Air Eliminator Series

ARMSTRONG

Air Separation Equipment

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Air Separation Equipment

Modern sealed heating and cooling systems are expected to operate within designed parameters incorporating high efficiency boilers, chillers, pumps etc. together with valve-control technology which allows for effective distribution of the pumped medium. However, the presence of air in the system in the form of both free-air and dissolved gases can present serious problems of corrosion, noise and reduced efficiency of the pumping equipment, as well as causing unnecessary long delays for commissioning at site.

▶ Causes of air occurring in system

To avoid or solve these problems, it is necessary to analyse the causes of air being present in a system.

Air present in a heating or cooling system may consist of:–

1. Air which is present before or during the filling of the system.
2. Air bubbles in the water which collect after the system is filled.
3. Air which comes into the system in the form of bubbles or micro-bubbles entrained in the water.
4. Air which is dissolved in the water of the system.

The presence of air dissolved in water can be explained by reference to Henry's Law. This states that $C = K \times P$

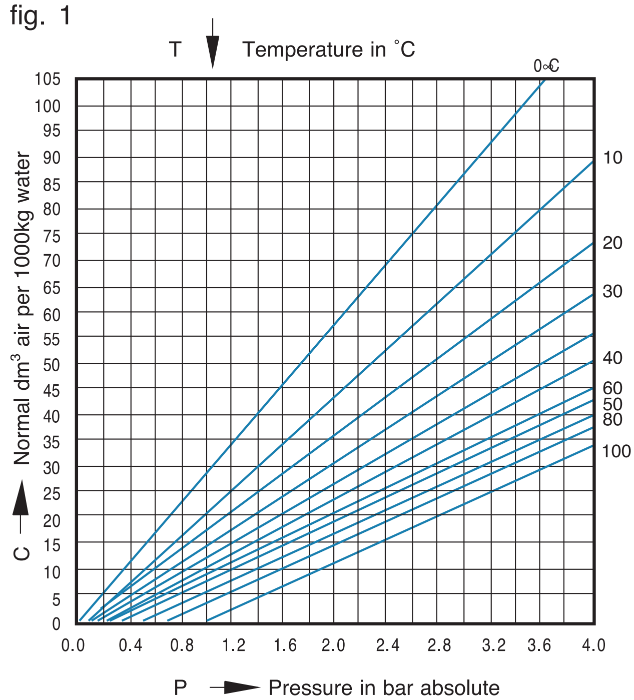
where:–

C = concentration of dissolved air

K = absorption factor (dependent on the temperature)

P = Pressure

fig. 1



Removal of air in sealed systems

The presence of air can also lead to:-

1. Damage to the circulating pump such as wear to the pump and motor bearings and shock damage to the impeller hubs, causing premature failure to impeller, mechanical seal and eletric motor shafts (close-coupled pumps).

2. Damage to the mechanical seal due to partial dry running at the seal faces. The increase in temperature causes vapourisation resulting in the deposit of salts from the pumped water, in systems containing water treatment. This in turn damages the sealing faces resulting in premature leakage.

3. Malfunction of pressurisation units (low pressure lock-out) in sealed systems. If systems are installed without adequate venting devices air will collect in pockets at high points throughout the system.

   On start-up the circulating pump will momentarily search for optimum resistance which, due to the system not being completely full of water, will be artificially low. Under this condition the pump will work down to the low point of its performance curve. This causes an abnormal low pressure condition at the suction to the pump, which can in turn activate the low pressure cut-out switch on the pressurisation unit, which if interlocked, will switch the pump off.

   Pressure at this stage will revert to static pressure and reset the low pressure cut-out switch. If not attended to the cycle of events will repeat itself.

Venting

Inadequate venting devices will allow gases created by the chemical action between the system water and the water- treatment chemicals to build up. This can have a serious effect on the efficiency of the equipment in the system. Removal of these gases is therefore essential in order to maintain optimum performance from equipment.

