95	3.57	2.70	2.27	0.90	1.43	0.29	7
8	6.37	10.18	4.08	3.45	2.60	1.15	1.63	0.37	8
9	7.16	12.66	4.59	4.30	2.92	1.43	1.84	0.46	9
10	7.96	15.38	5.10	5.22	3.25	1.74	2.04	0.56	10
11	8.75	18.35	5.62	6.23	3.57	2.07	2.24	0.67	11
12	9.55	21.56	6.13	7.32	3.90	2.43	2.45	0.79	12
13	10.35	25.01	6.64	8.49	4.22	2.82	2.65	0.91	13
14	11.14	28.69	7.15	9.74	4.55	3.24	2.86	1.05	14
15	11.94	32.60	7.66	11.07	4.87	3.68	3.06	1.19	15
16	12.73	36.73	8.17	12.47	5.19	4.15	3.26	1.34	16
17	13.53	41.10	8.68	13.95	5.52	4.64	3.47	1.50	17
18	14.33	45.69	9.19	15.51	5.84	5.16	3.67	1.67	18
19	15.12	50.50	9.70	17.14	6.17	5.70	3.88	1.84	19
20	15.92	55.53	10.21	18.85	6.49	6.27	4.08	2.03	20
22	17.51	66.25	11.23	22.49	7.14	7.48	4.49	2.42	22
24	19.10	77.84	12.25	26.42	7.79	8.79	4.90	2.84	24
25			12.76	28.50	8.12	9.48	5.10	3.06	25
26			13.27	30.65	8.44	10.19	5.31	3.29	26
28			14.29	35.15	9.09	11.69	5.71	3.78	28
30			15.31	39.95	9.74	13.28	6.12	4.29	30
32			16.34	45.02	10.39	14.97	6.53	4.84	32
34			17.36	50.37	11.04	16.75	6.94	5.41	34
35			17.87	53.14	11.36	17.67	7.14	5.71	35
36			18.38	55.99	11.69	18.62	7.35	6.02	36
38			19.40	61.89	12.34	20.58	7.75	6.65	38
40					12.99	22.63	8.16	7.31	40
42					13.64	24.77	8.57	8.00	42
44					14.29	27.00	8.98	8.72	44
45					14.61	28.15	9.18	9.09	45
46					14.94	29.32	9.39	9.47	46
48					15.58	31.72	9.79	10.25	48
50					16.23	34.21	10.20	11.05	50
55					17.86	40.82	11.22	13.19	55
60					19.48	47.95	12.24	15.49	60
65					13.26	17.97	10.13	9.33	65
70					14.28	20.61	10.91	10.70	70
75					15.30	23.42	11.69	12.16	75
80					16.32	26.39	12.47	13.70	80
85					17.35	29.53	13.25	15.33	85
90					18.37	32.83	14.03	17.04	90
95					19.39	36.28	14.81	18.83	95
100							15.58	20.71	100
110							17.14	24.71	110
120							18.70	29.03	120
130							12.96	11.35	130
140							13.96	13.02	140
150							14.95	14.80	150
175							17.45	19.69	175
200							19.94	25.21	200
225							15.31	12.37	225
250							17.01	15.04	250
275							18.71	17.94	275
300									300
325									325
350									350
400									400

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Class 315 IPS PVC Plastic Pipe

(1120,1220) C=150 SDR 13.5
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3½" THRU 6"

Nominal Size Pipe ID Pipe OD Wall Thick	4" 3.834 4.500 0.333	6" 5.643 6.625 0.491		Nominal Size Pipe ID Pipe OD Wall Thick	4" 3.834 4.500 0.333	6" 5.643 6.625 0.491
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	Flow GPM	Velocity FPS	PSI LOSS
6				340	9.44	3.00
7				350	9.71	3.17
8				360	9.99	3.34
9				370	10.27	3.51
10	0.28	0.00		380	10.55	3.69
11	0.31	0.01		390	10.82	3.87
12	0.33	0.01		400	11.10	4.06
13	0.36	0.01		410	11.38	4.25
14	0.39	0.01		420	11.66	4.44
15	0.42	0.01		430	11.94	4.64
16	0.44	0.01		440	12.21	4.84
17	0.47	0.01		450	12.49	5.04
18	0.50	0.01		460	12.77	5.25
19	0.53	0.01		470	13.05	5.47
20	0.56	0.02		480	13.32	5.68
22	0.61	0.02		490	13.60	5.91
24	0.67	0.02		500	13.88	6.13
26	0.72	0.03		510	14.16	6.36
28	0.78	0.03	0.36 0.00	520	14.43	6.59
30	0.83	0.03	0.38 0.01	530	14.71	6.83
32	0.89	0.04	0.41 0.01	540	14.99	7.07
34	0.94	0.04	0.44 0.01	550	15.27	7.31
36	1.00	0.05	0.46 0.01	560	15.54	7.56
38	1.05	0.05	0.49 0.01	570	15.82	7.81
40	1.11	0.06	0.51 0.01	580	16.10	8.07
42	1.17	0.06	0.54 0.01	600	16.65	8.59
44	1.22	0.07	0.56 0.01	625	17.35	9.27
48	1.33	0.08	0.62 0.01	650	18.04	9.97
50	1.39	0.09	0.64 0.01	675	18.74	10.69
55	1.53	0.10	0.70 0.02	700	19.43	11.43
60	1.67	0.12	0.77 0.02	725		9.29 1.86
65	1.80	0.14	0.83 0.02	750		9.61 1.98
70	1.94	0.16	0.90 0.02	775		9.93 2.10
75	2.08	0.18	0.96 0.03	800		10.25 2.23
80	2.22	0.21	1.03 0.03	825		10.57 2.36
85	2.36	0.23	1.09 0.04	850		10.89 2.50
90	2.50	0.26	1.15 0.04	875		11.21 2.64
95	2.64	0.28	1.22 0.04	900		11.53 2.78
100	2.78	0.31	1.28 0.05	925		11.85 2.92
110	3.05	0.37	1.41 0.06	950		12.17 3.07
120	3.33	0.44	1.54 0.07	975		12.49 3.22
130	3.61	0.51	1.67 0.08	1000		12.81 3.37
140	3.89	0.58	1.79 0.09	1025		13.13 3.53
150	4.16	0.66	1.92 0.10	1050		13.45 3.69
160	4.44	0.74	2.05 0.11	1075		13.77 3.86
170	4.72	0.83	2.18 0.13	1100		14.09 4.03
180	5.00	0.92	2.31 0.14	1125		14.41 4.20
190	5.27	1.02	2.43 0.16	1150		14.73 4.37
200	5.55	1.12	2.56 0.17	1175		15.05 4.55
210	5.83	1.23	2.69 0.19	1200		15.38 4.73
220	6.11	1.34	2.82 0.20	1225		15.70 4.91
230	6.38	1.46	2.95 0.22	1250		16.02 5.10
240	6.66	1.57	3.08 0.24	1275		16.34 5.29
250	6.94	1.70	3.20 0.26	1300		16.66 5.49
260	7.22	1.83	3.33 0.28	1325		16.98 5.68
270	7.49	1.96	3.46 0.30	1350		17.30 5.88
280	7.77	2.09	3.59 0.32	1375		17.62 6.09
290	8.05	2.24	3.72 0.34	1400		17.94 6.29
300	8.33	2.38	3.84 0.36	1425		18.26 6.50
310	8.60	2.53	3.97 0.39	1450		18.58 6.72
320	8.88	2.68	4.10 0.41	1475		18.90 6.93
330	9.16	2.84	4.23 0.43	1500		19.22 7.15

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Schedule 40 IPS PVC Plastic Pipe

(1120,1220) C=150

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 3"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.622 0.840 0.109	0.824 1.050 0.113	1.049 1.315 0.133	1.380 1.660 0.140	1.610 1.900 0.145	2.067 2.375 0.154	2.469 2.875 0.203	3.068 3.500 0.216	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	1.05	0.43	0.60	0.11	0.37	0.03	0.21	0.01	1
2	2.11	1.55	1.20	0.39	0.74	0.12	0.43	0.03	2
3	3.16	3.28	1.80	0.84	1.11	0.26	0.64	0.07	3
4	4.22	5.59	2.40	1.42	1.48	0.44	0.86	0.12	4
5	5.27	8.45	3.00	2.15	1.85	0.66	1.07	0.17	5
6	6.33	11.85	3.61	3.02	2.22	0.93	1.29	0.25	6
7	7.38	15.76	4.21	4.01	2.60	1.24	1.50	0.33	7
8	8.44	20.18	4.81	5.14	2.97	1.59	1.71	0.42	8
9	9.49	25.10	5.41	6.39	3.34	1.97	1.93	0.52	9
10	10.55	30.51	6.01	7.77	3.71	2.40	2.14	0.63	10
11	11.60	36.40	6.61	9.26	4.08	2.86	2.36	0.75	11
12	12.65	42.77	7.21	10.88	4.45	3.36	2.57	0.89	12
13	13.71	49.60	7.81	12.62	4.82	3.90	2.79	1.03	13
14	14.76	56.90	8.41	14.48	5.19	4.47	3.00	1.18	14
15	15.82	64.65	9.01	16.45	5.56	5.08	3.21	1.34	15
16	16.87	72.86	9.61	18.54	5.93	5.73	3.43	1.51	16
17	17.93	81.52	10.22	20.75	6.30	6.41	3.64	1.69	17
18	18.98	90.62	10.82	23.06	6.67	7.12	3.86	1.88	18
19			11.42	25.49	7.04	7.87	4.07	2.07	19
20			12.02	28.03	7.42	8.66	4.28	2.28	20
22			13.22	33.44	8.16	10.33	4.71	2.72	22
24			14.42	39.29	8.90	12.14	5.14	3.20	24
25			15.02	42.38	9.27	13.09	5.36	3.45	25
26			15.62	45.57	9.64	14.08	5.57	3.71	26
28			16.83	52.27	10.38	16.15	6.00	4.25	28
30			18.03	59.40	11.12	18.35	6.43	4.83	30
32			19.23	66.94	11.86	20.68	6.86	5.44	32
34					12.61	23.13	7.28	6.09	34
35					12.98	24.41	7.50	6.43	35
36					13.35	25.72	7.71	6.77	36
38					14.09	28.43	8.14	7.48	38
40					14.83	31.26	8.57	8.23	40
42					15.57	34.22	9.00	9.01	42
44					16.31	37.29	9.43	9.82	44
45					16.68	38.88	9.64	10.24	45
46					17.06	40.49	9.86	10.66	46
48					17.80	43.81	10.28	11.54	48
50					18.54	47.26	10.71	12.44	50
55							11.78	14.84	55
60							12.85	17.44	60
65					13.93	20.23	10.23	9.55	65
70					15.00	23.20	11.02	10.96	70
75					16.07	26.36	11.81	12.45	75
80					17.14	29.71	12.59	14.03	80
85					18.21	33.24	13.38	15.70	85
90					19.28	36.95	14.17	17.45	90
95							14.95	19.29	95
100							15.74	21.21	100
110							17.31	25.31	110
120							18.89	29.74	120
130							12.41	10.22	130
140							13.37	11.73	140
150							14.32	13.33	150
160							15.28	15.02	160
170							16.23	16.80	170
180							17.19	18.68	180
190							18.14	20.65	190
200							19.10	22.70	200
225									225
250									250
275									275
300									300
325									325
350									350
375									375
400									400

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Schedule 40 IPS PVC Plastic Pipe

(1120,1220) C=150

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3½" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	4" 4.026 4.500 0.237	6" 6.065 6.625 0.280	8" 7.981 8.625 0.322	10" 10.020 10.750 0.365	12" 11.814 12.750 0.406	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
20	0.50 0.01					20
22	0.55 0.01					22
24	0.60 0.02					24
25	0.63 0.02					25
26	0.65 0.02					26
28	0.70 0.02					28
30	0.76 0.03					30
32	0.81 0.03					32
34	0.86 0.03					34
35	0.88 0.04	0.39 0.00				35
36	0.91 0.04	0.40 0.01				36
38	0.96 0.04	0.42 0.01				38
40	1.01 0.04	0.44 0.01				40
42	1.06 0.05	0.47 0.01				42
44	1.11 0.05	0.49 0.01				44
45	1.13 0.06	0.50 0.01				45
46	1.16 0.06	0.51 0.01				46
48	1.21 0.06	0.53 0.01				48
50	1.26 0.07	0.55 0.01				50
55	1.38 0.08	0.61 0.01				55
60	1.51 0.10	0.67 0.01				60
65	1.64 0.11	0.72 0.02				65
70	1.76 0.13	0.78 0.02	0.45 0.00			70
75	1.89 0.14	0.83 0.02	0.48 0.01			75
80	2.01 0.16	0.89 0.02	0.51 0.01			80
85	2.14 0.18	0.94 0.02	0.54 0.01			85
90	2.27 0.20	1.00 0.03	0.58 0.01			90
95	2.39 0.22	1.05 0.03	0.61 0.01			95
100	2.52 0.25	1.11 0.03	0.64 0.01			100
120	3.02 0.34	1.33 0.05	0.77 0.01	0.49 0.00		120
140	3.52 0.46	1.55 0.06	0.90 0.02	0.57 0.01		140
160	4.03 0.59	1.77 0.08	1.02 0.02	0.65 0.01		160
180	4.53 0.73	2.00 0.10	1.15 0.03	0.73 0.01		180
200	5.03 0.89	2.22 0.12	1.28 0.03	0.81 0.01	0.58 0.00	200
250	6.29 1.34	2.77 0.18	1.60 0.05	1.02 0.02	0.73 0.01	250
300	7.55 1.88	3.33 0.26	1.92 0.07	1.22 0.02	0.88 0.01	300
350	8.81 2.50	3.88 0.34	2.24 0.09	1.42 0.03	1.02 0.01	350
400	10.07 3.20	4.44 0.44	2.56 0.11	1.63 0.04	1.17 0.02	400
450	11.33 3.98	4.99 0.54	2.88 0.14	1.83 0.05	1.32 0.02	450
500	12.59 4.83	5.55 0.66	3.20 0.17	2.03 0.06	1.46 0.03	500
600	15.10 6.77	6.66 0.92	3.84 0.24	2.44 0.08	1.75 0.04	600
700	17.62 9.01	7.76 1.23	4.48 0.32	2.84 0.11	2.05 0.05	700
800		8.87 1.57	5.12 0.41	3.25 0.14	2.34 0.06	800
900		9.98 1.95	5.76 0.51	3.66 0.17	2.63 0.08	900
1000		11.09 2.38	6.41 0.62	4.06 0.21	2.92 0.09	1000
1200		13.31 3.33	7.69 0.88	4.88 0.29	3.51 0.13	1200
1400		15.53 4.43	8.97 1.16	5.69 0.39	4.09 0.17	1400
1600		17.75 5.67	10.25 1.49	6.50 0.49	4.68 0.22	1600
1800			11.53 1.86	7.31 0.61	5.26 0.28	1800
2000			12.81 2.26	8.13 0.75	5.85 0.33	2000
2200			14.09 2.69	8.94 0.89	6.43 0.40	2200
2400			15.37 3.16	9.75 1.04	7.02 0.47	2400
2600			16.65 3.67	10.57 1.21	7.60 0.54	2600
2800			17.94 4.21	11.38 1.39	8.19 0.62	2800
3000				12.19 1.58	8.77 0.71	3000
3200				13.00 1.78	9.35 0.80	3200
3400				13.82 1.99	9.94 0.89	3400
3600				14.63 2.21	10.52 0.99	3600
3800				15.44 2.45	11.11 1.10	3800
4000				16.25 2.69	11.69 1.21	4000
4500	Shaded area represents velocities over 5 fps. Use with caution where water hammer is a concern.			18.29 3.35	13.15 1.50	4500
5000					14.62 1.83	5000
5500					16.08 2.18	5500
6000					17.54 2.56	6000
6500					19.00 2.97	6500

Schedule 80 IPS PVC Plastic Pipe

(1120,1220) C=150

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 3"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.546 0.840 0.147	0.742 1.050 0.154	0.957 1.315 0.179	1.278 1.660 0.191	1.500 1.900 0.200	1.939 2.375 0.218	2.323 2.875 0.276	2.900 3.500 0.300	
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
1	1.37 0.81	0.74 0.18	0.45 0.05	0.25 0.01	0.18 0.01	0.11 0.00			1
2	2.74 2.92	1.48 0.66	0.89 0.19	0.50 0.05	0.36 0.02	0.22 0.01	0.15 0.00		2
3	4.11 6.19	2.22 1.39	1.34 0.40	0.75 0.10	0.54 0.05	0.33 0.01	0.23 0.01		3
4	5.47 10.54	2.96 2.37	1.78 0.69	1.00 0.17	0.73 0.08	0.43 0.02	0.30 0.01		4
5	6.84 15.94	3.71 3.58	2.23 1.04	1.25 0.25	0.91 0.12	0.54 0.03	0.38 0.01	0.24 0.00	5
6	8.21 22.34	4.45 5.02	2.67 1.46	1.50 0.36	1.09 0.16	0.65 0.05	0.45 0.02	0.29 0.01	6
7	9.58 29.72	5.19 6.68	3.12 1.94	1.75 0.47	1.27 0.22	0.76 0.06	0.53 0.03	0.34 0.01	7
8	10.95 38.05	5.93 8.55	3.56 2.48	2.00 0.61	1.45 0.28	0.87 0.08	0.60 0.03	0.39 0.01	8
9	12.32 47.33	6.67 10.64	4.01 3.08	2.25 0.75	1.63 0.35	0.98 0.10	0.68 0.04	0.44 0.01	9
10	13.69 57.53	7.41 12.93	4.45 3.75	2.50 0.92	1.81 0.42	1.09 0.12	0.76 0.05	0.49 0.02	10
11	15.05 68.63	8.15 15.43	4.90 4.47	2.75 1.09	1.99 0.50	1.19 0.14	0.83 0.06	0.53 0.02	11
12	16.42 80.63	8.89 18.13	5.35 5.26	3.00 1.29	2.18 0.59	1.30 0.17	0.91 0.07	0.58 0.02	12
13	17.79 93.52	9.63 21.02	5.79 6.09	3.25 1.49	2.36 0.68	1.41 0.20	0.98 0.08	0.63 0.03	13
14	19.16 107.3	10.37 24.12	6.24 6.99	3.50 1.71	2.54 0.78	1.52 0.23	1.06 0.09	0.68 0.03	14
15		11.12 27.40	6.68 7.94	3.75 1.94	2.72 0.89	1.63 0.26	1.13 0.11	0.73 0.04	15
16		11.86 30.88	7.13 8.95	4.00 2.19	2.90 1.01	1.74 0.29	1.21 0.12	0.78 0.04	16
17		12.60 34.55	7.57 10.02	4.25 2.45	3.08 1.12	1.84 0.32	1.29 0.13	0.82 0.05	17
18		13.34 38.41	8.02 11.14	4.50 2.73	3.26 1.25	1.95 0.36	1.36 0.15	0.87 0.05	18
19		14.08 42.45	8.46 12.31	4.75 3.01	3.45 1.38	2.06 0.40	1.44 0.16	0.92 0.06	19
20		14.82 46.69	8.91 13.53	5.00 3.31	3.63 1.52	2.17 0.44	1.51 0.18	0.97 0.06	20
22		16.30 55.70	9.80 16.15	5.50 3.95	3.99 1.81	2.39 0.52	1.66 0.22	1.07 0.07	22
24		17.79 65.44	10.69 18.97	6.00 4.64	4.35 2.13	2.60 0.61	1.81 0.25	1.16 0.09	24
25		18.53 70.58	11.14 20.46	6.25 5.01	4.53 2.30	2.71 0.66	1.89 0.27	1.21 0.09	25
26			11.58 22.00	6.49 5.39	4.71 2.47	2.82 0.71	1.97 0.29	1.26 0.10	26
28			12.47 25.24	6.99 6.18	5.08 2.83	3.04 0.81	2.12 0.34	1.36 0.11	28
30			13.36 28.68	7.49 7.02	5.44 3.22	3.26 0.92	2.27 0.38	1.46 0.13	30
32			14.26 32.32	7.99 7.91	5.80 3.63	3.47 1.04	2.42 0.43	1.55 0.15	32
34			15.15 36.16	8.49 8.85	6.17 4.06	3.69 1.16	2.57 0.48	1.65 0.16	34
35			15.59 38.16	8.74 9.34	6.35 4.28	3.80 1.23	2.65 0.51	1.70 0.17	35
36			16.04 40.20	8.99 9.84	6.53 4.51	3.91 1.29	2.72 0.54	1.75 0.18	36
38			16.93 44.43	9.49 10.88	6.89 4.99	4.12 1.43	2.87 0.59	1.84 0.20	38
40			17.82 48.86	9.99 11.96	7.25 5.49	4.34 1.57	3.02 0.65	1.94 0.22	40
42			18.71 53.48	10.49 13.09	7.62 6.00	4.56 1.72	3.18 0.71	2.04 0.24	42
44				10.99 14.27	7.98 6.54	4.77 1.88	3.33 0.78	2.13 0.26	44
45				11.24 14.87	8.16 6.82	4.88 1.96	3.40 0.81	2.18 0.28	45
46				11.49 15.49	8.34 7.11	4.99 2.04	3.48 0.85	2.23 0.29	46
48				11.99 16.76	8.70 7.69	5.21 2.20	3.63 0.92	2.33 0.31	48
50				12.49 18.08	9.07 8.29	5.43 2.38	3.78 0.99	2.43 0.34	50
55				13.74 21.57	9.97 9.89	5.97 2.84	4.16 1.18	2.67 0.40	55
60				14.99 25.34	10.88 11.62	6.51 3.33	4.54 1.38	2.91 0.47	60
65				16.24 29.39	11.79 13.48	7.05 3.87	4.91 1.60	3.15 0.55	65
70				17.49 33.71	12.69 15.46	7.60 4.43	5.29 1.84	3.40 0.63	70
75				18.74 38.31	13.60 17.57	8.14 5.04	5.67 2.09	3.64 0.71	75
80					14.51 19.80	8.68 5.68	6.05 2.36	3.88 0.80	80
85					15.41 22.16	9.22 6.35	6.43 2.64	4.12 0.90	85
90					16.32 24.63	9.77 7.06	6.80 2.93	4.37 1.00	90
95					17.23 27.22	10.31 7.81	7.18 3.24	4.61 1.10	95
100					18.13 29.94	10.85 8.58	7.56 3.56	4.85 1.21	100
110						11.94 10.24	8.32 4.25	5.34 1.44	110
120						13.02 12.03	9.07 4.99	5.82 1.70	120
130						14.11 13.95	9.83 5.79	6.31 1.97	130
140						15.19 16.01	10.58 6.64	6.79 2.26	140
150						16.28 18.19	11.34 7.55	7.28 2.57	150
160						17.36 20.50	12.10 8.51	7.76 2.89	160
170						18.45 22.93	12.85 9.52	8.25 3.23	170
180							13.61 10.58	8.73 3.60	180
190							14.37 11.70	9.22 3.97	190
200							15.12 12.86	9.70 4.37	200
225							17.01 16.00	10.92 5.44	225
250							18.90 19.45	12.13 6.61	250
275								13.34 7.88	275
300								14.55 9.26	300
325								15.77 10.74	325
350								16.98 12.32	350
375								18.19 14.00	375

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Schedule 80 IPS PVC Plastic Pipe

(1120,1220) C=150

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3½" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	4" 3.826 4.500 0.337	6" 5.761 6.625 0.432	8" 7.625 8.625 0.500	10" 9.564 10.750 0.593	12" 11.376 12.750 0.687	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
20	0.56 0.02					20
22	0.61 0.02					22
24	0.67 0.02					24
25	0.70 0.02					25
26	0.72 0.03					26
28	0.78 0.03					28
30	0.84 0.03	0.37 0.00				30
32	0.89 0.04	0.39 0.01				32
34	0.95 0.04	0.42 0.01				34
35	0.98 0.04	0.43 0.01				35
36	1.00 0.05	0.44 0.01				36
38	1.06 0.05	0.47 0.01				38
40	1.11 0.06	0.49 0.01				40
42	1.17 0.06	0.52 0.01				42
44	1.23 0.07	0.54 0.01				44
45	1.25 0.07	0.55 0.01				45
46	1.28 0.07	0.57 0.01				46
48	1.34 0.08	0.59 0.01				48
50	1.39 0.09	0.61 0.01				50
55	1.53 0.10	0.68 0.01				55
60	1.67 0.12	0.74 0.02				60
65	1.81 0.14	0.80 0.02	0.46 0.00			65
70	1.95 0.16	0.86 0.02	0.49 0.01			70
75	2.09 0.18	0.92 0.03	0.53 0.01			75
80	2.23 0.21	0.98 0.03	0.56 0.01			80
85	2.37 0.23	1.04 0.03	0.60 0.01			85
90	2.51 0.26	1.11 0.04	0.63 0.01			90
95	2.65 0.29	1.17 0.04	0.67 0.01			95
100	2.79 0.31	1.23 0.04	0.70 0.01	0.45 0.00		100
120	3.34 0.44	1.48 0.06	0.84 0.02	0.54 0.01		120
140	3.90 0.59	1.72 0.08	0.98 0.02	0.62 0.01		140
160	4.46 0.75	1.97 0.10	1.12 0.03	0.71 0.01		160
180	5.02 0.93	2.21 0.13	1.26 0.03	0.80 0.01	0.57 0.00	180
200	5.57 1.13	2.46 0.15	1.40 0.04	0.89 0.01	0.63 0.01	200
250	6.97 1.72	3.07 0.23	1.75 0.06	1.12 0.02	0.79 0.01	250
300	8.36 2.40	3.69 0.33	2.11 0.08	1.34 0.03	0.95 0.01	300
350	9.76 3.20	4.30 0.44	2.46 0.11	1.56 0.04	1.10 0.02	350
400	11.15 4.10	4.92 0.56	2.81 0.14	1.78 0.05	1.26 0.02	400
450	12.54 5.10	5.53 0.70	3.16 0.18	2.01 0.06	1.42 0.03	450
500	13.94 6.19	6.15 0.85	3.51 0.22	2.23 0.07	1.58 0.03	500
600	16.72 8.68	7.38 1.18	4.21 0.30	2.68 0.10	1.89 0.04	600
700		8.61 1.58	4.91 0.40	3.12 0.13	2.21 0.06	700
800		9.83 2.02	5.61 0.52	3.57 0.17	2.52 0.07	800
900		11.06 2.51	6.32 0.64	4.01 0.21	2.84 0.09	900
1000		12.29 3.05	7.02 0.78	4.46 0.26	3.15 0.11	1000
1200		14.75 4.28	8.42 1.09	5.35 0.36	3.78 0.16	1200
1400		17.21 5.69	9.82 1.45	6.24 0.48	4.41 0.21	1400
1600			11.23 1.86	7.14 0.62	5.04 0.27	1600
1800			12.63 2.32	8.03 0.77	5.67 0.33	1800
2000			14.03 2.82	8.92 0.93	6.31 0.40	2000
2200			15.44 3.36	9.81 1.12	6.94 0.48	2200
2400			16.84 3.95	10.71 1.31	7.57 0.56	2400
2600			18.25 4.58	11.60 1.52	8.20 0.65	2600
2800				12.49 1.74	8.83 0.75	2800
3000				13.38 1.98	9.46 0.85	3000
3200				14.27 2.23	10.09 0.96	3200
3400				15.17 2.50	10.72 1.07	3400
3600				16.06 2.78	11.35 1.19	3600
3800				16.95 3.07	11.98 1.32	3800
4000				17.84 3.38	12.61 1.45	4000
4500					14.19 1.80	4500
5000					15.76 2.19	5000
5500					17.34 2.62	5500
6000					18.92 3.07	6000
6500						6500

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Polyethylene (PE) Pipe - SDR-7 Pressure Rated Pipe

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 2"

Nominal Size Pipe ID	½" 0.622	¾" 0.824	1" 1.049	1¼" 1.380	1½" 1.610	2" 2.067	Nominal Size Pipe ID
Note: This is an I.D. controlled pipe, O.D. may vary.							
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	1.05	0.49	0.60	0.12	0.37	0.04	1
2	2.11	1.76	1.20	0.45	0.74	0.14	2
3	3.16	3.73	1.80	0.95	1.11	0.29	3
4	4.22	6.35	2.40	1.62	1.48	0.50	4
5	5.27	9.60	3.00	2.44	1.85	0.76	5
6	6.33	13.46	3.61	3.43	2.22	1.06	6
7	7.38	17.91	4.21	4.56	2.60	1.41	7
8	8.44	22.93	4.81	5.84	2.97	1.80	8
9	9.49	28.52	5.41	7.26	3.34	2.24	9
10	10.55	34.67	6.01	8.82	3.71	2.73	10
11	11.60	41.36	6.61	10.53	4.08	3.25	11
12	12.65	48.60	7.21	12.37	4.45	3.82	12
13	13.71	56.36	7.81	14.34	4.82	4.43	13
14	14.76	64.65	8.41	16.45	5.19	5.08	14
15	15.82	73.47	9.01	18.70	5.56	5.78	15
16	16.87	82.79	9.61	21.07	5.93	6.51	16
17	17.93	92.63	10.22	23.57	6.30	7.28	17
18	18.98	103.00	10.82	26.21	6.67	8.10	18
19			11.42	28.97	7.04	8.95	19
20			12.02	31.85	7.42	9.84	20
22			13.22	38.00	8.16	11.74	22
24			14.42	44.65	8.90	13.79	24
25			15.02	48.15	9.27	14.87	25
26			15.62	51.78	9.64	16.00	26
28			16.83	59.40	10.38	18.35	28
30			18.03	67.50	11.12	20.85	30
32			19.23	76.06	11.86	23.50	32
34					12.61	26.29	34
35					12.98	27.74	35
36					13.35	29.22	36
38					14.09	32.30	38
40					14.83	35.52	40
42					15.57	38.88	42
44					16.31	42.38	44
45					16.68	44.18	45
46					17.06	46.01	46
48					17.80	49.79	48
50					18.54	53.70	50
55							55
60							60
65					13.93	22.98	65
70					15.00	26.36	70
75					16.07	29.96	75
80					17.14	33.76	80
85					18.21	37.77	85
90					19.28	41.99	90
95					14.17	19.83	95
100					14.95	21.92	100
110					15.74	24.11	110
120					17.31	28.76	120
130					18.89	33.79	130
140							140
150							150
160							160
170							170
180							180
190							190
200							200

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Polyethylene (PE) Pipe - SDR-7 Pressure Rated Pipe

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 2½" THRU 6"

