Review on Manufacturing Process Study of Air Handling Unit used in Industrial and Commercial Application

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***Abstract*: It's an review of under study report based on air handling unit used mostly in industrial and commercial application with their manufacturing process and timing study was done ZECO Aircon Ltd. Thane past one year where Creating ideal products that perform even in the harshest of conditions while still the practice of Supply duct, Fan compartment, isolator, vibration isolator, Heating And cooling coil, filter compartment, mix air duct.**

***Keywords*: AHU, GI, CFM, PI, HVAC**

Introduction

ZECO, India's most preferred air handling unit manufacturing company has been in existence from last two decades. With this experience and expertise they manufacture a wide range of air handling units in our automated manufacturing facility. Our Air Handling Units (AHU) are available up to 100,000 CFM capacity.[1] Superior Features: - Rigid framework design has inherent strength and stability. The aluminum profiles are corrosion resistant with specially designed three way corners. The panels are pressure injected with CFC free polyurethane foam up to 40 Kg/cum densities. The entire framework is mounted on a galvanized steel channel base. The condensate drain pan is fabricated out of corrosion resistant SS-304 stainless steel insulated on outside with close cell insulation. The units are compact in design to provide vibration-free, noiseless performance and are easily maintainable. Basic assembly consists of sections with imported centrifugal fan, cooling coil, and filters. Add-on optional modules such as thermal break with coved profiles, heating coil, face and pass damper, humidifiers and air mixing chambers are also available on specific demand. Units can be manufactured with direct drive plug fans as well.

2. TYPE OF AIR HANDLING UNIT

2.1 Single Skin Unit

Fig .1 Single Skin Unit

The Capacity range of single skin unit 1200 CFM to 5000 CFM. The applications of single skin unit are shopping malls ,multiplexes, offices and hotels. Feature of single skin unit are low height single skin unit. Single phase direct driven / 3 phase belt driven. Single / twin blower. Available in plain gi/powder-coated versions. Light weight statically/dynamically balanced blowers

2.2 Double skin unit

Fig .1.2 Double skin unit

The capacity rang of double skin unit is 800 CFM to 10,000 CFM the applications double skin unit comfort air-conditioning - for shopping malls, multiplexes, small offices, hotels. the feature of Double skin unit of compact, space saving with single /multi centrifugal fan. belt driven units available in double / single skin. double skin units available with aluminum profile. customized units available up to 20000 CFM.[1]

2.3 Floor mounting unit

Fig 1.3 Floor mounting unit

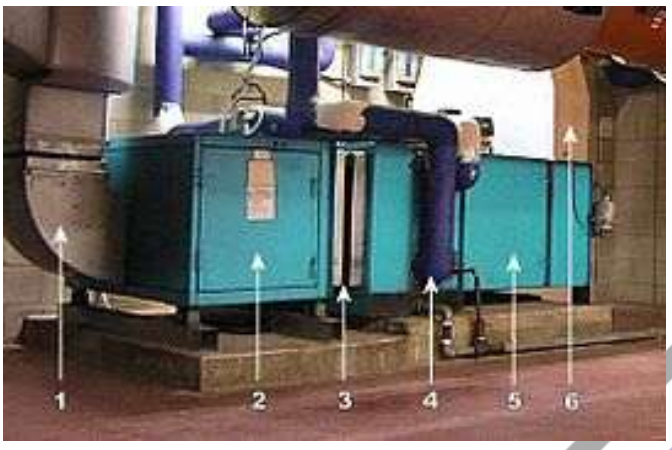
The capacity range of floor mounting unit 1000 CFM to 100,000 CFM.

The applications of Floor mounting unit comfort air conditioning - for schools, studio, airports, laboratories, multiplexes, offices, institutional buildings and hotels. Feature of floor mounting unit the unit is manufactured as per the customer's requirements

Options available

- Weatherproof Light, Limit switch, View glass.
- Filter sections for EU-5,EU-7,in Rigid/Bag construction.
- Humidification
- Heat recovery Wheel / Heat Pipe.
- Humidification, Pre/ Re Heat Package
- Mixing Box with Fresh / Return Air Dampers
- Single / Double Tier Construction

3. Manufacturing Process



An air handling unit; air flow is from the right to left in this case. Some AHU components shown are

1 Supply duct
2 Fan compartment
3 Vibration isolator ('flex joint')
4 Heating and cooling coil
5 Filter compartment
6 Mixed (re-circulated + outside) air duct

3.1 Filters

Air filtration is almost always present in order to provide clean dust-free air to the building occupants. It may be via simple low-MERV pleated media, HEPA, electrostatic, or a combination of techniques. Gas-phase and ultraviolet air treatments may be employed as well.

Filtration is typically placed first in the AHU in order to keep all the downstream components clean. Depending upon the grade of filtration required, typically filters will be arranged in two (or more) successive banks with a coarse-grade panel filter provided in front of a fine-grade bag filter, or other "final" filtration medium. The panel filter is cheaper to replace and maintain, and thus protects the more expensive bag filters.

