Cooling systems play an increasingly critical role in protecting sensitive IT systems from extreme variations in temperature and humidity that can cause system failure, degrade performance, and shorten equipment life—particularly in the high-density environments that have become common in enterprise data centers. Conventional air-conditioning, or comfort cooling, is typically inadequate for controlling the environmental conditions in most data centers. But by using precision cooling systems designed for data center requirements in conjunction with containment strategies using the SmartAisle™ containment system from Emerson Network Power, IT organizations can help protect critical equipment and maintain system availability while supporting efficient, cost-effective infrastructures.

**Comfort Cooling and Precision Cooling**

Many IT departments are still relying on comfort cooling systems for cooling IT equipment. But as rack densities increase, this approach to cooling can become highly inefficient—and expensive. To understand the difference between comfort cooling and precision cooling, and why precision cooling is generally better suited for data center environments than comfort cooling, it is important to understand their relative heat removal ratios.

Comfort cooling systems typically use 60–70 percent of their energy to reduce temperature (referred to as sensible cooling capacity) and 30–40 percent to remove moisture (referred to as latent cooling capacity). This capacity is expressed as a heat removal ratio of 0.60–0.70. Comfort cooling is well suited for environments where people gather or work, because people give off moisture.

Data centers, on the other hand, require cooling systems that address the dry heat generated by electronic equipment. Precision cooling systems are typically designed to provide a heat removal ratio of 0.85–1.0, which means that 85–100 percent of their energy is devoted to cooling rather than removing humidity (see Figure 1). When using a comfort cooling system, the focus is primarily on cooling the sensible dry heat generated by IT equipment, whereas precision cooling systems are designed to efficiently handle the total heat load of the data center, ensuring optimal performance and efficiency.

**Figure 1.** Precision cooling systems are designed to efficiently remove the sensible dry heat generated by IT equipment.
A data center would typically require a larger unit to cool the same IT environment compared with a precision system. In general, it takes three tons of comfort cooling capacity to equal two tons of precision cooling capacity.

The heat removal ratio plays a central role in calculating annual cooling costs. In addition, the cost of re-humidification, which is necessary to avoid static electricity in the data center, pushes up the cost of using a comfort cooling system compared with a precision cooling system that has humidification control built in.

Comparing heat removal costs between comfort and precision cooling systems reveals significant operational savings for precision systems, even for relatively small data centers. For example, in a 500-square-foot data center operating at 72°F and 50 percent relative humidity, with equipment producing a heat load of 9 tons and an energy price of US$0.10/kWh, a 15-ton comfort cooling system consuming 18.5 kW of power to run the compressors and fan would cost US$1,878 per sensible ton per year to operate for heat removal alone. A 10-ton precision cooling system consuming 12.5 kW of power to run the compressors and fan, by comparison, would typically cost US$1,258 per sensible ton per year. When the cost of re-humidification is factored in, the total annual operating cost of the comfort cooling system is US$11,986 higher than the operating cost of the precision cooling system—offering payback within 12 months on the additional cost of the precision cooling system.1

**PRECISION COOLING SYSTEMS AND STRATEGIES**

Designing for high data center densities, or accelerating a migration to increased densities in an existing facility, can play a key role in helping organizations increase performance and reduce costs. Taking advantage of cooling strategies such as bringing cooling into the rack row and implementing SmartAisle containment configurations can help ensure that cooling systems can handle high-density environments.

For example, putting supplemental cooling systems close to a data center hotspot can help significantly reduce energy costs. High-density Liebert XD™ systems provide high-density cooling at the source of the heat, helping ease the load on the room cooling system. Liebert XD systems are also designed to fit a variety of space constraints—such as the top of the rack, in the row, or mounted on the ceiling—enabling high-density cooling to reach where it is needed.

Designed to be compatible with Liebert XD systems, the Liebert XDR helps accommodate growth from rack-level to row-level cooling. This rear-door module is designed to eliminate the cooling fans and utilize server fans to help efficiently transfer the server heat to the Liebert XD cooling module—helping to precisely cool specific loads with less energy waste than cooling the whole room.

The Liebert CRV offers flexibility, energy efficiency, and high value in a self-contained, row-based precision cooling unit designed for reliability. It can fit seamlessly within a row and helps protect

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1 Re-humidification based on 2.34 kW of latent removal per ton of sensible cooling for the comfort cooling system and 0.39 kW of latent removal per ton of sensible cooling for the precision cooling system, with the humidifier running from November through March for a total of 3,650 hours.
high-density equipment by precisely delivering cool air close to the heat source—the servers themselves.

Each of these systems is designed to work with the SmartAisle containment approach, which separates hot and cold airstreams to help maximize cooling unit performance and support increased rack densities using existing equipment (see Figure 2). SmartAisle containment can help reduce power consumption by up to 32 percent when used with cooling systems that have Liebert iCOM control and variable fan drives or electronically commutated (EC) fans.\textsuperscript{2} Data centers can be retrofitted for this approach without disrupting operations, and the equipment typically occupies minimal floor space.

In addition, Liebert uninterruptible power supplies (UPSs) and power distribution units (PDUs) can help organizations economically reconfigure how power is applied within the rack and then monitored and controlled for maximum efficiency. The Liebert series of rack PDUs enables changes to receptacles, power cords, and monitoring software without discarding the existing PDU—helping to reduce costs and ensure that IT staff can accommodate ever-changing rack power requirements.

**EFFICIENT DESIGNS FOR HIGH-DENSITY DATA CENTERS**

As virtualization, increasingly powerful multi-core processors, and other technologies become widespread, data center rack densities will likely continue increasing as well. Containment strategies using the SmartAisle system from Emerson Network Power can address these rising heat loads and help protect sensitive equipment while controlling data center costs. In addition, row- and rack-level cooling systems target specific heat sources in the data center to help increase overall efficiency.\textsuperscript{6}

\textsuperscript{2} Based on a data center with a 75°F average return-air temperature, 20 server racks at a load of 8 kW per rack with a delta T of 35°F, and three 56 kW air-cooled computer room air-conditioner (CRAC) units with constant-speed fans, two single-capacity compressors, a multi-fan condenser, and a delta T of 21°F, for a total system power consumption of 49.5 kW; compared with the same environment with a 92°F average return-air temperature using SmartAisle containment and three similar-sized 56 kW air-cooled CRAC units now with variable-speed fans, variable-capacity compressors, a multi-fan condenser, and a Liebert iCOM control system, for a total system power consumption of 33.9 kW.