

# How to reduce heat gain for cabinets and cold rooms

Minimising the heat gains on refrigerated cabinets and cold rooms cuts the cooling load on your refrigeration system and saves you energy and money.

Any energy efficiency initiative dealing with refrigeration should start by reviewing the heat gains on your system. If you understand the nature of these gains, you'll be able to manage the amount of cooling that needs to be done and make energy savings. Heat gains include warm air entering the cabinet or cold room and heat produced by electrical equipment within the cooled space. This guide covers in detail two opportunities to reduce heat gains: reducing cold air changes using strip curtains, and using EC (electronically commutated) replacement motors for evaporator fans.

## The business case

You will find opportunities for reducing heat gains on refrigerated cabinets and cold rooms in most applications.

Improving door management in cold rooms results in substantial energy savings. For example, installing plastic strip curtains to a cold room can give savings of up to 30%, and have a payback period of around a year.

Replacing conventional shaded-pole fan motors with equivalent EC motors can cut their energy use by 65%, as well as generating less heat and reducing your maintenance replacements. You can maximise the saving achieved by fitting a whole new fan assembly instead of just replacing the motor. In most applications the payback period for fitting EC motor fans is one to two years, but it can be much shorter.

## The technology

Refrigerated cabinets include catering fridges, bottle coolers and retail display cabinets. Some, such as catering fridges, have doors, while others, such as multi-deck display cabinets are open-fronted. Cabinets are almost always factory-built with no on-site assembly. Most cabinets are cooled by an integral, hermetically sealed refrigeration system located within the cabinet frame. Supermarket cabinets may use centralised refrigeration systems.

Cold rooms are refrigerated spaces large enough for the user to enter when loading or unloading the contents. Cold rooms tend to be assembled on-site from insulated panels and bespoke jointing systems. They may be cooled by 'mono-bloc' or split refrigeration systems. Mono-bloc systems consist of a single unit containing the evaporator, compressor and condenser, arranged so that the evaporator hangs inside the room and the compressor/condenser hangs outside. Split systems consist of a remote compressor/condenser assembly connected to the evaporator within the cold room.

Heat gain sources in a cold store or cold room are usually:

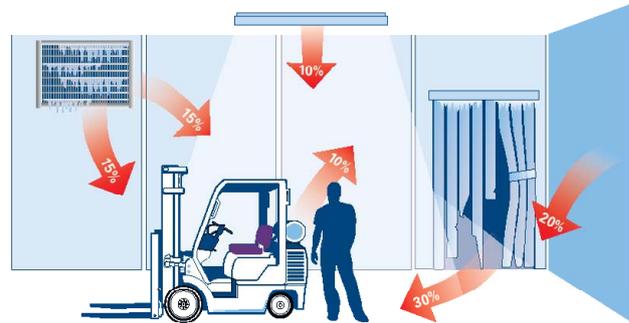
- Heat gained through the insulated walls, ceiling and floor (20%)
- Warm air and moisture leaking in through the doors and gaps (30%)
- Evaporator fans (15%)
- Evaporator defrost (15%)
- Lights (10%)
- Occupants and associated equipment (10%)

## Heat gains

The main sources of heat are similar for cabinets, although the proportions differ.

The following table summarises your opportunities for reducing the heat gain in existing cabinets and cold rooms. You'll find more detailed information on fitting strip curtains and EC motors below.

**Figure 1** Typical heat gains for a cold store



**Figure 2** Opportunities to reduce heat gains

Opportunity	Applicability
Fit plastic strip curtains	Open-fronted display cabinets, cold rooms
Fit insulated strip curtains	Cold rooms
Use night blinds when not in use	Open-fronted display cabinets
Fit transparent doors	Open-fronted display cabinets
Repair door seals	Cabinets with doors, cold rooms
Improve door management	Cabinets with doors, cold rooms
Fit self-closing doors	Cold rooms and cabinets with hinged doors
Fit automatic doors	Cold rooms
Install efficient lights	Any cabinet or cold room with lights
Improve lighting control	Any cabinet or cold room with lights
Fit EC motors	Retail display cabinets or cold rooms
Optimise defrost control settings	Any cabinet or cold room with defrost heating system
Fit defrost-on-demand controller	Any cabinet or cold room with defrost heating system
Locate away from sources of heat	All cabinets, especially open-fronted and integral ones

