



“Nearly 20% of GLOBAL energy is used by Refrigeration”

How refrigeration units work

Refrigeration units work in a series of cycles. This is when the unit starts and stops to maintain the required storage temperature. Air cycles (on/off) typically produce a minimum of 12 cycles per hour and, in some open display cases, 20 cycles per hour.

Refrigeration units usually monitor circulating air temperature in order to decide when to switch on and off. However, circulating air temperature tends to rise quickly, far more quickly than food temperature and, as a result, refrigeration works harder than necessary to maintain stored products at the right temperature. This in turn leads to excessive electricity consumption and undue wear and tear on the equipment.



How the eCube works

The eCube consists of a food simulant contained in a double-skinned enclosure. The food simulant mimics food temperature at around 10mm below the surface. It is like having your thermostat regulating the temperature by the temperature of the yogurt, instead of the air temperature. Due to its specific design, the eCube ensures that refrigeration keeps food at the correct temperature.

When fitted to the thermostat sensor, which controls the compressor, the eCube significantly reduces the frequency of the refrigeration cycles as they are now based on food temperature rather than fluctuating air temperature.

By using the eCube as a cycle control mechanism, refrigeration cycles last longer but can be reduced by as much as 80%.

For example, a Dairy Case air cycles 3 minutes on, 2 minutes off = 12 cycles per hour. With an eCube fitted, the cycles change to 8 minutes on, 7 minutes off = 4 cycles per hour. This equates to a 66.7% reduction in starts.

As the start-up of a refrigerator compressor uses 3 times more power (i.e. start-up 12 amps, run 4 amps) considerable energy savings are achieved. In addition, the more efficient refrigeration cycle leads to a more efficient unit, which then leads to a colder storage area. Consequently, by re-adjusting the thermostat back to its normal temperature settings, there are further substantial energy savings, without compromising food safety and quality.



Here are just some of the reasons to retrofit your refrigeration system with an eCube:

- ✓ **Significant energy savings (reduced electricity bills and Demand Charges/Climate Change Levy Charges)**
- ✓ **Considerable noise reduction**
- ✓ **Reduced wear and tear on equipment, leading to extended life of equipment;**
- ✓ **Fewer breakdowns**
- ✓ **Fewer sensor failures (as sensors are protected inside the eCube)**
- ✓ **Safer food and less product spoilage**
- ✓ **Reduced environmental pollution**
- ✓ **One-time retrofit product requiring no further attention or maintenance once fitted**
- ✓ **Lower temperatures achieved without heat induced defrost cycles.**

Benefit to Longer Duty Cycles

Benefit of longer on-cycles

Normal air cycles will operate as the air temperature attains the set point of the thermostat. This will generate several on/off cycles, without having very much effect on the food temperature (i.e. several 3 minute cycles). However, with the **eCube** fitted, this changes to 10 minute on-cycles, resulting in a positive food temperature reduction by cooling the food quicker. This, in turn, leads to safer food. *In effect, installing the eCube leads to more efficient use of the refrigerator system, lower energy consumption and safer food.* The longer on-cycle creates a more efficient refrigeration cycle i.e. longer runs at maximum benefit (compare it to fuel consumption and efficiency in a car on a stop start urban road, or a longer stretch of motorway driving at a steady 70 miles an hour).

Benefit of longer off-cycles

A longer off-cycle allows pressure equalization between the high and low pressure parts of the refrigerant system. This results in a softer start from a cooler system, thus avoiding compressor trip caused by high pressure or an unbalanced system i.e. lower amperage clean start obtains maximum efficiency far quicker (with a further energy saving). The electrical starting component and devices used on refrigeration equipment have an engineered life span, so less maximum power use of these components extends the reliability of the components, thereby reducing refrigeration failure. The **eCube** extends the life of the starting devices and, in turn, the refrigeration equipment. In time, this leads to fewer breakdowns and engineer call outs.

Refrigeration Control Systems

Food monitoring based on food temperature and not air temperature is now a widely accepted principle of refrigerated storage.

In response to EU food safety legislation, the **eCube** was originally designed to accurately monitor refrigerated food storage temperatures. This is achieved by using a food substitute contained within an enclosure that enables a microprocessor temperature sensing probe to be contained within a food grade food substitute.

