



**TECHNICAL NOTE:
DESIGNING THE MOST
EFFICIENT AND
RELIABLE ROW-BASED
COOLING SOLUTION**

Vertiv™ Row-Based Thermal Management

As the global leader in data center thermal management, Vertiv has worked extensively with its customers to develop and deliver the broadest range of efficient and reliable thermal management technologies. This allows us to be technology-agnostic in order to provide the best, most unbiased solutions to our customers. As such, Vertiv in 2003 was the first to introduce row-based cooling, launching the Liebert® XD™ line, which included the Liebert XDV™, Liebert XDO™, and Liebert XDH™ solutions. Since that time, we have optimized row-based cooling to provide the world's most efficient and reliable solution, the Liebert CRV™. This technical note describes important considerations when evaluating or applying this solution.

Controls Make All the Difference

The Liebert CRV incorporates the most advanced and flexible unit and system controls – Liebert iCOM™ thermal controls. At the cooling unit level, the Liebert iCOM™ unit control provides the highest protection available, with optimal performance. At the supervisory level, the Liebert iCOM™-S system control offers a revolutionary way to optimize thermal system performance across the data center, gain quick access to actionable data and automate system diagnostics and trending.

The Liebert CRV system with Liebert iCOM unit controls gives customers the option to control cooling operation based on data from the supply air sensor, rack sensors (up to 20 data points) or the return air sensor, regardless of whether the unit is deployed by itself, in a row with other Liebert CRV units, or in a containment design. Additionally, the Liebert CRV system is the ONLY row-based solution that can decouple the fan speed from the capacity to allow the servers to receive just what they need – more airflow, cooler temperatures or both AUTOMATICALLY.

Liebert iCOM controls provide 5 to 7% more efficiency at the unit level and 15 – 25% greater efficiency at the system or multi-unit level. These controls have advanced machine-to-machine (M2M) communication, so units can function as a team, coordinating cooling and eliminating fighting between units (some heating while some cooling). Liebert iCOM controls provide Cascade, Standby, Rotation and Lead/Lag routines, share rack sensor data over networked units (up to 32 units for 640 rack sensor data points) and include a supply temperature compensation mode that provides the most efficient unit and system control on the market.

In addition, Liebert iCOM controls provide the highest level of unit protection, with over 380 monitoring points, the industry's quickest cooling restart in case of a power outage, advanced DX freeze protection and chilled water valve auto-tuning.

Matching Airflow to Server Needs

IT equipment fan technology is not designed to support a specific temperature difference from the air intake to exhaust – it is designed for airflow. IT equipment manufacturers have been lowering flow rate requirements to increase equipment energy efficiency. This in turn has increased the temperature difference of the air across the equipment.

In 2007, the typical temperature difference of air across IT equipment was between 7°C and 17°C (12.6°F and 30.6°F). This equated to 100-250 CFM/kW. By 2010, IT equipment temperature differences ranged from 16°C to 27°C (28.8°F to 48.6°F), which is equivalent to about 55-120 CFM/kW. This range is expected to tighten to between 75 CFM/kW and 95 CFM/kW by 2020. See Figure 1.