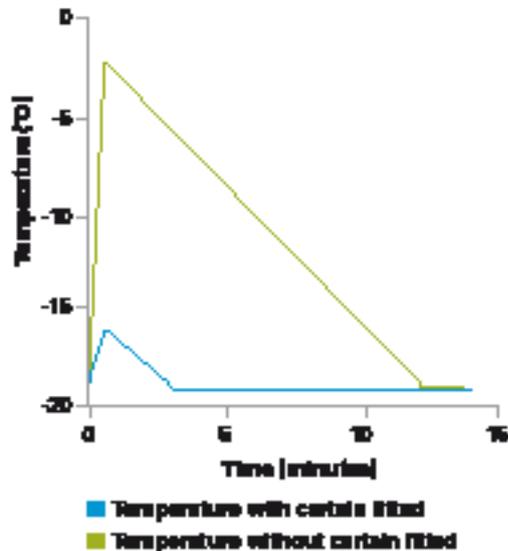
The single largest gain is usually caused by warm moist air getting in through openings – mainly open doors. Gaps around doors, between panels and where pipes penetrate the walls also allow a small but constant stream of warm moist air to enter. For cabinets without doors, warm moist air enters through the open front.

Where a cold room door is in frequent use, plastic strip curtains can keep cold air in and warm air out. They can also be used for open-fronted cabinets.

Figure 3 on the following page shows a small freezer store temperature measured with and without a strip curtain.

Every time the door opened the air temperature in the cooled space increased from -19°C to -2°C without the strip curtain, but only to -16°C with the curtain in place. The time taken to return the store temperature back to -19°C was 12 minutes without the strips and three minutes with.

**Figure 3** Effect of using a strip curtain for a freezer cold room



### Evaporator fan motors

Evaporator fan motors are another important source of heat gain. Recent advances in fan design and motor efficiency offer good savings for older cabinets or cold rooms. Conventional shaded-pole AC motors can be replaced with DC electronically commutated (EC) motors. This can result in energy savings of up to 65% for the fan motor. Since the fan motor consumes much less energy, there is also less heat for the refrigeration system to remove. For a large supermarket, replacing standard AC evaporator fan motors with EC types will save 6% of the running costs of the refrigeration equipment.

A fan assembly integrating the EC motor, impeller and inlet ring mounting can be supplied as a simple drop-in replacement for a standard evaporator fan and motor unit fitted in cabinets. This increases the efficiency of the fan, giving greater savings than replacing the motor alone. Usually EC motors have a two-speed operational option. By combining an EC motor with a suitable controller, the fan can operate at a reduced speed when the compressor is not operational or when night mode is engaged. At half its full speed the fan motor will use up to 87% less energy.

### Strip curtains

**Figure 4** Considerations for strip curtains

Considerations	Comments
Do you have a cabinet with an open front?	Consider fitting strip curtains. Recent merchandising studies have found a transparent barrier doesn't cause any noticeable loss of sales. However, if the cabinet has a night blind fitted, this will reduce the savings from installing a strip curtain and may make a curtain difficult to fit.
Is there evidence of ice build-up on the ceiling, walls or the floor of your cold room?	This is a good indication that a high level of air change is taking place and that you'll make significant savings by reducing the warm air ingress through the door.
Do you have a cold room with a door that needs to be frequently open?	If so, then consider fitting strip curtains to the doorway. Consider also whether you could reduce the time the door is open through better management or by automatically closing the door in some way.
Is the cold room used for chilled or frozen products?	If the cold room is at a low temperature i.e. for frozen products, then installing strip curtains will almost certainly be worthwhile. An insulated strip curtain may be cost-effective depending on the average time the door is open. If the cold room has a self-closing or automatic door the savings from installing strip curtains will be reduced. In the case of a freezer, it may still be worthwhile to install strip curtains if it is accessed frequently.

### Applications – strip curtains

You can easily apply strip curtains to open-fronted display cabinets, deli-counters and cold room doorways. For cold rooms, they are most applicable if the door is frequently open or the room is at a low temperature for frozen goods.

Figure 4 on the previous page outlines points for you to consider when installing strip curtains.

