

Nominee: Vertiv

Nomination title: Liebert AFC with Screw Compressors - The Adiabatic Freecooling Chiller providing the highest levels of efficiency and availability in the freecooling chillers market

With the aim of increasing energy efficiency of new generation data centres, while keeping cooling availability at top levels, Vertiv™ has further improved its Liebert® AFC adiabatic freecooling chiller range introducing screw compressors. Liebert AFC combines the extremely high energy efficiency obtained by adiabatic freecooling; together with the 24/7 availability of scroll or screw backup compressors where the latter further improves freecooling operation while reducing energy consumption. Other adiabatic solutions available in the market cannot provide 100% availability in all conditions within a single product.

The two key benefits of the Liebert AFC are:

- 1. Efficiency:** It is the highest efficiency chiller for data centre applications. Its unique design, including adiabatic, freecooling and mechanical cooling in one single unit, allows an annual efficiency 30% to 40% higher than any other freecooling chiller solution in the market. The adiabatic wet pads reduce ambient air temperature thus increasing freecooling capacity and expanding freecooling operation up to ambient temperatures higher than 30°C.
- 2. Availability:** 100% mechanical cooling backup granted via its multi-scroll or screw compressor system designed to guarantee full cooling up to more than 50°C ambient temperatures, even if adiabatic water is not available. It also offers fast restart after power failures, which enables all compressors to be on within 70 seconds. Lastly, it provides safe operation of the compressors even in extreme ambient conditions, thanks to the adiabatic system which reduces the condensing temperature thus guaranteeing longer compressors lifetime.

The Liebert AFC design is innovative, and is optimised for applications following the new ASHRAE standards in terms of temperatures required by new server generation and ensuring maximum efficiency with return chilled water temperatures of up to 32°C with screw compressors. The recent advancement to the Liebert AFC is the variable primary water flow, which enhances energy efficiency at partial load conditions. The inlet chilled water temperatures of up to 32°C maximise freecooling capacity all year round by 30% more when compared to similar products offered in the market. The 'extra free cooling' version provides a further 20% increase in freecooling capacity which translates into a significant reduction in energy consumption and a pPUE as low as 1.06. The

newly designed electronic control constantly optimises running costs by continuously calculating the sum of water and energy costs and then implementing the most efficient combination of adiabatic, freecooling or mechanical cooling mode depending on its constantly changing working conditions.

The modular design of Liebert AFC (via its multiple scroll or screw compressors and modular V coils) allows the flexibility of the installation, which can increase freecooling capacity independently of the compressors cooling capacity.

Liebert AFC development has been conceived and developed exclusively by Vertiv and currently has 3 different patents pending. The product development, which was initiated back in 2013, has targeted the need for extreme efficiency and availability in data centre applications. The validation of the concept has been completed via detailed tests on the first prototype in the Vertiv Customer Experience Centre located in Italy, specifically, in the Freecooling Chiller Validation Area. This testing facility is able to balance a thermal load of up to 2000 kW with a chamber air temperature between 20°C and 50°C and chilled water set point between 5°C and 20°C, providing customers with the most complete testing area to experience the capabilities of Vertiv technologies at peak conditions.

If we consider two representative European cities, such as London and Madrid, it is clear that, at full data centre load (wherein a 2N configuration this corresponds to a 50% chiller load), Liebert® AFC can run in hybrid mode (adiabatic freecooling plus backup compressors) at almost 100% of the time. Even more impressive is that even in cities such as Dubai, which registers a higher average ambient temperature, the hybrid mode is active for 50% of the time.

Moreover, for partial loads data centres, the use of freecooling is even greater and active for nearly the entire amount of hours in a year.

Refer to figure attached - 1 MW Tier 4 Data Center at full load (chillers at 50% load) – Adiabatic ON for ambient temperatures >8°C

The benefits are significant also when examining the pPUE obtained. If we consider a legacy solution, including a standard chilled water floor mount unit and an air-cooled chiller (units with efficiency at standard market levels), the pPUE obtained in London is of 1.21 and 1.31 in Dubai. If we consider the same data centre requirements, but with Liebert PCW (our indoor floor mount chilled water unit) and Liebert AFC (working with designed chilled water temperatures of 20-26°C and a data centre air supply of 22°C) the pPUE obtained is of 1.06 in London and 1.18 in Dubai, which are both significantly lower values compared to those obtained with the legacy solution.

(Refer to figure 2 attached)

In these units, in fact, the water consumption has a very low impact in terms of costs when compared to the energy savings achieved.

Moreover, a 1 MW Liebert AFC operating in London with 26-20°C chilled water temperatures, achieves an annual efficiency of up to 35 kWh/kWh, which means that for every kWh of electric consumption it supplies, on average, 35 kWh of cooling energy. The annual efficiency of the major competitor's freecooling chiller at the same conditions is around 20 kWh/kWh and around 5 kWh/kWh for a traditional chiller, resulting in an annual energy saving of 95,000 kWh with Liebert AFC, and a return of investment of 1 or 2 years compared to a freecooling chiller, and less of one year compared to a traditional chiller. This is possible as a result of an optimised design and advanced control logic specifically conceived for this product. The low energy consumption moreover, the lowest one compared to any chiller in the market, has a positive impact on the environment as this leads to lower CO2 emissions and a lower greenhouse effect. Price-wise, Liebert AFC can be considered as equivalent to other freecooling chillers, while providing also the unique benefits deriving from adiabatic cooling.

Why nominee should win

1. No other packaged chiller in the market can provide up to 32°C of return CW temperatures.
2. Unique software features: fast start (compressors restart in 70 seconds after a power failure) and power demand limit (BMS limits maximum consumption up to a value pre-set by the customer).
3. Adiabatic wet pads expand freecooling operation up to ambient temperatures higher than 30°C.
4. This solution is unique in the market and is patent pending.
5. The unit can be tested at any peak condition in the Vertiv Customer Experience Center in Italy: the validation area can balance a thermal load of up to 2000 kW.