With its variable size cable termination, the **eCube** fits modern refrigeration controls without changing the manufacturer's specification (i.e. the **eCube** is fitted to the sensor inside the evaporator in the refrigerated return air). Once in place, contained within the enclosed evaporator, the **eCube** requires no further attention or maintenance.

Energy Savings using the eCube

It was realized soon after the eCube had been used for temperature monitoring that it could also deliver substantial energy savings when fitted to a refrigeration unit thermostat.

By using the **eCube** as a device to control food storage temperature, a more efficient refrigeration cycle is attained. Currently air cycles (on/off) typically produce a minimum of 12 cycles/hour and, in some open display cases, 20 cycles/hour. By using the **eCube** as a cycle control mechanism, refrigerated cycles can be reduced by as much as 80%.

Example:

Dairy case air cycles 3 minutes on, 2 minutes off equals 12 cycles/hour.

With the **eCube** fitted, cycles change to 8 minutes on and 7 minutes off; this equates to 4 cycles/hour, a 66% reduction in starts. As the start-up of a refrigerator compressor uses three times more power (i.e. 12 Amps is required for start-up and 4 Amps for run), power consumption is reduced by 16 to 22%.

Testimonials

Holiday Inn Regents Park

Make: **Fosters**

Model: **PMC4**

kWh used **without** eCube: **145.5**

kWh used **with** eCube: **80.93**

kWh weekly saving: **64.57**

"I am very pleased to let you know that after calculating the kWh saving after fitting the eCube we achieved remarkable results. We were able to monitor food temperature during the trial which was not affected by the eCube managing the thermostat. We were very surprised that we could calculate an annual saving of £271.50 on just one unit."

Assistant Chief Engineer, Holiday Inn Regents Park

LEC

Make: **LEC**

Model: **T450L**

kWh used **without** eCube: **81.27**

kWh used **with** eCube: **71.4**

kWh weekly Saving: **9.87**

"The eCube maintained similar temperatures throughout the cabinet compare to the first test without the eCube. By using the eCube on this product we can save 514.65kWh saving which equates to £51.47. Tests carried out were based EN153."

N.Wyatt, LEC

Some of eCube Customers

| | | |
|-------------------------------|----------------------|---------------------|
| Hilton Hotels | Radisson Hotels | Park Plaza Hotel |
| Automatic Vending Association | BDL Hotel Management | Bunzl Vending |
| Caledonian Produce (Bakkavor) | Carel Italy | Climate Controls SE |
| Crown Plaza St.James | CJ Lang & Son(Spar) | Cools Controls |
| Delhaize Group(Belgium) | Enviroment Agency | Eliwell |
| GreeneKing I.P.A | HendersonGroup(Spar) | Hussman |
| Iceland | ISA | Inmarsat |
| James Hall & Co(Spar) | Kaspo | L.E.C |

Energy Savings Using eCube

Introduction

Numerous trials have been conducted to assess the energy savings that can be achieved by fitting the eCube to the temperature control sensors of cold storage.

Trials

Each trial ran for a period of two weeks. For the first week of each trial the cold storage unit was controlling temperature as normal, based upon air temperature. For the second week an eCube was fitted to the temperature control sensors. An electricity meter was used to measure the amount of electricity used (kWh) during each week of each trial.

While reduced electricity consumption is an attractive proposition for both financial and environmental reasons, reducing energy consumption using the eCube is not viable if the storage temperature of the food does not remain within legislative guidelines.

For the period of each trial, therefore, the temperature of food, food stimulant (eCube) and circulating air in each cold storage unit were also measured as experimental controls to ensure that there was no significant change in storage parameters when the eCube was fitted.

Results

In each case:

- Food temperature remained within legislative guidelines after the eCube was fitted
- The eCube food simulant provided temperature readings equivalent to that of the food
- Energy savings between 13% and 33% were achieved.

Conclusion

Fitting an eCube will reduce the electricity consumption of most commercial refrigerators and freezers by up to 33%, without changing the storage temperature of the food.

