

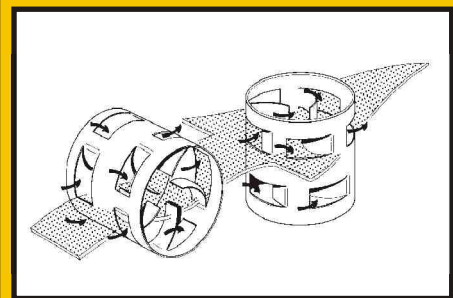
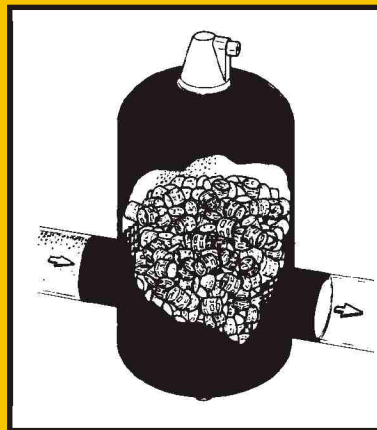
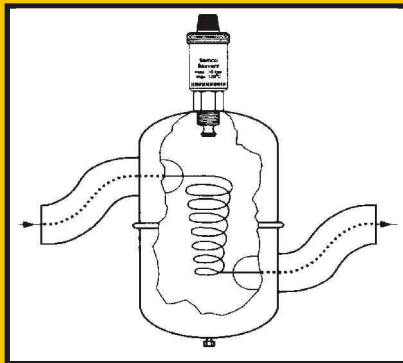
# MINIKIN

## Air & Dirt Separation Book

1st Edition

### EMFLEX Air Separators, Dirt Separators and Related Equipment for Pipework Systems

With special reference to the  
Building Services Industry



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Certificate No. Q 5468

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## **Appendix 1. Water Flow Rates and Velocities Through Pipe**

### **Conditions of Business**

If you have any additional requirements for equipment related to the removal of air and dirt from pipe work systems then please ask, even if you do not see it listed here.

We reserve the right to alter or amend any information detailed. E&OE  
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**This Air & Dirt Separation Book presented by:**

# Introduction

## Air in heating and air conditioning systems

The presence of air in heating and cooling water systems causes the following problems:-

- \* Noise
- \* Corrosion
- \* Damage to pumps
- \* Reduced heat transfer
- \* Loss of efficiency
- \* Higher maintenance costs
- \* Increased energy consumption

## Causes of air occurring in heating / air conditioning systems

To overcome the problems above, it is necessary to analyse the causes of air being present in the water system:-

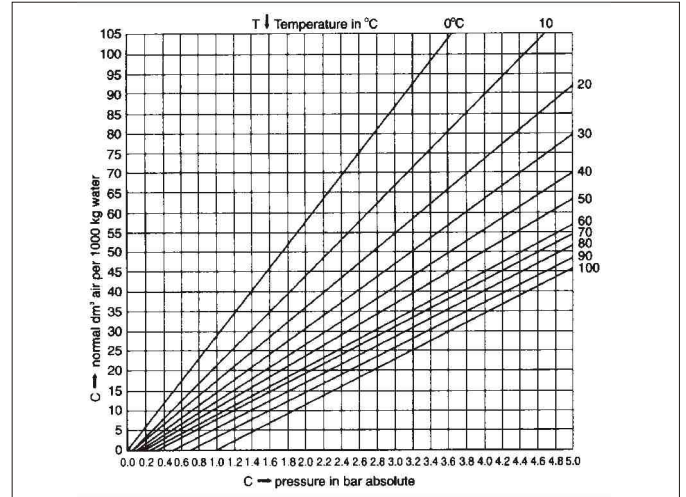
- \* Air is present before filling the system
- \* Air is trapped in the system when filled
- \* Air is entrained in mains water when filling the system
- \* Air is dissolved in water when the system is filled

The presence of air dissolved in water can be explained by reference to Henry's Law.

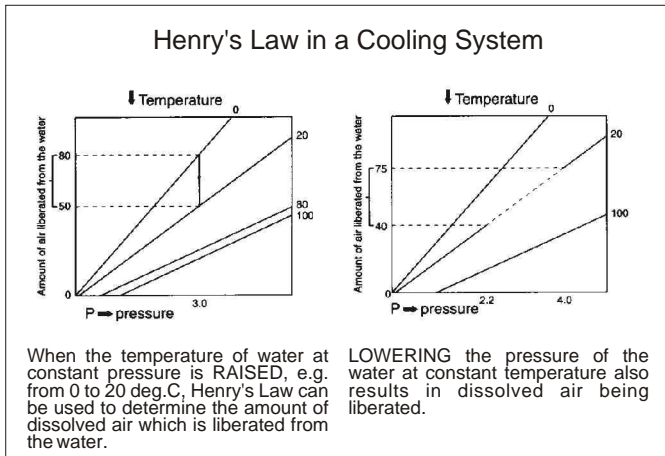
This Law states that  $C = K \times P$  where,

- C = concentration of dissolved air
- K = absorption factor (dependent on temperature)
- P = pressure

From the diagram it is apparent that the amount of air which is dissolved in water, is dependent on both temperature and pressure. Air dissolved in water is liberated when the temperature rises or the pressure falls.



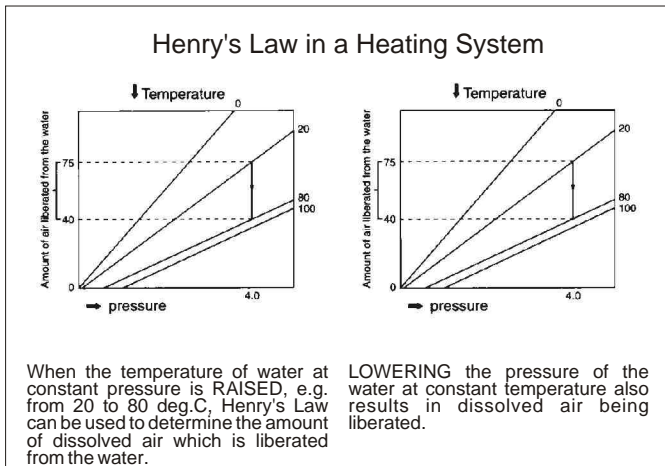
## Henry's Law in a Cooling System



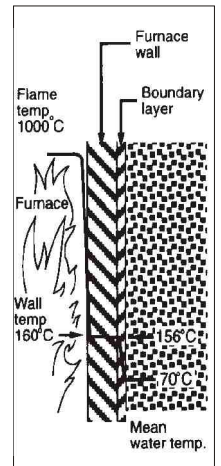
In cooling systems part of the air is dissolved in water and part is air bubbles. When the water (and air) runs through the system it encounters different temperatures and pressures. Henry's Law says that, during these temperature / pressure fluctuations, air is successively liberated from and dissolved in the water. Pressure has the largest influence on the formation of air bubbles in a cooling system.

The largest air bubbles will appear in places with low pressure (the upper part of the system), this is therefore the best place to site an EMFLEX separator. The temperature of water in the coil decreases which means that part of the air bubbles will again dissolve in the water; it is therefore preferable to mount the separator before the coil. To prevent air bubbles causing pump damage due to cavitation, a separator should be installed before the pump.

## Henry's Law in a Heating System



Very high temperatures occur at the combustion chamber wall of the boiler. It is here that very small air bubbles will be liberated from water containing air. These so called 'microbubbles' will be re-dissolved elsewhere in the system where the temperature is lower, unless they are immediately removed. If the microbubbles are removed immediately upon leaving the boiler, air free (unsaturated) water results. Air present elsewhere in the system can be dissolved (absorbed) in this water. This absorption effect is utilised to bind all the free air in the system and to vent it to the outside by the combination of the boiler and the EMFLEX separator. This venting process is continuous until eventually the water that remains is strongly unsaturated.



# EMFLEX Centrifugal Air Separators

## EMFLEX Centrifugal Air Separators

The EMFLEX centrifugal air separator has been specially designed to separate air from sealed heating and cooling water systems in buildings. It is used for the removal of air in systems up to a maximum temperature of 120 deg.C and a maximum pressure of 10 bar. The principle on which this unit is based on the established physics of centrifugal force.

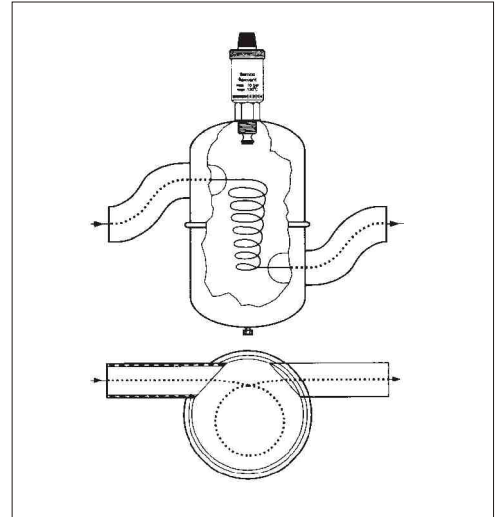
## Operating Principle of EMFLEX Centrifugal Air Separators

The operation of EMFLEX Centrifugal Air Separators is based on the operation of the centrifuge, whereby, when rotated, heavier fluids are flung furthest most from the rotation centre and lighter fluids remain centre most. In the case of heating and cooling systems, the heavier fluid is a liquid (water) and the lighter fluid is a gas (air).

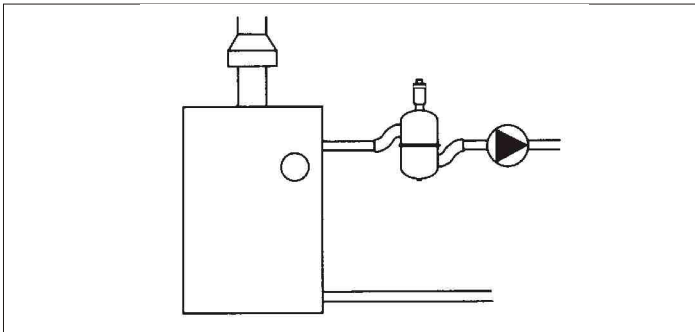
Due to the tangential mounted inlet and outlet connections, the water inside the separator is forced to rotate. This rotation forces the heavy medium - the water - against the wall of the shell of the separator whilst the air is collected in the middle of the separator.

Mounted on top of the separator is an automatic air vent which will automatically discharge any air collected in the unit. (See page 15 for full details of EMFLEX automatic air vents). Centrifugal air separators up to 50mm nominal size have 'standard' air vents fitted; 65mm nominal size and above have 'superior' air vents fitted.