The life of a filter may be assessed by monitoring the pressure drop through the filter medium at design air volume flow rate. This may be done by means of a visual display using a pressure gauge, or by a pressure switch linked to an alarm point on the building control system. Failure to replace a filter may eventually lead to its collapse, as the forces exerted upon it by the fan overcome its inherent strength, resulting in collapse and thus contamination of the air handler and downstream ductwork.

3.2 Heating and/or cooling elements

Air handlers may need to provide heating, cooling, or both to change the supply air temperature, and humidity level depending on the location and the application. Such conditioning is provided by heat exchanger coil(s) within the air handling unit air stream, such coils may be direct or indirect in relation to the medium providing the heating or cooling effect.

Direct heat exchangers include those for gas-fired fuel-burning heaters or a refrigeration evaporator, placed directly in the air stream. Electric resistance heaters and heat pumpscan be used as well. Evaporative cooling is possible in dry climates.

Indirect coils use hot water or steam for heating, and chilled water for cooling (prime energy for heating and cooling is provided by central plant elsewhere in the building). Coils are typically manufactured from copper for the tubes, with copper or aluminium fins to aid heat transfer. Cooling coils will also employ eliminator plates to remove and drain condensate. The hot water or steam is provided by a central boiler, and the chilled water is provided by a central chiller. Downstream temperature sensors are typically used to monitor and control "off coil" temperatures, in conjunction with an appropriate motorized control valve prior to the coil.[2]

If dehumidification is required, then the cooling coil is employed to over-cool to that the dew point is reached and condensation occurs. A heater coil placed after the cooling coil re-heats the air (therefore known as a re-heat coil) to the desired supply temperature. This process has the effect of reducing the relative humidity level of the supply air.

In colder climates, where winter temperatures regularly drop below freezing, then frost coils or pre-heat coils are often employed as a first stage of air treatment to ensure that downstream filters or chilled water coils are protected against freezing. The control of the frost coil is such that if a certain off-coil air temperature is not reached then the entire air handler is shut down for protection.[2]

3.3 Humidifier

Humidification is often necessary in colder climates where continuous heating will make the air drier, resulting in uncomfortable air quality and increased static electricity. Various types of humidification may be used:

- Evaporative: dry air blown over a reservoir will evaporate some of the water. The rate of evaporation can be increased by spraying the water onto baffles in the air stream.
- Vaporizer: steam or vapor from a boiler is blown directly into the air stream.
- Spray mist: water is diffused either by a nozzle or other mechanical means into fine droplets and carried by the air.
- Ultrasonic: A tray of fresh water in the airstream is excited by an ultrasonic device forming a fog or water mist.
- Wetted medium: A fine fibrous medium in the airstream is kept moist with fresh water from a header pipe with a series of small outlets. As the air passes through the medium it entrains the water in fine droplets. This type of humidifier can quickly clog if the primary air filtration is not maintained in good order.

3.4 Mixing chamber

In order to maintain indoor air quality, air handlers commonly have provisions to allow the introduction of outside air into, and the exhausting of air from the building. In temperate climates, mixing the right amount of cooler outside air with warmer return air can be used to approach the desired supply air temperature. A mixing chamber is therefore used which has dampers controlling the ratio between the return, outside, and exhaust air.

3.5 Blower/fan

Air handlers typically employ a large squirrel cage blower driven by an AC induction electric motor to move the air. The blower may operate at a single speed, offer a variety of set speeds, or be driven by a variable-frequency drive to allow a wide range of air flow rates. Flow rate may also be controlled by inlet vanes or outlet dampers on the fan. Some residential air handlers in USA (central "furnaces" or "air conditioners") use a brushless DC electric motor that has variable speed capabilities.[1] Air handlers in Europe and Australia and New Zealand now commonly use backward curve fans without scroll or "plug fans". These are driven using high efficiency EC (electronically commutated) motors with built in speed control.

Multiple blowers may be present in large commercial air handling units, typically placed at the end of the AHU and the beginning of the supply ductwork (therefore also called "supply fans"). They are often augmented by fans in the return air duct ("return fans") pushing the air into the AHU

3.6 Balancing

Un-balanced fans wobble and vibrate. For home AC fans, this can be a major problem: air circulation is greatly reduced at the vents (as wobble is lost energy), efficiency is compromised, and noise is increased. Another major problem in fans that are not balanced is longevity of the bearings (attached to the fan and shaft) is compromised. This can cause failure to occur long before the bearings life expectancy.

