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Psychromertic Room

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Abstract: The project reports on the performance of Air Conditioners at different test standards. The future design of air conditioners is being driven primarily by (a) increased energy efficiency standards and (b) the need to eliminate ozone-depleting working fluids. Various national and international agencies continue to impose more stringent requirements for energy efficiency. In addition, consumer pressure to select unit with lower operating costs further drives the need for improved performance. The main objective of this project is to give wide understand of the standards and to maintain the standard conditions in psychrometric room (Air conditioner test room), which have been constructed to test the air conditioners and to establish different test procedures. The tests that should be performed in Air conditioner test room are cooling capacity test, power consumption test. The main objective of the manufacturers is to produce the systems according to requirements of costumers which can give more cooling, low power consumption, high ERR to with stand competition in the market. In every country, the manufacturers follow some standards according to the climatic conditions to test the appliances.

Keywords: Psychrometric room; EER; cooling test; power consumption test; climatic conditions.

I. INTRODUCTION

India falls in the hot zone therefore the comfort air conditioning has always been felt to be a necessity for mankind. To achieve comfort heat is extracted from the comfort region and transferred to the environment, which is at a higher temperature. This is done with the help of refrigeration. Though there are many methods to achieve cooling, one process that is predominantly applied in refrigeration equipment and its application is vapor compression cycle is in air conditioning units, the more commonly used one is room air conditioners, and then comes the packaged systems which are used for higher tonnages till 50Ton. Ever since the invention of Air Conditioning as one of Refrigeration application by WH carrier in US in earlier 19th century, there has been a radical change in the methods and process used in manufacturing air-conditioning equipment but there is no change in the principle i.e. vapor compression system used in the cycle.

II. AIR CONDITIONING

"A system for controlling the temperature and humidity of the air in a building."Controlling the temperature is being able to heat and cool. Not only cool.

The air that we breathe is made up of 3 major components all capable of carrying energy (heat):

The component molecular constituents of air: Oxygen (23%), Nitrogen (76%), Carbon Dioxide (1%) and Inert Gases (1%)

Moisture or Water Vapour: Water vapour is present in the air at all times, the quantity present being dependent upon the air temperature. The higher the air temperature the higher the water vapour (quantity).

Airborne Particulate: These are the suspended impurities within the air from either industrial or natural pollution such as pollen, dust, smoke, germs etc.

As air is the only media that encompasses the whole of our body, we need to condition this air to provide comfort. The action we need to take is:

Control Temperature (heating & cooling) which entails adding energy (heating) or removing unwanted energy (cooling). General comfort conditions range between 20 – 25^0 Cin the UK.

Control Humidity (moisture content in the air), either humidify (add moisture) when dry, which can result in dryness of skin, dry throat and encourages static build-up) or de-humidify (remove moisture) when the amount of moisture in the air is high, which can result in breathing discomfort. Comfort humidity is generally between 30-70 % RH (Relative Humidity) for the UK.

Provide Ventilation to provide the necessary oxygen for breathing and dispelling carbon dioxide, odour, dust, smoke etc. General ventilation requirement ranges between 5 - 18 litres per second per person.

Provide Filtration to clean outside and inside air by removing dust, pollen, etc. Dust in dry air combined with dryness (lack of moisture in the air) is the main cause of static shocks.

Lack of ventilation and filtration combined with the lack of maintenance is the main causes of Sick Building Syndrome (SBS).

Considerations while selecting an air conditioning system:
There are many types of air conditioning systems available and therefore there are factors to take into consideration when choosing a suitable system:
Capital Cost: Includes not only the cost of equipment and its installation, but also all ancillary requirements such as build work, plant location and size, electrical work, progress time, administration, etc. Whole life costs also consist of maintenance, energy efficiency and life expectancy.
Energy Efficiency (Running Cost): Energy efficiency of air conditioning systems is becoming increasingly important as it can account for the largest single element of the energy requirement of a building. Also, in the near future, energy tax might be introduced. It may be more cost effective to install a system with higher initial cost but which provides greater energy efficiency.
Maintenance Cost: Maintenance cost is often over looked in any calculation and can be very costly dependent on the complexity of the system and the availability of professional service companies.
Flexibility: Flexibility of the system should be assessed in terms of installation, operation, future expansion and changes, operation, maintenance and controls.
User Friendliness: This needs to be assessed in relation to the occupier or user, the operator and/or the maintenance personnel. Many systems have standard controls, which are simple in concept yet sophisticated in nature and can combine user friendliness with full technical diagnostics.
Environmental Issues: These need to be checked, such as equipment compliance with current and future legislation in terms of CO2 emissions, Ozone Depletion and Health & Safety.

Type of cycle used in air conditioning system:
The basis of most (more than 95%) air conditioning systems is the "vapour compression cycle". The media (vapour) is Refrigerant (hydro chlorofluorocarbons - HCFC) which is non-toxic, non-explosive and non-corrosive. These Refrigerants have a boiling point of approx. Minus 53℃ which means that even if the air (outside or inside) temperature is as low as minus 50℃ it still has heat to be absorbed by refrigerants.

The vapour compression cycle requires four components:
The Compressor: To raise the pressure of low-pressure low temperature gas to high-pressure high temperature gas.
The Condenser: To change the state of high-pressure, high temperature gas to high-pressure, high temperature LIQUID. This is achieved by passing ambient air (known as air-cooled) or water (known as water-cooled) over the condenser tubes.
The Expansion Device: The purpose of the device is to change the state of the refrigerant from high-pressure, high temperature liquid to low pressure low temperature saturated liquid. This is achieved by passing the liquid through an orifice.
The Evaporator: To absorb the heat from room air or water, which in the case of a chiller is circulated around the evaporator coil? This will change the state of low-pressure, low temperature saturated liquid to low pressure, low/medium temperature gas.