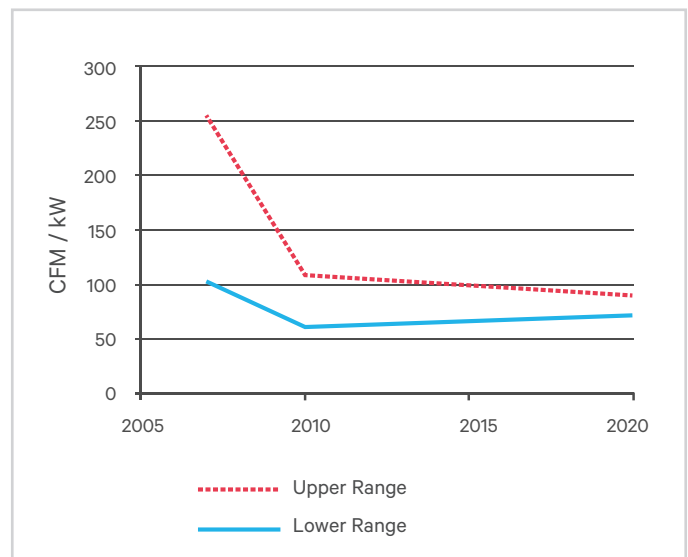


Figure 1: Server Air Flow Requirements by Year of Introduction

By overlaying the Liebert® CRV™ row-based unit air flow per kW (Figure 2), it is clear that the Liebert CRV system better matches IT equipment needs in either high protection or high efficiency. Other cooling products on the market are designed for obsolete IT equipment and are wasting energy by over provisioning air that is simply not needed.

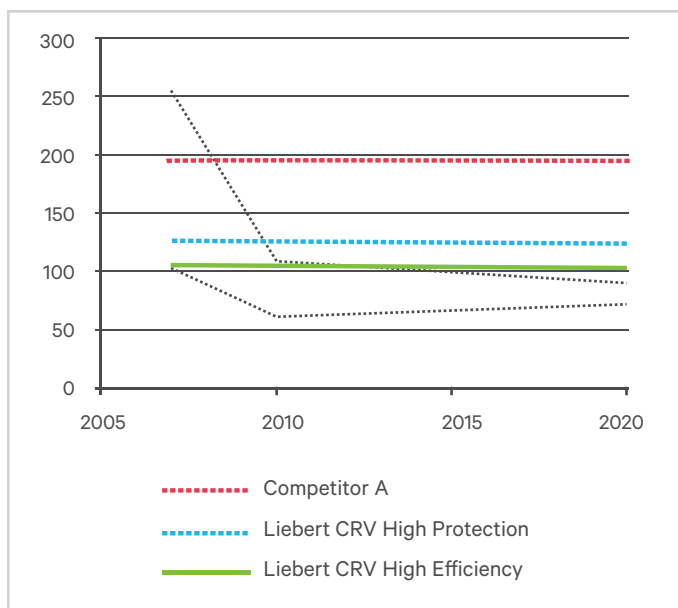


Figure 2: Row based Equipment Air Flow

Turning Vanes for Optimal Air Flow

There are those who believe that turning vanes in cooling units are not necessary, because the units can capture 100% of the hot IT exhaust air. Technically, this is true, but it requires a near perfect implementation of containment and air flow management, which almost never happens. At Vertiv, we design our products with turning vanes, so they perform at the highest levels of efficiency and reliability in practical, day-to-day applications. Turning vanes help direct the air to where the cooling is needed, increasing efficiency and the protection of the equipment.

Factoring in Heat Rejection

A large part of your thermal management system efficiency and protection is determined by how heat is rejected into the environment. For DX systems, we use microchannel condensers that are over 50% more efficient and significantly quieter than traditional fin/tube condensers. These microchannel condensers communicate back to the row-based cooling units via Canbus communications,

providing precise control for optimal protection and efficiency.

For chilled water applications, we offer a range of highly efficient and reliable air-cooled chillers designed specifically for mission critical applications, using more robust electronics and components, as well as advanced controls that optimize economization hours and chilled water temperatures for reduced energy usage. The chillers generally use 15-20 percent less energy than standard air-cooled chillers. When coupled with the Liebert CRV, the overall system can save up to 35% in energy consumption over the competitive designs.

Ensuring Proper Placement and Application of Row-based Cooling

Understanding when to implement row-based solutions, along with how to implement them, is critical for customers. These products do not fit every data center challenge nor satisfy every customer goal. Row-based cooling is an ideal solution for quick deployment in smaller applications or spaces and where spot cooling is needed for higher rack densities. For cooling larger spaces – approaching 250kW and greater – row-based cooling becomes more expensive and no more efficient at a system level than perimeter cooling solutions.

In summary, row-based cooling is best used to cool individual rows, and generally should not be used to cool racks or rows in other pods, as it will generally be very difficult to ensure proper airflow, given typical data center configurations. Be sure that data center designs do not assume perfect or ideal conditions. Make sure your designs will achieve the protection, capacity and efficiency you need under typical conditions.

