

# Air Management

for Hydronic Heating and Cooling Systems



A-307A

 **Bell & Gossett**  
a xylem brand

# Bell & Gossett

## A Complete Line of Air Elimination Products for Commercial Heating and Cooling Applications

Every heating, cooling or dual hydronic system requires effective air management to provide maximum performance efficiency. Proper air control enhances hydronic system energy efficiency by helping reduce pipe corrosion and scaling which adds extra unnecessary friction losses. Less internal corrosion decreases maintenance costs, increasing system life, and with air removed there can be less system noise, reducing occupant complaints.

Bell & Gossett has been the hydronic systems innovator with over 90 years' experience in providing reliable products and systems design advice for hydronic, HVAC and plumbing systems. Our air management products are designed to make your system more energy efficient, trouble-free and long lasting.



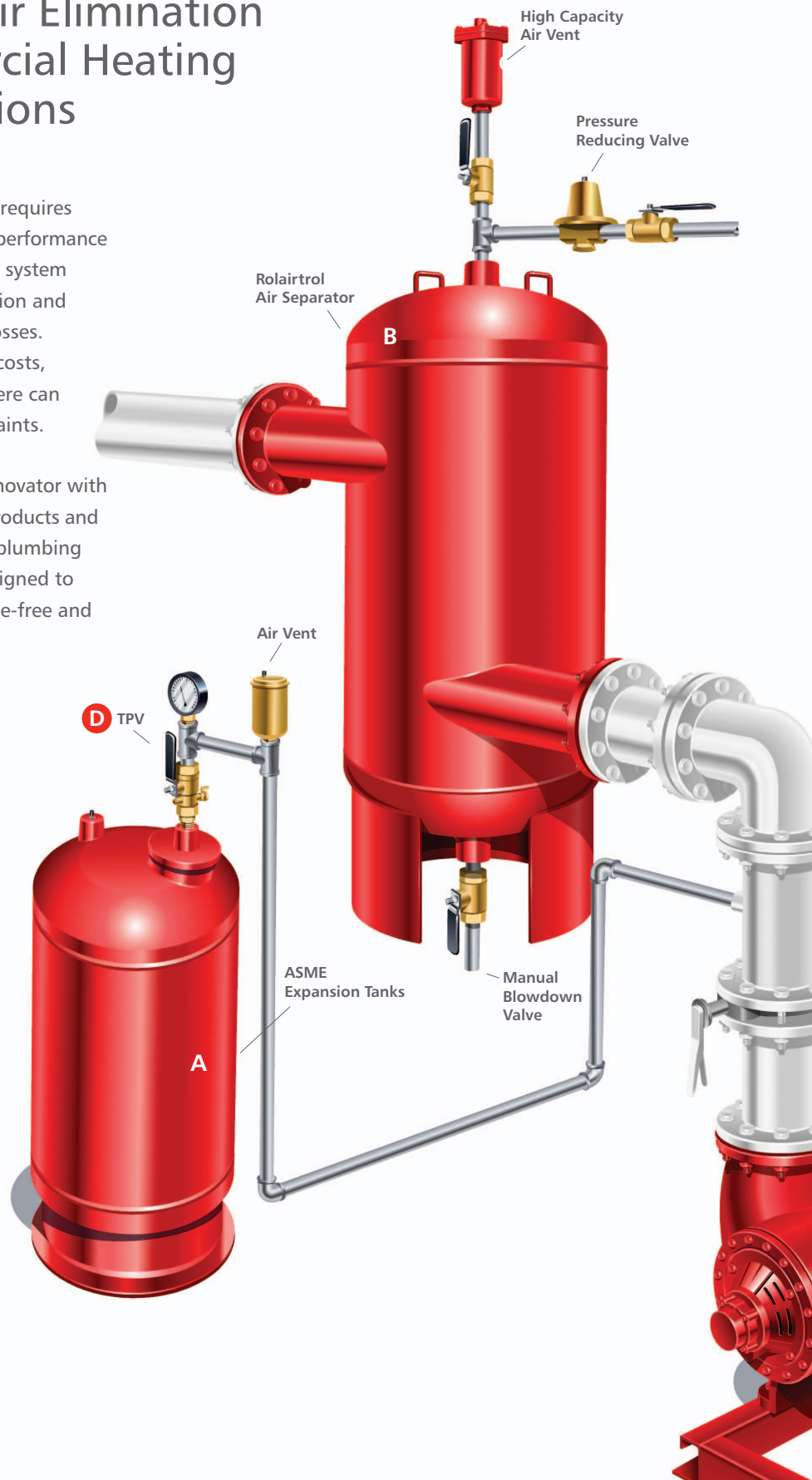
### **A** ASME Expansion Tanks

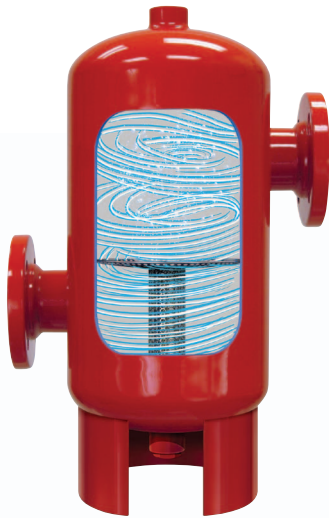
- Improve system performance.
- Reduce oxygen corrosion.
- Prevent waterlogging.



