

Nominee: Airedale International Air Conditioning

Nomination title: AireFlow™ indirect adiabatic air handling unit (100-440kW)

Adiabatic systems are generally considered the most efficient cooling method but can present challenges in environments requiring close control of air quality, temperature, humidity and pressure. A further issue is their sheer physical size required to generate sufficient air volume for cooling.

The AireFlow™ AHU was developed in response to increased demand from the industry to provide an ultra-high efficiency solution which addresses the challenges of AHU cooling.

Basics of operation:

In low ambient temperatures the AireFlow™ can deliver 100% free-cooling under ASHRAE conditions simply by using the outside ambient air and modulating the exhaust fans. Using wetted media, instead of an evaporative spray, the AireFlow's cooling system suppresses the temperature of the ambient air directed onto the heat exchanger. The lower temperature drives heat exchange allowing the exhaust fans to run more slowly, reducing airflow and power input, to deliver the same level of free-cooling. Under higher ambient temperature conditions, the adiabatic system is activated to maintain free-cooling.

Available in 5 footprints delivering up to 440kW of total cooling capacity, the AireFlow™ is available in 27 configurations including: FreeCool only; FreeCool with optional fresh air cooling; DX or CW top-up cooling; DX or CW back-up cooling.

Key features:

Aluminium air-to-air heat exchanger: significantly increases thermal conductivity over plastic (or composites) and allows heat transfer to occur without any mixing of indoor and outdoor

air, preventing ingress of contaminants and eliminating the need for 100% mechanical or direct expansion (DX) back-up cooling.

Adiabatic cooling system: allows the unit to deliver free-cooling for 100% of the year within ASHRAE recommended conditions (London UK; 26°C supply/35°C return) with 32% reduction in air volume, saving fan power input.

High efficiency EC fans: deliver airflow across the adiabatic system and heat exchangers and are up to 70% more efficient at part-load than AC fans. Because the ambient air path is modulating, power input can be significantly reduced due to the large portion of the year spent at low fan speeds. To further maximise efficiency the fans are offset from one another.

Optional DX or Chilled Water (CW) cooling: provides top-up concurrent cooling in locations and/or conditions where free-cooling cannot be achieved, in addition to redundancy. DX may be required under higher ambient temperatures where the suppressed ambient temperature is unable to deliver full adiabatic free-cooling or where a low supply air set point (eg 22°C) is required. The DX system also removes the need for separate water storage, saving footprint.

Optional integral fresh air inlet (patent pending): maintains data centre air pressure and air quality, removing the need for a separate AHU.

Key differentiators:

The AireFlow™ offers a number of major benefits compared with other high performance cooling technologies:

- Annualised running costs up to 70% lower than typical DX precision air conditioning (PAC) systems*
- Annualised running costs up to 22% lower than typical free-cooling chillers*
- 5-year Total Costs of Ownership (TCO) 43% lower than typical DX PAC systems*
- 5-year TCO 7% lower than typical free-cooling chillers*

- Achievable PUE below 1.1 (100kW system can achieve a pPUE of 1.035)
- Impressive flow rates of 3 to 21m³/s
- N+1 redundancy

* For simplicity these comparisons are made against Airedale's own systems which generally offer the best performance in the marketplace. The comparisons are based on a fixed load of 500kW under London, UK ambient conditions.

A further major differentiator is that the AireFlow™ significantly reduces water consumption:

- The AireFlow's wetted media design uses less water (250kg/hr) without compromising saturation levels compared with a spray system (typically 400kg/hr)
- Evaporative spray systems require large water storage vessels, adding to footprint (typically 9.6m³ vs 6m³). The need for water treatment also comes with high capital and operational costs as salt is required for water softening. A further benefit is that, since the AireFlow's heat exchanger remains dry, it does not require regular descaling.

Other benefits:

Ease of installation and operation

- Easy to install on the ground or roof with a choice of ducting options
- Low maintenance adiabatic cooling system with UV sterilisation
- System automatically drains and self-cleans; no nozzles to maintain or water treatment required

Corrosion protection and longevity

- G3 / G4 / F7 air filtration preserves critical data centre environments; optional contaminant filtration (NO₂, SO_x and H₂S)
- Coated galvanised steel casing - protects against corrosion
- Epoxy coated aluminium heat exchanger – highly efficient but robust against corrosion

- No moving parts within heat exchanger - reduces noise and extends unit life
- Reduced risk of corrosion – water is contained within the media and drip tray (with a ‘spray’ system, water coats all internal surfaces in the adiabatic section)
- Mono-pitch roof - ensures drainage when units are paired, protecting against corrosion

Minimal footprint

- Outdoor unit saves valuable internal footprint
- Right and left-handed configurations reduce overall footprint as no walkway is required between a pair of units

Control

- Modular electrical and control panels fitted as and only when required keeping costs down
- Adjustment of setpoints allows customers to balance water consumption with power input
- Industry standard controls software and ability to integrate with BMS for full visibility and control
- Dehumidification system provides precise control of temperature and humidity

Tangible impact on the market and customers:

Whilst the AireFlow™ has only just been launched, the market is already showing significant interest.

The AireFlow™ presents significant energy savings opportunities for customers and the market overall. According to DCD Intelligence (2013) UK & Ireland data centres consumes 15TWh of power annually. Taking a crude estimate that cooling infrastructure consumes 27% of data centre power, we estimate that the AireFlow™ could save between 0.9 and 2.8 TWh of power annually in the UK and Ireland:

$$15,000,000,000\text{kWh} \times 27\% = 4,050,000,000\text{kWh}$$

22% saving compared with annualised running costs of typical free-cooling chiller = 891,000,000kWh

70% saving compared with annualised running costs of typical DX PAC system = 2,835,000,000kWh

Taking primary energy, a calculation used by DECC, the potential impact on data centre cooling power is even more significant. (Primary energy is the amount of energy needed to produce consumed electricity ie the input rather than the output energy at point of generation and is achieved by applying a factor of 2.6.) Even on a conservative estimate of 30% the AireFlow could achieve aggregate savings of 3.2TWh annually.

$15,000,000,000\text{kWh} \times 27\% \times 30\% \times 2.6 = 3,159,000,000\text{kWh}$

Why nominee should win

- The AireFlow™ (with patent pending for optional integral fresh air inlet) is the result of significant investment using the very latest design and virtual engineering techniques and a commitment to developing systems that maximise energy efficiency and reduce carbon footprint
- The AireFlow™ is the output of the combined expertise of cooling specialist Airedale and bespoke AHU manufacturer Barkell who joined forces in 2014
- The AireFlow™ provides data centres with a further innovative, high efficiency free-cooling alternative with an achievable PUE below 1.1, delivering significant operational cost benefits and a wide range of configurations to suit varying customer needs