Energy Efficient Cooling Solutions

Keeping People And Processes Cool

CELSIUS
DESIGN LIMITED

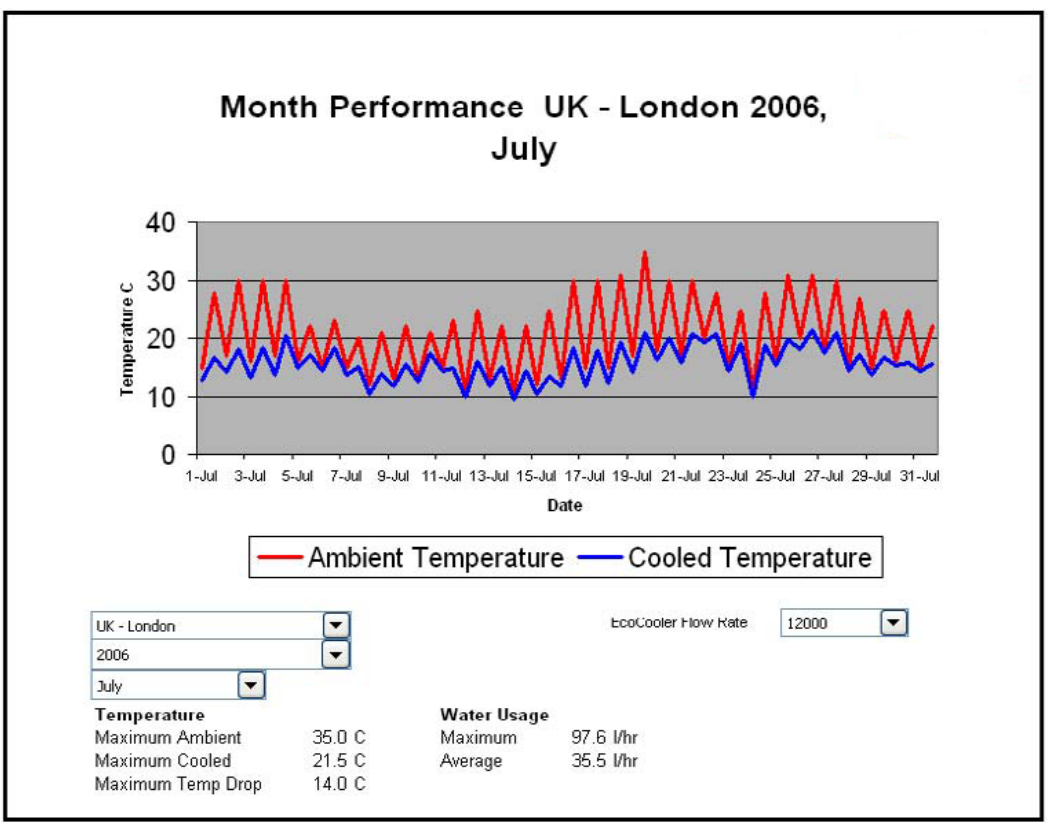
Contents

Evaporative cooling is a completely natural way of producing refreshing cool air.

SIMPLE air distribution systems deliver cool, fresh air to provide complete building coverage or spot cooling.

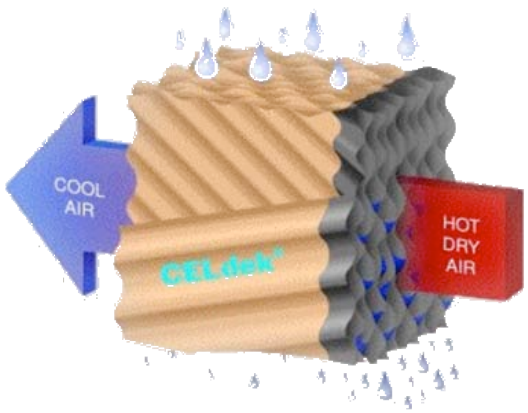
Sophisticated process controls together with naturally low water operating temperatures assure a hygienic and SAFE cooling unit.