### Specification checklist – strip curtains

When specifying strip curtains you will first need to decide whether they should be plastic or insulated. Insulated curtains provide better heat retention than conventional plastic strips, so are particularly applicable to freezer cold rooms.

You will then need to consider how the strip curtains will be attached to the doorway – some fixing methods may be more suitable than others depending on the application.

Finally you will need to measure the dimensions of the opening where they are to be fitted. Your supplier will need this information before quoting for and supplying strip curtains for your cabinets or doorways.

### Commissioning checklist – strip curtains

When installing strip curtains you'll need to check for the following:

- Good strip overlap

- No gaps at the sides of the opening
- Strips are long enough to reach the bottom of the opening
- Detailed installation instructions should be provided with the strip curtains.

### Common problems – strip curtains

Where strip curtains are fitted on cabinets or cold rooms, you should regularly make sure that they:

- Are in good condition – replace any damaged or missing strips;
- Are being used properly – operators should be discouraged from holding open strip curtains unnecessarily.
- To minimise heat gains through doorways in cold rooms in general, you should regularly make sure that:
  - Doors are kept closed whenever possible.
  - Doors fit well with good alignment and seal when closed. If a door is knocked, its hinges or slides may be damaged, preventing the door from shutting properly. If so, these should be repaired as soon as possible.
  - Door seals are in good condition. Look for any gaps or damaged rubber. For frozen food cold stores, faulty seals may be indicated by ice or frost build up around the door. Rubber seals commonly deteriorate and may need replacing after a few years of use. Door seals should be replaced by a suitably qualified service technician.

## EC motors

Figure 5 Considerations for EC motors

Considerations	Comments
What type of motor is used by the evaporator fans? Are they shaded-pole AC motors?	Replacing shaded-pole AC motors offers the largest saving.
What are the ratings of the evaporator fan motors and how many are there per unit?	This will determine the potential power savings along with the existing motor type.
Is it worthwhile to replace the whole fan assembly?	Fitting a new fan assembly will give efficiency savings for both the fan and motor.
Do the fans run continuously?	The hours of use, along with the power saving of the motor will determine the overall saving.
Could the evaporator fans run at low speed part of the time, for example, at night or when the compressor is off?	The fan can be run at either full or low speed if a controller is installed. This will increase the energy savings but also the cost.

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## Applications – EC motors

You can fit EC motors to evaporator fans in retail display cabinets and cold rooms. They can also be used in vending machines and drinks coolers, but the payback period will be longer.

*Figure 5* on the previous page outlines points for you to consider when choosing whether to install EC motors. You may need to ask the equipment supplier or your refrigeration contractor to supply most of the information.

## Specification checklist – EC motors

Your supplier will need to know the details of the existing motors, such as their rating and electrical supply. If you plan to replace the whole fan assembly, he will also need the following:

- the design air flowrate of the fan and/or
- the diameter of the ring mount in the cabinet to make sure the replacement is the same size.

If you want the fan to run at low speed part of the time you will need to tell your supplier, who may need to install a different controller. Your supplier will also need to know how the fan will be controlled to run at reduced speed e.g. when the cabinet is operating in night mode or when the compressor is off.

The company supplying and installing the EC motors should do a survey of your existing refrigeration systems to ensure they select suitable replacements for the existing evaporator fan motors and where applicable, fan assemblies.

## Commissioning checklist – EC motors

There are many suppliers with experience in installing EC motors replacements for conventional fan motors. A good supplier should carefully specify a replacement motor and fan to match the size and air flow of the original, and then install and commission.

## Common problems – EC motors

EC motors are relatively simple to install, have a 15-year lifespan and are usually more reliable than conventional types. Motors should be replaced by a suitably qualified service technician.

## Finding a supplier

Strip curtains come under the Government's Enhanced Capital Allowances scheme. You can see a list of ECA approved suppliers at [www.eca.gov.uk](http://www.eca.gov.uk).

You should be able to obtain a list of competent contractors to supply and install replacement EC motors from the following trade associations:

### Institute of Refrigeration

020 8647 7033  
[www.ior.org.uk](http://www.ior.org.uk)

### British Refrigeration Association (BRA)

0118 940 3416  
[www.feta.co.uk](http://www.feta.co.uk)

See the Carbon Trust website at [www.carbontrust.co.uk](http://www.carbontrust.co.uk) for further information to help you make your refrigeration more energy efficient.