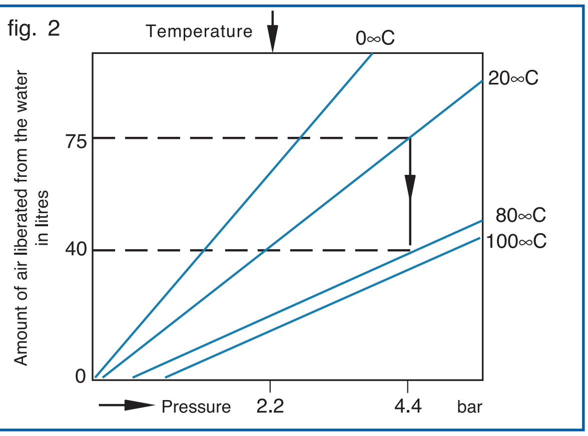
Figure 1.

From fig. 1 left, it is apparent that the amount of air which is dissolved in water is dependent upon temperature and pressure. Air dissolved in water is liberated when the temperature rises or the pressure falls.

▶ Applying Henry's Law in heating systems

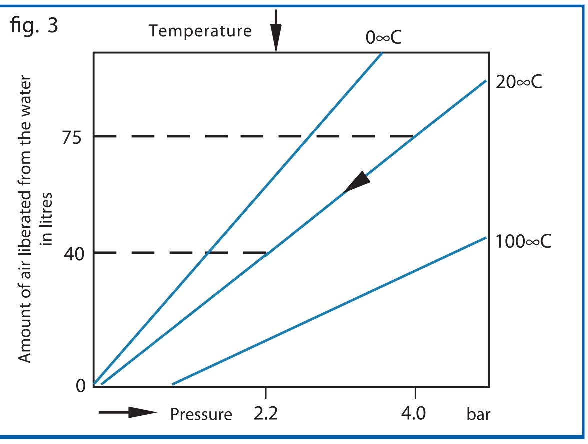
When the temperature of water at constant pressure is raised e.g. from 20°C to 80°C, Henry's Law can be used to determine the amount of dissolved air which is liberated from the water. See fig. 2.

fig. 2



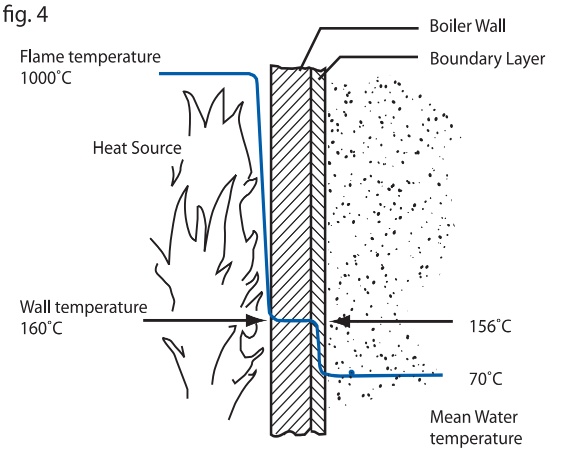
Lowering the pressure of the water at constant temperature also results in dissolved air being liberated. See fig. 3.
If the temperature falls and the pressure increases the reverse happens and any air bubbles present will then be dissolved (absorbed) in the water.

fig. 3



This natural phenomenon is, for example, encountered in central heating systems. Very high temperatures occur at the combustion chamber wall of the boiler, see fig. 4. It is here that very small air bubbles will be liberated from the water containing air.

