Solid Air recommendations for water fed systems and waterquality

This information has been compiled for the use of the following products:
- Chilled Beam.
- Duct heater and cooler.
- VVI or VVR with duct heater.

Before use, analyse the water or water/antifreeze solution and verify compatibility with the copper used - DHP 'Deoxidized High Phosphorus' (UNS C12200) for air conditioning and refrigeration systems. Incompatibility of the cooling medium used with the above-mentioned copper quality can cause corrosion of the heat exchanger.

Too high a water hardness can cause internal deposits in the heat exchanger resulting in loss of performance. Only use the heat exchanger on a closed water circuit with softened water and a low chlorine content.

When selecting the products, take into account the maximum permissible operating pressure (Ps) and operating temperature (T) described in the technical product documentation or the nameplate of the product. Also take into account the maximum recommended water-side pressure loss of approx. 15 kPa. At higher kPa values, analysis of the water velocity may be necessary. For selections below 15 kPa, this analysis is not necessary. Do not expose the heat exchanger to unnecessary pressure or temperature fluctuations. The water quality is of great importance for the performance and lifespan of the heat exchanger. Consider the chemical composition (salt content, pH), the amount of suspended solids, the dissolved oxygen content and biological pollution (bacteria, algae and macro-organisms).

Due to the chemical compounds, in solution or suspension, a deposit can form in the copper tubes of the heat exchanger. This deposit reduces the heat transfer, which reduces the performance of the heat exchanger. The quality of the water can affect both the performance and the life of the heat exchanger.

Our recommendations should prevent two important phenomena:
- Corrosion of copper DHP tube (UNS C12200).
- Presence of significant limescale ($CaCO_3$ and $MgCO_3$).

Our recommendations are based on analysis of numerous literature and are valid for the usual operating temperature of 1 °C - 90 °C with occasional short (1 - 2 days) periods of stagnation. Pay attention to a proper flushing policy in advance. In both summer and winter situations it is important that both the cooling circuit and the heating circuit are flushed at least every three days to keep the system in optimum condition.

Details of maximum concentrations of chemical compounds and solids can be found in the table below.

The values in the table below are mostly used as a guideline for good use, small deviations (up to approximately 10 %) are permitted and will not cause the product to fail. Values marked with (a) are defined as strict maximum and these values should not be exceeded.

Parameter			
Name	**Designation**	**Units**	**DHP Copper (UNS C12200)**
pH	**pH**	ppm	7.5 - 8.5
Ammonia	**NH_4^+**	ppm	< 5[a]
Sulfide	**S^{2-}**	ppm	0[a]
Bicarbonate	**HCO_3^-**	ppm	70 - 150
Carbon dioxide	**CO_2**	ppm	< 15
Chlorine	**Cl_2**	ppm	< 0.2
Suspended solids		ppm	< 15
Oxigen	**O_2**	ppm	< 0.1
Chloride	**Cl^-**	ppm	< 100
Sulfate	**SO_4^{2-}**	ppm	< 50
Total iron (dissolved)	**Fe**	ppm	< 0.2
Manganese	**Mn**	ppm	< 100
Total hardness	**$CaCO_3$**	ppm	30 - 120
Total number of bacteria	**TBC**	CFU[b]/ml	< 1,000
Sulfate reducing bacteria	**SRB**	CFU[b]/ml	0[a]

(a) Obligatory.
(b) Colony forming units (viable cells) - unit of measurement of microorganisms.

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Explanation and clarification of the above listed values and parameters

PH
Copper tends to form a stabilized protective layer in a slightly alkaline solution (above 7 PH). Too high PH promotes the formation of flakes and is not recommended.

Ammonia
Ammonia should be avoided as much as possible because it is corrosive to copper.

Sulfide
Sulfide is very aggressive to copper and should be completely avoided.

Bicarbonate
Bicarbonate promotes the formation of a protective layer. Without it, the copper is still protected, but the addition of Bicarbonate improves the protective layer. Above a certain range the Bicarbonate is aggressive to copper.

Free carbon dioxide
Free carbon dioxide is dangerous for copper because it forms carbon dioxide and the limit concentration is 15 ppm.

Chlorine
Aggressive to metals and should be limited to the 0.2 value.

Suspended Solids
Should be limited as this can cause pollution and local attack in both promotes metals.

Oxygen
At high temperature, oxygen accelerates corrosion in metals and should be kept to a minimum.

Chloride
Can cause corrosion and should be limited in copper.

Sulfate
Copper is very sensitive to sulphate, much more than to chlorides, so the permissible level concentration is smaller than with chloride.

Total iron (dissolved)
Corrosive to copper (oxidizing copper) and should be limited in copper.

Manganese
Can cause pitting corrosion in copper and should be limited.

Total hardness
To prevent deposits, the total hardness must be 30 - 120 ppm $CaCO_3$.

Total number of bacteria (TB) and sulphate reducing bacteria (SRB): In any cooling water system there is a danger of microbiologically induced corrosion (MIC). TB shows the general presence of microorganisms, and their amount should be < 1,000. The most dangerous type of microorganisms for metals is SRB, hence their amount should be zero.