

Brooklyn Union Verification Correspondence
&
Commercial Refrigeration Test Results

Commercial Refrigeration Unit Test Results as verified by Brooklyn Union (see Appendix A)

Test Conducted
at
Key Food Supermarket

OVERVIEW

This report gives the results of an extensive series of tests of the ThermoMi\$er™-RU energy economizing device for commercial refrigeration. The test site was a Key Food Supermarket store located at 73-01 37th Avenue, Jackson Heights, New York. The results presented in this report were obtained during the period from June 16, 1997 to January 31, 1998. Testing was performed on two different freezers, a walk-in storage freezer driven by a 3-HP compressor and a 12-door upright display-case freezer driven by a 7-HP compressor.

Preliminary testing, performed on the walk-in storage freezer, for the month of April 1997 had shown that the compressor run-time was significantly reduced when using the ThermoMi\$er™-RU. This promising result led to an expanded and more formalized testing program. First, to expand the test, a second ThermoMi\$er™-RU was installed on a 12-door upright display-case freezer. Secondly, in order to obtain independent validation of the tests, Brooklyn Union, who during prior meetings expressed interest in the product, was approached and agreed to oversee the testing. This oversight started on June 16, 1997. At Brooklyn Union's request, electric consumption metering was added to the walk-in freezer.

The results obtained under Brooklyn Union's supervision (see Appendix A), show that the ThermoMi\$er™-RU reduces electric consumption significantly (18.6% for the walk-in freezer and 14.6% for the 12 door display-case freezer). Additional results obtained through Feb. 13, 1998 further verify these savings.

Using an average cost of \$.0954/kWh as calculated from electric bills for this store; Intellidyne estimates that the annual cost savings, attributed to the ThermoMi\$er™-RU, would be \$436 for the walk-in storage freezer and \$679 for the 12-door display-case freezer.

TEST CONDITIONS

CONTROL DEVICE: ThermoMi\$er™-RU

FREEZER 1

FREEZER TYPE; WALK-IN STORAGE FREEZER

FREEZER COMPRESSOR: 3 TON (APPROX. 36,000 BTU/hr), 3.2 kW ELECTRIC

FREEZER COMPRESSOR CONTROL; THERMOSTAT

FREEZER 2

FREEZER TYPE; 12-DOOR DISPLAY-CASE FREEZER

FREEZER COMPRESSOR: 7 TON (APPROX. 84,000 BTU/hr), 5.5 kW ELECTRIC

FREEZER COMPRESSOR CONTROL; PRESSURETROL

TEST PROCEDURE

The ThermoMi\$er™-RU's were wired in series between the compressor control and the compressor contactor. To measure the differences in performance both with and without the ThermoMi\$er™-RU, the units were wired to be "in circuit" and "out of circuit" on alternate days. The days when the ThermoMi\$er™ is "in" and "out" of the circuit, is alternated via a time clock.

For each freezer, electric run-time meters were installed to record the cumulative "on" time of the freezer's compressor. There are separate meters dedicated to recording compressor run-time for the ThermoMi\$er™ "in circuit" days and the "out of circuit" days (i.e. all "in circuit" days will be recorded on one meter, all "out of circuit" days recorded on the other). Upon Brooklyn Union's involvement in the test program, additional metering of electric consumption (kWh) was installed on the walk-in freezer. Again, separate meters are used to make measurements on "in circuit" and "out of circuit" meters.

To monitor the space temperatures in each freezer, Omega Engineering data loggers are used to record the temperatures within the freezers. These data loggers store up to 1,800 measurements consisting of the date, time and temperature. During the tests reported here, measurements were made at intervals of either 12 or 16 minutes depending on the site visit schedule. Approximately 10,000 measurements were made for each freezer during the course of the testing.

At periodic intervals, the Brooklyn Union test engineer made site visits and manually recorded the values of the compressor run-times and kWh consumption. When necessary the freezer temperature data loggers were removed for data analysis and replaced by new ones. Brooklyn Union was provided with all the data in Jan 1998 for final review.