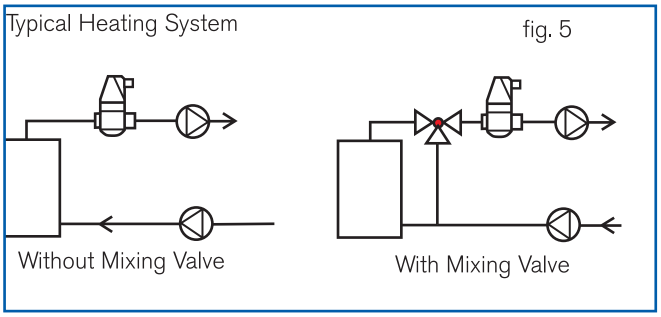
fig. 4

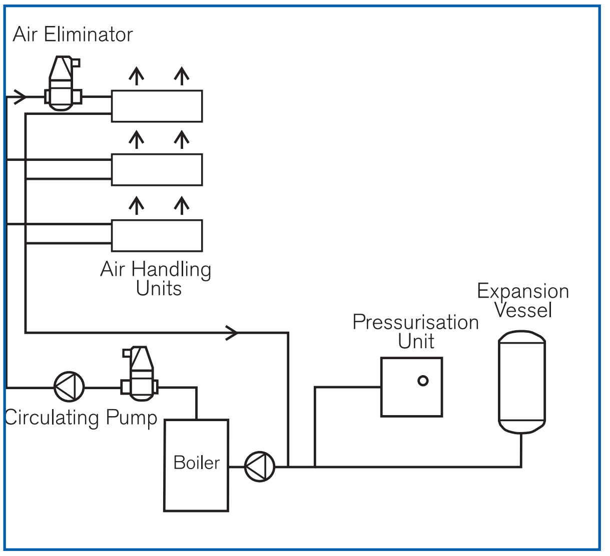


These so-called micro-bubbles will be re-dissolved elsewhere in the system where the temperature is lower, unless they are removed immediately upon leaving the boiler. This is the point where the air eliminator should be installed so that air-free (unsaturated) water will result see fig. 5.

Air present elsewhere in the system can be dissolved (absorbed) in the water. This absorption effect is utilised to bind all the free-air in the systems and vent it to the atmosphere by the actions of the automatic air vent which forms part of the Armstrong air eliminator. This venting process operates continuously until eventually the water that remains is very unsaturated and absorbent.

Recommended position of Micro-bubble Air Eliminators in a typical heating system





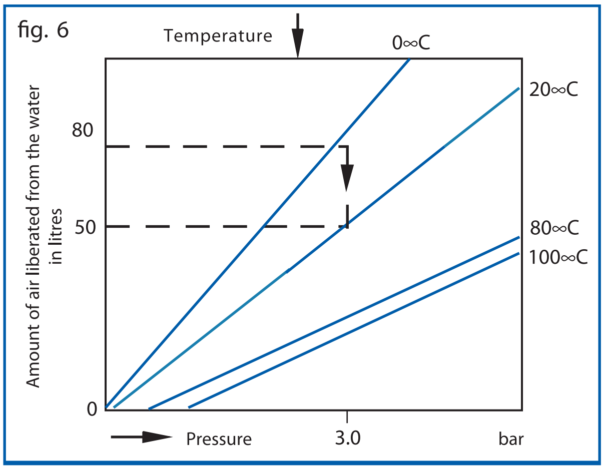
Static head above 30m

The company recommends the installation of a Armstrong Holden Brooke Pullen air eliminator on each floor over 30m.

Applying Henry's Law in cooling systems

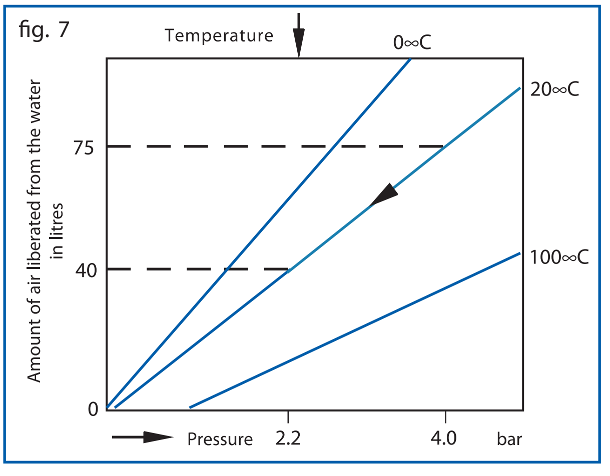
In cooling systems part of the air in the system is dissolved in the water and part appears as air bubbles. When water, together with air, passes through the system it encounters different temperatures and pressures. Henry's Law states that during temperature and pressure fluctuations air is successively liberated from, and dissolved into water.

In cooling systems pressure changes have a greater influence on the formation of air bubbles than do temperature changes, which are much lower than those occurring in heating systems. When the temperature of the water at constant pressure is raised, for example, from 0°C to 20°C, Henry's Law can be used to determine the amount of dissolved air which is liberated from the water. See fig. 6.



Lowering pressure of water at constant temperature results in dissolved air being liberated. See fig. 7.