Example of Savings

REFRIGERATION UNIT A, FIVE YEARS OLD, WITHOUT AN eCube

ASSUMPTIONS

£1,000 cost (capital outlay) in 2002

Depreciation of £100 per annum

Average life of equipment type: 10 years

Average breakdown / maintenance / engineer charges: £50 per annum

PROJECTED COSTS OF UNIT A OVER NEXT FIVE YEARS (WITHOUT eCube)

Depreciation: £500 (i.e., £100 per annum)

Maintenance / breakdown / engineer charges: £250 (i.e., £50 per annum)

Electricity: £1,200 (i.e., £240 per annum)

Climate Change Levy: £100 (i.e., £20 average per annum)

TOTAL: £2,050

Refrigeration Unit A replaced in 2012

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**REFRIGERATION UNIT A, FIVE YEARS OLD, WITH AN eCube FITTED NOW**

ASSUMPTIONS

Life extended 50% due to less wear and tear

Maintenance / breakdown / engineer costs 40% less per annum

25% reduction in electricity consumption

25% reduction in Climate Change Levy charge

**PROJECTED COSTS OF UNIT A OVER NEXT FIVE YEARS (WITH eCube)**

Depreciation: £334

Maintenance / breakdown / engineer charges: £150

Electricity: £900

Climate Change Levy: £75

**TOTAL: £1,459**

**Saving: £591**

**Refrigeration Unit A replaced in 2014 / 2015 (i.e., capital outlay deferred)**

**SAVING ON ELECTRICITY ONLY - £60 per annum (at 2007 prices)**



## Energy Saving Calculator ~ Example of Small Business with 14 Refrigeration Units

| Type                           | Size        | Number    | Yearly kWh Savings | kWh cost £ | Total Annual Savings |
|--------------------------------|-------------|-----------|--------------------|------------|----------------------|
| <b><u>Chillers-fridges</u></b> |             |           |                    |            |                      |
| upright fridge                 | single door | 1         | 650                | 0.075      | £48.75               |
| upright fridge                 | double door | 1         | 1200               | 0.075      | £90.00               |
| 1/2 Height fridge              | single door | 1         | 360                | 0.075      | £27.00               |
| 1/2 Height fridge              | double door | 1         | 470                | 0.075      | £35.25               |
| bench / topping                |             | 1         | 400                | 0.075      | £30.00               |
| open sandwich/dairy case       |             | 1         | 1090               | 0.075      | £81.75               |
| walk-in chiller                | 3m x 3m     | 1         | 1140               | 0.075      | £85.50               |
| <b><u>Freezers</u></b>         |             |           |                    |            |                      |
| upright freezer                | single door | 1         | 1250               | 0.075      | £93.75               |
| upright freezer                | double door | 1         | 1740               | 0.075      | £130.50              |
| 1/2 Height freezer             | single door | 1         | 480                | 0.075      | £36.00               |
| 1/2 Height freezer             | double door | 1         | 600                | 0.075      | £45.00               |
| ice cream scoop unit           |             | 1         | 780                | 0.075      | £58.50               |
| bench freezer                  |             | 1         | 600                | 0.075      | £45.00               |
| walk-in freezer                | 3m x 3m     | 1         | 1300               | 0.075      | £97.50               |
| <b>Grand total</b>             |             | <b>14</b> | <b>12060</b>       |            | <b>£904.50</b>       |

## Frequently Asked Questions

### **1. How long does an eCube last?**

For the life of the refrigerator.

### **2. How much electricity will the eCube save?**

This will depend on various factors, which include the type, age, location and condition of the refrigeration equipment, together with the ambient air temperature. Energy savings are usually between 20 - 35%, although significantly better results have been achieved. Generally speaking, more energy is saved on freezers than fridges.

### **3. How soon does the eCube start to save electricity?**

If the eCube is at room temperature initially, it will save electricity within an hour, once the food simulant in the eCube has cooled down in the refrigeration unit.

### **4. Is it difficult to install the eCube or can anyone do it?**

You need to know where the correct sensor is located and how to access it in order to install the eCube. For this reason it should be fitted by a qualified refrigeration engineer.

### **5. Does the eCube work on all refrigerators?**

It is estimated that an eCube will work on around 95% of all refrigeration. Most modern refrigeration units use microprocessors with electronic sensors that fit comfortably into an eCube. The versatility of the eCube is only limited by the size of the sensor or thermostat phial. If the sensor is too large, for commercial refrigeration it would be well worthwhile to fit a microprocessor so that an eCube can be attached.