### Compression Tanks

- Absorb system fluid expansion.
- Provide proper pressurization.
- Provide positive air control.





**B** Rolairtrol® Air Separators  
For Hot and Chilled  
Water Systems

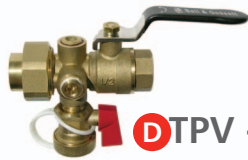
- Remove entrained air to protect system against damage.
- Eliminate noise caused by air bubbles.
- Tangential flow pattern increases efficiency.
- Chilled water buffer tank capability.

**C** High Capacity Air Vent



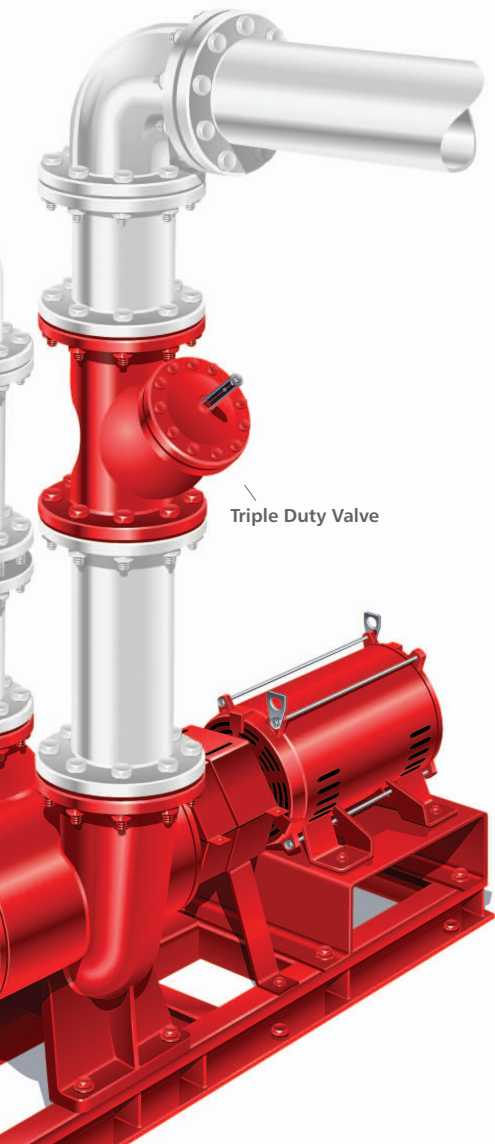
**Model 107A**

- Float-actuated operation for the instant venting of free air.
- Rugged cast iron construction with stainless steel, brass and EPDM internal components.
- Positive shut-off at pressures up to 150 psig.



**D** TPV - Tank Purge Valve

- Combination full port shut-off valve and drain valve.
- Allows for the expansion tank to be drained for easy servicing or tank replacement.



Triple Duty Valve

VSX Pump System

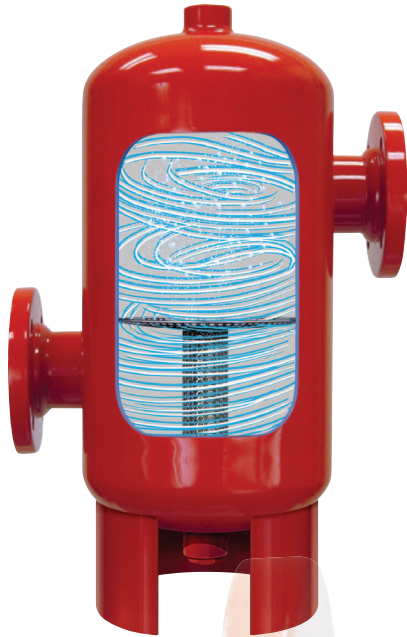


**Turney Center  
Correctional Facility, TN**

Although the original specification called for a Bell & Gossett product, the contractor installed a competitor's unit. Within the first year of its installation, the facility started to experience air lock and heat transfer difficulties. The original air separator device was enhanced with a coalescing medium to increase its efficiency but it just couldn't get the air out properly. The competitor's unit was taken out and it was replaced with a Bell & Gossett RL-8. The system is now operating properly with no air problems. The facility has operated without air problems for over 10 years.

# Rolairtrol Air Separators

## Supreme Air Separation for Commercial Systems



Rolairtrol is a patented air separator with significant advantages over all other types of air separators. It removes air that commonly causes problems in commercial hot and chilled water systems, and provides air-free flow, improving system efficiency and performance.

The Rolairtrol removes entrained air from the system fluid through time-tested centrifugal action. It provides maximum air separation efficiency through a combination of centrifugal force and velocity reduction. Unwanted air is separated by the differences in density between air and water.

Its tangential design creates a whirlpool inside the vessel, sending denser air-free water to the outer section near the shell, while the separated air migrates to the low-velocity center where it is drawn to the air collector. The separated air is removed from the system through the Hi-Capacity Air Vent in an air elimination system, or directed to the compression tank in an air control system.