Therefore, the largest air bubbles will appear in those parts of the system with low pressure (the uppermost part of the circuit). This is the most appropriate position to place the air eliminator. See fig. 8 on page 6.



▶ Recommended position of Micro-bubble Air Eliminators in chilled water systems

The other decision to make is whether to install the air eliminator before or after
(a) the cooling coil and
(b) the circulating pump.

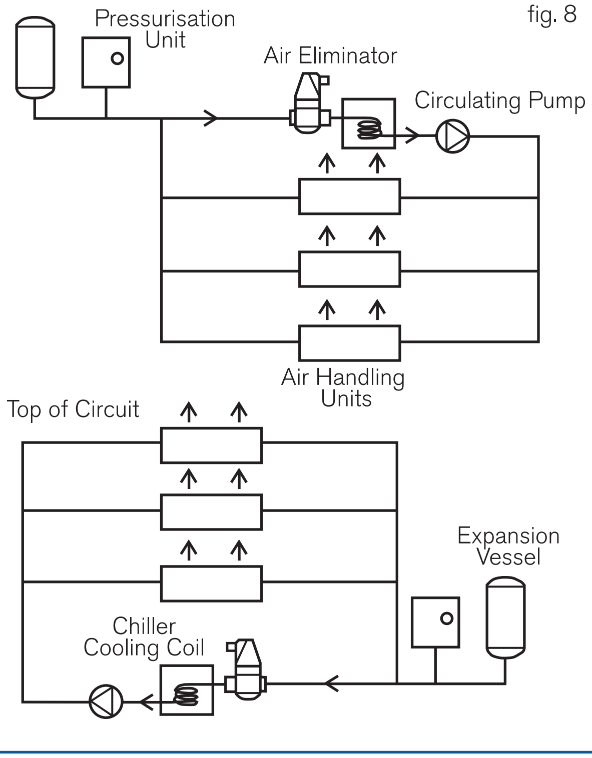
a) The water temperature inside the chiller coil, by virtue of its function, is decreasing. This means that some of the air bubbles will dissolve back into the water. Therefore, it would be preferable to install the Armstrong air eliminator before the coil.

b) To prevent air bubbles from causing pump damage due to cavitation, the air eliminator should also be installed before the pump.
See figure 8. The efficient functioning of the air eliminator, correctly positioned, provides virtually air-free water after the cooling coil.

When the pressure rises, at lower elevations in the circuit, water becomes more and more unsaturated (according to Henry's Law more air can be dissolved in the water at higher pressures). This means that air present elsewhere in the system will be absorbed into the water. This absorption effect is used to bind all the free-air in the system.

As water circulates and approaches the air eliminator the pressure is decreasing and the absorbed air will appear as micro-bubbles in the water. These bubbles will be vented out to the atmosphere by the action of the automatic air vent that forms part of the Armstrong air eliminator.

fig. 8



Micro-bubble Air Eliminators

Armstrong Air Eliminators are used for the total removal of air from central heating and air conditioning systems.

Used in sealed heating and cooling systems up to a maximum temperature of 120°C and a maximum pressure of 10 bar (see fig. 9 showing steel version.)

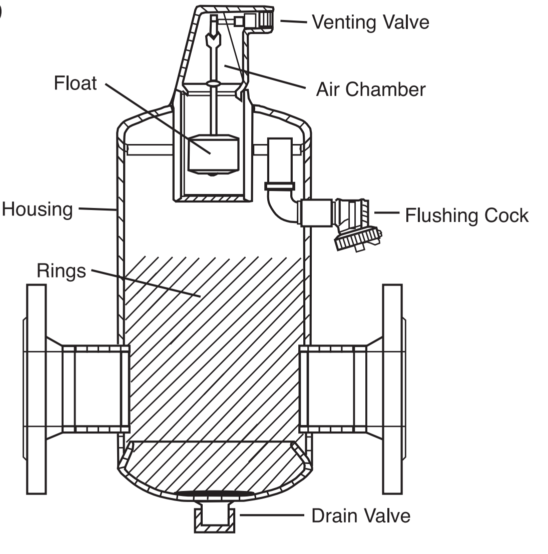
The air eliminator is constructed using a vertical housing with an air receiving/venting mechanism mounted on the upper part of the chamber. This housing accommodates numerous rings specially designed to provide a large contact surface which collects the optimum amount of air as it is transferred from the water in the form of micro-bubbles.

