Tech Byte 27: Small Computer Room and IT Closet Cooling

The Benefits of Investing in a Liebert Precision Cooling System for Small IT Applications

Questions Answered in This Paper

- *Sensible cooling capacity is the measuring stick for IT cooling capacity needs. What is the sensible cooling capacity of the comfort split system in comparison to the precision cooling unit? How does this translate to unit selection and on-going costs of operation?*
- *Cooling of IT equipment is a year-round proposition. Is the comfort system's outdoor condensing unit designed to operate in the harsh winter months? Is the indoor evaporator designed for the rigorous 7x24x365 operation, or just seasonal operation?*

In too many cases, cooling of small computer rooms and IT closets is being "value engineered" by substituting small, comfort cooling split systems in place of precision cooling systems. While this downgrade may present a lower first cost, can a specific tonnage comfort system actually provide equivalent cooling capacity to the same tonnage precision cooling system? How does the comfort system pan out in regards to performance and on-going operational costs? Are there risks being taken through this exchange? These are the questions we want to address in this paper.

Network access and telecom rooms are housing more powerful and critical equipment as businesses rely on these spaces to support an increasing number of business-critical applications. The technologies supporting the deployment of IP telephony, wireless networking, converged applications, and other equipment outside traditional IT data storage and management are finding their way into nontraditional spaces that weren't designed as data centers. These rooms also support important operational functions including time and attendance equipment, building maintenance alarms and security equipment. In the event of a failure within a network access room, organizations may be susceptible to the disruption of revenue-generating activities or the inoperability of security and phone systems, among other serious consequences.

Because network access equipment has traditionally been housed in converted closets or other spaces not well suited for electronics, its reliability and that of newer devices has been placed in jeopardy. These spaces often constrain growth or enhanced use of the closet because of the lack of physical space and power/cooling infrastructure required to support the powerful and critical equipment on which the business is now dependent.

Ceiling Mount Liebert Minimate
1 to 8 Ton Capacity Precision Cooling System

More powerful equipment generates more heat. When the equipment is trapped in a small, poorly ventilated space, heat can quickly raise the temperature to unsafe levels that reduce performance and shorten equipment life. Configuring the appropriate solution involves both overcoming the physical challenges imposed by the space and understanding the cost of downtime for the environment. The good news is that there are solutions available today that allow powerful and sensitive network equipment to operate safely and reliably in almost any environment.

Cooling requirements depend primarily on the equipment type and room size. In cases where switch power requirements are very low, simple ventilation may suffice. Higher density equipment will typically require a dedicated cooling system. In fact, the Uptime Institute has reported that equipment located in the top one-third of a data center rack fails twice as often as equipment in the bottom two-thirds of the same rack. The organization estimates that for every increase of 18 degrees F above 70 degrees F, long-term electronics reliability falls by 50 percent.

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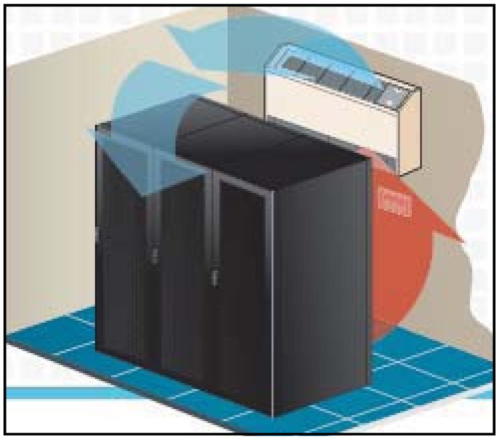
When selecting a dedicated cooling system, it is important to consider what it is that we need to cool, and how best to cool it. Not all cooling systems are the same. For example, there is a big difference between cooling electronics and cooling people. For starters, people add humidity to a room, and electronics do not. So, when selecting a cooling system for people, you have to consider the latent cooling capability of the cooling system, which is the ability to remove humidity, and the sensible cooling capability, which is the ability to remove heat. When selecting a cooling system for electronics, you are strictly focused on its sensible cooling capability. Latent capability does not aide in the cooling process for electronics applications. Therefore, excessive investment in latent cooling capacity is a wasted investment for IT applications.



Wall Mount Liebert Datamate
1.5 to 3 Ton Capacity Precision Cooling System

Comfort cooling systems have a sensible heat ratio (SHR) of ~ 0.60. This means 60 percent of their energy used is dedicated to lowering temperature, and ***40 percent is dedicated to removing humidity***. IT spaces require a 0.85 to 1.0 sensible heat ratio for effective and efficient cooling. **Precision cooling systems** have been designed with a sensible heat ratio of 0.90 to 1.0. This means ***90 to 100 percent of their effort is devoted to sensible cooling*** and only a maximum of 10 percent is dedicated to removing humidity. Therefore, it will take a larger comfort cooling unit to cool the same IT environment as a precision system. **In general, it takes three tons of comfort cooling capacity to equal two tons of precision cooling capacity.**

So when these "value engineering" processes take place, most often a like-size to like-size cooling system exchange is made, (comfort system in place of precision system) although the sensible cooling performance is much different between the two. Many times this results in the installation of a cooling system that does not have the cooling capacity to keep the IT equipment at the proper environmental conditions.

Comparing heat removal costs between comfort and precision cooling systems reveals significant operational savings for precision systems, even for relatively small data centers. Below is a basic calculation of operating cost comparisons between the two cooling approaches, using the assumptions outlined below:

- Each ton of cooling requires 1.0 horsepower (or 0.747 kW)
- The compressor motors and fans are 90 percent efficient
- Electricity costs $0.10 per kilowatt-hour
- Humidification is required November through March (3,650 hours)
- The precision cooling system has a SHR of 0.90; the comfort system has a SHR of 0.60.

First, calculate the cost per ton of cooling for a year:

$$\frac{0.747 \text{ kW/ton} \times 8760 \text{ hrs./yr.} \times \$0.10\text{/kWh}}{0.90 \text{ efficiency}}$$

This results in a cost of $727 ton/yr.

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Then, determine the cost per sensible ton of cooling by dividing the total cost by the SHR for each system. For the precision cooling system the cost per sensible ton is:

$$\frac{\$727}{0.90\ \text{SHR}} = \$808\ \text{ton/yr.}$$

For the comfort cooling system, the cost per sensible ton is:

$$\frac{\$727}{0.60\ \text{SHR}} = \$1{,}212\ \text{ton/yr.}$$

In this example, the operating cost to run a comfort cooling system for one year exceeds the cost to run a precision cooling system by $404 per ton of sensible load. This is consistent with the generally accepted principle that it takes three tons of comfort cooling capacity to equal two tons of precision capacity.

A second point of comparison is the cost of humidification, which is determined by calculating the latent cooling that occurs per ton of sensible cooling.

For a precision system:

$$\frac{12{,}000\ \text{BTU/ton}}{0.90\ \text{SHR} - 12{,}000\ \text{BTU/ton}} = 1{,}333\ \text{latent BTU/ton}$$

For a comfort system:

$$\frac{12{,}000\ \text{BTU/ton}}{0.60\ \text{SHR} - 12{,}000\ \text{BTU/ton}} = 8{,}000\ \text{latent BTU/ton}$$

The comfort system expends 6,667 BTU of energy per ton of sensible cooling to remove humidity that must be replaced to maintain required data center moisture content of 45-50 percent.

The added cost is:

$$\frac{6{,}667\text{BTU/ton} \times 3{,}650\text{hrs./yr.} \times \$0.10/\text{kWh}}{3{,}413\ \text{BTU/hr./kW}} = \$713\ \text{ton/yr.}$$

In this scenario, when all cooling and humidification costs are considered, **the operating cost of a comfort-based system exceeds the operating cost of a precision cooling system by <u>$1,119 per ton of sensible cooling annually</u>.**

Because they are more effective at removing sensible heat and controlling humidity levels, precision cooling systems require less power to operate than comfort cooling systems. When initial costs and operating costs both are taken into account, precision cooling systems represent the most cost-effective solution to cooling critical IT equipment.

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Other Important Precision Cooling Benefits Over Comfort Cooling Splits:

Precision Humidity Control:

If humidity in a computer room gets too high, you're going to get paper handling problems and face the possibility of condensation in the electronics. If it gets too low, static electricity from the touch of a finger can fry components and alter data. And your magnetic media can suffer oxide shed, increasing the possibility of altered and lost data. A relative humidity target of 45% ±5% is no problem for a Liebert precision air conditioning system. It has the accuracy and precision to meet that target, and it can operate in whatever mode is most appropriate (see chart, next section). A comfort system has only two modes of operation… cooling and off. True, while it's cooling, it's also dehumidifying, but that's incidental. Moreover, it is incapable of adding humidity during the winter season. When you get right down to it, a comfort system offers no control over relative humidity.

Operating Hours:

A Liebert precision air conditioning system is designed to operate whenever your electronic equipment is operating. For most companies, that means 24 hours per day, 365 days a year. The total is 8,760 hours per year. So, the circulating fan runs 8,760 hours a year, while the other components turn on and off as directed by strategically placed temperature and humidity sensors. The table to the left shows what the typical year might look like in both northern and southern states:

Naturally, these percentages will vary depending on the room conditions, the heat load, and your geographical location. Your Liebert sales associate will calculate the load represented by your room as a prerequisite to recommending a precision air conditioning system. From that calculation, he can pretty well predict how the system will operate over a year's time.

Not surprisingly, comfort systems are designed to operate whenever people are occupying the area. That usually turns out to be 8 hours a day and five days a week, but only during the cooling season. A good average number for that is 1,200 hours a year.

% OF OPERATING TIME (north/south)	TASK
30%/50%	COOLING
0%/20%	Dehumidifying
10%/20%	Dehumidifying & Heating
10%/5%	Humidifying
30%/5%	Cooling & Humidifying

Low Ambient Operation:

Another consideration is cold weather operation. Comfort systems with outside heat exchangers are typically inoperable when outside temperatures drop below about 40°F due to liquid slugging and evaporator freeze-up. Even systems equipped with a "low ambient" option only operate down to 0 degrees at best, unless it's windy. A precision system, by way of comparison, will operate perfectly well down to -30 °F.

The diagram on the following page shows one method of low ambient operational control for Liebert small systems, involving a "Lee-Temp" receiver and a "3-way head pressure relief valve". During operation in cold ambient conditions, the system may encounter a low head pressure condition. When this happens, the 3-way head pressure relief valve closes. The Lee Temp receiver, which is a refrigerant reservoir, then supplies refrigerant to the evaporator unit while the condenser coil fills with refrigerant. As the condenser coil fills, less of the coil surface area is available for cooling of incoming refrigerant. Thus, the temperature will begin to climb, eventually restoring nominal system head pressure levels. When the proper head pressure is restored, the 3-way head pressure relief valve opens to allow normal system operation.

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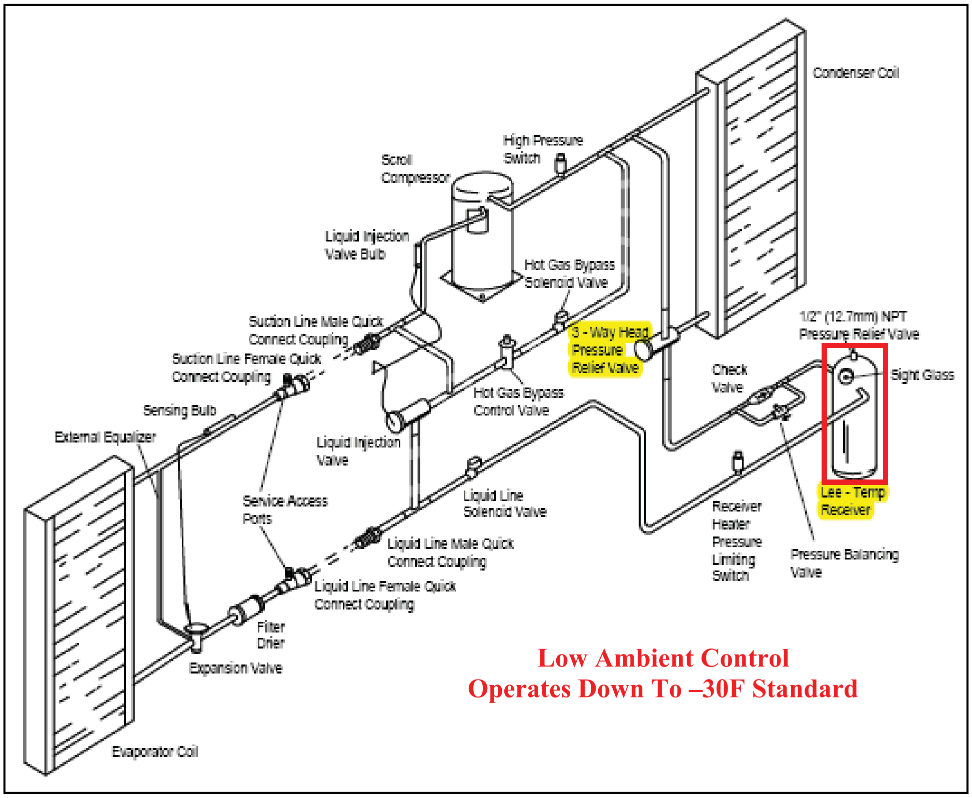
Service and Support:

Critical environments require high availability of critical support systems. Therefore, it is important that these systems operate reliably, and that their performance is tuned specifically to control the environment for the computer systems with which they are deployed. Precision air systems often feature greater internal redundancy of components than comfort cooling systems, allowing them to continue operating in the event of some failures. In addition, they are supported by factory-trained, locally-based installation, service and support partners that are accustomed to the needs and sensitivities of working in the data center environment. For Liebert systems, 24-hour service is available and all critical components are stocked locally. Because even a short amount of downtime can impact the bottom line, leading precision air systems are designed for serviceability.