RESULTS OF TESTING:

The test results, as validated by Brooklyn Union (see Appendix A), show that the ThermoMi\$er™-RU energy economizing device leads to significant reductions in electric consumption. For the walk-in storage freezer, the energy consumption was reduced by 18.6%. For the larger 12-door display-case freezer, the savings were 14.6%.

Using the totalized test data from the “in circuit” and “out of circuit” meters for each compressor, the average daily reduction in power consumption, due to the action of the ThermoMi\$er™-RU, was found to be 12.52 kWh per day for the 3-HP walk-in freezer unit and 19.50 kWh per day for the 7-HP 12-door display-case freezer. These savings were found to be very consistent from month to month.

To convert these savings in power consumption into cost savings, Intellidyne analyzed two years worth of electric bills for this supermarket. Because a month by month comparison of the two years of data showed that the monthly power consumption varied in a somewhat random manner, an average rate for electricity was computed from the totals of all bills. This average rate of \$0.0954/kWh was then used to estimate the annual savings which will occur when a ThermoMi\$er™-RU is installed on a given freezer. Based on this rate, the ThermoMi\$er™-RU would reduce electric bills by \$436 per year for the walk-in freezer and \$679 per year for the 12-door display-case freezer. The results are summarized in the Table below and illustrated in Figures 7 and 8.

Freezer Unit	% Reduction in Power Usage due to ThermoMi\$er™-RU	Annual Power Savings due to ThermoMi\$er™-RU	Annual Cost Savings due to ThermoMi\$er™-RU (@ \$.0954/kWh)
Walk-in Freezer 3-HP Compressor	18.6%	4569.8 kWh	\$435.96
12-Door Upright 7-HP Compressor	14.6%	7117.5 kWh	\$679.01

Summary of Test Results

In addition to the power consumption data, the recorded space temperature data was analyzed to ascertain if there was any effect on the freezer temperatures due to the ThermoMiSer™-RU. Due to the random nature of the usage and loading patterns of these freezers, a detailed statistical analysis was performed. The results are presented in Figures 1 through 6.

Figures 1 through 4 are histogram plots that show the percentage of time that the freezer temperature fell within one of a set of 2-degree “bands” (as indicated by the width of the bars in the plot). The data presented includes the defrost cycles of the freezer. Examination of these plots shows no meaningful differences between the ThermoMiSer™ “on” and “off” data for either freezer. The higher temperatures and lower percentages for the walk-in freezer compared to the 12-door display-case freezer are due to the fact that the compressor is automatically turned off when the door is opened on the walk-in, thus the temperature swings during loading and unloading are large. In addition, the defrost cycle on this freezer occurs more frequently than for the 12-door display-case freezer leading to larger temperature excursions in the space.

In addition to the histograms, the probability of exceeding a given space temperature was computed for the “on” and “off” days of each freezer. This data is presented in Figures 5 and 6 and again shows that there is no meaningful differences of the freezer space temperatures due to the action of the ThermoMiSer™-RU

CONCLUSIONS:

1. During the testing period, as verified by Brooklyn Union, the actual reduction in power consumption achieved using the ThermoMiSer™-RU was 18.6% for the 3-HP walk-in freezer and 14.6% for the 7-HP, 12-door display-case freezer.
2. Based on the average rate for electric power as calculated from two years worth of electric bills, the ThermoMiSer™-RU would reduce the annual cost of energy by \$436 for the walk-in freezer and \$679 for the 12-door display-case freezer
3. A statistical analysis of the data gathered from the freezer space temperature data loggers verifies that the operation of the ThermoMiSer™-RU caused no meaningful change in the test freezer’s space temperature.

