

Refrigeration System Controls

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1. Definition of Technology

Refrigeration system controls are products that are specifically designed to automatically optimise the operating temperatures and/or pressures within a distributed commercial refrigeration system in a manner that minimises the system's energy consumption, whilst maintaining the spaces or equipment being refrigerated within predefined temperature limits.

2. Technology Description

Refrigeration system controls are used to control the temperatures and pressures within a distributed, commercial refrigeration system, and to automatically adjust the refrigeration system operation to reflect changes in load, weather conditions, and operating requirements.

A wide range of refrigeration system control products is available. The ECA scheme aims to encourage the purchase of products that automatically optimise the operation of a distributed, commercial refrigeration system and minimise its energy consumption.

The ECA Scheme covers two categories of products:

- **System management units or packages** consisting of one or more control units or modules that are designed to optimise an entire refrigeration system, including the operation of refrigeration compressor(s), evaporator(s) and condenser(s).
- **'Add-on' controllers** that are designed to be used in conjunction with a specific system management unit or package, and enable the operation of additional refrigeration compressors, evaporators and condensers to be optimised.

Investments in refrigeration controls can only qualify for Enhanced Capital Allowances if the product is named on the Energy Technology Product List. To be eligible for inclusion on the Energy Technology Product List, products must meet the eligibility criteria as set out below.

3. Eligibility Criteria

To be eligible, products must:

1. Incorporate a microprocessor based controller that is pre-programmed to automatically control the rate of flow of refrigerant through, and/or operating temperature of, at least one of the following types of refrigeration equipment:
 - a) Evaporators.
 - b) Condensers.
 - c) Compressors.
2. Be one of the following:
 - a) A system management unit or package that:
 - Automatically adjusts system operating set points in a manner that minimises the refrigeration system's energy consumption under different operating loads, weather conditions and surrounding air temperatures.
 - Is pre-programmed to undertake one or more of the following:

- i. Monitor temperatures and/or pressures around the refrigeration system, and automatically initiate defrost cycles, or inhibit (or delay) scheduled defrost cycles, within individual parts of the refrigeration system, as required, to optimise the overall performance of the refrigeration system.
 - ii. Monitor refrigeration system energy input (kWh) and generate a visual or audible alarm when system power consumption exceeds a pre-defined limit, or when system efficiency degradation is preventing automatic adjustment.
 - iii. Automatically in accordance with a pre-defined weekly time schedule, turn off, or turn down, ancillary power loads around the refrigeration system (such as lighting in display cabinets, trim heaters or fans), or activate night blinds, in order to reduce system energy consumption.
 - Provides facilities that enable system managers to define the default set points, and alarm limits, for each item of refrigeration equipment controlled.
 - b) An add-on controller that:
 - Automatically accepts instructions from the system manager to change its operating set points or alarm limits, or to initiate or inhibit a defrost cycle.
 - Automatically transmits data on operating temperatures, pressures, or flow rates to the system manager at intervals not exceeding 10 minutes.
 3. Comply with the relevant requirements, as set out in Tables 1 to 3 below, for products that directly control by means of an analogue or digital signal connection:
 - a) Evaporators (see Table 1).
 - b) Condensers (see Table 2).
 - c) Compressors (see Table 3).
 4. Incorporate an anti-tampering mechanism that prevents the product's control strategy and configuration settings from being modified, and automatic control from being disabled, except during commissioning, maintenance or testing.
 5. Conform to the requirements of the EU EMC Directive 89/336/EEC (as amended) or its replacement EU EMC Directive 2004/108/EC, or be CE Marked.
 6. **Not** incorporate any form of variable speed drive, fan, pump, heat exchanger or valve, except where incorporated solely for the purposes of cooling electronic circuitry.
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Table 1 Control of evaporators
<p>All products that directly control evaporators must:</p> <ol style="list-style-type: none"> 1. Be designed to directly measure evaporator pressure or temperature by means of a sensor, and automatically adjust the flow of refrigerant through the evaporator to maintain the refrigerated space within pre-defined operating limits. 2. Automatically terminate its defrost cycle when: <ul style="list-style-type: none"> ● The temperature of the evaporator or refrigerated space exceeds a preset value. ● A maximum defrost time consistent with sensor failure has been exceeded. 3. Provide facilities that enable system managers to define separate temperature set points and alarm limits for each evaporator being controlled. 4. Provide facilities that enable system managers to take the equipment out of service for cleaning or maintenance. 5. Generate an alarm signal when the temperature of the refrigerated space is in danger of straying outside, or has strayed outside, its pre-defined safe operating limits.

Table 2 Control of condensers
<p>All products that directly control condensers must:</p> <ol style="list-style-type: none"> 1. Be designed to directly measure condenser pressure or temperature by means of a sensor, and automatically adjust the airflow across the condenser(s) in a manner that maintains condensation at the rate required to maintain the thermal balance of the refrigeration system under different operating loads and weather conditions. 2. Allow the compressor discharge (head) pressure to “float” with ambient temperature down to the minimum safe level for the particular refrigeration system. 3. Provide facilities that enable system managers to define separate temperature set points and alarm limits for each condenser being controlled. 4. Generate an alarm signal when the condensing pressure or temperature is in danger of straying outside, or has strayed outside, the predefined safe limits.

Table 3 Control of compressors
<p>All products that are designed to directly control compressors must:</p> <ol style="list-style-type: none"> 1. Be able to control the operation of at least two refrigeration compressors. 2. Incorporate automatic control algorithms that monitor rate of change in system suction pressure or refrigerant temperature to prevent compressors from unnecessarily being controlled to load or unload in response to small fluctuations in cooling demand.

Where:

- Automatic control may be implemented either directly by means of an analogue or digital signal connection, or indirectly by means of another control device or network.
- A mechanism is defined as “any sequence of pre-defined actions that performs a given function, where an action can be defined in hardware and/or software”.
- An algorithm is defined as “a mechanism that is defined in software”.
- The product’s control strategy is the combination of automatic control functions, mechanisms and facilities specified for the particular equipment controlled. In this context, products may be pre-programmed in one of the following ways:
 - a) One or more fixed control strategies that are designed to control a specific set of equipment that can be selected during commissioning.
 - b) One or more flexible control strategies that can be configured to control different equipment, as part of a clearly defined commissioning procedure.
- Products that incorporate control strategies that are designed to control any type of equipment that is not directly related to refrigeration systems are not eligible.

4. Scope of Claim

Expenditure on the provision of plant and machinery can include not only the actual costs of buying the equipment, but other direct costs such as the transport of the equipment to site, and some of the direct costs of installation. Clarity on the eligibility of direct costs is available from [HMRC](#).