The float mechanism and venting valve are incorporated in a special air-collecting chamber which protects the device from floating debris such as oil, grease or hemp. The flushing cock fitted to larger air eliminators can be used to remove floating debris. It can also be used to release large amounts of air during the system filling operation. The small air eliminator is protected by a perforated filter.

The advantage of the conical shaped air chamber, over straight-sided designs, is that the clearance between the water level and the venting valve is as large as possible. This means that the water in the air eliminator will remain well clear of the venting valve under normal operating conditions, so that the likelihood of fouling the gearing mechanism and venting valve is kept to a minimum. The venting valve itself can be closed off.

Impurities heavier than water such as sand, welding debris and the like may collect in the bowl shaped lower part of the air eliminator and can be removed via the drain plug on the larger air eliminators.

fig. 9



Micro-bubble Air Eliminators - Selection procedures

The effectiveness of the air eliminator depends upon the position in which it is placed in the system and the water velocity.

For the best performance it is recommend that the water velocity should not be higher than 1.5m/s when the air eliminator is installed at the optimum point in the system (highest temperature and lowest pressure) and a water velocity of 1.0m/s if it is placed elsewhere.

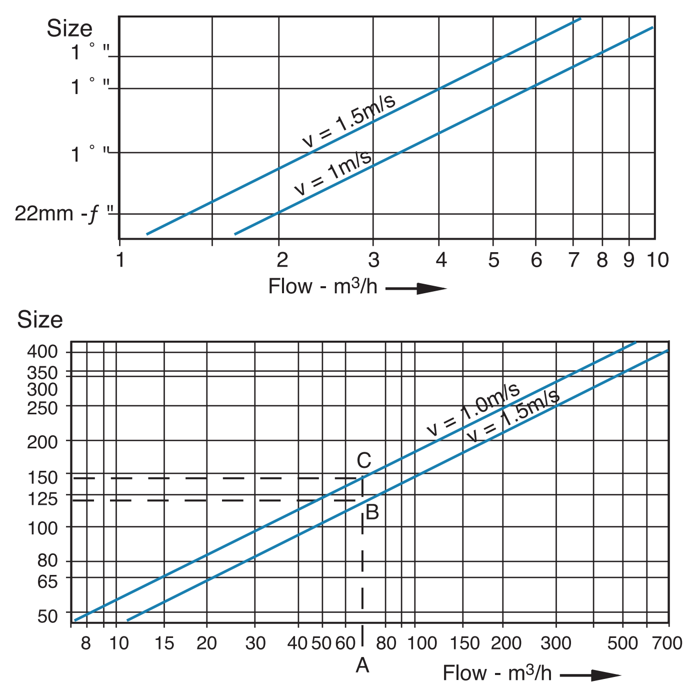
Water speeds in excess of 1.5m/s will reduce the venting capacity considerably.

If the air eliminator is installed in a system with a water velocity greater than 1.5m/s the performance will be maintained if it is installed with adaptors attached to its inlet and outlet. This measure will decrease the water velocity inside the unit. To ensure a smooth flow inside the adaptors they must not deflect by more than 4°.

The effectiveness of the elimininators is reliant on the water velocity being less than 1.5m/s or 1.0m/s in the entrance of the air eliminator, depending upon where the unit is placed in the system. (See fig.10.)