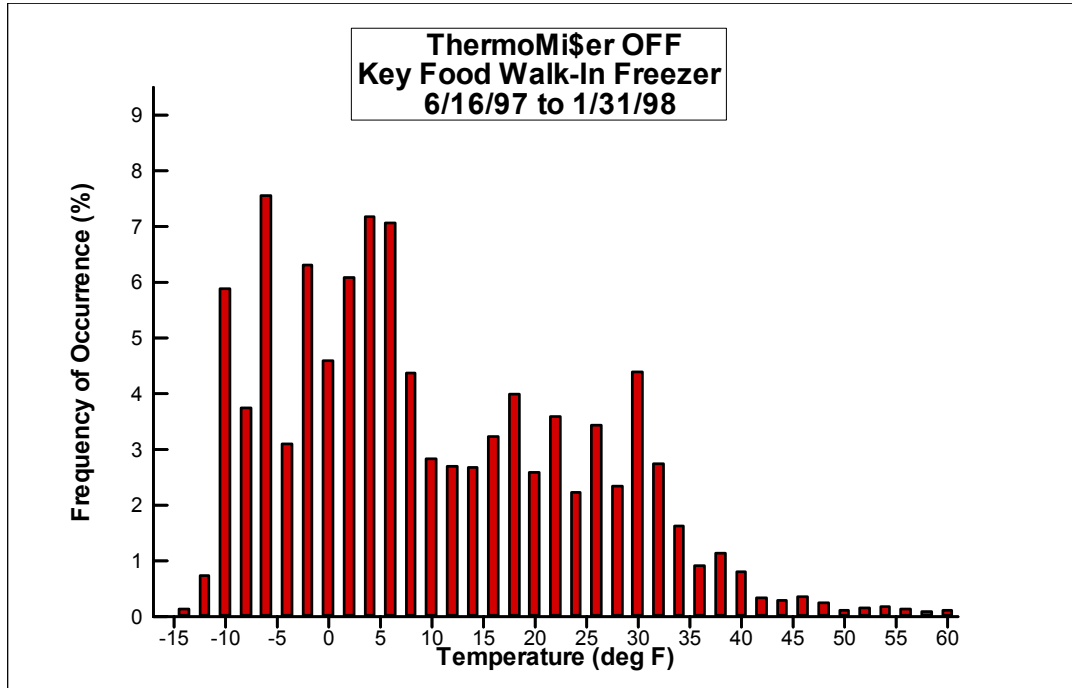


Figure 1 - Frequency of Temperature Occurrence Without ThermoMi\$er™ – Walk-in Freezer

