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ABSTRACT

A computer simulation program was developed to model the performance of a side-by-side refrigerator-freezer unit. The program, which employs a quasi steady-state model, is able to predict the refrigeration capacity, compressor power consumption, on cycle time and off-cycle time of the freezer and refrigerator cycles to within 6% accuracy (maximum deviation from the measured value). To enable an accurate prediction of the parameters in the model, the program relies on the input of, among others, the overall heat transfer coefficient-area product (UA) of the condenser and evaporators in the system. Since the UA values of these heat exchangers were not readily available from the refrigerator manufacturer, a set of experiments was performed to measure them. The scope of this experiment was later broadened by performing the UA measurements over a range of different airflow rates to allow a study on the accurate sizing of these heat exchangers.

Using this computer program, a number of proposals with the potential of enhancing the performance of the system were evaluated. Specifically, the benefits of mechanical subcooling and the advantages of using a two-stage system as opposed to the present two single-stage cycles were investigated. In addition to these proposals, a detailed study was also conducted on the benefits of using suction-line heat exchangers and the use of mullion tubes to prevent sweating on the outer surfaces of the refrigerator cabinet; suction-line heat exchangers and mullion tubes are currently installed in this refrigerator. In the study of mullion tubes, a comparison was made between the use of these tubes and electric heaters to determine the more economical method to prevent

sweating. The results of these studies are ranked according to their potential in the table below.

Proposal	Savings in Total Energy Consumption (%)
Freezer suction-line heat exchanger	8.3%
DC fan in the freezer evaporator	6.0%
Refrigerator suction-line heat exchanger	5.4%
DC fan in the refrigerator evaporator	2.8%
Two-stage cycle	2.6%
Increasing freezer evaporator UA	2.0%
Mechanical subcooling	1.0%
Mullion tubes	If freezer heater > 19 Btu/hr and refrigerator heater > 7 Btu/hr

Table A.1 The estimated impact of each proposal on the performance of the system.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES