

Effective Air and Dirt Removal to Improve Performance and Extend the Life of Thermal Distribution Systems



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Objectives

- Understand How Air Affects Hydronic Systems
- Understand What “Dirt” Is and How It Impacts Hydronic Systems
- Identify Sources of Air and Clues to Air in Systems
- Know How and Where to Remove System Air and Dirt
- Define Reduced Thermal Performance (RTP)
- Define Reduced Pump Performance (RPP)
- Understand the Energy Usage and Energy Cost Impact of Air on Heating and Cooling Systems

Reality Check #1

In most systems,

$$Q_{\text{Water (in BTUH)}} \neq 500 \times \text{GPM} \times \Delta T$$

A fluid-air mixture cannot transfer heat as effectively as a fluid by itself.

Reality Check #2



Negative Effects of Air

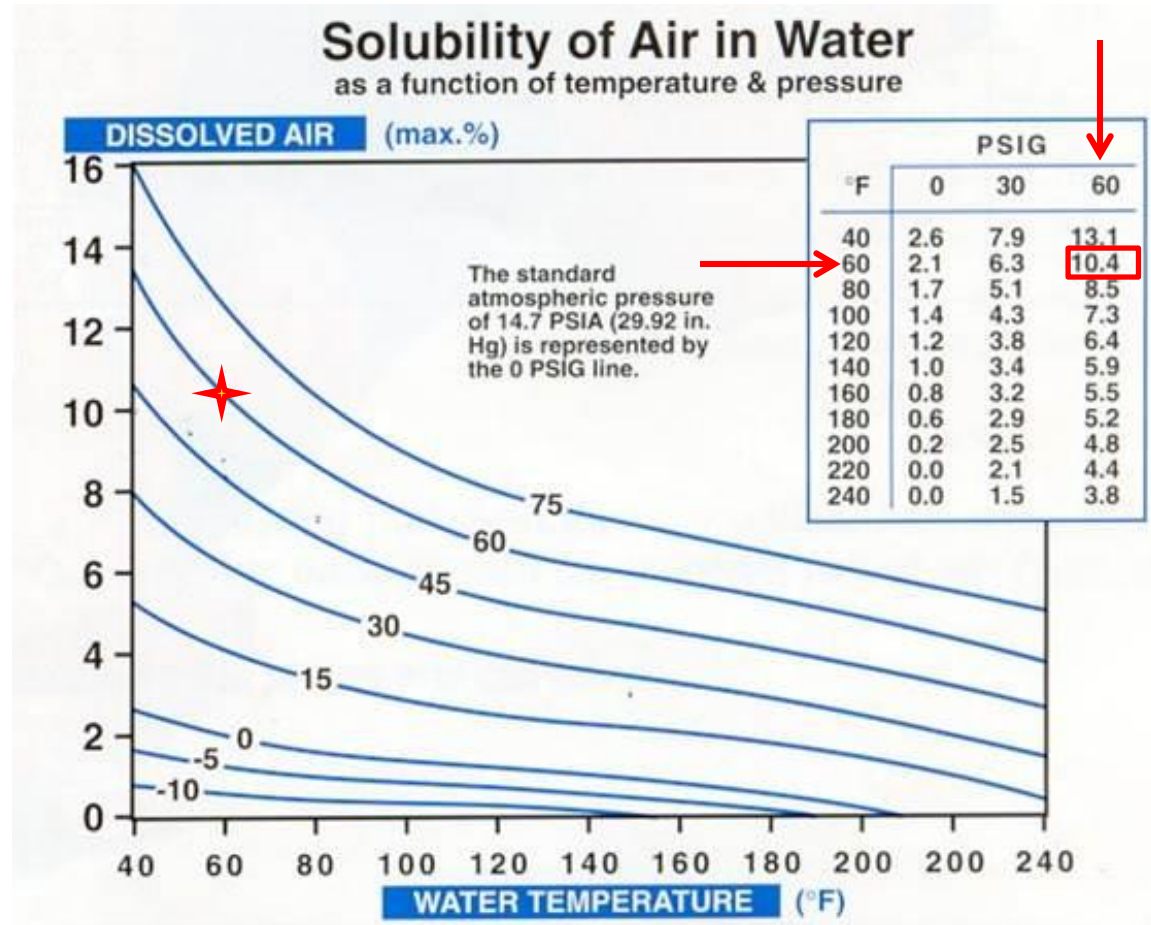
- Reduced Heat Transfer Capability
- Increased Pump Energy
- Increased Supply Fan Energy
- Reduced System Energy Efficiency
- System Corrosion as Air is ~20% Oxygen
- Increased Chemical Treatment Costs
- Increased Maintenance Costs and Life Cycle Costs For Equipment and the Overall System

Air: Entrained, Free and Dissolved

Henry's Law:

“At a given temperature, the amount of gas absorbed by a liquid is proportional to its pressure.”