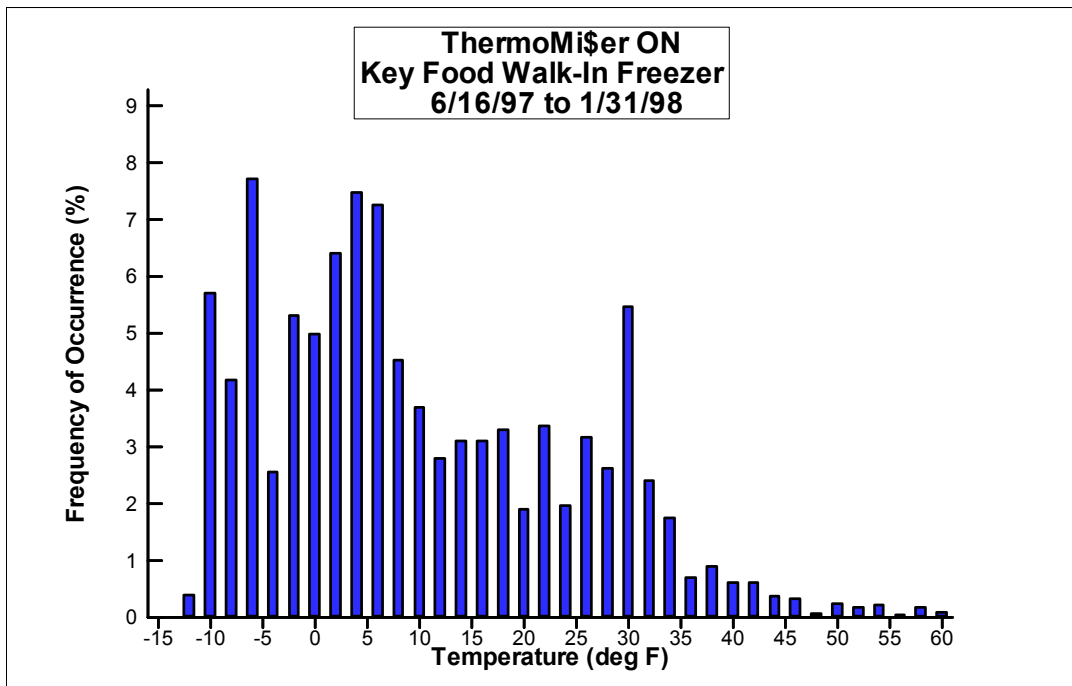


Figure 2 - Frequency of Temperature Occurrence With ThermoMi\$er™ – Walk-in Freezer

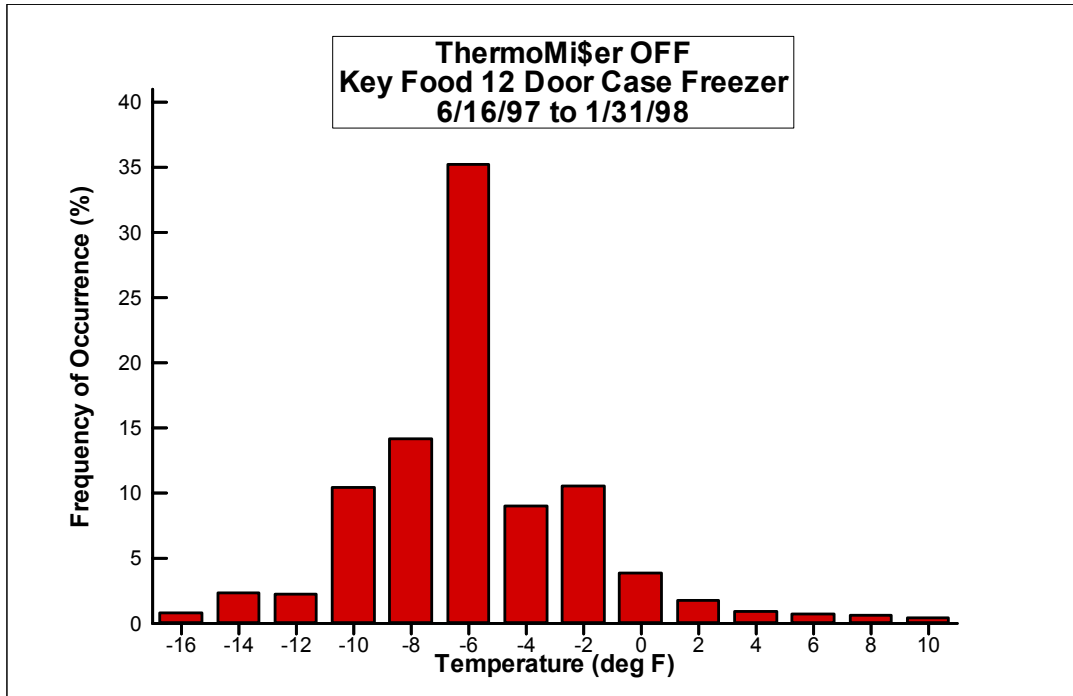


Figure 3 - Frequency of Temperature Occurrence Without ThermoMi\$er™ – 12 Door Freezer

