

HVAC for Offset Printing Plates

The magazine you are reading, like most magazines the world over, is printed on an "offset printing machine" (shown above) using "offset printing plates" to transfer images and text of each page onto the paper. This article explains how the temperature and humidity required during the manufacture of these printing plates is achieved. See box on next page for further details of printing plates.

By **B. Gautham Baliga**

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A recent project in Mumbai involved air conditioning of controlled environment rooms which needed to run 24×7 and meet close tolerance requirement on temperature and relative humidity. The hall mark of the design is that all heating comes from the refrigeration system itself. Electric heaters have been provided to be activated in extreme weather conditions only, which for Mumbai are a few days in a year. Considering the fact that 10 such rooms are involved, each with one ton of air conditioning and the units work 24×7, not using electric heaters saves huge amount of electricity bills.

Design Conditions

The inside conditions for the rooms were 35°C±1°C and 50±5% RH.

Heat Load Profile

The room load other than solar heat gain comprised of product load. The product came in at 22°C. It was seen that there was initially negative load on the refrigeration system. The product load (negative) was in excess of the solar loads and the air-con system needed to be in the heating mode. Thereafter, as the product temperature increased, depending on outside ambient, the aircon system needed to switch to cooling mode.

System Requirements

It can be seen from the foregoing that the systems have a requirement of i) heating or cooling and ii) dehumidification or humidification.

In addition to the above, the close tolerance for temperature (i.e. ±1°C) and relative humidity (i.e. ±5% RH)

was needed to be achieved all over the room. Continuous temperature & RH measurement is carried out through 4 sensors located at various points in each room.

Features of the Aircon System

To meet the above requirements, the aircon systems would need to have the following features:

- Cooling and humidification

About the Author

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Note by the Author: The system design contained herein was carried out by Mr. Surendra Shah, Panasia Corporation. The equipment and controls were all supplied by Panasia. Opal HVAC Engineers Pvt. Ltd carried out the turn key contract. Sincere thanks are due to Mr. Surendra Shah for vetting this article.

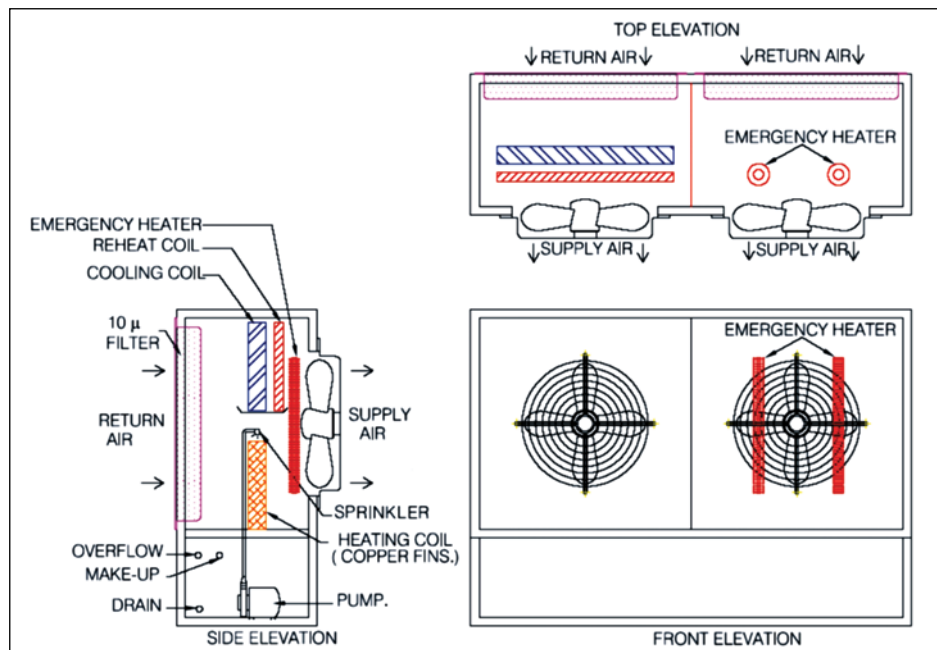


Figure 1 : General arrangement drawing of indoor unit.

- Cooling with dehumidification and heating for RH control
- Heating with humidification
- Close tolerance on temperature (+/-1°C)
- Close tolerance on relative humidity (+/-5%)

In addition to meeting the above system requirements it was thus decided that instead of going in for electric heating, the cooling systems should double up as heat-pumps, which on an average give 4kW of heating for 1kW of energy. It was found that in extreme monsoon & winter, the system in heat-pump mode would not be able to provide the necessary heat. For these occasions, the heat-pump mode was augmented with electric heating.

Indoor Unit

A general arrangement drawing of the indoor unit has been given in Figure 1. The special features of the indoor unit may be noted:

- There are 2 fans. One fan draws air through filter and then cooling & heating coils. The other fan draws air through filter only. The sole purpose of the latter fan is to increase air circulation in the room.
- The heating coil for the humidification has hot condenser liquid or hot gas passing through it thereby heating the sprinkled water. The evaporated water then humidifies the room.
- For reducing RH, heating is done using hot condensate liquid and not electric heaters.

