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Regulations Determining Computer Room Cooling Selection

Precision vs Comfort Cooling

White Paper

New Regulatory Standards and their effect on Precision vs Comfort Cooling in Computer Rooms

Many engineers and contractors today are facing increasing concern about comfort (residential) cooling units being misapplied to computer room applications. There is no shortage of misinformation defining the appropriate use of air conditioning equipment and specifying the delineation between comfort cooling applications and computer room applications.

To make sense of it all, it helps to understand the history and the evolution of the various requirements for computer room cooling. These are fast changing requirements and many engineers, authorities having jurisdiction (AHJs), and end users are inadvertently misapplying comfort cooling units in computer rooms simply because they are not aware of the benefits of the application specific units or the regulatory aspects of the application.

Computer room air conditioners were developed in the 1960's to specifically address the unique environmental conditions at which the computer room had to be maintained. The high sensible load associated with the computer room required thin coils and high coil face velocities to provide the required cooling effect without stripping moisture from the space. The concern about this moisture stripping was primarily due to electrostatic discharge (ESD) which commonly takes place in low moisture content environments. At the time, it was all too common for electronic IT equipment to be damaged during servicing or reconfiguration due to electrostatic shock. To offset this moisture stripping the room had to be constantly re-humidified at great expense to the end user.

The computer room air conditioner (CRAC) was developed specifically to maintain the server and switch gear inlet temperatures and moisture content within an acceptable envelope. This is accomplished with variable capacity operation that closely matches cooling output to the IT load while simultaneously maintaining the moisture content using humidifiers or dehumidification operations. The American Society of Heating, Air Conditioning, and Refrigeration Engineers (ASHRAE) publication "Thermal Guidelines for Data Processing Environments" details the best practices envelope for maintaining the computer room for maximum uptime and IT equipment longevity. Units designed specifically to provide this tight control have advanced algorithms embedded in their programmable logic controllers that facilitate the constant monitoring and adjustment of the computer room environmental conditions.

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Direct expansion comfort cooling systems are not designed for the high return air temperatures associated with the data processing environment. In ASHRAE standard 127-2012 the highest return air test dry bulb temperature is 105°F. At these high return temperatures the comfort cooling units may fail due to compressor failure caused by excessive suction gas temperatures. Computer room air conditioners are designed from the ground up to operate continuously at these elevated return temperatures.

Most comfort cooling systems are designed around the premise that they will only operate during the cooling season, and for this reason comfort cooling units must meet a minimum Seasonal Energy Efficiency Ratio (SEER). The seasonal hours of operation are defined in ANSI/AHRI 210/240- 2008 and are dependent on bin weather data. Typical operating hours from this standard would be 8 hours a day for 125 days a year for a total of 1000 hours of operation a year. By contrast, computer room air conditioners are engineered for 24 hour a day, year-round operation. They have a robust design that is intended to provide reliable mission critical cooling for 8760 hours a year.

Since computer rooms consume large amounts of power, CRAC manufacturers have dedicated thousands of hours of research and development in an effort to create the most energy efficient equipment for this particular application. Comfort cooling equipment has neither the tight control, robust design, nor the built in energy efficiency required to serve the computer room adequately.

Prior to 2010 there was no required energy efficiency standard for computer room cooling equipment in the United States. This type of equipment was exempt from HVAC efficiency requirements under the process cooling clause of ASHRAE 90.1 (Energy Standard for Buildings Except Low Rise Residential Buildings). In the ASHRAE 90.1-2010 standard, computer room units were for the first time no longer exempted from meeting an efficiency standard and were given an energy efficiency metric specific to this type of cooling equipment. This metric is the Sensible Co-efficient of Performance (SCOP) and is defined in ASHRAE 127-2007 (Method Of Testing For Rating Computer And Data Processing Room Unitary Air Conditioners). This metric is specific to the computer room air conditioner as it gives no credit for the latent cooling performed. This is not true of comfort cooling metrics such as EER and SEER. Units not rated for SCOP are not intended for use in computer rooms.

How does this translate to your local area? Let's take the example of New York State. On March 9, 2016 the New York State Fire Prevention and Building Code Council voted to adopt an update to both the commercial provisions and the residential provisions of the Energy Conservation Construction Code of New York State (ECCCNYS). The updated Commercial provisions of the energy code are IECC-2015 as modified by the 2016 New York State Supplement. For commercial buildings, the IECC allows alternative design with ASHRAE 90.1-2013 specifically for computer room design. The ECCCNYS-2016 addresses the design and construction of energy-efficient building envelopes and the installation of energy-efficient mechanical equipment. The ECCCNYS-2016 had an effective date of October 3, 2016.

