Peerless Pump Company

HVAC & Hydronics Equipment

Triple Duty Valves & Suction Diffusers
Diaphragm Type Hydro-pneumatic Tanks
Air Separators
Automatic Air Eliminators
Grundfos Inline Circulator Pumps

Peerless Pump Company
P O Box 7026
Indianapolis IN 46206-7026
Phone: 317-925-9661
Fax: 317-924-7388

Brochure B-2100

Design Features & Typical Installations

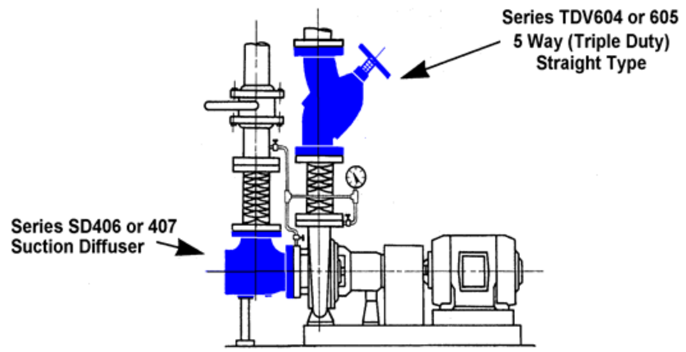
Triple Duty Valves Series TDV604 & 605:

- Non-slam spring closure type check valve
- O. S. & Y type shut off valve
- Flow Throttling
- Balancing valve
- By pass function
- Re-positional inlet body for angle connection
- Series TDV604 Cast iron body 125 Lb. ANSI flanged 150 psi maximum Working Pressure
- Series TDV605 Ductile iron body 250 Lb. ANSI 250 psi maximum working pressure
- NPT Taps on inlet and outlet side
- Bronze seat and 400 Series SS Disc
- Overall system pressure drop is reduced since less pipe and fittings are required for installed pump
- 175° F. Maximum Temperature

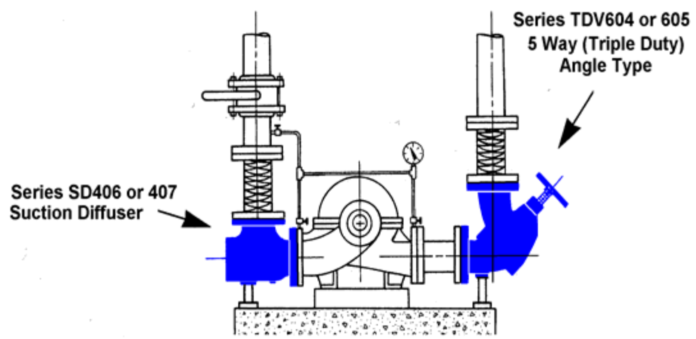
Suction Diffuser Series SD406 & 407

- Angle design for direct connection to pump suction flange
- Removable 304 SS fine mesh screen for preliminary start up of system for removal of extraneous material from system to prevent mechanical seal failures and instrumentation damage during initial running period.
- Permanent 304 SS screen for free flow minimizing pressure drop
- Guide vanes for reducing turbulence while providing proper flow conditions.
- Available with inlet and outlet of equal size or with reduced outlet size eliminating need for reducing fitting
- Overall system pressure drop is reduced since less pipe and fittings are required for installed pump
- Series SD406 Cast iron body 125 Lb. ANSI flanged 150 psi maximum Working Pressure
- Series SD407 Ductile iron body 250 Lb. ANSI 250 psi maximum working pressure
- 175° F. Maximum Temperature

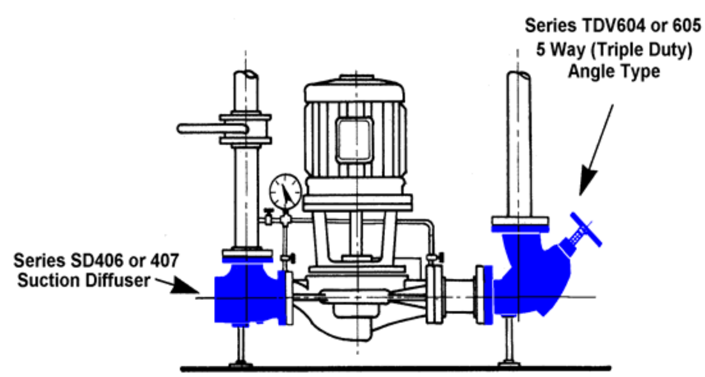
Typical Installations



Base Mounted F Series
Radially Split Case Pumps



Base Mounted Series BT, AE, TU, TUT Horizontal Split Case Pumps



In-Line Mounted PV Series
Radially Split Case Pumps

Triple Duty Valve Selection and Typical Specification

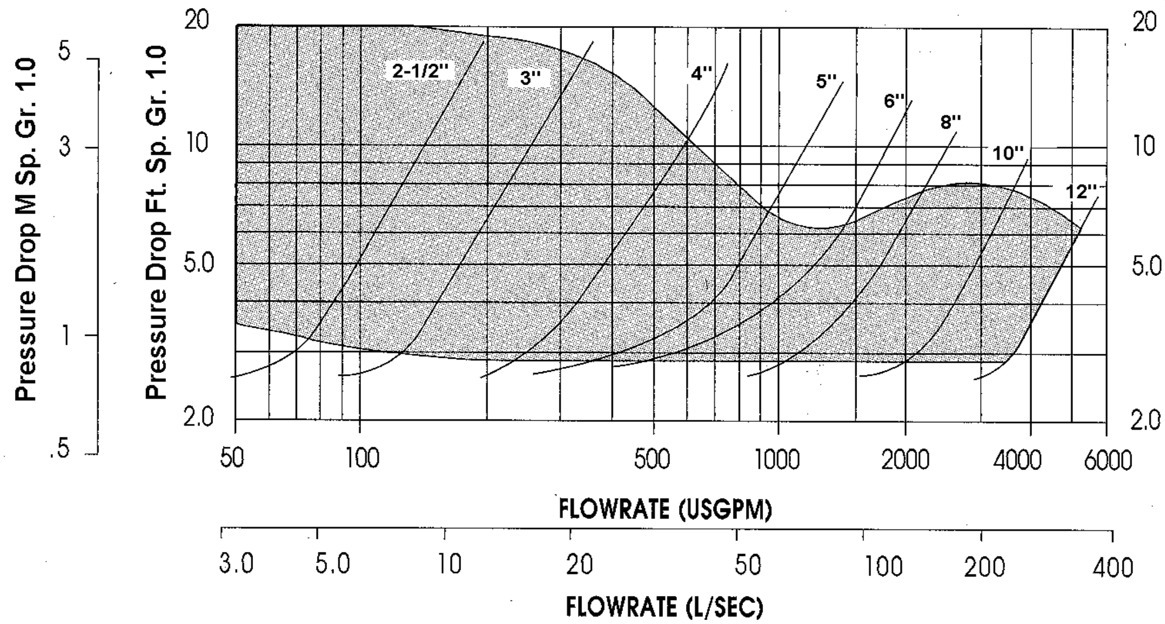


Figure 1

VALVE SELECTION CRITERIA

1 Minimum Flow Rate - To ensure sufficient flow to hold disc in full open position during operation, size valves in shaded area only of TDV Performance Curve Figure 1.

2 Maximum Flow Rate - Select valve in shaded area only. However, consideration should be given to selecting the valve with the lowest pressure drop and velocity in accordance with ASHRAE practice. This will ensure a quiet, energy-efficient system and maximum valve life.

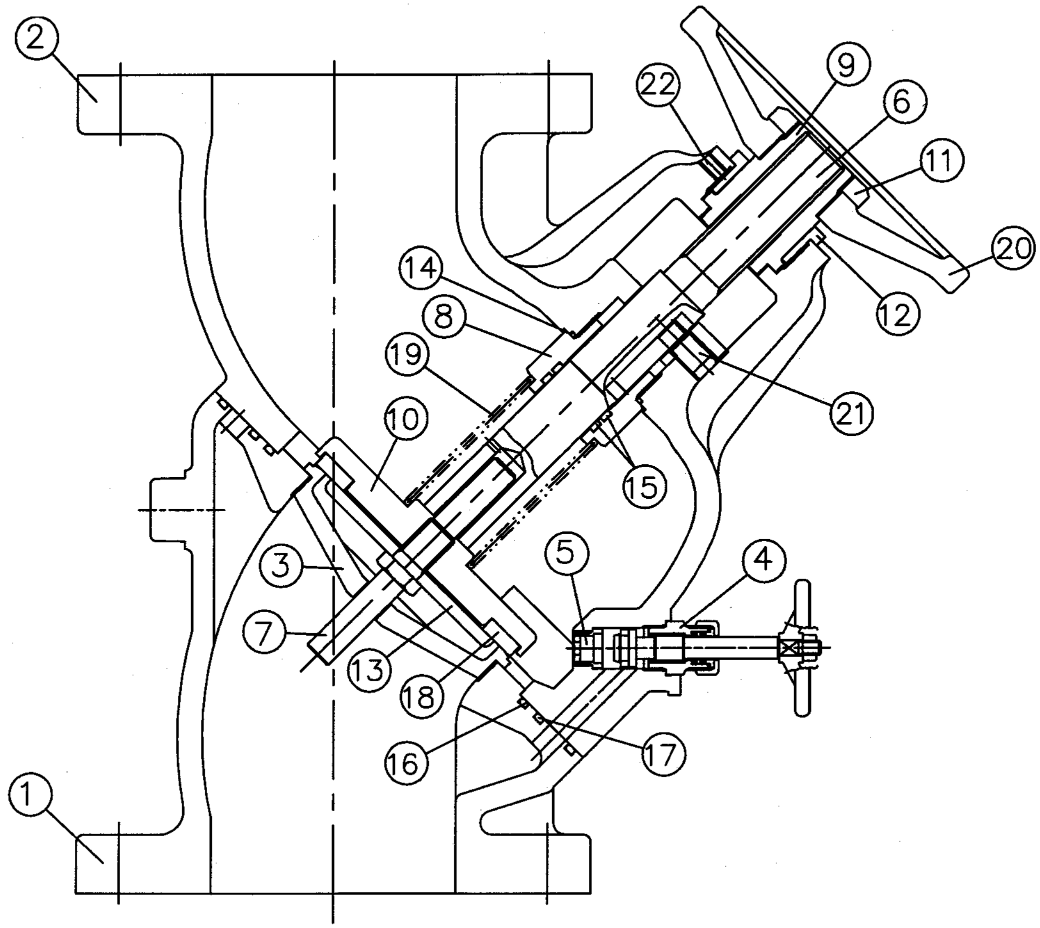
Typical Specifications Series TDV604 & 605 Triple Duty Valves

Furnish and install on the discharge side of each pump a Peerless Pump Triple Duty Valve incorporating three functions in one body: tight shut-off valve, spring-closure type silent non-slam check, flow throttling. Additional features shall include balancing valve with by-pass function and re-positional inlet body for angle mounting configuration.

Valve body shall be (cast iron with 125 x125 Lb ANSI flanges Series TDV604)(ductile iron with 250 x250 Lb. ANSI flanges - Series TDV605) ends. The body shall have two NPT connections on each side of the valve seat.