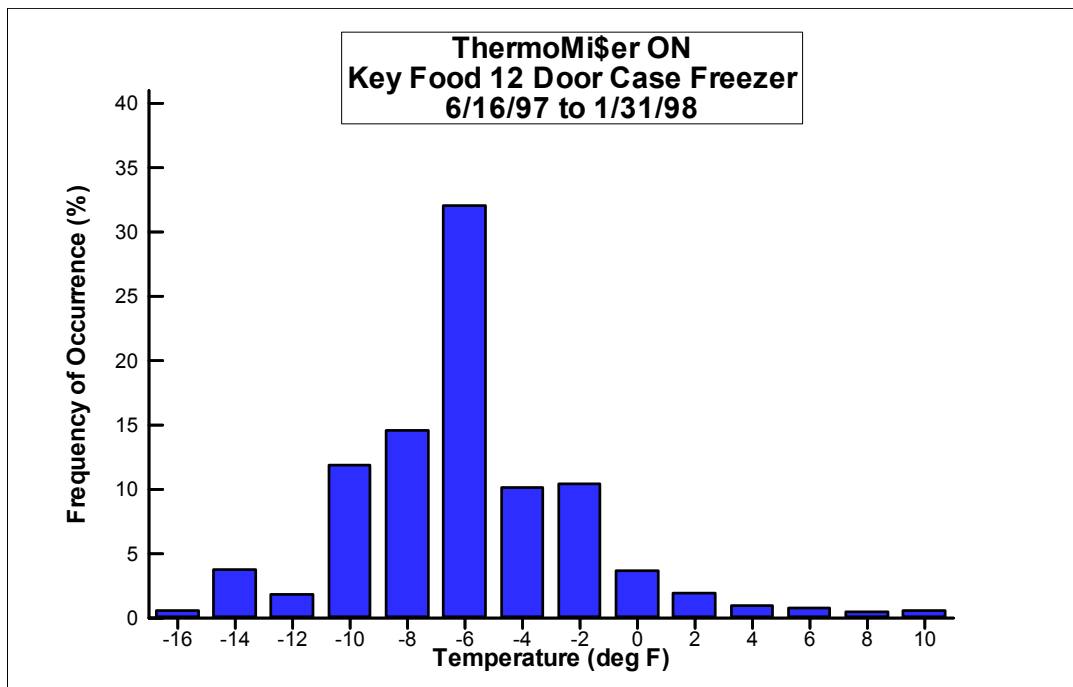


Figure 4 - Frequency of Temperature Occurrence With ThermoMi\$er™ – 12 Door Freezer