Refrigerant Piping Schematic

The refrigerant schematic drawing is given in Figure 2.

Unit Operation Logic

Hot condenser liquid from the condenser flows into the reheat coil (Item5) and heats the cold air from the cooling coil (Item3).

The hot condenser liquid gets cooled in the reheat coil (Item 5) by the cold air from cooling coil. The hot liquid refrigerant sub cools, thus improving system performance and also provides reheat.

The sub-cooled refrigerant from the reheat coil gets into the evaporator (Item 3) through expansion valve in the cooling mode when solenoid (Item 9B) is open.

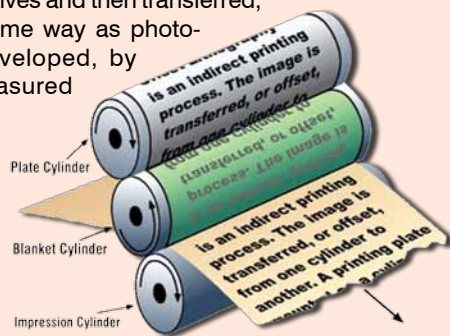
When in heat pump mode, the solenoid 9 closes & the solenoid (Item 9A) opens and the refrigerant flows into the external evaporator (Item 8). In this mode the fan of the air cooled condenser (Item 2) is switched OFF. Effectively, no refrigerant gas condensation takes place in outdoor condenser coil (Item2) and only hot gas enters reheat coils (Items 5 & 6). The hot gas condenses in the reheat coils (Items 5 & 6) in the indoor unit and the condensed liquid expands into external evaporator (Item 8) after passing through the open solenoid valve (Item 9A).

Offset Printing Explained

This is the most commonly used method of printing where an image on a a special plate coated with chemicals, is" offset" onto rubber blanket cylinders, which, in turn, transfer the image to a sheet of paper. Before the job can be printed, the document must be placed on printing plates.

What are Printing Plates

Printing plates are made of thin aluminum sheets which are coated with light sensitive chemicals by a special proprietary process. Images of the documents to be printed are placed on negatives and then transferred, in much the same way as photographs are developed, by allowing a measured amount of light to pass through the film negatives to expose the printing plates.



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There is a possibility that the compressor top shell temperatures will go up on occasion. To remedy such a situation, solenoid (Item 9C) opens and expands cool refrigerant into the compressor suction line through capillary (Item 14).

It is quite possible that the heat provided by the system in heat pump mode is inadequate in severe winter. For such exigencies, emergency supplementary electric heaters are provided.

Control Logic

Control logic is at the heart of this HVAC system. To achieve the results, each system has a *Carel* Controller installed which was programmed for the various situations detailed below.

There can be 4 conditions that need to be taken care of: There is the set point (35°C & 50%RH) as shown in the psychrometric chart. The actual room condition may lie in the segment A, B, C or D.

- i.) We calculate the dew point from the set value (of dry bulb & RH values)
- ii.) We calculate the dew point from the actual values (of dry bulb & RH values)

Condition A

Dry bulb temperature is more than (set temperature + 0.3°C) and the dew point of the read values is higher than dew point of set values.

Action: The internal evaporator is ON, pump is OFF & the outdoor condenser fan speed is at 100%.

After the set temperature and RH are achieved, switch compressor OFF.

Restart the compressor only after a variation of 0.5°C

Condition B

Dry bulb temperature is less than (set temperature

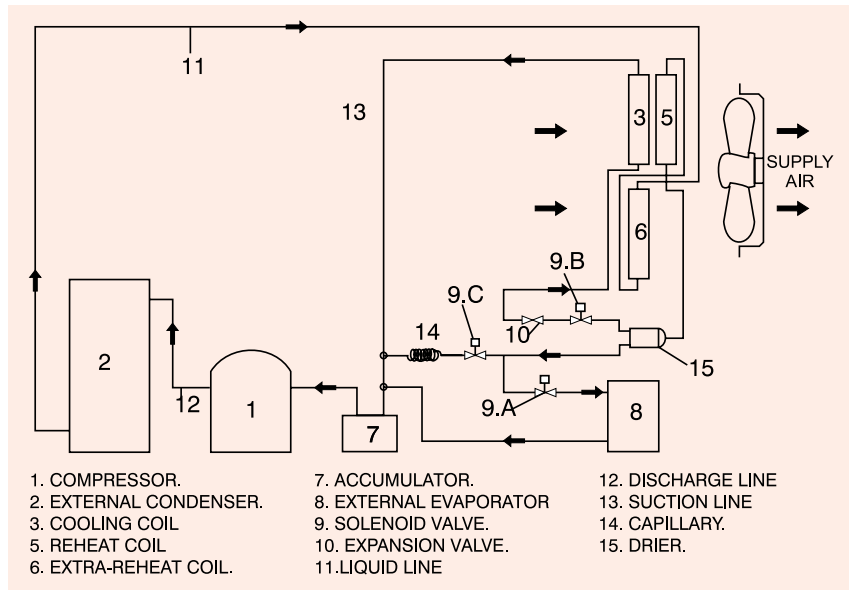


Figure 2 : Refrigerant piping schematic.