The valve disc shall be bronze plug disc type with high impact engineered seat to ensure tight shut-off and silent check valve operation.

PEERLESS PUMP ®



Triple Duty Valve

24	Plug	FBsBe	3	
23	Bolt	STS304	4 ~	
22	Socket set screw	SCM	1	
21	Socket set screw	SCM	1	
20	Hand wheel	GCD450	1	
19	Spring	STS304	1	
18	Disc packing	NBR	1	
17	O-Ring	NBR	2	
16	O-Ring	NBR	1	
15	O-Ring	NBR	2	
14	O-Ring	NBR	1	
13	Packing plate	SS400	1	
12	Yoke nut	S45C	1	
11	Hand wheel nut	S45C	1	
10	Disc	S45C,GCD450	1	
9	Sleeve	GCD450	1	
8	Bush	C3771	1	
7	Guide pin	C3771	1	
6	Stem	C3771	1	
5	Seat(B/P)	FBsBe	1	
4	Bonnet Set	C3771	1set	
3	Seat	Bc6	1	
2	High Body	GC200	1	
1	2	3	4	5
No	Part Name	Material	Quantity	Remark

Scale	Designed By	Checked By	Approved By	TITLE	6
9	J.P		B.C	Size	7
Date	8/14		8/14	DrawingDate	8

Drwg. No. 4854054

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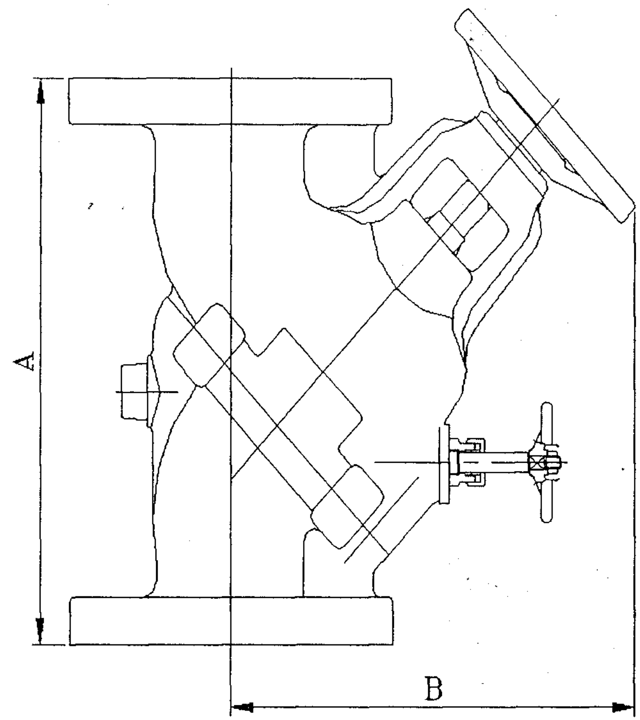


ANSI 125Lb

unit : inch

SIZE	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"
A	8.98	9.29	11.61	13.19	17.28	17.28	20.39	23.70	26.65	29.88	34.02	36.34	39.61
B	7.99	8.62	9.37	10.16	14.41	14.41	16.50	20.20	22.48	26.38	28.07	32.13	33.78

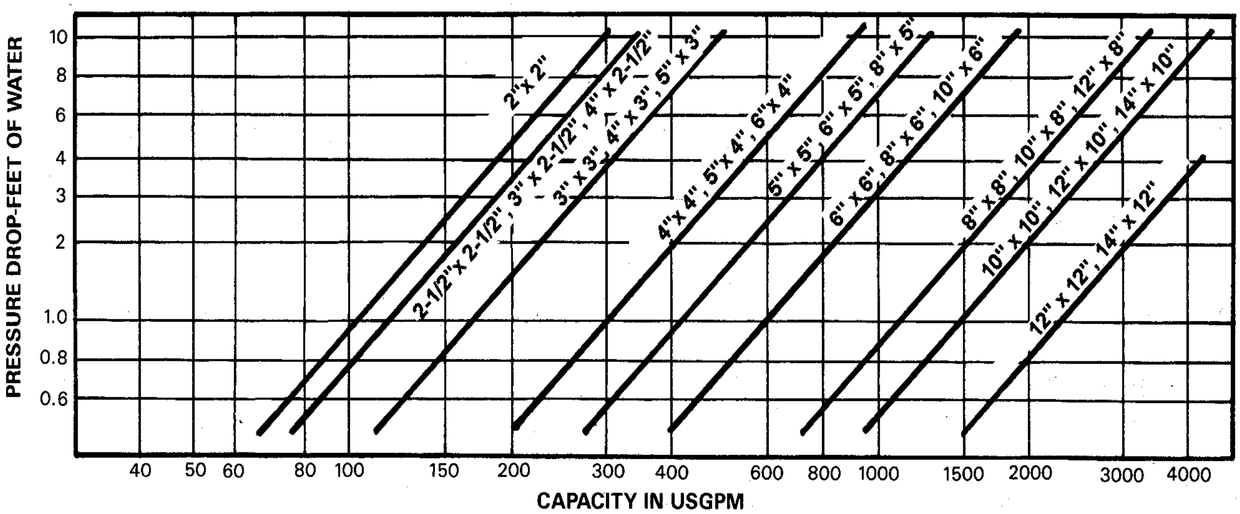
ANSI 250Lb

unit : inch

SIZE	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"
A	9.13	9.53	11.77	13.82	14.49	18.15	21.34	25.12	28.15	30.59	35.59	37.91	41.22
B	7.99	8.62	9.37	10.16	11.65	14.41	16.50	20.20	22.48	26.38	28.07	32.13	33.78

Suction Diffuser Selection and Typical Specification

Suction Diffuser Pressure Drop Curves



Typical Specification Series SD406 & 407 Suction Diffusers

Furnish and install on the suction of each pump, a Peerless Pump Suction Diffuser. with (Cast Iron Body with 125 x125 Lb. ANSI Flanges -Series SD406)(Ductile Iron Body with 250 x 250 Lb ANSI flanges -Series SD407), with Integrally Cast Outlet Guide Vanes, Removable Stainless Steel Strainer and Fine Mesh Start-up Strainer. The mechanical contractor shall inspect the Strainer prior to start-up of pump and shall remove the Fine Mesh Brass Strainer after a short running period. Space shall be provided for removal of Strainer and connection of blow down valve.

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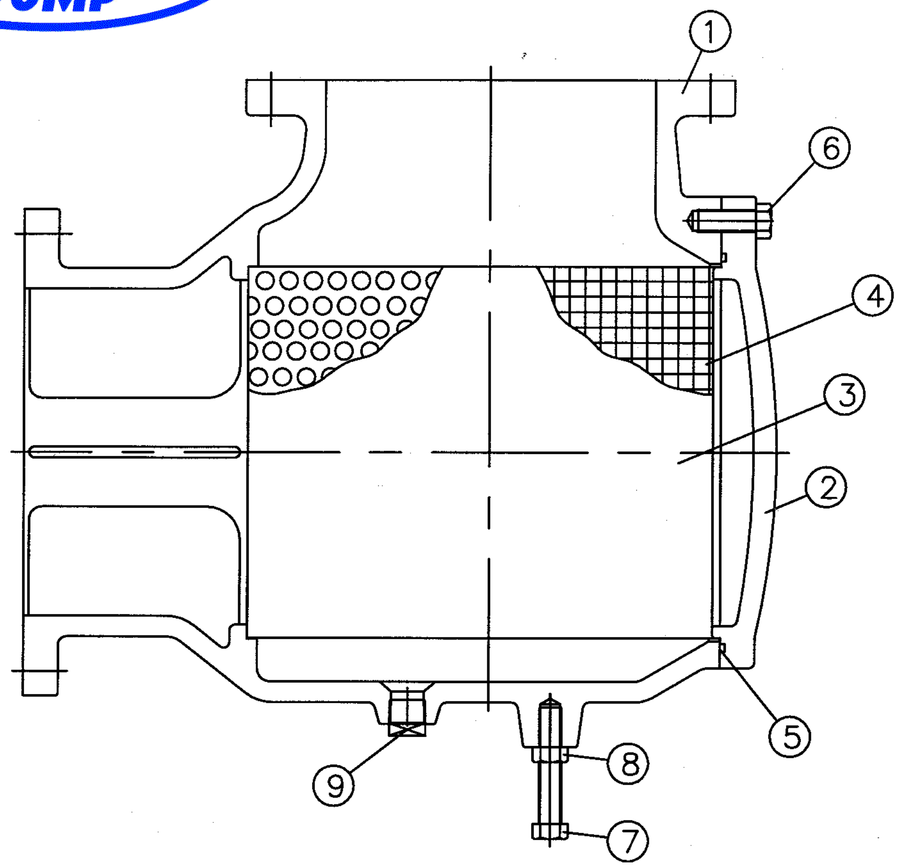

Suction Diffuser

No	Part Name	Material	Quantity	Remark
9	Plug	FBsBe	2~	
8	Nut	SS400	1	
7	Bolt	SS400	1	
6	Bolt	SS400	4	
5	O-ring	NBR	1	
4	Screen(mash)	STS304	1	
3	Screen	STS304	1	
2	Cover	GC200	1	
1	Body	GC200	1	

Scale	Designed By	Checked By	Approved By		
	J.P		B.C	Size	50A~450A (2"~18")
Date	8/14		8/14	DrawingDate	

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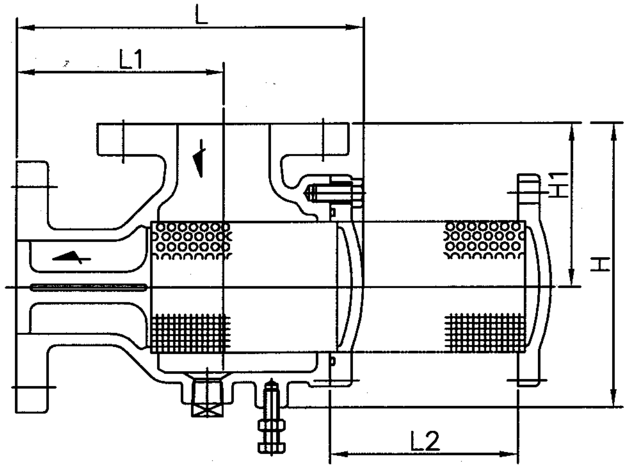

ANSI 125Lb

Suction Diffusers

unit : inch

SIZE																		
SIZE	IN	2"	21/2"	21/2"	3"	3"	4"	4"	4"	5"	5"	5"	6"	6"	6"	8"	8"	8"
	OUT	2"	2"	21/2"	21/2"	3"	21/2"	3"	4"	3"	4"	5"	4"	5"	6"	5"	6"	8"
L		8.43	9.49	9.57	10.47	10.55	11.97	11.93	12.13	14.45	14.45	14.09	16.10	16.10	15.83	20.43	19.69	19.33
L1		5.12	5.83	5.91	6.46	6.54	7.40	7.36	7.56	9.17	9.17	8.82	9.88	9.88	9.61	12.76	12.05	11.69
L2		4.06	4.96	4.96	5.79	5.79	6.69	6.69	6.69	7.99	7.99	7.99	8.98	8.98	8.98	11.26	11.26	11.26
H		7.32	4.49	8.11	9.21	9.21	10.79	10.79	10.79	12.09	12.09	12.09	13.86	13.86	13.86	16.89	16.89	16.89
H1		4.13	8.11	4.49	5.20	5.20	4.13	4.13	4.13	6.85	6.85	6.85	7.95	7.95	7.95	9.72	9.72	9.72