At 25% of the installed cost and 15% of the running cost of air conditioning, the EcoCooling evaporative cooler is a truly LOW COST cooling system

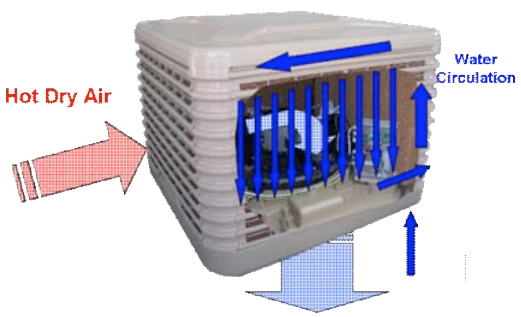


How Evaporative Cooling Works

As warm air passes over wet filter pads water naturally evaporates into the air. The air is cooled as it gives up the heat required to evaporate the water.



An EcoCooler has CELdek pads, made by Munters, which are kept saturated with water when in 'Cool' Mode. Water from the sump is pumped over the pads via a water distribution system.



An axial fan draws the air through the pads and then into the air distribution system.

The CELdek pads, manufactured by Munters, are cellulose based. A removable insect screen is incorporated into the side panel to protect the pad and provide basic hygiene.

Performance

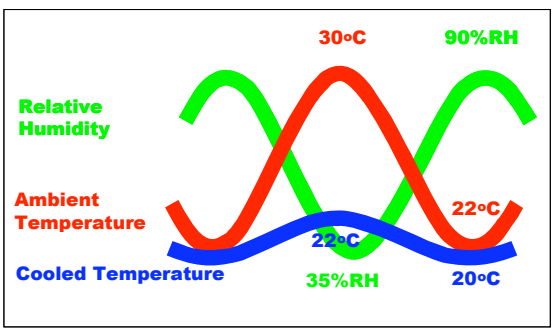
The performance of an EcoCooler is dependent upon the temperature of the air and its relative humidity (RH). Higher temperatures give greater cooling. Low RH gives greater cooling.

EcoCooler Performance

	Relative Humidity						
Temp	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**
20^{0}C	10.2	11.6	13.1	14.3	15.6	16.8	17.9
25^{0}C	13.7	15.4	17.0	18.6	20.0	21.3	22.6
30^{0}C	17.0	19.1	21.0	22.8	24.4	26.0	27.4
35^{0}C	20.4	22.9	25.1	27.1	29.0	30.6	32.1

In a temperate climate, such as the UK, hot weather coincides with low RH. Detailed information about local weather can be found on www.wunderground.com.

The diagram below shows the typical profile for temperature and humidity on a very hot day in the UK. It is very rare for the cooled air temperature to exceed 22^{0}C.



It can be seen that the RH is low when the temperature is high. This means that the maximum cooling effect occurs at the highest temperatures.

From the performance chart for London in July 2006 shown on page 2 it can be seen that the combination of temperature and RH levels meant that the maximum air off temperature would be 21.5C.

In April and October we often see days with the air at 20C and RH over 90%. An EcoCooler takes August weather conditions and transforms them into April conditions.

In cool conditions the EcoCooler operates in ventilation mode and in hot conditions operates in cooling mode. A control system can automatically set the fan speed to constantly minimise the electricity use of the fan.

Fixed Systems – Products

Fixed installations are based on three variants of EcoCooler; down, side and top discharge.

Down Discharge

Top Discharge

Side Discharge

Factors affecting the choice of EcoCooler are:

- Avoidance of roof penetrations
- Safe access for installation and maintenance
- Ductwork lengths

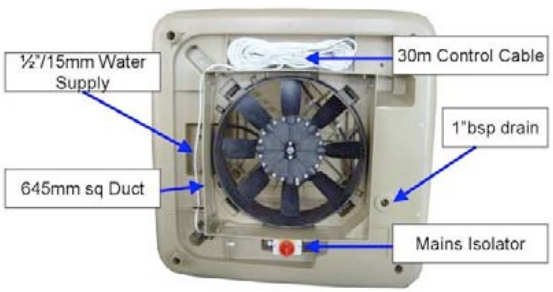
Wet Boxes

EcoCoolers can be supplied without the fan. These are used as pre-coolers for existing systems or where higher duty fans are required. Wet boxes can be supplied in down, top and side discharge configurations.