Impurities which are heavier than water such as grit, weld debris etc. will collect in the bowl shaped lower section of the air separator. These impurities can be readily removed through the drain plug located at the base of the unit.



## Installation of EMFLEX Centrifugal Air Separators

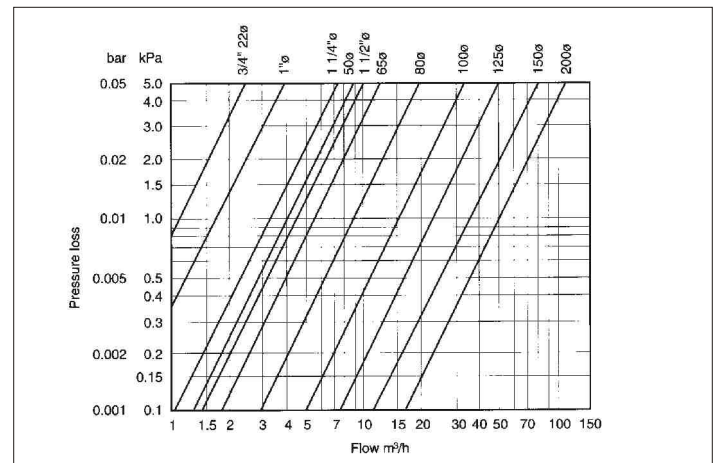


In order to discharge air as efficiently as possible with the centrifugal air separator, we recommend that the unit is connected to the suction side of the circulating pump on the flow from the boiler. This will reduce the amount of air bubbles entering the pump and hence reduce any damaging of the pump.

## Selection Procedure for EMFLEX Centrifugal Air Separators

Separator effectiveness is dependant on the system water velocity. For best results we advise a water velocity of not more than 1.5m/s. Where higher velocities are expected, high flow microbubble air separators must be used; see pages 11 and 12.

## EMFLEX Centrifugal Air Separators Resistance Diagram



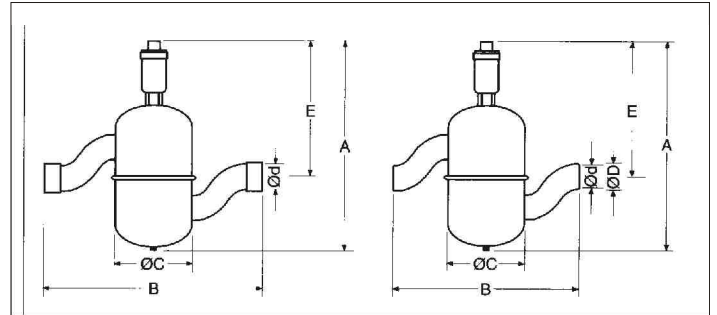
# EMFLEX Centrifugal Air Separators

EMFLEX centrifugal air separators are used in pipelines for the virtual elimination of air from sealed heating and cooling systems in buildings.

By using the processes detailed earlier in this booklet, it is possible to remove:-

\* Air which is present in the system water in the form of small bubbles.

\* Air which is present where an EMFLEX automatic air vent can not be installed.



## Type SCAT

A steel body with female threaded end connections from 25mm to 50mm nominal size.

## Type SCAW-1

A steel body with weld end connections from 25mm to 50mm nominal size. This unit has dog-legged inlet and outlet ports.

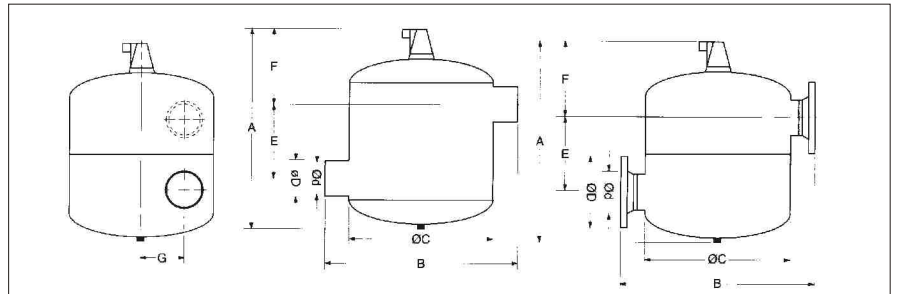
Type	Nominal Size	Overall Height	Length 'B'	Body Diam. 'C'	Diameter 'D'	Diameter 'd'	Pipe C/L to C/L	Pipe C/L to Top	Dim. 'G'	Volume (litres)	Weight (empty)
	mm	mm	mm	mm	mm	mm	mm	mm	mm	l	kg
SCAT	25	275	290	114	-	25 BSP F	176	-	33	1.2	1.5
	32	275	304	114	-	32 BSP F	176	-	31	1.2	1.5
	40	285	332	124	-	40 BSP F	180	-	33	1.5	1.7
	50	305	340	134	-	50 BSP F	192	-	32	2.3	2.3
SCAW-1	25	275	252	114	33.7	28.5	176	-	33	1.2	1.3
	32	275	262	114	42.4	37.2	176	-	31	1.2	1.3
	40	285	290	124	48.3	43.1	180	-	33	1.5	1.5
	50	305	310	134	60.3	54.5	192	-	32	2.3	2.1

## Type SCAW-2

A steel body with weld end connections from 65mm to 150mm nominal size. This unit has off-set inlet and outlet ports.

## Type SCAF

A steel body with BS4504-PN16 flanged end connections from 65mm to 150mm nominal size.



SCAW-2	65	475	400	254	76.1	70.3	155	205	78	17	7.7
	80	475	400	254	88.9	82.5	155	205	78	17	7.9
	100	695	570	450	114.3	107.1	212	277	158	79	27.4
	125	695	570	450	139.7	131.7	186	290	144	79	27.7
	150	775	570	450	168.3	159.3	234	305	130	91	30.9
SCAF	65	475	490	254	185	70.3	155	205	78	17	13.7
	80	475	490	254	200	82.5	155	205	78	17	15.9
	100	695	675	450	220	107.1	212	277	158	79	37.4
	125	695	675	450	250	131.7	186	290	144	79	40.7
	150	775	675	450	285	159.3	234	305	130	91	46.9

### Notes:

Other designs of air separators are available.

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include microbubble air separators, combined microbubble air and dirt separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see page 2 of this booklet.

Larger sizes of centrifugal air separators are available up to 600mm nominal size connections. Please ask for specific details.

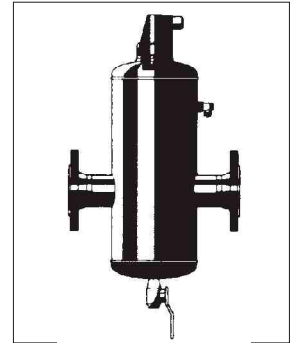
# EMFLEX Microbubble Air Separators

## EMFLEX Microbubble Air Separators

The EMFLEX microbubble air separator has been specially designed to separate air from heating and cooling water systems in buildings. It is used for the virtual elimination of air in systems up to a maximum temperature of 120 deg.C and a maximum pressure of 10 bar. The principle on which this unit is based is a completely new method of removing gases from water - the PALL ring process. (Patented).

By applying this process, it is possible to remove:-

- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.



## Operating Principle of EMFLEX Microbubble Air Separators

EMFLEX Microbubble Air Separators utilise the highly efficient and effective PALL ring method of removing gases from liquids. The PALL ring has been developed from the Raschig ring and has been used for many years in the processing industry. The use of PALL rings to remove air from heating and cooling water systems is relatively new.

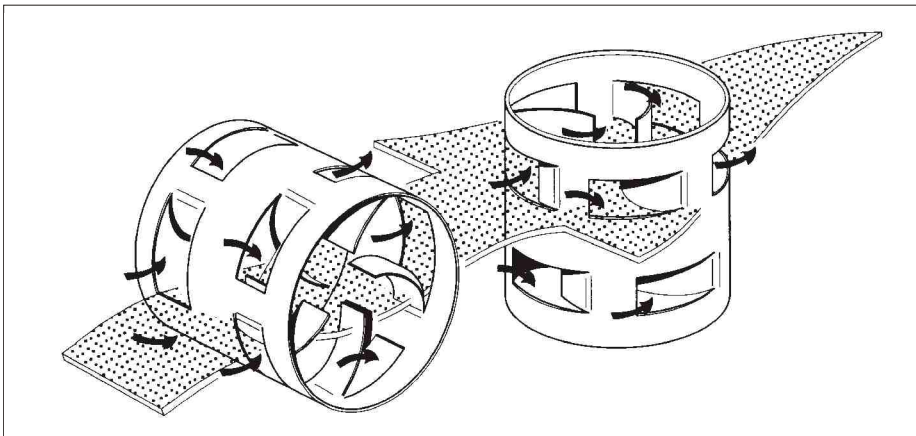
The operating principle of the PALL rings results from the special properties they possess, namely:-

- \* Large surface area per cubic metre.
- \* High probability of collision and adhesion.
- \* Low resistance to fluid flow.

## EMFLEX Microbubble Air Separators and the Coalescence Effect

The operation of EMFLEX Microbubble Air Separators is based on the concept of coalescence. This means in practice that small air bubbles tend to adhere to a surface, and then grow together to form larger bubbles.

When a stream of water flows past and through the PALL rings, the stream is deflected in many different directions.



The construction of the PALL ring is such that all the water is brought into contact with the total surface area of the PALL ring that is available for adhesion.

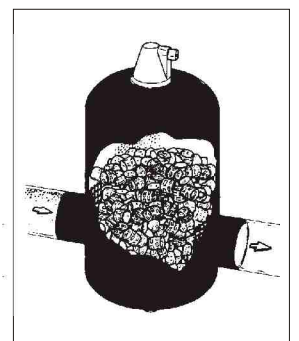
The microscopically small air bubbles present in the water attach themselves to the contact surface of the PALL ring. Once these microbubbles have grown to form larger bubbles, they can be separated from the water.

The adhesion of air bubbles after which they grow and become separable is known as 'coalescence'.

A large number of PALL rings are used in the EMFLEX Microbubble Air Separators, (from 115 in the smallest to 4000 in the largest), so that a very large contact and adhesion surface is obtained.