SIZE	IN	10"	10"	10"	12"	12"	12"	14'	14"	14"	14"	16"	16"	16"	18"	18"	18"	
	OUT	6"	8"	10"	8"	10"	12"	8"	10"	12"	14"	12"	14"	16"	14"	16"	18"	
L		23.23	23.39	22.99	28.07	27.44	26.97	30.75	30.16	29.29	29.53	32.13	32.17	32.20	36.30	36.34	36.46	
L1		14.13	14.29	13.90	17.80	17.17	16.69	19.45	18.86	17.99	18.23	19.21	19.25	19.29	21.73	21.77	21.89	
L2		14.17	14.17	14.17	16.93	16.93	16.93	18.98	18.98	18.98	18.98	20.67	20.67	20.67	24.21	24.21	24.21	
H		19.96	19.96	19.96	24.02	24.02	24.02	26.54	26.54	26.54	26.54	29.09	29.09	29.09	31.26	31.26	31.26	
H1		11.42	11.42	11.42	13.39	13.39	13.39	14.88	14.88	14.88	14.88	15.79	15.79	15.79	16.85	16.85	16.85	

Drwg. No. 4854056

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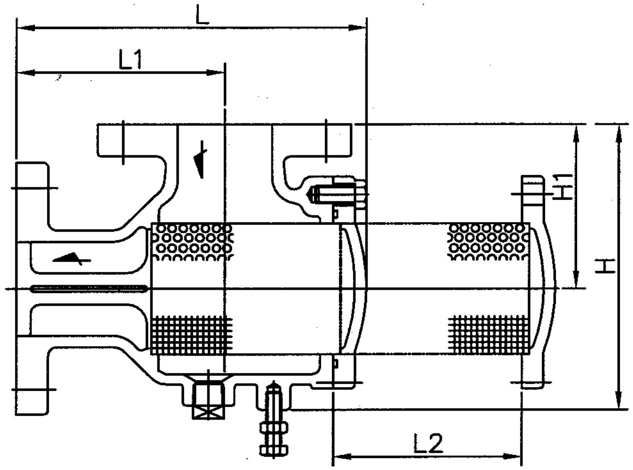


ANSI 250Lb

Suction Diffusers

unit : inch

SIZE																		
SIZE	IN	2”	21/2”	21/2”	3”	3”	4”	4”	4”	5”	5”	5”	6”	6”	6”	8”	8”	8”
	OUT	2”	2”	21/2”	21/2”	3”	21/2”	3”	4”	3”	4”	5”	4”	5”	6”	5”	6”	8”
L		8.50	9.57	9.69	10.55	10.55	12.09	11.93	12.44	14.45	14.69	14.53	16.42	16.77	16.26	20.87	20.12	19.80
L1		5.20	5.91	6.02	6.54	6.54	7.52	7.36	7.87	9.17	9.41	9.25	10.20	10.55	10.04	13.19	12.48	12.17
L2		4.06	4.96	4.96	5.79	5.79	6.69	6.69	6.69	7.99	7.99	7.99	8.98	8.98	8.98	11.26	11.26	11.26
H		7.40	8.23	8.23	5.20	9.21	11.10	11.10	11.10	12.52	12.52	12.52	14.45	14.45	14.45	17.36	17.36	17.36
H1		4.21	4.61	4.61	9.21	5.20	6.22	6.22	6.22	7.28	7.28	7.28	8.54	8.54	8.54	10.20	10.20	10.20

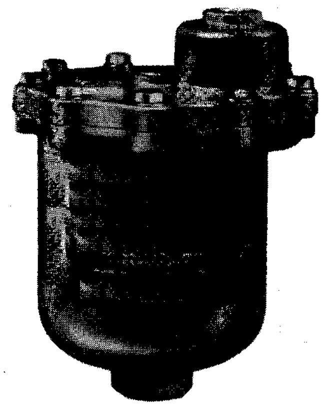
SIZE																		
SIZE	IN	10”	10”	10”	12”	12”	12”	14’	14”	14”	14”	16”	16”	16”	18”	18”	18”	
	OUT	6”	8”	10”	8”	10”	12”	8”	10”	12”	14”	12”	14”	16”	14”	16”	18”	
L		23.66	23.90	23.70	28.54	28.15	27.72	31.26	30.87	30.04	30.28	32.87	32.91	32.95	37.05	37.13	37.24	
L1		14.57	14.80	14.61	18.27	17.87	17.44	19.96	19.57	18.74	18.98	19.96	20.00	20.04	22.48	22.56	22.68	
L2		14.17	14.17	14.17	16.93	16.93	16.93	18.98	18.98	18.98	18.98	20.67	20.67	20.67	24.21	24.21	24.21	
H		20.67	20.67	20.67	24.76	24.76	24.76	27.28	27.28	27.28	27.28	29.69	29.69	29.69	32.05	32.05	32.05	
H1		12.13	12.13	12.13	14.13	14.13	14.13	15.63	15.63	15.63	15.63	16.46	16.46	16.46	17.64	17.64	17.64	

Drwg. No. 4854056

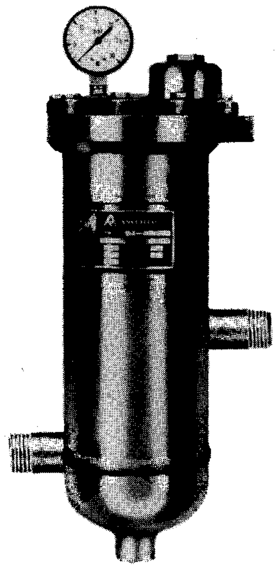
Technical Data
Pressuration and Air Elimination System

The pressurization and air elimination system accommodates the expanded water generated by the increase in temperature in a water heating or chilled water system. It maintains the necessary minimum operating pressure and ensures that all "system air" will be eliminated. It controls the increase in pressure at all critical components in the system to the maximum allowable for those components.

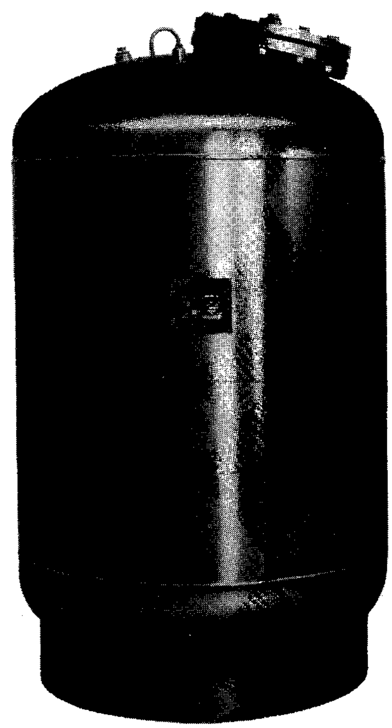
SYSTEM COMPONENTS



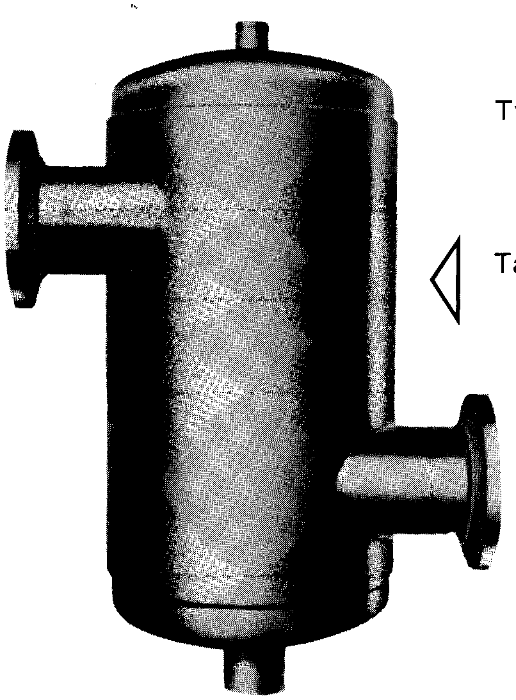
Air Elimination Valve (Model 720)



Air Separator/ Eliminator (Model 721)



Diaphragm-Type Expansion Tank



Tangential-Type Air Separator

PEERLESS PUMP®

APPLICATION OF THE PRESSURIZATION AND AIR ELIMINATION SYSTEM

COMPONENTS

1. Pressurization Controller

The pressurization controller is a diaphragm-type expansion tank with a permanent sealed-in air cushion, pre-charged to the minimum operating pressure at the location in the system where it is installed.

The minimum operating pressure consists of the static pressure plus adequate positive pressure required at the top of the system to eliminate air bubbles.

2. Air Separating and Elimination Components

The air separating and elimination component is normally installed at the point of lowest solubility of air in water, typically at a high point in the system. It consists of:

a. A tangential type air separator which separates entrained air from flowing system water by the creation of a vortex allowing free air bubbles to rise in the center, the point of lowest velocity, to an air collection chamber.

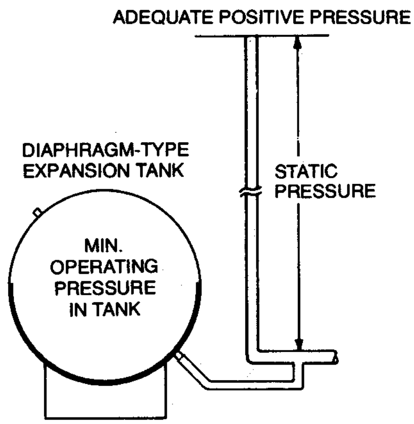
b. A unique, pilot-operated, air elimination valve, capable of eliminating air to the atmosphere as fast as it is separated from system water, through a full open orifice. In the closed position, the exit ports are sealed tight by the positive sealing force created by system pressure exerted upon surfaces of dissimilar areas.
NOTE: For detailed description, see page 9.

APPLICATION

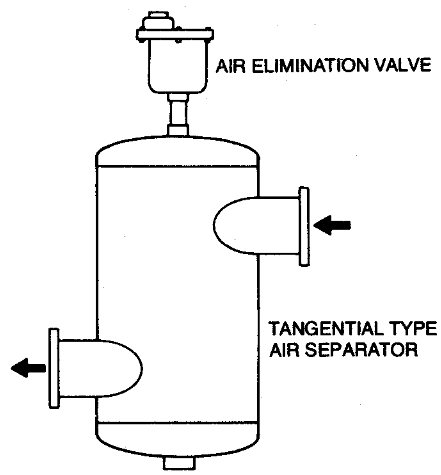
The pressurization and air elimination system is reliable, simple, and saves valuable space in the building as well as labor to install.