Note: Entering domestic water may contain 10%-15+% air by volume.



* Dissolved air by volume.

Clues to Air in the System

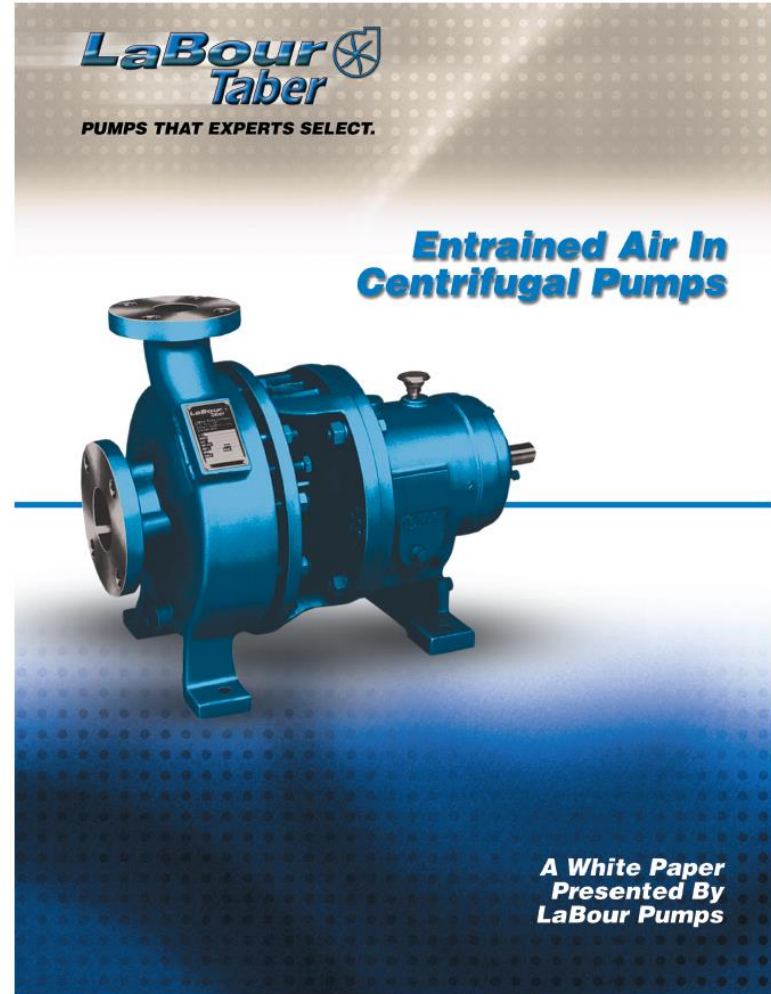
- Noisy Flow in Piping
- Fluctuating Pressure Gauges
- Reduced Pump Performance
- Chillers, Boilers, and Other Heat Transfer Equipment Not Meeting Scheduled Capacity
- Observable System Corrosion and Debris

Reduced Thermal Performance (RTP)

Air present in a hydronic heating or cooling system negatively impacts the system's ability to transfer heat.