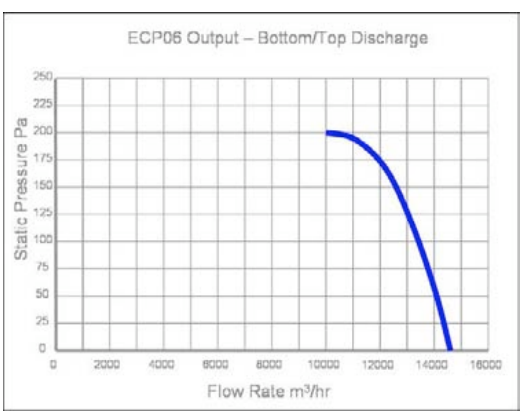
At 14,000m^3/hr a down discharge wet box has an air flow resistance of 50Pa.

Services Requirements

Water: Supply minimum 1 bar max 7 bar. Minimum supply 500 L/hr. Sump Capacity 23L Cooler is supplied with 300mm flexible connector pipe fitted with isolation valve and finishing in 15mm compression fitting.
Electricity: 240V 50Hz. 12A start 8A running. External isolator fitted as standard.
Drain: Minimum capacity 2000l/hr to an appropriate effluent point in accordance with local water regulations. The drain valve is supplied connected to the controls but not fitted to prevent damage in transit and installation.



Basic Specification
Circulation Pump: 50W Centrifugal
Dimensions: Height 950mm, Length 1170mm Width 1170mm, Volume 1.3m^3
Duct Size (Down Discharge): Length 645mm x Width 645mm
Weight: Dry 55Kg Operating 92kg
Warranty: Two years: parts only dependent upon cooler being installed and maintained by EcoCooling authorised Installer.
Control: Cooler is supplied with standard wall control with 30m control cable incorporating spare cores for timer, alarm, thermostat and humidistat. The control cable is fitted to the cooler and the wall control is separately packed in the cooler.
Fan: 1.5kW axial



Fixed Products – Installations

ECPD - Down Discharge Coolers
The down discharge cooler is designed to be supported by a 645mm square plain edged duct with a minimum up-stand of 250mm.

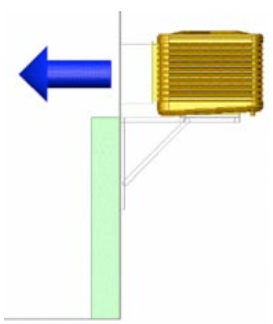
Extract fans are installed to provide a balanced ventilation system. There is a contact in the EcoCooler control system to automatically start an extract fan. Dependent upon local water regulations the drain is normally run onto the roof. Profiles soaker sheets are sometimes used.

All types of membrane roofs can be finished with an appropriately designed up-stand and weather proofing.

ECPT - Top Discharge Coolers
Top discharge coolers offer a simple access solution. Note that the duct work must be completely self supporting – no weight must be carried by the cooler.

The duct can be finished in either 630mm round or square duct which can be attached to the stainless steel top element.

ECPS - Side Discharge Installation
Side discharge coolers are supported from simple brackets and are ideal for modern metal clad structures.



Side discharge coolers are easily fitted with sound attenuators to reduce noise levels in buildings.

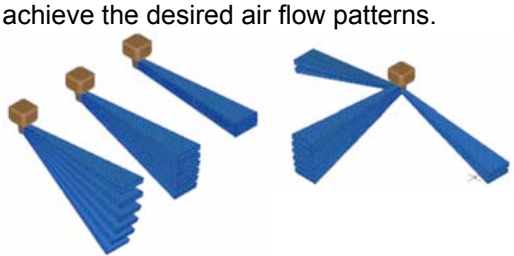
Internal Systems – Products

Evaporative coolers can be installed internally where there is existing ventilation. **The flow rate of ventilation should exceed the total flow rate of the installed internal cooler.**