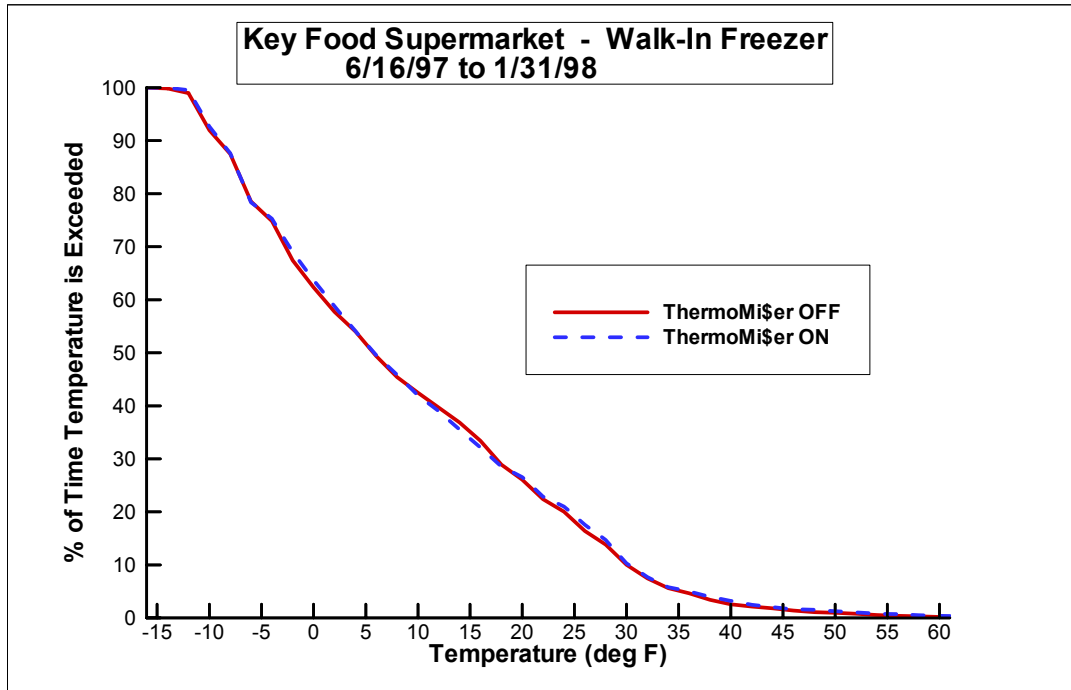


Figure 5 - Comparison of Temperature Probabilities – Walk-in Freezer

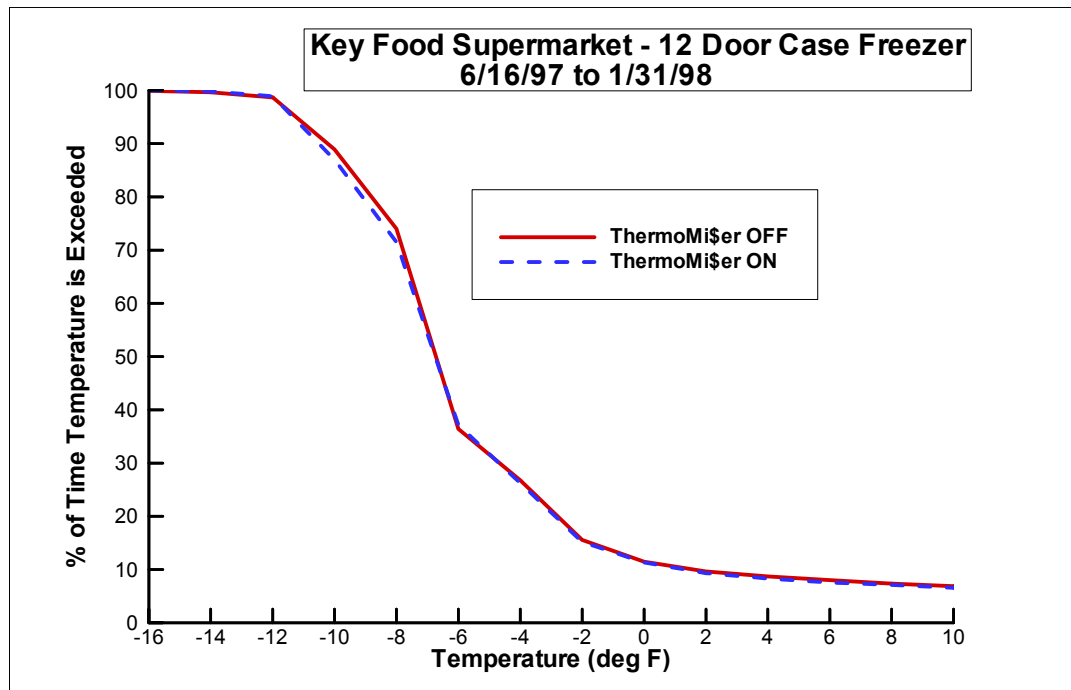


Figure 6 - Comparison of Temperature Probabilities - 12 Door Freezer

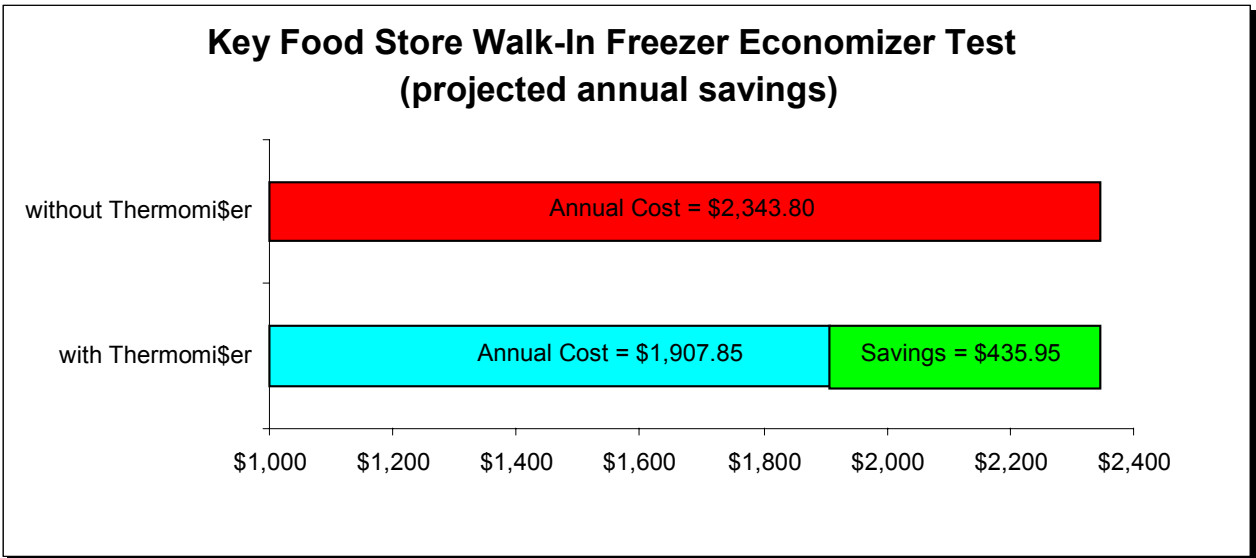


Figure 7 – Walk-In Freezer Projected Annual Savings