Nominal Size Pipe ID	2½" 2.469		3" 3.068		4" 4.026		6" 6.065		Nominal Size Pipe ID
Note: This is an I.D. controlled pipe, O.D. may vary.									
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
10	0.67	0.04	0.43	0.01	0.25	0.00			10
15	1.00	0.09	0.65	0.03	0.38	0.01			15
20	1.34	0.15	0.87	0.05	0.50	0.01			20
25	1.67	0.23	1.08	0.08	0.63	0.02			25
30	2.01	0.32	1.30	0.11	0.76	0.03	0.33	0.00	30
35	2.34	0.43	1.52	0.15	0.88	0.04	0.39	0.01	35
40	2.68	0.55	1.73	0.19	1.01	0.05	0.44	0.01	40
45	3.01	0.69	1.95	0.24	1.13	0.06	0.50	0.01	45
50	3.35	0.83	2.17	0.29	1.26	0.08	0.55	0.01	50
55	3.68	0.99	2.38	0.35	1.38	0.09	0.61	0.01	55
60	4.02	1.17	2.60	0.41	1.51	0.11	0.67	0.01	60
65	4.35	1.36	2.82	0.47	1.64	0.13	0.72	0.02	65
70	4.69	1.55	3.03	0.54	1.76	0.14	0.78	0.02	70
75	5.02	1.77	3.25	0.61	1.89	0.16	0.83	0.02	75
80	5.35	1.99	3.47	0.69	2.01	0.18	0.89	0.03	80
85	5.69	2.23	3.68	0.77	2.14	0.21	0.94	0.03	85
90	6.02	2.48	3.90	0.86	2.27	0.23	1.00	0.03	90
95	6.36	2.74	4.12	0.95	2.39	0.25	1.05	0.03	95
100	6.69	3.01	4.33	1.05	2.52	0.28	1.11	0.04	100
110	7.36	3.59	4.77	1.25	2.77	0.33	1.22	0.05	110
120	8.03	4.22	5.20	1.47	3.02	0.39	1.33	0.05	120
130	8.70	4.89	5.63	1.70	3.27	0.45	1.44	0.06	130
140	9.37	5.61	6.07	1.95	3.52	0.52	1.55	0.07	140
150	10.04	6.38	6.50	2.22	3.78	0.59	1.66	0.08	150
175	11.71	8.48	7.59	2.95	4.41	0.79	1.94	0.11	175
200	13.39	10.87	8.67	3.78	5.03	1.01	2.22	0.14	200
225	15.06	13.51	9.75	4.70	5.66	1.25	2.50	0.17	225
250	16.73	16.43	10.84	5.71	6.29	1.52	2.77	0.21	250
275	18.41	19.60	11.92	6.81	6.92	1.81	3.05	0.25	275
300			13.00	8.00	7.55	2.13	3.33	0.29	300
325			14.09	9.28	8.18	2.47	3.60	0.34	325
350			15.17	10.64	8.81	2.84	3.88	0.39	350
375			16.25	12.10	9.44	3.22	4.16	0.44	375
400			17.34	13.63	10.07	3.63	4.44	0.49	400
425			18.42	15.25	10.70	4.06	4.71	0.55	425
450			19.51	16.95	11.33	4.52	4.99	0.62	450
475					11.96	4.99	5.27	0.68	475
500					12.59	5.49	5.55	0.75	500
525					13.22	6.01	5.82	0.82	525
550					13.84	6.55	6.10	0.89	550
575					14.47	7.11	6.38	0.97	575
600					15.10	7.70	6.66	1.05	600
650					16.36	8.93	7.21	1.22	650
700					17.62	10.24	7.76	1.39	700
750					18.88	11.64	8.32	1.58	750
800							8.87	1.79	800
850							9.43	2.00	850
900							9.98	2.22	900
950							10.54	2.45	950
1000							11.09	2.70	1000
1100							12.20	3.22	1100
1200							13.31	3.78	1200
1300							14.42	4.39	1300
1400							15.53	5.03	1400
1500							16.64	5.72	1500
1600							17.75	6.45	1600
1700							18.86	7.21	1700
1800							19.97	8.02	1800

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Polyethylene Pipe - Pepco Products

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 1/16" THRU 3/8"

Pepco Products

Nominal Size	1/16"	1/8"	3/16"	7/32"	Note: 5/16" ID & PSI loss is the same as 11/32" ID.						Nominal Size
Pipe ID	0.040	0.070	0.125	0.160	0.170	0.250	0.375				Pipe ID
Pipe OD	0.080	0.125	0.185	0.220	0.250	0.307	0.455				Pipe OD
Wall Thick	0.020	0.028	0.030	0.030	0.040	0.028	0.040				Wall Thick
Flow GPH	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPH
0.25	1.06	11.99	0.35	0.79	0.11	0.05	0.07	0.01	0.03	0.00	0.25
0.50	2.13	43.28	0.69	2.84	0.22	0.17	0.13	0.05	0.05	0.01	0.50
0.75	3.19	91.71	1.04	6.02	0.33	0.36	0.20	0.11	0.18	0.08	0.75
1.00	4.25	156.20	1.39	10.26	0.44	0.61	0.27	0.18	0.24	0.14	1.00
1.25	5.31	236.20	1.73	15.51	0.54	0.92	0.33	0.28	0.29	0.21	1.25
1.50	6.38	331.10	2.08	21.74	0.65	1.29	0.40	0.39	0.35	0.29	1.50
1.75	7.44	440.40	2.43	28.92	0.76	1.72	0.46	0.52	0.41	0.39	1.75
2.00	8.50	564.00	2.78	37.04	0.87	2.20	0.53	0.66	0.47	0.49	2.00
2.50	10.63	852.70	3.47	56.00	1.09	3.33	0.66	1.00	0.59	0.75	2.50
3.00			4.16	78.49	1.31	4.67	0.80	1.41	0.71	1.05	3.00
3.5	Note: Flows are GPH		4.86	104.40	1.52	6.22	0.93	1.87	0.82	1.39	3.5
4.0			5.55	133.70	1.74	7.96	1.06	2.39	0.94	1.78	4.0
4.5			6.24	166.30	1.96	9.90	1.20	2.98	1.06	2.22	4.5
5.0			6.94	202.10	2.18	12.03	1.33	3.62	1.18	2.69	5.0
6.0			8.33	283.30	2.61	16.86	1.59	5.07	1.41	3.78	6.0
7			9.71	377.00	3.05	22.44	1.86	6.75	1.65	5.03	7
8			11.10	482.70	3.48	28.73	2.13	8.64	1.88	6.44	8
9			12.49	600.40	3.92	35.74	2.39	10.75	2.12	8.00	9
10			13.88	729.70	4.35	43.44	2.66	13.07	2.35	9.73	10
12					5.22	60.88	3.19	18.32	2.82	13.64	12
14					6.09	81.00	3.72	24.37	3.29	18.14	14
16					6.96	103.70	4.25	31.20	3.76	23.23	16
18					7.83	129.00	4.78	38.81	4.24	28.89	18
20					8.70	156.80	5.31	47.17	4.71	35.12	20
22					9.57	187.10	5.84	56.28	5.18	41.90	22
24					10.44	219.80	6.38	66.12	5.65	49.23	24
26					11.32	254.90	6.91	76.68	6.12	57.09	26
28					12.19	292.40	7.44	87.96	6.59	65.49	28
30					13.06	332.30	7.97	99.95	7.06	74.42	30
32					13.93	374.40	8.50	112.60	7.53	83.87	32
34					14.80	418.90	9.03	126.00	8.00	93.83	34
36					15.67	465.70	9.56	140.10	8.47	104.30	36
38					16.54	514.80	10.09	154.90	8.94	115.30	38
40					17.41	566.10	10.63	170.30	9.41	126.80	40
42					18.28	619.60	11.16	186.40	9.88	138.80	42
44					19.15	675.30	11.69	203.20	10.35	151.30	44
46							12.22	220.60	10.82	164.20	46
48							12.75	238.70	11.29	177.70	48
50							13.28	257.40	11.76	191.70	50
55							14.61	307.10	12.94	228.70	55
60							15.94	360.80	14.12	268.60	60
65							17.27	418.50	15.29	311.60	65
70							18.59	480.00	16.47	357.40	70
75							19.92	545.50	17.65	406.10	75
80									18.82	457.70	80
85									9.25	78.40	85
90									9.79	87.16	90
95									10.34	96.33	95
100									10.88	105.90	100
110									11.97	126.40	110
120									13.06	148.50	120
130									14.14	172.20	130
140									15.23	197.50	140
150									16.32	224.50	150
160									17.41	253.00	160
180									19.58	314.60	180
200											200
225											225
250											250
300											300
350											350
375											375
400											400

Polyethylene Pipe - Pepco Products

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 1¼"

Pepco Products

Nominal Size Pipe ID Pipe OD Wall Thick	Note: Pepco manufacturers nominal ½": Poly in three different ID's.										1" 1.060 1.200 0.070	1¼" 1.390 1.550 0.080	Nominal Size Pipe ID Pipe OD Wall Thick
	½"	½"	½"	½"	¾"	¾"	¾"	¾"	¾"	¾"			
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
0.25	0.38	0.09	0.28	0.04	0.27	0.04	0.20	0.02	0.15	0.01	0.09	0.00	0.25
0.50	0.75	0.32	0.57	0.16	0.53	0.14	0.39	0.07	0.30	0.03	0.18	0.01	0.50
0.75	1.13	0.68	0.85	0.34	0.80	0.29	0.59	0.14	0.44	0.07	0.27	0.02	0.75
1.00	1.51	1.17	1.13	0.58	1.06	0.50	0.79	0.24	0.59	0.12	0.36	0.04	1.00
1.25	1.89	1.76	1.42	0.88	1.33	0.75	0.98	0.36	0.74	0.18	0.45	0.06	1.25
1.50	2.26	2.47	1.70	1.23	1.59	1.05	1.18	0.51	0.89	0.25	0.54	0.08	1.50
1.75	2.64	3.29	1.98	1.64	1.86	1.40	1.38	0.67	1.04	0.34	0.64	0.10	1.75
2.00	3.02	4.21	2.27	2.10	2.12	1.79	1.57	0.86	1.18	0.43	0.73	0.13	2.00
2.25	3.39	5.23	2.55	2.61	2.39	2.22	1.77	1.07	1.33	0.54	0.82	0.16	2.25
2.50	3.77	6.36	2.83	3.17	2.65	2.70	1.97	1.31	1.48	0.65	0.91	0.20	2.50
2.75	4.15	7.59	3.12	3.78	2.92	3.22	2.16	1.56	1.63	0.78	1.00	0.24	2.75
3.00	4.53	8.91	3.40	4.44	3.18	3.79	2.36	1.83	1.78	0.92	1.09	0.28	3.00
3.25	4.90	10.34	3.68	5.15	3.45	4.39	2.56	2.12	1.92	1.06	1.18	0.32	3.25
3.50	5.28	11.86	3.97	5.91	3.71	5.04	2.75	2.43	2.07	1.22	1.27	0.37	3.50
3.75	5.66	13.48	4.25	6.72	3.98	5.73	2.95	2.77	2.22	1.38	1.36	0.42	3.75
4.0	6.04	15.19	4.53	7.57	4.25	6.45	3.15	3.12	2.37	1.56	1.45	0.47	4.0
4.5	6.79	18.89	5.10	9.41	4.78	8.03	3.54	3.88	2.67	1.94	1.63	0.59	4.5
5.0	7.54	22.96	5.67	11.44	5.31	9.76	3.94	4.71	2.96	2.36	1.82	0.72	5.0
5.5	8.30	27.39	6.23	13.65	5.84	11.64	4.33	5.62	3.26	2.81	2.00	0.86	5.5
6.0	9.05	32.18	6.80	16.04	6.37	13.67	4.72	6.61	3.55	3.31	2.18	1.01	6.0
6.5	9.81	37.32	7.37	18.60	6.90	15.86	5.12	7.66	3.85	3.84	2.36	1.17	6.5
7.0	10.56	42.82	7.93	21.34	7.43	18.19	5.51	8.79	4.15	4.40	2.54	1.34	7.0
7.5	11.32	48.65	8.50	24.25	7.96	20.67	5.90	9.99	4.44	5.00	2.72	1.52	7.5
8.0	12.07	54.83	9.07	27.33	8.49	23.30	6.30	11.25	4.74	5.63	2.90	1.71	8.0
8.5	12.83	61.34	9.63	30.57	9.02	26.06	6.69	12.59	5.03	6.30	3.09	1.92	8.5
9.0	13.58	68.19	10.20	33.99	9.55	28.98	7.08	14.00	5.33	7.01	3.27	2.13	9.0
9.5	14.33	75.37	10.77	37.57	10.08	32.03	7.48	15.47	5.63	7.75	3.45	2.36	9.5
10	15.09	82.88	11.33	41.31	10.61	35.22	7.87	17.01	5.92	8.52	3.63	2.59	10
11	16.60	98.89	12.47	49.29	11.68	42.02	8.66	20.30	6.51	10.16	3.99	3.09	11
12	18.11	116.20	13.60	57.90	12.74	49.36	9.44	23.85	7.11	11.94	4.36	3.63	12
13	19.62	134.7	14.73	67.16	13.80	57.25	10.23	27.66	7.70	13.85	4.72	4.21	13
14			15.87	77.04	14.86	65.67	11.02	31.72	8.29	15.88	5.08	4.83	14
15			17.00	87.54	15.92	74.63	11.81	36.05	8.88	18.05	5.45	5.49	15
16			18.13	98.65	16.98	84.10	12.59	40.63	9.48	20.34	5.81	6.19	16
18					19.11	104.60	14.17	50.53	10.66	25.30	6.54	7.69	18
20							15.74	61.42	11.84	30.75	7.26	9.35	20
22							17.31	73.27	13.03	36.68	7.99	11.16	22
24							18.89	86.08	14.21	43.10	8.71	13.11	24
26									15.40	49.99	9.44	15.20	26
28									16.58	57.34	10.17	17.44	28
30									17.77	65.15	10.89	19.82	30
32									18.95	73.43	11.62	22.33	32
34											12.35	24.99	34
36											13.07	27.78	36
38											13.80	30.70	38
40											14.52	33.76	40
42											15.25	36.95	42
44											15.98	40.28	44
46											16.70	43.74	46
48											17.43	47.32	48
50											18.16	51.04	50
55											19.97	60.89	55
60													60
65													65
70													70
75													75
80													80
85													85
90													90

Polyethylene Pipe - Bowsmith, Inc.

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3/8" THRU 1 1/4"

Bowsmith, Inc.

Nominal Size	Note: Bowsmith manufacturers more than one pipe in similar nominal sizes but with different ID's.												Nominal Size
	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	
Pipe ID	0.375	0.390	0.525	0.530	0.590	0.600	0.605	0.605	0.605	0.605	0.605	0.605	Pipe ID
Pipe OD	0.455	0.490	0.625	0.625	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	Pipe OD
Wall Thick	0.040	0.050	0.050	0.0475	0.055	0.050	0.0475	0.0475	0.0475	0.0475	0.0475	0.0475	Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
0.25	0.73	0.44	0.67	0.36	0.37	0.09	0.36	0.08	0.29	0.05	0.28	0.04	0.25
0.50	1.45	1.58	1.34	1.31	0.74	0.31	0.73	0.29	0.59	0.17	0.57	0.16	0.50
0.75	2.18	3.36	2.01	2.77	1.11	0.65	1.09	0.62	0.88	0.37	0.85	0.34	0.75
1.00	2.90	5.72	2.68	4.73	1.48	1.11	1.45	1.06	1.17	0.63	1.13	0.58	1.00
1.25	3.63	8.65	3.35	7.14	1.85	1.68	1.82	1.61	1.47	0.95	1.42	0.88	1.25
1.50	4.35	12.12	4.02	10.01	2.22	2.36	2.18	2.25	1.76	1.34	1.70	1.23	1.50
1.75	5.08	16.12	4.69	13.32	2.59	3.14	2.54	2.99	2.05	1.78	1.98	1.64	1.75
2.00	5.80	20.65	5.36	17.06	2.96	4.02	2.90	3.83	2.34	2.28	2.27	2.10	2.00
2.5	7.25	31.21	6.71	25.79	3.70	6.07	3.63	5.80	2.93	3.44	2.83	3.17	2.5
3.0	8.70	43.75	8.05	36.15	4.44	8.51	4.36	8.13	3.52	4.82	3.40	4.44	3.0
4	11.61	74.53	10.73	61.58	5.92	14.50	5.81	13.84	4.69	8.21	4.53	7.57	4
5	14.51	112.70	13.41	93.09	7.40	21.92	7.26	20.93	5.86	12.42	5.67	11.44	5
6	17.41	157.90	16.09	130.50	8.88	30.72	8.71	29.33	7.03	17.41	6.80	16.04	6
7			18.78	173.60	10.36	40.87	10.17	39.03	8.20	23.16	7.93	21.34	7
8					11.84	52.33	11.62	49.97	9.38	29.66	9.07	27.33	8
9					13.32	65.09	13.07	62.16	10.55	36.88	10.20	33.99	9
10					14.80	79.11	14.52	75.55	11.72	44.83	11.33	41.31	10
12					17.76	110.90	17.43	105.90	14.06	62.84	13.60	57.90	12
14									16.41	83.60	15.87	77.04	14
16									18.75	107.10	18.13	98.65	16
Nominal Size	5/8"	5/8"	3/4"	3/4"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	Nominal Size
Pipe ID	0.625	0.730	0.811	0.818	1.050	1.057	1.057	1.057	1.360	1.360	1.360	1.360	Pipe ID
Pipe OD	0.720	0.835	0.935	0.935	1.195	1.195	1.195	1.195	1.530	1.530	1.530	1.530	Pipe OD
Wall Thick	0.475	0.0525	0.0625	0.059	0.0725	0.069	0.069	0.069	0.085	0.085	0.085	0.085	Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	1.04	0.48	0.77	0.22	0.62	0.13	0.61	0.13	0.37	0.04	0.37	0.01	1.0
2	2.09	1.72	1.53	0.81	1.24	0.48	1.22	0.46	0.74	0.14	0.73	0.13	2
3	3.13	3.64	2.30	1.71	1.86	1.03	1.83	0.98	1.11	0.29	1.10	0.28	3
4	4.18	6.21	3.06	2.91	2.48	1.75	2.44	1.68	1.48	0.50	1.46	0.48	4
5	5.22	9.38	3.83	4.41	3.10	2.64	3.05	2.53	1.85	0.75	1.83	0.73	5
6	6.27	13.15	4.59	6.18	3.72	3.70	3.66	3.55	2.22	1.05	2.19	1.02	6
7	7.31	17.50	5.36	8.22	4.34	4.92	4.27	4.72	2.59	1.40	2.56	1.36	7
8	8.36	22.40	6.12	10.52	4.96	6.31	4.88	6.05	2.96	1.79	2.92	1.74	8
9	9.40	27.86	6.89	13.09	5.58	7.84	5.49	7.52	3.33	2.23	3.29	2.16	9
10	10.44	33.87	7.66	15.91	6.20	9.53	6.10	9.14	3.70	2.71	3.65	2.63	10
12	12.53	47.47	9.19	22.30	7.44	13.36	7.32	12.82	4.44	3.80	4.38	3.68	12
14	14.62	63.16	10.72	29.67	8.68	17.78	8.54	17.05	5.18	5.06	5.11	4.90	14
16	16.71	80.88	12.25	37.99	9.93	22.77	9.76	21.83	5.92	6.48	5.84	6.27	16
18	18.80	100.60	13.78	47.25	11.17	28.32	10.98	27.16	6.66	8.06	6.57	7.80	18
20			15.31	57.43	12.41	34.42	12.20	33.01	7.40	9.79	7.30	9.48	20
22			16.84	68.52	13.65	41.06	13.41	39.38	8.14	11.68	8.03	11.31	22
24			18.37	80.50	14.89	48.24	14.63	46.26	8.88	13.73	8.76	13.29	24
26			19.91	93.36	16.13	55.95	15.85	53.66	9.62	15.92	9.49	15.41	26
28					17.37	64.18	17.07	61.55	10.36	18.26	10.23	17.68	28
30					18.61	72.93	18.29	69.94	11.10	20.75	10.96	20.09	30
32					19.85	82.18	19.51	78.82	11.84	23.39	11.69	22.64	32
34									12.58	26.17	12.42	25.33	34
36									13.32	29.09	13.15	28.16	36
38									14.06	32.15	13.88	31.13	38
40									14.80	35.36	14.61	34.23	40
42									15.54	38.70	15.34	37.47	42
44									16.28	42.18	16.07	40.84	44
46									17.02	45.80	16.80	44.34	46
48									17.76	49.56	17.53	47.98	48
50									18.50	53.45	18.26	51.75	50
55											12.13	18.11	55
60											13.24	21.28	60
65											14.34	24.68	65
70											15.44	28.31	70
75											16.54	32.16	75
80											17.65	36.25	80
85											18.75	40.55	85
90											19.85	45.08	90

Polyethylene Pipe - Hardie & Rain Bird

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ¼" THRU ¾"

Hardie Dura-Pol™					Rain Bird				
Nominal Size Pipe ID Pipe OD Wall Thick	¼"	½"	¾"		Vinyl Tubing ¼"	Xeri-Tube™700 ½"		Nominal Size Pipe ID Pipe OD Wall Thick	
	0.170 0.250 0.040	0.613 0.709 0.048	0.810 0.936 0.063		0.160 0.280 0.060	0.580 0.700 0.060			
Flow GPH	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPH
1	0.24	0.14			0.27	0.18			1
2	0.47	0.49			0.53	0.66	0.07	0.00	2
3	0.71	1.05			0.80	1.41	0.11	0.01	3
4	0.94	1.78	0.07	0.00	1.06	2.39	0.14	0.02	4
5	1.18	2.69	0.09	0.01	1.33	3.62	0.18	0.03	5
6	1.41	3.78	0.11	0.01	1.59	5.07	0.21	0.04	6
8	1.88	6.44	0.14	0.01	2.13	8.64	0.28	0.06	8
10	2.35	9.73	0.18	0.02	2.66	13.07	0.35	0.10	10
12	2.82	13.64	0.22	0.03	3.19	18.32	0.42	0.13	12
14	3.29	18.14	0.25	0.04	3.72	24.37	0.49	0.18	14
15	3.53	20.61	0.27	0.04	3.98	27.69	0.53	0.20	15
20	4.71	35.12	0.36	0.07	5.31	47.17	0.70	0.34	20
30	7.06	74.42	0.54	0.14	7.97	99.95	0.61	0.19	30
40	9.41	126.80	0.72	0.25			1.40	1.24	40
50			0.90	0.37			1.76	1.87	50
60			1.09	0.52			1.21	0.69	60
70			1.27	0.70			2.46	3.50	70
80			1.45	0.89			2.81	4.48	80
90			1.63	1.11			1.82	1.45	90
100			1.81	1.35			3.51	6.77	100
110			1.99	1.61			3.86	8.07	110
120			2.17	1.89			2.43	2.42	120
130			2.35	2.19			4.57	11.00	130
140			2.53	2.51			4.92	12.62	140
150			2.71	2.86			3.03	3.74	150
160			2.90	3.22			5.62	16.16	160
170			3.08	3.60			5.97	18.08	170
180			3.26	4.00			3.64	5.24	180
190			3.44	4.42			6.67	22.21	190
200			3.62	4.87			7.02	24.43	200
210			3.80	5.33			4.24	6.97	210
220			3.98	5.80			7.73	29.14	220
230			4.16	6.30			8.08	31.64	230
240			4.34	6.82			4.85	8.93	240
Flow GPM									Flow GPM
4.5			4.89	8.48	2.80	2.19	5.46	11.10	4.5
5.0			5.43	10.31	3.11	2.66	6.06	13.50	5.0
5.5			5.97	12.30	3.42	3.17	6.67	16.10	5.5
6.0			6.51	14.45	3.73	3.72	7.28	18.93	6.0
6.5			7.06	16.76	4.04	4.32	13.70	84.14	6.5
7.0			7.60	19.23	4.35	4.95			7.0
7.5			8.14	21.85	4.66	5.63			7.5
8.0			8.69	24.62	4.97	6.34			8.0
8.5			9.23	27.55	5.29	7.10			8.5
9.0			9.77	30.62	5.60	7.89			9.0
9.5			10.31	33.85	5.91	8.72			9.5
10			10.86	37.22	6.22	9.59			10
11			11.94	44.40	6.84	11.44			11
12			13.03	52.17	7.46	13.44			12
13			14.12	60.50	8.08	15.59			13
14			15.20	69.41	8.71	17.89			14
15			16.29	78.87	9.33	20.32			15
16			17.37	88.88	9.95	22.90			16
17			18.46	99.44	10.57	25.62			17
18			19.54	110.50	11.19	28.49			18
19					11.82	31.49			19
20					12.44	34.62			20
22					13.68	41.31			22
24					14.92	48.53			24
26					16.17	56.28			26
28					17.41	64.56			28
30					18.66	73.36			30
32					19.90	82.68			32

Note:
Flows are
GPHNote:
Flows are
GPM

Agricultural Products Flexible PVC

C=150

PRESSURE LOSS PER 100 FEET (PSI) SIZES ½" THRU 1"

Agriculture Products IPS Hose						Agriculture Products IRRIG Hose					
Nominal Size	½"	¾"	1"	½"	⅝"	¾"	Nominal Size	½"	¾"	1"	Nominal Size
Pipe ID	0.546	0.740	0.960	0.500	0.625	0.750	Pipe ID	0.500	0.625	0.750	Pipe ID
Pipe OD	0.840	1.050	1.315	0.680	0.825	0.970	Pipe OD	0.680	0.825	0.970	Pipe OD
Wall Thick	0.147	0.154	0.179	0.090	0.100	0.110	Wall Thick	0.090	0.100	0.110	Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS
0.5	0.68	0.22	0.37	0.05	0.22	0.01	0.5	0.68	0.22	0.37	0.05
1.0	1.37	0.81	0.75	0.18	0.44	0.05	1.0	1.37	0.81	0.75	0.18
1.5	2.05	1.71	1.12	0.39	0.66	0.11	1.5	2.05	1.71	1.12	0.39
2.0	2.74	2.92	1.49	0.67	0.89	0.19	2.0	2.74	2.92	1.49	0.67
2.5	3.42	4.41	1.86	1.01	1.11	0.28	2.5	3.42	4.41	1.86	1.01
3.0	4.11	6.19	2.24	1.41	1.33	0.40	3.0	4.11	6.19	2.24	1.41
3.5	4.79	8.23	2.61	1.87	1.55	0.53	3.5	4.79	8.23	2.61	1.87
4.0	5.47	10.54	2.98	2.40	1.77	0.68	4.0	5.47	10.54	2.98	2.40
4.5	6.16	13.11	3.35	2.99	1.99	0.84	4.5	6.16	13.11	3.35	2.99
5.0	6.84	15.94	3.73	3.63	2.21	1.02	5.0	6.84	15.94	3.73	3.63
5.5	7.53	19.01	4.10	4.33	2.43	1.22	5.5	7.53	19.01	4.10	4.33
6.0	8.21	22.34	4.47	5.09	2.66	1.43	6.0	8.21	22.34	4.47	5.09
6.5	8.90	25.91	4.84	5.90	2.88	1.66	6.5	8.90	25.91	4.84	5.90
7.0	9.58	29.72	5.22	6.77	3.10	1.91	7.0	9.58	29.72	5.22	6.77
7.5	10.26	33.77	5.59	7.69	3.32	2.17	7.5	10.26	33.77	5.59	7.69
8.0	10.95	38.05	5.96	8.67	3.54	2.44	8.0	10.95	38.05	5.96	8.67
8.5	11.63	42.58	6.33	9.70	3.76	2.73	8.5	11.63	42.58	6.33	9.70
9.0	12.32	47.33	6.71	10.78	3.98	3.04	9.0	12.32	47.33	6.71	10.78
9.5	13.00	52.31	7.08	11.92	4.21	3.36	9.5	13.00	52.31	7.08	11.92
10.0	13.69	57.53	7.45	13.10	4.43	3.69	10.0	13.69	57.53	7.45	13.10
11	15.05	68.63	8.20	15.63	4.87	4.41	11	15.05	68.63	8.20	15.63
12	16.42	80.63	8.94	18.37	5.31	5.18	12	16.42	80.63	8.94	18.37
13	17.79	93.52	9.69	21.30	5.76	6.00	13	17.79	93.52	9.69	21.30
14	19.16	107.30	10.43	24.43	6.20	6.89	14	19.16	107.30	10.43	24.43
15			11.18	27.76	6.64	7.82	15			11.18	27.76
16			11.92	31.29	7.08	8.82	16			11.92	31.29
17			12.67	35.01	7.53	9.87	17			12.67	35.01
18			13.41	38.92	7.97	10.97	18			13.41	38.92
19			14.16	43.02	8.41	12.12	19			14.16	43.02
20			14.90	47.30	8.85	13.33	20			14.90	47.30
21			15.65	51.78	9.30	14.59	21			15.65	51.78
22			16.39	56.43	9.74	15.90	22			16.39	56.43
23			17.14	61.28	10.18	17.27	23			17.14	61.28
24			17.88	66.30	10.63	18.68	24			17.88	66.30
25			18.63	71.51	11.07	20.15	25			18.63	71.51
26			19.37	76.90	11.51	21.67	26			19.37	76.90
27					11.95	23.24	27				
28					12.40	24.86	28				
29					12.84	26.53	29				
30					13.28	28.25	30				
31					13.72	30.01	31				
32					14.17	31.83	32				
33					14.61	33.70	33				
34					15.05	35.61	34				
35					15.49	37.58	35				
36					15.94	39.59	36				
37					16.38	41.65	37				
38					16.82	43.76	38				
39					17.27	45.92	39				
40					17.71	48.12	40				
41					18.15	50.37	41				
42					18.59	52.67	42				
43					19.04	55.02	43				
44					19.48	57.41	44				
45					19.92	59.85	45				

Pepco Flexible PVC

C=150

PRESSURE LOSS PER 100 FEET (PSI) SIZES ½" THRU 1"

Pepco Products **IPS Heavy Hose**Pepco Products **Flexible Irrigation Hose**

Nominal Size Pipe ID Pipe OD Wall Thick	1/2"		3/4"		1"		1"		1/2"		5/8"		3/4"		Nominal Size Pipe ID Pipe OD Wall Thick
	0.546 0.840 0.147		0.740 1.050 0.154		0.960 1.315 0.179		1.000 1.315 0.158		0.500 0.680 0.090		.625 .825 0.100		0.750 0.970 0.110		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
0.5	0.68	0.22	0.37	0.05	0.22	0.01	0.20	0.01	0.82	0.34	0.52	0.12	0.36	0.05	0.5
1.0	1.37	0.81	0.75	0.18	0.44	0.05	0.41	0.04	1.63	1.24	1.04	0.42	0.73	0.17	1.0
1.5	2.05	1.71	1.12	0.39	0.66	0.11	0.61	0.09	2.45	2.63	1.57	0.89	1.09	0.37	1.5
2.0	2.74	2.92	1.49	0.67	0.89	0.19	0.82	0.15	3.26	4.48	2.09	1.51	1.45	0.62	2.0
2.5	3.42	4.41	1.86	1.01	1.11	0.28	1.02	0.23	4.08	6.77	2.61	2.29	1.81	0.94	2.5
3.0	4.11	6.19	2.24	1.41	1.33	0.40	1.22	0.33	4.90	9.50	3.13	3.21	2.18	1.32	3.0
3.5	4.79	8.23	2.61	1.87	1.55	0.53	1.43	0.43	5.71	12.63	3.66	4.26	2.54	1.76	3.5
4.0	5.47	10.54	2.98	2.40	1.77	0.68	1.63	0.55	6.53	16.18	4.18	5.46	2.90	2.25	4.0
4.5	6.16	13.11	3.35	2.99	1.99	0.84	1.84	0.69	7.34	20.12	4.70	6.79	3.26	2.80	4.5
5.0	6.84	15.94	3.73	3.63	2.21	1.02	2.04	0.84	8.16	24.45	5.22	8.26	3.63	3.40	5.0
5.5	7.53	19.01	4.10	4.33	2.43	1.22	2.24	1.00	8.98	29.18	5.74	9.85	3.99	4.06	5.5
6.0	8.21	22.34	4.47	5.09	2.66	1.43	2.45	1.18	9.79	34.28	6.27	11.57	4.35	4.77	6.0
6.5	8.90	25.91	4.84	5.90	2.88	1.66	2.65	1.36	10.61	39.75	6.79	13.42	4.71	5.53	6.5
7.0	9.58	29.72	5.22	6.77	3.10	1.91	2.86	1.56	11.42	45.60	7.31	15.40	5.08	6.34	7.0
7.5	10.26	33.77	5.59	7.69	3.32	2.17	3.06	1.78	12.24	51.82	7.83	17.50	5.44	7.20	7.5
8.0	10.95	38.05	5.96	8.67	3.54	2.44	3.26	2.00	13.06	58.40	8.36	19.72	5.80	8.12	8.0
8.5	11.63	42.58	6.33	9.70	3.76	2.73	3.47	2.24	13.87	65.34	8.88	22.06	6.17	9.08	8.5
9.0	12.32	47.33	6.71	10.78	3.98	3.04	3.67	2.49	14.69	72.63	9.40	24.52	6.53	10.10	9.0
9.5	13.00	52.31	7.08	11.92	4.21	3.36	3.88	2.75	15.50	80.28	9.92	27.10	6.89	11.16	9.5
10.0	13.69	57.53	7.45	13.10	4.43	3.69	4.08	3.03	16.32	88.28	10.44	29.81	7.25	12.27	10.0
11	15.05	68.63	8.20	15.63	4.87	4.41	4.49	3.61	17.95	105.30	11.49	35.56	7.98	14.64	11
12	16.42	80.63	8.94	18.37	5.31	5.18	4.90	4.24	19.58	123.70	12.53	41.78	8.70	17.20	12
13	17.79	93.52	9.69	21.30	5.76	6.00	5.30	4.92			13.58	48.45	9.43	19.95	13
14	19.16	107.30	10.43	24.43	6.20	6.89	5.71	5.65			14.62	55.58	10.15	22.89	14
15			11.18	27.76	6.64	7.82	6.12	6.41			15.67	63.16	10.88	26.01	15
16			11.92	31.29	7.08	8.82	6.53	7.23			16.71	71.18	11.61	29.31	16
17			12.67	35.01	7.53	9.87	6.94	8.09			17.76	79.63	12.33	32.79	17
18			13.41	38.92	7.97	10.97	7.34	8.99			18.80	88.53	13.06	36.46	18
19			14.16	43.02	8.41	12.12	7.75	9.94			19.85	97.85	13.78	40.30	19
20			14.90	47.30	8.85	13.33	8.16	10.93					14.51	44.31	20
21			15.65	51.78	9.30	14.59	8.57	11.96					15.23	48.50	21
22			16.39	56.43	9.74	15.90	8.98	13.04					15.96	52.87	22
23			17.14	61.28	10.18	17.27	9.38	14.16					16.68	57.40	23
24			17.88	66.30	10.63	18.68	9.79	15.32					17.41	62.11	24
25			18.63	71.51	11.07	20.15	10.20	16.52					18.13	66.99	25
26			19.37	76.90	11.51	21.67	10.61	17.77					18.86	72.03	26
27					11.95	23.24	11.02	19.05					19.58	77.25	27
28					12.40	24.86	11.42	20.38							28
29					12.84	26.53	11.83	21.75							29
30					13.28	28.25	12.24	23.16							30
31					13.72	30.01	12.65	24.61							31
32					14.17	31.83	13.06	26.10							32
33					14.61	33.70	13.46	27.63							33
34					15.05	35.61	13.87	29.20							34
35					15.49	37.58	14.28	30.81							35
36					15.94	39.59	14.69	32.46							36
37					16.38	41.65	15.10	34.15							37
38					16.82	43.76	15.50	35.88							38
39					17.27	45.92	15.91	37.65							39
40					17.71	48.12	16.32	39.45							40
41					18.15	50.37	16.73	41.30							41
42					18.59	52.67	17.14	43.18							42
43					19.04	55.02	17.54	45.11							43
44					19.48	57.41	17.95	47.07							44
45					19.92	59.85	18.36	49.07							45
46							18.77	51.11							46
47							19.18	53.18							47
48							19.58	55.30							48
49							19.99	57.45							49
50															50

