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Performance Of Domestic Refrigerator Using Test Rig

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ABSTRACT

This work presents the development process of Refrigerator test ring and then carry-out the performance analysis of domestic refrigerator. The experiment platform which is called refrigerator test ring will be developed from refrigerator model. Performance of refrigerator also depends on inlet and outlet condition of each components. So in this research work refrigerator test ring will be developed and obtain performance of domestic refrigerator in term of Refrigeration Capacity, Compressor Work and Coefficient of Performance (COP) by determining two important parameter during operating condition which are temperature and pressure.

Keywords: COP, Capacity, Work, temperature, pressure.

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I. INTRODUCTION

Refrigeration is defined as the process of removing heat from a body or enclosed space so that the temperature first lowered and then maintained at level below the temperature of surrounding. The equipment used to maintain the required temperature is called refrigerating equipment. Refrigerator is a cooling appliance comprising a thermally insulated compartment and a refrigeration system is a system to produce cooling effect in the insulated compartment .Mean while, refrigeration is define as a process of removing heat from a space or substance and transfers that heat to another space or substance. Now a days, refrigerators are extensively used to store foods which deteriorate at ambient temperatures; spoilage from bacterial growth and other processes is much slower in refrigerator that has low temperatures. In refrigeration process, the working fluid employed as the heat absorber or cooling agent is called refrigerant. The refrigerant absorbs heat by evaporating at low temperature and pressure and remove heat by condensing at a higher temperature and pressure. As the heat is removed from the refrigerated space, the area appears to become cooler.

II. PPROBLEM STATEMENT

Refrigerator is widely used in the world, Hence the actual performance of the refrigerator must be known. By comparing actual and theoretical performance we can improve the efficiency of refrigerator.Nowadays, refrigeration system is important in a wide variety used for domestic application. However, the actual performance of the refrigerator is need to be checked from undergraduate student level to develop test rig, to analyze the actual performance of refrigerator.

As refrigeration has become one of the basic needs to modern people, it is important to know the actual working principle of the domestic refrigerator so that the users can always maintain the refrigeration system at its maximum performance. Therefore by understanding the working principle of the refrigeration system, it will allow the users to make the best use of the domestic refrigerator without wasting any electricity and materials used. There are 2 problem statements in this project, first is that study is needed to analyze the actual performance of refrigerator and second, is to determine the optimum COP by using different quantities of refrigerant charges on the improved previous developed refrigerator test rig.

III. EXPERIMENTAL SETUP

The all four temperatures of point of thermocouple wire are connected to thermocouple scanner. The thermocouple is there to measure temperature at particular point. Behind the test rig panel pressure gauge is connected on suction side and discharge side of compressor to measure the pressure at inlet and discharge .The data was recorded at time interval.

Experimental procedure

Put the machine in proper position where its level is vertical position and machine must have at least 1.5m clearance from all sides.

Apply power supply to switch.

- Put the main switch ON.
- Start the refrigerator.
- Put heater ON.
- Run the system for minimum 1 Hour.
- Record all readings as per table.
- Not down readings by interval.

LOAD	LOW	MEDIUM	HIGH
T1	-4.0	-8.40	-6.50
T2	76.0	86.0	90.63
T3	49.0	54.57	53.0
T4	-10.0	1.50	4.80
SUCTION PRESSURE	11=0.758	15=1.03444	17=1.172
DISCHARGE PRESSURE	325=22.4135	380=26.203	410=28.21
TIME FOR 10 PULSES	90 sec	86 sec	80 sec
V	120V	145V	180V
I	0.210	0.260	0.320
Q =(V*I)	25.21	37.7	57.62

I. OBSERVATION TABLE

IV. CALCULATION

T1=After Evaporation
T2=After Compression
T3=After Condensation
T4=After Expansion
The load varies from 37.7 watt
Suction pressure = 15psi =1.034 bar
Discharge pressure = 380psi = 26.206 bar
Time for 10 blinks = 86 sec
V = 145
I = 0.26
Q = V * I = 37.7 watt
Work of compressor
Wact = (10/3200)*(3600/time required for 10 blinks in sec)
Wact=130 watt
Actual COP
COPact = Q/Wact = 0.29

Theoretical COP = (h1-h4/h2-h1) COPth = Qact/Wact =1.8954
Carnot COP
COPcarnot = (T lowest) / (T highest-T lowest)=2.803
Relative COP = COPact / COPth =0.103

EER = 3.412 * COP act = 0.9894
SEER=1.12-[(1.2544-0.08*EER)^1/2 /(0.04)]
SEER =3.6734

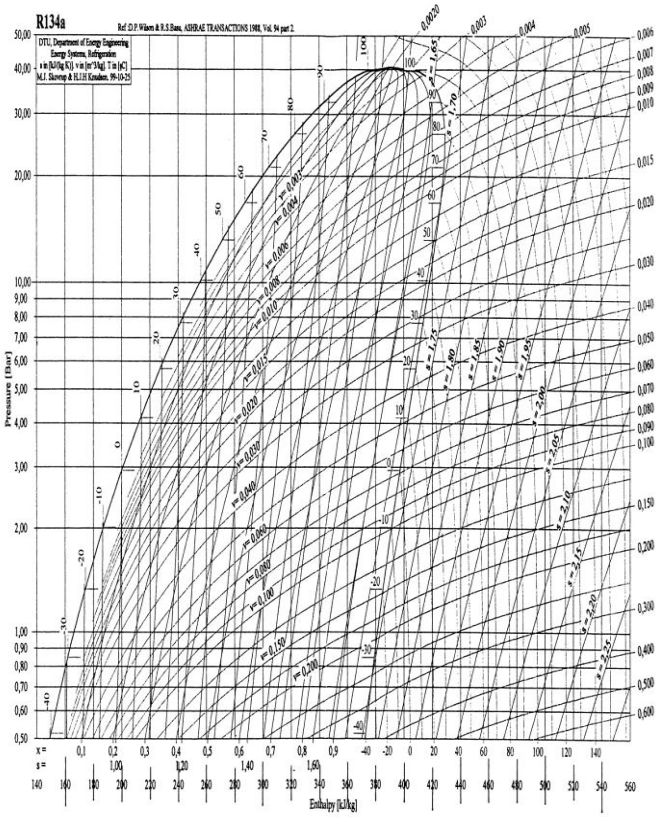

Fig. P-H chart

V. RESULT TABLE

LOAD	LOW	MEDIUM	HIGH
RE act	25.2	37.7	57.6
W act	125	130.8	140.6
COP act	0.202	0.288	0.41
H1	386	245.72	246.92
H2	440	306.93	312.29
H3=H4	263	129.6	127
RE th	123	116.12	119.92
W th	54	61.21	65.37
COP th	2.2777	1.8970	1.8344
T lowest	269	264.6	266.5
T highest	349	359	363.6
COPcarnot	3.363	2.803	2.745
COPrel	0.0885	0.1519	0.2233
EER	0.6892	0.9834	1.3978
SEER	0.6227	0.8915	1.2782

VI. CONCLUSION

In low load condition the actual COP is minimum that is 0.202 and theoretical COP is 2.2777.

- The Carnot COP in low load condition is 3.363.
- The difference between Actual COP and Theoretical COP is very large.
- This process is same in Medium load and High load condition .

Besides that, test rig development method that has been presented in this work was plays important role in order to investigate the performance of the refrigerator. The correct data from experiment can be produced from a reliable test rig as such presented and the method must be parallel with high skill of work and reliable measurement devices.

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