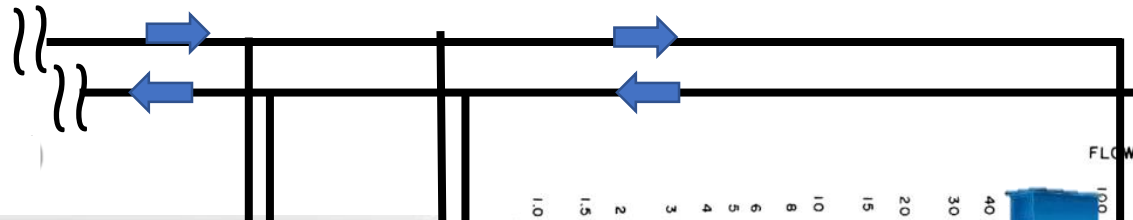


# HVAC Chilled Water Pipe Size Calculations



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

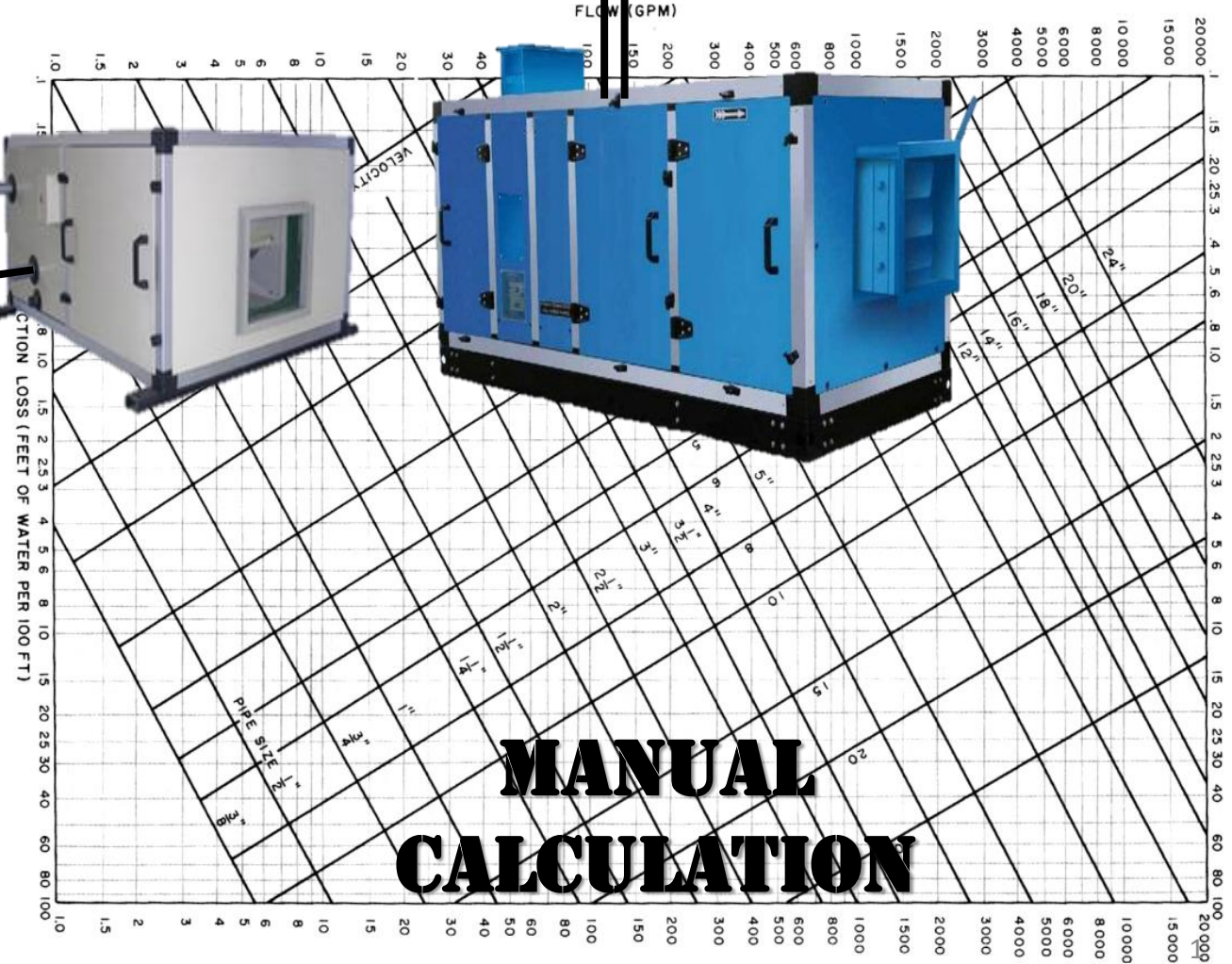
1.4

Outside Diameter	0.84 in	Fluid density	62.4 lb/ft <sup>3</sup>
Wall Thickness	0.109 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	0.622 in	Specific Heat	1.002 Btu/lb°F
Inside Area	0.304 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	0.2502 in <sup>2</sup>	Fluid velocity	1.48 ft/s
Section Modulus	0.04071 in <sup>3</sup>	Reynolds Number	5,436
Moment of Inertia	0.0171 in <sup>4</sup>	Friction factor	0.03972
Radius Gyration	0.2613 in	Head Loss	2.602 ft/100 ft
Weight of Pipe	0.851 lb/ft	Elbow loss	0.068 ft
Weight Pipe + Fluid	0.983 lb/ft		

**SOFTWARE CALCULATION**

**McQuay**  
Air Conditioning

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**MANUAL CALCULATION**

CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS  
Schedule 40 Pipe

# Chilled Water Flow Formula in Round Steel Pipe

$$\text{Flow (GPM)} = \frac{\text{Tr} \times 24}{\Delta T}$$

Suppose;

Tr = Tonnage = 1

$\Delta T$  = Temp Diff =  $55^{\circ}\text{F} - 45^{\circ}\text{F} = 10^{\circ}\text{F}$

$$\text{Flow} = \frac{1 \times 24}{10} = 2.4 \text{ gpm, (1ton} = 2.4\text{gpm)}$$

$$\text{Flow} = \frac{2 \times 24}{10} = 4.8 \text{ gpm, (2ton} = 4.8\text{gpm)}$$

$$\text{Flow} = \frac{3 \times 24}{10} = 7.2 \text{ gpm, (3ton} = 7.2\text{gpm)}$$