Air Eliminators Selection Charts

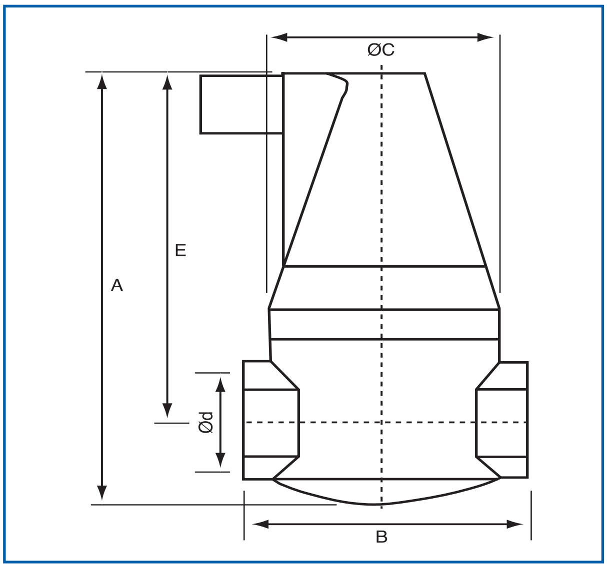
fig. 10



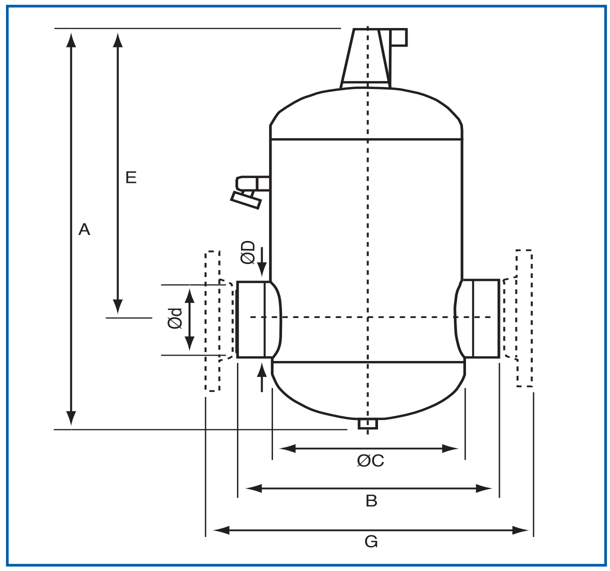
Air Eliminators Benefits

- Maintains system efficiency
- Improves circulation
- Reduces corrosion
- Protects circulating pumps
- Reduces noise
- Reduces commissioning time

Micro-bubble Air Eliminators - Brass



Micro-bubble Air Eliminators - Steel



Dimensions and Weights

Type	Item No.	A	B	ØC	ØD	Ød	E	G	Weight kg
Brass Compression									
22mm	51995	151	74	71	-	22mm	121	-	1.4
3/4" BSPF	51996	151	88	71	-	3/4"	121	-	1.4
1" BSPF	51997	171	100	80	-	1"	139	-	1.8
1 1/4" BSPF	51998	192	114	87	-	1 1/4"	154	-	2.4
1 1/2" BSPF	51999	192	114	87	-	1 1/2"	154	-	2.5
Steel Welded Connection									
50W	52000	480	260	175	60.3	54.5	364	-	8.6
65W	52001	480	260	175	76.1	70.3	364	-	8.8
80W	52002	645	370	270	88.9	82.5	456	-	20.6
100W	52003	645	370	270	114.3	107.1	456	-	21.2
125W	52004	805	525	360	139.7	131.7	549	-	41.3
150W	52005	805	525	360	168.3	159.3	549	-	42.4
200W	52006	970	650	450	219.1	206.5	709	-	75.3
250W	52007	1310	850	600	273.0	260.4	910	-	155.0
300W	52008	1475	850	600	323.9	309.7	1050	-	175.0
350W	52009	1655	1050	800	355.6	339.6	1165	-	305.0
400W	52010	1795	1050	800	406.4	388.8	1293	-	340.0
Steel Flanged Connection DIN2633 (NP16)									
50F	52011	480	-	175	-	-	364	350	13.7
65F	52012	480	-	175	-	-	364	350	14.9
80F	52013	645	-	270	-	-	456	470	28.0
100F	52014	645	-	270	-	-	456	470	20.4
125F	52015	805	-	360	-	-	549	635	53.8
150F	52016	805	-	360	-	-	549	635	57.9
200F	52017	970	-	450	-	-	709	774	97.3
250F	52018	1310	-	600	-	-	910	990	190.0
300F	52019	1475	-	600	-	-	1050	1016	220.0
350F	52020	1655	-	800	-	-	1165	1214	365.0
400F	52021	1795	-	800	-	-	1293	1220	415.0

Tangential Air Eliminators

Armstrong Tangential Air Eliminators are designed for the removal of air from central heating and air conditioning systems, by the efficient centrifugal principle.

