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DATA CENTER PRECISION COOLING:

The Need For A Higher Level Of Service Expertise

Executive Summary

Today's data centers are changing rapidly, and it is more important than ever to ensure that each component of the support infrastructure is operating at maximum efficiency and reliability. The failure of a critical data center cooling system can lead to downtime, which translates into a loss of service, money and customer goodwill.

Data center cooling systems often receive far less attention than servers, operating systems and network configurations. Yet, the performance of these IT systems is just as dependent on cooling support as on the network connection.

Precision cooling systems have been designed specifically to meet the needs of data center heat loads and have very different service and maintenance needs than standard building air conditioning which is designed for occupant comfort.

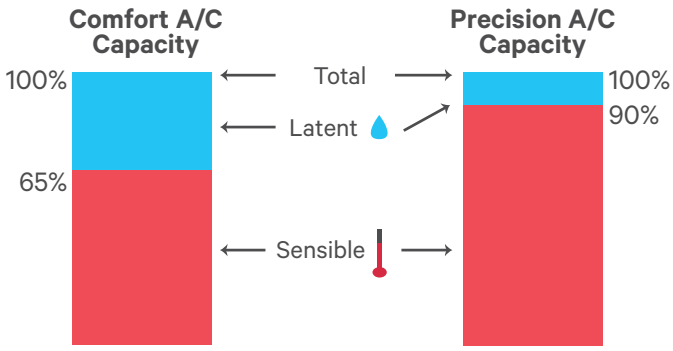
However, maximizing the performance and efficiency of a precision cooling system requires it be properly maintained by original equipment manufacturer (OEM) factory-trained and certified technicians. Factory-trained technicians have an extensive knowledge of how to maintain these critical systems supporting the data center. Integration of the cooling system into the data center infrastructure support strategy is key and most non-manufacturer backed maintenance sources lack this experience.

Changes In Today's Data Center Cooling

The critical nature of IT equipment and the unique environmental requirements that support its operation have made it necessary to use specialized precision cooling systems in data center locations. Since most data centers operate 24 x 7 x 365, temperature and humidity conditions must be maintained around the clock.

Precision systems are designed specifically to cool electronic equipment. Electronics generate pure sensible heat, that is heat without humidity, and require continuous cooling. Comfort air conditioning is not intended to deal with these types of conditions.

Computers Generate Heat, But Not Humidity



That's why about 95% of a precision cooling system's energy and capacity are designed to remove the dry heat that electronic equipment produces. Building systems are designed to keep people comfortable and are only capable of using about 60% of their cooling capacity to remove heat generated by computers. The other 40% is used to remove moisture, commonly found in office space, but not server or network rooms. This can lower humidity too much, causing static problems and even electronic failures.

Servers and other IT equipment are generally designed to operate within a certain temperature and humidity range that must be maintained. Conditions outside these ranges can cause degradation of performance and shorten the life of the equipment.

Because precision cooling is engineered to operate continuously, the service requirements are much more stringent than with comfort cooling. It calls for servicing at greater intervals especially on motor lubrication and other moving components.

Precision cooling also utilizes humidification, which involves another set of maintenance procedures. This is critical because the electronic equipment requires a steady level of humidity. Incorrect humidity levels can actually result in processor slow downs or create static electricity problems.

Non-OEM service providers may not be familiar with maintaining this type of humidification equipment. There may also be a need to have more frequent maintenance if a unit has a humidifier to reduce potential condensate draining issues and flooding the computer room.

There are many things that have to be looked at — and many things the service person has to know and understand. Because precision cooling is so different from comfort air conditioning systems, so too are the service requirements and expertise to perform this maintenance.

Higher Densities Mean Higher Heat Loads

In recent years, there have been many changes in data center cooling requirements and capabilities that affect operation. Primary among these is an increase in the heat load density of new-technology IT equipment and the resulting increase in heat loads. Higher density heat loads demand more sophisticated cooling technologies.