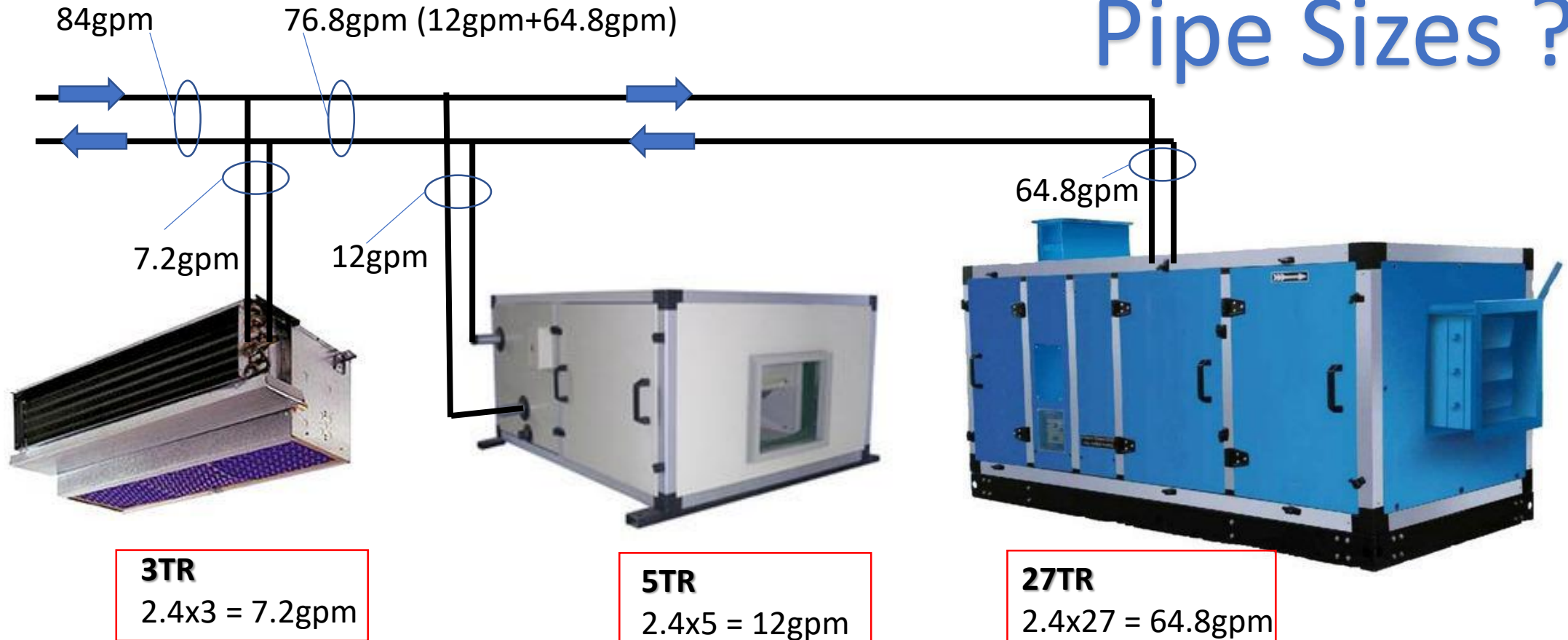
$$\text{Flow} = \frac{4 \times 24}{10} = 9.6 \text{ gpm, (4ton} = 9.6\text{gpm)}$$



Note: 1 ton = 2.4gpm according to  $\Delta T$ .  
If  $\Delta T$  change then 1 ton's flow will be changed.

# Find Chilled Water Pipe Sizes according to Flow?

## Pipe Sizes ?



**Note:** 1 TR = 2.4gpm, therefore  $2.4\text{gpm} \times 3\text{TR} = 7.2\text{gpm}$ ,.....

# Standard Requirements of Chilled Water Pipe Sizing

As per ASHRAE Handbook- Application

- Pipe diameter 2" and smaller - Velocity limit 4fps
- Pipe diameter is greater than 2" - Pressure drop limit 4 ft-Wg/100ft

**Table 6 Water Velocities Based on Type of Service**

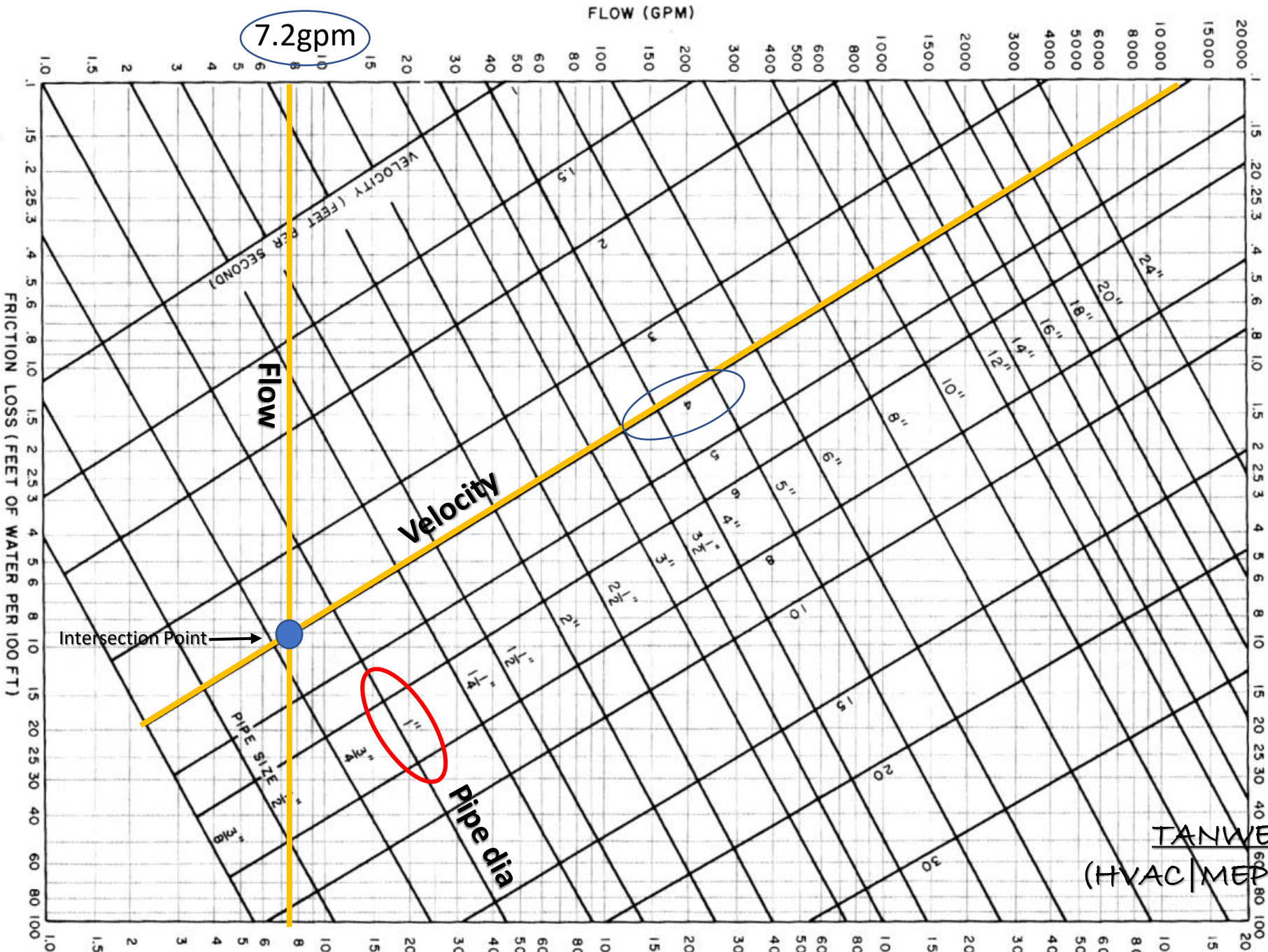
Type of Service	Velocity, fps	Reference
General service	4 to 10	a, b, c
City water	3 to 7	a, b
	2 to 5	c
Boiler feed	6 to 15	a, c
Pump suction and drain lines	4 to 7	a, b