## EMFLEX Microbubble Air Separators Operation

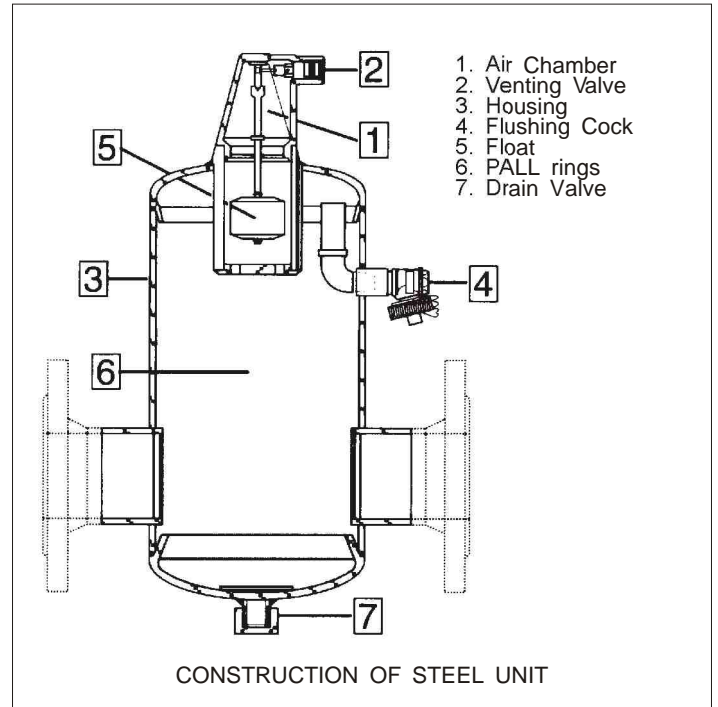
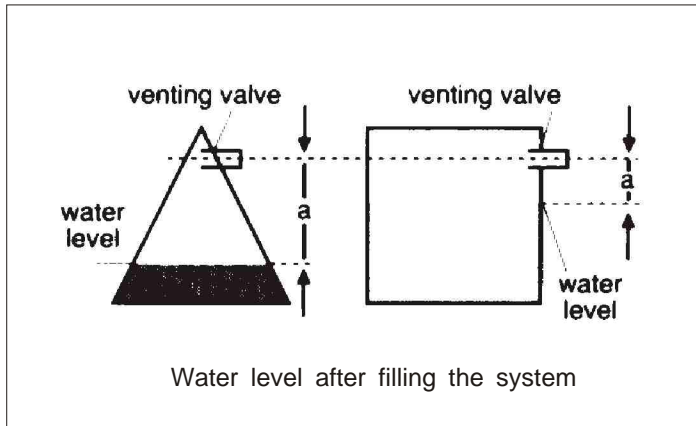
The velocity with which water flows into the separator will be greatly reduced as a result of the enlargement of the flow passage. The larger air bubbles are thus given time and opportunity to rise upwards to the air chamber. At the same time, the stream of water collides with the many PALL rings present. As a result, very many small, evenly distributed currents are created in and around each PALL ring, so that all gas containing water particles are brought into contact with the entire PALL ring contact surface. Even the smallest microbubbles present in the water will adhere to the surface of the PALL ring. Since the stream of water in the unit comes to a complete standstill, the microbubbles can accumulate in the direction of the overlying chamber. The float mechanism and venting valve serve to expel the air separated from the water to the outside, and keep the volume of the air chamber constant.



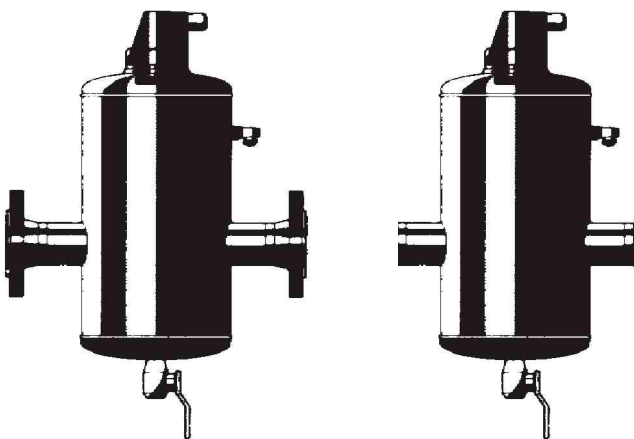
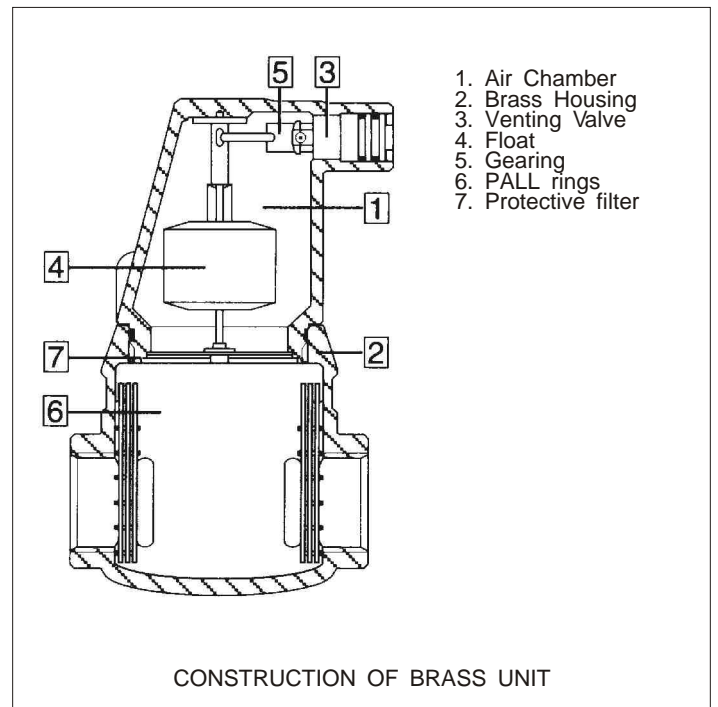
# EMFLEX Microbubble Air Separators

## Construction of EMFLEX Microbubble Air Separators

EMFLEX microbubble air separators are constructed from a vertical housing on which an air chamber is mounted. The housing contains the PALL rings which ensure a very large contact area with minimal resistance. The float mechanism and venting valve are located in the air chamber. The air chamber is conical in shape. Compared with a straight chamber this design ensures maximum clearance between the water and venting valve to prevent fouling of the mechanism. (see diagram below).



Additional protection is given by the filter between the water and the air chamber. The larger steel separators (50mm to 400mm nom.size) incorporate a flushing cock to eliminate floating impurities and may be used to release large quantities of air, e.g. during filling. Impurities heavier than water will collect in the lower bowl shaped part of the unit and these may be removed by means of the drain valve at the base. The venting valve is secured in the air chamber so that external damage is not possible. There is a facility to close the venting valve with the screw located in the outlet.



The following table shows approximated flow rates through various sizes of steel pipes that result in a water velocity of approximately 1.5m/s. Note that the microbubble air separator has the same connection size as the pipework.

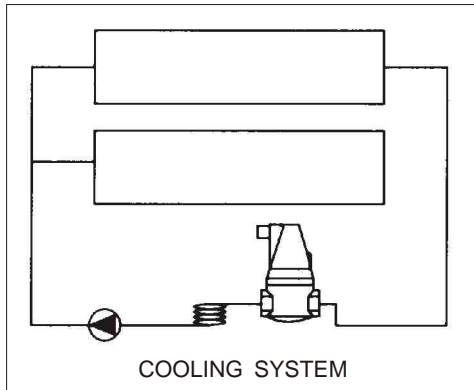
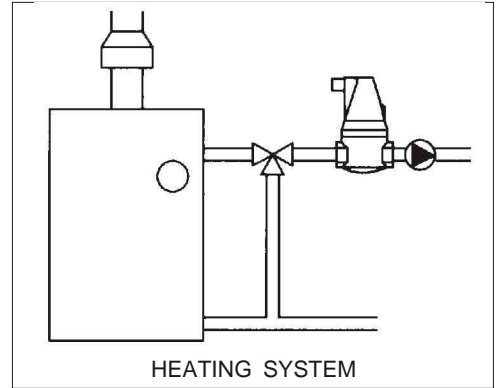
Pipework Nominal Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Separator Connection Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Pipework Water Flow Rate (l/s)	3.3	5.5	7.6	13	20	28	52	80	113	130	180
Pipework Water Velocity (m/s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

# EMFLEX Microbubble Air Separators

## Installation of EMFLEX Microbubble Air Separators

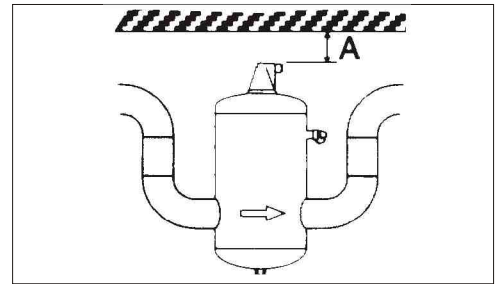
### Heating Systems

Microbubbles which are liberated from the water in the boiler (high temp) will be re-dissolved elsewhere in the system (lower temp) if they are not immediately removed. Therefore in order to discharge air as efficiently as possible, the unit should be installed in the flow circuit immediately after the boiler or mixing valve. Install before the pump to prevent air bubbles damaging the pump and to prevent air bubbles being reduced to smaller bubbles by the pump's action.



### Cooling Systems

Air bubbles that exist in the system will have a larger size before the coil than after. This is due to lower water temperature after the coil (Henry's Law). Therefore in order to discharge the air as efficiently as possible, the unit should be installed in the flow circuit just before the coil. It should also be installed before the pump to prevent air bubbles from damaging the pump.