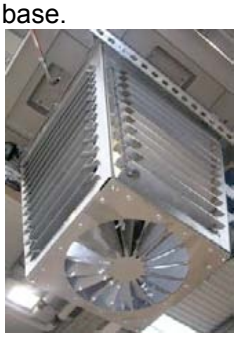
ECPSDU – Internal Suspended Cooler

Water: Supply minimum 1 bar max 7 bar. Minimum supply 500 L/hr. Sump Capacity 23L Cooler is supplied with 300mm flexible connector pipe fitted with isolation valve and finishing in 15mm compression fitting.
Electricity: 240V 50Hz. 12A start 8A running. External isolator fitted as standard.
Drain: Minimum capacity 2000l/hr to an appropriate effluent point in accordance with local water regulations. The drain valve is supplied connected to the controls but not fitted to prevent damage in transit and installation
Control: 30m cable supplied as standard to wall mounted controller. Units can be controlled individually or in groups.
Suspension: Total operating weight 120Kg Suspension points at 1450mm x 700mm
Plenum: The stainless steel plenum is delivered with the louvers closed.

These are opened during commissioning to achieve the desired air flow patterns.



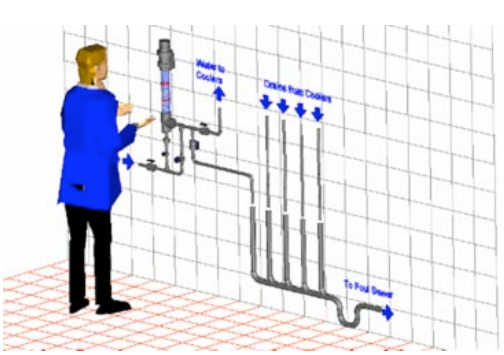
All four sides have louvers and a spiral diffuser is cut into the base.



ECM – Mobile Cooler

Water: Manual fill or mains supply.(1 bar max 7 bar. Minimum supply 300 L/hr. Sump Capacity 90L
Electricity: 240V 50Hz. 6A start 3A running

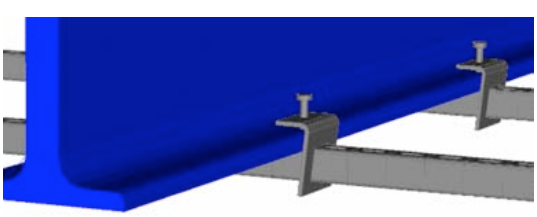
Brominator
In many cases the air being processed is contaminated and requires the use of a brominator. This supplies a constant flow of 0.5ppm bromine to prevent any bio-films developing.



A single standard brominator can support up to 10 EcoCoolers. It is normal to check and re-fill bromine tablets weekly. When a brominator is used waste water must be directed to a foul sewer.

Internal Systems – Installation

The ECPSDU is normally supported from the building structural steelwork using Uni-strut components. 'Window' brackets are one method of simple fixing to existing structural steelwork.

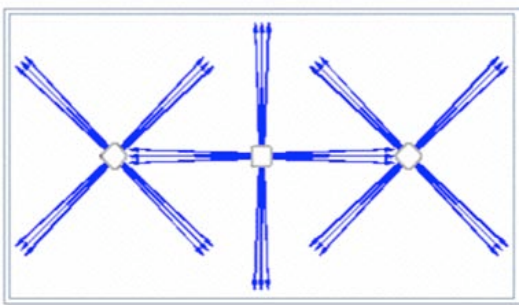


All services are run from above and a peripheral pump with a maximum head of 40m removes waste water.

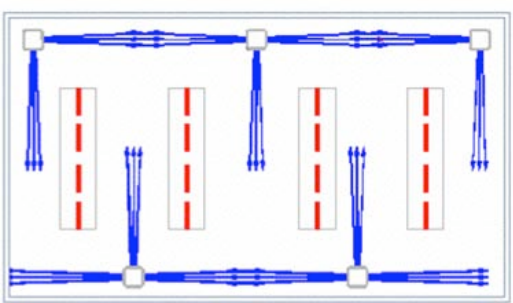
Coolers are delivered located onto a pallet for ease of installation.

