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Precision Air Conditioning for Server Rooms

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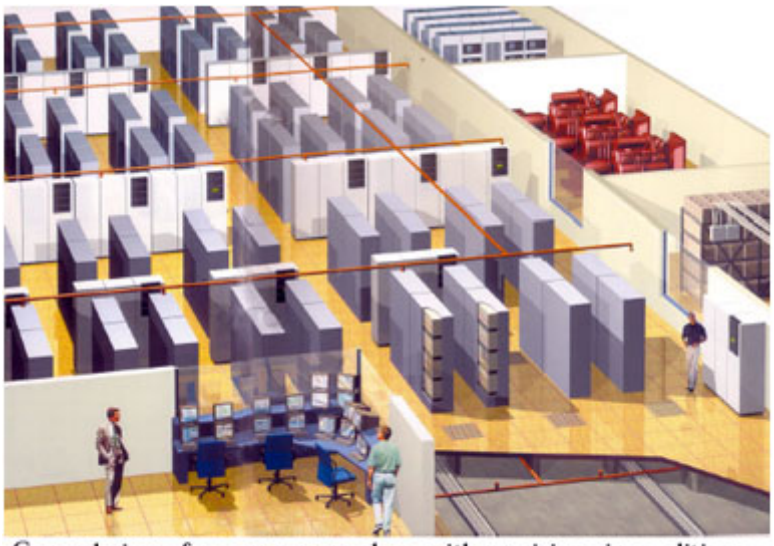
Precision airconditioners were originally developed prior to the advent of PC's when large main frame computers were used by corporations to cater to their business operational requirements. These large computers required reliable air conditining systems capable of running round the clock, maintain very close control on environmental conditions i.e. temperature and humidity and have high sensible cooling capacity (equipment cooling / equipment heat removal) since the equipment loads were dominant in these applications.

These computers were housed in buildings which had their own central air conditioning plants not designed for these requirements. The industry developed packaged units that could perform reliably and meet the expectations of computer manufacturers. These specially developed packaged units were called precision air conditioners mainly based on the applications and to differentiate them from the normal comfort packaged air conditioners.

Today, precision air conditioning systems are used in a wide range of applications such as Server rooms, Computer rooms, Data centres, Switch centres, Telecom shelters, Quality Control labs, Precision Manufacturing CNC Machine, Pharmaceutical industry, Medical equipment, Clean rooms and many more.



General view of a server room along with precision air conditioners

What is a Server Room?

A basic PC comprises of a monitor, key board, mouse and a CPU which houses the motherboard, hard disk etc. These CPUs based on the application vary in capacity. For large applications the CPU is replaced by Servers which have larger capacities of storage space, memory, operating speed, operating options, possibility of networking etc. Also, Servers give flexibility for several workstations to share and access data simultaneously with suitable networking.

along with precision air conditioners To cater to a larger requirement, several Servers have to be grouped together in a common housing called a rack. Depending on the number of work stations and types of application, the Server capacity and rack capacity is estimated. We can define a Server room as a room in which the main frame Server is located (with or without racks) which is the nucleus of a computer integrated work place having many operational terminals which are connected with suitable networking arrangements.

A Server room is normally operational for 24 hours and 365 days, hence design criteria includes redundancy and standby provisions.

In the past, Server rooms were built for internal use i.e. to cater to the computerisation needs of the company's internal staff. In today's scenario, to meet changing business needs, the application for Server room infrastructure is more wide spread. Data centers are a current trend, and are basically "infrastructure" provided by companies for outside clients to house their Servers in a readymade location i.e. the data center owner provides all

infrastructure like power, airconditioning, UPS, Generator backups etc. and the client merely puts up his Server and pays a rent for the services rendered.

This kind of an option is very suitable for companies from outside India setting up Call centers in India or Internet portals where their Server room needs and growth requirement can be increase or decrease in a small span of time or they need Servers to be located at various places for business operations or need a back up facility for e.g. banks and stock exchanges.

In todays scenario where almost all industries are catered to by the IT hardware and software products in most applications like banking, travel, hospital, software development, consultancy, designing, e–commerce, e–business and data centers, downtime in operations means huge losses (both monetary and goodwill) for the company and hence not affordable at any cost.

Any shut down in the Server due to internal faults or malfunctioning as a result of external factors such as power supply or environmental control will result in stoppage or delay in the activities of the end user.

All this emphasises the importance of designing and developing the Server room infrastructure of which precision air conditioning systems form an important part.

