

## Case Study of Adding Glass Doors to Multi-Deck Meat Case

### Project Summary

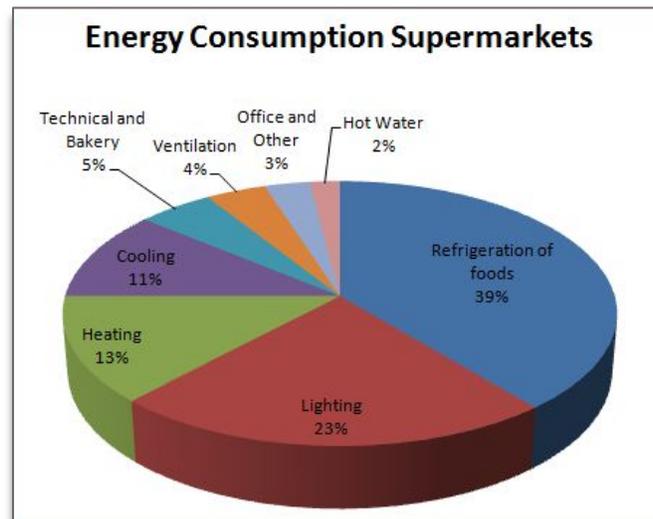
Two 8' multi-deck meat cases were installed and refrigerated in the Hillphoenix case laboratory. After confirming identical operating performance, one case was retrofitted with Anthony glass doors, and both cases were fully loaded with meat. The case with doors measured an 80% lower refrigeration load, and 71% lower total energy. The shelf life of the steak was extended by three days, and the ground beef by one day.



### Insight

Retailers are looking to save energy, and provide fresher products for their shoppers. Studies have shown over 39% supermarket energy is consumed by refrigeration, 23% by lighting, and 13% by heating. Open multi-deck display cases, dumping

cold air into the aisles, with traditional fluorescent lighting, are major consumers of supermarket energy.



The open multi-deck merchandiser is typically used to display fresh meat. Meat is one of the highest revenue departments in the supermarket, but also has the highest shrink rate. Typically, supermarket retailers experience a shelf-life of about four days for steak, and two days for ground beef. After these times, the meat has shifted in

color from bright red to dark red or brown, and shoppers feel it is no longer fresh. Myoglobin is the protein in the meat that is responsible for this bright red color. While many factors can effect color change (packaging, vitamin E, etc.), one of the largest contributors to color shift in fresh red meat is temperature.

## **Procedure**

For this study, two identical Hillphoenix O5DM-8 cases were refrigerated in the Richmond, Virginia laboratory, following the standard ASHRAE 72 test procedure for commercial refrigerators. After confirming identical temperature and energy performance with product simulators, one of the cases was retrofitted with Anthony glass doors with LED lights. Fluorescent canopy lights were turned off, expansion valves were adjusted, and the temperature and energy measurements were repeated. Performance was measured initially without changing the evaporator temperature or defrost frequency, and then again after raising the temperature and decreasing the defrost frequency.

After taking the case temperature and energy measurements, the ASHRAE simulators were removed and the cases were loaded with fresh red meat. A selection of both steaks and ground beef were prepared for the test. The product was machine-sliced and ground the morning of the test by a local supermarket, from a vacuum-packed carcass. The product was then transported in coolers for about 20 minutes, where it was immediately placed in the refrigerated display cases. Each day, two steaks and two ground beef packages were removed from the refrigerator and photographed to assess color shift and judge shelf-life.

## **Results**

Table 1 compares the performance of the open case, to the case after it was initially retrofitted with doors. The case heat load dropped 79%, from 1576 to 330 BTUH/ft. With such a large load reduction, some of the product temperatures were below freezing, so the evaporator temperature was raised 6 °F to achieve similar maximum product temperatures as the open case. Additionally, due to the reduced latent load, the defrost frequency was reduced from 6 times per day to 2 per day, to benefit the meat shelf-life in the next phase of the testing. These final adjustments resulted in a total load reduction of 80%, and 71% lower total energy.

Table 2 compares the color shift of the steak in the open case vs. the closed case. After four days, the steak from the open case is beginning to get darker and more brown, while the steak from the case retrofitted with doors is bright red after seven days.

Similarly, Table 3 compares the color shift of ground beef in the open case vs. the closed case. After two days, the ground beef from the open case was darkening and beginning to turn brown, while the ground beef from the closed case was still bright red.

