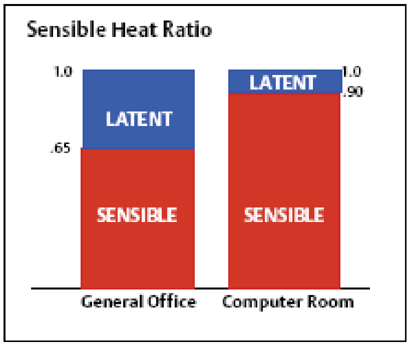
Tech Byte 9: Small Split-System Cooling Options

Small, split-system cooling options and factors that affect their selection...

Split-system cooling products come in a number of shapes and sizes, as do the applications that require their use. The question becomes, which type should be used and when? For a given application, the recommended types of small split systems are pretty clear. Small Liebert precision split systems offer many reliable and efficient solutions for cooling small heat loads generated by electronic equipment, ranging from as low as 1/2 ton up through 8 tons of capacity. Where criticality of the cooling is high and the cost of downtime of the room is high, the higher reliable Liebert small system cooling solutions are easy to cost justify. However, many equipment cooling applications considered non-mission critical are more cost sensitive, and in these cases, pairing a lower cost split evaporator with the high reliability of a Liebert condensing unit is an attractive option. In this article we will revisit the design differences of the precision cooling system versus the comfort cooling system, to understand why each is the proper choice for their target application. We will then discuss the "hybrid" option, of combining the two systems to provide a compromise between cost and performance for year round electronic equipment cooling.



Precision cooling systems are designed specifically to meet the needs of electronic loads which generate a dryer heat than typical comfort-cooling environments. Because of this, changes in the demands on the cooling system are significant. To address the dryer heat, precision systems are designed to accomplish higher levels of sensible cooling, which is the ability of the air conditioning system to remove heat that can be measured by a thermometer. This is accomplish by the use of a thinner evaporator coil, and more airflow across the coil per ton of cooling. Less interaction between the coil and the air flowing across it results in less moisture being removed from the air, and likewise a higher sensible cooling ratio.

Another unique feature of precision cooling systems is humidification control. The optimal relative humidity range for a computer room environment is 45-50 percent. An above-normal level of moisture can corrode switching circuitry, which can cause malfunctions and equipment failures. At the other end of the spectrum, low humidity can cause static discharges that interfere with normal equipment operation. This is a more likely scenario in a computer room, since it is typically cooled 24x7, creating lower levels of relative humidity. To control humidification, precision cooling systems come standard with humidifiers and reheat coils. As the space requires additional humidification, the integral humidifier turns on. If the humidity in the space is to high, the compressor comes on to dehumidify. If dehumidification is needed and the temperature of the space is at set-point, the integral reheat coils turn on to allow the system to dehumidify without over-cooling the space.

Precision cooling is typically a constant, year long job. Computer rooms generate heat regardless of season, and therefore require cooling solutions that can operate during any time of the year. A precision system can operate effectively to minus 30° F., and glycol cooled models cool effectively down to minus 60 degrees F. outside ambient temperatures.

Ceiling Mounted Liebert Minimate Precision Cooling Split System

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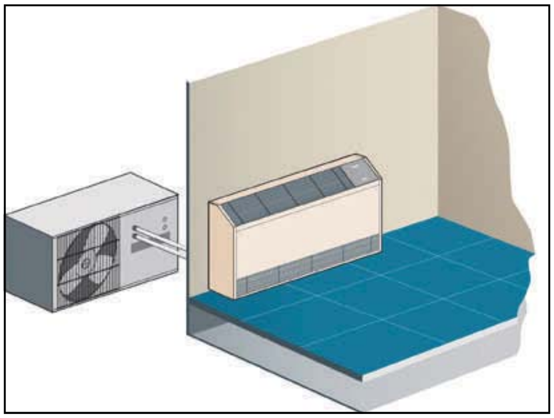
These systems must also stand up to the rigorous work load of 7 x 24 x 365 operation. Precision air conditioning systems and their components are engineered to meet this high cooling demand. A precision air unit's circulating fan operates continually, 8,760 hours per year, with other components turning on and off as needed. Internal design of precision air systems often feature greater internal redundancy of components than comfort cooling systems, because of the constant cooling demand and criticality of the equipment they support.

For environmental control of electronic equipment, precision cooling systems offer the needed set of performance characteristics to maintain an optimal environment. The use of precision systems for these applications will optimize the life and performance of the equipment being supported in the space.

In contrast to precision cooling systems, ***comfort air systems*** include room air conditioners, residential central air conditioners and air conditioning systems for office and commercial buildings. They are engineered primarily for the intermittent use, designed to operate an average of 8 hours per day, 5 days per week. This translates into about 1,200 hours per year, assuming cooling is required only during the summer months. Comfort systems are also only required to maintain a comfortable environment for people in facilities with a moderate amount of in-and-out traffic.



Wall Mounted Liebert Datamate Precision Cooling Split System

Comfort air conditioning systems have a sensible heat ratio of 0.60 to 0.70. This means that they are 60 to 70 percent dedicated to lowering temperature, and 30 to 40 percent dedicated to lowering humidity. In comparison, precision systems are designed with a sensible heat ratio of 0.85 to 1.0. This means 80 to 100 percent of their effort is devoted to cooling and only 0 to 20 percent to removing humidity. So more "nominal" 20-ton comfort units will be required to handle the same ***sensible*** load as "nominal" 20-ton precision units.