– 0.3°C) and the dew point of the read values is higher than dew point of set values.

Action: The internal evaporator is ON, pump is OFF & fan speed of outdoor condenser is at 40% of full speed. Because of lower condenser fan speed, the refrigerant entering reheat coils (Items 5 & 6) is warmer and heating takes place to correct the RH.

If set temperature is not achieved and the temperature is equal to or below (set temperature – 0.5°C), with a timer, the fan motor of the outdoor condenser is stopped (mode B1). Now the refrigerant does not get condensed in the condenser coil (item 2). The hot gas goes into heating coils (items 5 & 6) and is liquid by the time it reaches the open solenoid valve (item 9B) to get expanded into cooling coil 3. Dehumidification takes place in coil (item 3). In this mode, the unit operates for 6 minutes. Then using the timer, the unit goes into heat pump mode. The solenoid valve (item 9B) closes, solenoid valve (item 9A) opens, and the external evaporator (item 8) comes ON (mode B2). This mode continues for 6 minutes. In this mode there is only heating. Depending on the temperature achieved, the operation goes back into mode B1 or A, C or D (all described herein). If temperature is still not achieved, electric heaters come ON. When the temperature is achieved, the unit compressor is switched OFF.

This timing of 6 minutes of the timer from mode B1 to mode B2 is site adjusted to achieve the temperature and RH in the required band.

Restart the compressor only after a

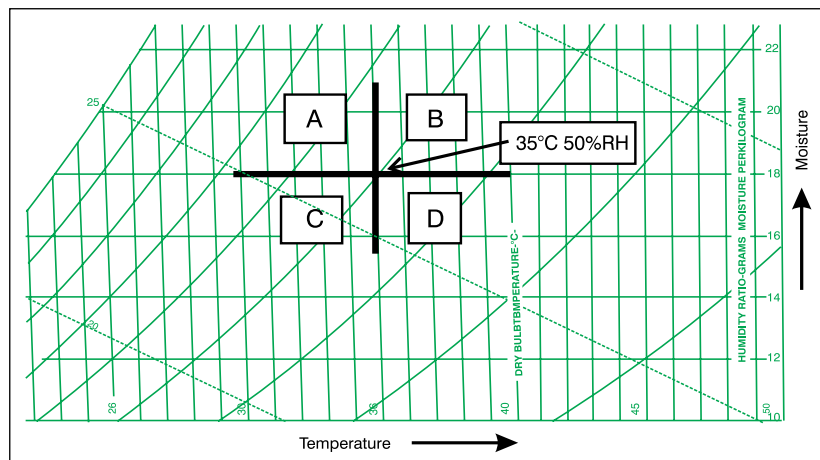


Figure 3 : Temperature & RH chart with set point.

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variation of 0.5°C.

Condition C

Dry bulb temperature is less than (set temperature – 0.3°C) and the dew point of read values is lower than dew point temperature of set values.

Action: The internal evaporator is OFF; pump is ON & compressor goes to heat pump mode. The fan speed of external condenser is at 40%. If the dry bulb temperature is less than (set temperature – 0.5°C), the fan of external condenser is shut OFF. When this happens, the entire hot gas heat is going into the reheat coils 5 & 6. If the temperature is still not achieved after operation in this mode for 6 minutes, the emergency heaters come on.

After the set temperature and RH are achieved, switch OFF the emergency heaters and then the compressor OFF.

The timer setting of 6 minutes is site determined to maintain the temperature & RH in the stipulated band.

Restart the compressor only after a variation of 0.5°C.

Condition D

Dry bulb temperature is more than set temperature and the dew point of read values is lower than dew point of set values.

Action: Internal evaporator is ON; pump is ON & fan speed is at 100%

After the set temperature and RH are achieved, switch

compressor OFF.

Restart the compressor only after a variation of 0.5°C

Other Design Considerations

Room Construction

Since the tolerance limits on temperature & RH are close and the conditions are to be maintained 24×7 all year round, the room walls & ceiling are covered with vapor barrier treatment and insulation so that load variations due to ambient conditions are limited.

Isolation of the Incubation Rooms

To reduce the effect of variation in load due to ambient conditions and moisture ingress, the rooms do not have exposed walls. All rooms open into a common conditioned passage so that infiltration loads too are kept at a minimum.

Air Quantity

Since the tolerance limits on temperature & RH are close the air quantity is kept high so that the temperature variation due to change in load is kept low. Air quantity equivalent of 100 air changes was chosen for each room.

Water for Humidification

To avoid scaling DM water was used for humidification.

100% Standby

Because of 24×7 operations each incubation room is provided with a standby unit. These units cycle every eight hours. ♦

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