Can be used in sealed heating and cooling systems up to a maximum temperature of 120°C and a maximum pressure of 10 bar.

There are three different types available: with threaded connection, welded connection and flanged connection. The dimensions of the connections are according to ISO standards.

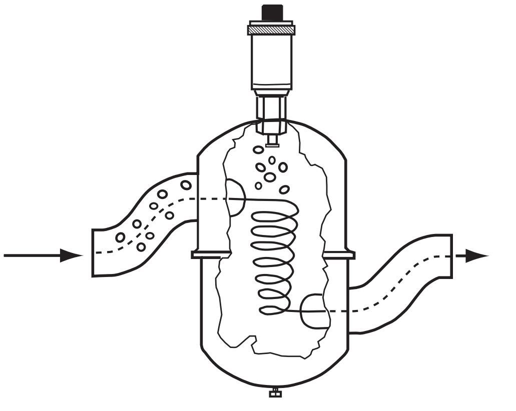
Operation of the Armstrong tangential air eliminator is based on the principle of centrifuge. Due to the tangential mounted connections, the water inside the eliminator is brought into rotation. This rotation forces the heavy medium (water) against the wall while the air is collected in the middle. See fig. 11.

A float vent is mounted on top of the air eliminators. This automatically vents the collected air to the atmosphere. The separation capacity of the eliminator will increase with increasing water speed.

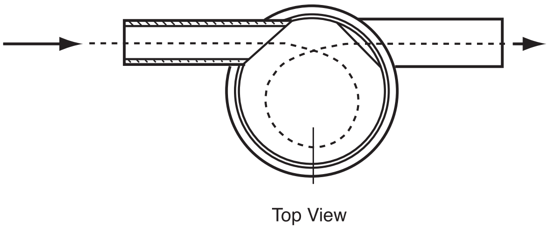
Impurities which are heavier than water such as sand, welding debris etc. will collect in the bowl shaped lower part of the eliminator. These impurities can easily be removed via the drain valve located in the centre of the bottom of the eliminator.