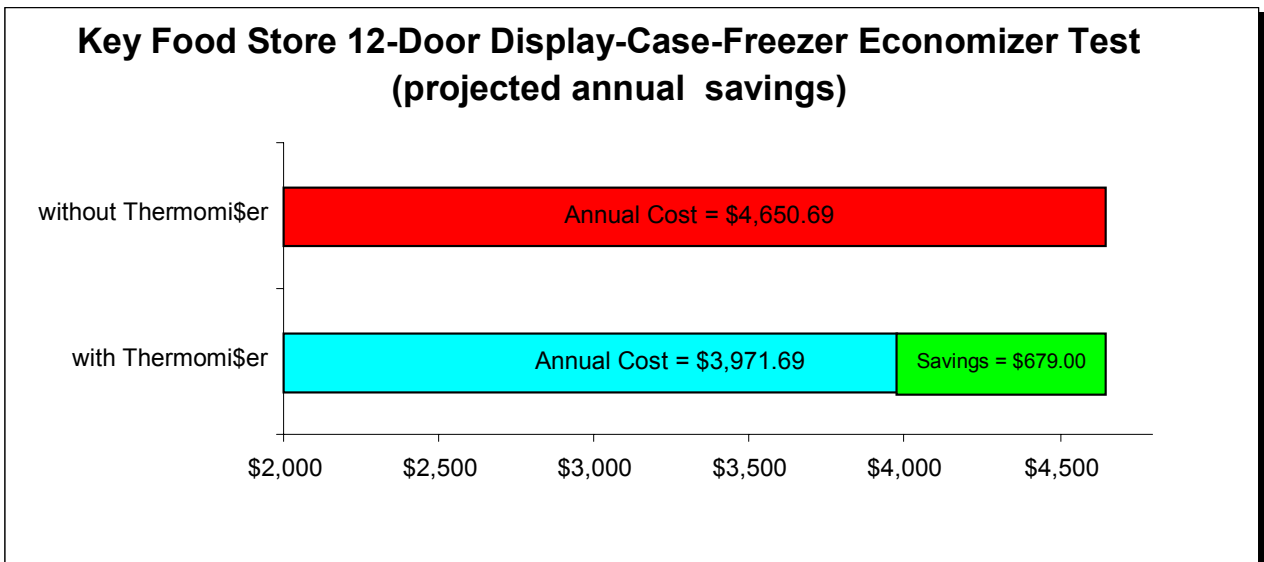


Figure 8 – 12-Door Display-Case-Freezer Projected Annual Savings

APPENDIX A

Validation Results from BROOKLYN UNION



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Steven A. Vitale, P.E.
General Manager
Engineering & Research Services