Summary:

“Value engineering” that replaces a product designed for a given application with a product that was NOT designed for that same application offers no other value than a cheaper price tag on day one. In IT cooling applications where a precision cooling unit is replaced with comfort cooling systems, the real value has been eliminated. The cooling capacity is reduced with the comfort system’s lesser sensible cooling capacity. Operating cost per ton of sensible cooling goes up with the comfort system. Cooling reliability is jeopardized in winter months, due to the comfort system’s suspect low ambient capability. Cooling reliability is also reduced by utilizing the comfort system 7x24x365, when it was designed for intermittent, seasonal operation. Lastly, the level of environmental control is reduced with the comfort systems inability to concurrently manage humidity level and precise temperature control.

IT closets and small computer rooms are critical to business operations. The infrastructure equipment supporting them should be designed to meet the challenge of supporting them at all times.

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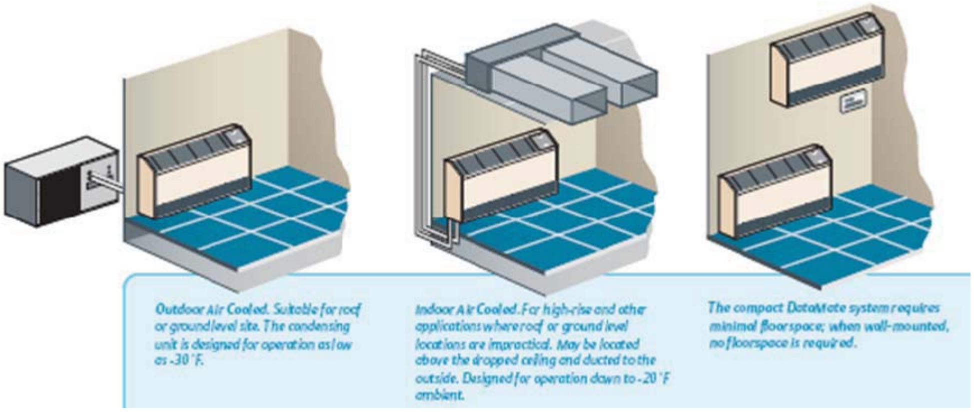
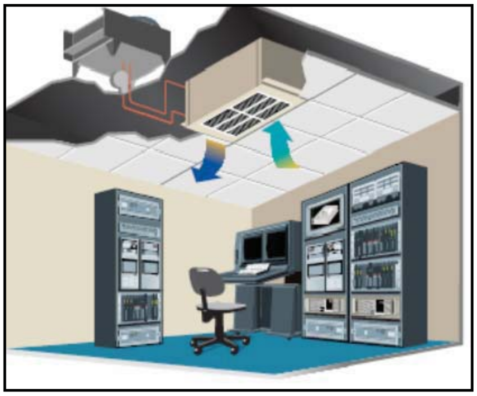
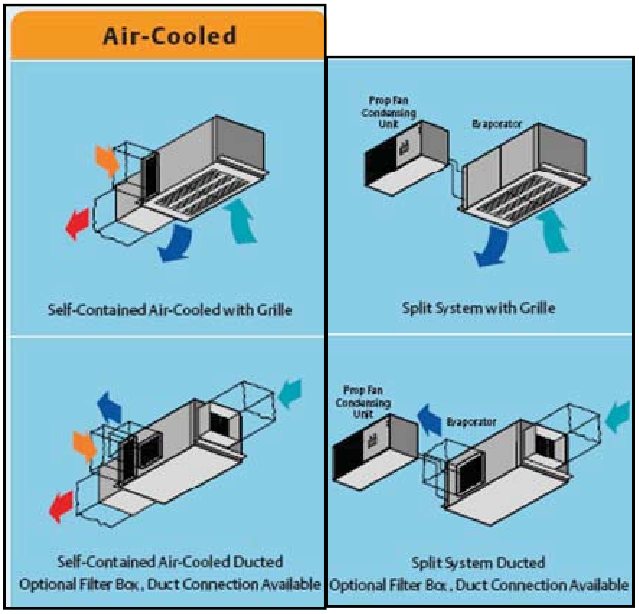




Ceiling Mount Liebert Minimate



Floor Mount Liebert Challenger

New Digital Scroll, Variable Speed Evaporator Fan, and Micro-Channel Condenser features combine to make the Challenger an industry leader in lowest operating cost small precision cooling systems!!

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