

Experiment(1)

Experiment name : Mechanical Heat pump.

Objectives: -To determine the COP and Tonnage capacity of a Mechanical Heat pump.

Apparatus Used: - Compressor, Condenser, Evaporator, Capillary Tube, Ammeter and Voltmeter

Name of device: Mechanical Heat pump

Theory: -

A mechanical heat pump is mechanical equipment which is used to supply the heat to the system, where it is installed, and maintain its temperature more than that of surrounding. Mechanical heat pump absorbs heat from surrounding (atmosphere). Work input to a heat pump is supplied by compressor. With reference to the fig.

Heat Q_2 is supplied to the room and temperature T_2 is maintained above the T_1 whereas heat Q_1 is absorbed by the surrounding. Hence performance of heat pump is given by

$$COP = \frac{Q}{P}$$

Where Q = heat removed from the system.

p = work supplied in compressor

Coefficient of performance of mechanical heat pump is the ratio of heat removed by it and work supplied i.e.

$$COP = \frac{Q}{W}$$

Where,

Q = heat removed

$W = m \cdot C_p \Delta T$ watts.

m = mass of water in heating (condensation) or cooling (evaporator) tank.

Heat Pump

C_p = Specific heat of water kJ / kg. K

ΔT = Initial and final temperature of water for unit time K.

W = Power consumer by compressor of unit time W . = energy meter reading

Technical Specification: -

Compressor = hermetically sealed of 1/3 T

Discharge pressure gauge = 0-3 - PSI

Suction pressure gauge = - 30-0-150 PSI

T_1 & T_2 are temperature of discharge suction side 0° C

T_3 and T_7 are temperature of water 0° C

T_2 , T_3 , T_5 and T_6 are temperature of inlet and outlet of heating and cooling coil.

Procedure: -

Fill measured quantity of water in condenser and evaporator banks and note down the initial temperature of tanks by means of selector switch as T_{4i} . Now note down the energy meter and switch on the power supply to compressor. Run the compressor for unit time (say 30 minute) and note down the change in temperature of T_{4f} and energy meter reading. Above procedure may be repeated for cooling coil also.



photograph A simple heat pump unit

Temperature sensor details: -

1. T_1 = Temperature Sensor: Fixed at Compressor Discharge Line
2. T_2 = Temperature Sensor: Fixed after Condenser
3. T_3 = Temperature Sensor: Inside hot water tank
4. T_4 = Temperature Sensor: fixed after capillary tube
5. T_5 = Temperature Sensor : Inside cold water tank
6. T_6 = Temperature Sensor : Fixed at Compressor Suction Line

S. no.	Time	T _{3i}	T _{4f}	Mass of water in condensation	Mass of water in evaporator	Energy meter reading

Calculation:

$Q = m.C_p \Delta T = \dots\dots\dots$ Watts

$W = \dots\dots\dots$ Watts

$COP = \frac{Q}{W}$

Precautions: -

1. Use stabilized power supply.
2. Drain the water from tanks after performing experiment.
3. When apparatus is no longer in use condense the refrigerant.
4. Use stop watch for time measurement.

Result: -

Questions: -

1. Explain the working principle of mechanical heat pump?
2. What is the COP of mechanical heat pump?
3. What is the difference between air conditioning and mechanical heat pump?
4. How the cooling and heating is done in mechanical heat pump?