Installation Patterns for Suspended Coolers

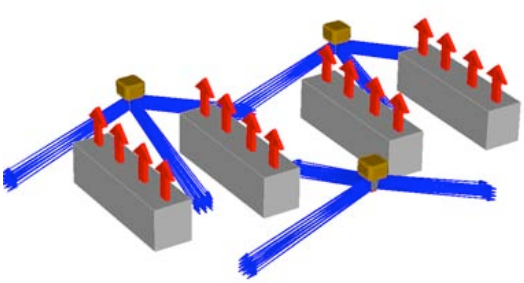
There are two options when locating suspended coolers. When complete coverage is required then the air flows from the plenums are alternated to give an interlocked effect.



In more energy intensive operations it is possible to identify 'corridors' between machines and direct the air to exactly where it will have most effect.



Hot air from the machines rises naturally through convection. The corridors are then filled with cooled air



Internal Ducted Systems

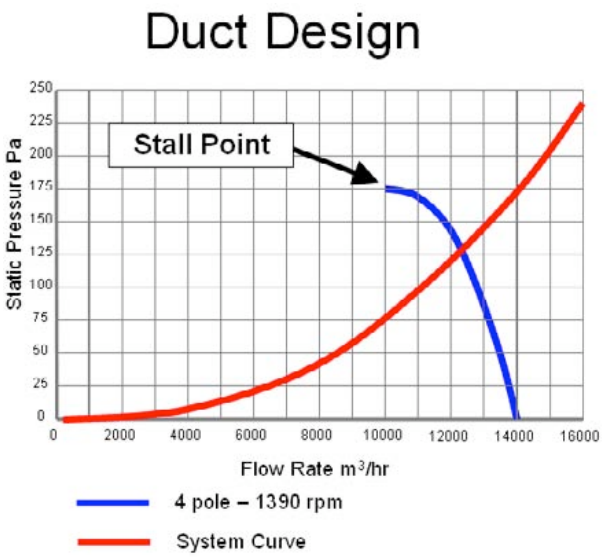
Standard coolers can also be employed internally. The examples below show coolers installed in a print application where there is also the added benefit of humidification throughout the year.

Air Distribution

With careful design the optimum distribution can be achieved taking into account the following factors:

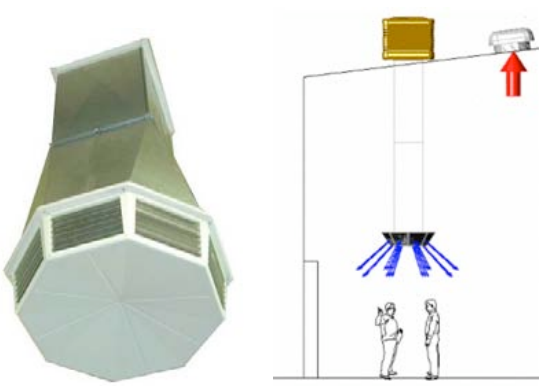
- Introduction of cooled air as low as possible
- Complete coverage or spot cooling
- Option of Draught free conditions

System Design
In all cases it is important that the systems are designed to fall within the performance of the fan.



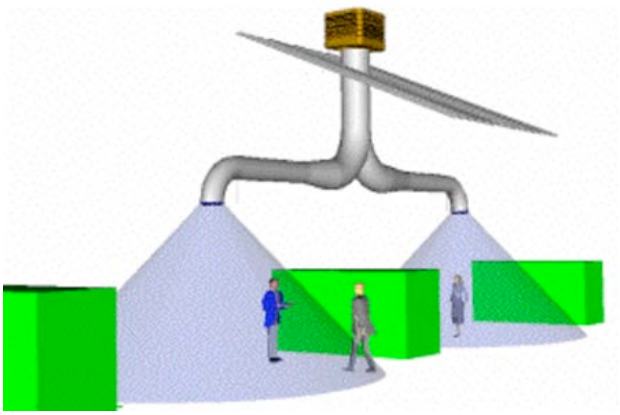
The characteristic pressure curve of the system must fall below the stall point of the fan otherwise the flow will be unstable and the flow rate can drop considerably.