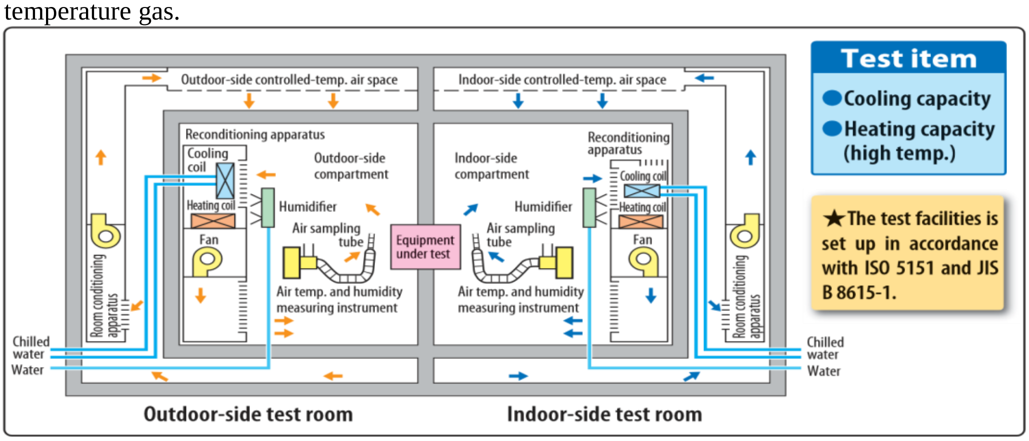

Fig.1 :Psycrometric room over view

III. EXPERIMENTAL ANALYSIS

Cooling capacity test:
Observation values:
Suction pressure: 1 kg/sqcm to 1.5 kg/sqcm
Discharge pressure: 9.5 kg/sqcm to 11 kg/sqcm

Table I: Observations made with the **THERMAL EXPANSION VALVE** used as the expansion device, at the time intervals of one hour.

	T1	T2	T3
Receiver gas	23.1	21.4	22.6
Discharge gas	69.4	114.0	127.0

Liquid line	26.3	27.0	27.6
Shell top	66.7	95.9	118.2
Shell bottom	70.6	90.3	88.0
Evaporator entry	17.4	13.6	12.2
Evaporator exit	22	18.6	21.6
Plate	20.5	16.1	17.4
Ambient	23.8	22.3	23.8

Sample Calculation:

Area, A_i = ((22/7*4)*SQRT (48.66/1000))+((22/7*4)*SQRT(99.43/1000))
= 0.00962 m2Cubic flow per minute,

C_{fm} = C_i*Y_i*A_i*SQRT ((2*D_P)/Dle)*3600*0.5885
=0.985*0.998*0.00962*SQRT ((2*445)/1.2138)*3600* 0.5885
= 542.56 or 543

Volume flow rate, Qva= C_{fm}/2118.88
= 543/2118.88
= 0.2562 m^3/sec

Enthalpy difference, D_h = h_{en}-h_{le}
= 54.3878 - 34.5613
= 19.8265 kj/kg

Mass flow rate, M_a = Volume flow rate (Q_{va})/Specific volume of leaving air (V_{le})
= 0.2562/0.8238
= 0.3109 kg/sec

Cooling capacity in KW = Mass flow rate (M_a)*Enthalpy difference (D_h)
= 0.3109*19.8265
= 6.1640 kw

Cooling capacity in Btu/hr = cooling capacity in kw*3412.14
= 6.1640*3412.14
= 21032.43 Btu/hr

Cooling capacity in TON of refrigeration = cooling capacity in kw / 3.516
= 6.1640 / 3.516
= 1.7531 Ton

Energy efficiency ratio,EER = (cooling capacity in Btu/hr) / (Input power in watts)
= 21032/2240
= 9.389 Btu/W-hr

IV. CONCLUSION

- Every product that is manufactured is tested to know who it works and up to what level it can satisfy the costumers.
- The main objective of this project is testing the air conditioner appliance according to differentstandards by maintaining different climatic conditions in Air conditioner test room.
- The testing includes cooling test, power consumption test.
- From capacity test, cooling capacity of system at different temperatures is known. Cooling capacity test is done on air conditioner appliance.
- The specification given by manufacturer for cooling capacity of Air conditioner at 35oC ambient is 21200 Btu/hr, by conducting capacity test in the air conditioner test room it is found that its capacity is lower by 1.4% i.e. 20908 Btu/hr. at 35oC ambient.
- Similarly cooling capacity at 46oC and 54oC ambient is found as 19332Btu/hr. and 5582Btu/hr.
- Power consumption testisdone on air conditioner and found that it consumes when operated for 24hrs, 16.5 Kwhr units power i.e. 0.687 kw/hr. at 35oC Ambient.
- At 46oC Ambient it is found to at it consumes 24.5 Kwhr units of power i.e. 1.021kw/hr. in Air conditioner test room.
- The various factors observed amidst the testing were, amount of charge of refrigerant, pressure drop, suction and discharge pressures, power, current etc. From these work different procedures for testing air conditioners are established.
- The test results will give awareness to the customers and manufacturers. Useful data is generated for the air conditioning engineers.

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