A removable strainer is standard on the "R" model, reducing the quantity of components required for installation. The strainer has a free area of not less than five times the cross sectional area of the flange connection size. All debris that is collected within the strainer can be removed from the vessel through the blowdown connection on the bottom of the vessel.

In chilled water applications the Rolairtrol acts as a buffer tank to increase the chilled water volume. The increased water volume of the Rolairtrol improves chiller water temperature control, stabilizing system operation, and reducing compressor cycling compared to chiller loops with insufficient water volume.

Patented in 1951, the Rolairtrol has been the best overall air separator in the commercial HVAC market with respect to initial cost, effectiveness, maintenance and operating cost for over 40 years.

- Higher capacities than coalescing designs.
- Less pressure loss than coalescing designs, greatly reducing overall pump operation costs.
- ASME stamped.
- Patented tangential flow-through design maximizes air separation efficiency.
- Proven reliability – Rolairtrol has successfully increased system efficiencies for 40 years.
- Buffer tank ability – The Rolairtrol contributes to meeting the minimum loop volume.
- Backed by Bell & Gossett's 90 years' experience in hydronic, HVAC and plumbing systems.

## Rolairtrol Features

## Rolairtrol Benefits

### A Tangential Flow-Through Design

**Patented B&G Design** – The Rolairtrol provides maximum air separation efficiency due to a combination of centrifugal force and velocity reduction. The Rolairtrol's tangential design creates a whirlpool inside the vessel. The tangential design had the greatest air separation efficiency when compared to less effective, straight flow separators or coalescing designs.

### B Designed for Typical Commercial HVAC Flow Rates

B&G sized the Rolairtrol for typical flow rates found in U.S. commercial HVAC applications. You won't need an 8" size unit for 6" piping.

### C Low Pressure Drops

Compared to coalescing air separators, the Rolairtrol has much less pressure loss at the flow rates recommended with the popular coalescing designs. Extra pressure drop costs money in monthly electric bills to operate the pump. The Rolairtrol costs less to operate, and has superior first pass air removal efficiency.

### D Baffle

The baffle assures that air-free water is transferred to the outlet connection while separated air is directed to the air collector.

### E Vertical Strainer with Bottom Access

Unlike the upper, horizontal strainer location in competitive air separators, the Rolairtrol's lower, vertical strainer does not interfere with the vortex action, maximizing efficiency. In addition, the strainer is accessible from the bottom of the unit, reducing floor space while simplifying maintenance.

### F NPT, Grooved and Flanged Connections

Three connection options offer installation flexibility.

### G Up to 36" Pipe Size Connections

Models up to 36" in pipe diameter meet the air separation requirements in the largest HVAC systems.

### H Optional B&G Manual Blowdown Valve

Simplifies installation, general maintenance and removal of start-up debris.