Data centers using traditional precision cooling configurations with large computer room air conditioning (CRAC) units feeding air underneath the raised floor can run into problems as high density rack configurations are implemented. Because of inadequate cooling capacities in certain high density areas, hot spots can develop. Typical underfloor discharge may not be adequate to cool these hot spots. Racks with loads higher than 4-5 kW will be susceptible to hot spots if supplemental cooling is not employed.

Rising Heat Loads In The Data Center

Even though there may be a high level of cooling capacity in the room, the way air is being distributed can lead to problems if a cooling unit fails. The raised floor configurations are not always designed for optimum airflow. They may be operating so close to the edge of capacity that any downtime due to maintenance issues can create a dilemma.

The solution to these problems has been the use of row-based cooling and other targeted cooling systems. Critical cooling technologies are evolving into overall roombased and networked solutions instead of just individual HVAC units. These different types of systems require advanced level service technicians who have in-depth knowledge of their operation.

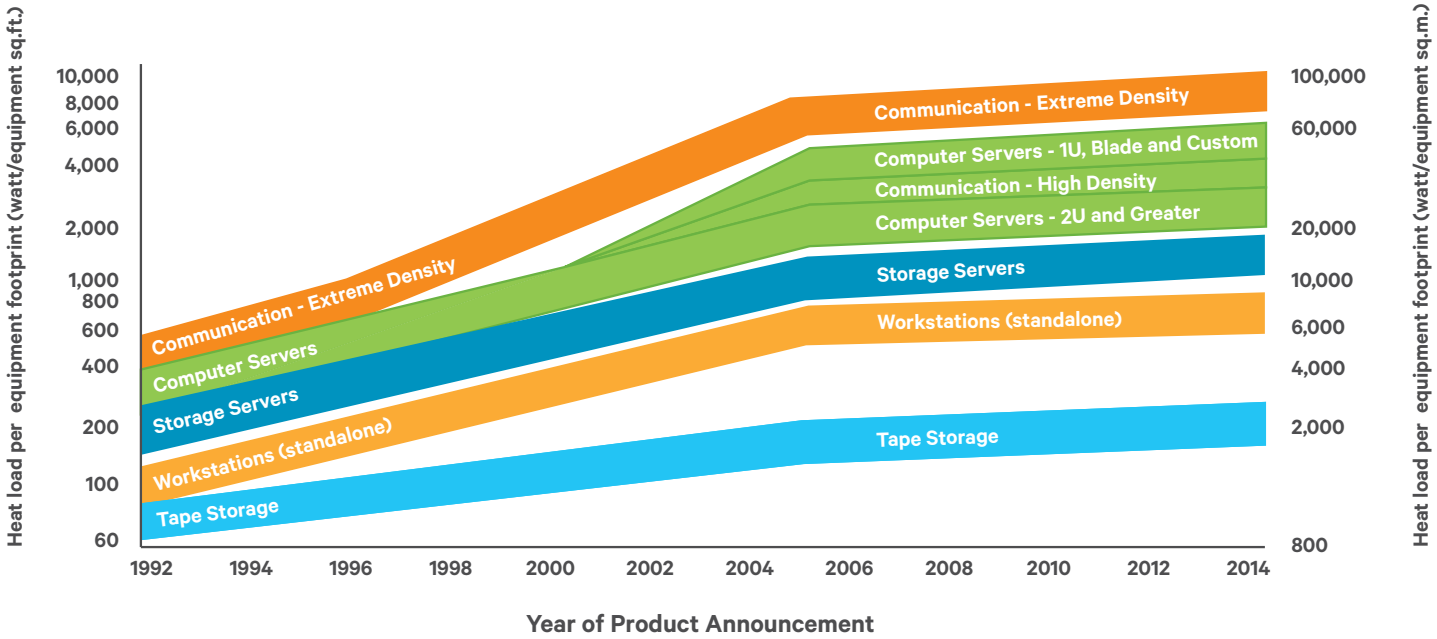
More Sophisticated Cooling Methods

Precision air conditioning utilizes a wide range of cooling mediums that require service technicians who have the knowledge to regulate controls and test the systems. These cooling methods include air, chilled water and refrigerants. In most cases these systems are more complex and require greater attention to maintenance than comfort cooling in order to deliver peak performance.