8 Way Plenum
Many industrial and commercial cooling systems use an EcoCooling 8 way plenum to distribute the air.

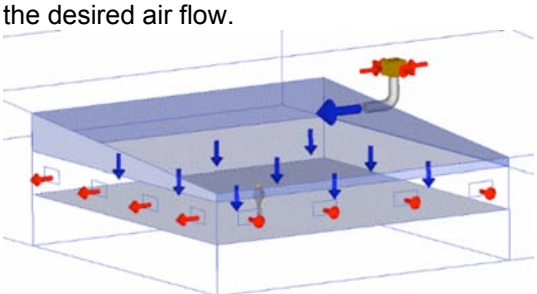


As with all systems it is better to introduce the air as low as possible and extract as high as possible. This creates stratification in the building. 8 way plenums can be installed as low as 3.5m.

Metal Ducted Systems
Metal systems can be either completely custom built or based on proprietary items. EcoCoolers can be used for spot cooling using swirl diffusers.

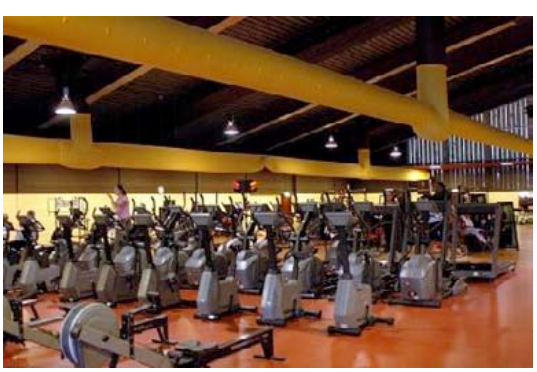


Suspended Ceilings
If a suspended ceiling exists then it is possible to use the void as a plenum chamber. The cooled air pressurises this space and ceiling tiles are replaced by diffusers or grills to give the desired air flow.



Windows are left open to provide natural extraction. Window openings can be fitted with limit switches which are linked to the timer control circuit. The cooler will then not run unless the window(s) are open.

Fabric Ducts
These can offer draft free conditions and are commonly used in leisure and commercial applications.



Sample Installations

Warehouse
A – Down Discharge EcoCooler
B – 8 Way Plenum Chamber
C- Extraction Fan (80% to 90% of EcoCooler flow rate)
Doors can be left open because building is positively pressurised

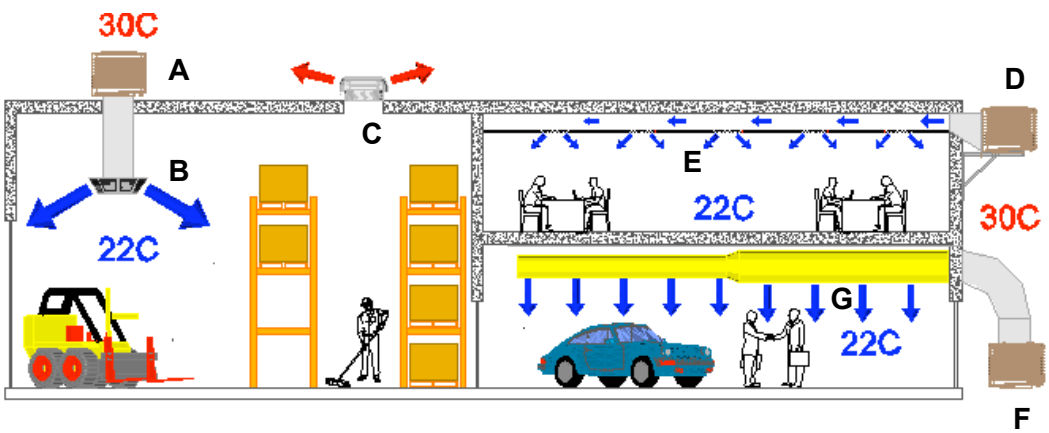
Printing Works
G – Internal Suspended EcoCooler
H- Extraction Fan
I – Inlet Fan
Note total ventilation MUST exceed flow rate of EcoCooler
M – Metal Duct air distribution