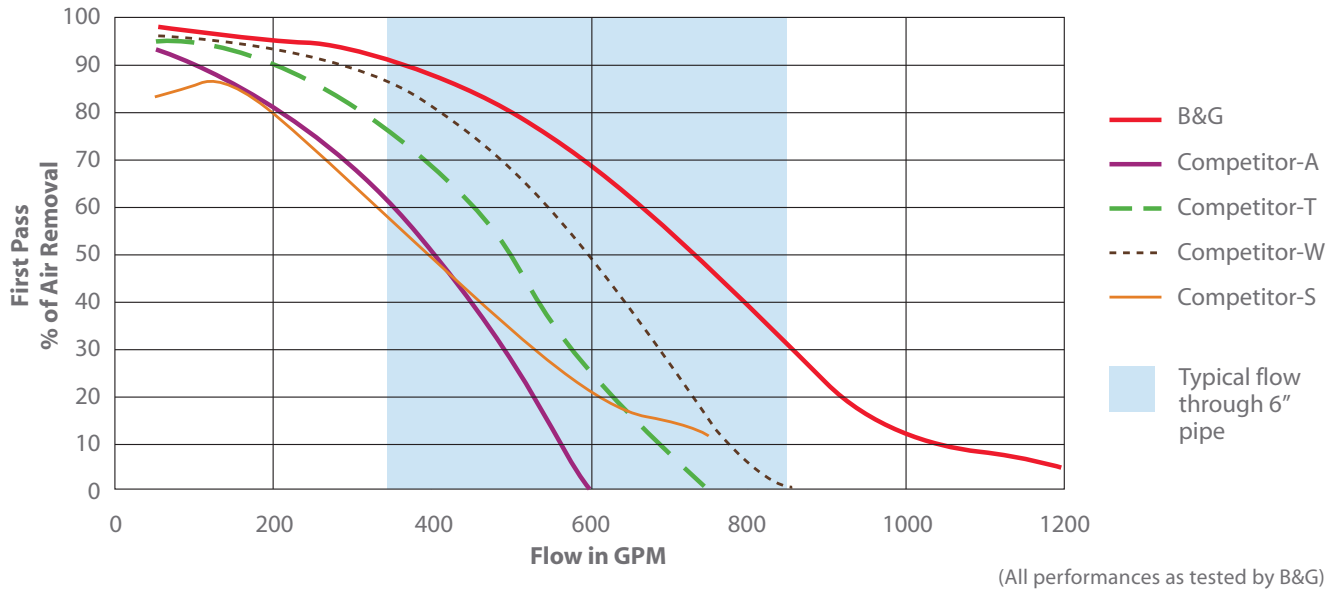


### Valley Creek W.W.T.P., Jefferson County, AL

The Phase II-A Expansion of the Valley Creek Wastewater Treatment Plant in Bessemer, Alabama was completed in 1998. As the largest wastewater facility in the state, the facility has two (2) 600 HP hot water boilers and is permitted to treat 85 million gallons per day, but currently is capable of treating up to 600 million gallons per day. The plant operates around the clock and cannot be shut-down for repairs, therefore, the reliability of all the equipment is crucial. Bell & Gossett's Rolairtrol proves to fill the bill. The Rolairtrol is part of boiler loop in the process that maintains a specific water temperature and

helps the chemical breakdown of the waste. In a "not too hot, but not too cold" scenario, the anaerobic digester operates optimally at 95° F to 98.6° F. At this temperature range the mesophilic bacteria break down dissolved organic material, releasing methane, carbon dioxide and water, along with the remaining organic and inorganic material residue that is stabilized into biosolids. The methane by-product can be used as the fuel to fire the boilers. The Rolairtrol separates the air out of water in the boiler loop to keep the heat transfer at its highest efficiency.

## Air Separation Efficiency Comparison



## Rolairtrol vs. Competition

6" Separators	Cv Comparison (w/o strainer)
<b>B&amp;G</b>	<b>B&amp;G RL-6 850</b>
Competitor-A	720
Competitor-T	750
Competitor-W	410
Competitor-S	500

In a side-by-side test we compared first pass air removal efficiency to flow rate between a Bell & Gossett RL-6 and four competing air separators: Competitor A, T, W, and S. The results: The Bell & Gossett Rolairtrol removes more air per pass than any other air separator. The patented design uses a combination of centrifugal force and velocity reduction to maintain high air removal efficiency over a broader band of flow compared to any other design.

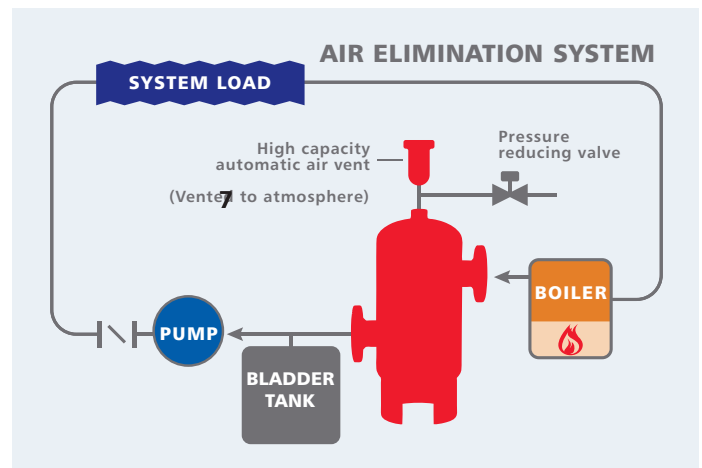
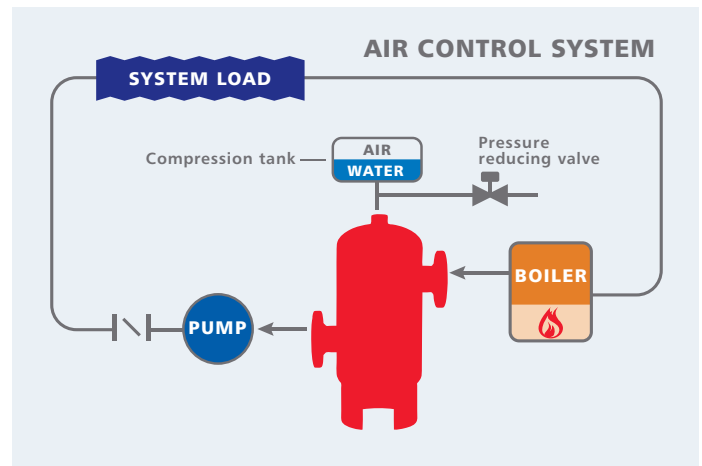
As illustrated in the graph above the Rolairtrol has the highest air removal efficiency across the flow range. The area that is shaded in blue is the typical flow range that commercial HVAC engineers design for a 6" pipe. The Rolairtrol is designed for typical HVAC applications. You don't have to have an 8" Rolairtrol for a 6" line. Using any other brand of air separator will require a larger size vessel for the same air removal efficiency. Some competitors limit the flow rate to ranges well below typical HVAC designs this will result in the selection of a larger sized vessel plus pipe reducers to match flange sizes. The B&G Rolairtrol won't need extra pipe fittings, saving installation cost. More money in extra fittings and energy bills can be saved when the Rolairtrol is provided with the integral strainer. When a non-integrated strainer is installed in the system, extra unnecessary pressure losses are added to the system meaning more pump horsepower, and the installer has to buy more pieces and add more labor.