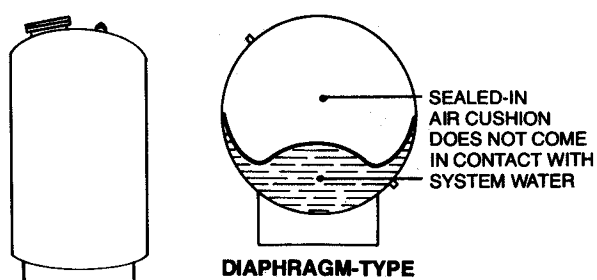
The problem of "system air" can be avoided by proper system design, exercising care to ensure a reasonably leak-proof system, and by following air elimination procedure.

The only air in the system will be the sealed-in air cushion in the diaphragm-type tank protected against contact with system water. Chemical treatment to counteract potential corrosion due to oxygen is unnecessary.

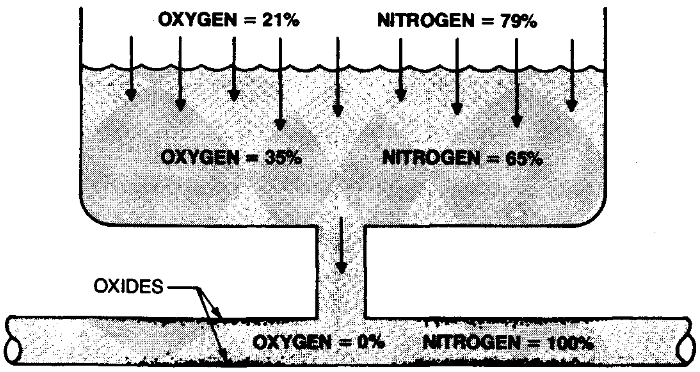


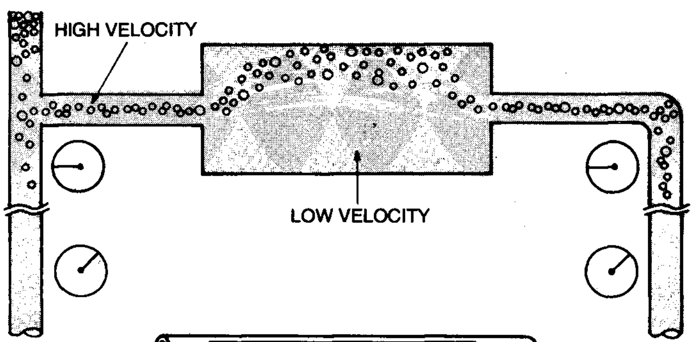
STATIC PRESSURE + ADEQUATE POSITIVE PRESSURE = MINIMUM OPERATING PRESSURE IN TANK

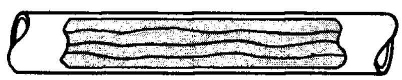




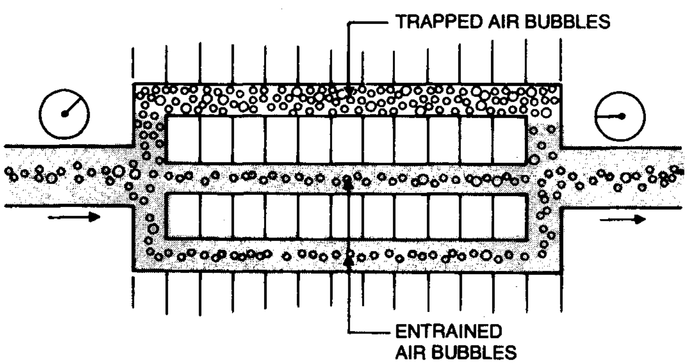
DIAPHRAGM-TYPE EXPANSION TANK



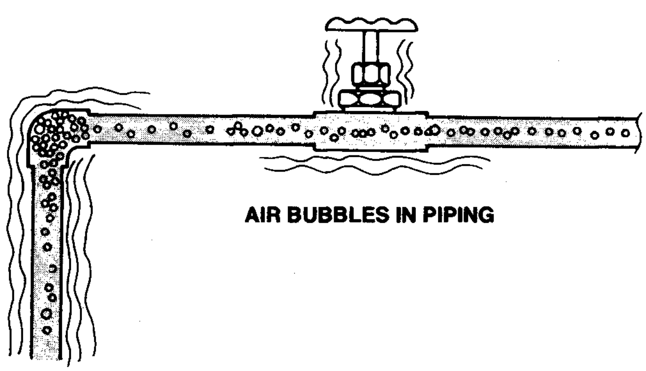




AIR IN SOLUTION



AIR BINDING OF TERMINAL UNITS



AIR BUBBLES IN PIPING

"SYSTEM AIR"

To approach the problem of "system air" we must understand its source and its effect on the system:

1. Changes in Chemical Composition

Initially, air in the system is 79% nitrogen by volume (including a small mixture of other gases) and 21% oxygen. Oxygen is absorbed more readily than nitrogen, is carried through the system in a dissolved state (in solution), and combines with metallic surfaces to form oxides.

Eventually "system air" consists only of nitrogen — unless more air enters the system, either in gaseous form, or in solution in make-up water.

2. Changes in Physical Form

a. Free Air Bubbles

Free air bubbles collect at the top of vertical or horizontal pipes and system components.

b. Entrained Air Bubbles

When system water flows at a velocity of 1.5 to 2 feet per second or more, the free air bubbles are not allowed to rise, but are carried throughout the piping system.

c. Air in Solution

Air in direct contact with water is absorbed and carried through the system in a dissolved state (in solution).

The amount of air which will be absorbed depends upon temperature and pressure. Water at higher temperature is capable of holding less air in solution. Water at lower pressures is capable of holding less air in solution.

Because pressure and temperature in a system are constantly changing, depending on location and the operating cycle, the capability of system water to hold air in solution is constantly changing.

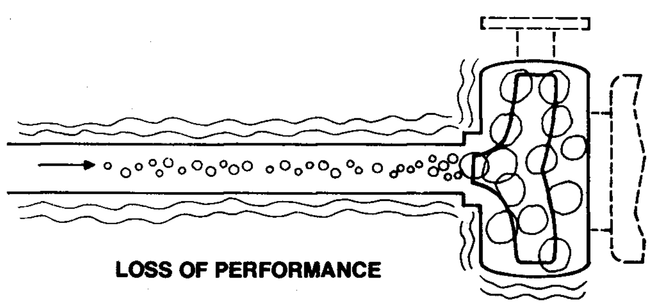
To solve the problem of system air, it is necessary to evaluate the effect of these changes.

SYMPTOMS OF SYSTEM AIR

Air binding of terminal units and accumulation of air bubbles in piping causes noise and inefficient operation.

Loss of performance in pumps and serious damage to equipment because of corrosion create expensive maintenance and replacement problems.

The energy wasted due to the presence of system air is substantial and seldom appreciated by maintenance personnel.



LOSS OF PERFORMANCE

THE SOURCES OF SYSTEM AIR

1. Initial Fill

Ideally, air should be removed at high points in the piping system and components during initial fill.

However, air pockets many times occur in horizontal piping. When system water velocity exceeds 1.5 to 2 feet per second, the air bubbles become entrained. Because of the increase in pressure at lower elevations in the piping, most, or all, of these bubbles will be absorbed and become air in solution.

2. Make-up Water

The closed hydronic system should be a tight system with as little fresh make-up water added as possible. Any air introduced to the system with make-up water should be eliminated immediately.

3. The Plain Steel Expansion Tank

The plain steel expansion tank (with no diaphragm) is a constant source of air. It is the one place in the system where water is in constant direct contact with air.

- **a.** In a heating system, during each operating cycle, expanded water enters the tank, absorbs air from the air cushion (at conditions of relatively high pressure and low temperature) and re-enters the system piping.
- **b.** In a chilled water system, the plain steel expansion tank is a prime source of air. At lower temperatures, water can hold much higher concentrations of air in solution. Air will migrate from the tank until either the system has reached its full capability to hold air in solution or until the tank is water-logged.

FORMATION OF BUBBLES

The table, Solubility of Air in Water (enlarged on page 14), shows the maximum amount of air which can be held in solution in system water at varying pressures and temperatures. When the amount of air present in the water is equal to or less than its capability to hold air in solution, absorbed air will stay in solution. When the amount of air present is greater than its capability, bubbles of released air must form.

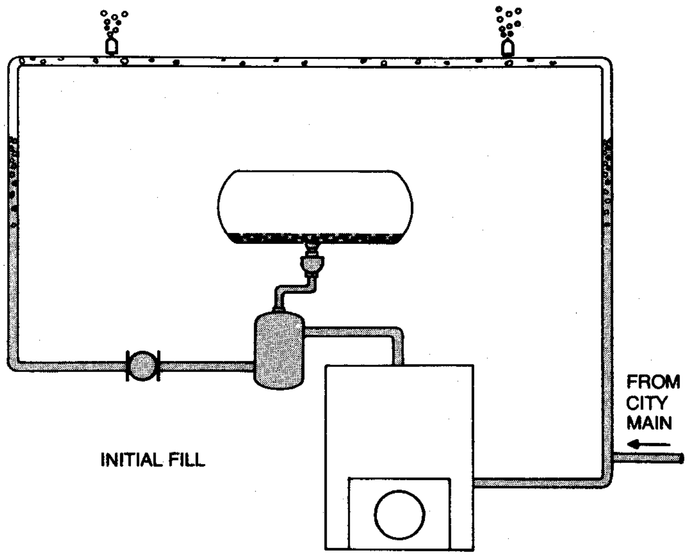
1. The Plain Steel Tank in a Heating System

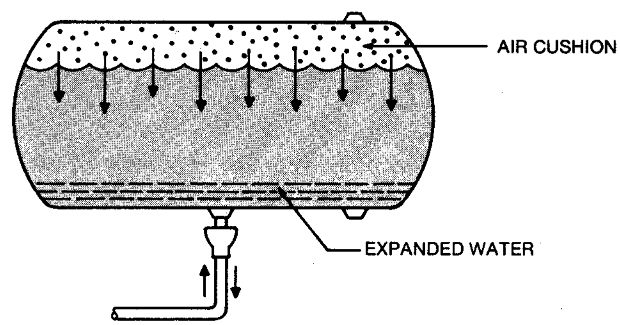
As system temperature increases, system pressure increases and the capability of the water in the plain steel expansion tank to hold air in solution increases. During each operating cycle, expanded water is forced into the tank, and then re-enters the system piping carrying its full capability, air in solution, absorbed from the air cushion in the tank.

At higher elevations in the piping system, the decrease in static pressure will normally cause the capability to drop below the equilibrium point and bubbles will form.

The bubbles will not only contain air released from solution, but water vapor. As the bubbles are carried to the top of the system, their size increases rapidly. There are three reasons for this:

- **a.** The law of perfect gases (Boyle-Mariott) will result in the volume of a given amount of gas increasing as the pressure decreases.
- **b.** As the pressure decreases, the amount of air released from solution will increase.