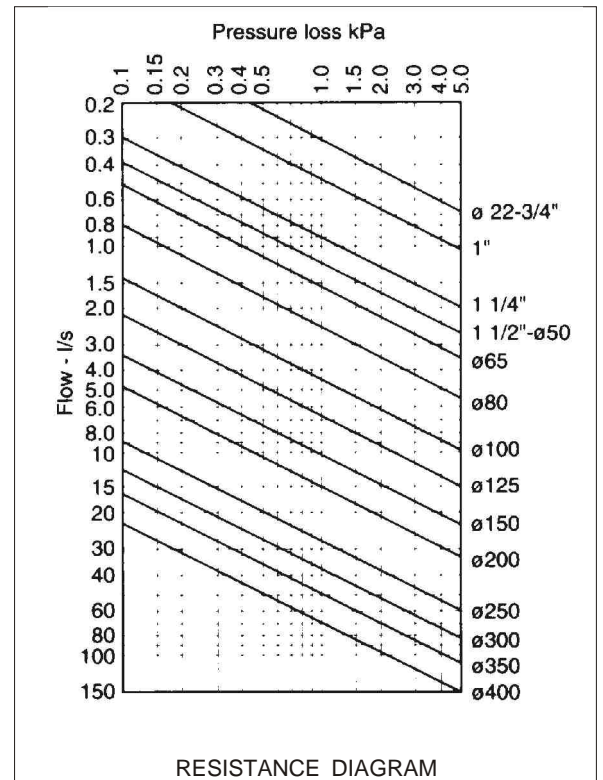
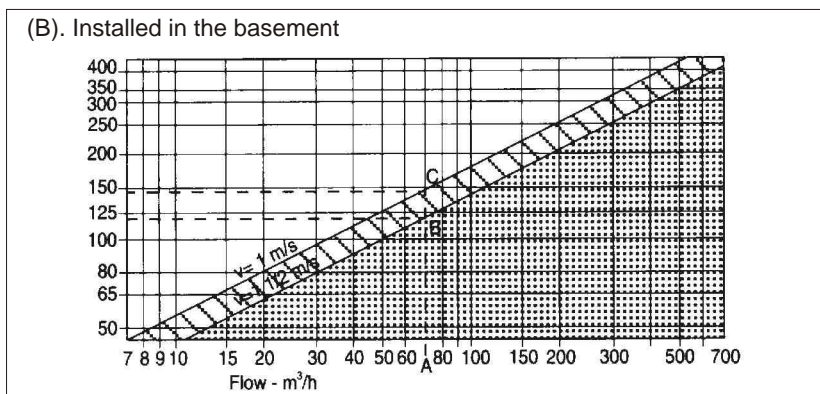
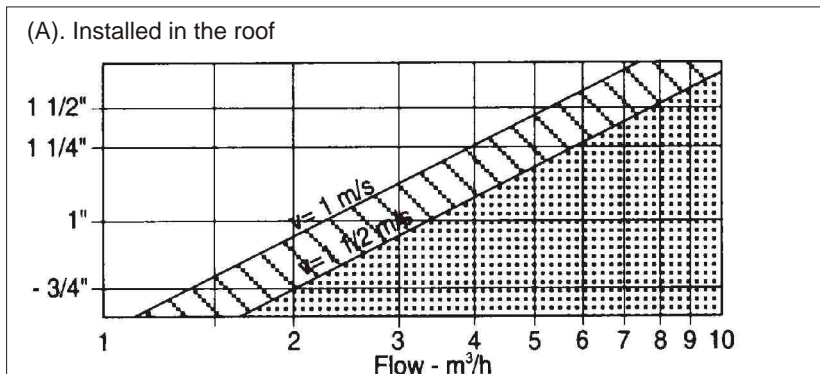


When installed in existing boiler house with supply circuit directly beneath the ceiling, mount as shown right. For servicing, clearance 'A' must be at least 100mm.

It is recommended that, for both heating and cooling systems, a unit be installed on each floor above 30m.

## Selection Procedure for EMFLEX Microbubble Air Separators

Separator effectiveness depends on the system water velocity. For best effect we advise a velocity of not more than 1.5m/s when installed in the optimum position (highest temp, lowest pressure), and 1.0m/s when it is not. If the unit is installed in a system with higher velocities then adaptors must be fitted on the inlets, and outlets to decrease the velocity through the unit; please contact our Technical Dept.



# EMFLEX Microbubble Air Separators

EMFLEX microbubble air separators are used in pipelines for the virtual elimination of air from heating and cooling systems in buildings.

By using the processes detailed earlier in this booklet, it is possible to remove:-

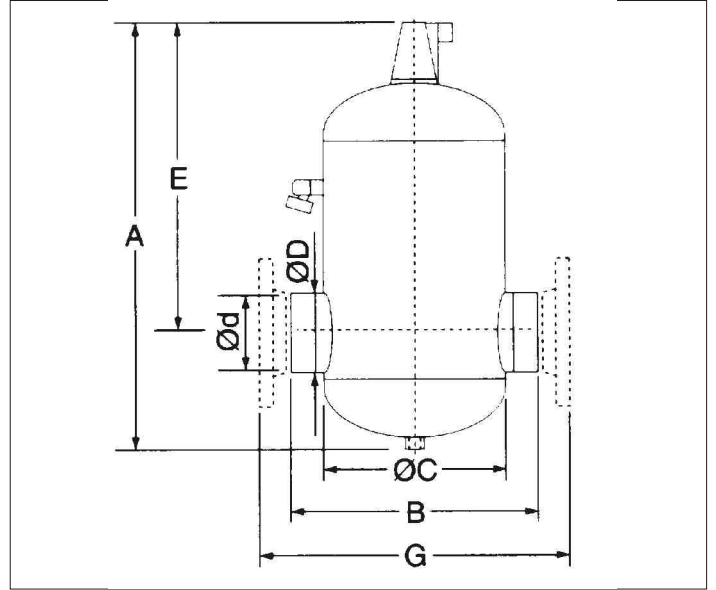
- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.

## Type SMAW

A steel shell with weld end connections.

## Type SMAF

A steel shell with flanged end connections.



Nominal Size	Overall Height 'A'	Pipe C/L to Top 'E'	Shell Diam. 'C'	Weld End O/D 'D'	Weld End I/D 'd'	Length		Weight (empty)	
						(SMAW) Dim B	(SMAF) Dim G	Weld Ends SMAW	Flanges SMAF
mm	mm	mm	mm	mm	mm	mm	mm	kg	kg
50	480	364	175	60.3	54.5	260	350	9	14
65	480	364	175	76.1	70.3	260	350	10	15
80	645	456	270	88.9	82.5	370	470	21	28
100	645	456	270	114.3	107.1	370	470	22	31
125	805	549	360	139.7	131.7	525	635	42	54
150	805	549	360	168.3	159.3	525	635	43	58
200	970	709	450	219.1	206.5	650	774	76	98
250	1310	910	600	273.0	260.4	850	990	155	190
300	1475	1050	600	323.9	309.7	850	1016	175	220
350	1655	1165	800	355.6	339.6	1050	1214	305	365
400	1795	1293	800	406.4	388.8	1050	1220	340	415

### Notes:

Other designs of air separators are available.

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include combined microbubble air and dirt separators, centrifugal air separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see pages 4, 5 and 6 of this booklet.

# EMFLEX Microbubble Air Separators

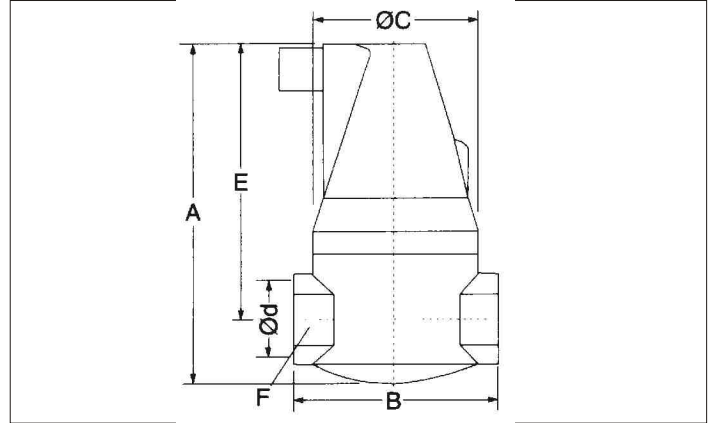
EMFLEX microbubble air separators are used in pipelines for the virtual elimination of air from heating and cooling systems in buildings.

By using the processes detailed earlier in this booklet, it is possible to remove:-

Air which is present in the system water in the form of small bubbles and microbubbles.

Air which is dissolved in the system water.

Air which is present where an EMFLEX automatic air vent can not be installed.



## Type SMAT

A brass body with female threaded end connections from 20mm to 40mm nominal size and compression fitting at 22mm nominal size.

Nominal Size	Overall Height 'A'	Pipe C/L to Top 'E'	Body Diam. 'C'	Across Nut Flats 'F'	End Fitting 'd'	Length 'B'	Weight (empty)
mm	mm	mm	mm	mm		mm	kg
22	151	121	71	36	22 COMP.	74	1.4
20	151	121	71	36	20 BSP F	88	1.4
25	171	139	80	45	25 BSP F	100	1.8
32	192	154	87	60	32 BSP F	114	2.4
40	192	154	87	60	40 BSP F	114	2.5

### Notes:

Other designs of air separators are available.

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include combined microbubble air and dirt separators, centrifugal air separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see pages 4, 5 and 6 of this booklet.

# EMFLEX Microbubble Air & Dirt Separators

## EMFLEX Microbubble Air and Dirt Separators

The EMFLEX combined microbubble air and dirt separator has been specially designed to separate solid particles as well as air from heating and cooling water systems in buildings.

Practical experience and testing have shown that the PALL rings inside the unit will separate solid particles as well as air bubbles from the mainstream of the installation.

The construction of the previously described microbubble air separator unit (pages 4 and 5) has been redesigned in such a way that in the enlarged bottom bowl a non-turbulent area is created. This allows relatively heavy particles to sink to the bottom of the 'combined' unit where there are no voices to force the particles back into the system again. The collected particles can be drained from the system through the ball valve at the base of the unit. There are no PALL rings or obstacles in the bottom bowl to prevent the collected particles from being drained away.

Lightweight solid particles that float on the water in the unit can be drained out through the drain valve on the side of the body shell.

The capability of the unit to separate solid particles from the water system has been tested and reported on by the Dutch TNO Institute of Environmental and Energy Technology (Report number R95-064). The summary of the results and the conclusions of this report are shown below.

The operating principle for air separation with this unit is the same as the EMFLEX Microbubble Air Separator. For details please refer to pages 4, 5 and 6.

By using the processes described above and on pages 4, 5 and 6, it is possible to remove:-

- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.
- \* Dirt and solid particles that are in suspension.
- \* Solid and solid particles that sink or float.

It should be noted that PALL rings are used only in microbubble air and dirt separators up to 150mm nominal size inclusive. For 200mm nominal size and larger, multiples of radially aligned stainless steel cohesion wires are used to provide the large surface area to trap the small air bubbles.