Why Precision Air Conditioners Fit the Bill

Server rooms can be ideally air conditioned using precision air conditioning systems originally developed to meet the cooling requirements of large main frame computers. Precision air conditioners are different from standard air conditioners in the following ways :

- High cfm per ton
- High sensible heat ratio
- Suitable for continuous 24 hour and 365 day operation
- Inbuilt options of heater, humidifier, dehumidificaiton to control temperature and humidity simultaneously.
- Microprocessor controls for close control on temperature and humidity with a user friendly interface.
- Better air filtration

Selecting the Right Capacity ACs for the Server Room

The basis of design for estimating a heat load is similar for precision air conditioning and comfort air conditioning. However the following points must be carefully considered and taken into account while making the equipment selection :

1. Inside conditions of temperature and humidity : The recommended inside condition by most Server manufacturers is 22°C±1°C db and 50% ±5%RH.
2. Outside conditions : Suitable derating of equipment capacity must be considered based on a condensing temperature which is normally 11°C higher than ambient temperature and varies with the ambient temperature.
3. Equipment selection must satisfy the heat load and air quantity requirements. Precision air conditioners have airflow in excess of 550 cfm per ton. Heat loads should account for the following internal loads in the Server room :
   • equipment loads are normally assumed on the basis of density per sq.ft.
   – scarcely populated 20-40 watts per sq.ft.
   – moderately populated 50-60 watts per sq.ft
   – densely populated 70-100 watts per sq.ft.
   – heavily populated 100-150 watts per sq.ft.
   • occupancy levels are minimum, normally 2 or 3 persons
   • lighting loads are normally considered at 1.5 watts per sq.ft.
   • diversity factor for equipment load is approximately 60-80%.
4. Standby requirement : having calculated the heat load, the next step is to decide the capacity and number of air conditioning units to be selected from the standard models available from most manufacturers and accordingly determine the capacity of the standby unit. As an example, if the heat load works out to 45 tons, one can select three units of 15 ton as operational plus one unit to work as a standby (commonly referred to as n = 3 + 1) or select two units of 22.5 ton as operational plus one unit as a standby (referred to as n = 2 + 1). The total price of each selection and the physical constraints at the installation site will finally determine the best choice.

The Difference Between Nominal and Actual Capacity Ratings

The cooling capacity of any air conditioner is determined by the room temperature being maintained by the AC and the outdoor air temperature which cools the condenser, other factors remaining unchanged (such as refrigerant used, fan speed and compressor design).

The lower the room temperature, the lower the actual cooling capacity. The higher the outdoor air temperature, the lower the actual cooling capacity.

To avoid confusion in the marketplace all AC manufacturers in the USA gathered together and decided that they would all rate the capacity of their product at a fixed room temperature and outdoor temperature for the sake of uniformity. This capacity rating is called a nominal rating and is the same as the ARI (Air conditioning and Refrigerating Institute) rating conditions. Similar standard rating conditions were enforced by European and Japanese manufacturers. In India ISI or BIS (Bureau of Indian Standards) has laid down similar conditions for rating room ACs and comfort packaged ACs.

Since precision ACs are not used for comfort conditions at which they are nominally rated but for lower temperatures required by Servers, their actual capacity will be much lower than the nominal capacity. Similarly for the high outdoor temperatures prevailing in India, compared to Europe and USA, the actual capacity will also be far lower than the nominal capacity. The consultant or the user of precision ACs should therefore avoid ambiguities and clearly specify evaporating/condensing temperatures at which compressor capacity is required, with a minimum of 4°C difference between coil ADP/evaporating and 10 °C between ambient/condensing temperatures.

Selecting the Right Type of Precision AC for the Server Room

Having calculated the heat load and selecting the right capacity and number of units including a standby, one must now decide the type of unit from the wide range available keeping in mind the reliability factor for a 24 hour and 365 days a year operation.

1. **Direct Expansion Air Cooled (Figure 1)**

   These are available with an external or internal air cooled condenser. The condensers are independent, one per air conditioning module thus reducing dependence on common components. Since air supply is free available these are the

most popular type.