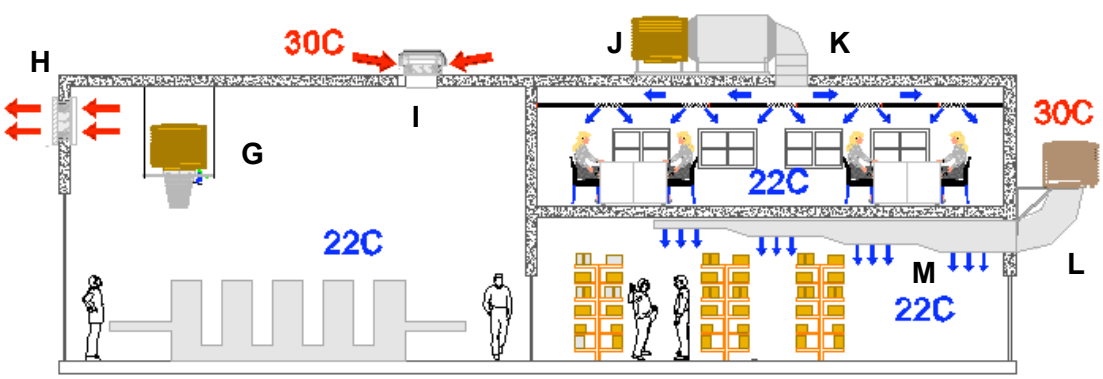
Office
D- Side Discharge EcoCooler
E – Air Distribution through suspended ceiling

Car Show Room
F- Top Discharge EcoCooler
G – Fabric duct air distribution

Office
J- Side Discharge EcoCooler
K – Sound Attenuator (Silencer)

Store
L – Down Discharge EcoCooler





Some factors to be considered are:

- Always bring the cooled air in as low as possible.
- Does the building require positive pressure?
- What noise level is acceptable? Both internal and external noise should be considered.
- Roof access and weather proofing. Sometimes the only solution is to enter the side of the building.
- If internal systems are used the ventilation system capacity must exceed the flow rate of the internal coolers.
- Is a draught free environment required? If so, consider the use of fabric ducts.
- Consider linking the extract fans to the EcoCooler control system for automatic start.
- Do not place the EcoCoolers close to the extraction fans to avoid re-circulation.
- Do not place the EcoCoolers close to any vents which may exhaust contaminated fumes.
- Consider equipment movement such as fork lifts and cranes in the building to avoid clashes with ductwork or plenums.

Commissioning

EcoCoolers are delivered fully assembled and only require the connection of the services and connection of the wall controller.

There are a number of options which can be set on commissioning using a set of dip switches in the main control panel.

1 – Pre Cool Cycle: This allows the pads to be saturated prior to the fan starting.
2- Water Bleed rate: The water bleed rate, which prevents scaling, is set at 30% which is suitable for most UK applications. This can be varied from 18% to 46% to accommodate different water properties.
3 - 24hr Dry Cycle: The cooler will dry out for 30 minutes during every 24 hours of continuous operation. This can be used in certain circumstances to improve the hygiene of the cooler.
4 – Maximum Speed Setting: The fan speed can be limited from 1340rpm to 1200rpm and 1000rpm to reduce output or reduce noise levels.
5 - Stop Conditions in Automatic: There is the option to stop completely or remain in speed 1, vent mode during cool periods.

Testing

The test switch, on the main control panel, is used to check all operations of the cooler. The test sequence is:

- Fan speeds 1 to 5
- Drain valve
- Water inlet valve
- Water level probes

All of the other functions, including thermostat and humidistat are shown on the control panel LED for testing.

Maintenance

The maintenance regime for an EcoCooler is determined by:

- The total running hours
- The air quality
- The water quality

It is normal to maintain EcoCoolers twice per year.