January 28, 1998

Mr. Jack Hammer
Intellidyne LLC
2973 Brentwood Court
Wantagh, NY 11793-4522

Dear Mr. Hammer:

I am writing this letter to report the results of our validation of the testing of the ThermoMi\$er™-RU commercial refrigeration energy economizing device. After consultations between Intellidyne and Brooklyn Union in early June 1997, Brooklyn Union agreed to provide independent validation of the tests. To perform this task, Brooklyn Union engaged the services of Mr. Michael Riordan of Engercon. Mr. Riordan is a licensed professional engineer and former Brooklyn Union employee.

The tests were conducted on units installed in a Key Food Supermarket located at 73-01 37th Avenue, Jackson Heights, New York. Two ThermoMi\$er™-RU units were installed. One was on a 3 HP compressor cooling a walk-in storage freezer. The second unit was installed on a 7 HP compressor cooling a twelve-door upright case freezer.

To obtain measurements both with and without the ThermoMi\$er™, each of the units was set up with a time dock control to electrically disconnect the ThermoMi\$er™ on alternate days. Separate elapsed run-time meters were used to record the integrated compressor run-time for the off and on days. In addition, in order to verify the correlation between compressor run-time and electric consumption, Brooklyn Union requested that electric power consumption also be measured on one of the freezers. To this end, separate measurements of total kilowatt-hours for the ThermoMi\$er™ on and off periods were recorded on the walk-in freezer. In addition, the temperatures in each freezer were also recorded using data loggers to determine if there were any effects due to the operation of the ThermoMi\$er™.

The tests were observed during the four-month period from 6/16/97 to 10/8/97. Mr. Riordan made six separate site visits and manually recorded the readings of the run-time and power consumption. At the end of the tests he also examined the freezer space temperature time histories obtained from the data loggers. The results of the tests are as follows:

1. For the walk-in freezer, the measured reduction in power consumption due to the ThermoMi\$er™ was 18.6%. This correlates directly with the reduction in run-time of 18.4%.
2. The ThermoMi\$er™ reduced compressor run-times by 18.4% on the 3 HP walk-in freezer compressor and 14.6% on the 7 HP compressor of the twelve-door upright case freezer. This corresponds to a savings in power consumption of 12.52 kWh/day for the 3 HP compressor and 19.50 kWh/day for the 7 HP compressor.
3. Analysis of the freezer temperatures recorded by the data loggers in both freezers shows that there are no statistically significant differences between the freezer temperature patterns with and without the ThermoMi\$er™ operating.



Mr. Jack Hammer
Intellidyne LLC

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It is clear from the test results that using the ThermoMiSer™ reduces energy consumption significantly. From the measured data, obtained both with and without the ThermoMiSer™, the average daily reduction in power usage due to the ThermoMiSer™ was found for each of the compressors tested. Projecting this usage based on a 365 day year, the annual savings in power for each compressor, due to the action of the ThermoMiSer™, would be as shown in the table below:

	% Reduction in Power Consumption Due to ThermoMiSer™	Daily Reduction in Power Used (kWh/day)	Annual Power Savings (kWh/year)
Walk-in Freezer 3 HP Compressor	18.6	12.52	4569.8
12 Door Upright 7 HP Compressor	14.6	19.50	7117.5

If there are any questions concerning this data, please feel free to contact us.

Yours truly,

A handwritten signature in black ink that reads 'Steven Vitale'.

Steven A. Vitale
General Manager
Engineering & Research Services

SAV/bjg