<sup>a</sup>Crane Co. (1976).

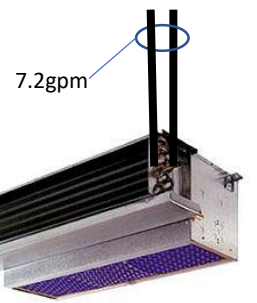
<sup>b</sup>Carrier (1960).

<sup>c</sup>Grimell Company (1951).

**CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS**  
Schedule 40 Pipe



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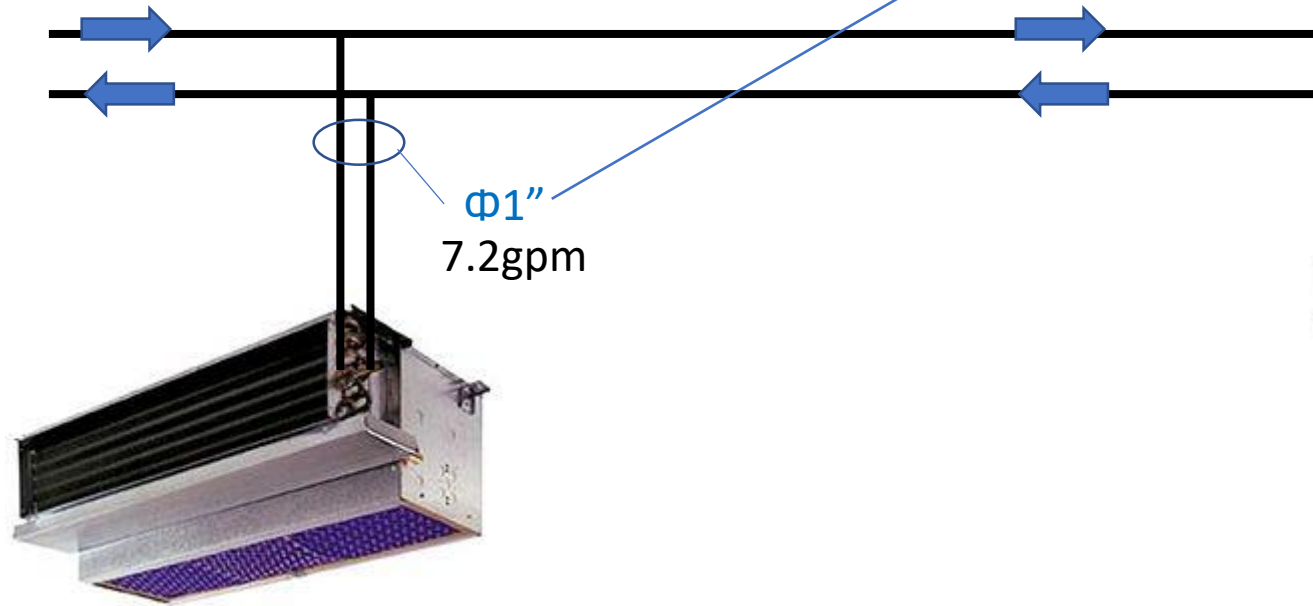
3TR  
2.4x3 = 7.2gpm



**MANUAL CALCULATION**

**Note:** Pipe size shall be taken upper line from intersection point. Pipe diameter 2" and smaller - Velocity limit 4fps

# Chilled Water Pipe Sizing



3TR

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Exit Print About

Sch 40 Steel

50°F Water

1" 7.2 USgpm

Outside Diameter	1.315 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.133 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	1.049 in	Specific Heat	1.002 Btu/lb°F
Inside Area	0.864 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	0.4936 in <sup>2</sup>	Fluid velocity	2.67 ft/s
Section Modulus	0.13288 in <sup>3</sup>	Reynolds Number	16,578
Moment of Inertia	0.08737 in <sup>4</sup>	Friction factor	0.03025
Radius Gyration	0.4205 in	Head Loss	3.842 ft/100 ft
Weight of Pipe	1.679 lb/ft	Elbow loss	0.167 ft
Weight Pipe + Fluid	2.055 lb/ft		



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

3/4" 7.2 USgpm

Outside Diameter	1.05 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.113 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	0.824 in	Specific Heat	1.002 Btu/lb°F
Inside Area	0.533 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	0.3325 in <sup>2</sup>	Fluid velocity	4.33 ft/s
Section Modulus	0.07056 in <sup>3</sup>	Reynolds Number	21,104
Moment of Inertia	0.03705 in <sup>4</sup>	Friction factor	0.02987
Radius Gyration	0.3337 in	Head Loss	12.683 ft/100 ft
Weight of Pipe	1.131 lb/ft	Elbow loss	0.496 ft
Weight Pipe + Fluid	1.363 lb/ft		