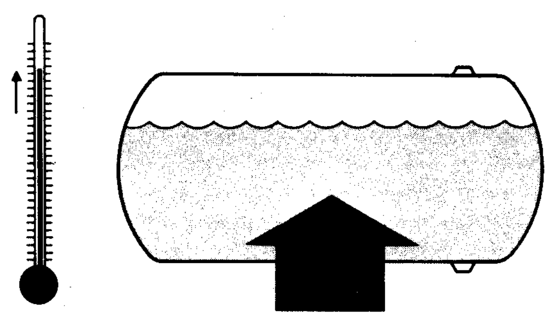




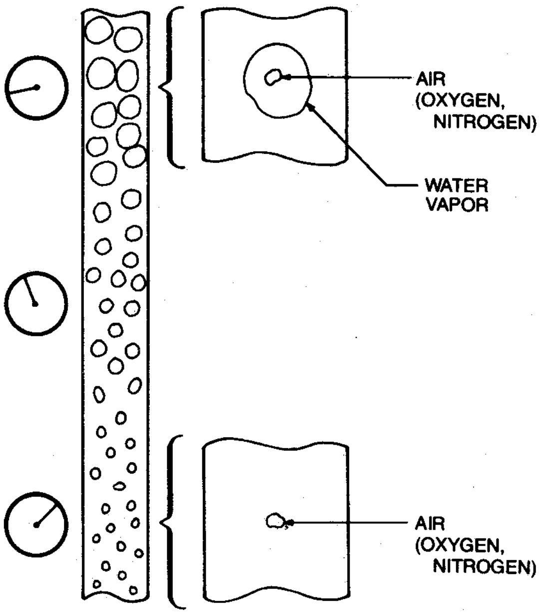
SOLUBILITY OF AIR IN WATER
RATIO OF ABSORBED AIR VOLUME TO WATER VOLUME
EXPRESSED AS A DECIMAL

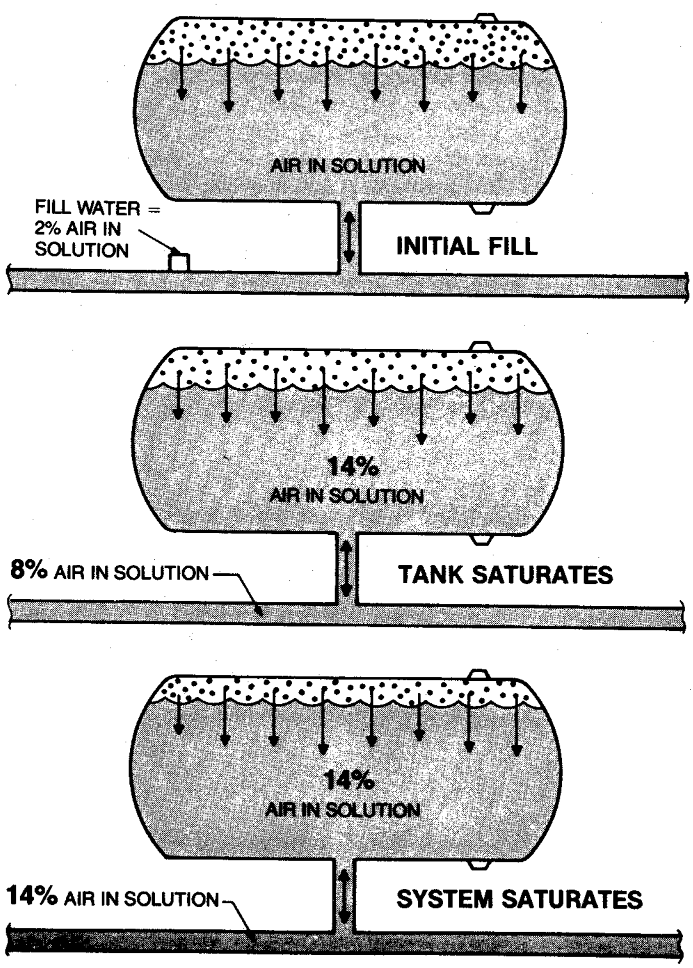
TEMP. (t) °F	PRESSURE, PSIG												
	0	10	20	30	40	50	60	70	80	90	100	110	120
40°	0.0258	0.0435	0.0613	0.0790	0.0967	0.1144	0.1321	0.1499	0.1676	0.1853	0.2030	0.2207	0.2384
50°	0.0223	0.0376	0.0529	0.0683	0.0836	0.0989	0.1143	0.1296	0.1449	0.1603	0.1756	0.1909	0.2063
60°	0.0197	0.0333	0.0469	0.0605	0.0742	0.0878	0.1014	0.1150	0.1296	0.1423	0.1559	0.1695	0.1831
70°	0.0177	0.0300	0.0423	0.0546	0.0669	0.0792	0.0916	0.1039	0.1162	0.1285	0.1408	0.1531	0.1654
80°	0.0161	0.0274	0.0387	0.0501	0.0614	0.0727	0.0840	0.0954	0.1067	0.1180	0.1293	0.1407	0.1520
90°	0.0147	0.0253	0.0358	0.0464	0.0569	0.0674	0.0750	0.0885	0.0990	0.1090	0.1201	0.1306	0.1412
100°	0.0136	0.0235	0.0334	0.0433	0.0532	0.0631	0.0730	0.0829	0.0928	0.1027	0.1126	0.1225	0.1324
110°	0.0126	0.0220	0.0314	0.0408	0.0501	0.0595	0.0689	0.0753	0.0877	0.0971	0.1065	0.1158	0.1252
120°	0.0117	0.0206	0.0296	0.0385	0.0475	0.0564	0.0654	0.0744	0.0833	0.0923	0.1012	0.1102	0.1191
130°	0.0107	0.0193	0.0280	0.0366	0.0452	0.0538	0.0624	0.0710	0.0796	0.0882	0.0968	0.1054	0.1140
140°	0.0098	0.0182	0.0265	0.0348	0.0432	0.0515	0.0598	0.0681	0.0765	0.0848	0.0931	0.1015	0.1098
150°	0.0089	0.0170	0.0251	0.0332	0.0413	0.0494	0.0574	0.0655	0.0736	0.0817	0.0898	0.0979	0.1060
160°	0.0079	0.0158	0.0237	0.0316	0.0395	0.0474	0.0553	0.0632	0.0711	0.0790	0.0869	0.0945	0.1027
170°	0.0068	0.0145	0.0223	0.0301	0.0378	0.0456	0.0534	0.0611	0.0689	0.0767	0.0844	0.0922	0.1000
180°	0.0055	0.0132	0.0208	0.0285	0.0361	0.0438	0.0514	0.0591	0.0667	0.0744	0.0820	0.0879	0.0973
190°	0.0041	0.0116	0.0192	0.0268	0.0344	0.0420	0.0496	0.0571	0.0647	0.0723	0.0799	0.0875	0.0950
200°	0.0024	0.0099	0.0175	0.0250	0.0326	0.0401	0.0477	0.0552	0.0628	0.0703	0.0779	0.0854	0.0930
210°	0.0004	0.0080	0.0155	0.0230	0.0306	0.0381	0.0457	0.0532	0.0607	0.0683	0.0758	0.0833	0.0909

Based on derivation by Professor Ferdinand Votta, Jr.,
Department of Chemical Engineering, University of Rhode Island



INCREASED TEMPERATURE → CAUSES → INCREASED PRESSURE = INCREASED CAPABILITY OF WATER IN PLAIN STEEL TANK TO HOLD AIR IN SOLUTION





c. The amount of water vapor in the bubbles is proportional to increasing temperature, decreasing pressure and increase in bubble size. The vapor pressure is a function of the water temperature. At the top of the system, with no static pressure, the total pressure on the bubble will be much closer to the vapor pressure. As a result, the amount of water vapor in the bubble may be many times greater than the amount of air in the bubbles.

Under the most ideal conditions, we could hope that the entrained gas bubbles would be carried back down to the bottom of the system, where the air would be re-absorbed in the system water and the water vapor would condense.

Experience has proven otherwise. Pervasive problems exist — noise in the piping, accumulation of bubbles in terminal units, blockage of circuit and inefficient operation.

Temporary relief can be achieved by the use of manual air vents, or by automatic air vents. However, as air is removed from the system, water-logging of the plain steel tank is accelerated.

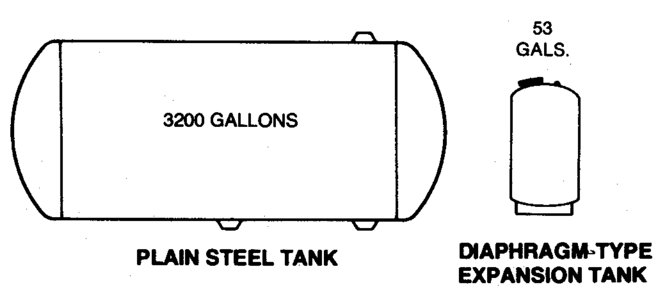
2. The Plain Steel Tank in the Chilled Water System

In the chilled water system, because of lower operating temperatures, system water can hold a much higher percentage of its volume, air in solution. As a result, the air charge in a plain steel tank is transferred as absorbed air in solution to system water in a relatively short period of time.

As a result, designers historically have used tank sizes much larger than that necessary to accommodate the expanded water in the system, in order to postpone water-logging as long as possible.

After the tank has been re-charged with air a number of times, system water will become saturated to its full capability — carrying entrained air bubbles at the top of the system, which are re-absorbed at the bottom.

A DIAPHRAGM-TYPE TANK WITH A SEALED-IN AIR CUSHION CAN BE SIZED ACCURATELY TO ACCOMMODATE THE AMOUNT OF EXPANDED WATER IN THE SYSTEM; WITHOUT OVERSIZING WHICH IS NECESSARY ONLY WITH THE PLAIN STEEL TANK.



AIR ELIMINATION SOLVES THE PROBLEM OF AIR BUBBLES

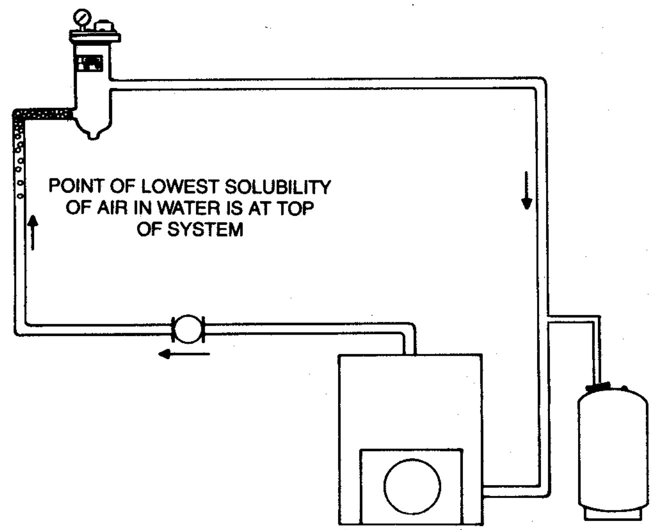
The installation of a diaphragm-type tank with a properly sized sealed-in air cushion allows the designer to eliminate "system air" and solve the problems of bubble formation.

Air separation must be accomplished at the location in the piping system where entrained air bubbles form — the point of lowest solubility of air in water, usually at the top of the system.

An air separating and elimination component at the top of the system, will allow flowing system water to enter terminal units in a deaerated condition.

The expansion tank should be placed in the system at a location where it can best perform its function in the system — usually on the suction side of the pump at the bottom of the system.