Salco Flexible PVC

C=150

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 1"

Salco A/R Flex Hose – PVC

Nominal Size Pipe ID Pipe OD Wall Thick	½"	¾"	1"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.500 0.600 0.090	0.750 0.150 0.150	1.000 0.135 0.158	
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
0.5	0.82 0.34	0.36 0.05	0.20 0.01	0.5
1.0	1.63 1.24	0.73 0.17	0.41 0.04	1.0
1.5	2.45 2.63	1.09 0.37	0.61 0.09	1.5
2.0	3.26 4.48	1.45 0.62	0.82 0.15	2.0
2.5	4.08 6.77	1.81 0.94	1.02 0.23	2.5
3.0	4.90 9.50	2.18 1.32	1.22 0.33	3.0
3.5	5.71 12.63	2.54 1.76	1.43 0.43	3.5
4.0	6.53 16.18	2.90 2.25	1.63 0.55	4.0
4.5	7.34 20.12	3.26 2.80	1.84 0.69	4.5
5.0	8.16 24.45	3.63 3.40	2.04 0.84	5.0
5.5	8.98 29.18	3.99 4.06	2.24 1.00	5.5
6.0	9.79 34.28	4.35 4.77	2.45 1.18	6.0
6.5	10.61 39.75	4.71 5.53	2.65 1.36	6.5
7.0	11.42 45.60	5.08 6.34	2.86 1.56	7.0
7.5	12.24 51.82	5.44 7.20	3.06 1.78	7.5
8.0	13.06 58.40	5.80 8.12	3.26 2.00	8.0
8.5	13.87 65.34	6.17 9.08	3.47 2.24	8.5
9.0	14.69 72.63	6.53 10.10	3.67 2.49	9.0
9.5	15.50 80.28	6.89 11.16	3.88 2.75	9.5
10.0	16.32 88.28	7.25 12.27	4.08 3.03	10.0
11	17.95 105.30	7.98 14.64	4.49 3.61	11
12	19.58 123.70	8.70 17.20	4.90 4.24	12
13		9.43 19.95	5.30 4.92	13
14		10.15 22.89	5.71 5.65	14
15		10.88 26.01	6.12 6.41	15
16		11.61 29.31	6.53 7.23	16
17		12.33 32.79	6.94 8.09	17
18		13.06 36.46	7.34 8.99	18
19		13.78 40.30	7.75 9.94	19
20		14.51 44.31	8.16 10.93	20
21		15.23 48.50	8.57 11.96	21
22		15.96 52.87	8.98 13.04	22
23		16.68 57.40	9.38 14.16	23
24		17.41 62.11	9.79 15.32	24
25		18.13 66.99	10.20 16.52	25
26		18.86 72.03	10.61 17.77	26
27		19.58 77.25	11.02 19.05	27
28			11.42 20.38	28
29			11.83 21.75	29
30			12.24 23.16	30
31			12.65 24.61	31
32			13.06 26.10	32
33			13.46 27.63	33
34			13.87 29.20	34
35			14.28 30.81	35
36			14.69 32.46	36
37			15.10 34.15	37
38			15.50 35.88	38
39			15.91 37.65	39
40			16.32 39.45	40
41			16.73 41.30	41
42			17.14 43.18	42
43			17.54 45.11	43
44			17.95 47.07	44
45			18.36 49.07	45
46			18.77 51.11	46
47			19.18 53.18	47
48			19.58 55.30	48
49			19.99 57.45	49
50				50

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

AWWA Standard C900 - Class 100 PVC

C=150 SDR 25
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 4" THRU 12"

Nominal Size Pipe ID* Pipe OD Wall Thick	4" 4.39 4.80 0.192	6" 6.31 6.90 0.276	8" 8.28 9.05 0.362	10" 10.15 11.10 0.444	12" 12.08 13.20 0.528	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
30	0.64 0.02					30
35	0.74 0.02	0.36 0.00				35
40	0.85 0.03	0.41 0.01				40
45	0.95 0.04	0.46 0.01				45
50	1.06 0.04	0.51 0.01				50
60	1.27 0.06	0.62 0.01				60
70	1.48 0.08	0.72 0.01				70
80	1.69 0.11	0.82 0.02	0.48 0.00			80
90	1.91 0.13	0.93 0.02	0.54 0.01			90
100	2.12 0.16	1.03 0.03	0.60 0.01			100
125	2.65 0.24	1.28 0.04	0.74 0.01	0.49 0.00		125
150	3.18 0.34	1.54 0.06	0.89 0.02	0.59 0.01		150
175	3.70 0.45	1.80 0.08	1.04 0.02	0.69 0.01		175
200	4.23 0.58	2.06 0.10	1.19 0.03	0.79 0.01	0.56 0.00	200
225	4.76 0.72	2.31 0.12	1.34 0.03	0.89 0.01	0.63 0.01	225
250	5.29 0.88	2.57 0.15	1.49 0.04	0.99 0.01	0.70 0.01	250
275	5.82 1.05	2.83 0.18	1.64 0.05	1.09 0.02	0.77 0.01	275
300	6.35 1.23	3.08 0.21	1.79 0.06	1.19 0.02	0.84 0.01	300
325	6.88 1.43	3.34 0.25	1.93 0.07	1.28 0.02	0.91 0.01	325
350	7.41 1.64	3.60 0.28	2.08 0.07	1.38 0.03	0.98 0.01	350
400	8.47 2.10	4.11 0.36	2.38 0.10	1.58 0.04	1.12 0.02	400
450	9.53 2.61	4.63 0.45	2.68 0.12	1.78 0.04	1.26 0.02	450
500	10.59 3.17	5.14 0.55	2.98 0.14	1.98 0.05	1.40 0.02	500
600	12.70 4.45	6.17 0.77	3.57 0.20	2.37 0.07	1.68 0.03	600
700	14.82 5.91	7.20 1.02	4.17 0.27	2.77 0.10	1.96 0.04	700
800	16.94 7.57	8.22 1.31	4.76 0.35	3.16 0.13	2.24 0.05	800
900	19.05 9.42	9.25 1.62	5.36 0.43	3.56 0.16	2.52 0.07	900
1000		10.28 1.97	5.95 0.52	3.95 0.19	2.80 0.08	1000
1100		11.31 2.36	6.55 0.62	4.35 0.23	3.08 0.10	1100
1300		13.36 3.21	7.74 0.85	5.14 0.31	3.63 0.14	1300
1400		14.39 3.68	8.33 0.97	5.53 0.36	3.91 0.16	1400
1500		15.42 4.18	8.93 1.11	5.93 0.41	4.19 0.18	1500
1600		16.45 4.72	9.52 1.25	6.32 0.46	4.47 0.20	1600
1700		17.48 5.28	10.12 1.40	6.72 0.52	4.75 0.22	1700
1800		18.50 5.86	10.71 1.55	7.11 0.57	5.03 0.25	1800
1900		19.53 6.48	11.31 1.71	7.51 0.63	5.31 0.27	1900
2000			11.90 1.89	7.91 0.70	5.59 0.30	2000
2100			12.50 2.06	8.30 0.76	5.87 0.33	2100
2200			13.09 2.25	8.70 0.83	6.15 0.36	2200
2300			13.69 2.44	9.09 0.90	6.43 0.39	2300
2400			14.28 2.64	9.49 0.98	6.71 0.42	2400
2600			15.47 3.07	10.28 1.13	7.27 0.49	2600
2800			16.66 3.52	11.07 1.30	7.83 0.56	2800
3000			17.85 4.00	11.86 1.48	8.39 0.64	3000
3200			19.04 4.50	12.65 1.66	8.95 0.72	3200
3400				13.44 1.86	9.51 0.80	3400
3600				14.23 2.07	10.07 0.89	3600
3800				15.02 2.29	10.62 0.99	3800
4000				15.81 2.51	11.18 1.08	4000
4200				16.60 2.75	11.74 1.19	4200
4400				17.39 3.00	12.30 1.29	4400
4600				18.18 3.26	12.86 1.40	4600
4800				18.97 3.53	13.42 1.52	4800
5000				19.76 3.80	13.98 1.64	5000
5200					14.54 1.76	5200
5400					15.10 1.89	5400
5600					15.66 2.02	5600
5800					16.22 2.16	5800
6000					16.78 2.30	6000
6200					17.33 2.44	6200
6400					17.89 2.59	6400
6700					18.73 2.82	6700
7000					19.57 3.05	7000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see chart on page 108.

AWWA Standard C900 - Class 150 PVC

C=150 SDR 18
PRESSURE LOSS PER 100 FEET (PSI) SIZES 4" THRU 12"

Nominal Size Pipe ID* Pipe OD Wall Thick	4" 4.23 4.80 0.267	6" 6.08 6.90 0.383	8" 7.98 9.05 0.503	10" 9.78 11.10 0.617	12" 11.64 13.20 0.733	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
30	0.68 0.02					30
35	0.80 0.03	0.39 0.00				35
40	0.91 0.04	0.44 0.01				40
45	1.03 0.04	0.50 0.01				45
50	1.14 0.05	0.55 0.01				50
60	1.37 0.07	0.66 0.01				60
70	1.60 0.10	0.77 0.02	0.45 0.00			70
80	1.82 0.13	0.88 0.02	0.51 0.01			80
90	2.05 0.16	0.99 0.03	0.58 0.01			90
100	2.28 0.19	1.10 0.03	0.64 0.01			100
125	2.85 0.29	1.38 0.05	0.80 0.01	0.53 0.00		125
150	3.42 0.41	1.65 0.07	0.96 0.02	0.64 0.01		150
175	3.99 0.54	1.93 0.09	1.12 0.02	0.74 0.01	0.53 0.00	175
200	4.56 0.70	2.20 0.12	1.28 0.03	0.85 0.01	0.60 0.01	200
225	5.13 0.87	2.48 0.15	1.44 0.04	0.96 0.01	0.68 0.01	225
250	5.70 1.05	2.75 0.18	1.60 0.05	1.06 0.02	0.75 0.01	250
275	6.27 1.26	3.03 0.21	1.76 0.06	1.17 0.02	0.83 0.01	275
300	6.84 1.48	3.30 0.25	1.92 0.07	1.28 0.02	0.90 0.01	300
325	7.41 1.71	3.58 0.29	2.08 0.08	1.38 0.03	0.98 0.01	325
350	7.98 1.96	3.85 0.33	2.24 0.09	1.49 0.03	1.05 0.01	350
400	9.12 2.51	4.40 0.43	2.56 0.11	1.70 0.04	1.20 0.02	400
450	10.26 3.13	4.95 0.53	2.88 0.14	1.92 0.05	1.35 0.02	450
500	11.40 3.80	5.50 0.65	3.20 0.17	2.13 0.06	1.50 0.03	500
600	13.68 5.33	6.60 0.90	3.84 0.24	2.55 0.09	1.80 0.04	600
700	15.96 7.09	7.70 1.20	4.48 0.32	2.98 0.12	2.10 0.05	700
800	18.24 9.07	8.80 1.54	5.13 0.41	3.41 0.15	2.40 0.07	800
900		9.90 1.92	5.77 0.51	3.83 0.19	2.71 0.08	900
1000		11.00 2.33	6.41 0.63	4.26 0.23	3.01 0.10	1000
1100		12.10 2.78	7.05 0.75	4.68 0.28	3.31 0.12	1100
1300		14.30 3.79	8.33 1.02	5.53 0.38	3.91 0.16	1300
1400		15.40 4.34	8.97 1.17	5.96 0.43	4.21 0.18	1400
1500		16.50 4.93	9.61 1.32	6.39 0.49	4.51 0.21	1500
1600		17.60 5.56	10.25 1.49	6.81 0.55	4.81 0.24	1600
1700		18.70 6.22	10.89 1.67	7.24 0.62	5.11 0.26	1700
1800		19.80 6.92	11.53 1.86	7.66 0.69	5.41 0.29	1800
1900			12.17 2.05	8.09 0.76	5.71 0.33	1900
2000			12.81 2.26	8.51 0.83	6.01 0.36	2000
2100			13.45 2.47	8.94 0.91	6.31 0.39	2100
2200			14.10 2.69	9.37 1.00	6.61 0.43	2200
2300			14.74 2.92	9.79 1.08	6.91 0.46	2300
2400			15.38 3.16	10.22 1.17	7.21 0.50	2400
2500			16.02 3.41	10.64 1.26	7.52 0.54	2500
2600			16.66 3.67	11.07 1.36	7.82 0.58	2600
2800			17.94 4.21	11.92 1.56	8.42 0.67	2800
3000			19.22 4.78	12.77 1.77	9.02 0.76	3000
3200				13.62 1.99	9.62 0.85	3200
3400				14.47 2.23	10.22 0.96	3400
3600				15.32 2.48	10.82 1.06	3600
3800				16.18 2.74	11.42 1.18	3800
4000				17.03 3.01	12.02 1.29	4000
4200				17.88 3.30	12.63 1.41	4200
4400				18.73 3.59	13.23 1.54	4400
4600				19.58 3.90	13.83 1.67	4600
4800					14.43 1.81	4800
5000					15.03 1.95	5000
5200					15.63 2.10	5200
5400					16.23 2.25	5400
5600					16.83 2.41	5600
5800					17.44 2.57	5800
6000					18.04 2.74	6000
6200					18.64 2.91	6200
6400					19.24 3.09	6400
6600					19.84 3.27	6600

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see chart on page 108.

AWWA Standard C900 - Class 200 PVC

C=150 SDR 14
PRESSURE LOSS PER 100 FEET (PSI) SIZES 4" THRU 12"

Nominal Size Pipe ID* Pipe OD Wall Thick	4" 4.07 4.80 0.343	6" 5.85 6.90 0.493	8" 7.67 9.05 0.646	10" 9.41 11.10 0.793	12" 11.19 13.20 0.943	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
30	0.74 0.03	0.36 0.00				30
35	0.86 0.03	0.42 0.01				35
40	0.99 0.04	0.48 0.01				40
45	1.11 0.05	0.53 0.01				45
50	1.23 0.06	0.59 0.01				50
60	1.48 0.09	0.71 0.02				60
70	1.72 0.12	0.83 0.02	0.46 0.00			70
80	1.97 0.15	0.95 0.03	0.53 0.01			80
90	2.22 0.19	1.07 0.03	0.59 0.01			90
100	2.46 0.23	1.19 0.04	0.66 0.01	0.46 0.00		100
125	3.08 0.35	1.49 0.06	0.82 0.01	0.57 0.01		125
150	3.69 0.49	1.78 0.08	0.99 0.02	0.69 0.01		150
175	4.31 0.66	2.08 0.11	1.15 0.03	0.80 0.01	0.57 0.00	175
200	4.93 0.84	2.38 0.14	1.31 0.03	0.92 0.01	0.65 0.01	200
225	5.54 1.04	2.67 0.18	1.48 0.04	1.03 0.02	0.73 0.01	225
250	6.16 1.27	2.97 0.22	1.64 0.05	1.15 0.02	0.81 0.01	250
275	6.77 1.52	3.27 0.26	1.81 0.06	1.26 0.03	0.89 0.01	275
300	7.39 1.78	3.56 0.30	1.97 0.07	1.38 0.03	0.98 0.01	300
325	8.00 2.06	3.86 0.35	2.14 0.08	1.49 0.03	1.06 0.01	325
350	8.62 2.37	4.16 0.40	2.30 0.10	1.61 0.04	1.14 0.02	350
375	9.24 2.69	4.46 0.46	2.46 0.11	1.72 0.05	1.22 0.02	375
400	9.85 3.03	4.75 0.51	2.63 0.12	1.84 0.05	1.30 0.02	400
425	10.47 3.39	5.05 0.58	2.79 0.14	1.95 0.06	1.38 0.02	425
450	11.08 3.77	5.35 0.64	2.96 0.15	2.07 0.06	1.46 0.03	450
475	11.70 4.17	5.64 0.71	3.12 0.17	2.18 0.07	1.54 0.03	475
500	12.32 4.58	5.94 0.78	3.29 0.18	2.30 0.08	1.63 0.03	500
550	13.55 5.47	6.53 0.93	3.61 0.22	2.53 0.09	1.79 0.04	550
600	14.78 6.43	7.13 1.09	3.94 0.26	2.76 0.11	1.95 0.05	600
650	16.01 7.45	7.72 1.26	4.27 0.30	2.99 0.13	2.11 0.05	650
700	17.24 8.55	8.32 1.45	4.60 0.34	3.22 0.14	2.28 0.06	700
800	19.70 10.95	9.51 1.86	5.26 0.44	3.68 0.18	2.60 0.08	800
900		10.69 2.31	5.91 0.55	4.14 0.23	2.93 0.10	900
1000		11.88 2.81	6.57 0.66	4.60 0.28	3.25 0.12	1000
1100		13.07 3.35	7.23 0.79	5.06 0.33	3.58 0.14	1100
1200		14.26 3.94	7.88 0.93	5.52 0.39	3.90 0.17	1200
1300		15.45 4.57	8.54 1.08	5.98 0.45	4.23 0.20	1300
1400		16.63 5.24	9.20 1.24	6.44 0.52	4.55 0.22	1400
1500		17.82 5.95	9.86 1.41	6.90 0.59	4.88 0.25	1500
1600		19.01 6.71	10.51 1.59	7.36 0.67	5.20 0.29	1600
1700			11.17 1.78	7.82 0.74	5.53 0.32	1700
1800			11.83 1.97	8.28 0.83	5.85 0.36	1800
2000			13.14 2.40	9.20 1.01	6.51 0.43	2000
2200			14.46 2.86	10.12 1.20	7.16 0.52	2200
2400			15.77 3.36	11.03 1.41	7.81 0.61	2400
2600			17.08 3.90	11.95 1.64	8.46 0.70	2600
2800			18.40 4.47	12.87 1.88	9.11 0.81	2800
3000			19.71 5.08	13.79 2.13	9.76 0.92	3000
3200				14.71 2.40	10.41 1.04	3200
3400				15.63 2.69	11.06 1.16	3400
3600				16.55 2.99	11.71 1.29	3600
3800				17.47 3.30	12.36 1.42	3800
4000				18.39 3.63	13.01 1.57	4000
4200				19.31 3.98	13.66 1.71	4200
4400					14.31 1.87	4400
4600					14.96 2.03	4600
4800					15.61 2.19	4800
5000					16.26 2.37	5000
5200					16.91 2.54	5200
5400					17.56 2.73	5400
5600					18.21 2.92	5600
5800					18.86 3.11	5800
6000					19.52 3.32	6000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see chart on page 108.

AWWA Standard C905 - Class 100 PVC

C=150 SDR 41
PRESSURE LOSS PER 100 FEET OF PIPE (PSI)

Nominal Size	30"	
Pipe ID*	30.15	
Pipe OD	32.00	
Wall Thick	0.780	
Flow GPM	Velocity FPS	PSI LOSS
2500	1.11	0.00
3000	1.33	0.00
3500	1.55	0.00
4000	1.77	0.01
4500	1.99	0.02
5000	2.21	0.02
5500	2.44	0.02
6000	2.66	0.03
6500	2.88	0.03
7000	3.10	0.03
7500	3.32	0.04
8000	3.54	0.04
8500	3.76	0.05
9000	3.99	0.05
9500	4.21	0.06
10000	4.43	0.07
10500	4.65	0.07
11000	4.87	0.08
11500	5.09	0.09
12000	5.32	0.09
12500	5.54	0.10
13000	5.76	0.11
13500	5.98	0.12
14000	6.20	0.12
14500	6.42	0.13
15000	6.64	0.14
15500	6.87	0.15
16000	7.09	0.16
16500	7.31	0.17
17000	7.53	0.18
17500	7.75	0.19
18000	7.97	0.20
18500	8.19	0.21
19000	8.42	0.22
19500	8.64	0.23
20000	8.86	0.24
20500	9.08	0.25
21000	9.30	0.26
21500	9.52	0.28
22000	9.74	0.29
22500	9.97	0.30
23000	10.19	0.31
23500	10.41	0.33
24000	10.63	0.34
24500	10.85	0.35
25000	11.07	0.36
25500	11.29	0.38
26000	11.52	0.39
26500	11.74	0.41
27000	11.96	0.42
28000	12.40	0.45
29000	12.85	0.48
30000	13.29	0.51
31000	13.73	0.54
32000	14.17	0.58
33000	14.62	0.61
34000	15.06	0.64
35000	15.50	0.68
36000	15.95	0.72
37000	16.39	0.75
38000	16.83	0.79
40000	17.72	0.87
42000	18.60	0.95
44000	19.49	1.04

FOR OPERATION AT TEMPERATURES
80° OR HIGHER, MULTIPLY THE PRESSURE
CLASS BY THESE DERATING FACTORS:

Temperature	Derating Factor
80°	0.88
90°	0.75
100°	0.62
110°	0.50
120°	0.40
140°	0.22

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see above chart.

AWWA Standard C905 - Class 165 PVC

C=150 SDR 25
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 14" THRU 30"

Nominal Size Pipe ID*	14"	16"	18"	20"	24"	30"	Nominal Size Pipe ID Pipe OD Wall Thick
Pipe OD	13.99	15.91	17.83	19.75	23.59	29.11	Pipe ID
Pipe OD	15.30	17.40	19.50	21.60	25.80	32.00	Pipe OD
Wall Thick	0.612	0.696	0.780	0.864	1.032	1.280	Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
400	0.82	0.01	0.64	0.00			400
600	1.23	0.02	0.96	0.01			600
800	1.65	0.03	1.27	0.01	0.83	0.00	800
1000	2.06	0.04	1.59	0.02	1.03	0.01	1000
1200	2.47	0.06	1.91	0.03	1.24	0.01	1200
1400	2.88	0.07	2.23	0.04	1.45	0.01	1400
1600	3.29	0.09	2.55	0.05	1.65	0.02	1600
1800	3.70	0.12	2.87	0.06	1.86	0.02	1800
2000	4.12	0.14	3.18	0.08	2.07	0.03	2000
2200	4.53	0.17	3.50	0.09	2.27	0.03	2200
2400	4.94	0.20	3.82	0.11	2.48	0.04	2400
2600	5.35	0.23	4.14	0.12	2.69	0.04	2600
2800	5.76	0.27	4.46	0.14	2.89	0.05	2800
3000	6.17	0.30	4.78	0.16	3.10	0.06	3000
3200	6.59	0.34	5.09	0.18	3.31	0.06	3200
3500	7.20	0.40	5.57	0.21	3.62	0.08	3500
4000	8.23	0.51	6.37	0.28	4.13	0.10	4000
4500	9.26	0.64	7.16	0.34	4.65	0.12	4500
5000	10.29	0.78	7.96	0.42	5.17	0.15	5000
5500	11.32	0.93	8.75	0.50	5.68	0.17	5500
6000	12.35	1.09	9.55	0.58	6.20	0.20	6000
6500	13.38	1.26	10.35	0.68	6.72	0.24	6500
7000	14.41	1.45	11.14	0.78	7.23	0.27	7000
7500	15.44	1.65	11.94	0.88	7.75	0.31	7500
8000	16.46	1.86	12.73	0.99	8.27	0.35	8000
8500	17.49	2.08	13.53	1.11	8.78	0.39	8500
9000	18.52	2.31	14.33	1.24	9.30	0.43	9000
9500	19.55	2.55	15.12	1.37	9.82	0.48	9500
10000			15.92	1.50	10.33	0.52	10000
10500			16.71	1.64	10.85	0.57	10500
11000			17.51	1.79	11.37	0.63	11000
11500			18.31	1.94	11.88	0.68	11500
12000			19.10	2.10	12.40	0.74	12000
12500			19.90	2.27	12.92	0.79	12500
13000					13.43	0.85	13000
14000					14.47	0.98	14000
15000					15.50	1.11	15000
16000					16.53	1.25	16000
17000					17.57	1.40	17000
18000					18.60	1.56	18000
19000					19.63	1.72	19000
20000							20000
21000							21000
22000							22000
23000							23000
24000							24000
25000							25000
26000							26000
27000							27000
28000							28000
29000							29000
30000							30000
31000							31000
32000							32000
33000							33000
34000							34000
35000							35000
36000							36000
37000							37000
38000							38000
39000							39000
40000							40000
41000							41000
42000							42000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see chart on page 108.

Friction Loss Characteristics

AWWA Standard C905 - Class 235 PVC

C=150 SDR 18
PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 14" THRU 24"

Nominal Size Pipe ID* Pipe OD Wall Thick	14" 13.48 15.30 0.850	16" 15.33 17.40 0.967	18" 17.18 19.50 1.083	20" 19.03 21.60 1.200	24" 22.56 25.80 1.433	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
400	0.88 0.01	0.68 0.00				400
500	1.10 0.01	0.85 0.01	0.68 0.00			500
600	1.32 0.02	1.02 0.01	0.82 0.01			600
700	1.54 0.02	1.19 0.01	0.95 0.01	0.77 0.00		700
800	1.76 0.03	1.37 0.02	1.09 0.01	0.89 0.01		800
900	1.99 0.04	1.54 0.02	1.22 0.01	1.00 0.01		900
1000	2.21 0.05	1.71 0.03	1.36 0.01	1.11 0.01		1000
1100	2.43 0.06	1.88 0.03	1.49 0.02	1.22 0.01	0.87 0.00	1100
1200	2.65 0.07	2.05 0.04	1.63 0.02	1.33 0.01	0.95 0.01	1200
1300	2.87 0.08	2.22 0.04	1.77 0.02	1.44 0.01	1.02 0.01	1300
1400	3.09 0.09	2.39 0.05	1.90 0.03	1.55 0.02	1.10 0.01	1400
1500	3.31 0.10	2.56 0.05	2.04 0.03	1.66 0.02	1.18 0.01	1500
1600	3.53 0.11	2.73 0.06	2.17 0.03	1.77 0.02	1.26 0.01	1600
1700	3.75 0.12	2.90 0.07	2.31 0.04	1.88 0.02	1.34 0.01	1700
1800	3.97 0.14	3.07 0.07	2.45 0.04	1.99 0.03	1.42 0.01	1800
2000	4.41 0.17	3.41 0.09	2.72 0.05	2.21 0.03	1.58 0.01	2000
2200	4.85 0.20	3.76 0.11	2.99 0.06	2.43 0.04	1.73 0.02	2200
2400	5.29 0.24	4.10 0.13	3.26 0.07	2.66 0.04	1.89 0.02	2400
2600	5.74 0.27	4.44 0.15	3.53 0.08	2.88 0.05	2.05 0.02	2600
2800	6.18 0.31	4.78 0.17	3.80 0.10	3.10 0.06	2.21 0.03	2800
3000	6.62 0.36	5.12 0.19	4.08 0.11	3.32 0.07	2.36 0.03	3000
3200	7.06 0.40	5.46 0.22	4.35 0.12	3.54 0.08	2.52 0.03	3200
3400	7.50 0.45	5.80 0.24	4.62 0.14	3.76 0.08	2.68 0.04	3400
3600	7.94 0.50	6.15 0.27	4.89 0.15	3.98 0.09	2.84 0.04	3600
3800	8.38 0.55	6.49 0.30	5.16 0.17	4.21 0.10	2.99 0.05	3800
4000	8.82 0.61	6.83 0.33	5.43 0.19	4.43 0.11	3.15 0.05	4000
4200	9.26 0.67	7.17 0.36	5.71 0.20	4.65 0.12	3.31 0.05	4200
4400	9.71 0.73	7.51 0.39	5.98 0.22	4.87 0.14	3.47 0.06	4400
4600	10.15 0.79	7.85 0.42	6.25 0.24	5.09 0.15	3.62 0.06	4600
4800	10.59 0.85	8.19 0.46	6.52 0.26	5.31 0.16	3.78 0.07	4800
5000	11.03 0.92	8.54 0.49	6.79 0.28	5.53 0.17	3.94 0.08	5000
5200	11.47 0.99	8.88 0.53	7.06 0.30	5.76 0.18	4.10 0.08	5200
5400	11.91 1.06	9.22 0.57	7.34 0.33	5.98 0.20	4.25 0.09	5400
5600	12.35 1.13	9.56 0.61	7.61 0.35	6.20 0.21	4.41 0.09	5600
5800	12.79 1.21	9.90 0.65	7.88 0.37	6.42 0.23	4.57 0.10	5800
6000	13.24 1.29	10.24 0.69	8.15 0.40	6.64 0.24	4.73 0.11	6000
6200	13.68 1.37	10.58 0.73	8.42 0.42	6.86 0.26	4.88 0.11	6200
6400	14.12 1.45	10.92 0.78	8.69 0.45	7.08 0.27	5.04 0.12	6400
6600	14.56 1.54	11.27 0.82	8.97 0.47	7.30 0.29	5.20 0.13	6600
6800	15.00 1.63	11.61 0.87	9.24 0.50	7.53 0.30	5.36 0.13	6800
7000	15.44 1.72	11.95 0.92	9.51 0.53	7.75 0.32	5.51 0.14	7000
7500	16.54 1.95	12.80 1.04	10.19 0.60	8.30 0.36	5.91 0.16	7500
8000	17.65 2.20	13.66 1.18	10.87 0.68	8.85 0.41	6.30 0.18	8000
8500	18.75 2.46	14.51 1.32	11.55 0.76	9.41 0.46	6.69 0.20	8500
9000	19.85 2.73	15.36 1.46	12.23 0.84	9.96 0.51	7.09 0.22	9000
9500		16.22 1.62	12.91 0.93	10.51 0.56	7.48 0.25	9500
10000		17.07 1.78	13.59 1.02	11.07 0.62	7.88 0.27	10000
10500		17.92 1.95	14.26 1.12	11.62 0.68	8.27 0.30	10500
11000		18.78 2.12	14.94 1.22	12.17 0.74	8.66 0.32	11000
12000			16.30 1.43	13.28 0.87	9.45 0.38	12000
13000			17.66 1.66	14.39 1.01	10.24 0.44	13000
14000			19.02 1.90	15.49 1.16	11.03 0.51	14000
15000				16.60 1.31	11.81 0.57	15000
16000				17.71 1.48	12.60 0.65	16000
17000				18.82 1.66	13.39 0.72	17000
18000				19.92 1.84	14.18 0.81	18000
19000					14.96 0.89	19000
20000					15.75 0.98	20000
21000					16.54 1.07	21000
22000					17.33 1.17	22000
23000					18.12 1.27	23000
24000					18.90 1.37	24000
25000					19.69 1.48	25000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

* These figures allow for manufacturing tolerances.
For operation at temperatures 80°F or higher see chart on page 108.