# Air Control vs. Air Elimination

The air in a closed hydronic system is managed by using one of two techniques. In the Air Control method, the air cushion and system water actually touch. During the fill and system pressurization step, all excess air is vented and the required air is stored in a compression tank where it acts as a cushion for the expansion and contraction of the system water volume. Changes in the system temperature and pressure change the solubility of air in water. The air separator constantly removes entrained air as the system air solubility falls.

In the Air Elimination method, a flexible diaphragm, or bladder, physically separates the system water and the air cushion. The entire hydronic system, piping, radiation and boiler or chiller is completely purged of air during the initial fill and any free air introduced later is separated in the air separator and vented to atmosphere.

- Tank can be mounted on the floor.
- Air cushion and system water do not touch.
- Tank smaller than standard tank for a given system.



## The Science of Air Separation



The separation of air from water is described by Henry's Law and Stokes' Law. Henry's Law describes the amount of air water can hold in solution depending on the temperature and pressure. Higher pressure or lower temperature water can absorb or hold more air in solution than water that is warmer or at lower pressure. Even the narrow temperature range of chilled water systems demonstrates the effect of temperature on solubility.

Air bubbles released from fresh tap water as it rises to room temperature show how a small change in temperature will give off free air from solution.

# How the Rolairtrol Works

In order to evaluate air management of a specific application a better understanding of how temperature and pressure affect the solubility of air in water is required. Air is a mixture of gases, approximately 80% nitrogen, 20% oxygen and trace amounts of others. Within a short time after the initial fill, the air in a properly operating closed system begins to lose its oxygen content through oxidation. Unless fresh water, with its 2% air is added, the gas remaining becomes nitrogen, an inert gas. The chart in Figure 2 illustrates the effects of pressure and temperature on the solubility of air in water.

With the air out of solution, the air separator will isolate the air and move it to the air vent for air elimination, or send it to the compression tank for air management. The principles governing

the design of air separators are simple. One is by reducing the water velocity to 1/2 ft/sec or less. Water will not carry along free air bubbles at that velocity. Stokes' Law explains the separation process. Separation occurs when the buoyancy of the air particle exceeds the gravitational force and the friction force created by the system water. The Rolairtrol enhances the separation process by using centrifugal force to separate the air from the water rather than relying on gravity alone. Gravity is the only variable that can be improved in the formula. The centrifugal force created by the Rolairtrol pushes the heavier water toward the shell and the lighter air toward the air collector where it will move to the top of the Rolairtrol. This is the most efficient method of separating air in large commercial HVAC applications.

## Stokes' Law

$$v = (2gr^2)(\rho_1 - \rho_2) / 9\eta$$

Where:

- v = velocity of rise (cm sec<sup>-1</sup>),
- g = acceleration of gravity (cm sec<sup>-2</sup>),
- r = "equivalent" radius of particle (cm),
- ρ<sub>1</sub> = density of particle (g cm<sup>-3</sup>),
- ρ<sub>2</sub> = density of medium (g cm<sup>-3</sup>), and
- η = viscosity of medium (dyne sec cm<sup>-2</sup>).

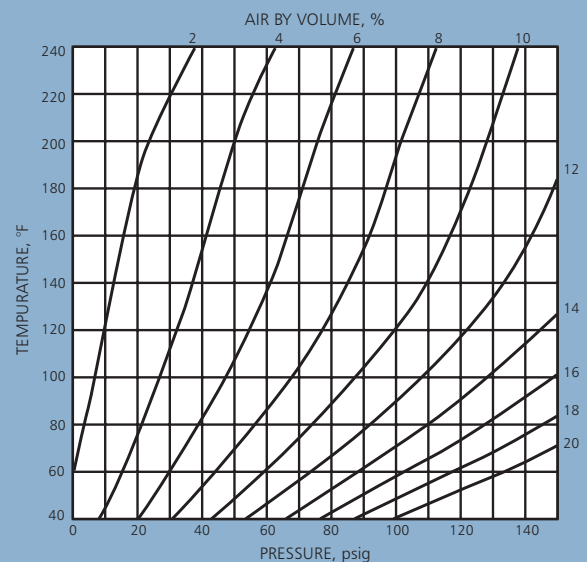
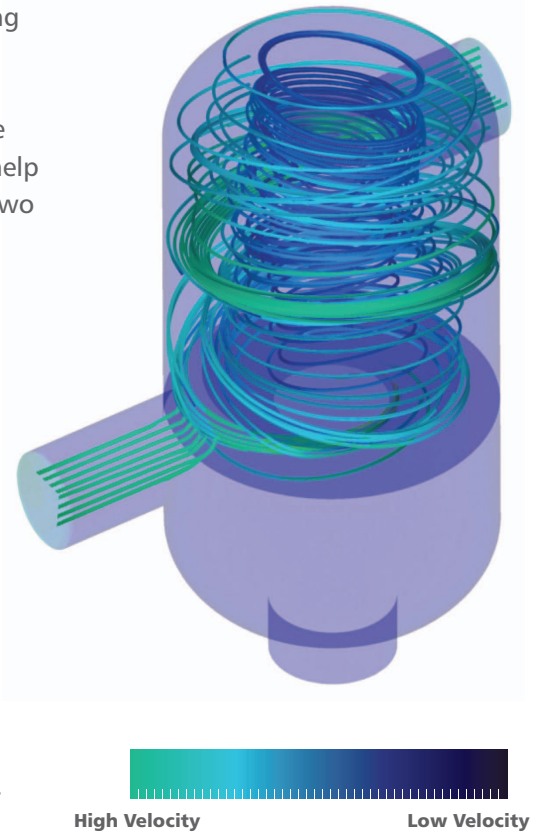