Tangential Air Eliminators - Principle of Centrifuge

fig. 11

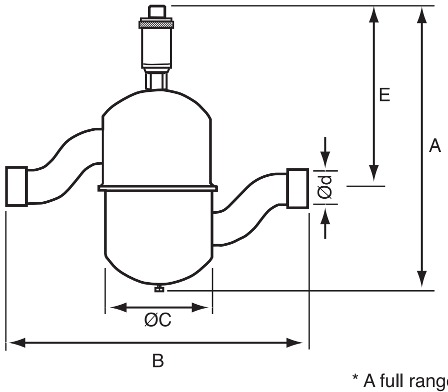


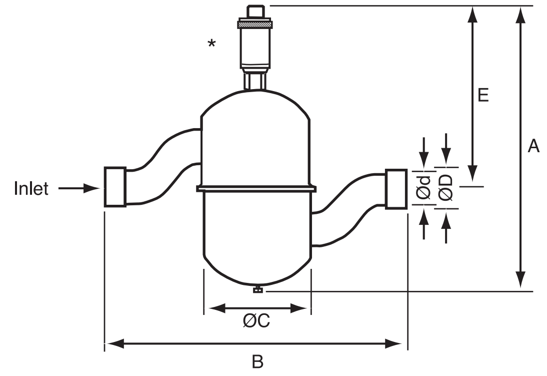
Side View



Top View

▶ Dimensions and Weights



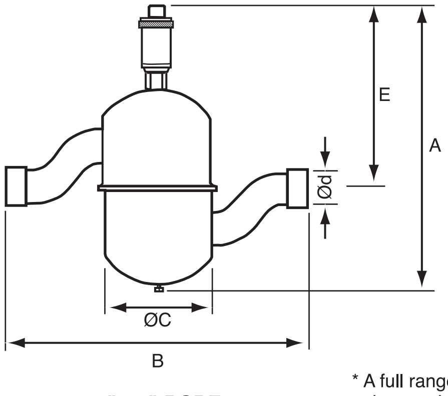


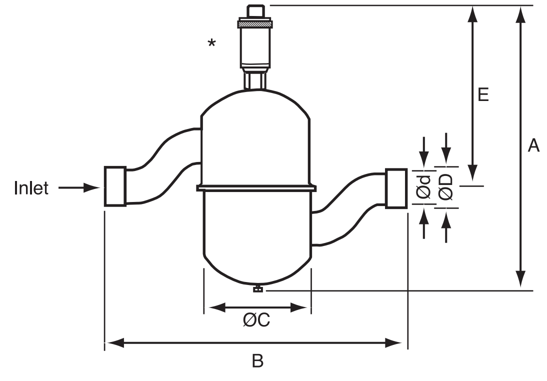
1" - 2" BSPF

* A full range of Automatic air vents is available upon request

25 - 50 W

Type	Item No.	A	B	ØC	ØD	Ød	E	G	Volume ltrs	Weight kg
1" BSPF	52022	275	290	114	-	1"	176	33	1.2	1.5
1 1/4" BSPF	52023	275	304	114	-	1 1/4"	176	31	1.2	1.5
1 1/2" BSPF	52024	285	332	124	-	1 1/2"	180	33	1.5	1.7
2" BSPF	52025	305	340	134	-	2"	192	32	2.3	2.3
25W	52026	275	252	114	33.7	28.5	176	33	1.2	1.3
32W	52027	275	262	114	42.4	37.2	276	31	1.2	1.3
40W	52028	285	290	124	48.3	43.1	180	33	1.5	1.5
50W	52029	305	310	134	60.3	54.5	192	32	2.3	2.1





1" - 2" BSPF

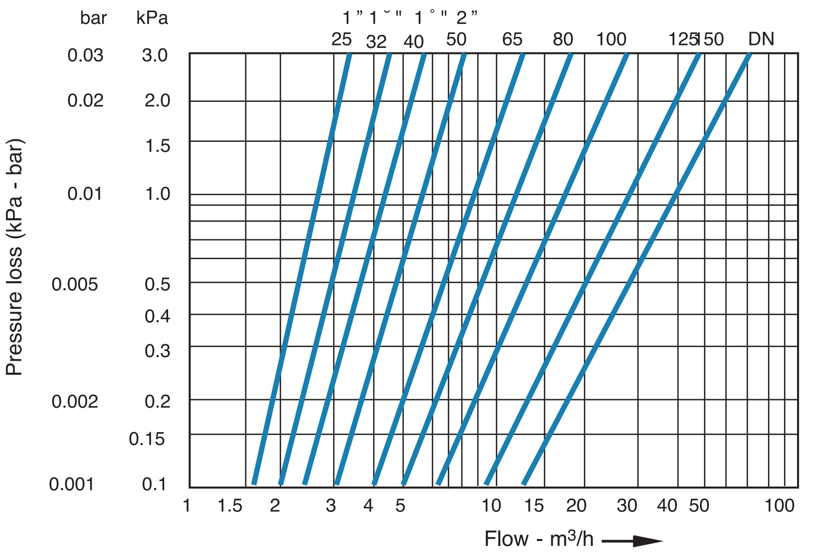
* A full range of Automatic air vents is available upon request

25 - 50 W

Type	Item No.	A	B	ØC	ØD	Ød	E	G	Volume ltrs	Weight kg
65W	52030	475	400	254	76.1	70.3	155	78	17	7.7
80W	52031	475	400	254	88.9	82.5	155	78	17	7.9
100W	52032	695	570	450	114.3	107.1	212	158	79	27.4
125W	52033	695	570	450	139.7	131.7	186	144	79	27.4
150W	52034	775	570	450	168.3	159.3	234	130	91	30.9
65F	52035	475	490	254	185.0	70.3	155	78	17	13.7
80F	52036	475	490	254	200.0	82.5	155	78	17	15.9
100F	52037	695	675	450	220.0	107.1	212	158	79	37.4
125F	52038	695	675	450	250.0	131.7	186	144	79	40.7
150F	52039	775	675	450	285.0	159.3	234	130	91	46.9

▶ Flow Resistance for Armstrong Tangential Eliminators

fig. 12



▶ Tangential Eliminator Benefits

- Maintains system efficiency.
- Reduces noise
- Improves circulation.
- Reduces corrosion.
- Protects circulating pumps.
- Reduces commissioning time.
- Suitable for higher velocity systems

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