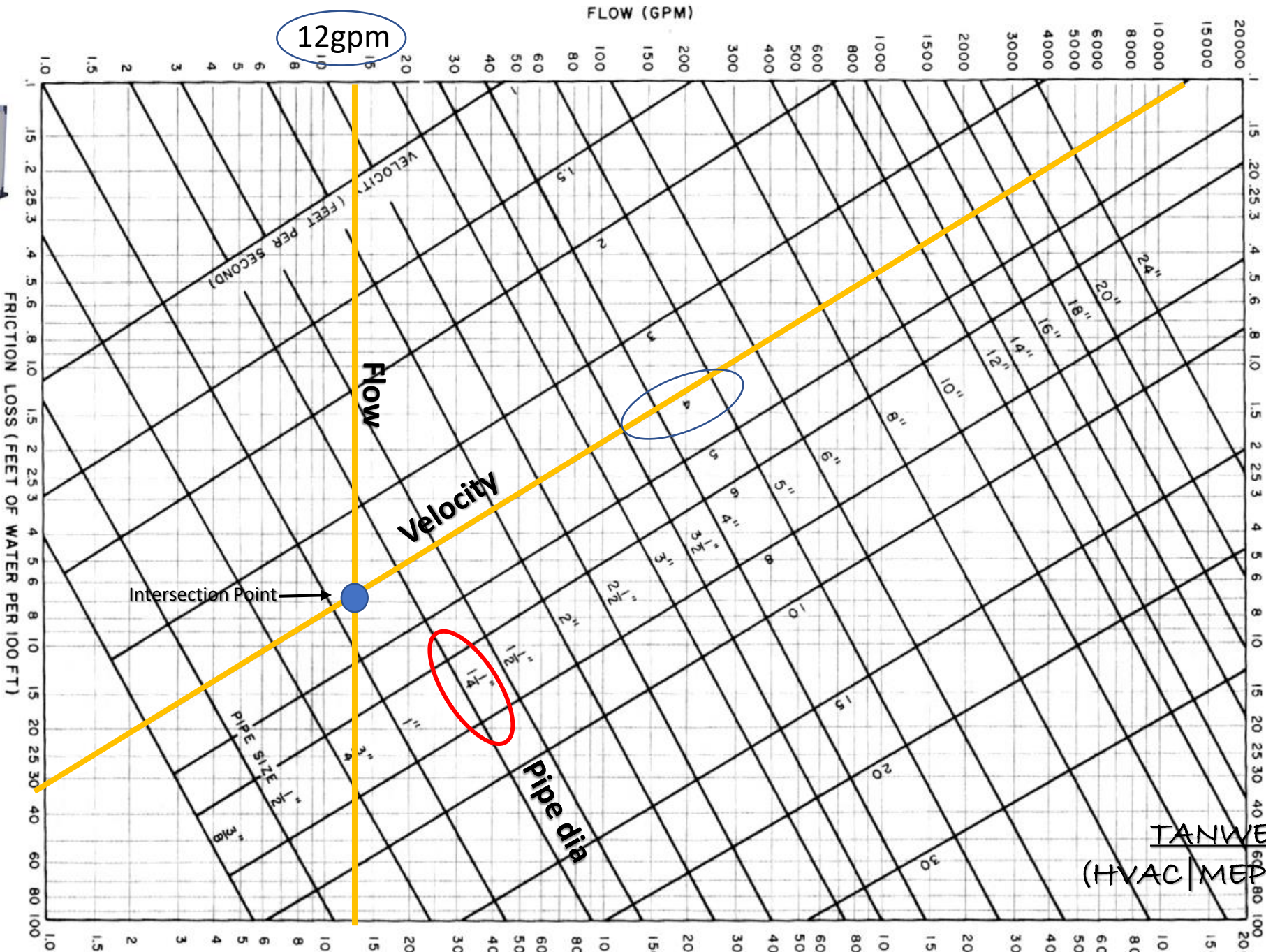


## SOFTWARE CALCULATION

Note: Pipe diameter 2" and smaller - Velocity limit 4fps

### CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS

Schedule 40 Pipe

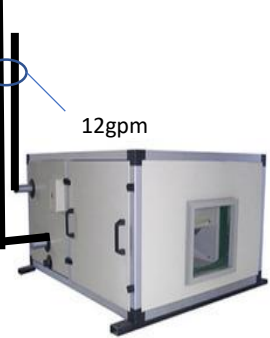


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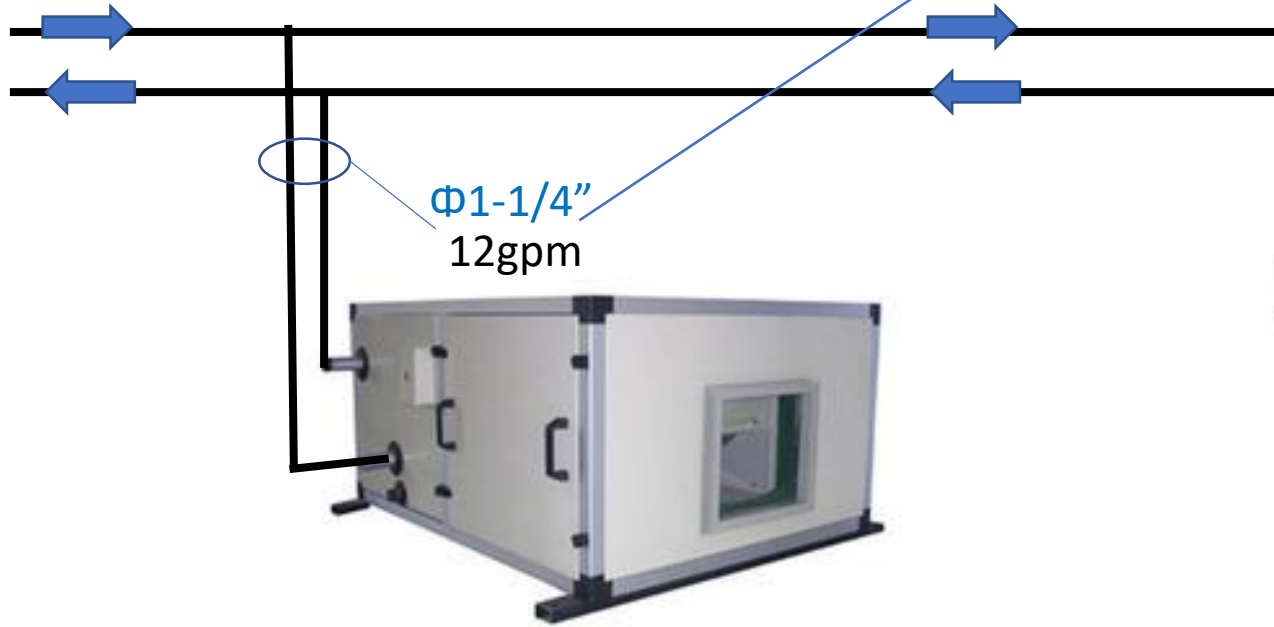
STR  
2.4x5 = 12gpm

MANUAL  
CALCULATION

Note: Pipe size shall be taken upper line from intersection point. Pipe diameter 2" and smaller - Velocity limit 4fps



