



SIZING THE SURGE-TROL®

Formula for Water Hammer Protection (Start-Up)

$$\text{Tank Volume (gallons)} = \frac{\left(\frac{-SG \times 2 \times Q_s \times L}{449 \times a} \right) \left(\frac{P_2 + 14.7}{P_1 + 14.7} \right)^{1/n}}{\left(\frac{P_2 + 14.7}{P_1 + 14.7} \right)^{1/n} - 1} \times 7.481$$

Example*

$$\text{Tank Volume (gallons)} = \frac{\left(\frac{1 \times 2 \times 400 \times 2500}{449 \times 4500} \right) \left(\frac{150 + 14.7}{85 + 14.7} \right)^{1/1.2}}{\left(\frac{150 + 14.7}{85 + 14.7} \right)^{1/1.2} - 1} \times 7.481$$

Tank Volume = 21.6 gallons (Select tank equal to or greater.)
Recommended Model: SPT-7

Formula for Cavitation Protection (Shut-Down)

$$T_c = \frac{2 \times L}{a}$$

$$V_v = Q_{ss} \times T_c \times 7.481$$

$$AF = 1 - \left(\frac{P_1 + 14.7}{P_2 + 14.7} \right)^{1/n}$$

$$\text{Tank Volume (gallons)} = \frac{V_v}{AF}$$

Example*

$$T_c = \frac{2 \times 2500}{4500} = 1.11$$

$$V_v = 10.08 \times 1.11 \times 7.481 = 83.70$$

$$AF = 1 - \left(\frac{50 + 14.7}{150 + 14.7} \right)^{1/1.2} = .541$$

$$\text{Tank Volume} = \frac{83.04}{.541}$$

Tank Volume = 153.5 gallons (Select tank equal to or greater.)
Recommended Model: SPT-21

Glossary of Terms

Abbreviation	Definition	Example
A	Pipe Size	
a	Speed of Pressure Wave (ft./sec.)	Steel, Cast Iron & Ductile Iron Pipe = 4,500 ft/sec PVC Pipe = 1,250 ft/sec
AF	Acceptance Factor	
L	Length of Pipe (feet)	
n	Gas Constant (pre-charge gas)	Dry Air = 1.2 Nitrogen = 1.4
P ₁	Tank Pre-Charge Pressure	Start-up: 15% below static pressure Shut-down: 50% below static pressure
P ₂	Maximum Allowable Pressure	
Q _s	Fire Pump Flow Rate (gal./min.)	
Q _{ss}	Fire Pump Flow Rate (ft./sec.)	See Chart
SG	Specific Gravity	Ammonia = 0.7 Ethylene Glycol = 1.1 Glycerin = 1.3 Propylene Glycol = 1.1 Water = 1
T _c	Critical Time (seconds)	
V	Velocity of Water (ft./sec.)	
V _v	Vacuum Volume	

Q_{ss} Fire Pump Flow Rate (feet per second)

GPM	Pipe Size		
	2"	3"	4"
90	8.60	-	-
100	9.56	-	-
125	11.97	-	-
150	14.36	-	-
175	16.75	-	-
200	19.14	8.68	-
225	-	9.77	-
250	-	10.85	-
275	-	11.94	-
300	-	13.00	-
325	-	14.12	8.19
350	-	-	8.82
375	-	-	9.45
400	-	-	10.08
425	-	-	10.71
450	-	-	11.34
475	-	-	11.97
500	-	-	12.60
550	-	-	13.85
600	-	-	15.12
-	-	-	-

GPM	Pipe Size		
	5"	6"	8"
500	8.02	-	-
550	8.82	-	-
600	9.63	-	-
650	10.43	-	-
700	11.23	-	-
750	12.03	8.33	-
800	12.83	8.88	-
850	13.64	9.44	-
900	14.44	9.99	-
950	15.24	10.55	-
1000	16.04	11.10	-
1100	17.65	12.22	-
1200	-	13.33	-
1300	-	14.43	8.33
1400	-	15.55	8.98
1500	-	16.66	9.62
1600	-	17.77	10.26
1800	-	19.99	11.54
2000	-	-	12.82
2500	-	-	16.03
3000	-	-	19.24

GPM	Pipe Size			
	10"	12"	14"	16"
2000	8.14	-	-	-
2500	10.17	-	-	-
3000	12.20	8.60	-	-
3500	14.24	10.30	8.30	-
4000	16.27	11.47	9.48	-
4500	18.31	12.90	10.67	8.17
5000	-	14.33	11.85	9.08

*System Information Used for Formula Examples

Fluid: Water
Pump: 400 GPM
Pipe Size: 4" Steel
Pipe Length: 2500 ft.
Static Pressure: 100 psi
Max. Pressure: 150 psi
Pre-charge Gas: Dry Air



1400 Division Road, West Warwick, RI USA 02893
T: 800.426.8765 www.amtrol.com