## Summary of Results and Conclusions of the TNO Report

### Removal of Suspended Solids

Figure 5 The Overall Removal Efficiency

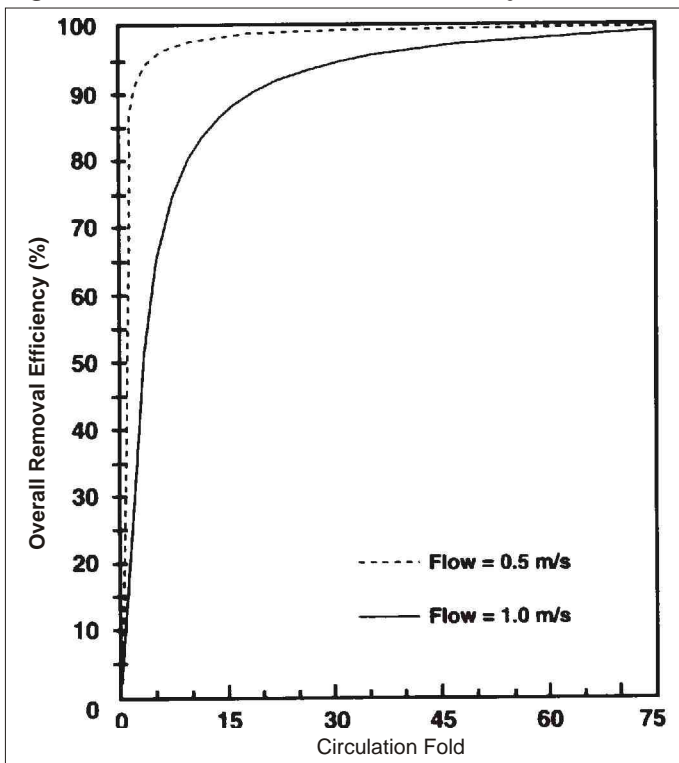


Table 5 Summary of Results

Experiment Number	Flow Velocity (m/s)	Circulation Cycle	Removal Efficiency (%)		
			Overall (38 to 250 mm)	Fine (38 to 63 mm)	Coarse (212 to 250 mm)
3	1.0	20	90.6	66.9	99.7
6	1.0	50	97.7	90.2	99.9
4	0.5	20	98.9	98.4	99.7
5	0.5	50	99.6	99.0	99.8

### Conclusion extracts from the TNO Report for the microbubble air & dirt separator

"...the removal efficiency of suspended particles increases with:  
 - decreasing flow velocity;  
 - increasing circulation fold;  
 - increasing settling velocity of particles, hence with larger and more dense particles."

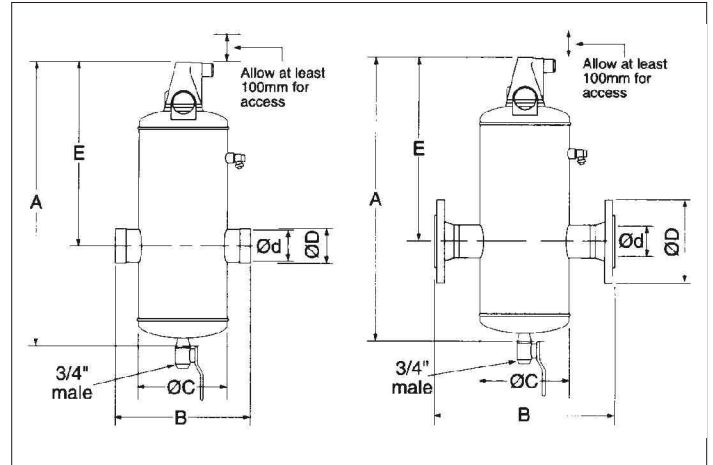
"...proves to be well capable of removing suspended particles from a water circuit. Sand particles larger than 38 micrometre (or particles with a similar sedimentation behavior) are removed well over 99% at a circulation fold of 50, using a flow rate of 1.0m/s. Although lower removal efficiencies are obtained at a flow rate of 1.0m/s, still over 90% of the fine particles (38-63micrometre) and over 99% of the coarse fraction (212-250micrometre) is removed at a circulation fold of 50."

# EMFLEX Microbubble Air & Dirt Separators

EMFLEX combined microbubble air and dirt separators are used in pipelines for the virtual elimination of air and separation of solid particles from heating and cooling systems in buildings.

By using the processes detailed earlier in this booklet, it is possible to remove:-

- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.
- \* Dirt and solid particles that are in suspension.
- \* Solid and solid particles that sink or float.



## Type SMADW

A steel shell with weld end connections.

## Type SMADF

A steel shell with BS4504 PN16 flanged end connections.

Nominal Size	Height 'A'	Pipe C/L to Top	Shell Diam.'C'	Pipe O/D 'D'	Flange O/D 'D'	I/D 'd'	Vessel Volume	Length		Weight (empty)	
								(SMADW) Dim 'B'	(SMADF) Dim 'B'	Weld Ends SMADW	Flanges SMADF
mm	mm	mm	mm	mm	mm	mm	litres	mm	mm	kg	kg
50	565	365	175	60.3	165	54.5	10	260	350	10	15
65	565	365	175	76.1	185	70.3	10	260	350	10	16
80	765	450	270	88.9	200	82.5	32	370	470	24	31
100	765	450	270	114.3	220	107.1	32	370	470	25	34
125	980	550	360	139.7	250	131.7	76	525	635	47	59
150	980	550	360	168.3	285	159.3	76	525	635	48	63
200	1160	580	405						780		110
250	1160	580	405						900		135
300	1160	495	510						1020		170
350	1500	770	650						1160		
400	1650	850	750						1260		
450	1650	850	750						1260		

### Notes:

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include microbubble air separators, centrifugal air separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see pages 4, 5, 6 and 9 of this booklet.

For conclusions on removal efficiency made by the Dutch TNO Institute of Environmental and Energy Technology see page 9.

It should be noted that PALL rings are used only in microbubble air and dirt separators up to 150mm nominal size inclusive. For 200mm nominal size and larger, multiples of radially aligned stainless steel cohesion wires are used to provide the large surface area to trap the small air bubbles.

# EMFLEX

## High Flow Microbubble Air Separators and High Flow Combined Microbubble Air & Dirt Separators

### Recap on EMFLEX Standard Flow Microbubble Air Separators

Standard microbubble air separators are highly efficient when water flows at low velocity through the vessel and increasingly less efficient as the water velocity increases. For best effect, we advise water velocities through the connecting pipework of not more than 1.5m/s when the standard microbubble air separators are installed in the optimum position. (see pages 4,5 and 6 for details).

This maximum velocity of 1.5m/s usually allows sufficient flow rate of heating and chilled water through all pipework nominal sizes, without unacceptable pressure losses. Air removal efficiencies will still remain high.

The following table shows approximated flow rates through various sizes of steel pipes that result in a water velocity of approximately 1.5m/s. Note that the microbubble air separator has the same connection size as the pipework. These units would be the standard models detailed on page 7 of this book.

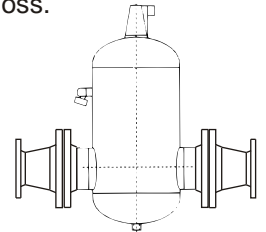
Pipework Nominal Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Separator Connection Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Pipework Water Flow Rate (l/s)	3.3	5.5	7.6	13	20	28	52	80	113	130	180
Pipework Water Velocity (m/s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

### Introduction to EMFLEX High Flow Microbubble Air Separators

There are occasions when the requirement for water flow rate through a particular pipework nominal size is greater than that allowed for the Standard microbubble air separators. If Standard units were to be used then the water velocity through the vessel would be increased, resulting in a reduction of air removal efficiency and an increase in pressure loss.

The solution is to use a vessel with a larger volume, resulting in acceptable water velocities through the vessel and ensuring that high air removal efficiency is maintained and that pressure losses are kept to a minimum.

A larger volume vessel is achieved by using a separator that is one nominal size larger than that of the pipework and install with transition spools on the inlet and outlet connections of the separator.



The following table shows allowable flow rates through various sizes of steel pipes and resultant water velocities. Note that the high flow microbubble air separator has a connection size that is one size above that of the pipework.

Pipework Nominal Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Separator Connection Size (mm)	65	80	100	125	150	200	250	300	350	400	NOT YET AVAILABLE
Transition Spool Size (mm)	65/50	80/65	100/80	125/100	150/125	200/150	250/200	300/250	350/300	400/350	
Pipework Water Flow Rate (l/s)	5.5	7.6	13	20	28	52	80	113	130	180	
Pipework Water Velocity (m/s)	2.5	2.1	2.5	2.3	2.1	2.7	2.3	2.1	1.7	1.8	

### EMFLEX Ultra High Flow Microbubble Air Separators

As with the high flow units above, transition spools can be used so that the separator is two nominal sizes larger than that of the pipework.

The following table shows allowable flow rates through various sizes of steel pipes and resultant water velocities. Note that the ULTRA high flow microbubble air separator has a connection size that is two sizes above that of the pipework.

Pipework Nominal Size (mm)	50	65	80	100	125	150	200	250	300	350	400
Separator Connection Size (mm)	80	100	125	150	200	250	300	350	400	NOT YET AVAILABLE	NOT YET AVAILABLE
Transition Spool Size (mm)	80/50	100/65	125/80	150/100	200/125	250/150	300/200	350/250	400/300		
Pipework Water Flow Rate (l/s)	7.6	13	20	28	52	80	113	130	180		
Pipework Water Velocity (m/s)	3.4	3.5	3.9	3.2	3.9	4.2	3.2	2.4	2.3		

# EMFLEX High Flow Microbubble Air Separators

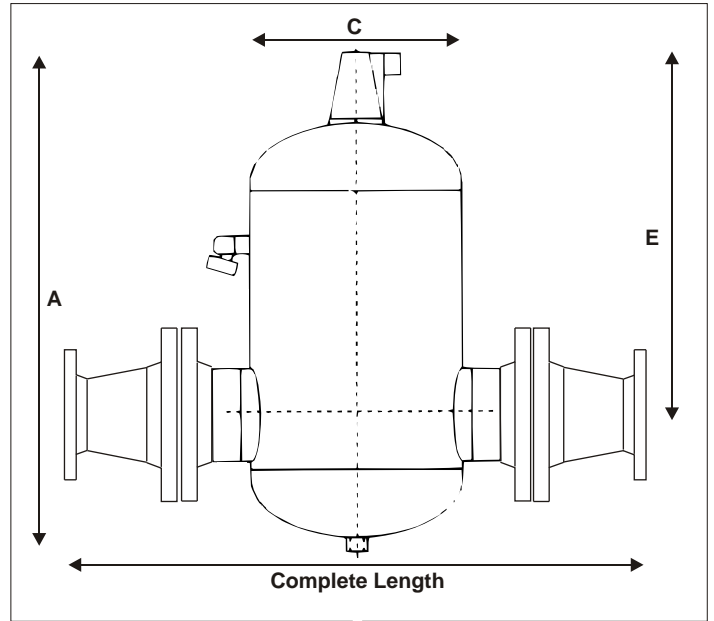
EMFLEX 'high flow' microbubble air separators are used in pipelines for the virtual elimination of air from heating and cooling systems in buildings where the water is flowing at high flow rates.