Entrained Air Impact on Pumps

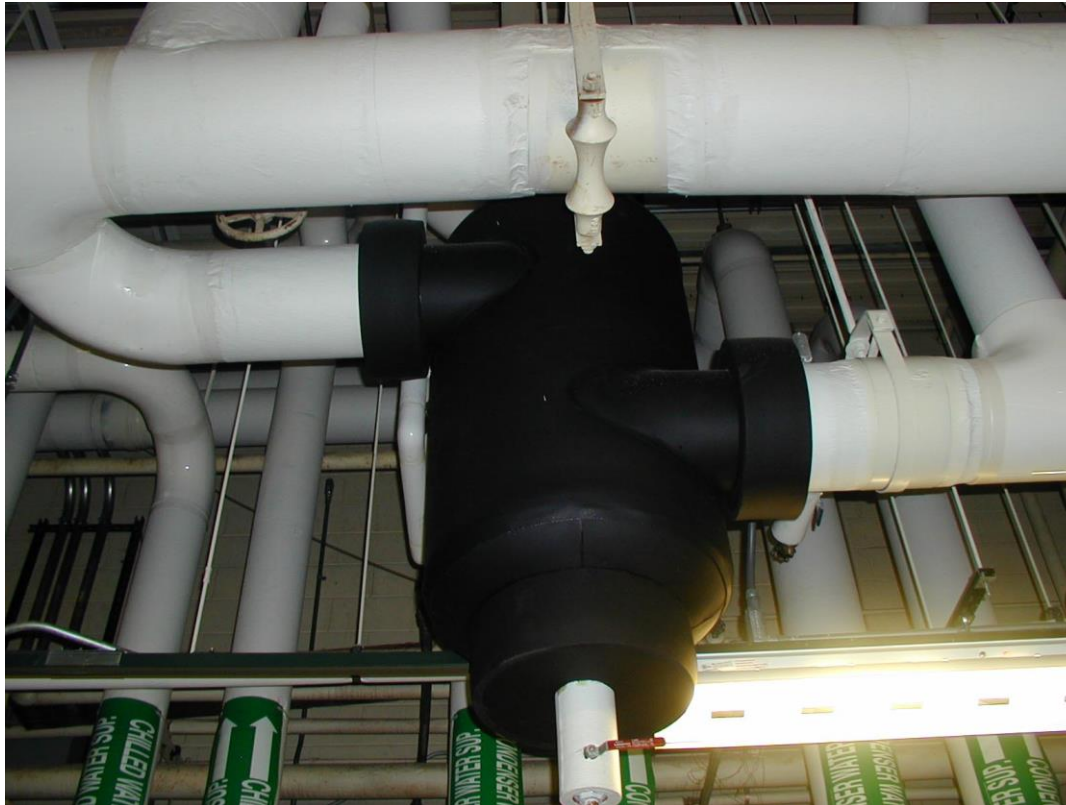
- Not Traditionally Addressed in the HVAC Industry
- *Gould's Pump Manual:*
“A mixture of only 2% gas by volume will cause a 10% reduction in capacity and 4% will cause a reduction in over 43%.”



Reduced Pump Performance (RPP)

Entrained air affects the ability of pumps to perform as designed and results in increased energy usage.