# Chilled Water Pipe Sizing



5TR

DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel 50°F Water

1 1/4" 12 USgpm

Outside Diameter	1.66 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.14 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	1.38 in	Specific Heat	1.002 Btu/lb°F
Inside Area	1.496 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	0.6682 in <sup>2</sup>	Fluid velocity	2.57 ft/s
Section Modulus	0.23465 in <sup>3</sup>	Reynolds Number	21,002
Moment of Inertia	0.19476 in <sup>4</sup>	Friction factor	0.02828
Radius Gyration	0.5397 in	Head Loss	2.532 ft/100 ft
Weight of Pipe	2.273 lb/ft	Elbow loss	0.113 ft
Weight Pipe + Fluid	2.923 lb/ft		



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel 50°F Water

1" 12 USgpm

Outside Diameter	1.315 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.133 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	1.049 in	Specific Heat	1.002 Btu/lb°F
Inside Area	0.864 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	0.4936 in <sup>2</sup>	Fluid velocity	4.45 ft/s
Section Modulus	0.13288 in <sup>3</sup>	Reynolds Number	27,629
Moment of Inertia	0.08737 in <sup>4</sup>	Friction factor	0.02784
Radius Gyration	0.4205 in	Head Loss	9.823 ft/100 ft
Weight of Pipe	1.679 lb/ft	Elbow loss	0.463 ft
Weight Pipe + Fluid	2.055 lb/ft		



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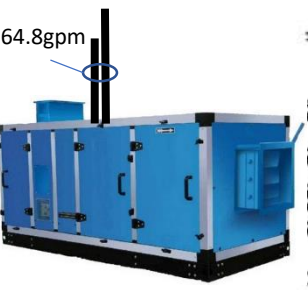
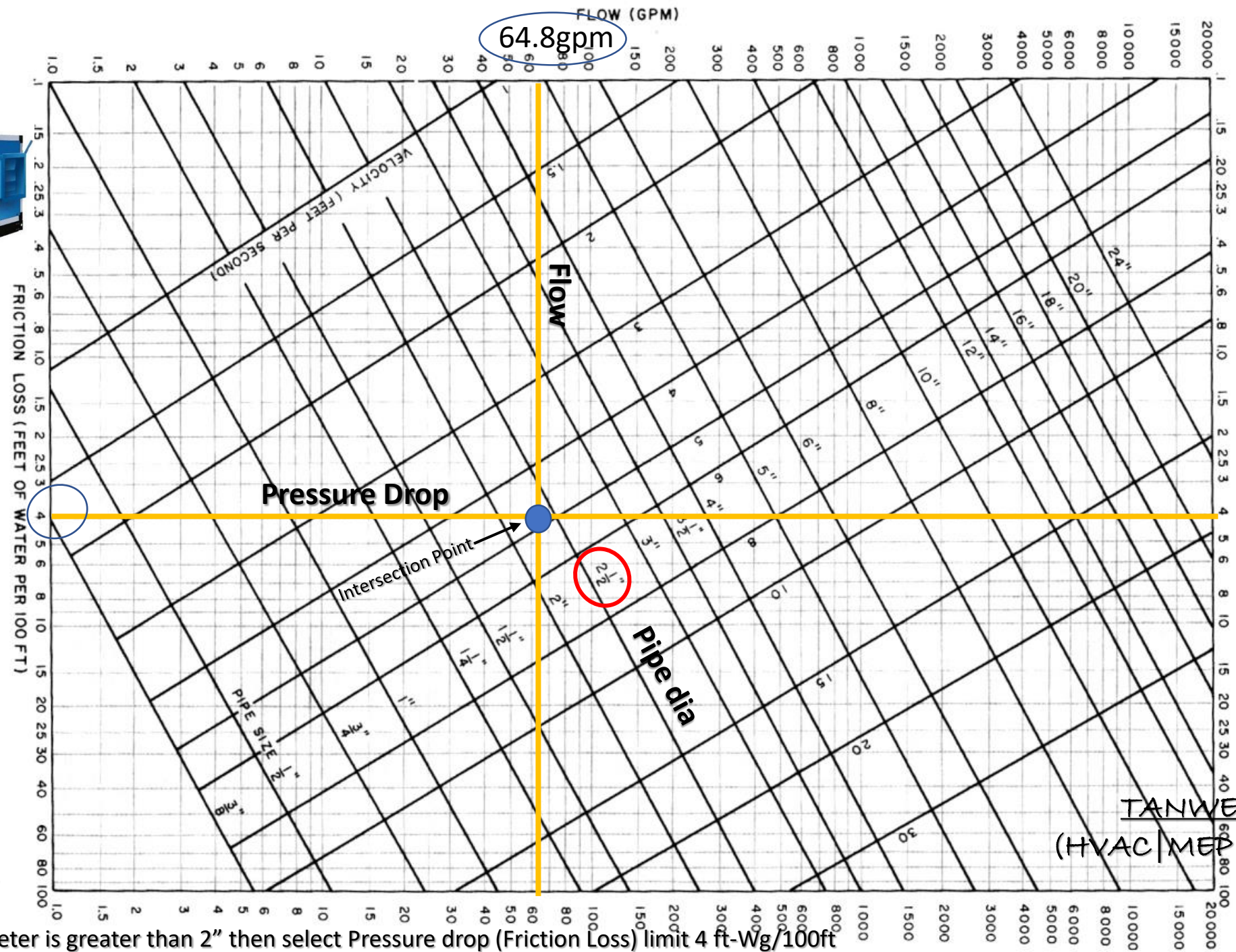
## SOFTWARE CALCULATION

Note: Pipe diameter 2" and smaller - Velocity limit 4fps



### CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS

Schedule 40 Pipe



**27TR**  
2.4x27 = 64.8gpm

Carrier Airconditioning Company

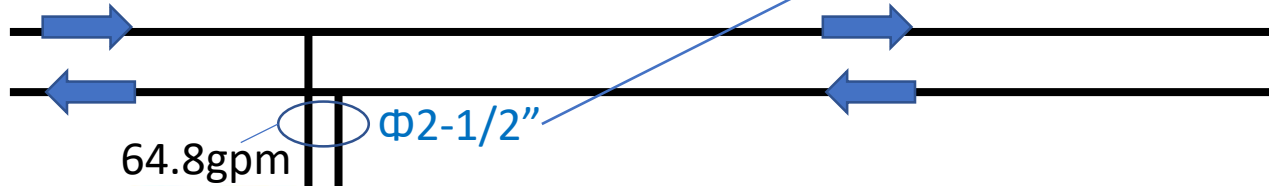


### MANUAL CALCULATION

Note: Pipe diameter is greater than 2" then select Pressure drop (Friction Loss) limit 4 ft-Wg/100ft