Schedule 40 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 2"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	¾"	1"	1¼"	1½"	2"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.622 0.840 0.109	0.824 1.050 0.113	1.049 1.315 0.133	1.380 1.660 0.140	1.610 1.900 0.145	2.067 2.375 0.154	
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
1	1.05 0.91	0.60 0.23	0.37 0.07	0.21 0.02	0.16 0.01	0.10 0.00	1
2	2.11 3.28	1.20 0.84	0.74 0.26	0.43 0.07	0.31 0.03	0.19 0.01	2
3	3.16 6.95	1.80 1.77	1.11 0.55	0.64 0.14	0.47 0.07	0.29 0.02	3
4	4.22 11.85	2.40 3.02	1.48 0.93	0.86 0.25	0.63 0.12	0.38 0.03	4
5	5.27 17.91	3.00 4.56	1.85 1.41	1.07 0.37	0.79 0.18	0.48 0.05	5
6	6.33 25.10	3.61 6.39	2.22 1.97	1.29 0.52	0.94 0.25	0.57 0.07	6
7	7.38 33.40	4.21 8.50	2.60 2.63	1.50 0.69	1.10 0.33	0.67 0.10	7
8	8.44 42.77	4.81 10.88	2.97 3.36	1.71 0.89	1.26 0.42	0.76 0.12	8
9	9.49 53.19	5.41 13.54	3.34 4.18	1.93 1.10	1.42 0.52	0.86 0.15	9
10	10.55 64.65	6.01 16.45	3.71 5.08	2.14 1.34	1.57 0.63	0.95 0.19	10
11	11.60 77.14	6.61 19.63	4.08 6.06	2.36 1.60	1.73 0.75	1.05 0.22	11
12	12.65 90.62	7.21 23.06	4.45 7.12	2.57 1.88	1.89 0.89	1.15 0.26	12
13	13.71 105.10	7.81 26.75	4.82 8.26	2.79 2.18	2.05 1.03	1.24 0.30	13
14	14.76 120.60	8.41 30.68	5.19 9.48	3.00 2.50	2.20 1.18	1.34 0.35	14
15	15.82 137.00	9.01 34.87	5.56 10.77	3.21 2.84	2.36 1.34	1.43 0.40	15
16	16.87 154.40	9.61 39.29	5.93 12.14	3.43 3.20	2.52 1.51	1.53 0.45	16
17	17.93 172.70	10.22 43.96	6.30 13.58	3.64 3.58	2.68 1.69	1.62 0.50	17
18	18.98 192.00	10.82 48.87	6.67 15.10	3.86 3.97	2.83 1.88	1.72 0.56	18
19		11.42 54.02	7.04 16.69	4.07 4.39	2.99 2.07	1.81 0.62	19
20		12.02 59.40	7.42 18.35	4.28 4.83	3.15 2.28	1.91 0.68	20
22		13.22 70.87	8.16 21.89	4.71 5.76	3.46 2.72	2.10 0.81	22
24		14.42 83.26	8.90 25.72	5.14 6.77	3.78 3.20	2.29 0.95	24
25		15.02 89.80	9.27 27.74	5.36 7.30	3.94 3.45	2.39 1.02	25
26		15.62 96.56	9.64 29.83	5.57 7.85	4.09 3.71	2.48 1.10	26
28		16.83 110.80	10.38 34.22	6.00 9.01	4.41 4.25	2.67 1.26	28
30		18.03 125.90	11.12 38.88	6.43 10.24	4.72 4.83	2.86 1.43	30
32			11.86 43.81	6.86 11.54	5.04 5.45	3.06 1.62	32
34			12.61 49.02	7.28 12.91	5.35 6.10	3.25 1.81	34
35			12.98 51.72	7.50 13.62	5.51 6.43	3.34 1.91	35
36			13.35 54.49	7.71 14.35	5.67 6.78	3.44 2.01	36
38			14.09 60.23	8.14 15.86	5.98 7.49	3.63 2.22	38
40			14.83 66.24	8.57 17.44	6.30 8.24	3.82 2.44	40
42			15.57 72.50	9.00 19.09	6.61 9.02	4.01 2.67	42
44			16.31 79.02	9.43 20.81	6.93 9.83	4.20 2.91	44
45			16.68 82.38	9.64 21.69	7.08 10.25	4.30 3.04	45
46			17.06 85.80	9.86 22.59	7.24 10.67	4.39 3.16	46
48			17.80 92.84	10.28 24.44	7.56 11.55	4.58 3.42	48
50			18.54 100.10	10.71 26.36	7.87 12.45	4.77 3.69	50
55				11.78 31.45	8.66 14.86	5.25 4.40	55
60				12.85 36.95	9.44 17.45	5.73 5.17	60
65				13.93 42.86	10.23 20.24	6.21 6.00	65
70				15.00 49.16	11.02 23.22	6.68 6.88	70
75				16.07 55.86	11.81 26.39	7.16 7.82	75
80				17.14 62.96	12.59 29.74	7.64 8.82	80
85				18.21 70.44	13.38 33.27	8.12 9.86	85
90					14.17 36.98	8.59 10.96	90
95					14.95 40.88	9.07 12.12	95
100					15.74 44.95	9.55 13.33	100
105					16.53 49.20	10.03 14.59	105
110					17.31 53.63	10.50 15.90	110
115					18.10 58.23	10.98 17.26	115
120					18.89 63.01	11.46 18.68	120
125					19.68 67.96	11.94 20.15	125
130						12.41 21.66	130
135						12.89 23.23	135
140						13.37 24.85	140
145						13.85 26.52	145
150						14.32 28.24	150
155						14.80 30.01	155
160						15.28 31.82	160
165						15.76 33.69	165
170						16.23 35.61	170
175						16.71 37.57	175
180						17.19 39.58	180
185						17.67 41.64	185
190						18.14 43.75	190

Shaded area represents velocities over 7.5 fps. Use with caution where water hammer is a concern.

Schedule 40 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 2½" THRU 8"

Nominal Size	2½"		3"		4"		6"		8"		Nominal Size
Pipe ID	2.469		3.068		4.026		6.065		7.981		Pipe ID
Pipe OD	2.875		3.500		4.500		6.625		8.625		Pipe OD
Wall Thick	0.203		0.216		0.237		0.280		0.322		Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
10	0.67	0.08	0.43	0.03	0.25	0.01					10
12	0.80	0.11	0.52	0.04	0.30	0.01					12
14	0.94	0.15	0.61	0.05	0.35	0.01					14
16	1.07	0.19	0.69	0.07	0.40	0.02					16
18	1.20	0.23	0.78	0.08	0.45	0.02					18
20	1.34	0.28	0.87	0.10	0.50	0.03					20
22	1.47	0.34	0.95	0.12	0.55	0.03	0.24	0.00			22
24	1.61	0.40	1.04	0.14	0.60	0.04	0.27	0.01			24
26	1.74	0.46	1.13	0.16	0.65	0.04	0.29	0.01			26
28	1.87	0.53	1.21	0.18	0.70	0.05	0.31	0.01			28
30	2.01	0.60	1.30	0.21	0.76	0.06	0.33	0.01			30
32	2.14	0.68	1.39	0.24	0.81	0.06	0.35	0.01			32
34	2.28	0.76	1.47	0.26	0.86	0.07	0.38	0.01			34
36	2.41	0.85	1.56	0.29	0.91	0.08	0.40	0.01			36
38	2.54	0.94	1.65	0.33	0.96	0.09	0.42	0.01			38
40	2.68	1.03	1.73	0.36	1.01	0.10	0.44	0.01			40
42	2.81	1.13	1.82	0.39	1.06	0.10	0.47	0.01			42
44	2.94	1.23	1.91	0.43	1.11	0.11	0.49	0.02			44
46	3.08	1.33	1.99	0.46	1.16	0.12	0.51	0.02			46
48	3.21	1.44	2.08	0.50	1.21	0.13	0.53	0.02	0.31	0.00	48
50	3.35	1.55	2.17	0.54	1.26	0.14	0.55	0.02	0.32	0.01	50
55	3.68	1.85	2.38	0.64	1.38	0.17	0.61	0.02	0.35	0.01	55
60	4.02	2.18	2.60	0.76	1.51	0.20	0.67	0.03	0.38	0.01	60
65	4.35	2.53	2.82	0.88	1.64	0.23	0.72	0.03	0.42	0.01	65
70	4.69	2.90	3.03	1.01	1.76	0.27	0.78	0.04	0.45	0.01	70
75	5.02	3.29	3.25	1.14	1.89	0.31	0.83	0.04	0.48	0.01	75
80	5.35	3.71	3.47	1.29	2.01	0.34	0.89	0.05	0.51	0.01	80
85	5.69	4.15	3.68	1.44	2.14	0.38	0.94	0.05	0.54	0.01	85
90	6.02	4.62	3.90	1.60	2.27	0.43	1.00	0.06	0.58	0.02	90
95	6.36	5.10	4.12	1.77	2.39	0.47	1.05	0.06	0.61	0.02	95
100	6.69	5.61	4.33	1.95	2.52	0.52	1.11	0.07	0.64	0.02	100
110	7.36	6.70	4.77	2.33	2.77	0.62	1.22	0.08	0.70	0.02	110
120	8.03	7.87	5.20	2.73	3.02	0.73	1.33	0.10	0.77	0.03	120
130	8.70	9.12	5.63	3.17	3.27	0.85	1.44	0.12	0.83	0.03	130
140	9.37	10.47	6.07	3.64	3.52	0.97	1.55	0.13	0.90	0.03	140
150	10.04	11.89	6.50	4.13	3.78	1.10	1.66	0.15	0.96	0.04	150
175	11.71	15.82	7.59	5.50	4.41	1.47	1.94	0.20	1.12	0.05	175
200	13.39	20.26	8.67	7.04	5.03	1.88	2.22	0.26	1.28	0.07	200
225	15.06	25.20	9.75	8.76	5.66	2.33	2.50	0.32	1.44	0.08	225
250	16.73	30.63	10.84	10.64	6.29	2.84	2.77	0.39	1.60	0.10	250
275	18.41	36.54	11.92	12.70	6.92	3.38	3.05	0.46	1.76	0.12	275
300			13.00	14.92	7.55	3.98	3.33	0.54	1.92	0.14	300
350			15.17	19.85	8.81	5.29	3.88	0.72	2.24	0.19	350
400			17.34	25.42	10.07	6.77	4.44	0.92	2.56	0.24	400
450			19.51	31.61	11.33	8.43	4.99	1.15	2.88	0.30	450
500					12.59	10.24	5.55	1.39	3.20	0.37	500
600					15.10	14.35	6.66	1.95	3.84	0.51	600
700					17.62	19.10	7.76	2.60	4.48	0.68	700
800							8.87	3.33	5.12	0.88	800
900							9.98	4.14	5.76	1.09	900
1000							11.09	5.03	6.41	1.32	1000
1100							12.20	6.01	7.05	1.58	1100
1200							13.31	7.06	7.69	1.86	1200
1300							14.42	8.18	8.33	2.15	1300
1400							15.53	9.39	8.97	2.47	1400
1500							16.64	10.67	9.61	2.80	1500
1600							17.75	12.02	10.25	3.16	1600
1700							18.86	13.45	10.89	3.54	1700
1800							19.97	14.95	11.53	3.93	1800
1900									12.17	4.35	1900
2000									12.81	4.78	2000
2200									14.09	5.70	2200
2400									15.37	6.70	2400
2600									16.65	7.77	2600
2800									17.94	8.91	2800
3000									19.22	10.12	3000

Shaded area represents
velocities over 7.5 fps.
Use with caution where
water hammer is a concern.

Schedule 40 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 10" THRU 24"

Nominal Size	10"		12"		14"		16"		18"		20"		24"		Nominal Size
Pipe ID	10.020		11.938		13.126		15.000		16.875		18.814		22.626		Pipe ID
Pipe OD	10.750		12.750		14.000		16.000		18.000		20.000		24.000		Pipe OD
Wall Thick	0.365		0.406		0.438		0.500		0.562		0.583		0.687		Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
100	0.41	0.01	0.29	0.00	0.24	0.00									100
200	0.81	0.02	0.57	0.01	0.47	0.01	0.36	0.00							200
300	1.22	0.05	0.86	0.02	0.71	0.01	0.54	0.01	0.43	0.00					300
400	1.63	0.08	1.15	0.03	0.95	0.02	0.73	0.01	0.57	0.01	0.46	0.00			400
500	2.03	0.12	1.43	0.05	1.18	0.03	0.91	0.02	0.72	0.01	0.58	0.01			500
600	2.44	0.17	1.72	0.07	1.42	0.05	1.09	0.02	0.86	0.01	0.69	0.01			600
700	2.84	0.23	2.00	0.10	1.66	0.06	1.27	0.03	1.00	0.02	0.81	0.01	0.56	0.00	700
800	3.25	0.29	2.29	0.12	1.89	0.08	1.45	0.04	1.15	0.02	0.92	0.01	0.64	0.01	800
900	3.66	0.36	2.58	0.15	2.13	0.10	1.63	0.05	1.29	0.03	1.04	0.02	0.72	0.01	900
1000	4.06	0.44	2.86	0.19	2.37	0.12	1.81	0.06	1.43	0.03	1.15	0.02	0.80	0.01	1000
1100	4.47	0.52	3.15	0.22	2.60	0.14	1.99	0.07	1.58	0.04	1.27	0.02	0.88	0.01	1100
1200	4.88	0.61	3.44	0.26	2.84	0.16	2.18	0.09	1.72	0.05	1.38	0.03	0.96	0.01	1200
1300	5.28	0.71	3.72	0.30	3.08	0.19	2.36	0.10	1.86	0.06	1.50	0.03	1.04	0.01	1300
1400	5.69	0.82	4.01	0.35	3.32	0.22	2.54	0.11	2.01	0.06	1.61	0.04	1.12	0.02	1400
1500	6.10	0.93	4.29	0.40	3.55	0.25	2.72	0.13	2.15	0.07	1.73	0.04	1.20	0.02	1500
1600	6.50	1.04	4.58	0.45	3.79	0.28	2.90	0.15	2.29	0.08	1.84	0.05	1.28	0.02	1600
1700	6.91	1.17	4.87	0.50	4.03	0.31	3.08	0.16	2.44	0.09	1.96	0.05	1.35	0.02	1700
1800	7.31	1.30	5.15	0.55	4.26	0.35	3.26	0.18	2.58	0.10	2.07	0.06	1.43	0.02	1800
1900	7.72	1.44	5.44	0.61	4.50	0.39	3.45	0.20	2.72	0.11	2.19	0.07	1.51	0.03	1900
2000	8.13	1.58	5.73	0.67	4.74	0.42	3.63	0.22	2.87	0.13	2.31	0.07	1.59	0.03	2000
2200	8.94	1.88	6.30	0.80	5.21	0.51	3.99	0.26	3.15	0.15	2.54	0.09	1.75	0.04	2200
2400	9.75	2.21	6.87	0.94	5.68	0.59	4.35	0.31	3.44	0.18	2.77	0.10	1.91	0.04	2400
2600	10.57	2.57	7.44	1.09	6.16	0.69	4.71	0.36	3.73	0.20	3.00	0.12	2.07	0.05	2600
2800	11.38	2.95	8.02	1.26	6.63	0.79	5.08	0.41	4.01	0.23	3.23	0.14	2.23	0.06	2800
3000	12.19	3.35	8.59	1.43	7.10	0.90	5.44	0.47	4.30	0.26	3.46	0.16	2.39	0.06	3000
3200	13.00	3.77	9.16	1.61	7.58	1.01	5.80	0.53	4.58	0.30	3.69	0.18	2.55	0.07	3200
3400	13.82	4.22	9.73	1.80	8.05	1.13	6.17	0.59	4.87	0.33	3.92	0.20	2.71	0.08	3400
3600	14.63	4.69	10.31	2.00	8.53	1.26	6.53	0.66	5.16	0.37	4.15	0.22	2.87	0.09	3600
3800	15.44	5.18	10.88	2.21	9.00	1.39	6.89	0.73	5.44	0.41	4.38	0.24	3.03	0.10	3800
4000	16.25	5.70	11.45	2.43	9.47	1.53	7.25	0.80	5.73	0.45	4.61	0.27	3.19	0.11	4000
4200	17.07	6.24	12.02	2.66	9.95	1.68	7.62	0.88	6.02	0.49	4.84	0.29	3.35	0.12	4200
4400	17.88	6.80	12.60	2.90	10.42	1.83	7.98	0.95	6.30	0.54	5.07	0.32	3.51	0.13	4400
4600	18.69	7.39	13.17	3.15	10.89	1.99	8.34	1.04	6.59	0.58	5.30	0.34	3.67	0.14	4600
4800	19.51	7.99	13.74	3.41	11.37	2.15	8.70	1.12	6.88	0.63	5.53	0.37	3.83	0.15	4800
5000			14.31	3.68	11.84	2.32	9.07	1.21	7.16	0.68	5.76	0.40	3.98	0.16	5000
5200			14.89	3.95	12.31	2.49	9.43	1.30	7.45	0.73	5.99	0.43	4.14	0.18	5200
5400			15.46	4.24	12.79	2.67	9.79	1.40	7.74	0.79	6.22	0.46	4.30	0.19	5400
5600			16.03	4.53	13.26	2.86	10.15	1.49	8.02	0.84	6.45	0.50	4.46	0.20	5600
5800			16.60	4.84	13.73	3.05	10.52	1.59	8.31	0.90	6.69	0.53	4.62	0.22	5800
6000			17.18	5.15	14.21	3.25	10.88	1.70	8.60	0.96	6.92	0.56	4.78	0.23	6000
6500			18.61	5.98	15.39	3.77	11.79	1.97	9.31	1.11	7.49	0.65	5.18	0.27	6500
7000					16.58	4.32	12.69	2.26	10.03	1.27	8.07	0.75	5.58	0.31	7000
7500					17.76	4.91	13.60	2.56	10.75	1.45	8.64	0.85	5.98	0.35	7500
8000					18.94	5.53	14.51	2.89	11.46	1.63	9.22	0.96	6.38	0.39	8000
8500							15.41	3.23	12.18	1.82	9.80	1.07	6.77	0.44	8500
9000							16.32	3.59	12.89	2.03	10.37	1.19	7.17	0.49	9000
9500							17.23	3.97	13.61	2.24	10.95	1.32	7.57	0.54	9500
10000							18.13	4.37	14.33	2.46	11.53	1.45	7.97	0.59	10000
0500							19.04	4.78	15.04	2.70	12.10	1.59	8.37	0.65	10500
11000							19.95	5.21	15.76	2.94	12.68	1.73	8.77	0.71	11000
11500									16.48	3.19	13.26	1.88	9.17	0.77	11500
12000									17.19	3.45	13.83	2.03	9.56	0.83	12000
12500									17.91	3.72	14.41	2.19	9.96	0.89	12500
13000									18.63	4.00	14.98	2.36	10.36	0.96	13000
13500									19.34	4.29	15.56	2.53	10.76	1.03	13500
14000											16.14	2.71	11.16	1.10	14000
14500											16.71	2.89	11.56	1.18	14500
15000											17.29	3.07	11.95	1.25	15000
15500											17.87	3.27	12.35	1.33	15500
16000											18.44	3.46	12.75	1.41	16000
16500													13.15	1.49	16500
17000													13.55	1.58	17000
17500													13.95	1.67	17500
18000													14.35	1.76	18000
18500													14.74	1.85	18500
19000													15.14	1.94	19000
20000													15.94	2.13	20000
21000													16.74	2.34	21000
22000													17.53	2.55	22000
23000													18.33	2.76	23000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Schedule 80 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 2"

Nominal Size Pipe ID Pipe OD Wall Thick	½" 0.546 0.840 0.147	¾" 0.742 1.050 0.154	1" 0.957 1.315 0.179	1¼" 1.278 1.660 0.191	1½" 1.500 1.900 0.200	2" 1.939 2.375 0.218	Nominal Size Pipe ID Pipe OD Wall Thick		
Flow GPH	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPH
1	1.37	1.71	0.74	0.39	0.45	0.11	0.25	0.03	1
2	2.74	6.19	1.48	1.39	0.89	0.40	0.50	0.10	2
3	4.11	13.11	2.22	2.95	1.34	0.85	0.75	0.21	3
4	5.47	22.34	2.96	5.02	1.78	1.46	1.00	0.36	4
5	6.84	33.77	3.71	7.59	2.23	2.20	1.25	0.54	5
6	8.21	47.33	4.45	10.64	2.67	3.08	1.50	0.75	6
7	9.58	62.97	5.19	14.16	3.12	4.10	1.75	1.00	7
8	10.95	80.63	5.93	18.13	3.56	5.26	2.00	1.29	8
9	12.32	100.30	6.67	22.54	4.01	6.54	2.25	1.60	9
10	13.69	121.90	7.41	27.40	4.45	7.94	2.50	1.94	10
11	15.05	145.40	8.15	32.69	4.90	9.48	2.75	2.32	11
12	16.42	170.90	8.89	38.41	5.35	11.14	3.00	2.73	12
13	17.79	198.20	9.63	44.55	5.79	12.91	3.25	3.16	13
14	19.16	227.30	10.37	51.10	6.24	14.81	3.50	3.63	14
15			11.12	58.06	6.68	16.83	3.75	4.12	15
16			11.86	65.44	7.13	18.97	4.00	4.64	16
17			12.60	73.21	7.57	21.23	4.25	5.20	17
18			13.34	81.39	8.02	23.60	4.50	5.78	18
19			14.08	89.96	8.46	26.08	4.75	6.38	19
20			14.82	98.92	8.91	28.68	5.00	7.02	20
22			16.30	118.00	9.80	34.22	5.50	8.37	22
24			17.79	138.70	10.69	40.20	6.00	9.84	24
25			18.53	149.50	11.14	43.36	6.25	10.61	25
26			19.27	160.80	11.58	46.62	6.49	11.41	26
28					12.47	53.48	6.99	13.09	28
30					13.36	60.77	7.49	14.87	30
32					14.26	68.49	7.99	16.76	32
34					15.15	76.62	8.49	18.75	34
35					15.59	80.85	8.74	19.79	35
36					16.04	85.18	8.99	20.85	36
38					16.93	94.15	9.49	23.04	38
40					17.82	103.50	9.99	25.34	40
42					18.71	113.30	10.49	27.74	42
44					19.60	123.50	10.99	30.23	44
45							11.24	31.52	45
46					11.49	32.83	8.34	15.06	46
48					11.99	35.52	8.70	16.29	48
50					12.49	38.31	9.07	17.57	50
55					13.74	45.70	9.97	20.96	55
60					14.99	53.70	10.88	24.63	60
65					16.24	62.27	11.79	28.56	65
70					17.49	71.44	12.69	32.77	70
75					18.74	81.17	13.60	37.23	75
80					19.98	91.48	14.51	41.96	80
85							15.41	46.95	85
90							16.32	52.19	90
95							17.23	57.68	95
100							18.13	63.43	100
110							19.95	75.68	110
120									120
130									130
140									140
150									150
160									160
170									170
180									180

Shaded area represents
velocities over 7.5 fps.
Use with caution where
water hammer is a concern.

Schedule 80 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI)

SIZES 2½" THRU 8"

Nominal Size Pipe ID Pipe OD Wall Thick	2½"		3"		4"		6"		8"		Nominal Size Pipe ID Pipe OD Wall Thick
	2.323 2.875 0.276		2.900 3.500 0.300		3.826 4.500 0.337		5.761 6.625 0.432		7.625 8.625 0.500		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
5	0.38	0.03	0.24	0.01	0.14	0.00					5
10	0.76	0.11	0.49	0.04	0.28	0.01					10
15	1.13	0.22	0.73	0.08	0.42	0.02					15
20	1.51	0.38	0.97	0.13	0.56	0.03	0.25	0.00			20
25	1.89	0.58	1.21	0.20	0.70	0.05	0.31	0.01			25
30	2.27	0.81	1.46	0.28	0.84	0.07	0.37	0.01			30
35	2.65	1.08	1.70	0.37	0.98	0.10	0.43	0.01			35
40	3.02	1.38	1.94	0.47	1.11	0.12	0.49	0.02	0.28	0.00	40
45	3.40	1.72	2.18	0.58	1.25	0.15	0.55	0.02	0.32	0.01	45
50	3.78	2.09	2.43	0.71	1.39	0.18	0.61	0.03	0.35	0.01	50
55	4.16	2.50	2.67	0.85	1.53	0.22	0.68	0.03	0.39	0.01	55
60	4.54	2.93	2.91	1.00	1.67	0.26	0.74	0.04	0.42	0.01	60
65	4.91	3.40	3.15	1.16	1.81	0.30	0.80	0.04	0.46	0.01	65
70	5.29	3.90	3.40	1.33	1.95	0.34	0.86	0.05	0.49	0.01	70
75	5.67	4.43	3.64	1.51	2.09	0.39	0.92	0.05	0.53	0.01	75
80	6.05	4.99	3.88	1.70	2.23	0.44	0.98	0.06	0.56	0.02	80
85	6.43	5.59	4.12	1.90	2.37	0.49	1.04	0.07	0.60	0.02	85
90	6.80	6.21	4.37	2.11	2.51	0.55	1.11	0.07	0.63	0.02	90
95	7.18	6.87	4.61	2.33	2.65	0.61	1.17	0.08	0.67	0.02	95
100	7.56	7.55	4.85	2.57	2.79	0.67	1.23	0.09	0.70	0.02	100
110	8.32	9.01	5.34	3.06	3.07	0.79	1.35	0.11	0.77	0.03	110
120	9.07	10.58	5.82	3.60	3.34	0.93	1.48	0.13	0.84	0.03	120
130	9.83	12.27	6.31	4.17	3.62	1.08	1.60	0.15	0.91	0.04	130
140	10.58	14.08	6.79	4.78	3.90	1.24	1.72	0.17	0.98	0.04	140
150	11.34	16.00	7.28	5.44	4.18	1.41	1.84	0.19	1.05	0.05	150
160	12.10	18.03	7.76	6.13	4.46	1.59	1.97	0.22	1.12	0.06	160
180	13.61	22.43	8.73	7.62	5.02	1.98	2.21	0.27	1.26	0.07	180
200	15.12	27.26	9.70	9.26	5.57	2.40	2.46	0.33	1.40	0.08	200
220	16.63	32.52	10.67	11.05	6.13	2.87	2.70	0.39	1.54	0.10	220
250	18.90	41.21	12.13	14.00	6.97	3.64	3.07	0.50	1.75	0.13	250
300			14.55	19.62	8.36	5.10	3.69	0.70	2.11	0.18	300
350			16.98	26.11	9.76	6.78	4.30	0.93	2.46	0.24	350
400			19.41	33.43	11.15	8.68	4.92	1.18	2.81	0.30	400
450					12.54	10.80	5.53	1.47	3.16	0.38	450
500					13.94	13.12	6.15	1.79	3.51	0.46	500
600					16.72	18.39	7.38	2.51	4.21	0.64	600
700					19.51	24.47	8.61	3.34	4.91	0.85	700
800							9.83	4.28	5.61	1.09	800
900							11.06	5.32	6.32	1.36	900
1000							12.29	6.47	7.02	1.65	1000
1100							13.52	7.71	7.72	1.97	1100
1200							14.75	9.06	8.42	2.32	1200
1300							15.98	10.51	9.12	2.69	1300
1400							17.21	12.06	9.82	3.08	1400
1500							18.44	13.70	10.53	3.50	1500
1600							19.67	15.44	11.23	3.95	1600
1700									11.93	4.42	1700
1800									12.63	4.91	1800
1900									13.33	5.43	1900
2000									14.03	5.97	2000
2100									14.74	6.53	2100
2200									15.44	7.12	2200
2300									16.14	7.73	2300
2400									16.84	8.36	2400
2500									17.54	9.02	2500
2700									18.95	10.40	2700

Shaded area represents
velocities over 7.5 fps.
Use with caution where
water hammer is a concern.