Tangential Air Separators

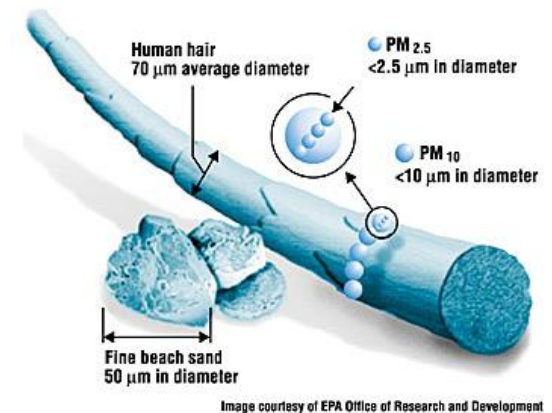


System Contamination

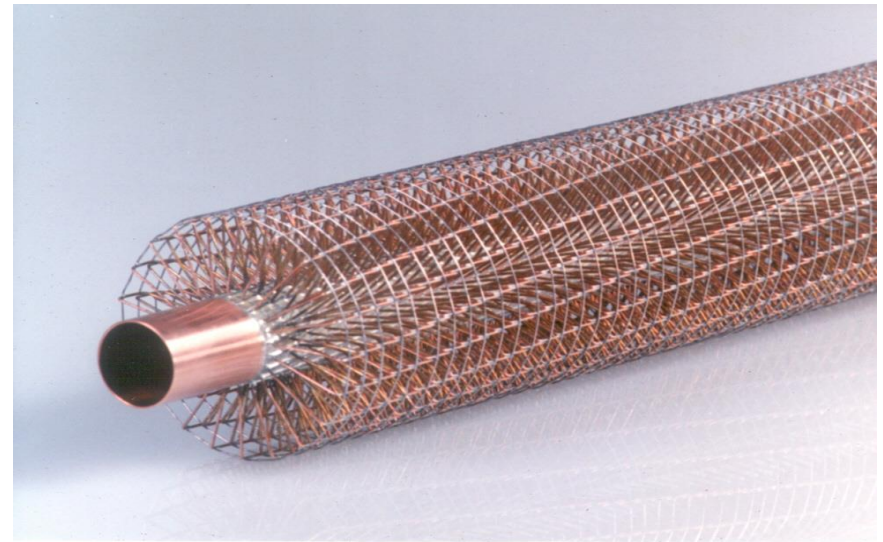
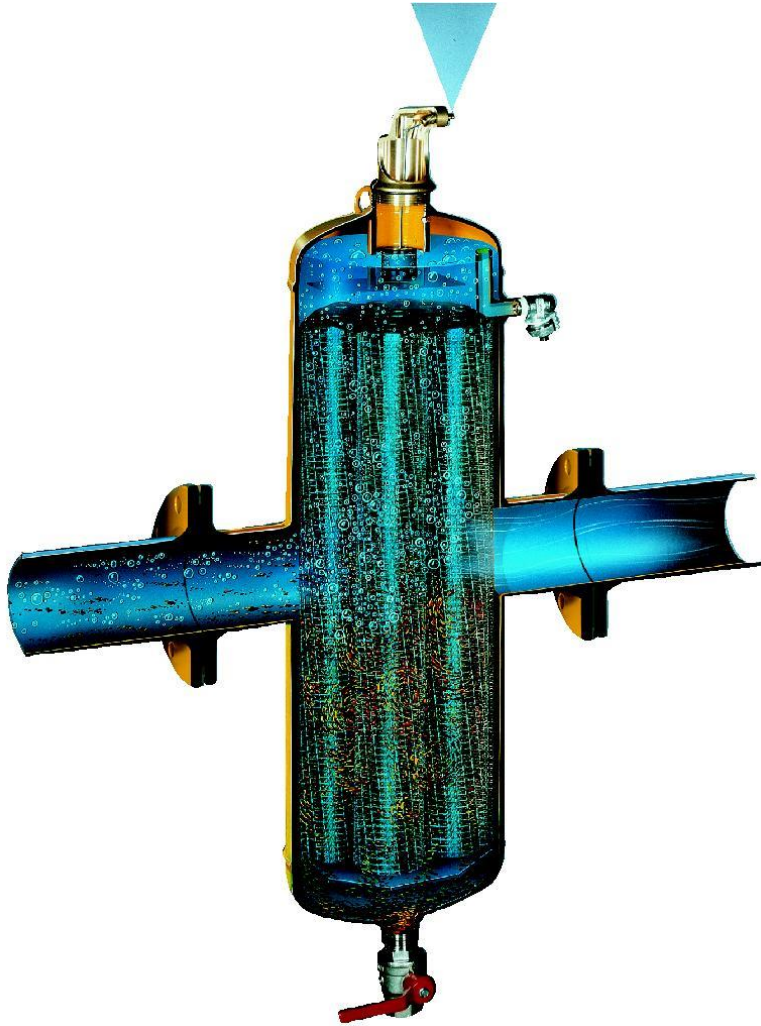


Sizes of Dirt and Debris

Mesh	Micron	Inches	Particle Size
	1270	0.05	Won't pass through the eye of a sewing needle
	400	0.0157	Coffee grounds
50	297	0.0117	Beach sand
80	177	0.007	Dust mites
100	149	0.0059	Table salt
	115	0.0045	120 grit sandpaper
200	74	0.0029	Silt
	40	0.0016	Lower limit of visibility
	31	0.0012	Pollen
	25	0.001	White blood cells
	8	0.0003	Red blood cells
	5	0.000197	Dust
	1	0.000039	Bacteria



Coalescing Air and Dirt Separators



Dirt Removal – Water and Glycol Systems



Energy Modeling Analysis of RTP and RPP Impact on Energy Usage & Cost

Significant Impact on Chilled Water and Heating Hot Water Systems with Reduced Energy Usage, Reduced Chilled Water kW/ton, and Overall Energy Use Index (EUI)

Review and Wrap-Up

- Air Affects Hydronic Systems by Causing Corrosion and Reducing Fluid Heat Transfer Capability
- Dirt Affects Hydronic Systems by Eroding the System and Reducing Fluid Heat Transfer Capability
- Many Sources of Air in Systems
- Numerous Clues to Air in Systems
- RPP and RTP Affect Energy Usage and Energy Costs Associated With Hydronic Heating and Cooling Systems
- Effective Ways of Removing Air and Dirt From Systems

Thank You

Questions?