The air separation and elimination component should be placed in the system at a location where it can best perform its function — usually at the top of the system.



PUMP PERFORMANCE IN A HYDRONIC SYSTEM

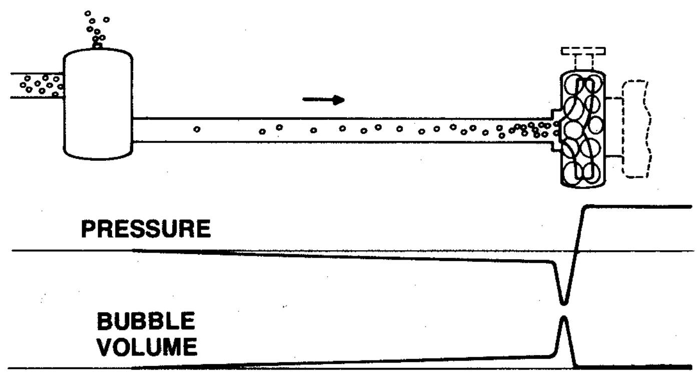
A key pump characteristic is the phenomenon of pressure reduction in the impeller eye — usually described as "required net positive suction head" ($NPSH_R$). It is generally understood that the net positive suction head available must exceed the net positive suction head requirement of a specific pump in order that the pressure at the eye of the impeller will not be less than the vapor pressure of the water at the pumping temperature.

1. Cavitation Dynamics

Cavitation occurs when vapor bubbles form in the pump impeller. As system water flows from the eye of the impeller outward to the periphery of the pump, the regained velocity head at the impeller tip increases static pressure causing any bubbles to collapse, implosion occurs.

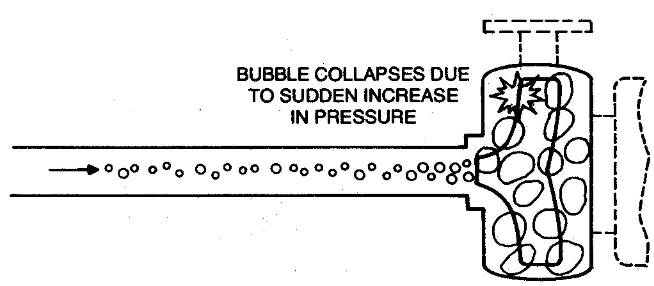
If the magnitude of the implosion is severe, particles of water are propelled with tremendous force against the surface of the impeller. The impingement of these particles can cause pitting of the surface, noise, vibration, and damage to seals and bearings.

When no air in solution is present, the bubbles are pure vapor. When there is air in solution, the bubbles consist of both air and water vapor.

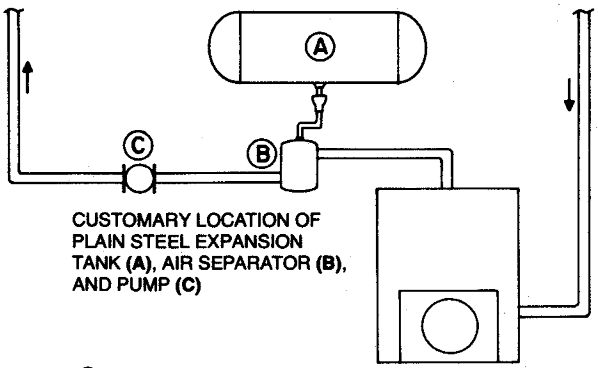


2. Formation of "Air" Bubbles at the Pump Interior

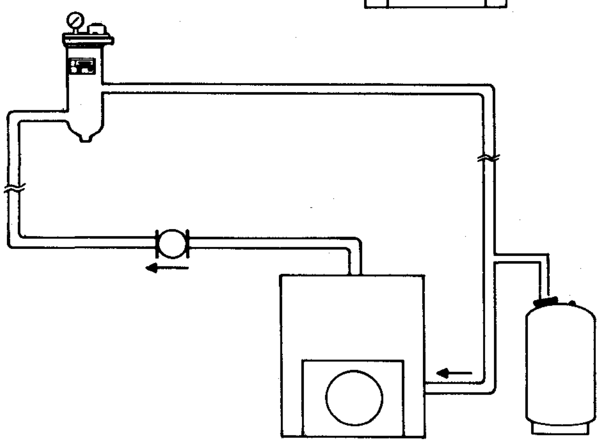
When water flowing to the pump suction is not deaerated but is at the equilibrium point, containing air in solution, bubbles will form at pressures far higher than the vapor pressure. Just as the decrease in static pressure at higher elevations in the system causes bubbles to form, the decrease in pressure which occurs as water flows to the interior of the pump causes bubbles to form. Similarly, the bubbles will not only contain air released from solution, but also water vapor, and the bubbles will grow rapidly in size as the pressure decreases.

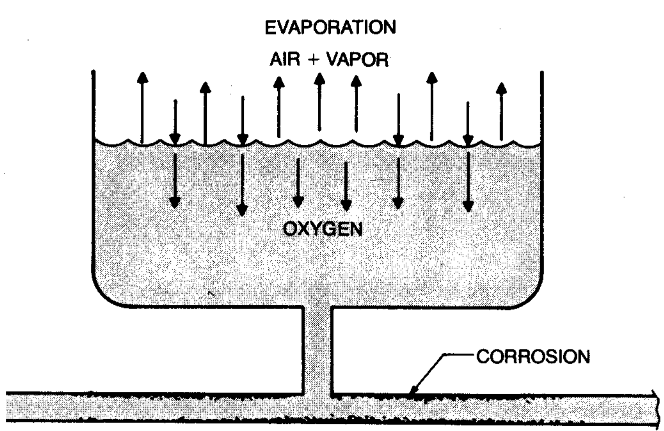


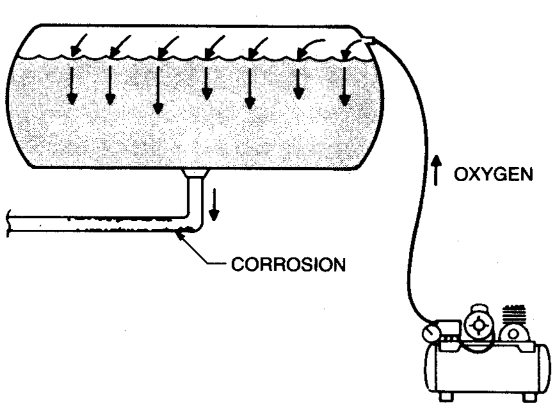
With a plain steel expansion tank and air separation device installed at the customary location adjacent to the pump suction, it can be assumed that any time during the operating



CUSTOMARY LOCATION OF PLAIN STEEL EXPANSION TANK **(A)**, AIR SEPARATOR **(B)**, AND PUMP **(C)**







cycle that entrained air bubbles are separated, the system water entering the pump will be at the saturation point. Since bubbles must form with any pressure decrease, the net positive suction pressure available should be increased to minimize the effect of these bubbles. The effects of these bubbles may be a reduction in pump performance, and in some cases a complete loss of head.

AIR ELIMINATION SOLVES THE PROBLEM OF BUBBLE FORMATION ABOVE THE VAPOR PRESSURE INSIDE THE PUMP

The diaphragm-type tank installed at the best location for proper system operation (normally at the pump suction at the bottom of the system) combined with the air separation and elimination component installed at the best location for this device (normally at the top of the system) will allow the problem of bubble formation to be solved (as shown at left).

Reference to the Table, Solubility of Air in Water, page 14, the operating temperature and pressure at the location of the air separation and elimination component will show the amount of air remaining in solution in the system water after elimination has taken place. If this amount is lower than the capability of water to hold air in solution at the pressure and temperature at the eye of the pump impeller, no bubbles will form unless the actual vapor pressure is reached.

CORROSION

1. Open System

The expansion tank installed at the top of the system, open to the atmosphere, is a souce of continuous oxygen contamination.

At the exposed surface of the water, oxygen is absorbed and transferred to system piping — an "open system".

Water vapor forms at the surface and escapes to the atmosphere. The water lost through evaporation must be replaced by make-up water carrying more oxygen.

Dust carried in the atmosphere is accumulated in system water. Suspended solids cause erosion in piping and equipment. In spite of chemical treatment, deposits of dirt at the bottom of horizontal piping cause localized pitting.

2. Closed Systems

The plain steel expansion tank (no diaphragm) contains, in theory, a trapped air cushion; and the system is referred to as a "closed system". Actually the "trapped air" eventually escapes into the system water and the tank becomes waterlogged — recharging with new air is necessary.

The use of a compressor to maintain the air cushion has become quite common, particularly on larger jobs.

In a sense, the system is no longer a closed system, but has become an open system. Oxygen is absorbed readily by water in the system; and combines with metal to form oxides. An efficient "oxygen pump" is created.

In a chilled water system, the corrosion rate is slower than in a heating system, but because of the lower temperature, the water can hold a relatively high percentage of its volume, oxygen in solution. Eventually, all the oxygen in the system will unite with metal. Corrosion is potentially very serious in the chilled water system.

CHEMICAL TREATMENT

Because a "closed system" so often becomes an "open system", chemical treatment has become more common. But this solution to the problem of corrosion is, in some ways, as troublesome as the original problem.

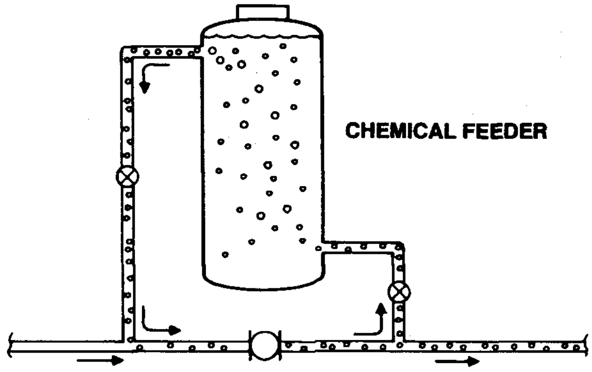
Too small an amount of one chemical could cause pitting. Excessive amounts added intermittently cause problems which could be avoided by constant feeding based on monitored results. The method of feeding can result in more oxygen being introduced to the system. Standard materials used for pump seals fail when exposed to high concentrations of certain chemicals. Special costly materials may have to be substituted.

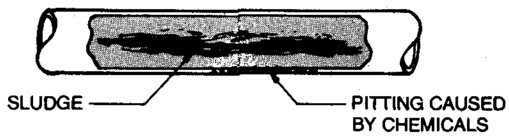
Accumulation of sludge causes inefficient operation. Frequent boiler blowdown is expensive.

Continued dumping of pervasive toxic waste into public sewer systems or streams is a questionable procedure in view of public concern over safety hazards.

The technology of applying chemicals seemingly requires highly trained specialists following careful, consistent, monitoring procedures which appear rather mystical to many engineers involved in maintenance.

In all of these different areas of concern, the role of the specifying engineer, contractor, owner or chemical specialist is difficult to define. Either overlapping responsibility or lack of responsibility is the result of this confusion.