Schedule 80 Standard Steel Pipe

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI)

SIZES 10" THRU 24"

Nominal Size Pipe ID Pipe OD Wall Thick	10"		12"		14"		16"		18"		20"		24"		Nominal Size Pipe ID Pipe OD Wall Thick
	9.564 10.750 0.593		11.376 12.750 0.687		12.500 14.000 0.750		14.314 16.000 0.843		16.126 18.000 0.937		17.938 20.000 1.031		21.564 24.000 1.218		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
100	0.45	0.01	0.32	0.00	0.26	0.00									100
200	0.89	0.03	0.63	0.01	0.52	0.01	0.40	0.00							200
300	1.34	0.06	0.95	0.03	0.78	0.02	0.60	0.01	0.47	0.00					300
400	1.78	0.10	1.26	0.04	1.04	0.03	0.80	0.01	0.63	0.01	0.51	0.00			400
500	2.23	0.15	1.58	0.07	1.31	0.04	1.00	0.02	0.78	0.01	0.63	0.01			500
600	2.68	0.21	1.89	0.09	1.57	0.06	1.19	0.03	0.94	0.02	0.76	0.01	0.53	0.00	600
700	3.12	0.28	2.21	0.12	1.83	0.08	1.39	0.04	1.10	0.02	0.89	0.01	0.61	0.01	700
800	3.57	0.36	2.52	0.16	2.09	0.10	1.59	0.05	1.26	0.03	1.01	0.02	0.70	0.01	800
900	4.01	0.45	2.84	0.19	2.35	0.12	1.79	0.06	1.41	0.04	1.14	0.02	0.79	0.01	900
1000	4.46	0.55	3.15	0.24	2.61	0.15	1.99	0.08	1.57	0.04	1.27	0.03	0.88	0.01	1000
1200	5.35	0.77	3.78	0.33	3.13	0.21	2.39	0.11	1.88	0.06	1.52	0.04	1.05	0.01	1200
1400	6.24	1.02	4.41	0.44	3.66	0.28	2.79	0.14	2.20	0.08	1.78	0.05	1.23	0.02	1400
1600	7.14	1.31	5.04	0.56	4.18	0.36	3.19	0.18	2.51	0.10	2.03	0.06	1.40	0.03	1600
1800	8.03	1.63	5.67	0.70	4.70	0.44	3.58	0.23	2.82	0.13	2.28	0.08	1.58	0.03	1800
2000	8.92	1.98	6.31	0.85	5.22	0.54	3.98	0.28	3.14	0.16	2.54	0.09	1.75	0.04	2000
2200	9.81	2.36	6.94	1.02	5.74	0.64	4.38	0.33	3.45	0.19	2.79	0.11	1.93	0.05	2200
2400	10.71	2.78	7.57	1.19	6.27	0.75	4.78	0.39	3.77	0.22	3.04	0.13	2.11	0.05	2400
2600	11.60	3.22	8.20	1.38	6.79	0.88	5.18	0.45	4.08	0.25	3.30	0.15	2.28	0.06	2600
2800	12.49	3.69	8.83	1.59	7.31	1.00	5.58	0.52	4.39	0.29	3.55	0.17	2.46	0.07	2800
3000	13.38	4.20	9.46	1.80	7.83	1.14	5.97	0.59	4.71	0.33	3.80	0.20	2.63	0.08	3000
3200	14.27	4.73	10.09	2.03	8.36	1.29	6.37	0.66	5.02	0.37	4.06	0.22	2.81	0.09	3200
3400	15.17	5.29	10.72	2.28	8.88	1.44	6.77	0.74	5.33	0.42	4.31	0.25	2.98	0.10	3400
3600	16.06	5.88	11.35	2.53	9.40	1.60	7.17	0.83	5.65	0.46	4.56	0.28	3.16	0.11	3600
3800	16.95	6.50	11.98	2.80	9.92	1.77	7.57	0.91	5.96	0.51	4.82	0.30	3.33	0.12	3800
4000	17.84	7.15	12.61	3.07	10.44	1.94	7.97	1.01	6.28	0.56	5.07	0.34	3.51	0.14	4000
4200	18.73	7.83	13.24	3.37	10.97	2.13	8.36	1.10	6.59	0.62	5.33	0.37	3.69	0.15	4200
4400	19.63	8.53	13.87	3.67	11.49	2.32	8.76	1.20	6.90	0.67	5.58	0.40	3.86	0.16	4400
4600			14.50	3.98	12.01	2.52	9.16	1.30	7.22	0.73	5.83	0.43	4.04	0.18	4600
4800			15.13	4.31	12.53	2.72	9.56	1.41	7.53	0.79	6.09	0.47	4.21	0.19	4800
5000			15.76	4.65	13.06	2.94	9.96	1.52	7.84	0.85	6.34	0.51	4.39	0.21	5000
5200			16.39	5.00	13.58	3.16	10.35	1.63	8.16	0.91	6.59	0.54	4.56	0.22	5200
5400			17.02	5.36	14.10	3.39	10.75	1.75	8.47	0.98	6.85	0.58	4.74	0.24	5400
5600			17.66	5.73	14.62	3.62	11.15	1.87	8.79	1.05	7.10	0.63	4.91	0.26	5600
5800			18.29	6.12	15.14	3.87	11.55	2.00	9.10	1.12	7.35	0.67	5.09	0.27	5800
6000			18.92	6.51	15.67	4.12	11.95	2.13	9.41	1.19	7.61	0.71	5.26	0.29	6000
6200			19.55	6.92	16.19	4.38	12.35	2.26	9.73	1.27	7.86	0.75	5.44	0.31	6200
6400					16.71	4.64	12.74	2.40	10.04	1.34	8.12	0.80	5.62	0.33	6400
6600					17.23	4.91	13.14	2.54	10.36	1.42	8.37	0.85	5.79	0.35	6600
6800					17.76	5.19	13.54	2.69	10.67	1.50	8.62	0.90	5.97	0.37	6800
7000					18.28	5.48	13.94	2.83	10.98	1.59	8.88	0.95	6.14	0.39	7000
7200					18.80	5.77	14.34	2.99	11.30	1.67	9.13	1.00	6.32	0.41	7200
7400					19.32	6.07	14.74	3.14	11.61	1.76	9.38	1.05	6.49	0.43	7400
7600					19.85	6.38	15.13	3.30	11.92	1.85	9.64	1.10	6.67	0.45	7600
7800							15.53	3.46	12.24	1.94	9.89	1.15	6.84	0.47	7800
8000							15.93	3.63	12.55	2.03	10.14	1.21	7.02	0.49	8000
8500							16.93	4.06	13.34	2.27	10.78	1.35	7.46	0.55	8500
9000							17.92	4.51	14.12	2.53	11.41	1.51	7.90	0.61	9000
9500							18.92	4.99	14.90	2.79	12.05	1.66	8.34	0.68	9500
10000							19.91	5.49	15.69	3.07	12.68	1.83	8.77	0.75	10000
10500									16.47	3.36	13.31	2.00	9.21	0.82	10500
11000									17.26	3.66	13.95	2.18	9.65	0.89	11000
11500									18.04	3.98	14.58	2.37	10.09	0.97	11500
12000									18.83	4.31	15.22	2.56	10.53	1.05	12000
12500									19.61	4.64	15.85	2.77	10.97	1.13	12500
13000											16.48	2.97	11.41	1.21	13000
13500											17.12	3.19	11.85	1.30	13500
14000											17.75	3.41	12.28	1.39	14000
14500											18.39	3.64	12.72	1.49	14500
15000											19.02	3.88	13.16	1.58	15000
15500											19.65	4.12	13.60	1.68	15500
16000													14.04	1.78	16000
16500													14.48	1.89	16500
17000													14.92	2.00	17000
17500													15.35	2.11	17500
18000													15.79	2.22	18000
18500													16.23	2.33	18500
19000													16.67	2.45	19000
19500													17.11	2.57	19500
20000													17.55	2.70	20000
21000													18.43	2.95	21000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Cast Iron Pipe - Class 150

C=100

PRESSURE LOSS PER 100 FEET (PSI)

SIZES 3" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	3"		4"		6"		8"		10"		12"		Nominal Size Pipe ID Pipe OD Wall Thick
	3.32 3.96 0.32		4.10 4.80 0.35		6.14 6.90 0.38		8.23 9.05 0.41		10.22 11.10 0.44		12.24 13.20 0.48		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
5	0.19	0.01	0.12	0.00									5
10	0.37	0.02	0.24	0.01									10
15	0.56	0.04	0.36	0.01									15
20	0.74	0.07	0.49	0.02	0.22	0.00							20
25	0.93	0.10	0.61	0.04	0.27	0.01							25
30	1.11	0.14	0.73	0.05	0.32	0.01							30
40	1.48	0.24	0.97	0.09	0.43	0.01							40
50	1.85	0.37	1.21	0.13	0.54	0.02	0.30	0.00					50
60	2.22	0.52	1.46	0.18	0.65	0.03	0.36	0.01					60
70	2.59	0.69	1.70	0.25	0.76	0.03	0.42	0.01					70
80	2.96	0.88	1.94	0.31	0.87	0.04	0.48	0.01					80
90	3.33	1.09	2.18	0.39	0.97	0.05	0.54	0.01	0.35	0.00			90
100	3.70	1.33	2.43	0.48	1.08	0.07	0.60	0.02	0.39	0.01			100
125	4.63	2.01	3.03	0.72	1.35	0.10	0.75	0.02	0.49	0.01			125
150	5.55	2.81	3.64	1.01	1.62	0.14	0.90	0.03	0.59	0.01	0.41	0.00	150
175	6.48	3.74	4.25	1.34	1.89	0.19	1.05	0.05	0.68	0.02	0.48	0.01	175
200	7.40	4.80	4.85	1.72	2.16	0.24	1.20	0.06	0.78	0.02	0.54	0.01	200
225	8.33	5.96	5.46	2.14	2.44	0.30	1.36	0.07	0.88	0.03	0.61	0.01	225
250	9.25	7.25	6.07	2.60	2.71	0.36	1.51	0.09	0.98	0.03	0.68	0.01	250
275	10.18	8.65	6.67	3.10	2.98	0.43	1.66	0.10	1.07	0.04	0.75	0.02	275
300	11.10	10.16	7.28	3.64	3.25	0.51	1.81	0.12	1.17	0.04	0.82	0.02	300
350	12.96	13.52	8.49	4.84	3.79	0.68	2.11	0.16	1.37	0.06	0.95	0.02	350
400	14.81	17.31	9.71	6.20	4.33	0.87	2.41	0.21	1.56	0.07	1.09	0.03	400
450	16.66	21.53	10.92	7.71	4.87	1.08	2.71	0.26	1.76	0.09	1.23	0.04	450
500	18.51	26.17	12.14	9.37	5.41	1.31	3.01	0.32	1.95	0.11	1.36	0.05	500
550			13.35	11.18	5.95	1.57	3.31	0.38	2.15	0.13	1.50	0.05	550
600			14.56	13.14	6.49	1.84	3.61	0.44	2.34	0.15	1.63	0.06	600
650			15.78	15.24	7.03	2.14	3.92	0.51	2.54	0.18	1.77	0.07	650
700			16.99	17.48	7.58	2.45	4.22	0.59	2.73	0.21	1.91	0.09	700
750			18.20	19.86	8.12	2.78	4.52	0.67	2.93	0.23	2.04	0.10	750
800			19.42	22.38	8.66	3.14	4.82	0.75	3.12	0.26	2.18	0.11	800
900					9.74	3.90	5.42	0.94	3.52	0.33	2.45	0.14	900
1000					10.82	4.74	6.02	1.14	3.91	0.40	2.72	0.17	1000
1100					11.90	5.66	6.63	1.36	4.30	0.47	3.00	0.20	1100
1200					12.99	6.65	7.23	1.60	4.69	0.56	3.27	0.23	1200
1300					14.07	7.71	7.83	1.85	5.08	0.65	3.54	0.27	1300
1400					15.15	8.84	8.43	2.13	5.47	0.74	3.81	0.31	1400
1500					16.23	10.05	9.04	2.42	5.86	0.84	4.08	0.35	1500
1600					17.32	11.32	9.64	2.72	6.25	0.95	4.36	0.39	1600
1700					18.40	12.67	10.24	3.05	6.64	1.06	4.63	0.44	1700
1800					19.48	14.08	10.84	3.39	7.03	1.18	4.90	0.49	1800
2000							12.05	4.11	7.81	1.43	5.45	0.60	2000
2200							13.25	4.91	8.59	1.71	5.99	0.71	2200
2400							14.46	5.77	9.37	2.01	6.54	0.84	2400
2600							15.66	6.69	10.16	2.33	7.08	0.97	2600
2800							16.87	7.67	10.94	2.68	7.63	1.11	2800
3000							18.07	8.72	11.72	3.04	8.17	1.26	3000
3200							19.28	9.83	12.50	3.43	8.71	1.42	3200
3400									13.28	3.83	9.26	1.59	3400
3600									14.06	4.26	9.80	1.77	3600
3800									14.84	4.71	10.35	1.96	3800
4000									15.62	5.18	10.89	2.15	4000
4500									17.58	6.44	12.25	2.68	4500
5000									19.53	7.83	13.62	3.25	5000
5500											14.98	3.88	5500
6000											16.34	4.56	6000
6500											17.70	5.29	6500
7000											19.06	6.07	7000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Cast Iron Pipe - Class 150

C=100

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 14" THRU 24"

Nominal Size Pipe ID Pipe OD Wall Thick	14" 14.28 15.30 0.51	16" 16.32 17.40 0.54	18" 18.34 19.50 0.58	20" 20.36 21.60 0.62	24" 24.34 25.80 0.73	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
200	0.40 0.00					200
300	0.60 0.01	0.46 0.00				300
400	0.80 0.01	0.61 0.01	0.49 0.00			400
500	1.00 0.02	0.77 0.01	0.61 0.01	0.49 0.00		500
600	1.20 0.03	0.92 0.02	0.73 0.01	0.59 0.01		600
700	1.40 0.04	1.07 0.02	0.85 0.01	0.69 0.01		700
800	1.60 0.05	1.23 0.03	0.97 0.02	0.79 0.01		800
900	1.80 0.06	1.38 0.03	1.09 0.02	0.89 0.01	0.62 0.00	900
1000	2.00 0.08	1.53 0.04	1.21 0.02	0.98 0.01	0.69 0.01	1000
1100	2.20 0.09	1.69 0.05	1.33 0.03	1.08 0.02	0.76 0.01	1100
1200	2.40 0.11	1.84 0.06	1.46 0.03	1.18 0.02	0.83 0.01	1200
1300	2.60 0.13	1.99 0.07	1.58 0.04	1.28 0.02	0.90 0.01	1300
1400	2.80 0.15	2.14 0.08	1.70 0.04	1.38 0.03	0.96 0.01	1400
1500	3.00 0.17	2.30 0.09	1.82 0.05	1.48 0.03	1.03 0.01	1500
1600	3.20 0.19	2.45 0.10	1.94 0.06	1.57 0.03	1.10 0.01	1600
1700	3.40 0.21	2.60 0.11	2.06 0.06	1.67 0.04	1.17 0.02	1700
1800	3.60 0.23	2.76 0.12	2.18 0.07	1.77 0.04	1.24 0.02	1800
1900	3.80 0.26	2.91 0.13	2.30 0.08	1.87 0.05	1.31 0.02	1900
2000	4.00 0.28	3.06 0.15	2.43 0.08	1.97 0.05	1.38 0.02	2000
2250	4.50 0.35	3.45 0.18	2.73 0.10	2.21 0.06	1.55 0.03	2250
2500	5.00 0.43	3.83 0.22	3.03 0.13	2.46 0.08	1.72 0.03	2500
2750	5.50 0.51	4.21 0.27	3.34 0.15	2.71 0.09	1.89 0.04	2750
3000	6.00 0.60	4.60 0.31	3.64 0.18	2.95 0.11	2.07 0.04	3000
3250	6.50 0.69	4.98 0.36	3.94 0.20	3.20 0.12	2.24 0.05	3250
3500	7.00 0.79	5.36 0.41	4.25 0.24	3.44 0.14	2.41 0.06	3500
3750	7.50 0.90	5.74 0.47	4.55 0.27	3.69 0.16	2.58 0.07	3750
4000	8.00 1.02	6.13 0.53	4.85 0.30	3.94 0.18	2.75 0.08	4000
4250	8.50 1.14	6.51 0.59	5.16 0.34	4.18 0.20	2.93 0.08	4250
4500	9.00 1.26	6.89 0.66	5.46 0.37	4.43 0.23	3.10 0.09	4500
4750	9.50 1.40	7.28 0.73	5.76 0.41	4.68 0.25	3.27 0.10	4750
5000	10.00 1.54	7.66 0.80	6.07 0.45	4.92 0.27	3.44 0.11	5000
5250	10.50 1.68	8.04 0.88	6.37 0.50	5.17 0.30	3.62 0.13	5250
5500	11.00 1.83	8.43 0.96	6.67 0.54	5.41 0.33	3.79 0.14	5500
5750	11.50 1.99	8.81 1.04	6.97 0.59	5.66 0.35	3.96 0.15	5750
6000	12.00 2.15	9.19 1.13	7.28 0.64	5.91 0.38	4.13 0.16	6000
6500	13.01 2.50	9.96 1.30	7.88 0.74	6.40 0.44	4.48 0.19	6500
7000	14.01 2.87	10.72 1.50	8.49 0.85	6.89 0.51	4.82 0.21	7000
7500	15.01 3.26	11.49 1.70	9.10 0.96	7.38 0.58	5.17 0.24	7500
8000	16.01 3.67	12.25 1.92	9.70 1.09	7.87 0.65	5.51 0.27	8000
8500	17.01 4.11	13.02 2.14	10.31 1.22	8.37 0.73	5.85 0.31	8500
9000	18.01 4.57	13.79 2.38	10.92 1.35	8.86 0.81	6.20 0.34	9000
10000		15.32 2.90	12.13 1.64	9.84 0.99	6.89 0.41	10000
11000		16.85 3.46	13.34 1.96	10.83 1.18	7.58 0.49	11000
12000		18.38 4.06	14.56 2.30	11.81 1.38	8.26 0.58	12000
13000		19.91 4.71	15.77 2.67	12.80 1.61	8.95 0.67	13000
14000			16.98 3.06	13.78 1.84	9.64 0.77	14000
15000			18.20 3.48	14.76 2.09	10.33 0.88	15000
16000			19.41 3.92	15.75 2.36	11.02 0.99	16000
17000				16.73 2.64	11.71 1.11	17000
18000				17.72 2.93	12.40 1.23	18000
19000				18.70 3.24	13.08 1.36	19000
20000				19.68 3.57	13.77 1.50	20000
21000					14.46 1.64	21000
22000					15.15 1.78	22000
23000					15.84 1.94	23000
24000					16.53 2.10	24000
25000					17.22 2.26	25000
26000					17.91 2.43	26000
27000					18.59 2.61	27000
28000					19.28 2.79	28000
29000					19.97 2.98	29000

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Friction Loss Characteristics

Type "K" Copper Water Tube

C = 140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI)

SIZES ½" THRU 2½"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	⅝"	¾"	1"	1¼"	1½"	2"	2½"	Nominal Size Pipe ID Pipe OD Wall Thick
	0.527 0.625 0.049	0.652 0.750 0.049	0.745 0.875 0.065	0.995 1.125 0.065	1.245 1.375 0.065	1.481 1.625 0.072	1.959 2.125 0.083	2.435 2.625 0.095	
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
1	1.47 1.09	0.96 0.39	0.74 0.20	0.41 0.05	0.26 0.02	0.19 0.01	0.11 0.00		1
2	2.94 3.94	1.92 1.40	1.47 0.73	0.82 0.18	0.53 0.06	0.37 0.03	0.21 0.01		2
3	4.41 8.35	2.88 2.97	2.21 1.55	1.24 0.38	0.79 0.13	0.56 0.05	0.32 0.01	0.21 0.00	3
4	5.88 14.23	3.84 5.05	2.94 2.64	1.65 0.65	1.05 0.22	0.74 0.09	0.43 0.02	0.28 0.01	4
5	7.35 21.51	4.80 7.64	3.68 3.99	2.06 0.98	1.32 0.33	0.93 0.14	0.53 0.04	0.34 0.01	5
6	8.81 30.15	5.76 10.70	4.41 5.59	2.47 1.37	1.58 0.46	1.12 0.20	0.64 0.05	0.41 0.02	6
7	10.28 40.12	6.72 14.24	5.15 7.44	2.88 1.82	1.84 0.61	1.30 0.26	0.74 0.07	0.48 0.02	7
8	11.75 51.37	7.68 18.24	5.88 9.53	3.30 2.33	2.11 0.78	1.49 0.34	0.85 0.09	0.55 0.03	8
9	13.22 63.90	8.64 22.68	6.62 11.85	3.71 2.90	2.37 0.97	1.67 0.42	0.96 0.11	0.62 0.04	9
10	14.69 77.66	9.60 27.57	7.35 14.41	4.12 3.52	2.63 1.18	1.86 0.51	1.06 0.13	0.69 0.05	10
11	16.16 92.66	10.56 32.89	8.09 17.19	4.53 4.21	2.90 1.41	2.05 0.61	1.17 0.16	0.76 0.05	11
12	17.63 108.86	11.52 38.64	8.82 20.20	4.95 4.94	3.16 1.66	2.23 0.71	1.28 0.18	0.83 0.06	12
13	19.10 126.25	12.48 44.82	9.56 23.42	5.36 5.73	3.42 1.93	2.42 0.83	1.38 0.21	0.89 0.07	13
14		13.44 51.41	10.29 26.87	5.77 6.57	3.69 2.21	2.60 0.95	1.49 0.24	0.96 0.08	14
15		14.40 58.42	11.03 30.53	6.18 7.47	3.95 2.51	2.79 1.08	1.59 0.28	1.03 0.10	15
16		15.36 65.83	11.76 34.41	6.59 8.42	4.21 2.83	2.98 1.22	1.70 0.31	1.10 0.11	16
17		16.32 73.66	12.50 38.50	7.01 9.42	4.47 3.16	3.16 1.36	1.81 0.35	1.17 0.12	17
18		17.28 81.88	13.23 42.80	7.42 10.47	4.74 3.52	3.35 1.51	1.91 0.39	1.24 0.13	18
19		18.24 90.50	13.97 47.30	7.83 11.57	5.00 3.89	3.53 1.67	2.02 0.43	1.31 0.15	19
20		19.20 99.52	14.70 52.02	8.24 12.72	5.26 4.28	3.72 1.84	2.13 0.47	1.38 0.16	20
22			16.17 62.06	9.07 15.18	5.79 5.10	4.09 2.19	2.34 0.56	1.51 0.19	22
24			17.64 72.91	9.89 17.84	6.32 5.99	4.46 2.58	2.55 0.66	1.65 0.23	24
25			18.38 78.64	10.30 19.24	6.58 6.46	4.65 2.78	2.66 0.71	1.72 0.25	25
26			19.11 84.56	10.71 20.69	6.84 6.95	4.84 2.99	2.76 0.77	1.79 0.27	26
28				11.54 23.73	7.37 7.97	5.21 3.43	2.98 0.88	1.93 0.30	28
30				12.36 26.96	7.90 9.06	5.58 3.89	3.19 1.00	2.06 0.35	30
32				13.19 30.39	8.42 10.21	5.95 4.39	3.40 1.12	2.20 0.39	32
34				14.01 34.00	8.95 11.42	6.32 4.91	3.61 1.26	2.34 0.44	34
35				14.42 35.87	9.21 12.05	6.51 5.18	3.72 1.33	2.41 0.46	35
36				14.84 37.79	9.48 12.70	6.70 5.46	3.83 1.40	2.48 0.49	36
38				15.66 41.77	10.00 14.04	7.07 6.03	4.04 1.55	2.61 0.54	38
40				16.48 45.94	10.53 15.43	7.44 6.63	4.25 1.70	2.75 0.59	40
42				17.31 50.28	11.06 16.89	7.81 7.26	4.47 1.86	2.89 0.65	42
44				18.13 54.80	11.58 18.41	8.18 7.91	4.68 2.03	3.03 0.70	44
45				18.54 57.13	11.84 19.20	8.37 8.25	4.78 2.11	3.10 0.73	45
46				18.96 59.51	12.11 19.99	8.56 8.59	4.89 2.20	3.17 0.76	46
48				19.78 64.39	12.63 21.63	8.93 9.30	5.10 2.38	3.30 0.83	48
50					13.16 23.33	9.30 10.03	5.32 2.57	3.44 0.89	50
55					14.48 27.84	10.23 11.96	5.85 3.07	3.78 1.06	55
60					15.79 32.70	11.16 14.05	6.38 3.60	4.13 1.25	60
65					17.11 37.93	12.09 16.30	6.91 4.18	4.47 1.45	65
70					18.43 43.51	13.02 18.70	7.44 4.79	4.82 1.66	70
75					19.74 49.44	13.95 21.24	7.97 5.45	5.16 1.89	75
80						14.88 23.94	8.51 6.14	5.50 2.13	80
85						15.81 26.79	9.04 6.87	5.85 2.38	85
90						16.74 29.78	9.57 7.63	6.19 2.65	90
95						17.67 32.91	10.10 8.44	6.54 2.93	95
100						18.60 36.19	10.63 9.28	6.88 3.22	100
110							11.69 11.07	7.57 3.84	110
120							12.76 13.01	8.26 4.51	120
130							13.82 15.08	8.95 5.23	130
140							14.88 17.30	9.63 6.00	140
150							15.95 19.66	10.32 6.82	150
160							17.01 22.16	11.01 7.69	160
170							18.07 24.79	11.70 8.60	170
180							19.14 27.56	12.39 9.56	180
190								13.07 10.57	190
200								13.76 11.62	200
225								15.48 14.46	225
250								17.20 17.57	250
275								18.92 20.96	275

Shaded area represents velocities over 7.5 fps. Use with caution where water hammer is a concern.

Type "K" Copper Water Tube

C = 140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3" THRU 12"

Nominal Size	3"	4"	6"	8"	10"	12"	Nominal Size
Pipe ID	2.907	3.857	5.741	7.583	9.449	11.315	Pipe ID
Pipe OD	3.125	4.125	6.125	8.125	10.125	12.125	Pipe OD
Wall Thick	0.109	0.134	0.192	0.271	0.338	0.405	Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
20	0.97	0.07	0.53	0.02			20
22	1.06	0.08	0.58	0.02			22
24	1.16	0.10	0.63	0.02			24
26	1.26	0.11	0.69	0.03			26
28	1.35	0.13	0.74	0.03			28
30	1.45	0.15	0.79	0.03			30
32	1.54	0.16	0.84	0.04			32
34	1.64	0.18	0.90	0.04			34
36	1.74	0.20	0.95	0.05			36
38	1.83	0.23	1.00	0.05			38
40	1.93	0.25	1.05	0.06			40
42	2.03	0.27	1.11	0.06			42
44	2.12	0.30	1.16	0.07			44
46	2.22	0.32	1.21	0.07			46
48	2.32	0.35	1.26	0.08			48
50	2.41	0.38	1.32	0.09			50
55	2.66	0.45	1.45	0.10			55
60	2.90	0.53	1.58	0.12	0.40	0.00	60
65	3.14	0.61	1.71	0.14	0.44	0.01	65
70	3.38	0.70	1.84	0.16	0.47	0.01	70
75	3.62	0.80	1.98	0.18	0.50	0.01	75
80	3.86	0.90	2.11	0.21	0.54	0.01	80
85	4.10	1.01	2.24	0.23	0.57	0.01	85
90	4.35	1.12	2.37	0.26	0.61	0.01	90
95	4.59	1.24	2.50	0.28	0.64	0.01	95
100	4.83	1.36	2.63	0.31	0.67	0.01	100
110	5.31	1.62	2.90	0.37	0.74	0.01	110
120	5.79	1.91	3.16	0.44	0.81	0.02	120
130	6.28	2.21	3.43	0.51	0.88	0.02	130
140	6.76	2.54	3.69	0.58	0.94	0.02	140
150	7.24	2.88	3.95	0.66	1.01	0.02	150
160	7.72	3.25	4.22	0.74	1.08	0.03	160
170	8.21	3.63	4.48	0.83	1.14	0.03	170
180	8.69	4.04	4.74	0.93	1.21	0.03	180
190	9.17	4.46	5.01	1.02	1.28	0.04	190
200	9.66	4.91	5.27	1.12	1.35	0.04	200
225	10.86	6.10	5.93	1.40	1.51	0.05	225
250	12.07	7.42	6.59	1.70	1.68	0.06	250
275	13.28	8.85	7.25	2.03	1.85	0.07	275
300	14.48	10.40	7.90	2.38	2.02	0.09	300
350	16.90	13.84	9.22	3.17	2.36	0.11	350
400	19.31	17.72	10.54	4.06	2.69	0.15	400
450			11.86	5.05	3.03	0.18	450
500			13.17	6.14	3.37	0.22	500
600			15.81	8.60	4.04	0.31	600
700			18.44	11.45	4.71	0.41	700
800			9.44	2.07	5.39	0.53	800
900			10.62	2.58	6.06	0.66	900
1000			11.80	3.14	6.73	0.80	1000
1200			14.16	4.40	8.08	1.12	1200
1400			16.52	5.85	9.42	1.49	1400
1600			18.87	7.49	10.77	1.91	1600
1800					12.12	2.38	1800
2000					13.46	2.89	2000
2200					14.81	3.45	2200
2400					16.16	4.05	2400
2600					17.50	4.70	2600
2800					18.85	5.39	2800
3000					12.14	1.85	3000
3500					13.01	2.10	3500
4000					15.17	2.79	4000
4500					17.34	3.58	4500
5000					19.51	4.45	5000
5500							5500
6000							6000

Shaded area represents velocities over 5 and 7.5 fps. Use with caution where water hammer is a concern.

Friction Loss Characteristics

Type "L" Copper Water Tube

C = 140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES ½" THRU 2½"

Nominal Size Pipe ID Pipe OD Wall Thick	½"	⅝"	¾"	1"	1¼"	1½"	2"	2½"	Nominal Size Pipe ID Pipe OD Wall Thick		
	0.545 0.625 0.040	0.666 0.750 0.042	0.785 0.875 0.045	1.025 1.125 0.050	1.265 1.375 0.055	1.505 1.625 0.060	1.985 2.125 0.070	2.465 2.625 0.080			
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	1.39	0.95	0.92	0.35	0.39	0.04	0.25	0.02	0.18	0.01	1
2	2.78	3.44	1.84	1.26	0.78	0.15	0.51	0.06	0.36	0.02	2
3	4.17	7.29	2.76	2.67	1.17	0.33	0.76	0.12	0.54	0.05	3
4	5.56	12.41	3.68	4.56	1.55	0.56	1.02	0.20	0.72	0.09	4
5	6.94	18.77	4.60	6.89	3.31	3.09	1.27	0.30	0.90	0.13	5
6	8.33	26.31	5.52	9.65	3.97	4.34	2.33	1.18	1.53	0.43	6
7	9.72	35.00	6.44	12.84	4.63	5.77	2.72	1.58	1.78	0.57	7
8	11.11	44.82	7.36	16.45	5.30	7.39	3.11	2.02	2.04	0.72	8
9	12.50	55.74	8.28	20.45	5.96	9.19	3.50	2.51	2.29	0.90	9
10	13.89	67.75	9.20	24.86	6.62	11.17	3.88	3.05	2.55	1.10	10
11	15.28	80.83	10.12	29.66	7.28	13.33	4.27	3.64	2.80	1.31	11
12	16.67	94.96	11.04	34.85	7.95	15.66	4.66	4.28	3.06	1.54	12
13	18.06	110.14	11.96	40.42	8.61	18.16	5.05	4.96	3.31	1.78	13
14	19.44	126.34	12.88	46.36	9.27	20.83	5.44	5.69	3.57	2.04	14
15			13.80	52.68	9.93	23.67	5.83	6.46	3.82	2.32	15
16			14.72	59.37	10.59	26.68	6.21	7.28	4.08	2.62	16
17			15.64	66.42	11.26	29.85	6.60	8.15	4.33	2.93	17
18			16.56	73.84	11.92	33.18	6.99	9.06	4.59	3.25	18
19			17.48	81.62	12.58	36.67	7.38	10.01	4.84	3.60	19
20			18.40	89.75	13.24	40.33	7.77	11.01	5.10	3.96	20
22					14.57	48.11	8.54	13.14	5.61	4.72	22
24					15.89	56.53	9.32	15.44	6.12	5.55	24
25					16.55	60.97	9.71	16.65	6.37	5.98	25
26					17.21	65.56	10.10	17.90	6.63	6.43	26
28					18.54	75.21	10.87	20.54	7.14	7.38	28
30					19.86	85.46	11.65	23.33	7.65	8.38	30
32							12.43	26.30	8.16	9.45	32
34							13.20	29.42	8.67	10.57	34
35							13.59	31.04	8.92	11.15	35
36							13.98	32.71	9.18	11.75	36
38							14.76	36.15	9.69	12.99	38
40							15.53	39.75	10.20	14.28	40
42							16.31	43.51	10.71	15.63	42
44							17.09	47.43	11.22	17.04	44
45							17.48	49.44	11.47	17.76	45
46							17.86	51.50	11.73	18.50	46
48							18.64	55.72	12.24	20.02	48
50									12.75	21.59	50
55									14.02	25.76	55
60									15.30	30.26	60
65									16.57	35.10	65
70									17.85	40.26	70
75									19.12	45.75	75
80									13.51	19.65	80
85									14.41	22.14	85
90									15.31	24.77	90
95									16.21	27.54	95
100									17.11	30.44	100
110									18.01	33.47	110
120									19.81	39.93	120
130									12.43	12.20	130
140									13.46	14.15	140
150									14.50	16.23	150
160									15.53	18.44	160
170									16.57	20.78	170
180									17.60	23.25	180
190									18.64	25.85	190
200											200
225											225
250											250
275											275
300											300
325											325
350											350
375											375
400											400
425											425

Shaded area represents velocities over 7.5 fps. Use with caution where water hammer is a concern.