Unique energy saving configurations such as dual cooling systems are becoming more popular as a way to save energy. Utilizing this option, a conventional air cooled unit is converted to a dual source cooling system by the addition of a second coil that utilizes a central building chiller supply. The unit can function either as a chilled water system, as a compressorized system — or a combination of both. During times when the chiller supply is available, compressor operation is eliminated, reducing energy costs.

For colder climates, an even more effective energy savings solution is to utilize an outdoor fluid cooler (drycooler and pump package) in conjunction with the chilled water coil conversion, this will provide “free cooling” when ambient temperatures permit. In this scenario the cooling load is not transferred to the chiller during peak load operating conditions.

It is essential, however, to operate and check all parts of these systems at regular intervals to make sure they are ready if needed. It takes an experienced service technician familiar with all aspects of precision cooling to service these sophisticated systems.



ASHRAE, Datacom Equipment Power Trends and Cooling Applications, 2005. © American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., www.ashrae.org

New Equipment Requires A New Set of Skills

The new generation of electronic control systems increases efficiency by coordinating and optimizing the operation of multiple cooling units in a data center. They also require increased knowledge to maintain and service. Service people who are untrained on this equipment can actually cause cooling systems to fail when trying to perform adjustment or maintenance.

New chilled water units with advance control systems and variable frequency drives are very different from past models. The use of advanced control systems requires highly trained service professionals. Technicians who are untrained in servicing these types of controls can void the unit's warranty.

Digital scroll compressors utilize advanced electronic control and modulation for more efficient operation. Digital scroll units, however, operate differently than a standard scroll compressor. Factorytrained service technicians know how to properly diagnose potential problems with the compressor as well as how to perform routine maintenance.

Unique Aspects Of Precision Cooling Affecting Service Needs

The differences in today's precision data center cooling systems also create a vastly different set of maintenance requirements, especially compared to comfort systems, in order to keep the equipment operating properly and efficiently. It is important to properly maintain a precision cooling system throughout its life cycle: a precision cooling system cannot fully benefit the data center if it is not functioning at the highest level.

For example, a non-OEM service source may not totally understand the intricacies of underfloor cooling. The movement of IT equipment and the perforated tiles that feed air into the room can result in the cooling equipment not performing efficiently. Improper positioning of tiles can even cause short cycling of the compressor.

Proper humidification of the room can be affected by maintenance issues. A dirty air filter can affect the humidity level by acting like a sponge and absorbing moisture. As soon as a clean air filter is put in the humidity levels return to optimal levels. There are also adjustments on the humidifier boards, drains and other factors that the service person must be able to implement.

The ability to make proper set point adjustments is also very important to the operation of a precision cooling system. This can depend on the size of the room and the way the heat load is distributed.

Condensate issues can develop if the drain from an evaporator coil becomes plugged, causing water to spill out. Condensation lying dormant on coils can also cause impurities to build up. Whether a pump or a gravity drain is used for condensate, it needs to be checked on a regular basis. Steam from a humidifier can cause moisture issues if its drainage is not maintained properly. Units that do not have the proper amount of airflow moving through them may develop condensation buildup inside the unit.

The use of lead/lag operation for cooling units is becoming standard practice. Unit networking facilitates this setup and helps prevent maintenance problems that can arise from one unit operating more frequently than another.

Leak detection systems are another unique element of data centers. These systems need to be checked on a regular basis to make sure they are operating properly.
A factory-trained service person knows what to look for on these types of systems to head off any problems.

Engineering changes from the manufacturer, including component rework and recalls, are also immediately communicated to factory-trained service personnel. They also have immediate access to any product upgrades or changes. Not knowing about these kinds of updates can result in excessive parts replacement or other problems.

The service provider also needs to be familiar with the various types of oils and refrigerants used in the precision units. Changes in the types of refrigerants used over the last few years have placed an even greater emphasis on the proper handling of this aspect of maintenance.