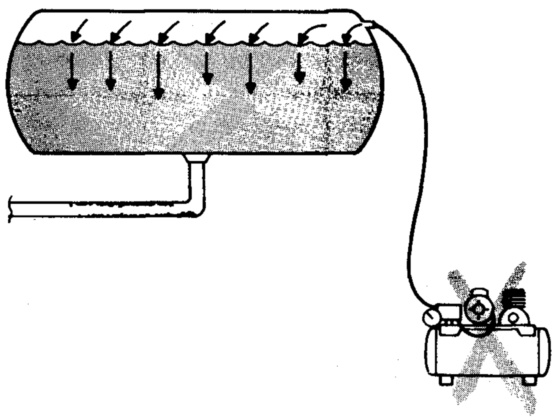


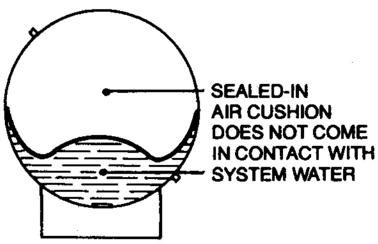


AIR ELIMINATION SOLVES THE PROBLEM OF OXYGEN CORROSION

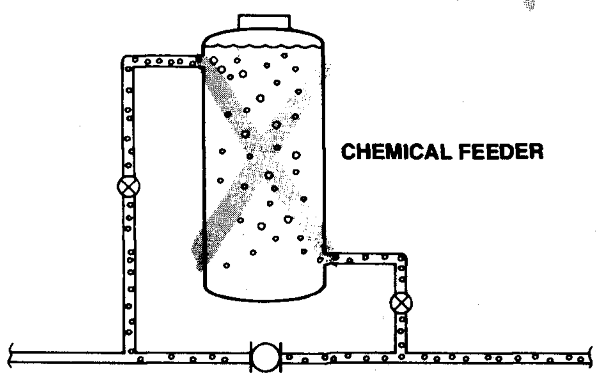
The diaphragm-type tank offers a better solution to the problem of corrosion caused by oxygen. Because the required size air cushion is permanently sealed in, all other air in the system can be eliminated. The oxygen in system water at initial fill can be eliminated before system corrosion takes place.

With reasonable care, the addition of make-up water can be minimized. No air need be added to re-charge a water-logged plain steel tank. The "oxygen pump" can be replaced. With proper PH control and, except in areas with abnormal water conditions, no chemicals to combat oxygen corrosion need be added to the water heating and chilled water system.





DIAPHRAGM-TYPE EXPANSION TANK



Diaphragm Hydro-Pneumatic Tank Design

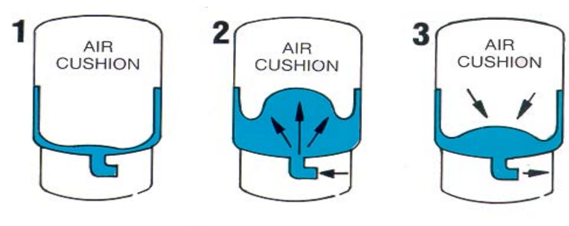
A specially compounded flexible diaphragm securely sealed into a sturdy tank separates the system air cushion from system water and maintains design expansion capacity.

1 No system water will enter the tank until the system pressure exceeds the air charge pressure. A small diaphragm tank provides the equivalent expansion capacity of a much larger conventional type compression tank.

2. When the heated water expands and enters the tank, the rugged diaphragm flexes... it doesn't stretch, as the permanent air cushion is compressed.

3. As system pressure decreases the air charge returns the expanded water to the system.

Water logged expansion tank and discharging relief valve are eliminated, and system corrosion is drastically reduced by systems removing the principal source of air found in hydronic systems



The Solution

Prevents Water logging

The plain steel expansion tank (with no diaphragm) is a constant source of air. It is the one place in the system where water is in constant direct contact with air.

In a heating system, during each operating cycle, expanded water enters the tank, absorbs air from the air cushion (at conditions of relatively high pressure and low temperature) and re-enters the system piping

In a chilled water system, the plain steel expansion tank is a prime source of air. At lower temperatures, water can hold much higher concentrations of air in solution. Air will migrate from the tank until either the system has reached its full capability to hold air in solution or until the tank is waterlogged.

With an diaphragm tank, air and water never mix and water logging is prevented.

Efficient Elimination of Air

The most serious potential problem to a heating system is oxygen corrosion. diaphragm tanks offer the best solution to this problem because the required system air cushion is sealed in and additional air in the system is eliminated minimizing oxygen corrosion.

Hydraulic Stability

Diaphragm tanks ensures maximum operating efficiency by maintaining a balance of design pressure ranges for the life of the system.

Easy Installation and Maintenance

Heavy weight plain steel tanks require additional installation costs for ceiling mounting pads, heavy duty support racks, rigging, draining and recharging. Diaphragm tanks eliminate all these costs because they are only a fraction of the size and weight of plain steel tanks. They eliminate the unnecessary heating of large quantities of system water and so save costly BTUs.

SIZING THE DIAPHRAGM-TYPE HYDRO-PNEUMATIC TANK

Critical Sizing Procedure

THINGS YOU MUST KNOW:

1. **Total System Water Content………………………(1)_______gallons**

2. **Minimum System Temperature……………………(2)_______°F.**

3. **Maximum System Temperature……………………(3)_______°F.**

4. **Minimum Operating Pressure at Tank…………….(4)_______PSIG**

5. **Maximum Operating Pressure at Tank…………..(5)_______PSIG**

SELECTION OF MODEL:

6. **Find and enter "Net Expansion Factor" (use TABLE 1)……(6)_________**

7. Amount of Expanded Water = line (1) x line(6)……………..(7)_______________gallons

8. **Find and enter "Acceptance Factor" (TABLE 2……………..(8)_________**

9. **Minimum Total Tank Volume = line (7) - line (8) …………..(9)________gallons**

10. **Using TABLE 3 a, b, c, d, select a tank that is at least equal to line (9) for "Total Volume" and line (7) for Max. Expanded Water Acceptance Gallons**

TABLE 1... NET EXPANSION OF WATER

Max. System Temp. °F.	Minimum System Temperature °F						
	40°F	50°F	60°F	70°F	80°F	90°F	100°F
60°F	.00050	.00490	-	-	-	-	-
70°F	.00149	.00143	.00094	-	-	-	-
80°F	.00260	.00254	.00204	.00111	-	-	-
90°F	.00405	.00399	00350	.00256	.00145	-	-
100°F	.00575	.00569	.00520	.00426	.00315	.00170	-
110°F	.00771	.00765	.00716	.00622	.00511	.00366	.00196
120°F	.01000	.00990	.00950	.00860	.00740	.00600	.00430
130°F	.01240	.01230	.01180	01090	00980	00830	00660
140°F	.01500	.01490	01450	01350	01240	01100	00930
150°F	.01790	.01780	.01730	.01640	.01530	.01330	.01210

Max. System Temp. °F.	Minimum System Temperature °F						
	40°F	50°F	60°F	70°F	80°F	90°F	100F
160°F	.0209	.0208	.0204	.0194	.0181	.0165	.0148
170°F	.0242	.0241	.0236	.0227	.0216	.0201	.0184
180°F	.0276	.0275	.0271	.0261	.0250	.0236	.0219
190°F	.0313	.0312	.0307	.0298	.0287	.0272	.0255
200°F	.0351	.0350	.0346	.0336	.0325	.0311	.0294
210°F	.0391	.0390	.0386	.0376	.0365	.0351	.0334
220^{1}F	.0434	.0433	.0428	.0419	.0408	.0393	.0376
230^{0}F	.0476	.0475	.0471	.0461	.0450	.0436	.0419
240°F	.0522	.0521	.0517	.0507	.0496	.0482	.0465

TABLE 2...ACCEPTANCE FACTORS

Maximum Operating Pressure at Tank (Psig)	Minimum Operating Pressure at Tank (Psig)										
	5	10	12	15	20	30	40	50	60	70	80
27	0.527	0 408	0.360	0.288	0.168	-	-	-	-	-	-
30	0.560	0.447	0.403	0.336	0.224	-	-	-	-	-	-
35	0.604	0.503	0.463	0.403	0.302	0.101	-	-	-	-	-
40	0.640	0.548	0.512	0.457	0.366	0.183	-	-	-	-	-
45	0.670	0.586	0.553	0.503	0.419	0.251	0.084	-	-	-	-
50	0.696	0.618	0.587	0.541	0.464	0.309	0.155	-	-	-	-
55	0.717	0.646	0 617	0.574	0.502	0.359	0.215	0.072	-	-	-
60	0.736	0.669	0.643	0.602	0.536	0.402	0.268	0.134	-	-	-
65	0.753	0.690	0.665	0.627	0.565	0.439	0.314	0.188	0.062	-	-
70	0.767	0.708	0.685	0.649	0.590	0.472	0.354	0.236	0.118	-	-
75	0.780	0.725	0.702	0.669	0.613	0.502	0.390	0.279	0.167	0.056	-
80	0.792	0.739	0.718	0.686	0.634	0.528	0.422	0.317	0.211	0.106	-
90	0.812	0.764	0 745	0.716	0.669	0.573	0.478	0.382	0.287	0.191	0.096
100	0 828	0 785	0 767	0.741	0 698	0.610	0.523	0 436	0 347	0.261	0.174
110	0.842	0.802	0.786	0.762	0.723	0.642	0.561	0.481	0.401	0.321	0.241

AX Series Tanks are ASME certified and come in two styles, vertical and horizontal, that can be installed in a suspended or free standing configuration. Eleven sizes are available in total tank volumes from 8 to 132 gallons. Table 3a

MAX WORKING PRESSURE: 125 psig
MAX. OPERATING TEMP: 240F

Model No.	Tank Volume (Gallons)	Max. Accept. (Gallons)	Vert. Series Height Inches	Series Length Inches	Dia. Inches
AX-15	7.8	2.40	-	19.00	12
AX-20	10.9	2.40	-	25.75	12
AX-40	21.7	4.80	-	49.00	12
AX-60	33.6	11.30	42.75	42.25	16
AX-80	44.4	22.60	56.00	55.25	16
AX-100	55.7	22.60	69.00	68.25	16
AX-120	68.0	34.00	44.25	40.25	24
AX-144	77.0	34.00	49.12	45.12	24
AX-180	90.0	34.00	56.50	52.50	24
AX-200	110.0	34.00	67.00	63.00	24
AX-240	131.7	45.20	76.25	74.25	24

TABLE 3a

L Series Tanks are ASME certified and eleven sizes are available in total tank volumes from 53 to 528 gallons. They are free standing on integral floor stands and are easily installed. Table 3b

MAX.WORKING PRESSURE: 125 psig
MAX. OPERATING TEMP: 240F

Model No.	Tank Volume (Gallons)	Max. Accept. (Gallons)	Height Inches	Dia. Inches
200-L	53	53	37.81	24
300-L	79	79	51.75	24
400-L	105	105	65.69	24
500-L	132	132	79.62	24
600-L	158	158	65.00	30
800-L	211	211	83.00	30
1000-L	264	264	73.50	36
1200-L	317	317	85.88	36
1400-L	370	370	98.25	36
1600-L	422	422	71.25	48
2000-L	528	528	85.25	48

TABLE 3b

WX-"L" Series Tanks are ASME certified and seven models are available in total tank volumes from 158 to 528 gallons. Free standing on integral floor stands for easy installation, they are designed for use with potable water. Table 3c

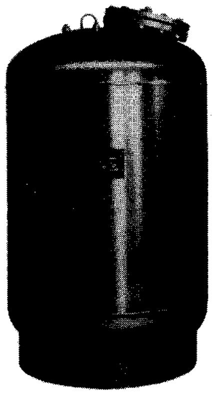
MAX. WORKING PRESSURE:125 psig
MAX. OPERATING TEMP: 240F

Model No.	Tank Volume (Gallons)	Max. Accept. (Gallons	Height Inches	Dia. Inches
WX-600-L	158	158	72.31	30
WX-800-L	211	211	90.25	30
WX-1000-L	264	264	84.50	36
WX-1200-L	317	317	97.00	36
WX-1400-L	370	370	109.25	36
WX-1600-L	422	422	80.50	48
WX-2000-L	528	528	93.50	48

TABLE 3c

PEERLESS PUMP®

PRESSURIZATION AND AIR ELIMINATION SYSTEM COMPONENTS



DETAILED DESCRIPTION

1. Pressurization controller

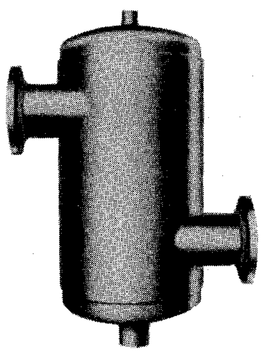
The pressurization controller, or diaphragm-type tank is available in three different models.