Type "L" Copper Water Tube

C = 140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	3"		4"		6"		8"		10"		12"		Nominal Size Pipe ID Pipe OD Wall Thick
	2.945		3.905		5.845		7.725		9.625		11.565		
	3.125		4.125		6.125		8.125		10.125		12.125		
	0.090		0.110		0.140		0.200		0.250		0.280		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
20	0.94	0.06	0.54	0.02									20
22	1.03	0.08	0.59	0.02									22
24	1.13	0.09	0.64	0.02									24
26	1.22	0.11	0.70	0.03									26
28	1.32	0.12	0.75	0.03									28
30	1.41	0.14	0.80	0.03	0.36	0.00							30
32	1.51	0.15	0.86	0.04	0.38	0.01							32
34	1.60	0.17	0.91	0.04	0.41	0.01							34
36	1.69	0.19	0.96	0.05	0.43	0.01							36
38	1.79	0.21	1.02	0.05	0.45	0.01							38
40	1.88	0.23	1.07	0.06	0.48	0.01							40
42	1.98	0.26	1.12	0.06	0.50	0.01							42
44	2.07	0.28	1.18	0.07	0.53	0.01							44
46	2.16	0.30	1.23	0.08	0.55	0.01							46
48	2.26	0.33	1.28	0.08	0.57	0.01							48
50	2.35	0.35	1.34	0.09	0.60	0.0							50
55	2.59	0.42	1.47	0.11	0.66	0.02							55
60	2.82	0.50	1.61	0.13	0.72	0.02	0.41	0.00					60
65	3.06	0.57	1.74	0.15	0.78	0.02	0.44	0.01					65
70	3.29	0.66	1.87	0.17	0.84	0.02	0.48	0.01					70
75	3.53	0.75	2.01	0.19	0.90	0.03	0.51	0.01					75
80	3.76	0.84	2.14	0.21	0.96	0.03	0.55	0.01					80
85	4.00	0.94	2.27	0.24	1.02	0.03	0.58	0.01					85
90	4.23	1.05	2.41	0.27	1.07	0.04	0.62	0.01					90
95	4.47	1.16	2.54	0.29	1.13	0.04	0.65	0.01					95
100	4.70	1.28	2.68	0.32	1.19	0.05	0.68	0.01					100
110	5.17	1.52	2.94	0.39	1.31	0.05	0.75	0.01	0.48	0.00			110
120	5.65	1.79	3.21	0.45	1.43	0.06	0.82	0.02	0.53	0.01			120
130	6.12	2.07	3.48	0.53	1.55	0.07	0.89	0.02	0.57	0.01			130
140	6.59	2.38	3.75	0.60	1.67	0.08	0.96	0.02	0.62	0.01			140
150	7.06	2.70	4.01	0.69	1.79	0.10	1.03	0.02	0.66	0.01			150
160	7.53	3.05	4.28	0.77	1.91	0.11	1.09	0.03	0.70	0.01			160
170	8.00	3.41	4.55	0.86	2.03	0.12	1.16	0.03	0.75	0.01			170
180	8.47	3.79	4.82	0.96	2.15	0.13	1.23	0.03	0.79	0.01	0.55	0.00	180
190	8.94	4.19	5.08	1.06	2.27	0.15	1.30	0.04	0.84	0.01	0.58	0.01	190
200	9.41	4.61	5.35	1.17	2.39	0.16	1.37	0.04	0.88	0.01	0.61	0.01	200
225	10.58	5.73	6.02	1.45	2.69	0.20	1.54	0.05	0.99	0.02	0.69	0.01	225
250	11.76	6.97	6.69	1.76	2.99	0.25	1.71	0.06	1.10	0.02	0.76	0.01	250
275	12.94	8.31	7.36	2.11	3.28	0.30	1.88	0.08	1.21	0.03	0.84	0.01	275
300	14.11	9.76	8.03	2.47	3.58	0.35	2.05	0.09	1.32	0.03	0.92	0.01	300
350	16.46	12.99	9.36	3.29	4.18	0.46	2.39	0.12	1.54	0.04	1.07	0.02	350
400	18.82	16.63	10.70	4.21	4.78	0.59	2.73	0.15	1.76	0.05	1.22	0.02	400
450			12.04	5.24	5.37	0.74	3.08	0.19	1.98	0.07	1.37	0.03	450
500			13.38	6.37	5.97	0.90	3.42	0.23	2.20	0.08	1.53	0.03	500
600			16.05	8.93	7.17	1.25	4.10	0.32	2.64	0.11	1.83	0.05	600
700			18.73	11.88	8.36	1.67	4.79	0.43	3.08	0.15	2.14	0.06	700
800					9.55	2.14	5.47	0.55	3.52	0.19	2.44	0.08	800
900					10.75	2.66	6.15	0.68	3.96	0.23	2.75	0.10	900
1000					11.94	3.23	6.84	0.83	4.40	0.29	3.05	0.12	1000
1200					14.33	4.53	8.20	1.17	5.28	0.40	3.66	0.16	1200
1400					16.72	6.03	9.57	1.55	6.17	0.53	4.27	0.22	1400
1600					19.11	7.72	10.94	1.99	7.05	0.68	4.88	0.28	1600
1800							12.31	2.47	7.93	0.85	5.49	0.35	1800
2000							13.67	3.00	8.81	1.03	6.10	0.42	2000
2200							15.04	3.58	9.69	1.23	6.71	0.50	2200
2400							16.41	4.21	10.57	1.44	7.32	0.59	2400
2600							17.78	4.88	11.45	1.67	7.93	0.69	2600
2800							19.14	5.60	12.33	1.92	8.54	0.79	2800
3000									13.21	2.18	9.15	0.89	3000
3500									15.41	2.90	10.68	1.19	3500
4000									17.62	3.72	12.20	1.52	4000
4500									19.82	4.62	13.73	1.89	4500
5000											15.25	2.30	5000
5500											16.78	2.74	5500
6000											18.30	3.22	6000

Shaded area represents
velocities over 5 and 7.5fps.
Use with caution where
water hammer is a concern.

Type "M" Copper Water Tube

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3/4" THRU 3"

Nominal Size Pipe ID Pipe OD Wall Thick	¾"		1"		1¼"		1½"		2"		2½"		3"		Nominal Size Pipe ID Pipe OD Wall Thick
	0.811 0.875 0.032		1.055 1.125 0.035		1.291 1.375 0.042		1.527 1.625 0.049		2.009 2.125 0.058		2.495 2.625 0.065		2.981 3.125 0.072		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
1	0.62	0.13	0.37	0.04	0.24	0.01	0.17	0.01	0.10	0.00					1
2	1.24	0.48	0.73	0.13	0.49	0.05	0.35	0.02	0.20	0.01					2
3	1.86	1.03	1.10	0.29	0.73	0.11	0.52	0.05	0.30	0.01	0.20	0.00			3
4	2.48	1.75	1.47	0.49	0.98	0.18	0.70	0.08	0.40	0.02	0.26	0.01			4
5	3.10	2.64	1.83	0.73	1.22	0.27	0.87	0.12	0.51	0.03	0.33	0.01	0.23	0.00	5
6	3.72	3.70	2.20	1.03	1.47	0.39	1.05	0.17	0.61	0.04	0.39	0.02	0.28	0.01	6
7	4.34	4.92	2.57	1.37	1.71	0.51	1.22	0.23	0.71	0.06	0.46	0.02	0.32	0.01	7
8	4.96	6.31	2.93	1.75	1.96	0.66	1.40	0.29	0.81	0.08	0.52	0.03	0.37	0.01	8
9	5.58	7.84	3.30	2.18	2.20	0.82	1.57	0.36	0.91	0.09	0.59	0.03	0.41	0.01	9
10	6.20	9.53	3.67	2.65	2.45	0.99	1.75	0.44	1.01	0.12	0.66	0.04	0.46	0.02	10
11	6.82	11.37	4.03	3.16	2.69	1.18	1.92	0.52	1.11	0.14	0.72	0.05	0.51	0.02	11
12	7.44	13.36	4.40	3.72	2.94	1.39	2.10	0.61	1.21	0.16	0.79	0.06	0.55	0.02	12
13	8.06	15.50	4.77	4.31	3.18	1.61	2.27	0.71	1.31	0.19	0.85	0.07	0.60	0.03	13
14	8.68	17.78	5.13	4.94	3.43	1.85	2.45	0.82	1.42	0.22	0.92	0.07	0.64	0.03	14
15	9.30	20.20	5.50	5.62	3.67	2.10	2.62	0.93	1.52	0.24	0.98	0.09	0.69	0.04	15
16	9.93	22.77	5.87	6.33	3.92	2.37	2.80	1.05	1.62	0.28	1.05	0.10	0.73	0.04	16
17	10.55	25.47	6.23	7.08	4.16	2.65	2.97	1.17	1.72	0.31	1.11	0.11	0.78	0.05	17
18	11.17	28.32	6.60	7.87	4.41	2.95	3.15	1.30	1.82	0.34	1.18	0.12	0.83	0.05	18
19	11.79	31.30	6.96	8.70	4.65	3.26	3.32	1.44	1.92	0.38	1.25	0.13	0.87	0.06	19
20	12.41	34.42	7.33	9.57	4.90	3.58	3.50	1.58	2.02	0.42	1.31	0.15	0.92	0.06	20
22	13.65	41.06	8.06	11.42	5.39	4.28	3.85	1.89	2.22	0.50	1.44	0.17	1.01	0.07	22
24	14.89	48.24	8.80	13.41	5.88	5.02	4.20	2.22	2.43	0.58	1.57	0.20	1.10	0.09	24
25	15.51	52.03	9.16	14.47	6.12	5.42	4.37	2.39	2.53	0.63	1.64	0.22	1.15	0.09	25
26	16.13	55.95	9.53	15.56	6.36	5.83	4.55	2.57	2.63	0.68	1.70	0.24	1.19	0.10	26
28	17.37	64.18	10.26	17.85	6.85	6.68	4.90	2.95	2.83	0.78	1.84	0.27	1.29	0.11	28
30	18.61	72.93	11.00	20.28	7.34	7.59	5.25	3.35	3.03	0.88	1.97	0.31	1.38	0.13	30
32	19.85	82.18	11.73	22.85	7.83	8.56	5.60	3.78	3.23	0.99	2.10	0.35	1.47	0.15	32
34			12.46	25.57	8.32	9.57	5.95	4.23	3.44	1.11	2.23	0.39	1.56	0.16	34
35			12.83	26.98	8.57	10.10	6.12	4.46	3.54	1.17	2.29	0.41	1.61	0.17	35
36			13.20	28.42	8.81	10.64	6.30	4.70	3.64	1.24	2.36	0.43	1.65	0.18	36
38			13.93	31.42	9.30	11.76	6.65	5.20	3.84	1.37	2.49	0.48	1.74	0.20	38
40			14.66	34.55	9.79	12.94	7.00	5.71	4.04	1.50	2.62	0.52	1.84	0.22	40
42			15.40	37.81	10.28	14.16	7.35	6.26	4.25	1.65	2.75	0.57	1.93	0.24	42
44			16.13	41.22	10.77	15.43	7.70	6.82	4.45	1.79	2.88	0.63	2.02	0.26	44
45			16.50	42.97	11.02	16.09	7.87	7.11	4.55	1.87	2.95	0.65	2.07	0.27	45
46			16.86	44.75	11.26	16.76	8.05	7.40	4.65	1.95	3.01	0.68	2.11	0.29	46
48			17.60	48.42	11.75	18.13	8.40	8.01	4.85	2.11	3.15	0.73	2.20	0.31	48
50			18.33	52.23	12.24	19.56	8.75	8.64	5.05	2.27	3.28	0.79	2.30	0.33	50
55					13.46	23.33	9.62	10.31	5.56	2.71	3.60	0.95	2.53	0.40	55
60					14.69	27.41	10.50	12.11	6.07	3.19	3.93	1.11	2.75	0.47	60
65					15.91	31.79	11.37	14.04	6.57	3.70	4.26	1.29	2.98	0.54	65
70					17.14	36.47	12.25	16.11	7.08	4.24	4.59	1.48	3.21	0.62	70
75					18.36	41.44	13.12	18.31	7.58	4.82	4.92	1.68	3.44	0.71	75
80					19.58	46.70	14.00	20.63	8.09	5.43	5.24	1.89	3.67	0.80	80
85							14.87	23.08	8.59	6.07	5.57	2.12	3.90	0.89	85
90							15.75	25.66	9.10	6.75	5.90	2.35	4.13	0.99	90
95							16.62	28.36	9.60	7.46	6.23	2.60	4.36	1.09	95
100							17.50	31.19	10.11	8.21	6.55	2.86	4.59	1.20	100
110							19.25	37.21	11.12	9.79	7.21	3.41	5.05	1.44	110
120									12.13	11.51	7.87	4.01	5.51	1.69	120
130									13.14	13.34	8.52	4.65	5.97	1.96	130
140									14.15	15.31	9.18	5.33	6.43	2.24	140
150									15.16	17.39	9.83	6.06	6.89	2.55	150
160									16.17	19.60	10.49	6.83	7.35	2.87	160
170									17.18	21.93	11.14	7.64	7.81	3.21	170
180									18.20	24.38	11.80	8.50	8.26	3.57	180
190									19.21	26.95	12.45	9.39	8.72	3.95	190
200											13.11	10.33	9.18	4.34	200
225											14.75	12.84	10.33	5.40	225
250											16.39	15.61	11.48	6.57	250
275											18.02	18.62	12.63	7.83	275
300											19.66	21.88	13.77	9.20	300
325													14.92	10.67	325
350													16.07	12.24	350
375													17.22	13.91	375
400													18.37	15.68	400
425													19.51	17.54	425

Shaded area represents
velocities over 7.5 fps.
Use with caution where
water hammer is a concern.

Type "M" Copper Water Tube

C=140

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3½" THRU 12"

Nominal Size Pipe ID Pipe OD Wall Thick	4"		6"		8"		10"		12"		Nominal Size Pipe ID Pipe OD Wall Thick
	3.935		5.881		7.785		9.701		11.617		
	4.125		6.125		8.125		10.125		12.125		
	0.095		0.122		0.170		0.212		0.254		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
30	0.79	0.03	0.35	0.00							30
32	0.84	0.04	0.38	0.01							32
34	0.90	0.04	0.40	0.01							34
36	0.95	0.05	0.42	0.01							36
38	1.00	0.05	0.45	0.01							38
40	1.05	0.06	0.47	0.01							40
42	1.11	0.06	0.50	0.01							42
44	1.16	0.07	0.52	0.01							44
46	1.21	0.07	0.54	0.01							46
48	1.26	0.08	0.57	0.01							48
50	1.32	0.09	0.59	0.01							50
55	1.45	0.10	0.65	0.01							55
60	1.58	0.12	0.71	0.02	0.40	0.00					60
65	1.71	0.14	0.77	0.02	0.44	0.01					65
70	1.84	0.16	0.83	0.02	0.47	0.01					70
75	1.98	0.18	0.88	0.03	0.50	0.01					75
80	2.11	0.21	0.94	0.03	0.54	0.01					80
85	2.24	0.23	1.00	0.03	0.57	0.01					85
90	2.37	0.26	1.06	0.04	0.61	0.01					90
95	2.50	0.28	1.12	0.04	0.64	0.01					95
100	2.63	0.31	1.18	0.04	0.67	0.01					100
110	2.90	0.37	1.30	0.05	0.74	0.01	0.48	0.00			110
120	3.16	0.44	1.42	0.06	0.81	0.02	0.52	0.01			120
130	3.43	0.51	1.53	0.07	0.88	0.02	0.56	0.01			130
140	3.69	0.58	1.65	0.08	0.94	0.02	0.61	0.01			140
150	3.95	0.66	1.77	0.09	1.01	0.02	0.65	0.01			150
160	4.22	0.74	1.89	0.11	1.08	0.03	0.69	0.01			160
170	4.48	0.83	2.01	0.12	1.14	0.03	0.74	0.01			170
180	4.74	0.93	2.12	0.13	1.21	0.03	0.78	0.01	0.54	0.00	180
190	5.01	1.02	2.24	0.14	1.28	0.04	0.82	0.01	0.57	0.01	190
200	5.27	1.12	2.36	0.16	1.35	0.04	0.87	0.01	0.60	0.01	200
225	5.93	1.40	2.65	0.20	1.51	0.05	0.98	0.02	0.68	0.01	225
250	6.59	1.70	2.95	0.24	1.68	0.06	1.08	0.02	0.76	0.01	250
275	7.25	2.03	3.24	0.29	1.85	0.07	1.19	0.03	0.83	0.01	275
300	7.90	2.38	3.54	0.34	2.02	0.09	1.30	0.03	0.91	0.01	300
325	8.56	2.76	3.83	0.39	2.19	0.10	1.41	0.03	0.98	0.01	325
350	9.22	3.17	4.13	0.45	2.36	0.11	1.52	0.04	1.06	0.02	350
375	9.88	3.60	4.42	0.51	2.52	0.13	1.63	0.04	1.13	0.02	375
400	10.54	4.06	4.72	0.57	2.69	0.15	1.73	0.05	1.21	0.02	400
450	11.86	5.05	5.31	0.71	3.03	0.18	1.95	0.06	1.36	0.03	450
500	13.17	6.14	5.90	0.87	3.37	0.22	2.17	0.08	1.51	0.03	500
550	14.49	7.32	6.49	1.04	3.70	0.26	2.38	0.09	1.66	0.04	550
600	15.81	8.60	7.08	1.22	4.04	0.31	2.60	0.11	1.81	0.04	600
750	19.76	13.01	8.85	1.84	5.05	0.47	3.25	0.16	2.27	0.07	750
800			9.44	2.07	5.39	0.53	3.47	0.18	2.42	0.08	800
900			10.62	2.58	6.06	0.66	3.90	0.23	2.72	0.09	900
1000			11.80	3.14	6.73	0.80	4.34	0.27	3.02	0.11	1000
1100			12.98	3.74	7.41	0.96	4.77	0.33	3.33	0.14	1100
1200			14.16	4.40	8.08	1.12	5.20	0.38	3.63	0.16	1200
1300			15.34	5.10	8.75	1.30	5.64	0.45	3.93	0.19	1300
1400			16.52	5.85	9.42	1.49	6.07	0.51	4.23	0.21	1400
1500			17.69	6.65	10.10	1.70	6.50	0.58	4.53	0.24	1500
1600			18.87	7.49	10.77	1.91	6.94	0.66	4.84	0.27	1600
1800					12.12	2.38	7.80	0.82	5.44	0.34	1800
2000					13.46	2.89	8.67	0.99	6.05	0.41	2000
2200					14.81	3.45	9.54	1.18	6.65	0.49	2200
2400					16.16	4.05	10.40	1.39	7.26	0.58	2400
2600					17.50	4.70	11.27	1.61	7.86	0.67	2600
2800					18.85	5.39	12.14	1.85	8.47	0.77	2800
3000							13.01	2.10	9.07	0.87	3000
3200							13.87	2.37	9.67	0.98	3200
3400							14.74	2.65	10.28	1.10	3400
3600							15.61	2.94	10.88	1.22	3600
3800							16.47	3.25	11.49	1.35	3800
4000							17.34	3.58	12.09	1.49	4000
4500							19.51	4.45	13.60	1.85	4500
5000							21.68	5.41	15.12	2.25	5000
5500							23.84	6.45	16.63	2.69	5500
6000									18.14	3.15	6000
6500									19.65	3.66	6500

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Class 150 Asbestos-Cement

K = 0.32

PRESSURE LOSS PER 100 FEET IN PIPE (PSI) SIZES 3" THRU 14"

Nominal Size Pipe ID Pipe OD Wall Thick	3"		4"		6"		8"		10"		12"		14"		Nominal Size Pipe ID Pipe OD Wall Thick
	3.00 4.03 0.515		3.95 5.15 0.600		5.85 7.13 0.640		7.85 9.45 0.800		10.00 11.85 0.925		12.00 14.12 0.106		14.00 16.40 1.200		
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
2	0.09	0.00													2
4	0.18	0.01													4
6	0.27	0.01	0.16	0.00											6
8	0.36	0.02	0.21	0.01											8
10	0.45	0.03	0.26	0.01											10
15	0.68	0.07	0.39	0.02											15
20	0.91	0.12	0.52	0.03	0.24	0.00									20
25	1.13	0.19	0.65	0.05	0.30	0.01									25
30	1.36	0.26	0.78	0.07	0.36	0.01									30
35	1.59	0.35	0.92	0.09	0.42	0.01									35
40	1.81	0.46	1.05	0.12	0.48	0.02	0.26	0.00							40
50	2.27	0.70	1.31	0.18	0.60	0.03	0.33	0.01							50
60	2.72	0.98	1.57	0.26	0.72	0.04	0.40	0.01							60
70	3.17	1.32	1.83	0.34	0.83	0.05	0.46	0.01							70
80	3.63	1.70	2.09	0.44	0.95	0.06	0.53	0.01	0.33	0.00					80
90	4.08	2.13	2.35	0.55	1.07	0.08	0.60	0.02	0.37	0.01					90
100	4.53	2.60	2.61	0.67	1.19	0.10	0.66	0.02	0.41	0.01					100
110	4.99	3.11	2.88	0.81	1.31	0.12	0.73	0.03	0.45	0.01					110
120	5.44	3.67	3.14	0.95	1.43	0.14	0.79	0.03	0.49	0.01					120
130	5.89	4.28	3.40	1.11	1.55	0.16	0.86	0.04	0.53	0.01	0.37	0.00			130
140	6.35	4.92	3.66	1.28	1.67	0.19	0.93	0.04	0.57	0.01	0.40	0.01			140
160	7.25	6.35	4.18	1.65	1.91	0.24	1.06	0.06	0.65	0.02	0.45	0.01			160
180	8.16	7.94	4.71	2.06	2.15	0.30	1.19	0.07	0.73	0.19	0.51	0.01	0.37	0.00	180
200	9.07	9.70	5.23	2.52	2.38	0.37	1.32	0.09	0.82	0.03	0.57	0.01	0.42	0.01	200
220	9.97	11.62	5.75	3.02	2.62	0.44	1.46	0.10	0.90	0.03	0.62	0.01	0.46	0.01	220
240	10.88	13.71	6.28	3.56	2.86	0.52	1.59	0.12	0.98	0.04	0.68	0.02	0.50	0.01	240
260	11.79	15.96	6.80	4.15	3.10	0.61	1.72	0.14	1.06	0.04	0.74	0.02	0.54	0.01	260
280	12.69	18.37	7.32	4.77	3.34	0.70	1.85	0.16	1.14	0.05	0.79	0.02	0.58	0.01	280
300	13.60	20.95	7.84	5.44	3.58	0.79	1.99	0.19	1.22	0.06	0.85	0.02	0.62	0.01	300
350	15.87	28.08	9.15	7.29	4.17	1.06	2.32	0.25	1.43	0.08	0.99	0.03	0.73	0.01	350
400	18.13	36.18	10.46	9.40	4.77	1.37	2.65	0.32	1.63	0.10	1.13	0.04	0.83	0.02	400
450			11.77	11.76	5.36	1.72	2.98	0.41	1.84	0.12	1.28	0.05	0.94	0.02	450
500			13.07	14.36	5.96	2.10	3.31	0.50	2.04	0.15	1.42	0.06	1.04	0.03	500
550			14.38	17.21	6.56	2.51	3.64	0.59	2.24	0.18	1.56	0.07	1.14	0.03	550
600			15.69	20.31	7.15	2.96	3.97	0.70	2.45	0.21	1.70	0.09	1.25	0.04	600
650			17.00	23.64	7.75	3.45	4.30	0.82	2.65	0.25	1.84	0.10	1.35	0.05	650
700			18.30	27.22	8.35	3.97	4.63	0.94	2.86	0.29	1.98	0.12	1.46	0.06	700
750			19.61	31.03	8.94	4.53	4.97	1.07	3.06	0.33	2.13	0.13	1.56	0.06	750
800					9.54	5.12	5.30	1.21	3.26	0.37	2.27	0.15	1.67	0.07	800
900					10.73	6.40	5.96	1.52	3.67	0.46	2.55	0.19	1.87	0.09	900
1000					11.92	7.82	6.62	1.85	4.08	0.57	2.83	0.23	2.08	0.11	1000
1100					13.11	9.38	7.28	2.22	4.49	0.68	3.12	0.28	2.29	0.13	1100
1200					14.31	11.06	7.95	2.62	4.90	0.80	3.40	0.33	2.50	0.15	1200
1300					15.50	12.88	8.61	3.05	5.30	0.93	3.68	0.38	2.71	0.18	1300
1400					16.69	14.83	9.27	3.51	5.71	1.07	3.97	0.44	2.91	0.21	1400
1500					17.88	16.90	9.93	4.00	6.12	1.22	4.25	0.50	3.12	0.23	1500
1600					19.08	19.11	10.59	4.52	6.53	1.38	4.53	0.57	3.33	0.27	1600
1700							11.26	5.08	6.94	1.55	4.82	0.63	3.54	0.30	1700
1800							11.92	5.66	7.34	1.73	5.10	0.71	3.75	0.33	1800
1900							12.58	6.27	7.75	1.91	5.38	0.78	3.96	0.37	1900
2000							13.24	6.91	8.16	2.11	5.67	0.86	4.16	0.41	2000
2200							14.57	8.28	8.98	2.53	6.23	1.04	4.58	0.49	2200
2400							15.89	9.77	9.79	2.98	6.80	1.22	5.00	0.57	2400
2600							17.21	11.38	10.61	3.47	7.37	1.42	5.41	0.67	2600
2800							18.54	13.10	11.42	4.00	7.93	1.64	5.83	0.77	2800
3000							19.86	14.93	12.24	4.56	8.50	1.87	6.24	0.88	3000
3500									14.28	6.11	9.92	2.50	7.29	1.18	3500
4000									16.32	7.88	11.33	3.22	8.33	1.51	4000
4500									18.36	9.85	12.75	4.03	9.37	1.89	4500
5000											14.17	4.93	10.41	2.31	5000
5500											15.58	5.90	11.45	2.77	5500
6500											18.42	8.11	13.53	3.81	6500
7500													15.61	5.00	7500
8500													17.69	6.34	8500
9500													19.78	7.84	9500

Friction losses calculated using the Scobey Formula.

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Class 150 Asbestos-Cement

K = 0.32

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 15" THRU 24"

Nominal Size Pipe ID Pipe OD Wall Thick	15" 15.00 17.91 1.455	16" 16.00 18.65 1.325	18" 18.00 21.21 1.605	20" 20.00 23.55 1.775	21" 21.00 24.94 1.990	24" 24.00 28.21 2.105	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Velocity FPS PSI LOSS	Flow GPM
200	0.36 0.00	0.32 0.00					200
300	0.54 0.01	0.48 0.01	0.38 0.00				300
400	0.73 0.01	0.64 0.01	0.50 0.01	0.41 0.00			400
500	0.91 0.02	0.80 0.02	0.63 0.01	0.51 0.01	0.46 0.00		500
600	1.09 0.03	0.96 0.02	0.76 0.01	0.61 0.01	0.56 0.01		600
700	1.27 0.04	1.12 0.03	0.88 0.02	0.71 0.01	0.65 0.01	0.50 0.00	700
800	1.45 0.05	1.28 0.04	1.01 0.02	0.82 0.01	0.74 0.01	0.57 0.01	800
900	1.63 0.06	1.43 0.05	1.13 0.03	0.92 0.02	0.83 0.01	0.64 0.01	900
1000	1.81 0.08	1.59 0.06	1.26 0.03	1.02 0.02	0.93 0.01	0.71 0.01	1000
1200	2.18 0.11	1.91 0.06	1.51 0.04	1.22 0.03	1.11 0.02	0.85 0.01	1200
1400	2.54 0.15	2.23 0.11	1.76 0.06	1.43 0.04	1.30 0.03	0.99 0.01	1400
1600	2.90 0.19	2.55 0.14	2.01 0.08	1.63 0.05	1.48 0.04	1.13 0.02	1600
1800	3.26 0.24	2.87 0.17	2.27 0.10	1.84 0.06	1.67 0.05	1.28 0.02	1800
2000	3.63 0.29	3.19 0.21	2.52 0.12	2.04 0.07	1.85 0.06	1.42 0.03	2000
2200	3.99 0.35	3.51 0.21	2.77 0.14	2.24 0.08	2.04 0.07	1.56 0.03	2200
2400	4.35 0.41	3.83 0.30	3.02 0.17	2.45 0.10	2.22 0.08	1.70 0.04	2400
2600	4.71 0.48	4.14 0.35	3.27 0.20	2.65 0.12	2.41 0.09	1.84 0.05	2600
2800	5.08 0.55	4.46 0.40	3.53 0.22	2.86 0.13	2.59 0.11	1.98 0.05	2800
3000	5.44 0.63	4.78 0.46	3.78 0.26	3.06 0.15	2.78 0.12	2.13 0.06	3000
3200	5.80 0.71	5.10 0.46	4.03 0.29	3.26 0.17	2.96 0.14	2.27 0.07	3200
3400	6.17 0.79	5.42 0.58	4.28 0.32	3.47 0.19	3.15 0.15	2.41 0.08	3400
3600	6.53 0.88	5.74 0.64	4.53 0.36	3.67 0.22	3.33 0.17	2.55 0.09	3600
3800	6.89 0.98	6.06 0.71	4.79 0.40	3.88 0.24	3.52 0.19	2.69 0.10	3800
4000	7.25 1.08	6.38 0.79	5.04 0.44	4.08 0.26	3.70 0.21	2.83 0.11	4000
4500	8.16 1.35	7.17 0.79	5.67 0.55	4.59 0.33	4.16 0.26	3.19 0.14	4500
5000	9.07 1.65	7.97 1.20	6.30 0.68	5.10 0.40	4.63 0.32	3.54 0.17	5000
5500	9.97 1.98	8.77 1.44	6.93 0.81	5.61 0.48	5.09 0.38	3.90 0.20	5500
6000	10.88 2.33	9.56 1.70	7.56 0.96	6.12 0.57	5.55 0.45	4.25 0.23	6000
6500	11.79 2.72	10.36 1.98	8.19 1.11	6.63 0.66	6.01 0.52	4.60 0.27	6500
7000	12.69 3.13	11.16 1.98	8.81 1.28	7.14 0.76	6.48 0.60	4.96 0.31	7000
7500	13.60 3.57	11.95 2.60	9.44 1.46	7.65 0.87	6.94 0.69	5.31 0.36	7500
8000	14.51 4.03	12.75 2.94	10.07 1.65	8.16 0.98	7.40 0.78	5.67 0.40	8000
8500	15.41 4.52	13.55 3.30	10.70 1.85	8.67 1.10	7.86 0.87	6.02 0.45	8500
9000	16.32 5.04	14.34 3.68	11.33 2.06	9.18 1.23	8.33 0.97	6.38 0.50	9000
9500	17.23 5.59	15.14 3.68	11.96 2.29	9.69 1.36	8.79 1.07	6.73 0.56	9500
10000	18.13 6.16	15.94 4.49	12.59 2.52	10.20 1.50	9.25 1.18	7.08 0.62	10000
10500	19.04 6.76	16.73 4.93	13.22 2.77	10.71 1.65	9.71 1.30	7.44 0.68	10500
11000	19.95 7.38	17.53 5.38	13.85 3.02	11.22 1.80	10.18 1.42	7.79 0.74	11000
11500		18.33 5.86	14.48 3.29	11.73 1.96	10.64 1.55	8.15 0.80	11500
12000		19.13 5.86	15.11 3.57	12.24 2.13	11.10 1.68	8.50 0.87	12000
12500		19.92 6.86	15.74 3.85	12.75 2.30	11.56 1.81	8.85 0.94	12500
13000			16.37 4.15	13.26 2.48	12.03 1.95	9.21 1.01	13000
13500			17.00 4.46	13.77 2.66	12.49 2.10	9.56 1.09	13500
14000			17.63 4.78	14.28 2.85	12.95 2.25	9.92 1.17	14000
14500			18.26 5.11	14.79 3.05	13.41 2.40	10.27 1.25	14500
15000			18.89 5.45	15.30 3.25	13.88 2.56	10.63 1.33	15000
15500			19.52 5.80	15.81 3.46	14.34 2.72	10.98 1.42	15500
16000				16.32 3.68	14.80 2.89	11.33 1.50	16000
16500				16.83 3.90	15.27 3.07	11.69 1.59	16500
17000				17.34 4.12	15.73 3.25	12.04 1.69	17000
17500				17.85 4.36	16.19 3.43	12.40 1.78	17500
18000				18.36 4.60	16.65 3.62	12.75 1.88	18000
18500				18.87 4.84	17.12 3.81	13.10 1.98	18500
19000				19.38 5.09	17.58 4.01	13.46 2.08	19000
19500				19.89 5.35	18.04 4.21	13.81 2.19	19500
20000					18.50 4.42	14.17 2.30	20000
21000					19.43 4.85	14.88 2.52	21000
22000						15.58 2.75	22000
23000						16.29 3.00	23000
24000						17.00 3.25	24000
25000						17.71 3.51	25000
26000						18.42 3.78	26000
27000						19.13 4.06	27000
28000						19.83 4.36	28000
29000							29000

Friction losses calculated using the Scobey Formula.

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Portable Aluminum Pipe With Couplings

K = 0.40

PRESSURE LOSS PER 100 FEET OF PIPE (PSI) SIZES 3" THRU 10"

Nominal Size Pipe ID Pipe OD Wall Thick	3" 2.91 3.00 0.045	4" 3.91 4.00 0.045	6" 5.88 6.00 0.060	7" 6.87 7.00 0.065	8" 7.86 8.00 0.070	10" 9.82 10.00 0.090	Nominal Size Pipe ID Pipe OD Wall Thick
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Flow GPM
5	0.24	0.01	0.13	0.00			5
10	0.48	0.04	0.27	0.01			10
15	0.72	0.08	0.40	0.02			15
20	0.96	0.14	0.53	0.03	0.24	0.00	20
25	1.20	0.22	0.67	0.03	0.29	0.01	25
30	1.44	0.30	0.80	0.07	0.35	0.01	30
35	1.68	0.41	0.94	0.10	0.41	0.01	35
40	1.92	0.53	1.07	0.13	0.47	0.02	40
45	2.16	0.66	1.20	0.16	0.53	0.02	45
50	2.40	0.80	1.34	0.16	0.59	0.03	50
60	2.88	1.13	1.60	0.27	0.71	0.04	60
70	3.36	1.52	1.87	0.36	0.82	0.05	70
80	3.84	1.96	2.14	0.47	0.94	0.06	80
90	4.32	2.45	2.41	0.58	1.06	0.08	90
100	4.80	3.00	2.67	0.58	1.18	0.10	100
110	5.29	3.59	2.94	0.85	1.30	0.11	110
120	5.77	4.24	3.21	1.01	1.41	0.14	120
130	6.25	4.93	3.48	1.17	1.53	0.16	130
140	6.73	5.68	3.74	1.35	1.65	0.18	140
150	7.21	6.47	4.01	1.35	1.77	0.21	150
160	7.69	7.32	4.28	1.74	1.89	0.23	160
170	8.17	8.21	4.55	1.95	2.00	0.26	170
180	8.65	9.15	4.81	2.18	2.12	0.29	180
190	9.13	10.14	5.08	2.41	2.24	0.32	190
200	9.61	11.18	5.35	2.41	2.36	0.36	200
225	10.81	13.98	6.02	3.33	2.65	0.45	225
250	12.01	17.08	6.69	4.07	2.95	0.55	250
275	13.21	20.48	7.35	4.87	3.24	0.65	275
300	14.41	24.16	8.02	5.75	3.54	0.77	300
325	15.62	28.12	8.69	5.75	3.83	0.90	325
350	16.82	32.38	9.36	7.70	4.12	1.03	350
375	18.02	36.91	10.03	8.78	4.42	1.18	375
400	19.22	41.73	10.70	9.93	4.71	1.33	400
425			11.37	11.14	5.01	1.50	425
450			12.03	11.14	5.30	1.67	450
475			12.70	13.76	5.60	1.85	475
500			13.37	15.17	5.89	2.04	500
550			14.71	18.18	6.48	2.44	550
600			16.05	21.45	7.07	2.88	600
650			17.38	21.45	7.66	3.35	650
700			18.72	28.75	8.25	3.86	700
750					8.84	4.40	750
800					9.43	4.98	800
850					10.02	5.58	850
900					10.61	6.23	900
1000					11.78	7.61	1000
1100					12.96	9.11	1100
1200					14.14	10.75	1200
1300					15.32	12.52	1300
1400					16.50	14.41	1400
1500					17.68	16.43	1500
1600					18.86	18.58	1600
1700					14.69	9.74	1700
1800					15.55	10.86	1800
1900					16.42	12.03	1900
2000					17.28	13.27	2000
2250					19.44	16.59	2250
2500							2500
2750							2750
3000							3000
3250							3250
3500							3500
3750							3750
4000							4000
4250							4250

Friction losses calculated using the Scobey Formula.