Why Factory-Trained And Certified Service Is Better Qualified

While non-OEM service providers may have the knowledge required to install precision cooling equipment, they do not necessarily have the service expertise needed to assure optimum performance of these systems after they are installed.

The level of knowledge required to maintain standard building comfort cooling systems is simply not the same as what is required for precision cooling systems.

Manufacturer backed service technicians are trained by the factory to handle all aspects of service. They have the knowledge and experience required to identify areas of concern in the data center that may be causing issues with the cooling units.

Data center uptime is critical. Factory-trained technicians have the resources available for fast access to critical service parts. This access allows the technician to quickly bring a disabled unit back online with minimal interruption.

Unlike a comfort cooling service call, you cannot leave the data center for the night and come back tomorrow to finish the job. The goal of the service technician is to minimize the downtime of the unit as much as possible. While onsite, the technician can work on other units to ensure efficient operation of the data center.

OEM-based service is also trained to provide installation of the most up-to-date software and firmware to help assure proper control. Complete knowledge of firmware upgrades will ensure that the precision cooling units are running at the highest efficiency. Only factory-trained service technicians have access to and the knowledge needed to perform these software/firmware changes.

Around-the-clock emergency service and preventive maintenance is available for precision cooling systems. In most cases, factory backed service personnel can arrive onsite in nearly half the time required by other providers. This service is offered 24-hours-a-day in the event of an emergency.

As a factory-trained technician, access to differentiated service offerings designed to improve performance and energy efficiency is readily available. These include enterprise remote monitoring, controls networking/ upgrading, thermal assessments and CFD modeling.

	PRECISION AIR CONDITIONING	COMFORT AIR CONDITIONING
Application	Cooling for critical electronic applications	Room air conditioning for human occupants
Range Of Cooling/Heating Capacity Per Individual Air Conditioning Unit	5-150 kW (partially modular)	2-30 kW
Proportion Of Capacity Sensible/Latent	85-100%/0-15%	50-70%/30-50%
Control Accuracy	±0.5 K / ±3 % rel. hum.	± 1-2 K
Humidity Regulation	Controlled humidity (to help avoid electrostatic charge)	Unregulated dehumidification (for comfortable environmental cooling)
Air Volume	5,000-30,000 m3/h	300-2,000 m3/h
Air Outlet Speed	2-3 m/s	0.2-0.5 m/s
Noise Level In Room	45-70 dB(A)	20-40 dB(A)
Diversity Of Options	Very large, due to individual production	Lower, due to mass production
Operator Controls	More intricate	Basic temperature setting
Cycle Of Operation	24 x 7 x 365 operation	Seasonal operation with time-dependent setpoint changes
Software And Firmware Updates	Needed on a regular basis	Not normally required
Use With Raised Floor Installations	In most cases	Very rarely

A comparison of precision cooling and comfort air conditioning operation

Cooling Data Center Assessments Track Changing Needs

As a data center grows and changes, the precision cooling system will have to evolve along with it. To ensure optimal performance of the cooling system, this evolution should be guided by metrics collected by your service provider during thermal assessments.

Knowing where the performance of a data center's cooling system stands is key to planning proper maintenance. Customers need to have their data center's cooling performance assessed when they are running at peak capacity to get a true view of their cooling requirements.

This type of detailed analysis is key to optimizing data center cooling. A study of this magnitude requires someone who has the tools to determine where hot spots are and how to correct them.

For more information on Cooling Data Center Assessments, please refer to the Vertiv white paper on this subject.

A Different Kind Of Cooling Needs A Different Kind of Service

Because precision cooling systems are engineered in ways that make them very different from building comfort air conditioning, service providers without specific knowledge of how to maintain the equipment may not be prepared to handle the job. Inexperienced service providers greatly increase the risk of equipment failure, whereas use of OEM factory-trained service providers ensures that a precision cooling system is operating at its optimal point of performance and efficiency.

Precision cooling runs continuously and is necessary for the proper operation of IT equipment. This makes maintenance of the utmost importance. It certainly does not make sense to potentially undercut the investment in precision air conditioning by utilizing a service provider that may not have the expertise required to maintain the level of performance that was paid for in the first place.

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