Fig. 2 Solubility Versus Temperature and Pressure for Air/Water Solutions



# Velocity Gradient of Water in a Rolairtrol

The picture to the right illustrates the velocity change for water passing through an RL Rolairtrol. A computational fluid dynamics program, using color to depict the changes of fluid velocity and flow path within the Rolairtrol vessel, was used to create this illustration. The green color indicates the higher velocity fluid; the dark blue a low velocity fluid. The Rolairtrol uses a combination of low velocity and centrifugal action to help separate entrained air from the water. The difference in density of the two fluids forces the air toward the low velocity area in the center, where it rises to the top of the vessel and accumulates in the air collector. The air then passes through an air vent and is vented to the atmosphere or it is directed to a compression tank.



## Reduced Life Cycle Costs

No doubt, when operated at manufacturer's recommendations, the pressure loss of an air separator in a hydronic system will be very low compared to the rest of the system. When the Rolairtrol is operated at the same flow rate recommended for the competitors units, not only does first pass efficiency increase, but operating costs are also significantly reduced. Pumping costs of a Rolairtrol can be from 50% to 25% of competitive devices. That helps make attaining green energy design guidelines easier for the designer. Considering that many competitive units are more expensive than the Rolairtrol, and that the Rolairtrol costs less to operate and has better air removal performance, the Rolairtrol just makes good sense!



### **Scales Hall, Southwestern Adventist University**

Scales Hall on the campus of Southwestern Adventist University is a long, low building. Therefore its combination heating/cooling system has little static height and long pipe runs. The system often experienced pump noise and air bound circuits causing poor performance in both the heating and cooling modes. When it came time to replace the original cast iron boiler, Putnam Services searched for a better solution to control the air in the system and reduce operating costs. They installed a new boiler and selected a Bell & Gossett Rolairtrol to act as the air separator on this retrofit

project. They were pleased with the results. The complaints about uneven heating and pump noise went away. The efficiency and performance of Scale Hall's hot and chilled water system both improved. "We've never had to run the boiler on full," says Jere W. Putnam, President of Putnam Services, "the 1.2 million BTU boiler only needs to be run on 800,000 BTU's and our 120-ton chiller operates at only 60 ton." The Rolairtrol proved to be the solution for getting the suspended air out of Scales Hall's chilled and hot water and providing better overall heat transfer.

# Compression Tank & Airtrol Fittings

Pre-charge tanks are designed to absorb the forces of thermal expansion in hydronic heating and cooling systems. The rubber membrane completely isolates the air from the system fluid, which prevents waterlogging of the tank. The pre-charge minimizes the size of the tank.



## Series B

- ASME Section VIII, Division 1 design and constructed
- Heavy duty full acceptance replaceable butyl bladder
- Sizes: 53 - 3,963 gallon
- Factory pre-charge to 12 PSI, adjustable in the field
- High pressure models up to 250 PSI available
- Seismic restraints available
- California-code sight glass available



## Series B-LA

- ASME Section VIII, Division 1 design and constructed
- Economical heavy duty replaceable butyl bladder
- Sizes: 10 - 158 gallon
- Factory pre-charge to 12 PSI, adjustable in the field
- Seismic restraints available
- California-code sight glass available



*The plain steel compression tank absorbs the expansion of system fluid in hydronic heating and cooling systems, and provides proper pressurization under varying operating conditions. When used with Airtrol Tank Fittings, it provides positive air control.*



## Series D

- ASME Section VIII, Division 1 design and constructed
- Economical fixed butyl diaphragm
- Sizes: 8 - 211 gallon
- Vertical and horizontal designs
- Factory pre-charge to 12 PSI, adjustable in the field
- Seismic restraints available
- California-code sight glass available



*Airtrol® Tank Fittings direct free air to the compression tank and restrict thermal circulation to the boiler. The fitting establishes initial tank air level and allows a reduction in compression tank size. An Airtrol Tank Fitting should always be used with a plain steel compression tank. Do not use with pre-charged diaphragm and bladder tanks.*

## Plain Steel Compression Tanks

- ASME Section VIII, Division 1 design and constructed
- Sizes: 15 – 505 gallons
- Gauge glass tapings are standard
- High pressure models available
- Custom tanks with additional tapings and alternative materials of construction are available

## In-Line Air Separator Model IAS Air Control

Bell & Gossett In-Line Air Separators are designed to effectively separate free air in hydronic heating/cooling systems. The air separators are a single piece of cast iron with an integral weir, designed to reduce system flow to maximize air separation. The IAS-1½ and IAS-3 have a ¾" NPT tapping to accept a high capacity air vent or can be piped to a plain steel compression tank. The IAS-1 and IAS-1¼ have a ⅛" vent tapping to accept an air vent. All models have a ½" NPT bottom tank connection.