By using the processes detailed earlier in this booklet, it is possible to remove:-

- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.

## Type SMAF-H

A steel shell with BS4504 PN16 flanged end connections, complete with flanged transition spools for connection to the pipe work.



Nominal Size	Overall Height 'A'	Pipe C/L to Top 'E'	Shell Diam. 'C'	Shell Flange O/D	Spool Flange O/D	Complete Length	Weight (empty)	Allowable Flow Rate
mm	mm	mm	mm	mm	mm	mm	kg	litres/sec
40	480	364	175	165	150	530	23	3.3
50	480	364	175	185	165	560	27	5.5
65	645	456	270	200	185	680	44	7.6
80	645	456	270	220	200	714	50	13
100	805	549	360	250	220	879	78	20
125	805	549	360	285	250	959	89	28
150	970	709	450	340	285	1124	140	52
200	1310	910	600	405	340	1396	254	80
250	1475	1050	600	460	405	1476	306	113
300	1655	1165	800	520	460	1934	505	130
350	1795	1293	800	580	520	2000	599	180

### Notes:

Other designs of air separators are available.

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include combined microbubble air and dirt separators, centrifugal air separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see pages 4, 5 and 6 of this booklet.

It should be noted that PALL rings are used only in high flow microbubble air separators up to 125mm nominal size inclusive. For 150mm nominal size and larger, multiples of radially aligned stainless steel cohesion wires are used to provide the large surface area to trap the small air bubbles.

# EMFLEX High Flow Microbubble Air & Dirt Separators

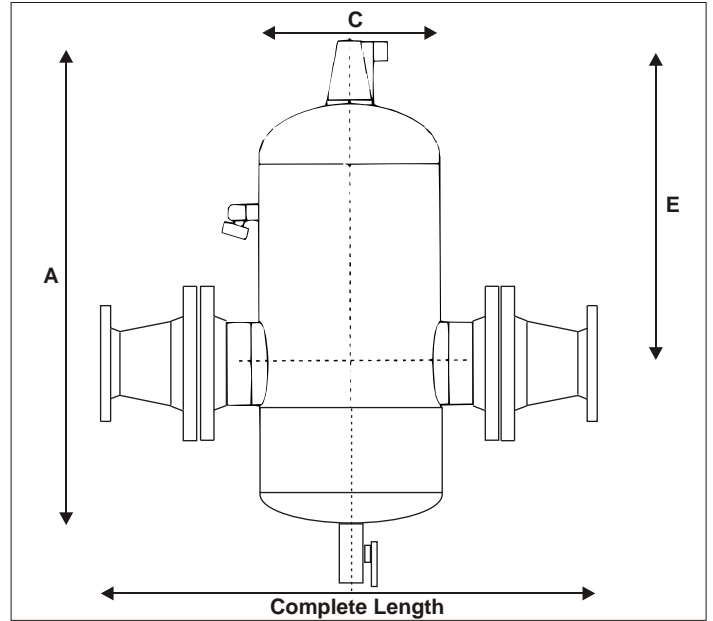
EMFLEX 'high flow' combined microbubble air and dirt separators are used in pipelines for the virtual elimination of air and separation of solid particles from heating and cooling systems in buildings where the water is flowing at high flow rates.

By using the processes detailed earlier in this booklet, it is possible to remove:-

- \* Air which is present in the system water in the form of small bubbles and microbubbles.
- \* Air which is dissolved in the system water.
- \* Air which is present where an EMFLEX automatic air vent can not be installed.
- \* Dirt and solid particles that are in suspension.
- \* Solid and solid particles that sink or float.

## Type SMADF-H

A steel shell with BS4504 PN16 flanged end connections, complete with flanged transition spools for connection to the pipe work.



Nominal Size	Height 'A'	Pipe C/L to Top 'E'	Shell Diam. 'C'	Shell Flange O/D	Spool Flange O/D	Complete Length	Weight (empty)	Allowable Flow Rate
mm	mm	mm	mm	mm	mm	mm	kg	litres/sec
40	565	365	175	165	150	530	24	3.3
50	565	365	175	185	165	560	28	5.5
65	765	450	270	200	185	680	47	7.6
80	765	450	270	220	200	714	53	13
100	980	550	360	250	220	879	83	20
125	980	550	360	285	250	959	94	28
150	1160	580	405	340	285	1130	152	52
200	1160	580	405	405	340	1306	199	80
250	1160	495	510	460	405	1480	256	113
300	1500	770	650	520	460	1880	-	130
350	1650	850	570	580	520	2040	-	180
400	1650	850	570	640	580	-	-	-

### Notes:

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include microbubble air separators, centrifugal air separators, dirt separators, automatic air vents and combined dirt filter/ball valves.

### Design Consideration:

For details of operation, installation and selection see pages 4, 5, 6 and 9 of this booklet.

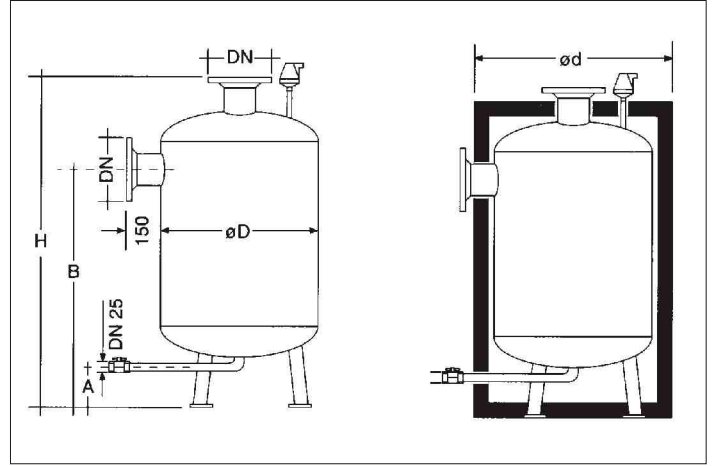
For conclusions on removal efficiency made by the Dutch TNO Institute of Environmental and Energy Technology see page 9.

It should be noted that PALL rings are used only in high flow microbubble air and dirt separators up to 125mm nominal size inclusive. For 150mm nominal size and larger, multiples of radially aligned stainless steel cohesion wires are used to provide the large surface area to trap the small air bubbles.

# EMFLEX Dirt Separators

EMFLEX dirt separators are used in pipelines for the high efficiency removal of impurities from heating and cooling systems in buildings.

It is possible to remove dirt and solid particles that are heavier than the system water by gravitating out as the water velocity decreases whilst passing through the large reservoir.



## Type SDF

A steel shell with BS4504 PN16 flanged end connections.

## Type SDFI (with Insulation)

A steel shell with BS4504 PN16 flanged end connections. This unit has an insulated enclosure.

Nominal Size	Height 'H'	Pipe C/L to Feet 'B'	Shell Diam.'D'	Insul'n Diam.'d'	Flange O/D 'DN'	Valve C/L to Feet 'A'	Vessel Volume	Maximum Flow Rate	Weight (empty)
mm	mm	mm	mm	mm	mm	mm	litres	litres/sec	kg
65	935	620	450	610	185	180	80	3.3	45
80	1030	675	550	710	200	265	110	4.4	60
100	1325	960	550	710	220	265	180	8.6	75
125	1790	1400	550	710	250	265	300	11.9	110
150	1470	1030	750	910	285	265	400	18.3	145
200	1900	1430	750	910	340	265	600	30.5	200
250	2285	1800	750	910	406	265	800	53.3	225
300	2020	1450	1000	1160	460	395	1000	79	320

## Temperature and Pressure

Maximum Working Pressure = 5 barg.  
(10 bar units are available on special request)

Maximum Operating Temperature = 120 deg.C.

## Specification

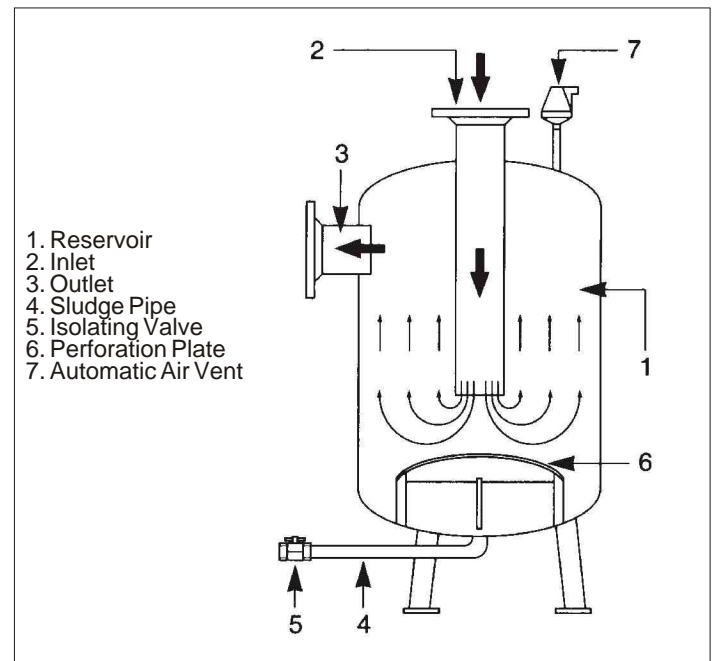
Construction: Steel, welded fabrication.  
Isolating valve.  
See page 15 for AAV.  
Insulation is an optional extra (Type SDFI)

## Notes:

We also provide a full range of air and dirt separation equipment for building services pipework systems. These include microbubble air separators, centrifugal air separators, combined microbubble air and dirt separators, automatic air vents and combined dirt filter/ball valves.