Shaded area represents
velocities over 5 fps.
Use with caution where
water hammer is a concern.

Australian Standard PVC PN 6 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 40 mm THRU 80 mm

Nominal Size Pipe ID Pipe OD Wall Thick	40 mm		50 mm		80 mm		Nominal Size Pipe ID Pipe OD Wall Thick
	45.2 48.2 1.5		56.7 60.3 1.8		83.7 88.9 2.6		
Flow L/min	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Flow Cu. M/Hr L/sec
12	0.12	0.00					0.72 0.20
14	0.15	0.01					0.84 0.23
16	0.17	0.01					0.96 0.27
18	0.19	0.01					1.08 0.30
20	0.21	0.01					1.20 0.33
22	0.23	0.02	0.14	0.00			1.32 0.37
24	0.25	0.02	0.16	0.01			1.44 0.40
26	0.27	0.02	0.17	0.01			1.56 0.43
28	0.29	0.02	0.18	0.01			1.68 0.47
30	0.31	0.03	0.20	0.01			1.80 0.50
32	0.33	0.03	0.21	0.01			1.92 0.53
34	0.35	0.03	0.22	0.01			2.04 0.57
36	0.37	0.04	0.24	0.01			2.16 0.60
38	0.39	0.04	0.25	0.01			2.28 0.63
40	0.41	0.05	0.26	0.02			2.40 0.67
42	0.44	0.05	0.28	0.02			2.52 0.70
44	0.46	0.05	0.29	0.02			2.64 0.73
46	0.48	0.06	0.30	0.02			2.76 0.77
48	0.50	0.06	0.32	0.02			2.88 0.80
50	0.52	0.07	0.33	0.02			3.00 0.83
55	0.57	0.08	0.36	0.03			3.30 0.92
60	0.62	0.10	0.39	0.03	0.18	0.00	3.60 1.00
65	0.67	0.11	0.43	0.04	0.20	0.01	3.90 1.08
70	0.73	0.13	0.46	0.04	0.21	0.01	4.20 1.17
75	0.78	0.15	0.49	0.05	0.23	0.01	4.50 1.25
80	0.83	0.17	0.53	0.05	0.24	0.01	4.80 1.33
85	0.88	0.19	0.56	0.06	0.26	0.01	5.10 1.42
90	0.93	0.21	0.59	0.07	0.27	0.01	5.40 1.50
95	0.99	0.23	0.62	0.07	0.29	0.01	5.70 1.58
100	1.04	0.25	0.66	0.08	0.30	0.01	6.00 1.67
110	1.14	0.30	0.72	0.10	0.33	0.01	6.60 1.83
120	1.24	0.35	0.79	0.12	0.36	0.02	7.20 2.00
130	1.35	0.41	0.85	0.13	0.39	0.02	7.80 2.17
140	1.45	0.47	0.92	0.15	0.42	0.02	8.40 2.33
150	1.56	0.53	0.99	0.17	0.45	0.03	9.00 2.50
175	1.82	0.71	1.15	0.23	0.53	0.04	10.50 2.92
200	2.07	0.90	1.31	0.30	0.61	0.05	12.00 3.33
225	2.33	1.12	1.48	0.37	0.68	0.06	13.50 3.75
250	2.59	1.37	1.64	0.45	0.76	0.07	15.00 4.17
275	2.85	1.63	1.81	0.54	0.83	0.08	16.50 4.58
300	3.11	1.92	1.97	0.63	0.91	0.10	18.00 5.00
325	3.37	2.22	2.14	0.73	0.98	0.11	19.50 5.42
350	3.63	2.55	2.30	0.84	1.06	0.13	21.00 5.83
375	3.89	2.90	2.46	0.95	1.13	0.14	22.50 6.25
400	4.15	3.26	2.63	1.07	1.21	0.16	24.00 6.67
425	4.41	3.65	2.79	1.20	1.29	0.18	25.50 7.08
450	4.67	4.06	2.96	1.34	1.36	0.20	27.00 7.50
475	4.93	4.49	3.12	1.48	1.44	0.22	28.50 7.92
500	5.19	4.93	3.28	1.62	1.51	0.25	30.00 8.33
525	5.45	5.40	3.45	1.78	1.59	0.27	31.50 8.75
550	5.71	5.89	3.61	1.94	1.66	0.29	33.00 9.17
575	5.97	6.39	3.78	2.10	1.74	0.32	34.50 9.58
600			3.94	2.28	1.82	0.34	36.00 10.0
650			4.27	2.64	1.97	0.40	39.00 10.8
700			4.60	3.03	2.12	0.46	42.00 11.7
750			4.93	3.44	2.27	0.52	45.00 12.5
800			5.26	3.88	2.42	0.59	48.00 13.3
850					2.57	0.66	51.00 14.2
900					2.72	0.73	54.00 15.0
950					2.87	0.81	57.00 15.8
1000					3.03	0.89	60.00 16.7
1100					3.33	1.06	66.00 18.3
1200					3.63	1.25	72.00 20.0
1300					3.93	1.44	78.00 21.7
1400					4.24	1.66	84.00 23.3
1500					4.54	1.88	90.00 25.0
1600					4.84	2.12	96.00 26.7
1700					5.14	2.37	102.00 28.3
1800					5.45	2.64	108.00 30.0

Shaded area represents
velocities over 1.5 mps.
Use with caution where
water hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 6 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 100 mm THRU 375 mm

Nominal Size	100 mm	150 mm	200 mm	225 mm	250 mm	300 mm	375 mm	Nominal Size		
Pipe ID	107.8	151.3	213.8	236.4	266.2	299.5	380.3	Pipe ID		
Pipe OD	114.3	160.3	225.3	250.4	280.4	315.5	400.5	Pipe OD		
Wall Thick	3.25	4.50	5.25	7.00	7.10	8.00	10.10	Wall Thick		
Flow L/min	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Flow Cu. M/Hr	L/sec
100	0.18	0.00							6.0	1.67
125	0.23	0.01							7.5	2.08
150	0.27	0.01							9.0	2.50
175	0.32	0.01							10.5	2.92
200	0.36	0.01							12.0	3.33
225	0.41	0.02							13.5	3.75
250	0.46	0.02							15.0	4.17
275	0.50	0.02	0.25	0.00					16.5	4.58
300	0.55	0.03	0.28	0.01					18.0	5.00
325	0.59	0.03	0.30	0.01					19.5	5.42
350	0.64	0.04	0.32	0.01					21.0	5.83
375	0.68	0.04	0.35	0.01					22.5	6.25
400	0.73	0.05	0.37	0.01					24.0	6.67
475	0.87	0.07	0.44	0.01					28.5	7.92
500	0.91	0.07	0.46	0.01					30.0	8.33
550	1.00	0.09	0.51	0.02					33.0	9.17
600	1.09	0.10	0.56	0.02					36.0	10.0
650	1.19	0.12	0.60	0.02					39.0	10.8
700	1.28	0.13	0.65	0.03	0.32	0.00			42.0	11.7
750	1.37	0.15	0.69	0.03	0.35	0.01			45.0	12.5
800	1.46	0.17	0.74	0.03	0.37	0.01			48.0	13.3
900	1.64	0.21	0.83	0.04	0.42	0.01			54.0	15.0
1000	1.82	0.26	0.93	0.05	0.46	0.01			60.0	16.7
1100	2.01	0.31	1.02	0.06	0.51	0.01			66.0	18.3
1200	2.19	0.36	1.11	0.07	0.56	0.01	0.36	0.00	72.0	20.0
1300	2.37	0.42	1.20	0.08	0.60	0.02	0.39	0.01	78.0	21.7
1400	2.55	0.48	1.30	0.09	0.65	0.02	0.42	0.01	84.0	23.3
1500	2.74	0.55	1.39	0.11	0.70	0.02	0.56	0.01	90.0	25.0
1600	2.92	0.62	1.48	0.12	0.74	0.02	0.60	0.01	96.0	26.7
1800	3.28	0.77	1.67	0.15	0.83	0.03	0.54	0.01	108	30.0
2000	3.65	0.94	1.85	0.18	0.93	0.03	0.75	0.02	120	33.3
2200	4.01	1.12	2.04	0.21	1.02	0.04	0.83	0.02	132	36.7
2400	4.38	1.31	2.22	0.25	1.11	0.05	0.90	0.03	144	40.0
2600	4.74	1.52	2.41	0.29	1.21	0.05	0.98	0.03	156	43.3
2800	5.11	1.75	2.59	0.34	1.30	0.06	1.05	0.04	168	46.7
3000	5.47	1.98	2.78	0.38	1.39	0.07	1.13	0.04	180	50.0
3500			3.24	0.51	1.62	0.09	1.31	0.06	210	58.3
4000			3.70	0.65	1.85	0.12	1.50	0.07	240	66.7
4500			4.17	0.81	2.09	0.15	1.69	0.09	270	75.0
5000			4.63	0.98	2.32	0.18	1.88	0.11	300	83.3
5500			5.09	1.17	2.55	0.22	2.06	0.13	330	91.7
6000			5.56	1.38	2.78	0.26	2.25	0.15	360	100.0
6500					3.01	0.30	2.44	0.18	390	108.3
7000					3.25	0.34	2.63	0.20	420	116.7
7500					3.48	0.39	2.81	0.23	450	125.0
8000					3.71	0.44	3.00	0.26	480	133.3
8500					3.94	0.49	3.19	0.29	510	141.7
9000					4.17	0.54	3.38	0.32	540	150.0
9500					4.41	0.60	3.56	0.36	570	158.3
10000					4.64	0.66	3.75	0.39	600	166.7
11000					5.10	0.79	4.13	0.47	660	183.3
12000					5.56	0.92	4.50	0.55	720	200.0
13000							4.88	0.64	780	216.7
14000							5.25	0.73	840	233.3
15000							5.63	0.83	900	250.0
16000					6.00	0.94	4.79	0.54	960	266.7
17000							5.08	0.61	1020	283.3
18000							5.38	0.67	1080	300.0
19000							5.68	0.74	1140	316.7
20000							5.98	0.82	1200	333.3
22000							5.20	0.55	1320	366.7
24000							5.67	0.65	1440	400.0
26000									1560	433.3
28000									1680	466.7
30000									1800	500.0
32000									1920	533.3
34000									2040	566.7
36000									2160	600.0
38000									2280	633.3
40000									2400	666.7

Shaded area represents
velocities over 1.5 mps.
Use with caution where water
hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 9 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES SIZES 25 mm THRU 80 mm

Nominal Size	25 mm		32 mm		40 mm		50 mm		80 mm		Nominal Size	
Pipe ID	30.5		38.4		44.0		55.1		81.3		Pipe ID	
Pipe OD	33.5		42.2		48.2		60.3		88.9		Pipe OD	
Wall Thick	1.50		1.90		2.10		2.60		3.80		Wall Thick	
Flow L/min	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Flow Cu. M/Hr	L/sec
4	0.09	0.00									0.24	0.07
5	0.11	0.01									0.30	0.08
6	0.14	0.01									0.36	0.10
7	0.16	0.01	0.10	0.00							0.42	0.12
8	0.18	0.02	0.11	0.01							0.48	0.13
9	0.21	0.02	0.13	0.01							0.54	0.15
10	0.23	0.02	0.14	0.01	0.11	0.00					0.60	0.17
12	0.27	0.03	0.17	0.01	0.13	0.01					0.72	0.20
14	0.32	0.04	0.20	0.01	0.15	0.01					0.84	0.23
15	0.34	0.05	0.21	0.02	0.16	0.01					0.90	0.25
16	0.36	0.06	0.23	0.02	0.17	0.01					0.96	0.27
18	0.41	0.07	0.26	0.02	0.20	0.01					1.08	0.30
20	0.46	0.09	0.29	0.03	0.22	0.01	0.14	0.00			1.20	0.33
22	0.50	0.10	0.31	0.03	0.24	0.02	0.15	0.01			1.32	0.37
24	0.55	0.12	0.34	0.04	0.26	0.02	0.17	0.01			1.44	0.40
26	0.59	0.14	0.37	0.05	0.28	0.02	0.18	0.01			1.56	0.43
28	0.64	0.16	0.40	0.05	0.31	0.03	0.19	0.01			1.68	0.47
30	0.68	0.18	0.43	0.06	0.33	0.03	0.21	0.01			1.80	0.50
32	0.73	0.21	0.46	0.07	0.35	0.03	0.22	0.01			1.92	0.53
34	0.77	0.23	0.49	0.07	0.37	0.04	0.24	0.01			2.04	0.57
36	0.82	0.26	0.51	0.08	0.39	0.04	0.25	0.01			2.16	0.60
38	0.87	0.28	0.54	0.09	0.41	0.05	0.26	0.02			2.28	0.63
40	0.91	0.31	0.57	0.10	0.44	0.05	0.28	0.02			2.40	0.67
42	0.96	0.34	0.60	0.11	0.46	0.06	0.29	0.02			2.52	0.70
44	1.00	0.37	0.63	0.12	0.48	0.06	0.31	0.02			2.64	0.73
46	1.05	0.40	0.66	0.13	0.50	0.07	0.32	0.02			2.76	0.77
48	1.09	0.44	0.69	0.14	0.52	0.07	0.33	0.02			2.88	0.80
50	1.14	0.47	0.71	0.15	0.54	0.08	0.35	0.03			3.00	0.83
55	1.25	0.56	0.79	0.18	0.60	0.09	0.38	0.03	0.18	0.00	3.30	0.92
60	1.37	0.66	0.86	0.21	0.65	0.11	0.42	0.04	0.19	0.01	3.60	1.00
65	1.48	0.76	0.93	0.25	0.71	0.13	0.45	0.04	0.21	0.01	3.90	1.08
70	1.59	0.88	1.00	0.28	0.76	0.15	0.49	0.05	0.22	0.01	4.20	1.17
75	1.71	1.00	1.07	0.32	0.82	0.17	0.52	0.06	0.24	0.01	4.50	1.25
80	1.82	1.12	1.14	0.36	0.87	0.19	0.56	0.06	0.26	0.01	4.80	1.33
85	1.94	1.26	1.22	0.40	0.93	0.21	0.59	0.07	0.27	0.01	5.10	1.42
90	2.05	1.40	1.29	0.45	0.98	0.23	0.63	0.08	0.29	0.01	5.40	1.50
95	2.16	1.54	1.36	0.50	1.04	0.26	0.66	0.09	0.30	0.01	5.70	1.58
100	2.28	1.70	1.43	0.55	1.09	0.28	0.70	0.09	0.32	0.01	6.00	1.67
110	2.51	2.03	1.57	0.65	1.20	0.34	0.77	0.11	0.35	0.02	6.60	1.83
120	2.73	2.38	1.72	0.77	1.31	0.40	0.83	0.13	0.38	0.02	7.20	2.00
130	2.96	2.76	1.86	0.89	1.42	0.46	0.90	0.15	0.42	0.02	7.80	2.17
140	3.19	3.17	2.00	1.02	1.53	0.53	0.97	0.18	0.45	0.03	8.40	2.33
150	3.42	3.60	2.14	1.16	1.63	0.60	1.04	0.20	0.48	0.03	9.00	2.50
175	3.99	4.79	2.50	1.54	1.91	0.80	1.22	0.27	0.56	0.04	10.5	2.92
200	4.56	6.13	2.86	1.97	2.18	1.02	1.39	0.34	0.64	0.05	12.0	3.33
225	5.13	7.62	3.22	2.45	2.45	1.27	1.57	0.43	0.72	0.06	13.5	3.75
250	5.70	9.27	3.57	2.98	2.72	1.54	1.74	0.52	0.80	0.08	15.0	4.17
275			3.93	3.56	3.00	1.84	1.91	0.62	0.88	0.09	16.5	4.58
300			4.29	4.18	3.27	2.16	2.09	0.72	0.96	0.11	18.0	5.00
325			4.65	4.85	3.54	2.50	2.26	0.84	1.04	0.13	19.5	5.42
350			5.00	5.56	3.81	2.87	2.43	0.96	1.12	0.15	21.0	5.83
375			5.36	6.32	4.09	3.26	2.61	1.09	1.20	0.17	22.5	6.25
400			5.72	7.12	4.36	3.68	2.78	1.23	1.28	0.19	24.0	6.67
450					4.90	4.58	3.13	1.53	1.44	0.23	27.0	7.50
500					5.45	5.56	3.48	1.87	1.60	0.28	30.0	8.33
550					5.99	6.64	3.83	2.23	1.76	0.34	33.0	9.17
600							4.17	2.61	1.92	0.40	36.0	10.0
650							4.52	3.03	2.08	0.46	39.0	10.8
700							4.87	3.48	2.24	0.53	42.0	11.7
750							5.22	3.95	2.41	0.60	45.0	12.5
800							5.56	4.45	2.57	0.68	48.0	13.3
900									2.89	0.84	54.0	15.0
1000									3.21	1.02	60.0	16.7
1100									3.53	1.22	66.0	18.3
1200									3.85	1.43	72.0	20.0
1300									4.17	1.66	78.0	21.7
1400									4.49	1.91	84.0	23.3
1500									4.81	2.17	90.0	25.0
1600									5.13	2.44	96.0	26.7
1700									5.45	2.73	102.0	28.3

Shaded area represents velocities over 1.5 mps. Use with caution where water hammer is a concern.

Conversions:
 Bars/100 M x 100 = kPa/100 M
 Bars/100 M x 10.21 = Metres/100 M
 Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 9 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 100 mm THRU 375 mm

Nominal Size Pipe ID Pipe OD Wall Thick	100 mm 104.7 114.3 4.8	150 mm 146.9 160.3 6.7	200 mm 208.5 225.3 8.4	225 mm 231.7 250.4 9.3	250 mm 259.4 280.4 10.5	300 mm 292.0 315.5 11.7	375 mm 370.7 400.5 14.9	Nominal Size Pipe ID Pipe OD Wall Thick
Flow L/min	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Flow Cu. M/Hr L/sec
100	0.19	0.00						6.0
125	0.24	0.01						7.5
150	0.29	0.01						9.0
175	0.34	0.01						10.5
200	0.39	0.02						12.0
225	0.44	0.02						13.5
250	0.48	0.02	0.25	0.00				15.0
275	0.53	0.03	0.27	0.01				16.5
300	0.58	0.03	0.29	0.01				18.0
325	0.63	0.04	0.32	0.01				19.5
350	0.68	0.04	0.34	0.01				21.0
375	0.73	0.05	0.37	0.01				22.5
400	0.77	0.06	0.39	0.01				24.0
475	0.92	0.08	0.47	0.01				28.5
500	0.97	0.08	0.49	0.02				30.0
550	1.07	0.10	0.54	0.02				33.0
600	1.16	0.12	0.59	0.02				36.0
650	1.26	0.14	0.64	0.03	0.32	0.00		39.0
700	1.36	0.16	0.69	0.03	0.34	0.01		42.0
750	1.45	0.18	0.74	0.03	0.37	0.01		45.0
800	1.55	0.20	0.79	0.04	0.39	0.01		48.0
850	1.65	0.22	0.83	0.04	0.41	0.01		51.0
900	1.74	0.25	0.88	0.05	0.44	0.01		54.0
950	1.84	0.27	0.93	0.05	0.46	0.01		57.0
1000	1.94	0.30	0.98	0.06	0.49	0.01		60.0
1100	2.13	0.36	1.08	0.07	0.54	0.01		66.0
1200	2.32	0.42	1.18	0.08	0.59	0.01		72.0
1300	2.52	0.49	1.28	0.09	0.63	0.02		78.0
1400	2.71	0.56	1.38	0.11	0.68	0.02		84.0
1500	2.91	0.64	1.47	0.12	0.73	0.02		90.0
1600	3.10	0.72	1.57	0.14	0.78	0.02	0.40	96.0
1700	3.29	0.80	1.67	0.15	0.83	0.03	0.42	102
1800	3.49	0.89	1.77	0.17	0.88	0.03	0.45	108
1900	3.68	0.99	1.87	0.19	0.93	0.03	0.47	114
2000	3.87	1.08	1.96	0.21	0.98	0.04	0.50	120
2200	4.26	1.29	2.16	0.25	1.07	0.05	0.55	132
2400	4.65	1.52	2.36	0.29	1.17	0.05	0.60	144
2600	5.04	1.76	2.55	0.34	1.27	0.06	0.65	156
2800	5.42	2.02	2.75	0.39	1.37	0.07	0.70	168
3000	5.81	2.30	2.95	0.44	1.46	0.08	0.75	180
3200			3.14	0.50	1.56	0.09	0.80	192
3400			3.34	0.55	1.66	0.10	0.85	204
3600			3.54	0.62	1.76	0.11	0.89	216
3800			3.73	0.68	1.85	0.12	0.94	228
4000			3.93	0.75	1.95	0.14	0.99	240
4500			4.42	0.93	2.19	0.17	1.12	270
5000			4.91	1.13	2.44	0.21	1.24	300
5500			5.40	1.35	2.68	0.25	1.37	330
6000			5.89	1.59	2.93	0.29	1.49	360
6500			3.17	0.34	2.57	0.20	1.62	390
7000			3.41	0.38	2.76	0.23	1.74	420
8000			3.90	0.49	3.16	0.29	1.99	480
9000			4.39	0.61	3.55	0.37	2.24	540
10000			4.88	0.74	3.95	0.45	2.49	600
11000			5.36	0.89	4.34	0.53	2.73	660
12000			5.85	1.04	4.74	0.62	2.98	720
14000					5.53	0.83	3.48	840
16000							4.41	960
18000							5.04	1080
20000							5.67	1200
22000							5.47	1320
26000								1560
30000								1800
34000								2040
38000								2280

Shaded area represents
velocities over 1.5 mps.
Use with caution where
water hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 12 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 20 mm THRU 80 mm

Nominal Size Pipe ID Pipe OD Wall Thick	20 mm 23.7 26.7 1.5		25 mm 29.7 33.5 1.9		32 mm 37.4 42.2 2.4		40 mm 42.8 48.2 2.7		50 mm 53.7 60.3 3.3		80 mm 79.1 88.9 4.9		Nominal Size Pipe ID Pipe OD Wall Thick	
Flow L/min	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Flow Cu. M/Hr	L/sec
1													0.06	0.02
2	0.08	0.00											0.12	0.03
3	0.11	0.01											0.18	0.05
4	0.15	0.01	0.10	0.00									0.24	0.07
5	0.19	0.02	0.12	0.01									0.30	0.08
6	0.23	0.03	0.14	0.01									0.36	0.10
7	0.26	0.04	0.17	0.01	0.11	0.00							0.42	0.12
8	0.30	0.05	0.19	0.02	0.12	0.01							0.48	0.13
9	0.34	0.07	0.21	0.02	0.14	0.01							0.54	0.15
10	0.38	0.08	0.24	0.03	0.15	0.01	0.12	0.00					0.60	0.17
12	0.45	0.11	0.29	0.04	0.18	0.01	0.14	0.01					0.72	0.20
14	0.53	0.15	0.33	0.05	0.21	0.02	0.16	0.01					0.84	0.23
16	0.60	0.19	0.38	0.06	0.24	0.02	0.19	0.01					0.96	0.27
18	0.68	0.24	0.43	0.08	0.27	0.03	0.21	0.01	0.13	0.00			1.08	0.30
20	0.75	0.29	0.48	0.10	0.30	0.03	0.23	0.02	0.15	0.01			1.20	0.33
22	0.83	0.35	0.53	0.12	0.33	0.04	0.25	0.02	0.16	0.01			1.32	0.37
24	0.91	0.41	0.57	0.14	0.36	0.04	0.28	0.02	0.18	0.01			1.44	0.40
26	0.98	0.48	0.62	0.16	0.39	0.05	0.30	0.03	0.19	0.01			1.56	0.43
28	1.06	0.55	0.67	0.18	0.42	0.06	0.32	0.03	0.21	0.01			1.68	0.47
30	1.13	0.62	0.72	0.20	0.45	0.07	0.35	0.04	0.22	0.01			1.80	0.50
32	1.21	0.70	0.76	0.23	0.48	0.08	0.37	0.04	0.24	0.01			1.92	0.53
34	1.28	0.79	0.81	0.26	0.51	0.08	0.39	0.04	0.25	0.01			2.04	0.57
36	1.36	0.87	0.86	0.29	0.54	0.09	0.42	0.05	0.26	0.02			2.16	0.60
38	1.43	0.97	0.91	0.32	0.57	0.10	0.44	0.05	0.28	0.02			2.28	0.63
40	1.51	1.06	0.95	0.35	0.60	0.11	0.46	0.06	0.29	0.02			2.40	0.67
42	1.58	1.16	1.00	0.38	0.63	0.12	0.49	0.07	0.31	0.02			2.52	0.70
44	1.66	1.27	1.05	0.42	0.66	0.14	0.51	0.07	0.32	0.02			2.64	0.73
46	1.74	1.38	1.10	0.45	0.69	0.15	0.53	0.08	0.34	0.03			2.76	0.77
48	1.81	1.49	1.15	0.49	0.72	0.16	0.56	0.08	0.35	0.03			2.88	0.80
50	1.89	1.61	1.19	0.53	0.75	0.17	0.58	0.09	0.37	0.03	0.17	0.00	3.00	0.83
55	2.08	1.92	1.31	0.63	0.83	0.21	0.64	0.11	0.40	0.04	0.19	0.01	3.30	0.92
60	2.26	2.25	1.43	0.74	0.90	0.24	0.69	0.13	0.44	0.02	0.20	0.01	3.60	1.00
65	2.45	2.61	1.55	0.86	0.98	0.28	0.75	0.15	0.48	0.05	0.22	0.01	3.90	1.08
70	2.64	2.99	1.67	0.98	1.06	0.32	0.81	0.17	0.51	0.06	0.24	0.01	4.20	1.17
75	2.83	3.40	1.79	1.12	1.13	0.36	0.87	0.19	0.55	0.06	0.25	0.01	4.50	1.25
80	3.02	3.83	1.91	1.26	1.21	0.41	0.93	0.22	0.59	0.07	0.27	0.01	4.80	1.33
85	3.21	4.29	2.03	1.41	1.28	0.46	0.98	0.24	0.62	0.08	0.29	0.01	5.10	1.42
90	3.40	4.77	2.15	1.56	1.36	0.51	1.04	0.27	0.66	0.09	0.31	0.01	5.40	1.50
95	3.58	5.27	2.27	1.73	1.43	0.57	1.10	0.30	0.70	0.10	0.32	0.02	5.70	1.58
100	3.77	5.79	2.39	1.90	1.51	0.62	1.16	0.33	0.74	0.11	0.34	0.02	6.00	1.67
110	4.15	6.91	2.63	2.27	1.66	0.74	1.27	0.39	0.81	0.13	0.37	0.02	6.60	1.83
120	4.53	8.12	2.86	2.66	1.81	0.87	1.39	0.46	0.88	0.15	0.41	0.02	7.20	2.00
130	4.91	9.42	3.10	3.09	1.96	1.01	1.50	0.53	0.96	0.18	0.44	0.03	7.80	2.17
140	5.28	10.81	3.34	3.55	2.11	1.16	1.62	0.61	1.03	0.20	0.48	0.03	8.40	2.33
150	5.66	12.28	3.58	4.03	2.26	1.32	1.74	0.69	1.10	0.23	0.51	0.04	9.00	2.50
175			4.18	5.36	2.64	1.75	2.02	0.92	1.29	0.31	0.59	0.05	10.5	2.92
200			4.77	6.86	3.01	2.24	2.31	1.18	1.47	0.39	0.68	0.06	12.0	3.33
225			5.37	8.54	3.39	2.79	2.60	1.47	1.65	0.49	0.76	0.07	13.5	3.75
250			5.97	10.38	3.77	3.39	2.89	1.78	1.84	0.59	0.85	0.09	15.0	4.17
275					4.14	4.05	3.18	2.13	2.02	0.70	0.93	0.11	16.5	4.58
300					4.52	4.75	3.47	2.50	2.21	0.83	1.02	0.13	18.0	5.00
325					4.90	5.51	3.76	2.90	2.39	0.96	1.10	0.15	19.5	5.42
350					5.28	6.32	4.05	3.32	2.57	1.10	1.19	0.17	21.0	5.83
375					5.65	7.19	4.34	3.78	2.76	1.25	1.27	0.19	22.5	6.25
400							4.63	4.26	2.94	1.41	1.36	0.22	24.0	6.67
450							5.21	5.29	3.31	1.75	1.53	0.27	27.0	7.50
500							5.79	6.43	3.68	2.13	1.70	0.33	30.0	8.33
550									4.04	2.54	1.87	0.39	33.0	9.17
600									4.41	2.99	2.04	0.46	36.0	10.0
650									4.78	3.47	2.21	0.53	39.0	10.8
700			Shaded area represents velocities over 1.5 mps. Use with caution where water hammer is a concern.						5.15	3.98	2.38	0.61	42.0	11.7
750									5.51	4.52	2.55	0.69	45.0	12.5
800									5.88	5.09	2.72	0.78	48.0	13.3
900										3.06	0.97	54.0	15.0	
1000									3.40	1.18			60.0	16.7
1100			Conversions: Bars/100 M x 100 = kPa/100 M Bars/100 M x 10.21 = Metres/100 M Bars/100 M x 4.42 = psi/100 ft.								3.74	1.40	66.0	18.3
1200										4.08	1.65	72.0	20.0	
1300										4.42	1.91	78.0	21.7	
1400										4.75	2.19	84.0	23.3	
1600									5.43	2.81			96.0	26.7

Shaded area represents
velocities over 1.5 mps.
Use with caution where
water hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 12 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 100 mm THRU 375 mm

