SIMPLIFIED
HAZEN-WILLIAMS FORMULA FACTORS

HAZEN-WILLIAMS FORMULA:

$$P = (4.52)(Q)^{1.85}/(C)^{1.85}(d)^{4.87}$$

Where:

P = Pressure loss (psi/foot)
Q = Flow rate (gpm)
C = Pipe Roughness Coefficient
d = Pipe Interior Diameter (inches)

For a given pipe length in a specific system, the values of the "C" factor and the diameter are known and the numeric value of $C^{1.85}$ and $d^{4.87}$ can be calculated. Hence, the Hazen-Williams formula can be simplified to the following:

$$P = (Factor)\ X\ Q^{1.85}$$

$$Factor = 4.52/(C)^{1.85}(d)^{4.87}$$

The factors for Schedule 10 and Schedule 40 steel pipe used in the simplified Hazen-Williams formula are on the following pages. The factors shown are in what is referred to as "scientific notation". Scientific notation is used to avoid errors in entering numbers.

The following are examples of scientific notation:

$$3{,}240{,}000 = 3.24\ X\ 10^{6}$$

$$0.000453 = 4.53\ X\ 10^{-4}$$

Note 1: 10^{6} is equal to 1,000,000.

Note 2: 10^{-4} is equal to 0.0001

The number $3.24\ X\ 10^{6}$ is entered into a hand-held calculator as follows:

3.24 EXP (or EE) 6

The number $4.53\ X\ 10^{-4}$ is entered in a hand-held calculator as follows:

4.53 EXP (or EE) +/- 4

Example #1:

Calculate the friction loss in a 12 foot length of 1-1/2 inch Schedule 10 steel pipe in a wet system with 80 gpm flowing through the pipe.

$P = (Factor) \times Q^{1.85}$

Factor for 1-1/2 Pipe = $5.12 \times (10)^{-5}$

$P = [5.12 \times (10)^{-5}] \times (80\ GPM)^{1.85}$

$P = [5.12 \times (10)^{-5}] \times 3316.78$

P = 0.17 PSI/FT

Friction Loss = 0.17 psi/Ft X 12 Ft = **2.04 psi**

Example #2:

Calculate the friction loss in a 12 foot length of 1-1/2 inch Schedule 40 steel pipe in a wet system with 80 gpm flowing through the pipe.

$P = (Factor) \times Q^{1.85}$

Factor for 1-1/2 Pipe = $6.33 \times (10)^{-5}$

$P = [6.33 \times (10)^{-5}] \times (80\ GPM)^{1.85}$

$P = [6.33 \times (10)^{-5}] \times 3316.78$

P = 0.21 PSI/FT

Friction Loss = 0.21 psi/Ft X 12 Ft = **2.52 psi**

Example #3:

420 gpm flows through a portion of a 4 inch cross main in a wet system. The length of this portion of the cross main is 82 feet and the main is Schedule 10 steel piping. What is the friction loss in this length of the cross main?

$P = (\text{Factor}) \times Q^{1.85}$

Factor for 4 inch pipe = $5.54 \times (10)^{-7}$

$P = [5.54 \times (10)^{-7}] \times (420 \text{ gpm})^{1.85}$

$P = [5.54 \times (10)^{-7}] \times 71{,}287.14$

$P = 0.039$ PSI/FT

Friction Loss = 0.039 psi/Ft X 82 Ft = **3.20 psi**

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Schedule 40 Steel Pipe, C = 120 (Wet Systems)		
Pipe Size	**Inside Diameter (I.D.)**	**Factor**
1	1.049	$5.10 \times (10)^{-4}$
1-1/4	1.380	$1.34 \times (10)^{-4}$
1-1/2	1.610	$6.33 \times (10)^{-5}$
2	2.067	$1.87 \times (10)^{-5}$
2-1/2	2.469	$7.89 \times (10)^{-6}$
3	3.068	$2.74 \times (10)^{-6}$
3-1/2	3.548	$1.35 \times (10)^{-6}$
4	4.026	$7.29 \times (10)^{-7}$
5	5.047	$2.43 \times (10)^{-7}$
6	6.065	$9.91 \times (10)^{-8}$

Schedule 10 Steel Pipe, C = 120 (Wet Systems)		
Pipe Size	**Inside Diameter (I.D.)**	**Factor**
1	1.097	$4.10 \times (10)^{-4}$
1-1/4	1.442	$1.08 \times (10)^{-4}$
1-1/2	1.682	$5.12 \times (10)^{-5}$
2	2.157	$1.52 \times (10)^{-5}$
2-1/2	2.635	$5.75 \times (10)^{-6}$
3	3.260	$2.04 \times (10)^{-6}$
3-1/2	3.760	$1.02 \times (10)^{-6}$
4	4.260	$5.54 \times (10)^{-7}$
5	5.295	$1.92 \times (10)^{-7}$

Schedule 40 Steel Pipe, C = 100 (Dry Systems)		
Pipe Size	**Inside Diameter (I.D.)**	**Factor**
1	1.049	$7.14 \times (10)^{-4}$
1-1/4	1.380	$1.88 \times (10)^{-4}$
1-1/2	1.610	$8.87 \times (10)^{-5}$
2	2.067	$2.63 \times (10)^{-5}$
2-1/2	2.469	$1.11 \times (10)^{-5}$
3	3.068	$3.84 \times (10)^{-6}$
3-1/2	3.548	$1.89 \times (10)^{-6}$
4	4.026	$1.02 \times (10)^{-6}$
5	5.047	$3.40 \times (10)^{-7}$
6	6.065	$1.39 \times (10)^{-7}$

Schedule 10 Steel Pipe, C = 100 (Dry Systems)		
Pipe Size	**Inside Diameter (I.D.)**	**Factor**
1	1.097	$5.75 \times (10)^{-4}$
1-1/4	1.442	$1.52 \times (10)^{-4}$
1-1/2	1.682	$7.17 \times (10)^{-5}$
2	2.157	$2.13 \times (10)^{-5}$
2-1/2	2.635	$8.05 \times (10)^{-6}$
3	3.260	$2.86 \times (10)^{-6}$
3-1/2	3.760	$1.43 \times (10)^{-6}$
4	4.260	$7.76 \times (10)^{-7}$
5	5.295	$2.69 \times (10)^{-7}$

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