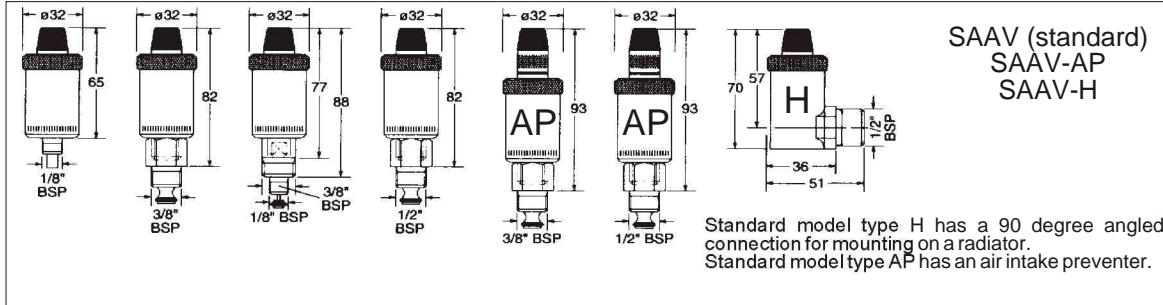
## Principle of Operation

See the diagram below for flow directions and critical parts that are numbered and identified as shown.

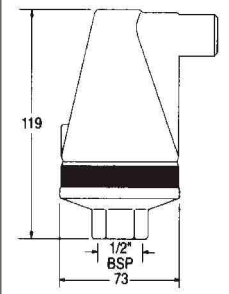


# EMFLEX Automatic Air Vents

EMFLEX automatic air vents are used in pipelines for the venting of air from both open and sealed heating and cooling systems in buildings. Most standard models, excluding type 1/8" and type H, are supplied with a shut-off valve. When the air vent is disconnected from the shut-off valve, the valve will close automatically making it easy to exchange or clean without draining down. To operate, the red cap should be turned anti-clockwise through one revolution.



## SAAV-S (superior)



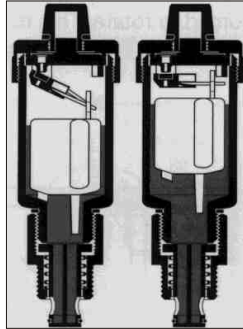
The superior model type S is available with an optional shut-off valve.

## Type SAAV (standard)

The standard in the range, with a number of different model types; see data table below.

### Principle of Operation of the Standard Model

The float keeps the venting valve closed. When air is collected inside the float chamber, the water level inside the unit will decrease and the venting valve will open. The collected air will escape through the venting valve and the water level inside the unit will increase again, which in turn closes off the venting valve. This process is continuous as long as air is collected in the unit.



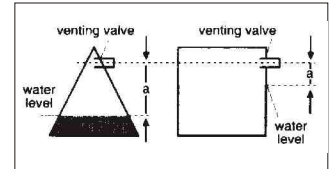
The air cushion in the upper part of the unit protects the venting valve against pollution. When the pressure inside the system is decreased below the ambient pressure, e.g. during draining, the unit acts as a vent.

## Type SAAV-S (superior)

A superior model than the SAAV. The venting valve is incorporated in the air chamber so that damage from the outside is almost impossible.

### Principle of Operation of the Superior Model

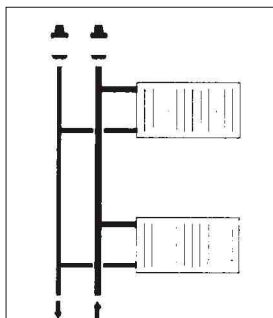
The air chamber is conical in shape. The advantage of this construction is that the clearance between the water level and venting valve is larger than in a straight chamber.



For example if both straight and conical shaped chambers have the same height and bottom surface area, when the water level rises the pressure rise in the conical shape will be faster than the straight shape due to the smaller volume. Therefore the pressure balance in the conical shape will be reached at a lower water level. Dirt floating on the water in this superior model will remain clear of the venting valve in normal conditions. This means that fouling of the gearing and venting valve is reduced to a minimum.

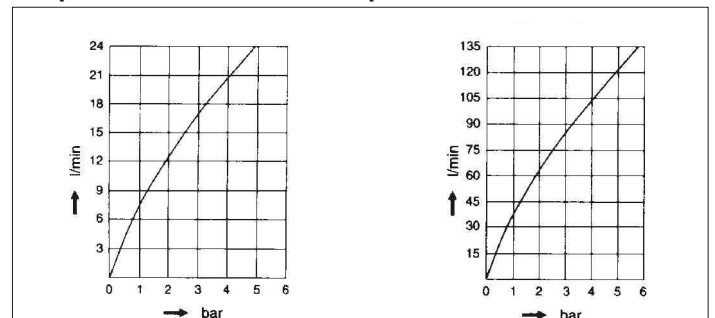
Model Type	Threaded Connection	Maximum Temperature	Maximum Pressure	Material of Construction	Shut-off Valve
	inch BSP	deg. C	bar		
1/8	1/8" BSP M	120	10	brass	no
3/8	3/8" BSP M	120	10	brass	yes
1/8-3/8	1/8" and 3/8" BSP M	120	10	brass	yes
1/2	1/2" BSP M	120	10	brass	yes
AP 3/8	3/8" BSP M	120	10	brass	yes
AP 1/2	1/2" BSP M	120	10	brass	yes
H	1/2" BSP M	120	10	nickel plated brass	no
S superior	1/2" BSP F	120	10	brass	optional

## Installation of Automatic Air Vents



Automatic air vents should be mounted in a vertical position where air is collected naturally in the

## Graphs for Standard and Superior Models



# Appendix 1

## Flow Rates and Water Velocities Through Pipe

Pipe nominal sizes up to 150mm inclusive are based on BS 1387 Medium steel pipes.

Pipe nominal sizes of 200mm and above based on ANSI B36 Schedule 40 steel pipes.

A volume flow rate of 1.0 litre per second is approximately equal to 3.6 cubic metres per hour.

Volume flow rates for water (litres/sec) can be taken as equivalent to mass flow rates for water (kg/s).

Nominal Pipe Size	Mean Pipe ID	Water Content	Approximate Flow Rates In Steel Pipes At The Stated Water Velocity					
			Velocity 0.5m/s	Velocity 1.0m/s	Velocity 1.5m/s	Velocity 2.0m/s	Velocity 2.5m/s	Velocity 3.0m/s
	mm	litres/m	litres/sec	litres/sec	litres/sec	litres/sec	litres/sec	litres/sec
15mm	16.2	0.2	0.1	0.2	0.3	0.4	0.5	0.6
20mm	21.6	0.4	0.2	0.4	0.6	0.8	1.0	1.2
25mm	27.3	0.6	0.3	0.6	0.9	1.2	1.5	1.8
32mm	35.9	1.0	0.5	1.0	1.5	2.0	2.5	3.0
40mm	41.9	1.4	0.7	1.4	2.1	2.8	3.5	4.2
50mm	53.0	2.2	1.1	2.2	3.3	4.4	5.5	6.6
65mm	68.7	3.7	1.9	3.7	5.5	7.4	9.3	11.1
80mm	80.7	5.1	2.6	5.1	7.6	10.2	12.8	15.3
100mm	105.1	8.7	4.4	8.7	13	17.4	22	26
125mm	129.8	13.3	6.7	13.3	20	27	33	40
150mm	155.3	18.9	9.5	19	28	38	48	57
200mm	202.7	32.3	16	32	48	64	80	96
250mm	254.5	50.9	25	51	76	102	127	153
300mm	303.3	72.2	36	72	108	144	180	216
350mm	333.3	87.2	44	87	130	174	217	261
400mm	381.0	114.0	57	114	171	228	285	342
450mm	428.7	144.3	72	144	216	288	360	432
500mm	477.8	179.3	89	179	268	358	447	537
550mm	527.0	218.1	109	218	327	436	545	654
600mm	574.6	259.3	129	259	388	518	647	777

# N.MINIKIN AND SONS LIMITED

## CONDITIONS OF BUSINESS

1.00

The following conditions ("the Conditions") apply to and are deemed to be incorporated in all contracts for the sale of Goods by N. Minikin & Sons Limited ("the Company") to the buyer and the provision of advice or other services ("Services") by Salesmen or Engineers employed by the Company either during telephone negotiations or site or office visits and the Buyer acknowledges that these Conditions exclusively define the relationship and agreement between the Company and Buyer and that they supersede all other agreements and conditions between the parties. No variation in these Conditions, expressed or implied, shall be accepted by the Company unless expressly agreed in writing and signed by a director of the Company and signed on behalf of the Buyer

2.00

To the extent that these Conditions limit or exclude the liability of the Company to the Buyer or any person claiming through or under the buyer such limitation or exclusion of liability is imposed to avoid the need for the Company to increase the level of its insurance against the risks so limited or excluded, and thereby to minimise the cost to the Buyer of the Goods or Services supplied. If the Buyer nevertheless wishes the Company to be responsible for risks, or liability which is otherwise limited or excluded by these Conditions, then the Company will, at its option, quote an alternative price for the supply of the Goods or Services to reflect the additional cost of obtaining the appropriate additional insurance or other appropriate cover

3.00

All orders for the Goods made by the Buyer, orally or by telephone, shall be confirmed to the Company by the Buyer, in writing (including telex or fax) within 48 hours of being received by the Company whereupon a binding contract for the purchase by the Buyer of the Goods comprised in the order upon these Conditions shall be concluded. Any order made by the Buyer is subject to acceptance by the Company and a Contract will only be formed when the Company has accepted the Buyer's offer to buy

4.00

### CANCELLATION AND RETURNS

4.01

No cancellation by the Buyer is permitted except where previously agreed in writing by a Director of the Company

4.02

The Buyer will in the event of cancellation by the Buyer not previously agreed as aforesaid indemnify the company fully against all expenses incurred up to the time of such cancellation together with by way of liquidated damages a sum of 50% of the contract price such sum being intended to represent a genuine pre-estimate by the Company and the Buyer of the loss (apart from the said expenses) suffered by the Company by reason of such cancellation and which shall be paid by the Buyer to the Company forthwith on cancellation

4.03

Goods supplied cannot be returned for credit without the previous approval in writing of the Company. A minimum handling charge of 30% will be made on the value of the Goods returned together with all carriage charges shall be paid by the Buyer. Specially manufactured items cannot be returned after delivery and orders for such items cannot be cancelled

5.00

### DELIVERY

5.01

The Buyer shall accept delivery by the Company or its agents on the date, or within the time period stipulated by the Company. However, any time or period for delivery stipulated by the Company shall be deemed an estimate only and the Company shall not be liable in any way for the costs and consequences of any delay except where the parties agree otherwise in writing

5.02

The Company may make and the Buyer shall accept deliveries of the Goods comprised in any order by instalments