Also, comfort air systems typically have no humidity control, which makes it difficult to maintain stable relative humidity levels. In a comfort application, this is not a problem, as the seasonal workload in the summer months typically requires dehumidification of the space only. To add to this, people are tolerant of a wide range of relative humidity in a comfort application - somewhere between 35% and 70% RH. The comfort system does an effective job meeting the needs of people cooling in regards to humidity, but what if the system was applied to a computer room and had to operate in winter months? The problem that is faced with a comfort system operating in the winter is that humidity levels are lower in winter, and since the comfort system dedicates more of its capacity to latent cooling (moisture removal), the space becomes too dry and static concerns exist. A supplemental humidification system would be required along with controls to coordinate operation.

Another concern in winter months is the condensing unit operation in lower outdoor ambient conditions. In a low ambient outdoor condition, cooling system head pressure will drop. For a comfort system, this can cause improper refrigerant expansion into the condenser coil, and can very often lead to coil ice up. When the condenser coil ices up, the system can not provide cooling to the load inside until the ice is removed. In the worst case scenario of this situation, which happens often, liquid refrigerant makes its way back to the system compressor and causes damage. The compressor would have to be replaced in this situation, and the room would be without cooling until the unit is repaired.

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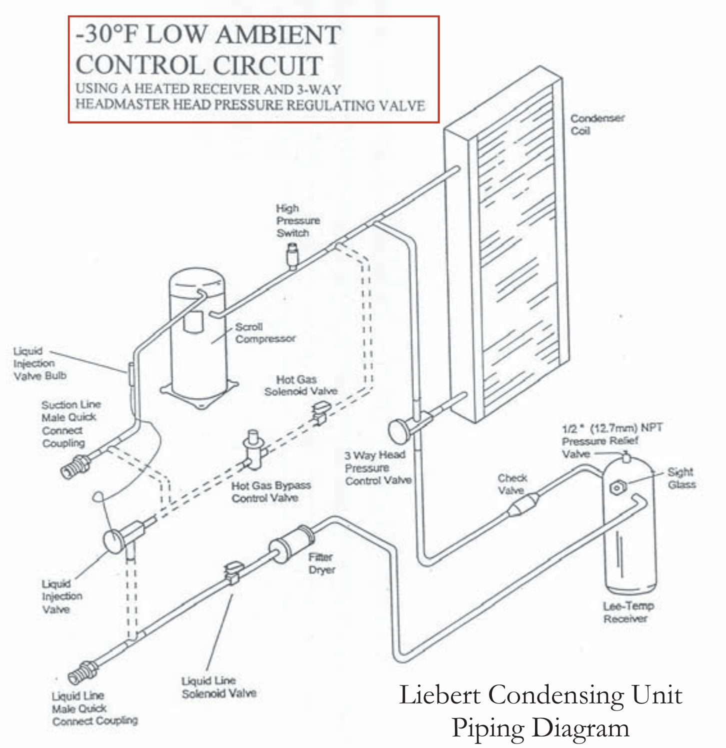
Because of basic engineering, design and equipment differences, a purchase price comparison of comfort versus precision air conditioning systems does not tell the complete story. A more accurate comparison will consider the difference in operating costs between the two systems. When all cooling and rehumidification costs are considered, the operating cost of a comfort-based system will exceed the operating cost of a precision air system.



Liebert Condensing Unit Piping Diagram

Split-System Cooling Option

Many times a main concern on a particular project is reducing first cost of the cooling solution, regardless of the on-going operational cost implications. If the application would normally call for a precision system, but cost has become a hurdle, what would option #2 be? In this case, many people reach for the low cost, comfort cooling split system. This accomplishes the goal of reducing first cost, but was it the ***ONLY*** option? The answer is no.

The ability exists to marry a precision cooling system with a comfort cooling system to obtain characteristics of each system, and achieve a cost lower than a full precision solution. This is done by pairing the comfort cooling evaporator coil with the precision cooling condensing unit. What has this gained us over the typical comfort system? We now have a solution that can operate in low ambient conditions, down to -30 degrees F. It also has a hot gas bypass feature, to limit compressor cycling in light load conditions, and a standard Copeland scroll compressor. What have we gained over the precision cooling system? We have reduced the first cost of the system.

What have we lost in this exchange? We now have a *cooling only* solution (no humidification control), and a less robust evaporator component. Again, the comfort splits are designed for seasonal workload. We must also ensure that the evaporator coil unit has the sensible cooling capacity to meet the load demand. We can not simply assume that a 2-ton comfort system will have the same cooling capacity as a 2-ton precision cooling system, because we are dealing with a high sensible cooling application. At the end of the day we are providing a better compromise between cost and performance than we would have by going with a straight comfort split system.

An example of this "hybrid" split system would be to combine a 3-ton PFH037A Liebert prop fan condensing unit with a 3-Ton MHWX Multi-Aqua Evaporator coil. The systems are compatible and can utilize R407C, a green refrigerant. See links below:

Multi-Aqua Fan Coil Unit Link:
http://www.multiaqua.com/products.htm#MHWX

Liebert PFH Condensing Unit Link:
http://www.liebert.com/product_pages/Product.aspx?id=45&hz=60