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# Chilled Water Pipe Sizing



27TR

DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

2½" 64.8 USgpm

Outside Diameter	2.875 in	Fluid density	62.411 lb/ft³
Wall Thickness	0.203 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	2.469 in	Specific Heat	1.002 Btu/lb°F
Inside Area	4.788 in²	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	1.7 in²	Fluid velocity	4.34 ft/s
Section Modulus	1.064 in³	Reynolds Number	63,390
Moment of Inertia	1.53 in⁴	Friction factor	0.02246
Radius Gyration	0.9474 in	Head Loss	3.199 ft/100 ft
Weight of Pipe	5.793 lb/ft	Elbow loss	0.108 ft
Weight Pipe + Fluid	7.874 lb/ft		



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

2" 64.8 USgpm

Outside Diameter	2.375 in	Fluid density	62.411 lb/ft³
Wall Thickness	0.154 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	2.067 in	Specific Heat	1.002 Btu/lb°F
Inside Area	3.356 in²	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	1.07 in²	Fluid velocity	6.2 ft/s
Section Modulus	0.56077 in³	Reynolds Number	75,718
Moment of Inertia	0.66592 in⁴	Friction factor	0.02241
Radius Gyration	0.7871 in	Head Loss	7.76 ft/100 ft
Weight of Pipe	3.653 lb/ft	Elbow loss	0.567 ft
Weight Pipe + Fluid	5.111 lb/ft		

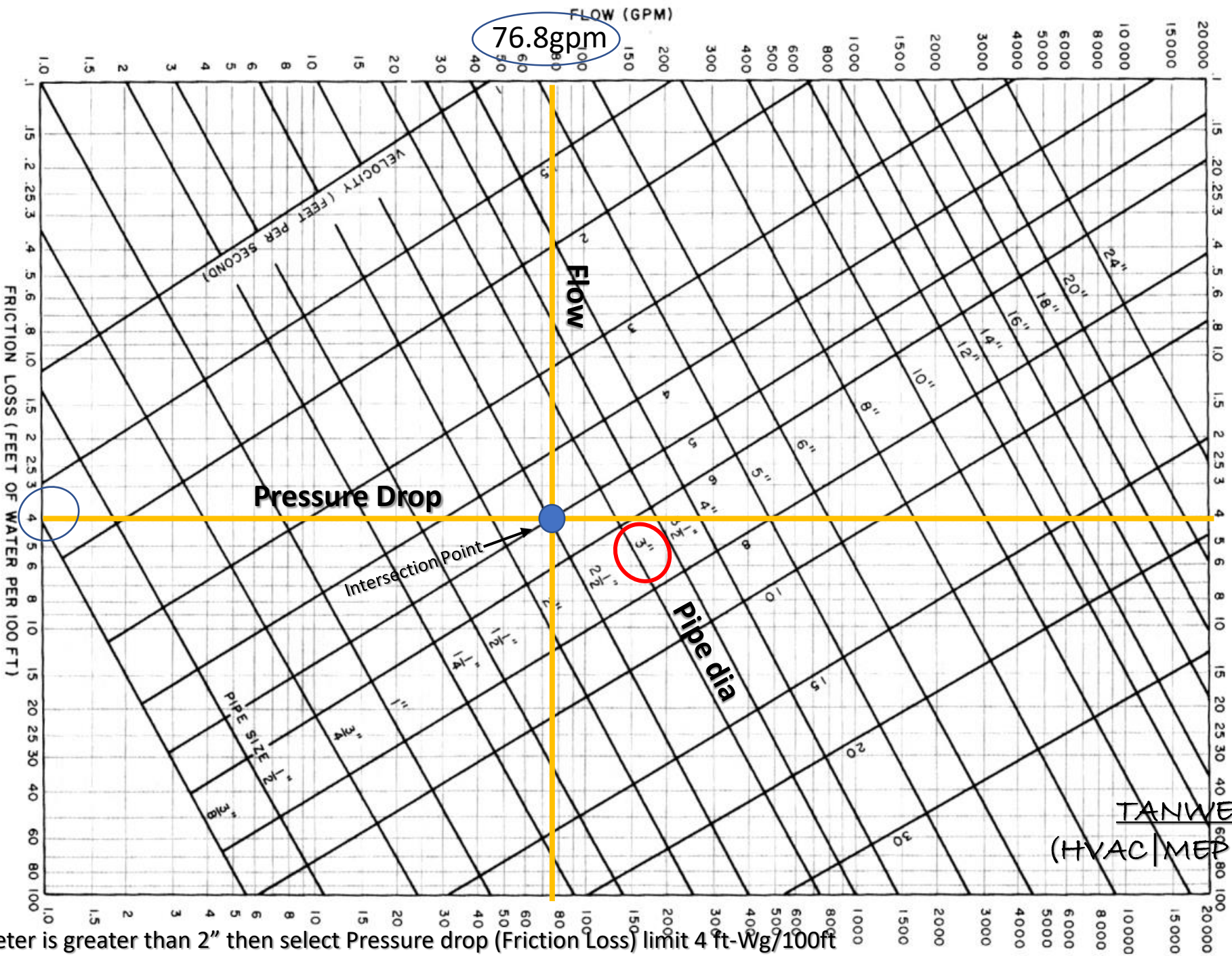


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## SOFTWARE CALCULATION

Note: Pipe diameter is greater than 2" then Pressure drop (Head Loss) limit 4ft-Wg/100ft

**CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS**  
Schedule 40 Pipe



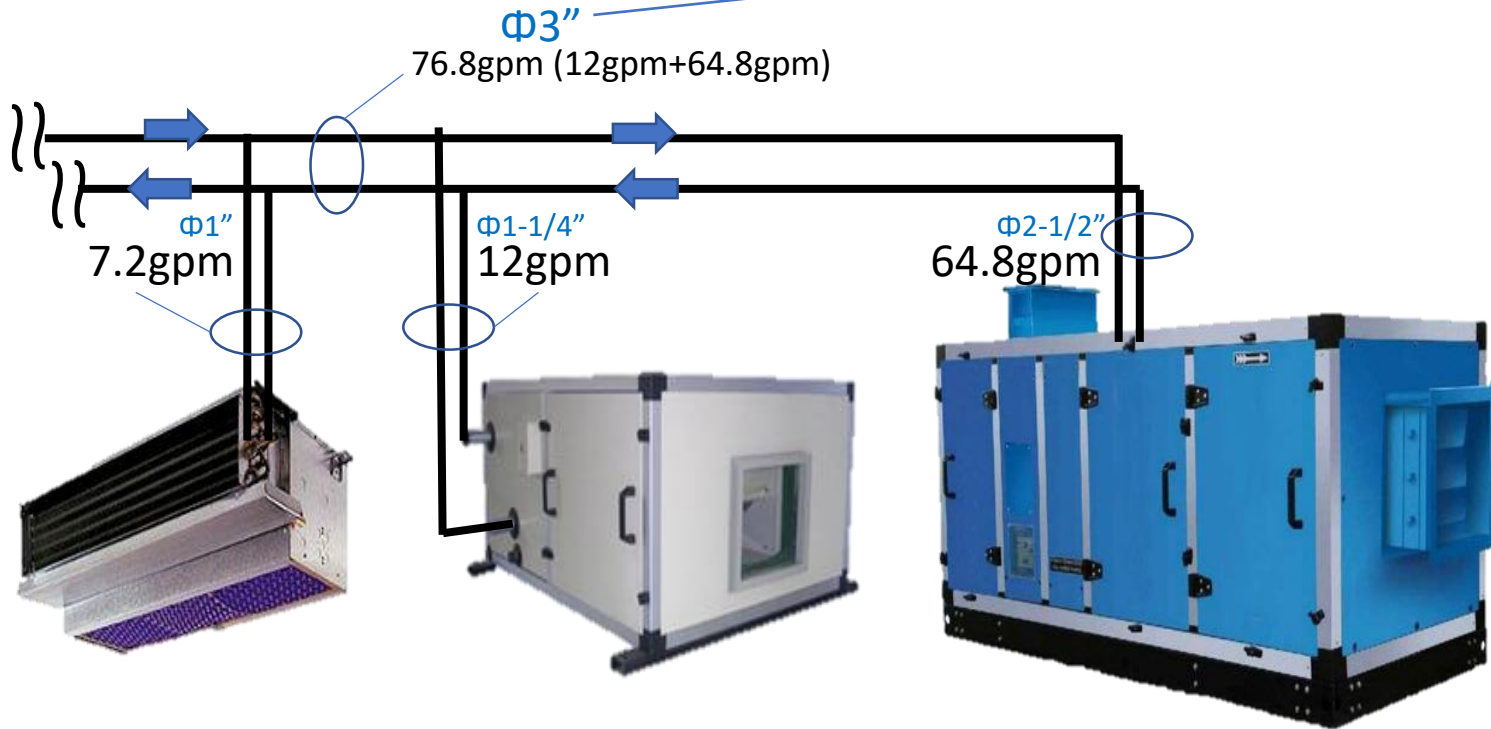
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**MANUAL  
CALCULATION**

Note: Pipe diameter is greater than 2" then select Pressure drop (Friction Loss) limit 4 ft-Wg/100ft

# Chilled Water Pipe Sizing



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

3" 76.8 USgpm

Outside Diameter	3.5 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.216 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	3.068 in	Specific Heat	1.002 Btu/lb°F
Inside Area	7.393 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	2.23 in <sup>2</sup>	Fluid velocity	3.33 ft/s
Section Modulus	1.725 in <sup>3</sup>	Reynolds Number	60,460
Moment of Inertia	3.018 in <sup>4</sup>	Friction factor	0.02216
Radius Gyration	1.16 in	Head Loss	1.496 ft/100 ft
Weight of Pipe	7.576 lb/ft	Elbow loss	0.06 ft
Weight Pipe + Fluid	10.788 lb/ft		



DesignTools PipeSizer Version 6.2

Exit Print About

Sch 40 Steel

50°F Water

2 1/2" 76.8 USgpm

Outside Diameter	2.875 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.203 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	2.469 in	Specific Heat	1.002 Btu/lb°F
Inside Area	4.788 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	1.7 in <sup>2</sup>	Fluid velocity	5.15 ft/s
Section Modulus	1.064 in <sup>3</sup>	Reynolds Number	75,129
Moment of Inertia	1.53 in <sup>4</sup>	Friction factor	0.02196
Radius Gyration	0.9474 in	Head Loss	4.393 ft/100 ft
Weight of Pipe	5.793 lb/ft	Elbow loss	0.152 ft
Weight Pipe + Fluid	7.874 lb/ft		



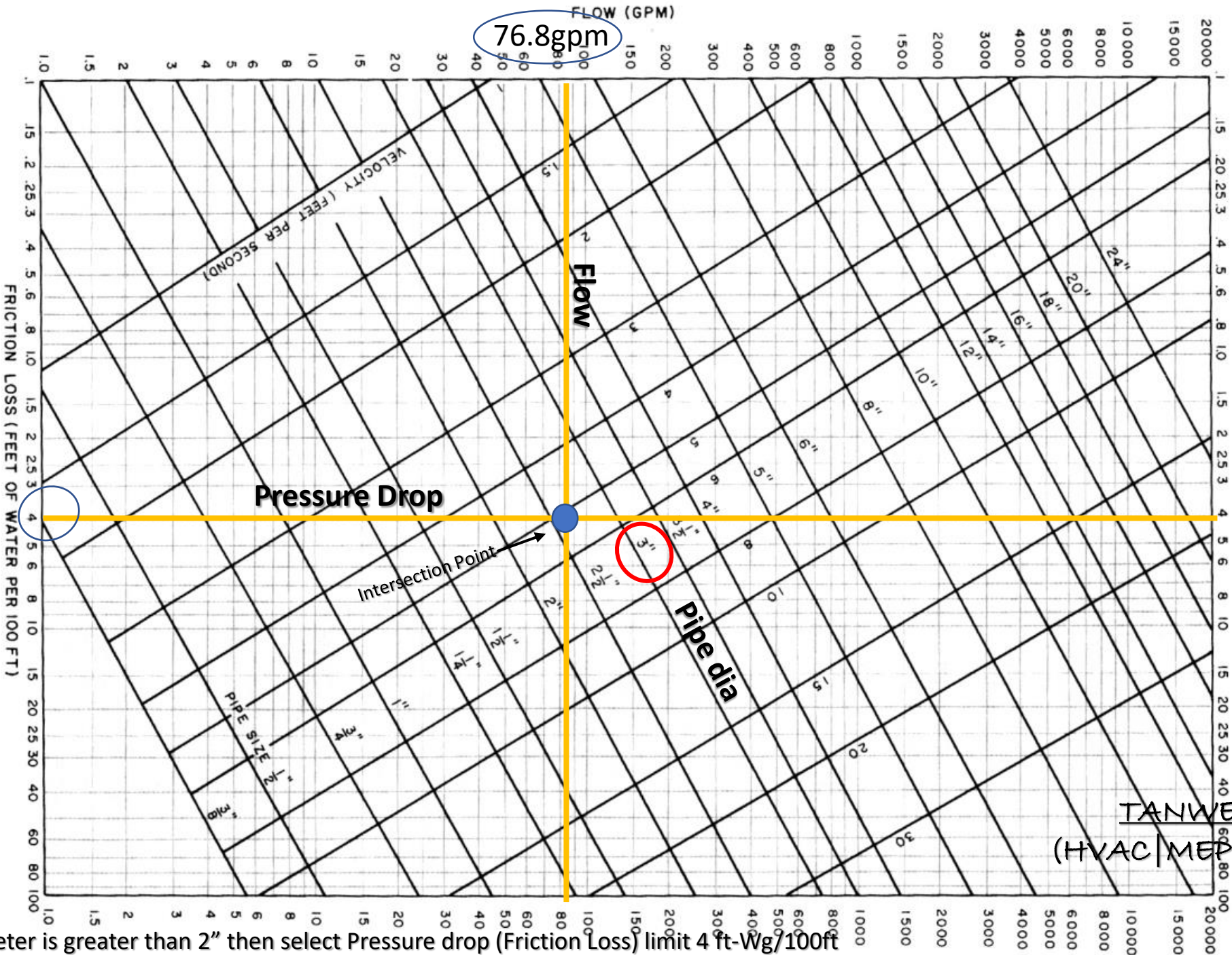
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@mechahmedradwan