### Construction:

One piece cast iron

### Maximum operating limitations:

Working pressure: 175 psig (12.1 Bar)  
Temperature: 300°F (149°C)

## Model EAS Enhanced Air Separator

The Enhanced Air Separator is an efficient device designed for air separation in residential or light commercial hydronic heating or cooling systems. It differs from an air scoop because it has an internal diffuser and coalescing medium. The diffuser forces the system fluid to cover the entire inlet portion of the coalescing medium. Air bubbles, including micro air bubbles, will separate from the system fluid and adhere to the stainless steel coalescing medium. The separated air rises to the top of the separator where it is vented to the atmosphere through an automatic air vent or directed to a standard compression tank. The EAS comes ready for installation as a straight or angle-pattern pipe design.



### Construction:

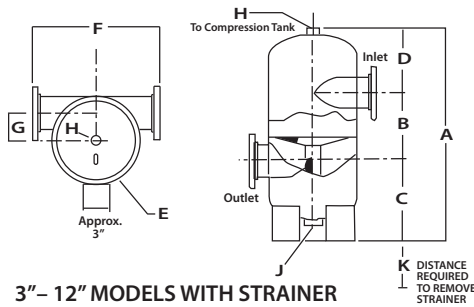
Enhanced Air Separator cast iron body and cap; stainless steel internal Air Vent; brass body, nonferrous internals

### Maximum operating limitations:

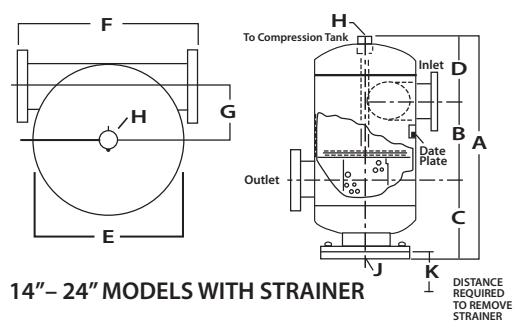
Working pressure: 150 psig (10.3 Bar)  
Temperature: 250°F (121°C)

Model Number	Part Number	Size NPT	Vent Tapping	Max Flow Rate (GPM)
IAS-1	112118	1"	⅛"	15
IAS-1 ¼	112119	1 ¼"	⅛"	25
IAS-1 ½	112097	1 ½"	¾"	35
IAS-2	112098	2"	¾"	50
IAS-2 ½	112099	2 ½"	¾"	75
IAS-3	112100	3"	¾"	125

Model Number	Part Number	Size Inches	Max Flow Rate (GPM)
EAS-1	112105	1"	35
EAS-1-1/4	112106	1 ¼"	35
EAS-1-1/2	112107	1 ½"	45
EAS-2	112108	2"	70



