

embraco

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**ENERGY EFFICIENCY
IMPROVEMENT IN
LIGHT COMMERCIAL
REFRIGERATION
SYSTEMS**

— CASE STUDY






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ABOUT THE COMPANY

Embraco is a global market and technological leader in hermetic compressors for refrigeration, with a clear mission to provide innovative solutions for a better quality of life. As one of the pioneers in the development of environmentally friendly products, Embraco reinforces its commitment to global sustainability by offering a full range of high efficiency compressors and condensing units.

With factories in Brazil, Italy, China and Slovakia and a production capacity of 36 million compressors per year, Embraco is a truly global company. Embraco produces electronic systems to make intelligent household and light commercial appliances.

Energy efficiency improvement in light commercial refrigeration systems

INTRODUCTION

The main purpose of this case study is to promote the use of hydrocarbon (HC) refrigerants and variable speed compressor technology in light commercial refrigeration systems by demonstrating the simplicity, as well as the benefits, of substituting HFCs refrigerants with hydrocarbons. To show this, the case study will analyze the substitution of a HFC compressor with a conventional on-off HC compressor as well as the switching of an compressor with variable cooling capacity using propane for a conventional HFC compressor. All information presented in this article comes from actual measurements of selected appliances.

Both studies presented here represent energy consumption levels of plug-in vertical freezers. The first example is a glass-door vertical freezer with 14 cuft of internal volume and the second one is a solid door vertical freezer manufactured from stainless steel with an internal volume of 20 cubic feet; both are used as cooling equipment for retail stores, supermarkets and restaurants. The original configuration of the selected systems were manufactured with Embraco compressor models NT2178GK and NEK2150GK using R404A and R507 refrigerant respectively. The condensers and evaporators both utilize fans, so both heat exchangers have forced air circulation. A standard capillary tube is used as the expansion device and the control unit of both systems is a standard electronic thermostat with a temperature range from 14°F to -13°F. Both systems are designed to climate class 4.

SUMMARY

R290 was selected as a substitute for the original refrigerants R507 and R404A. Propane is a natural refrigerant with a minimal environmental impact and possesses good physical properties for this type of application. The configurations of all refrigeration systems tested were almost identical, without any component change. Condensers, evaporators, piping, fans and all other components remain the same, except in the case of the glass-door freezer where high efficiency fan motors and LED lighting were installed. The same thermostat can be used again. For this comparative testing, compressors and filter dryers obviously have been changed. Refrigeration systems were tested in an environmental chamber. Temperature stability of the chamber was $\pm 0.9^{\circ}\text{F}$. Relative humidity during the testing was $\pm 3\%$ from set point. Placement of the refrigeration system during the test has been defined by the standard. Accuracy of the data acquisition system for temperature was $\pm 0.54^{\circ}\text{F}$, for pressure 0.2% and all electrical values were measured with accuracy 1%. All results from measurements are listed in Tables 1 and 2.

TABLE 1. RESULTS OF GLASS DOOR VERTICAL FREEZER TESTING

	HFC	HC
Compressor	NT217BGK	NT21T70U
Compressor Type	on-off reciprocating	on-off reciprocating
Refrigerant	R404A	R290
Ambient temperature / Rel. humidity	86°F / 55 %	86°F / 55%
Refrigerant charge	14oz	4.8oz
Thermostat setting	62.6°F	62.6°F
Energy Consumption per 24 hours	14.400 kWh	8.219 kWh(*)
Energy consumption comparison	Reference	-42.9%

OPERATIONAL COST FOR END USER

Data from measurements can be used to predict operational costs of each specific system. Service and maintenance costs are not included in this

calculation.

RESULTS

From the analysis presented in this article, it is clearly demonstrable that systems using HC refrigerants show an improved performance in all parameters. System energy consumption and environmental impact have been significantly decreased. There is an energy consumption reduction from 37.5 % to 42.9% respectively when using VNEK213U and NT2170U and carbon dioxide emission reduction in the range 41 – 46% that represents an excellent option to meet future energy regulations.

TABLE 2. RESULTS OF SOLID DOOR VERTICAL FREEZER TESTING

	HFC	HC
Compressor	NEK2150GK	VNEK213U
Compressor Type	on-off reciprocating	variable speed recipro
Refrigerant	R507	R290
Ambient temperature / Rel. humidity	86°F / 55 %	86°F / 55%
Condensing temperature	109°F	98.4°F
Evaporation temperature	- 11.7°F	-14.3°F
Refrigerant charge	14.8 oz	3.9 oz
Power (before turn off of the compressor)	606.2W	384.7W
Thermostat setting	62.6°F	62.6°F
Energy consumption per 24 hours	13,829 kWh	8,641 kWh





Get in touch with shecco's Market Development team to learn more about the market for natural refrigerants in North America or find out how we can help you in gathering market intelligence and proactively building your business with our tailored market development services, to get your technology faster to market.

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