### **6. Are there any new products available for energy savings?**

Several are in the pipeline. (Sign up for our early alerts and newsletter).

### **7. Does an eCube save energy on anything else?**

We have identified several additional energy saving applications for the eCube. For example, when used on air-conditioning / comfort cooling units to resolve short-cycling and noise problems, the eCube appears to have reduced electricity consumption. Further trials are now planned in order to evaluate our initial findings more fully.

### **8. Does the fitting of an eCube affect the manufacturer's warranty?**

This has never been an issue during trials with manufacturers as the eCube can do no harm to the equipment.

### **9. Doesn't refrigeration now have electronic delays built in to do what the eCube does?**

The time delay (usually 60 seconds) makes no difference to the number of cycles whereas an eCube does. Whilst the time delay protects the microprocessor, it does not save energy.

### **10. How can an eCube act like different types of food?**

With the eCube you are checking the performance of the refrigeration in relation to a food sample. The size or consistency of the food is irrelevant. The fridge does not differentiate between the types of food as it is not trying to measure different types of food. Instead, it measures the performance of the refrigeration in relation to a simulated food sample.

## Installation Guide

The **eCube** is designed to monitor the refrigeration performance in relation to the refrigerated stored food, whilst smoothing out air temperature irregularities.

The construction of the **eCube** is an inner enclosure containing a high grade, safe, food substitute inside an outer enclosure that forms an air barrier within.

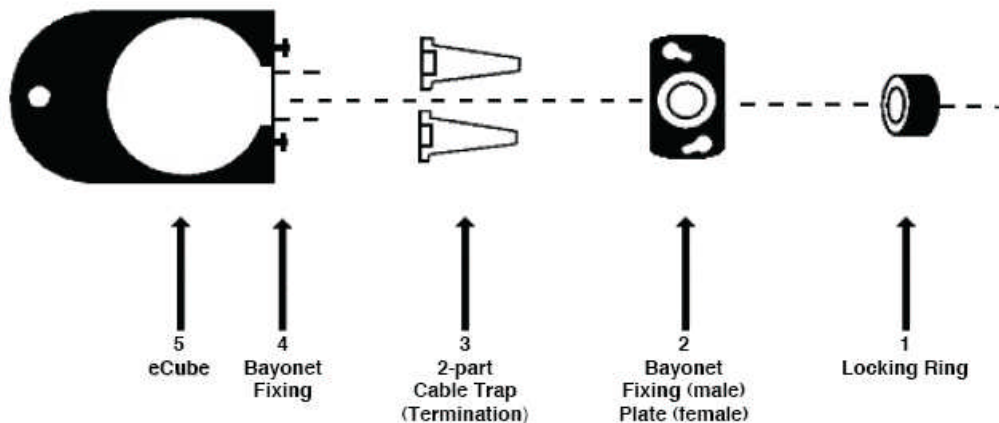
This construction will simulate an average small food sample in a pre-packed condition

### INSTALLATION

**Warning:** Should only be fitted by a qualified refrigeration engineer

#### Siting of the eCube

The siting of the **eCube** is dependent upon the position of the existing sensor or thermostat phial. Identify the position of the appropriate sensor. It is essential to be able to adjust the parameters of a microprocessor (when fitted), if necessary.



#### To fit the eCube

- Thread sensor and cable through locking ring 1.
- Thread bayonet fixing plate 2 as A (hollow side of plate to left-hand side).
- Place two-part cable termination 3 on both sides of cable approximately 1cm from the probe.
- Slide forward bayonet fixing plate 2 over two-part cable termination 3 and lock with locking ring 1.
- Push sensor probe into recess inside the **eCube**.
- Lock the assembly onto the **eCube** bayonet fixing 4.

NOTE: It is a local decision as to whether or not the **eCube** is to be held in position with a screw.

#### General

- If there is a separate digital read-out thermometer and/or thermostat, fit one **eCube** to each of the sensors.
- No benefit will be obtained from the **eCube** either for temperature monitoring or energy saving if the equipment is inadequate, in a poor condition, badly sited or poorly ventilated.