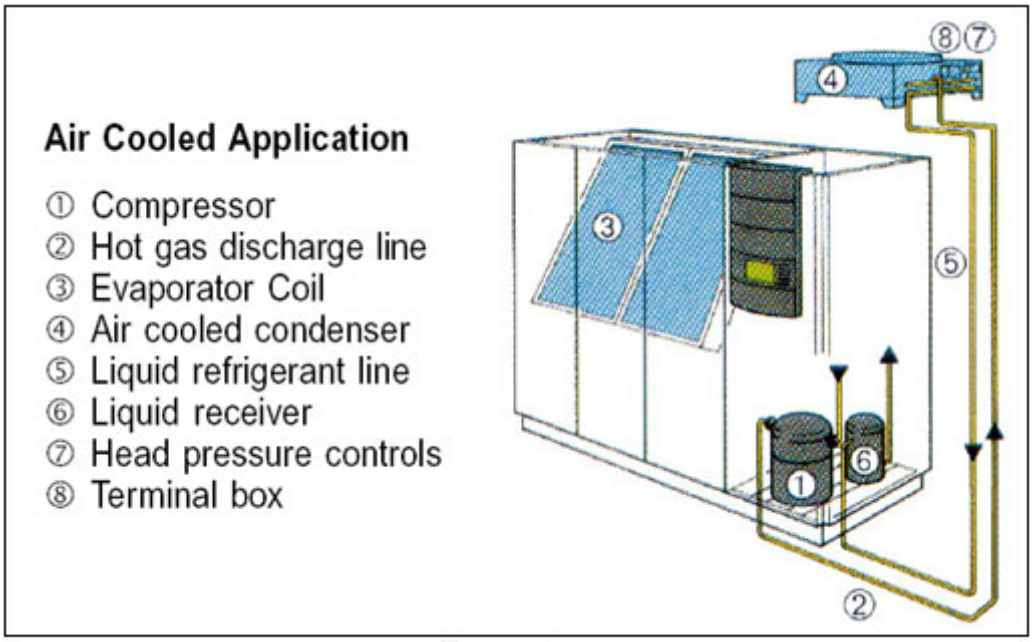


Figure 1

2. **Direct Expansion Water Cooled (Figure 2)**

   The condenser is of stainless steel plate type with water circulated through the condenser and heat rejected into the atmosphere via a drycooler (equivalent to an automobile radiator). A glycol solution can be substituted for water if outdoor temperatures are expected to go down below freezing point during the winter. The drycooler eliminates the need for a cooling tower with all its usual problems of scale formation and large quanity of makeup water required. However with two heat exchangers in the water circuit, the head pressure will be at a higher level than with a normal condenser / cooling tower combination. Reliability of operation with minimum maintenance is however more important in such applications than the higher cost of operation with a higher discharge pressure. of operation with a higher

discharge pressure.

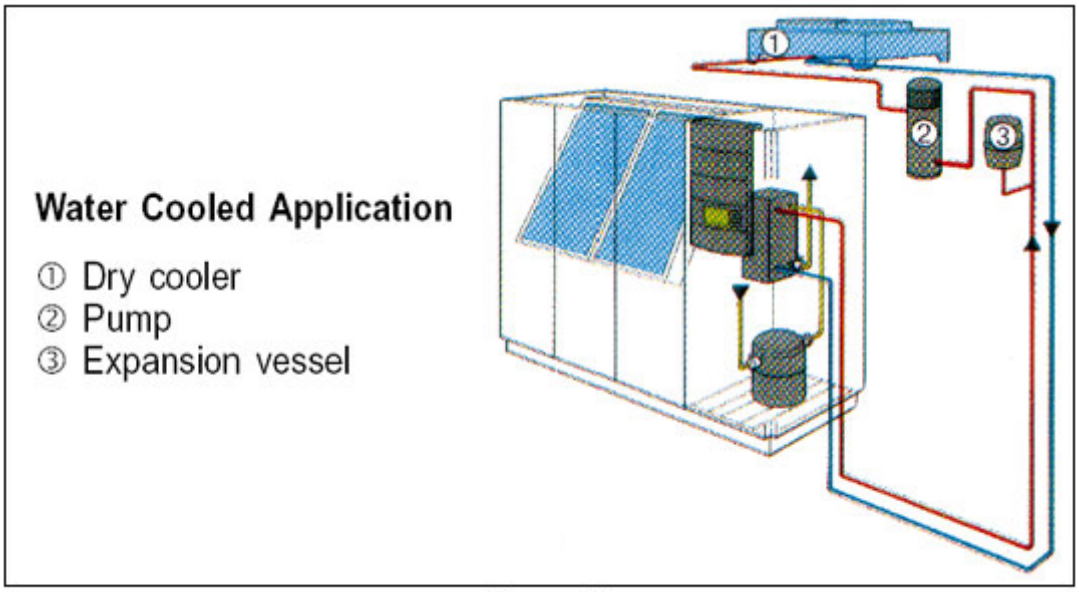


Figure 2

3. **Chilled Water Air Handling Units**

   When a central chiller system is available for the building air conditioning and provided it is reliable enough for the intended application, chilled water AHUs can be installed complete with microprocessor controls, heaters, humidifiers and inbuilt 2 way or 3 way modulating valve for control of water flow rates from the unit's microprocessor. The chilled water flow rate through the coils for precision AHUs is approximately 20 percent higher than comfort AHUs and the piping should be sized accordingly.

4. **Dual Fluid Units (Figure 3)**

   A combination of two different fluids, DX refrigerant and chilled water each with its independent cooling circuit gives the unit the advantage of power saving and redundancy. During normal daytime operation when the building's main chiller plant if functioning, the precision unit works with its own chilled water coil and control valve saving energy since the builtin compressor with DX coil and air cooled condenser is switched off. During night time and on holidays, when the buildings

chiller plant is not functioning, the precision units works on the DX mode.