Table 1. Open Case vs. Door Case Performance

Open Case vs. Retrofitted Door Case Performance				
Case Configuration		O5M8 NRG without Doors	O5M8 NRG with Doors	O5M8 NRG with Doors
		Angled Shelves with Mirror	Same Evaporator Temp and Defrosts	Higher Evaporator Temp and Lower Defrosts per Day
Performance Factors	Average Product Temperature	33.5	30.4	36.6
	Maximum Product Temperature	39.3	32.8	38.3
	Evaporator Temperature	23.3	23	30.9
	BTUH/ft	1576	330	315(80% lower)
	kWh(per day)	33.3	9.7	9.6(71% lower)
	\$/year @ \$0.12/kWh	\$1459/yr	\$425/yr	\$420/yr
	Def/Day	6	6	2

Table 2, Steak Color Shift Comparison

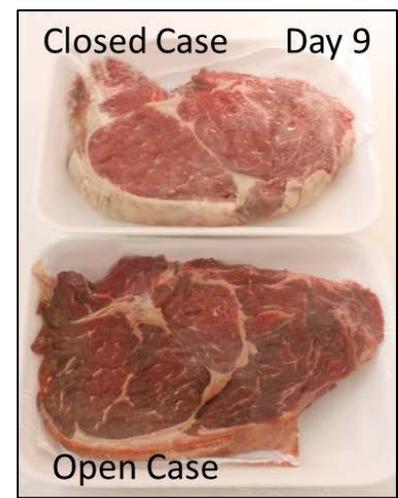
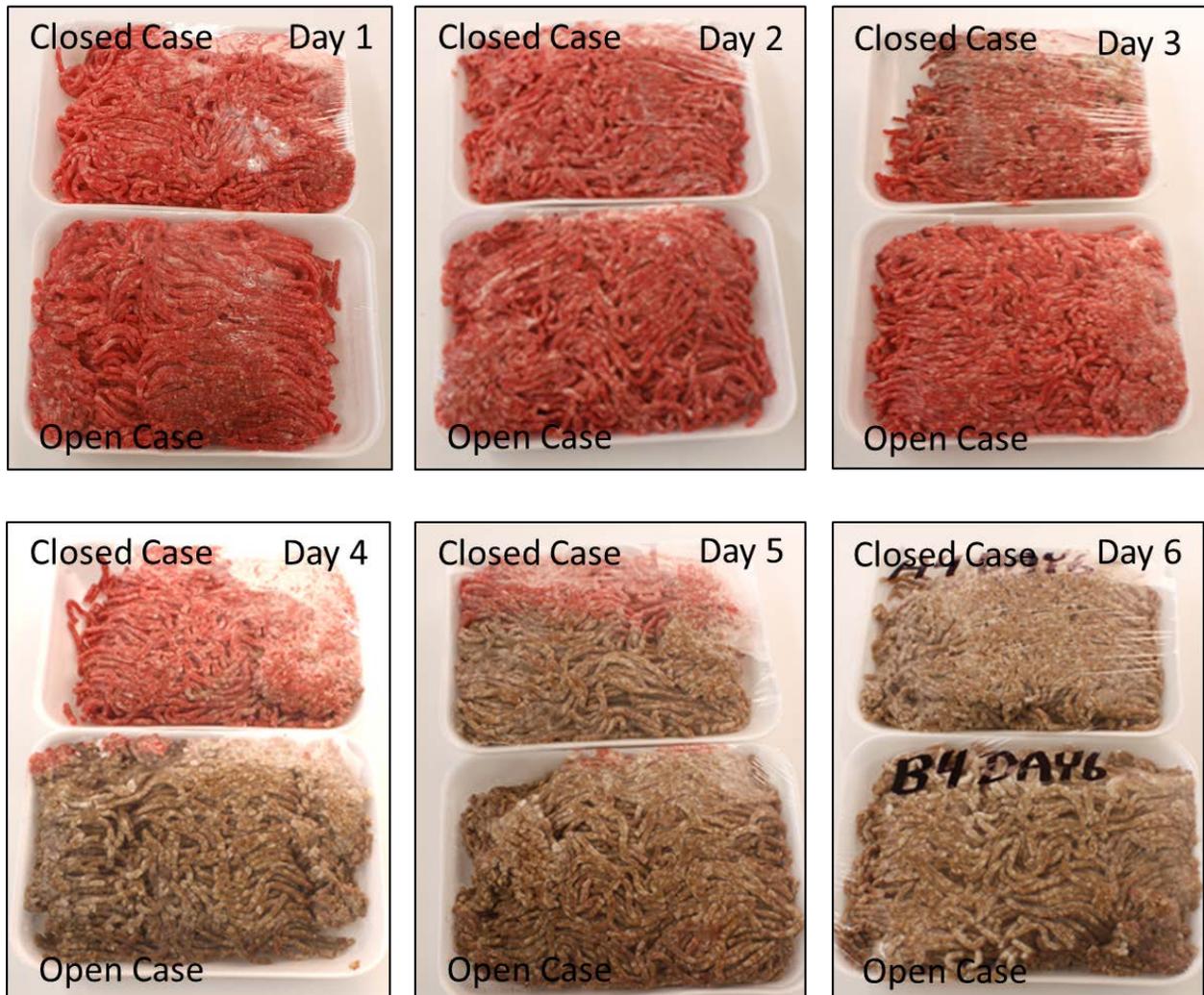


Table 3, Ground Beef Color Shift Comparison



## CONCLUSIONS & RECOMMENDATIONS

This test demonstrated under controlled laboratory conditions, that adding doors to open cases can reduce the load by 80%, and total energy consumption by 71%. Additionally, the more uniform and stable temperatures resulted in shelf life extension on fresh red meat by several days. The additional energy savings from raising the evaporator temperature was negligible, unless the overall rack suction temperature could be raised. However, this step is necessary and recommended to prevent freezing the products.