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In the ASHRAE 90.1-2013 a computer room is defined as the following:
"Computer room: A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density exceeding 20 watts per square foot of conditioned floor space."

ASHRAE 90.1-2013 contains table 6.8.1.1-11 that lists the required SCOP values for air conditioners used in computer rooms that meet the definition listed above.

TABLE 6.8.1-11 Air Conditioners and Condensing Units Serving Computer Rooms

Equipment Type	Net Sensible Cooling Capacity[a]	Minimum SCOP-127[b] Efficiency Downflow Units/Upflow Units	Test Procedure
Air conditioners, air cooled	<65,000 Btu/h	2.20/2.09	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10/1.99	
	≥ 240,000 Btu/h	1.90/1.79	
Air conditioners, water cooled	<65,000 Btu/h	2.60/2.49	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.50/2.39	
	≥ 240,000 Btu/h	2.40 /2.29	
Air conditioners, water cooled with fluid economizer	<65,000 Btu/h	2.55 /2.44	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.45/2.34	
	≥ 240,000 Btu/h	2.35/2.24	
Air conditioners, glycol cooled (rated at 40% propylene glycol)	<65,000 Btu/h	2.50/2.39	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.15/2.04	
	≥ 240,000 Btu/h	2.10/1.99	
Air conditioners, glycol cooled (rated at 40% propylene glycol) with fluid economizer	<65,000 Btu/h	2.45/2.34	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10/1.99	
	≥ 240,000 Btu/h	2.05/1.94	

a. Net sensible cooling capacity: The total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross – Latent – Fan Power)
b. Sensible coefficient of performance (SCOP-127): A ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding reheaters and humidifiers) at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

Table courtesy of The American Society of Heating, Refrigeration, and Air Conditioning, Engineers

Comfort cooling units that have not been tested for the SCOP per ASHRAE 127-2007 and do not meet the minimums listed do not appear to meet the requirements laid forth in ECCCNYS. In addition to the state-specific energy requirements, there are the federal requirements for computer room cooling units that must be met to satisfy current federal regulations.

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The minimum Sensible Coefficients of Performance (SCOP) requirement as set forth in the United States code of federal regulations, Title 10, Volume 3, Chapter II, Subchapter D, Part 431, and Subpart F for 2016 references the same value shown above in table 6.8.1-11. This federal requirement became effective in October, 2013. The federal government goes further in defining a computer room air conditioner as:

"Computer room air conditioner" means a basic model of commercial packaged air conditioning and heating equipment (packaged or split) that is:

1. Used in computer rooms, data processing rooms, or other information technology cooling applications.
2. Rated for sensible co-efficient of performance (SCOP) and tested in accordance with 10 C.F.R. section 436 and
3. Not a covered consumer product under 42 U.S.C. section 6291(1)-(2) and 6292.

Currently there are no minimum SCOP requirements for horizontal flow air conditioners, only those computer room air conditioners that are categorized as an up flow or down flow unit have minimum SCOP's that they must meet. The department of Energy (DOE) has given computer room air conditioning OEM's the following guidance in respect to horizontal flow CRACs:

1. They meet the definition of a computer room air conditioner as defined in 10 CFR 431.92
2. They are federally regulating pieces of HVAC equipment
3. They must be tested in accordance with ASHRAE 127-2007 before any information on energy consumption or cost of energy consumed may be disseminated.
4. They do not have to meet a specific minimum SCOP at this time.

To date, the Department of Energy (D.O.E.) has not exempted any state from this energy efficiency standard. States may petition D.O.E. to exempt a state regulation from preemption. In conclusion comfort cooling air conditioners should not be used in spaces that meet the definition of a computer room because:

- They are not designed for the tight energy efficient control required in the computer room.
- They may not meet the requirements of your local conservation code.
- They do not meet the federally mandated energy efficiencies and have not been submitted to the DOE for acceptance in this specific application.

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ABOUT THE AUTHOR

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ABOUT STULZ USA

STULZ Air Technology Systems, Inc. (STULZ USA) is an ISO 9001 registered manufacturer of environmental control equipment and is responsible for product development, manufacturing, and distribution for the North American arm of the international STULZ Group. STULZ USA has provided environmental control equipment to some of the premier grow facilities in the United States.

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