5.03

Delivery will be made by or on behalf of the Company to anywhere within the United Kingdom specified by the Buyer. Delivery to the Buyer's carrier or agent shall be deemed to be delivery to the buyer for the purpose of these Condition of Business

6.00

### TERMS OF PAYMENT

6.01

Unless otherwise expressly agreed in writing in accordance with Condition 1 payment for the Goods or Services will be made within 30 days after the end of the month in which the Goods or Services in question are delivered or rendered to the Buyer (except for any of the Goods in respect of which a claim has been made by the Buyer in accordance with Condition 12.00 hereof) No discount or allowance shall be made (unless otherwise agreed). Interest on any overdue account may be charged on a day to day basis, with monthly rests, at a rate of 4% above the base lending rate of National Westminster Bank Plc from time to time, whether before or after judgement

6.02

Value Added Tax at the rate from time to time ruling shall be added to the price and shall form part of the purchase price of the Goods or Services for the purpose of these Conditions

7.00

If the Buyer fails to make payment in accordance with Condition 6.00 the Company reserves the right to discontinue, defer or suspend the supply to the buyer of any other of the Goods or Services contracted to be supplied and the Company shall be entitled to claim against the Buyer for any loss or damage whatsoever sustained by it in consequence thereof

8.00

If the Buyer shall be unable or unwilling for any reason to take delivery of the Goods or Services on the specified date or within the specified period, delivery shall for the purposes of calculating time for payment in accordance with Condition 6.00 be deemed to have taken place 14 days after the said date or period. The Company reserves the right to charge the Buyer for the cost of storage, labour, insurance and transport if the Buyer shall be unable or unwilling to take delivery of the Goods or Services as aforesaid

9.00

### PRICE

9.01

The Goods or Services will be sold to the Buyer at the prices agreed at time of order placed by the Buyer. The Company reserves the right to increase prices specified in the price list issued by the Company without notice to take account of any change in cost of wages, materials, insurance, transport, duty, tax, surcharge or levy of any kind

9.02

Any price quoted by the Company or contained in any order or contract shall be valid only for 28 days from the date of such quotation, order or contract

9.03

Carriage by the Company's normal transport in Great Britain is paid on orders over 750 value. Delivery of export orders will be F.O.B. the relevant United Kingdom port. Special packing or special delivery requirements will be charged extra

9.04

The Company shall not be liable for any loss whatsoever or howsoever arising caused by its non-delivery or by the failure to make Goods available ready for collection on the due date

10.00

### PROPERTY OF THE GOODS

10.01

Notwithstanding risk in the Goods passes to the Buyer as soon as the Goods become ascertained Goods and subject as provided below, the Goods shall remain the sole and absolute property of the Company and title to and legal and equitable ownership of the Goods shall not pass to the Buyer until payment is received by the Company for all monies due from the buyer to the Company in respect of all Goods supplied by the Company to the Buyer and the buyer acknowledges that until such payment is made in full it is in possession of the Goods solely as a fiduciary for the Company

10.02

If Goods the property of the Company are admixed with Goods being the property of the Buyer or are processed or incorporated therein the product thereof will become or deemed to be the sole and exclusive property of the Company

10.03

If Goods the property of the Company are admixed with Goods the property of any person other than the Buyer or are processed or incorporated therein the product thereof shall become or deemed to be owned in common with that other person in proportion to the respective invoice values of the Goods comprised in such product

10.04

The Buyer is licensed by the Company to use or to agree to sell the Goods provided that the entire proceeds of sale of such Goods (or if such Goods have been converted into some other product or mixed with other Goods being the property of some person other than the Buyer a fair proportion of the proceeds of sale) are held in trust for the Company are not mixed with other monies or paid into an overdrawn bank account and shall at all times be identifiable as the Company's money

10.05

Until title to the Goods passes to the buyer the Goods shall be kept separate and distinct from all other property of the Buyer and of third parties and in good condition and stored in such a way as to be clearly identifiable as belonging to the Company and the buyer will not cause or permit or suffer any labels, badges, serial numbers, packaging or other means of identification of the Goods to be removed or obscured

10.06

Without prejudice to any other right or remedies available to it the Company may for the purpose of recovering its Goods and at any time before payment to it of all monies due from the Buyer enter upon any premises where such goods are stored or where they are reasonably thought to be stored and may re possess the same

10.07

If the Buyer being an individual commits any act of bankruptcy or enters into or takes steps to enter into an individual voluntary arrangement under the Insolvency Act 1986 or being a company enters into liquidation (whether compulsory or voluntary) or has a receiver appointed over the whole or any part of its assets or is the subject of an administration order or any person becomes entitled to exercise the powers conferred on an administrative receiver and any payment due from the Buyer to the Company is overdue in whole or in part or the Buyer is unable to meet its obligations as and when they fall due then the Company may (without prejudice to any of its other rights) recover or re-sell the Goods or any of them and may enter upon the Buyer's premises by its servants or agents, for that purpose

11.00

11.01 Where the Goods are ordered by reference to any sample the Company shall use its best endeavours to ensure that the bulk corresponds with the sample

11.02

The Company warrants that the Goods supplied or Services given to the Buyer will be suitable for the primary purpose for which the Goods and Services given is/are made and normally used. Subject thereto no warranty is given or to be implied as to the suitability of the Goods or Services given for any particular purpose or for use under any specific conditions unless such purpose or conditions have been previously agreed in writing by the Company

11.03

In connection with the supply of the Goods the Company warrants to the Buyer in the terms implied by Section 12 of the Sale of Goods Act 1979 as to title, quiet possession and freedom from encumbrances of the Goods but except as aforesaid and without prejudice to the generality of paragraphs 12.01 and 12.02 of these Conditions, the Company gives no warranty whether expressed or implied, by law or otherwise as regards the Goods supplied by it provided that in the event of the Company's negligence nothing herein shall limit or exclude the Company's liability for personal injury or death

11.04

Subject to the operation of any other specific provisions of these Conditions the Buyer's remedies against the Company in respect of any liability of the Company, whether in contract or in tort, shall not exceed the sum of 50,000 or the invoice value of the Goods directly giving rise to the claim or loss (whichever is less) for the Buyer's direct financial loss and any indirect or consequential loss (including loss of profit) suffered by the Buyer or for any claim made against the Buyer by a third party

12.00

Subject to the provisions of paragraph 11.00:-

12.01

All claims for loss caused by damage in transit, in storage or on delivery by the Company must be notified in writing by the Buyer to the Company within three days after receipt of the Goods and must within seven days thereafter be supported by a detailed written claim by the Buyer to the Company

12.02

All claims for non delivery, shortages, variances in design, or incorrect specification must be notified to the Company by the Buyer verbally or by telephone, telex, or fax no later than three days after the date of delivery in the case of claims for variances in design or incorrect specification and no later than 48 hours after the date for delivery in the case of claims for non delivery and shortages and in all such cases confirmed in writing no later than seven days after the date of delivery and it is expressly provided that no claims for shortages, variances in design or incorrect specification shall be accepted in whole or in part if the Goods in question have been installed or cut or worked-upon by the Buyer or its employees or agents

12.03

The risk of accidental loss whilst the Goods are being returned will be borne by the Buyer

12.04

Time shall be of the essence in respect of any notification to be given by the Buyer to the Company in accordance with this paragraph 12

13.00

Any failure on the part of the Company to exercise, or any delay by the Company in exercising, any right or remedy available to it, whether contained in these Conditions or otherwise, shall not operate as a waiver of such right nor shall any single or partial exercise by the Company of such right or remedy preclude the exercise, successively or concurrently of any right or remedy. Subject to the provisions of Condition 1, no waiver by the Company, whether as a part of the course of dealings between the Company and the Buyer, or otherwise of any time limit specified in these Conditions shall be effective

14.00

The Company shall not be liable or deemed to be in default for any delay or failure to perform its obligations under these Conditions if such delay or failure results directly or indirectly from any cause beyond the reasonable control of the Company, including, but not limited to, acts or restrains of government or governmental agencies, force majeure, act of God, war, riot, civil or criminal disturbance, insurrection, accidents, fire, explosion, earthquake, flood, the elements, strikes, labour disputes, shortages of suitable material, labour or transport

15.00

The Company shall be entitled forthwith to terminate any contract incorporating these Conditions and payment thereunder shall immediately become due if the Buyer shall make any default in or commit a breach of these Conditions or of any of its obligations to the Company or if any distress or execution shall be threatened or levied on the Buyer's property or assets, or if the Buyer shall make or offer to make any arrangement or composition with creditors or seek to obtain pursuant to statute or otherwise any moratorium with creditors or shall pass any resolution or shall suffer a petition to be presented for the winding-up of the Buyer (other than for the purpose of a solvent amalgamation or reconstruction notified to the Company) or if a receiver or manager of the Buyer's undertaking, property or assets or any part thereof shall be appointed without prejudice or any claim or right the Company might otherwise make or exercise

16.01

All contracts incorporating these Conditions shall be interpreted in accordance with the laws of England and shall be enforceable in the English Courts

16.02

Any contract incorporating these Conditions may not be assigned by the Buyer without the prior written consent of the Company

16.03

The obligations of the Company may be performed in whole or in part by its authorised distributors sub-contractors or agents at the discretion of the Company

16.04

In making these Conditions the Company does so for itself and for and on behalf of every employee servant sub-contractor or agent of the Company and the Buyer hereby confirms that any exemption from liability granted to the Company by these Conditions shall also extend to any such employee servant sub-contractor or agent of the Company

16.05

Any notice sent under a contract incorporating these Conditions shall be sent to the registered office of the Company or the Buyer (as the case may be) and shall be deemed duly given by letter 48 hours after being posted by pre-paid registered post or if delivered by hand at the time of delivery or if given by telex or fax when the sender shall receive the answerback of the recipient sent

**ALSO AVAILABLE TO THE ENGINEER**

- \* Technical Advice
- \* CIBSE Recognised CPD Courses
- \* Product Catalogue: Expansion Joints, Flexible Connectors & Related Equipment
- \* Anti-Vibration Book: Vibration Isolators, Inertia Bases & Related Equipment
- \* Pipe Guiding Book: Pipe Guides, Pipe Skids & Related Equipment
- \* Slide Rule: Expansion Joint Calculator
- \* Standard Specifications
- \* Technical Reports
- \* Design Book: "The Application of Expansion Joints to Pipework Systems"
- \* Installation Instructions
- \* Quality Assurance to BS EN ISO 9002

**MINIKIN IS A PATRON OF  
THE CHARTERED INSTITUTION OF BUILDING  
SERVICES ENGINEERS**

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