3"– 12" MODELS WITH STRAINER



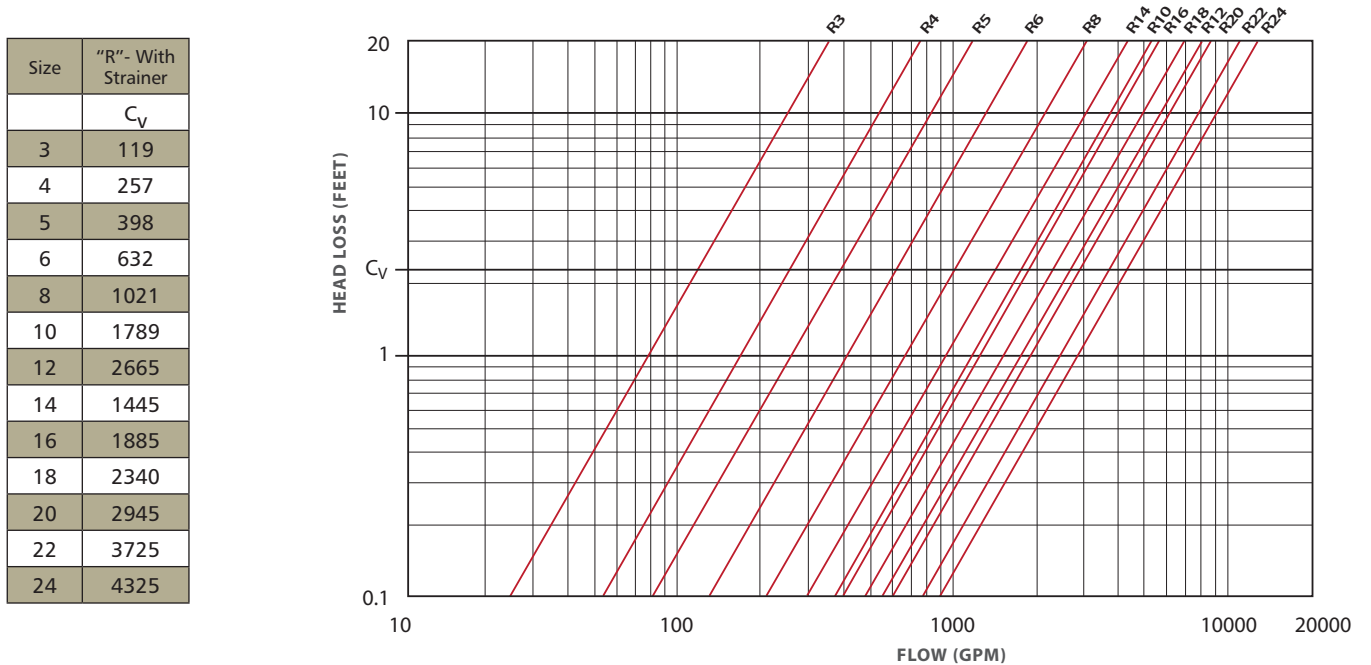
14"– 24" MODELS WITH STRAINER

Dimensions in Inches (mm)

Model Number	A	B	C	D	E	F	G	H	J	K
R-3F	26 7/8 (683)	8 (203)	10 13/16 (275)	8 1/16 (205)	10 3/4 (273)	22 3/4 (578)	3 5/8 (92)	1 1/4 (32)	3 (76)	12 (305)
R-4F	31 7/16 (799)	10 (254)	11 15/16 (303)	9 1/2 (241)	12 3/4 (324)	20 1/2 (521)	4 1/8 (105)	1 1/2 (38)	3 (76)	14 (356)
R-5F	37 (940)	12 (305)	14 1/16 (357)	10 15/16 (278)	16 (406)	23 3/4 (603)	5 1/4 (133)	1 1/2 (38)	3 (76)	16 (406)
R-6F	44 1/16 (1119)	14 (356)	16 13/16 (427)	13 1/4 (337)	18 (457)	25 3/4 (654)	5 11/16 (144)	1 1/2 (38)	3 (76)	19 (483)
R-8F	54 (1372)	18 (457)	19 7/16 (494)	16 9/16 (421)	24 (610)	31 3/4 (806)	7 11/16 (195)	2 (51)	3 (76)	23 (584)
R-10F	64 11/16 (1643)	22 (559)	22 5/8 (575)	20 1/16 (510)	30 (762)	37 3/4 (959)	9 5/8 (244)	2 (51)	3 (76)	28 (711)
R-12F	75 3/8 (1915)	27 (686)	25 3/4 (654)	22 5/8 (575)	36 (914)	46 3/4 (1187)	11 5/8 (295)	2 (51)	3 (76)	31 (787)
R-14F	89 7/8 (2283)	31 1/2 (800)	32 1/2 (826)	25 7/8 (657)	42 (1067)	54 1/2 (1384)	14 (356)	2 (51)	2 (51)	37 (940)
R-16F	102 3/4 (2610)	36 (914)	36 1/2 (927)	30 1/4 (768)	48 (1219)	62 1/2 (1588)	16 (406)	2 (51)	2 (51)	42 (1067)
R-18F	125 7/8 (3197)	40 1/2 (1029)	47 5/8 (1210)	37 3/4 (959)	54 (1372)	70 1/4 (1784)	18 (457)	2 (51)	2 (51)	52 (1321)
R-20F	135 7/8 (3451)	45 (1143)	49 1/8 (1248)	41 3/4 (1060)	60 (1524)	78 (1981)	20 (508)	2 (51)	2 (51)	56 (1422)
R-22F	148 1/8 (3762)	49 5/8 (1260)	52 3/4 (1340)	45 3/4 (1162)	66 (1676)	85 7/8 (2181)	22 (559)	2 (51)	2 (51)	60 (1524)
R-24F	159 3/8 (4048)	54 (1372)	56 1/8 (1426)	49 1/4 (1251)	72 (1829)	93 1/2 (2375)	24 (610)	2 (51)	2 (51)	64 (1626)

Please Note: Rolairtrols are also available in 2" and 2 1/2" sizes, w/ grooved connections, w/ optional support brackets, and w/o strainers. Cv values for units w/o strainers can be approximated by multiplying the above Cv values by a factor of 1.4 for units 3" – 12" and a factor of 2.7 for units 14" – 24". Please see official Bell & Gossett submittals for more specific information on these products.

Rolairtrol Pressure Drop Chart (Consult Submittals for Detailed Data)



# Trust the name that set the standard in the HVAC industry – Bell & Gossett.

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For over 90 years Bell & Gossett has brought you the most reliable and innovative products for hydronic, HVAC and plumbing systems. From pumps and heat exchangers, to air management systems and valves, Bell & Gossett knows what you need to get the job done right the first time and provide lasting value.

Your local Bell & Gossett representative is an experienced professional with a wealth of technical expertise. Because they know systems from design to operation, they can give you the advice and support you need to successfully install, operate and maintain your hydronic systems.

## Unparalleled Training and Product Support

The famous Bell & Gossett Little Red Schoolhouse opened in 1954 as a dedicated facility for training. Over the past 55 years we have trained more than 50,000 engineers, contractors and installers in the proper design, installation and maintenance of HVAC systems. We can help you understand the complexities of air management from a system perspective. Our fully equipped learning center is the only facility of its kind, and Bell & Gossett is proud to set the standard for professional education and HVAC system innovation.



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