The L Series up to 528 gallon volume, with a replaceable diaphragm.

The AX Series, up to 131.7 gallons. Both the L Series and AX Series may be installed horizontally or vertically, free standing on an integral floor stand.

The AX300, 150 gallon volume for vertical installation only, has an integral floor stand.

All three models above are ASME designed and constructed.



2. Tangential-Type Air Separator

The tangential-type air separator, with low velocity vortex, is designed for use with the air elimination system, without a strainer and without baffling, in order to keep friction loss at a minimum. Since any pressure drop at the outlet of any air separation device immediately reduces the capability of water to hold absorbed air in solution, entrained or free air bubbles in system water can result from the installation of a strainer in the air separator — low pressure drop through the air separator is critical.

3. Model 720 Air Elimination Valve

The Model 720 Air Elimination Valve is designed to eliminate air to the atmosphere as fast as it is separated from water

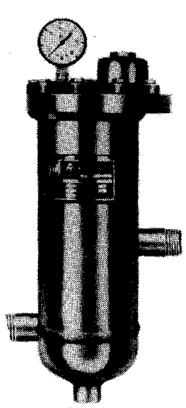
The valve consists of a body containing system water and air, a bolted-on cover into which is assembled a pilot operated elimination mechanism; and a float.

The function of the float is to position a piston moving vertically through a unique diaphragm within the elimination mechanism.

The top of the piston moves through a tight fitting hole in the top of the diaphragm.

The lower part of the piston moves through a tight fitting hole in the bottom of the diaphragm.

Between both top and bottom holes in the diaphragm, there is an intermediate chamber connected by ports to the upper surface of the diaphragm.



4. Model 721 Air Separator/Eliminator

The Model 721 Air Separator/Eliminator combines the functions of the Tangential-Type Air Separator with those of the Model 720 Air Elimination Valve into one economical, easily installed, compact, integral unit.

It features a combination vortex separator and patented remote pilot piston air elimination valve that uses the system pressure itself for tight sealing. Prevents air from entering system in vacuum conditions.

By-pass around terminal heat transfer unit ensures flow through air separator/eliminator at all times

By-pass around circulating pump creates low point of solubility at pump location

Compact size allows installation at top of system in finished space or ceiling crawl space. ASME "UM" coded.

PEERLESS PUMP®

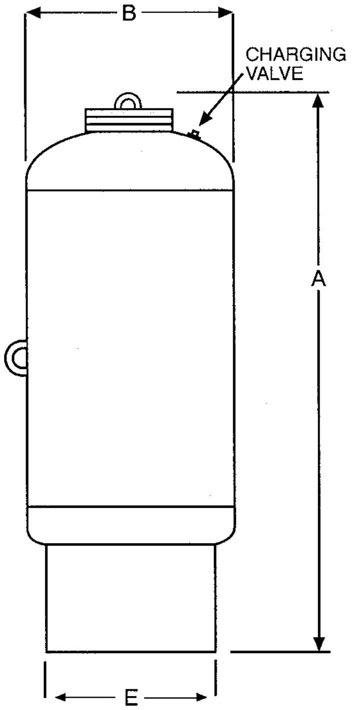
WX-440-C/450-C Series (ASME)

125 PSIG Working Pressure

ASME Models

Model No.	Tank Vol.		Max. Acc. Factor	A Height		B Diameter		Sys. Conn.	C	D	E	Ship Wt.	
	Lit.	Gal		mm	ins.	mm	ins.	ins.	ins.	ins.	ins.	kg	lbs.
WX-447-C	200	53	.65	1150	45¼	610	24	2	2	3¾	19	120	263
WX-448-C	300	80	.65	1502	59⅛	610	24	2	2	3¾	19	140	308
WX-449-C	400	106	.65	1857	73⅛	610	24	2	2	3¾	19	160	352
WX-450-C	500	132	.65	2200	86⅝	610	24	2	2	3¾	19	178	392
WX-451-C	600	158	.65	1867	73¼	762	30	2	3½	5½	24	233	513
WX-452-C	800	211	.65	2312	91	762	30	2	3½	5½	24	275	607
WX-453-C	1000	264	.65	2184	86	914	36	3	4½	7	30	367	810
WX-454-C	1200	317	.65	2489	98	914	36	3	4½	7	30	415	914
WX-455-C	1400	370	.65	2804	110⅜	914	36	3	4½	7	30	462	1018
WX-456-C	1600	422	.65	2080	81⅞	1220	48	3	7½	7⅛	42	567	1250
WX-457-C	2000	528	.65	2470	97¼	1220	48	3	7½	7⅛	42	616	1358

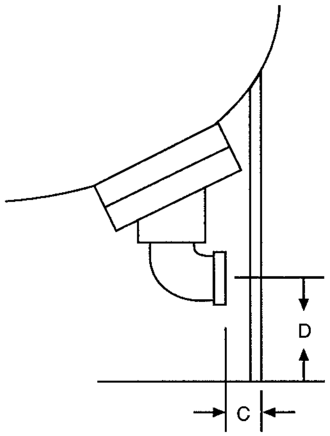
Note: Allow 18" (460mm) minimum clearance.



Maximum Operating Conditions

Operating Temperature	240° F (115° C)
Working Pressure	125 PSIG (8.8 kg/cm^2)* ASME

* Also available with optional working pressure of 175 PSIG or 250 PSIG.



Specifications

Description	Standard Construction
Shell	Steel
Bladder	Heavy Duty Butyl
System Connection	Malleable Iron (NPTF)
Coating	Red Oxide Primer
Factory Precharge	25 PSIG (1.8 kg/cm^2)

Constructed per ASME Code Section VIII.
All dimensions and weights are approximate.

CODE APPROVALS

City of Los Angeles

Job Name ______________________

Location ______________________

____

____

Engineer ______________________

Contractor ______________________

Contractor P.O. No. ______________________

Sales Representative ______________________

Model No. Ordered ______________________

ASME CERTIFICATION REQUIRED ❑ YES ❑ NO

PEERLESS PUMP®

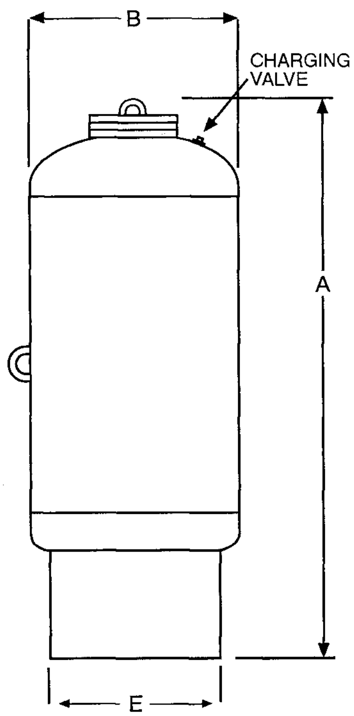
WX-440-C/450-C Series (ASME)

175 PSIG Working Pressure

ASME Models

Model No.	Tank Vol. Lit.	Tank Vol. Gal	Max. Acc. Factor	A Height mm	A Height ins.	B Diameter mm	B Diameter ins.	Sys. Conn. ins.	C ins.	D ins.	E ins.	Ship Wt. kg	Ship Wt. lbs.
WX-447-C	200	53	.65	1165	45 7/8	610	24	2	2	3 3/4	19	141	310
WX-448-C	300	80	.65	1519	59 13/16	610	24	2	2	3 3/4	19	184	404
WX-449-C	400	106	.65	1873	73 3/4	610	24	2	2	3 3/4	19	226	495
WX-450-C	500	132	.65	2226	87 5/8	610	24	2	2	3 3/4	19	267	585
WX-451-C	600	158	.65	1880	74	762	30	2	3 1/2	5 1/2	24	308	675
WX-452-C	800	211	.65	2337	92	762	30	2	3 1/2	5 1/2	24	373	817
WX-453-C	1000	264	.65	2184	86	914	36	3	4 1/2	7	30	515	1,130
WX-454-C	1200	317	.65	2489	98	914	36	3	4 1/2	7	30	588	1,290
WX-455-C	1400	370	.65	2804	110 3/8	914	36	3	4 1/2	7	30	661	1,450
WX-456-C	1600	422	.65	2080	81 7/8	1220	48	3	7 1/2	7 1/8	42	798	1,750
WX-457-C	2000	528	.65	2470	97 1/4	1220	48	3	7 1/2	7 1/8	42	926	2,030

Note: Allow 18" (460mm) minimum clearance.



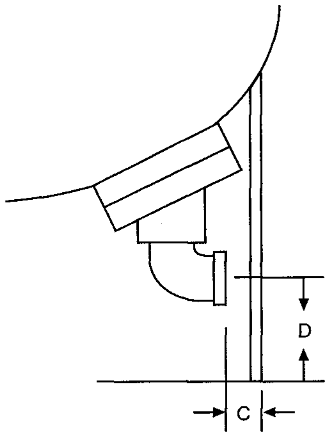
Maximum Operating Conditions

Operating Temperature	240° F (115° C)
Working Pressure	175 PSIG (12.3 kg/cm^2) ASME

Specifications

Description	Standard Construction
Shell	Steel
Bladder	Heavy Duty Butyl
System Connection	Malleable Iron (NPTF)
Coating	Red Oxide Primer
Factory Precharge	25 PSIG (1.8 kg/cm^2)

All dimensions and weights are approximate.



CODE APPROVALS

City of Los Angeles

Job Name ____________________

Location ____________________

____

____

Engineer ____________________

Contractor ____________________

Contractor P.O. No. ____________________

Sales Representative ____________________

Model No. Ordered ____________________

ASME CERTIFICATION REQUIRED ❑ YES ❑ NO