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Note: Pipe diameter is greater than 2" then Pressure drop (Head Loss) limit 4ft-Wg/100ft

**CHART 3—FRICTION LOSS FOR CLOSED PIPING SYSTEMS**  
Schedule 40 Pipe



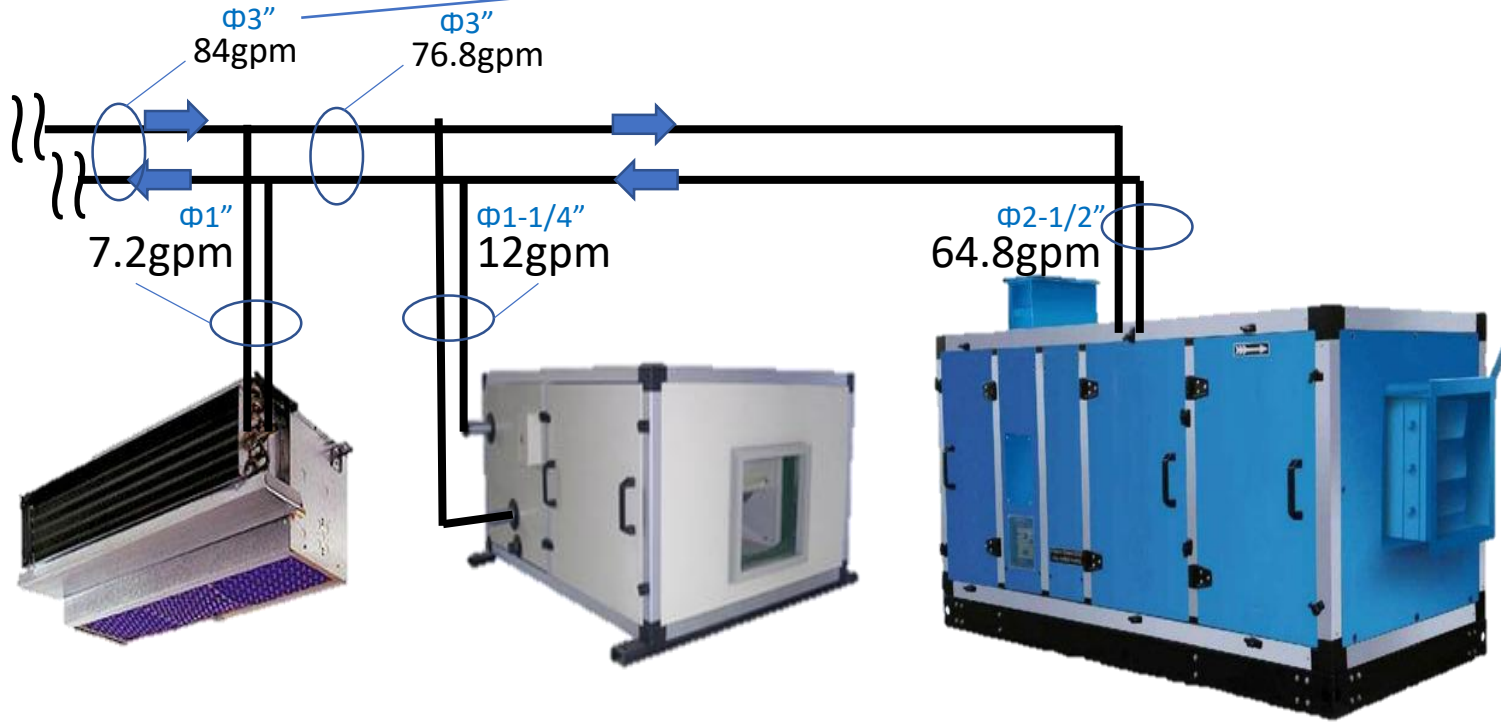
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**MANUAL CALCULATION**

Note: Pipe diameter is greater than 2" then select Pressure drop (Friction Loss) limit 4 ft-Wg/100ft

# Chilled Water Pipe Sizing



DesignTools PipeSizer Version 6.2  
Exit Print About

Sch 40 Steel  
3"

50°F Water  
84 USgpm

Outside Diameter	3.5 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.216 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	3.068 in	Specific Heat	1.002 Btu/lb°F
Inside Area	7.393 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	2.23 in <sup>2</sup>	Fluid velocity	3.65 ft/s
Section Modulus	1.725 in <sup>3</sup>	Reynolds Number	66,129
Moment of Inertia	3.018 in <sup>4</sup>	Friction factor	0.02186
Radius Gyration	1.16 in	Head Loss	1.766 ft/100 ft
Weight of Pipe	7.576 lb/ft	Elbow loss	0.072 ft
Weight Pipe + Fluid	10.788 lb/ft		

DesignTools PipeSizer Version 6.2  
Exit Print About

Sch 40 Steel  
2 1/2"

50°F Water  
84 USgpm

Outside Diameter	2.875 in	Fluid density	62.411 lb/ft <sup>3</sup>
Wall Thickness	0.203 in	Fluid viscosity	3.1667 lb/ft-h
Inside Diameter	2.469 in	Specific Heat	1.002 Btu/lb°F
Inside Area	4.788 in <sup>2</sup>	Energy factor	501.6 Btu/h°F-gpm
Cross Section Area	1.7 in <sup>2</sup>	Fluid velocity	5.63 ft/s
Section Modulus	1.064 in <sup>3</sup>	Reynolds Number	82,172
Moment of Inertia	1.53 in <sup>4</sup>	Friction factor	0.02171
Radius Gyration	0.9474 in	Head Loss	5.196 ft/100 ft
Weight of Pipe	5.793 lb/ft	Elbow loss	0.182 ft
Weight Pipe + Fluid	7.874 lb/ft		



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Note: Pipe diameter is greater than 2" then Pressure drop (Head Loss) limit 4ft-Wg/100ft

# Final HVAC Chilled Water Pipe Sizes