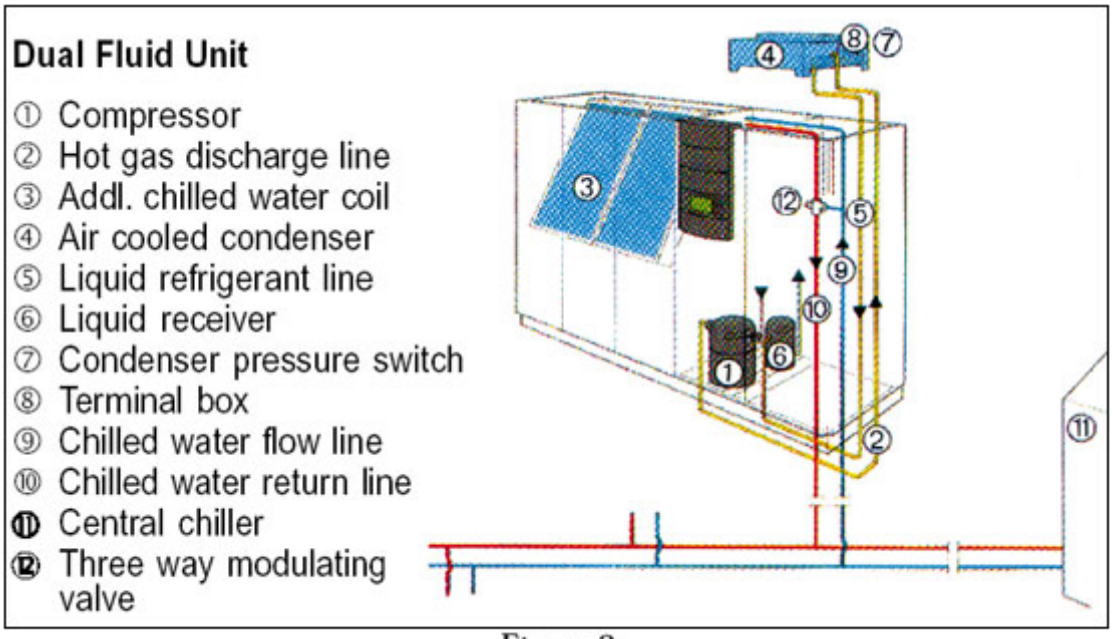


Figure 3

Choice of Air Distribution Pattern

For greaer design flexibility precision units are available either with a top discharge (upflow) for connection to a duct distribution system and a blower with external static pressure of 20 to 25 mm or a bottom discharge, (downflow) for underfloor air distribution using a raised floor. The later ype is more commonly used in Server rooms and has several advantags such as :

1. **No ducting required**

   The gap between the raised or false floor and the true floor acts as a supply air plenum eliminating ducts and shrinking the project completion time. Incidentally the false floor is installed in any case to simplify electric wiring which is simply laid on the floor and hence the additional cost should not be offset against the saving in ductwork.

2. **Natural convection**

   As the conditioned air is supplied through floor grilles with volume control, the cold air cools the electronic equipment much faster and more efficiently as it moves up, after extracting heat from the equipment. The follows the natural convection path of the air. The warm air is then sucked back from the top of the precision unit, cooled and fed back to the room from the bottom.

3. **Even Air Distribution**
   Air distribution is even and uniform through floor grilles with VCDs (Volume Control Dampers) installed on the false floor tiles.
4. **Greater Flexibility**
   If equipment layout is changed in the future, air distribution can be changed very easily by relocating the floor grilles wherever required.
5. **Eliminates Pests**
   Since the air temperature below the raised floor is between 11-16°C, rats and cockroaches don't feel welcome and tend to keep away.
6. **Lower Fan Static Pressure**
   Underfloor air distribution requires only 7-10mm E.S.P. against 20-25 in a ducted system, which keeps power consumption down and reduces noise level.

An important precaution is the need for insulating the true floor to avoid condensation on the ceiling of the floor below, keeping in mind the low supply air temperature in the floor plenum.

Standard Options and Customisation

Many users find it difficult to obtain financial approval from their 'project-approving-authority' for precision air conditioning systems which are more expensive than standard comfort systems. A correctly designed system can strike a balance between initial cost and performance criteria.

A standard precision air conditioner is equipped with many features to make it suitable for extreme applications which may not be necessary in all cases. Examples of possible savings are :

- in locations like Mumbai and Chennai where humidity is always high, units can be obtained without a humidifier or a smaller capacity humidifier.
- if room loads are correctly ascertained, heaters of minimum capacity or units without heaters can be provided.
- in an installation with multiple precision units, each unit need not have an independent microprocessor control as one such controller can handle several units giving better unit response due to the internal communication system.