Weights can be strategically placed to correct for a smooth spin (for a ceiling fan, trial and error placement typically resolves the problem). Home / central AC fans or other big fans are typically taken to shops, which have special balancers for more complicated balancing (trial and error can cause damage before the correct points are found). The fan motor itself does not typically vibrate.[2]

3.7 Heat recovery device

A heat recovery device heat exchanger may be fitted to the air handler between supply and extract airstreams for energy savings and increasing capacity. These types more commonly include for:

- Recuperate, or Plate Heat exchanger: A sandwich of plastic or metal plates with interlaced air paths. Heat is transferred between airstreams from one side of the plate to the other. The plates are typically spaced at 4 to 6mm apart. Heat recovery efficiency up to 70%.
- Thermal Wheel, or Rotary heat exchanger: A slowly rotating matrix of finely corrugated metal, operating in both opposing airstreams. When the air handling unit is in heating mode, heat is absorbed as air passes through the matrix in the exhaust airstream, during one half rotation, and released during the second half rotation into the supply airstream in a continuous process. When the air handling unit is in cooling mode, heat is released as air passes through the matrix in the exhaust airstream, during one half rotation, and absorbed during the second half rotation into the supply airstream. Heat recovery efficiency up to 85%. Wheels are also available with a hydroscopic coating to provide latent heat transfer and also the drying or humidification of airstreams.
- Run around coil: Two air to liquid heat exchanger coils, in opposing airstreams, piped together with a circulating pump and using water or a brine as the heat transfer medium. This device, although not very efficient, allows heat recovery between remote and sometimes multiple supply and exhaust airstreams. Heat recovery efficiency up to 50%.
- Heat Pipe: Operating in both opposing air paths, using a confined refrigerant as a heat transfer medium. The heat pipe uses multiple sealed pipes mounted in a coil configuration with fins to increase heat transfer. Heat is absorbed on one side of the pipe,

by evaporation of the refrigerant, and released at the other side, by condensation of the refrigerant. Condensed refrigerant flows by gravity to the first side of the pipe to repeat the process. Heat recovery efficiency up to 65%.

3.8 Controls

Controls are necessary to regulate every aspect of an air handler, such as: flow rate of air, supply air temperature, mixed air temperature, humidity, air quality. They may be as simple as an off/on thermostat or as complex as a building automation system using Banat or Lon Works, for example.

Common control components include temperature sensors, humidity sensors, sail switches, actuators, motors, and controllers.

3.9 Vibration isolators

The blowers in an air handler can create substantial vibration and the large area of the duct system would transmit this noise and vibration to the occupants of the building. To avoid this, vibration isolators (flexible sections) are normally inserted into the duct immediately before and after the air handler and often also between the fan compartment and the rest of the AHU. The rubberized canvas-like material of these sections allows the air handler components to vibrate without transmitting this motion to the attached ducts.

The fan compartment can be further isolated by placing it on a spring suspension, which will mitigate the transfer of vibration through the floor.

4. Raw Material :

At ZECO sourcing of raw material plays a very important role

The units are compact in design to provide vibration-free, noiseless performance and are easily maintainable. Basic assembly consists of sections with imported centrifugal fan, cooling coil, and filters. Add-on optional modules such as thermal break with coved profiles, heating coil, face and pass damper, humidifiers and air mixing chambers are also available on specific demand. Units can be manufactured with direct drive plug fans as well.

5. Design :

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6. Testing :

Quality control engineers are very picky when it comes to clearing a AHU for dispatch. Typically, individual components of the air handling system require testing under specific atmospheric conditions (for example, test reheat/heating coil in winter, cooling coil in summer, and economizer during swing months). Therefore, functional performance testing encompasses all seasons in order to fully observe the entire system under normal operating conditions. However the construction and occupancy schedule may necessitate testing parts of the system during off-peak conditions. System operation and performance may be verified by either creating false loads on the equipment or through manipulation of set points to accommodate existing atmospheric conditions.

7. Mark of Quality :

Mark has developed a range of air handling units with several options for a wide variety of applications. From a simple air intake unit to a fully automatically controlled air handling unit suitable for both indoor or outdoor use.

There is a wide selection of heating systems, such as hot water batteries, gas or oil-fired modules, gas-fired make-up air systems or high performance gas-fired heating systems. Heat recovery and cooling are of course also possible.

Mark air handling units are made from seawater- resistant aluminium panels as standard. The benefit is lower weight and a longer life. The Mark air handling unit is a highly developed, premium quality product that can be adjusted to the customer's requirements.[3]

a) Features

- Air displacements up to 150,000 m3/h
- Very economical to buy and use Integration of high efficiency heating modules is possible
- Modular construction
- Easy to maintain
- Long life
- Flexible and variable
- Proven design
- Low weight

Conclusion

We are focus mainly on manufacturing process study of varies AHU which include AHU shop with filter, fan, cooling /heating coil and chiller after that assembly of AHU rough material, cutting, foaming, and testing also the part of manufacturing process. Their respective applications not only in industrial but Commercial / Industrial Air-conditioning, Window / Split Air conditioners, Refrigeration Systems, Bus / Car / Railway /Ship Air-conditioning, Specialized steam / Hot water coils.

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