Nominal Size Pipe ID Pipe OD Wall Thick	100 mm 101.7 114.3 6.3	150 mm 142.7 160.3 8.8	200 mm 203.1 225.3 11.1	225 mm 225.8 250.4 12.3	250 mm 252.9 280.4 13.7	300 mm 284.5 315.5 15.5	375 mm 361.2 400.5 19.7	Nominal Size Pipe ID Pipe OD Wall Thick
Flow L/min	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Flow Cu. M/Hr L/sec
100	0.20	0.00						6.0
125	0.26	0.01						7.5
150	0.31	0.01						9.0
175	0.36	0.01						10.5
200	0.41	0.02						12.0
225	0.46	0.02	0.23	0.00				13.5
250	0.51	0.03	0.26	0.01				15.0
275	0.56	0.03	0.29	0.01				16.5
300	0.61	0.04	0.31	0.01				18.0
325	0.67	0.04	0.34	0.01				19.5
350	0.72	0.05	0.36	0.01				21.0
375	0.77	0.06	0.39	0.01				22.5
400	0.82	0.06	0.42	0.01				24.0
475	0.97	0.09	0.49	0.02				28.5
500	1.02	0.10	0.52	0.02				30.0
550	1.13	0.11	0.57	0.02				33.0
600	1.23	0.13	0.62	0.03				36.0
650	1.33	0.16	0.68	0.03	0.31	0.00		39.0
700	1.43	0.18	0.73	0.03	0.33	0.01		42.0
750	1.54	0.20	0.78	0.04	0.36	0.01		45.0
800	1.64	0.23	0.83	0.04	0.39	0.01		48.0
900	1.84	0.28	0.94	0.05	0.41	0.01		54.0
1000	2.05	0.34	1.04	0.07	0.46	0.01		60.0
1100	2.25	0.41	1.14	0.08	0.51	0.01		66.0
1200	2.46	0.48	1.25	0.09	0.57	0.01		72.0
1400	2.87	0.64	1.46	0.12	0.62	0.02		84.0
1600	3.28	0.82	1.67	0.16	0.67	0.02	0.37	96.0
1800	3.69	1.02	1.87	0.20	0.72	0.02	0.42	108.0
2000	4.10	1.24	2.08	0.24	0.75	0.02	0.50	120.0
2200	4.51	1.48	2.29	0.29	0.83	0.03	0.52	132.0
2400	4.92	1.74	2.50	0.34	0.91	0.03	0.58	144.0
2600	5.33	2.02	2.71	0.39	1.00	0.04	0.63	156
2800	5.74	2.32	2.91	0.45	1.08	0.04	0.68	168
3000			3.12	0.51	1.16	0.05	0.73	180
3200			3.33	0.57	1.25	0.05	0.79	192
3500			3.64	0.67	1.33	0.06	0.84	210
4000			4.16	0.86	1.45	0.07	0.92	240
4500			4.68	1.07	1.66	0.08	1.05	270
5000			5.20	1.31	1.82	0.10	1.18	300
5500			5.72	1.56	2.08	0.14	1.31	330
6000				3.08	2.29	0.17	1.44	360
6500				3.34	2.49	0.20	1.57	390
7000				3.60	2.70	0.23	1.70	420
7500				3.85	2.91	0.26	1.83	450
8000				4.11	3.12	0.30	1.96	480
8500				4.37	3.33	0.33	2.09	510
9000				4.62	3.53	0.37	2.23	540
9500				4.88	3.74	0.42	2.36	570
10000				5.14	3.95	0.46	2.49	600
10500				5.40	4.16	0.51	2.62	630
11000				5.65	4.36	0.55	2.75	660
12000					4.57	0.60	2.88	720
13000					4.99	0.71	3.14	780
14000					5.40	0.82	3.40	840
15000					5.82	0.94	3.67	900
16000							3.93	960
17000							4.19	1020
18000							4.45	1080
19000							4.71	1140
20000							4.98	1200
21000							5.24	1260
22000							5.50	1320
24000							5.76	1440
26000								1560
28000								1680
30000								1800
32000								1920
34000								2040
36000								2160
38000								2280

Shaded area represents
velocities over 1.5 mps.
Use with caution where
water hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 15 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 15 mm THRU 65 mm

Nominal Size Pipe ID Pipe OD Wall Thick	15 mm 18.3 21.3 1.5	20 mm 22.9 26.7 1.9	25 mm 28.9 33.5 2.3	32 mm 36.4 42.2 2.9	40 mm 41.6 48.2 3.3	50 mm 52.1 60.3 4.1	Nominal Size Pipe ID Pipe OD Wall Thick
Flow L/min	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Velocity MPS	Flow Cu. M/Hr
	Bars/ 100 M LOSS	Bars/ 100 M LOSS	Bars/ 100 M LOSS	Bars/ 100 M LOSS	Bars/ 100 M LOSS	Bars/ 100 M LOSS	L/sec
1	0.06	0.00					0.06
2	0.13	0.01					0.12
3	0.19	0.03					0.18
4	0.25	0.05	0.08	0.00			0.24
5	0.32	0.08	0.13	0.01			0.30
6	0.38	0.11	0.15	0.01			0.36
7	0.44	0.15	0.18	0.02			0.42
8	0.51	0.19	0.20	0.02			0.48
9	0.57	0.24	0.23	0.03	0.11	0.00	0.54
10	0.63	0.29	0.25	0.03	0.12	0.01	0.60
12	0.76	0.40	0.30	0.04	0.15	0.01	0.72
14	0.89	0.53	0.35	0.06	0.17	0.01	0.84
16	1.01	0.68	0.40	0.07	0.20	0.01	0.96
18	1.14	0.85	0.45	0.09	0.22	0.02	1.08
20	1.27	1.04	0.50	0.11	0.24	0.02	1.20
22	1.39	1.23	0.55	0.13	0.27	0.02	1.32
24	1.52	1.45	0.60	0.15	0.29	0.03	1.44
26	1.65	1.68	0.66	0.18	0.32	0.03	1.56
28	1.77	1.93	0.71	0.21	0.34	0.04	1.68
30	1.90	2.19	0.76	0.23	0.37	0.04	1.80
32	2.03	2.47	0.81	0.26	0.39	0.05	1.92
34	2.15	2.77	0.86	0.29	0.42	0.05	2.04
36	2.28	3.07	0.91	0.33	0.44	0.06	2.16
38	2.41	3.40	0.96	0.36	0.47	0.06	2.28
40	2.53	3.74	1.01	0.40	0.49	0.07	2.40
42	2.66	4.09	1.06	0.44	0.51	0.08	2.52
44	2.78	4.46	1.11	0.47	0.54	0.08	2.64
46	2.91	4.84	1.16	0.52	0.56	0.09	2.76
48	3.04	5.24	1.21	0.56	0.59	0.10	2.88
50	3.16	5.65	1.26	0.60	0.61	0.10	3.00
55	3.48	6.74	1.39	0.72	0.67	0.12	3.30
60	3.80	7.92	1.51	0.84	0.73	0.15	3.60
65	4.11	9.18	1.64	0.98	0.80	0.17	3.90
70	4.43	10.53	1.76	1.12	0.86	0.19	4.20
75	4.75	11.97	1.89	1.27	0.92	0.22	4.50
80	5.06	13.49	2.02	1.44	0.98	0.25	4.80
85	5.38	15.09	2.14	1.61	1.04	0.28	5.10
90	5.70	16.78	2.27	1.79	1.10	0.31	5.40
95			2.39	1.97	1.16	0.34	5.70
100			2.52	2.17	1.22	0.38	6.00
110			2.77	2.59	1.35	0.45	6.60
120			3.02	3.04	1.47	0.53	7.20
130			3.28	3.53	1.59	0.61	7.80
140			3.53	4.05	1.71	0.70	8.40
150			3.78	4.60	1.84	0.79	9.00
175			4.41	6.12	2.14	1.06	10.5
200			5.04	7.84	2.45	1.35	12.0
225			5.67	9.74	2.76	1.68	13.5
250					3.06	2.05	15.0
275					3.37	2.44	16.5
300					3.67	2.87	18.0
325					3.98	3.33	19.5
350					4.29	3.82	21.0
375					4.59	4.34	22.5
400					4.90	4.89	24.0
450					5.51	6.08	27.0
500							30.0
550							33.0
600							36.0
650							39.0
700							42.0
750							45.0
800							48.0
900							54.0
1000							60.0
1100							66.0
1200							72.0
1300							78.0
1400							84.0
1500							90.0

Shaded area represents
velocities over 1.5 mps.
Use with caution where
water hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Australian Standard PVC PN 15 Plastic Pipe

C = 150

PRESSURE LOSS IN BARS PER 100 METRES

SIZES 80 mm THRU 300 mm

Nominal Size	80 mm		100 mm		150 mm		200 mm		250 mm		300 mm		Nominal Size	
Pipe ID	76.7		98.9		138.7		198.0		246.4		277.3		Pipe ID	
Pipe OD	88.9		114.3		160.3		225.3		280.4		315.5		Pipe OD	
Wall Thick	6.1		7.7		10.8		13.7		17.0		19.1		Wall Thick	
Flow L/min	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Velocity MPS	Bars/ 100 M LOSS	Flow Cu. M/Hr	L/sec
100	0.36	0.02	0.22	0.01									6.0	1.67
125	0.45	0.03	0.27	0.01									7.5	2.08
150	0.54	0.04	0.33	0.01									9.0	2.50
175	0.63	0.05	0.38	0.02									10.5	2.92
200	0.72	0.07	0.43	0.02									12.0	3.33
225	0.81	0.09	0.49	0.03	0.25	0.00							13.5	3.75
250	0.90	0.10	0.54	0.03	0.28	0.01							15.0	4.17
275	0.99	0.12	0.60	0.04	0.30	0.01							16.5	4.58
300	1.08	0.15	0.65	0.04	0.33	0.01							18.0	5.00
325	1.17	0.17	0.71	0.05	0.36	0.01							19.5	5.42
350	1.26	0.19	0.76	0.06	0.39	0.01							21.0	5.83
375	1.35	0.22	0.81	0.06	0.41	0.01							22.5	6.25
400	1.44	0.25	0.87	0.07	0.44	0.01							24.0	6.67
475	1.71	0.34	1.03	0.10	0.52	0.02							28.5	7.92
500	1.80	0.38	1.09	0.11	0.55	0.02							30.0	8.33
550	1.98	0.45	1.19	0.13	0.61	0.03	0.30	0.00					33.0	9.17
600	2.16	0.53	1.30	0.15	0.66	0.03	0.32	0.01					36.0	10.0
650	2.34	0.61	1.41	0.18	0.72	0.03	0.35	0.01					39.0	10.8
700	2.52	0.70	1.52	0.20	0.77	0.04	0.38	0.01					42.0	11.7
750	2.70	0.80	1.63	0.23	0.83	0.04	0.41	0.01					45.0	12.5
800	2.88	0.90	1.74	0.26	0.88	0.05	0.43	0.01					48.0	13.3
850	3.06	1.01	1.85	0.29	0.94	0.06	0.46	0.01					51.0	14.2
900	3.24	1.12	1.95	0.33	0.99	0.06	0.49	0.01					54.0	15.0
950	3.42	1.24	2.06	0.36	1.05	0.07	0.51	0.01					57.0	15.8
1000	3.60	1.36	2.17	0.40	1.10	0.08	0.54	0.01	0.35	0.00			60.0	16.7
1100	3.96	1.62	2.39	0.47	1.21	0.09	0.59	0.02	0.38	0.01			66.0	18.3
1200	4.32	1.90	2.61	0.56	1.32	0.11	0.65	0.02	0.42	0.01			72.0	20.0
1300	4.68	2.21	2.82	0.64	1.43	0.12	0.70	0.02	0.45	0.01			78.0	21.7
1400	5.04	2.53	3.04	0.74	1.54	0.14	0.76	0.03	0.49	0.01	0.39	0.00	84.0	23.3
1500	5.40	2.88	3.26	0.84	1.65	0.16	0.81	0.03	0.52	0.01	0.41	0.01	90.0	25.0
1600	5.76	3.24	3.47	0.95	1.76	0.18	0.87	0.03	0.56	0.01	0.44	0.01	96.0	26.7
1700			3.69	1.06	1.87	0.20	0.92	0.04	0.59	0.01	0.47	0.01	102	28.3
1800			3.91	1.18	1.98	0.23	0.97	0.04	0.63	0.01	0.50	0.01	108	30.0
1900			4.13	1.30	2.09	0.25	1.03	0.04	0.66	0.02	0.52	0.01	114	31.7
2000			4.34	1.43	2.20	0.27	1.08	0.05	0.70	0.02	0.55	0.01	120	33.3
2200			4.78	1.71	2.42	0.33	1.19	0.06	0.77	0.02	0.61	0.01	132	36.7
2400			5.21	2.01	2.64	0.38	1.30	0.07	0.84	0.02	0.66	0.01	144	40.0
2600			5.65	2.33	2.86	0.45	1.41	0.08	0.91	0.03	0.72	0.02	156	43.3
2800					3.08	0.51	1.51	0.09	0.98	0.03	0.77	0.02	168	46.7
3000					3.31	0.58	1.62	0.10	1.05	0.04	0.83	0.02	180	50.0
3200					3.53	0.66	1.73	0.12	1.12	0.04	0.88	0.02	192	53.3
3400					3.75	0.73	1.84	0.13	1.19	0.04	0.94	0.03	204	56.7
3600					3.97	0.82	1.95	0.14	1.26	0.05	0.99	0.03	216	60.0
3800					4.19	0.90	2.05	0.16	1.33	0.06	1.05	0.03	228	63.3
4000					4.41	0.99	2.16	0.18	1.40	0.06	1.10	0.03	240	66.7
4500					4.96	1.23	2.43	0.22	1.57	0.08	1.24	0.04	270	75.0
5000					5.51	1.50	2.70	0.27	1.75	0.09	1.38	0.05	300	83.3
5500							2.97	0.32	1.92	0.11	1.52	0.06	330	91.7
6000							3.24	0.37	2.09	0.13	1.65	0.07	360	100.0
6500							3.51	0.43	2.27	0.15	1.79	0.08	390	108.3
7000							3.78	0.49	2.44	0.17	1.93	0.10	420	116.7
7500							4.05	0.56	2.62	0.19	2.07	0.11	450	125.0
8000							4.33	0.63	2.79	0.22	2.21	0.12	480	133.3
8500							4.60	0.71	2.97	0.24	2.34	0.14	510	141.7
9000							4.87	0.79	3.14	0.27	2.48	0.15	540	150.0
9500							5.14	0.87	3.32	0.30	2.62	0.17	570	158.3
10000							5.41	0.96	3.49	0.33	2.76	0.19	600	166.7
10500							5.68	1.05	3.67	0.36	2.89	0.20	630	175.0
11000							5.95	1.14	3.84	0.39	3.03	0.22	660	183.3
11500									4.01	0.43	3.17	0.24	690	191.7
12000			Shaded area represents velocities over 1.5 mps. Use with caution where water hammer is a concern.						4.19	0.46	3.31	0.26	720	200.0
13000									4.54	0.54	3.58	0.30	780	216.7
14000									4.89	0.62	3.86	0.35	840	233.3
15000									5.24	0.70	4.13	0.39	900	250.0
16000									5.59	0.79	4.41	0.44	960	266.7
17000									5.93	0.88	4.69	0.50	1020	283.3
18000											4.96	0.55	1080	300.0
19000											5.24	0.61	1140	316.7
20000											5.51	0.67	1200	333.3
21000											5.79	0.73	1260	350.0

Shaded area represents
velocities over 1.5 mps.
Use with caution where water
hammer is a concern.

Conversions:
Bars/100 M x 100 = kPa/100 M
Bars/100 M x 10.21 = Metres/100 M
Bars/100 M x 4.42 = psi/100 ft.

Pressure Loss Through Water Meters

PRESSURE LOSS: (psi)

FLOW GPM	5/8"	3/4"	NORMAL SIZE					FLOW GPM
			1"	1 1/2"	2"	3"	4"	
1	0.2	0.1						1
2	0.3	0.2						2
3	0.4	0.3						3
4	0.6	0.5	0.1					4
5	0.9	0.6	0.2					5
6	1.3	0.7	0.3					6
7	1.8	0.8	0.4					7
8	2.3	1.0	0.5					8
9	3.0	1.3	0.6					9
10	3.7	1.6	0.7					10
11	4.4	1.9	0.8					11
12	5.1	2.2	0.9					12
13	6.1	2.6	1.0					13
14	7.2	3.1	1.1					14
15	8.3	3.6	1.2					15
16	9.4	4.1	1.4	0.4				16
17	10.7	4.6	1.6	0.5				17
18	12.0	5.2	1.8	0.6				18
19	13.4	5.8	2.0	0.7				19
20	15.0	6.5	2.2	0.8				20
22		7.9	2.8	1.0				22
24		9.5	3.4	1.2				24
26		11.2	4.0	1.4				26
28		13.0	4.6	1.6				28
30		15.0	5.3	1.8				30
32			6.0	2.1	0.8			32
34			6.9	2.4	0.9			34
36			7.8	2.7	1.0			36
38			8.7	3.0	1.2			38
40			9.6	3.3	1.3			40
42			10.6	3.6	1.4			42
44			11.7	3.9	1.5			44
46			12.8	4.2	1.6			46
48			13.9	4.5	1.7			48
50			15.0	4.9	1.9			50
52				5.3	2.1			52
54				5.7	2.2			54
56				6.2	2.3			56
58				6.7	2.5			58
60				7.2	2.7	1.0		60
65				8.3	3.2	1.1		65
70				9.8	3.7	1.3		70
75				11.3	4.3	1.5		75
80				12.8	4.9	1.6	0.7	80
90				16.1	6.2	2.0	0.8	90
100				20.0	7.8	2.5	0.9	100
110					9.5	2.9	1.0	110
120					11.3	3.4	1.2	120
130					13.0	2.9	1.4	130
140					15.1	4.5	1.6	140
150					17.3	5.1	1.8	150
160					20.0	5.8	2.1	160
170						6.5	2.4	170
180						7.2	2.7	180
190						8.0	3.0	190
200						9.0	3.2	200
220						11.0	3.9	220
240						13.0	4.7	240
260						15.0	5.5	260
280						17.3	6.3	280
300						20.0	7.2	300
350							10.0	300
400							13.0	400
450							16.2	450
500							20.0	500

Note: The greatest pressure loss reflects the maximum safe capacity for the meter.

Pressure Loss Through Water Meters

PRESSURE LOSS IN KILOPASCALS: (kPa)

FLOW L/min	METER SIZE				FLOW L/min
	15mm	20mm	25mm	40mm	
3.8	1.38	0.69			3.8
7.6	2.07	1.38			7.6
11.4	2.76	2.07			11.4
15.1	4.14	3.45	0.69		15.1
19.0	6.21	4.14	1.38		19.0
22.7	8.96	4.83	2.07		22.7
26.5	12.41	5.52	2.76		26.5
30.3	15.86	6.90	3.45		30.3
34.1	20.69	8.96	4.14		34.1
37.8	25.51	11.03	4.83		37.8
41.6	30.34	13.10	5.52		41.6
45.4	35.16	15.17	6.21		45.4
49.2	42.06	17.93	6.90		49.2
53.0	49.64	21.37	7.58		53.0
56.8	57.23	24.82	8.27		56.8
60.6	64.81	28.27	9.65	2.76	60.6
64.4	73.78	31.72	11.03	3.45	64.4
68.1	82.74	35.85	12.41	4.14	68.1
72.0	92.39	39.99	13.79	4.83	72.0
75.7	103.43	44.82	15.17	5.52	75.7
83.3		54.47	19.31	6.90	83.3
90.8		65.50	23.44	8.27	90.8
98.4		77.22	27.58	9.65	98.4
106.0		89.64	31.72	11.03	106.0
113.6		103.43	36.54	12.41	113.6
121.1			41.37	14.48	121.1
128.7			47.58	16.55	128.7
136.3			53.78	18.62	136.3
143.8			59.99	20.69	143.8
151.4			66.19	22.75	151.4
159.0			73.09	24.82	159.0
166.5			80.67	26.89	166.5
174.1			88.26	28.96	174.1
181.7			95.84	31.03	181.7
189.3			103.43	33.79	189.3
196.8				36.54	196.8
204.4				39.30	204.4
212.0				42.75	212.0
219.5				46.20	219.5
227.1				49.64	227.1
246.0				57.23	246.0
265.0				67.57	265.0
283.9				77.91	283.9
302.8				88.26	302.8

Note: The greatest pressure loss reflects the maximum safe capacity for the meter.

Loss of Pressure Due to Friction in Ordinary Rubber Hose

LOSS IN POUNDS PER SQ. INCH (PSI) PER 100 FEET OF LENGTH
SIZES ½" THRU 5"

Flow of Water in U.S. Gal. per Minute	½"	⅝"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	5"
0.5	0.40										
1.5	3.02	1.01	0.42								
2.5	7.75	2.58	1.08								
5	27.80	9.27	3.86	0.95	0.32	0.13					
10	99.50	33.20	13.80	3.38	1.14	0.47					
15		71.00	29.60	7.25	2.45	1.01	0.25	0.08			
20		121.00	50.30	12.40	4.15	1.71	0.42	.014			
25			76.50	18.70	6.34	2.60	0.64	0.22			
30			108.00	26.50	8.96	3.68	0.90	0.30	0.13		
35			142.00	34.80	11.80	4.83	1.18	0.40	0.17		
40				44.70	15.10	6.20	1.52	0.51	0.21		
45				55.00	18.60	7.65	1.87	0.63	0.26		
50				67.50	22.80	9.35	2.28	0.78	0.32		
60				94.30	31.80	13.10	3.19	1.08	0.45		
70				126.00	42.50	17.50	4.25	1.44	0.60		
80					54.60	22.50	5.48	1.86	0.77		
90					67.50	27.80	6.80	2.30	0.95	0.23	
100					81.50	33.50	8.19	2.78	1.15	0.28	
125					124.00	50/60	12.40	4.20	1.73	0.43	
150						72.10	17.60	5.97	2.46	0.60	0.20
175						94.50	23.10	7.83	3.23	0.79	0.27
200						122.00	29.60	10.10	4.15	1.02	0.34
225							36.80	12.50	5.15	1.26	0.43
250							44.60	15.20	6.25	1.53	0.52
275							55.30	18.10	7.45	1.83	0.62
300							62.50	21.20	8.75	2.15	0.73

Roughness Coefficient C Values for Hazen-Williams Equation

Values of C Type Of Pipe	Range	New Pipe	Design C
PVC	160 - 145	150	150
Polyethylene	150 - 130	140	140
Asbestos-Cement	160 - 140	150	140
Cement-Lined Steel	160 - 140	150	140
Welded Steel	150 - 80	140	100
Riveted Steel	140 - 90	110	100
Concrete	150 - 85	120	100
Wrought or Cast Iron	150 - 80	130	100
Copper, Brass	150 - 120	140	130
Wood Stave	145 - 110	120	110
Vitrified Clay		110	100
Corrugated Steel		60	60

Above values of C for use with Hazen-Williams Equation, friction head losses in psi per foot of pipe length for fresh water at 60 degrees Fahrenheit.

$$H_f = 0.00090194 \left(\frac{100}{C} \right)^{1.852} \frac{Q^{1.852}}{d^{4.866}} L$$

Where:

- H_f = head loss due to friction in pounds per square inch (psi)
- C = Hazen Williams coefficient for roughness of the inside of the pipe
- Q = flow in gallons per minute (gpm)
- d = inside diameter of pipe in inches
- L = length of pipe in feet

Reference Tables of Selected Data

Head Losses Through Standard Foot Valves

Nominal Pipe Size: Inches

Head Loss Ft H ₂ O F _f H ₂	1.50	2.00	2.50	3.00	4.00	6.00	8.00	10.00	12.00
Flow: gpm									
1	39	66	96	152	268	632	1122	1805	2603
2	57	97	140	221	390	919	1632	2625	3786
3	71	120	175	275	486	1145	2032	3269	4713
4	83	141	204	322	568	1337	2374	3819	5507
5	94	159	230	363	641	1509	2678	4308	6213
6	104	175	254	401	707	1665	2956	4755	6836
7	113	190	276	435	769	1810	3212	5168	7452
8	121	205	297	468	826	1945	3453	5555	8010
9	129	218	317	499	880	2073	3680	5920	8636
10	137	231	335	528	932	2195	3896	6267	9037

Table of Approximate Pressure Losses for Pipe Fittings

Listed in Equivalent Feet of Pipe

Steel Fitting Type	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
Coupling	0.6	0.8	1.0	1.2	1.5	2.0	2.5	3.0	4.0	6.0	8.0
Run of St. Tee	1.0	1.0	1.5	2.0	2.0	2.5	3.0	4.0	5.0	7.0	10.0
Tee, Side Outlet	3.0	4.5	5.0	7.0	9.0	11.0	13.0	16.0	20.0	31.0	42.0
Tee, Run Reduced ½"	1.5	2.5	3.0	4.0	5.0	6.0	7.0	8.0	12.0	16.0	20.0
Elbow, 90°	1.5	2.5	3.0	4.0	5.0	6.0	7.0	8.0	12.0	16.0	20.0
Elbow, 45°	0.75	1.0	1.3	1.7	2.0	2.5	3.0	3.5	5.0	7.5	10.0
Corporation Stop	9.0	9.0	9.0	9.0	9.0	9.0					
Curb Stop	6.0	6.0	7.0	7.0	8.0	8.0					
Plastic IPS or Copper Fitting Type	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
Coupling	1.5	2.5	3.0	3.0	4.0	6.0	7.0	8.0	11.0	18.0	24.0
Run of St. Tee	2.5	3.0	4.0	5.0	6.0	8.0	9.0	11.0	15.0	21.0	28.0
Tee, Side Outlet	7.0	9.0	12.0	15.0	18.0	24.0	30.0	36.0	45.0	70.0	90.0
Tee, Run Reduced ½"	3.5	4.5	6.0	8.0	9.0	11.0	14.0	17.0	24.0	34.0	45.0
Elbow, 90°	3.5	4.5	6.0	8.0	9.0	11.0	14.0	17.0	24.0	34.0	45.0
Elbow, 34°	1.5	2.0	3.0	3.5	4.0	5.0	7.0	8.0	10.0	16.0	20.0

TABLE OF APPROXIMATE PRESSURE LOSS

To use this chart, multiply the approximate “equivalent feet of pipe” value by the proper pipe pressure loss per 100 feet rating, then divide by 100. The result is the fitting loss in psi.

Note: It is recommended that the above chart be used only when the manufacturers recommended pressure loss values are not available.

Pressure Loss Through Swing Check Valves

Pressure Loss (PSI)

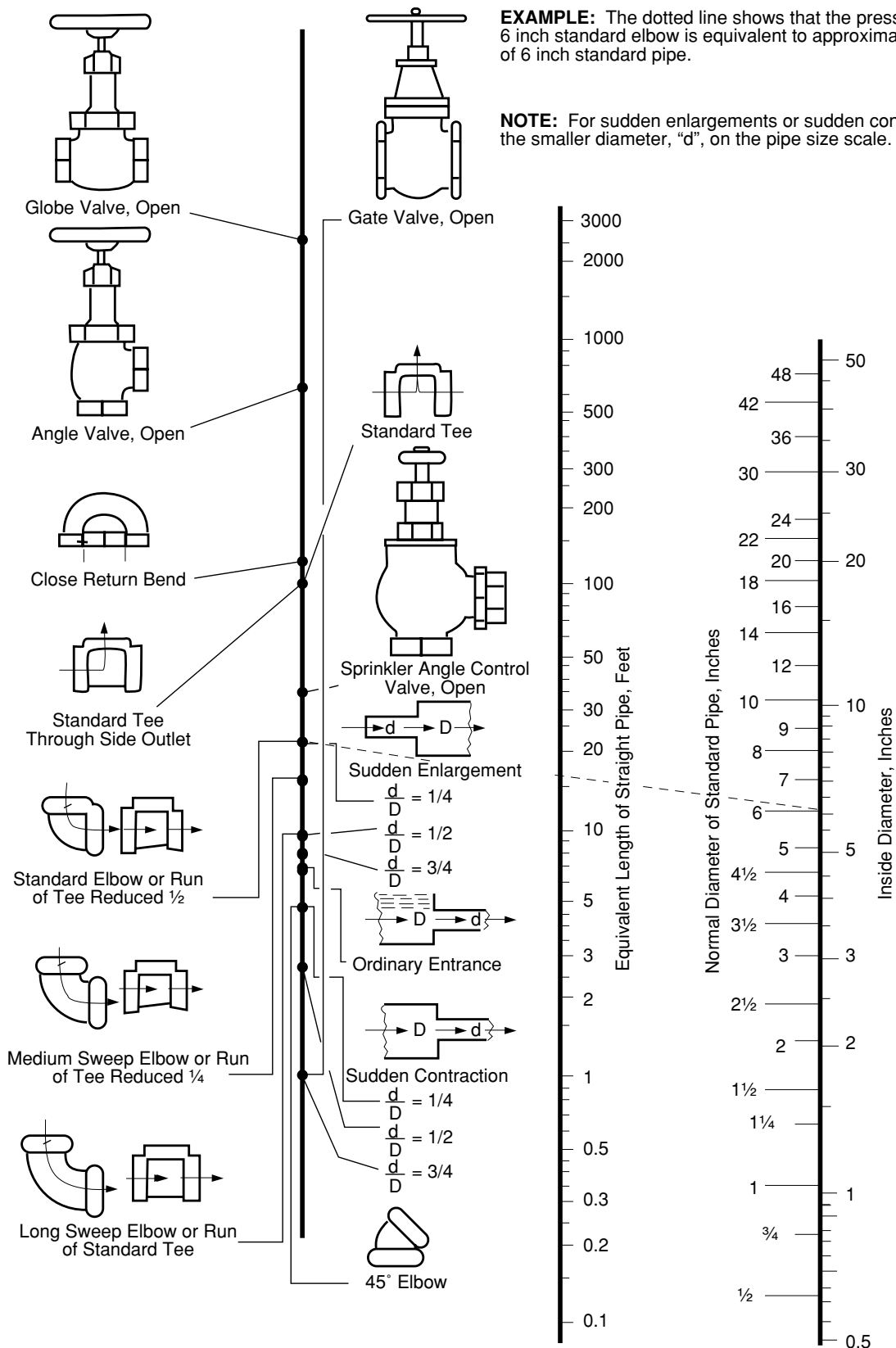
FLOW GPM	Valve Size						FLOW GPM	Valve Size					
	½"	¾"	1"	1¼"	1½"	2"		1¼"	½"	2"	¾"	3"	4"
2	0.2						46	2.1	1.1	0.4			
3	0.5						48	2.2	1.2	0.5			
6	1.0	0.3					50	2.4	1.3	0.5			
8	1.7	0.5					55	2.9	1.5	0.6			
10	2.6	0.8	0.3				60	3.4	1.8	0.7			
12	3.6	1.1	0.5				65	3.9	2.0	0.8			
14	4.8	1.5	0.6				70	4.5	2.4	0.9	0.4		
16		2.0	0.9				75		2.7	1.0	0.5		
18		2.4	1.0				80		3.0	1.2	0.6		
20		3.0	1.2	0.4			90		3.7	1.5	0.7		
22		3.5	1.4	0.5			100		4.6	1.8	0.9	0.4	
24		4.1	1.7	0.6			120			2.5	1.2	0.5	
26		4.8	2.0	0.7	0.4		140			3.3	1.6	0.7	
28			2.2	0.8	0.5		160			4.3	2.1	0.9	0.3
30			2.5	0.9	0.5		180			5.3	2.6	1.1	0.4
32			2.9	1.1	0.6		200			6.5	3.1	1.4	0.5
34			3.2	1.2	0.6		250				4.7	2.1	0.7
36			3.6	1.3	0.7		300				6.6	2.9	1.0
38			3.9	1.5	0.8		350					3.8	1.3
40			4.3	1.6	0.8	0.3	400					4.9	1.7
42			4.7	1.7	0.9	0.3	450						2.1
44				1.9	1.0	0.4	500						2.6

Pressure Losses Through Copper and Bronze Fittings

Equivalent Feet of Straight Tubing

Nominal Tube Size	Wrought Copper					Cast Bronze					
	90° Elbow	45° Elbow	Tee Run	Tee Side Outlet	90° Bend	180° Bend	90° Elbow	45° Elbow	Tee Run	Tee Side Outlet	Compression Stop
⅜	0.5	0.5	0.5	1	0.5	½	1	0.5	0.5	2	9
½	0.5	0.5	0.5	1	0.5	1	1	1	0.5	2	13
⅝	0.5	0.5	0.5	2	1	1	2	1	0.5	3	17
¾	1	0.5	0.5	2	1	2	2	1	0.5	3	21
1	1	1	0.5	3	2	2	4	2	0.5	5	30
1¼	2	1	0.5	4	2	3	5	2	1	7	-
1½	2	2	1	5	2	4	8	3	1	9	-
2	2	2	1	7	3	8	11	5	2	12	-
2½	2	3	2	9	4	16	14	8	2	16	-
3	3	4	-	-	5	20	18	11	2	20	-
3½	4	-	-	-	7	24	24	14	2	31	-
4	-	-	-	-	8	28	28	17	2	37	-
5	-	-	-	-	10	37	41	22	2	48	-
6	-	-	-	-	13	47	52	28	2	61	-

Pressure Losses in Valves and Fittings





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