- Remove the side frames, remove the insect screens
- Clean the CELdek pads using low pressure water (it is common to install a hose point on the cooler water supply so this can be done local to the cooler)
- Clean the insect screens
- Manually clean the sump and the water contact surfaces using the clean function. This is started by holding the 'test' button in for 10 seconds. The EcoCooler then fills with water to level 3 and empties so providing a continuous supply of water for cleaning
- The side frames can then be replaced and the EcoCooler restarted

During the winter the water is normally turned off and drained.

Pad life is dependent upon the ambient air conditions. With clean air these have a life of up to 5 years.

Noise

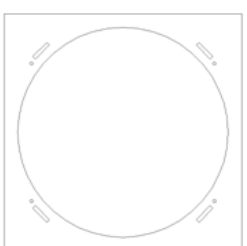
An EcoCooler generates 74dB at 3m at the standard fan speed of 1340rpm. For the purposes of attenuator design the sound spectrum is:

Octave	Noise Level
63Hz	61.9
125Hz	67.1
250Hz	71.3
500Hz	72.2
1KHz	73.6
2KHz	70.0
4KHz	63.5
8KHz	56.7

Noise can be reduced during commissioning to:

- Dip Switch 6, 1200rpm max; 69dB
- Dip Switch 7, 1000rpm max; 64dB

Where external noise levels have to be reduced then the fan can be relocated into the ductwork. The fan, completed with venturi, can be located into a flat plate. The template for this is available from EcoCooling.



Running Costs

Electricity and Water are the main running costs of an EcoCooler. Their usage is dependent upon:

- Air temperature
- Relative Humidity
- Flow rate of EcoCooler

EcoCooling can provide a model which, taking local weather data, utility costs and running hours, calculates the total cost.

In the UK the typical running costs average approximately 10p per hour per EcoCooler. This includes the cost of water and electricity. Detailed operating cost analysis, based on local weather data, can be performed using the EcoCooling Design Excel spreadsheet.

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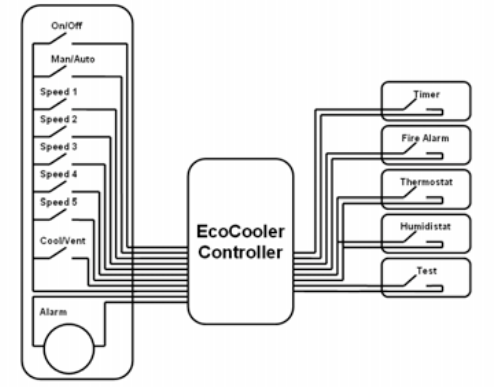
Control

The wall control box is supplied as standard with EcoCoolers.

The controls are:

- Power
- Fan speeds 1 to 5
- Cooling mode
- Automatic Mode
- Alarm Light

All functions are controlled using switches connected to the main controller using conventional control cable. The control voltage is 12VAC.



A 30m 16 core control cable connects the EcoCooler with the wall control. The standard cable permits connection of all of the field items.

Alarm Light; The alarm light flashes according to the fault which is present.

- 1 flash – Slow Fill
- 2 flash – Overflow
- 3 flashes – Probe error
- 4 flashes – Slow evaporation
- 5 flashes – Slow drain
- 6 flashes – External Alarm

Automatic Mode; In automatic mode the control system monitors a thermostat every 10 minutes. If the thermostat shows a closed contact then the cooler will increase the speed of the fan by one increment up to the maximum speed 5 with cool mode. If the thermostat shows an open contact then the cooler will decrease the speed of the fan by one increment until it either stays at VENT/Speed 1 or shuts down completely according to dip switch 8 setting.

Off*	Off*
Vent	Speed 1
Cool	Speed 1
Cool	Speed 2
Cool	Speed 3
Cool	Speed 4
Cool	Speed 5

Note the OFF/OFF status is only enabled by using dip switch 8. Default is the cooler will slow down to a minimum of VENT/Speed 1.

If automatic mode is not used then the button is removed and replaced by a blank which is provided.

Humidistat; There is an option to use a humidistat in Automatic Mode. This disables the water circulation when the set point is exceeded. All other functions are unaffected.

Timer; Any volt-free contact timer can be connected to start and stop the EcoCooler.

Fire Alarm; A volt-free link into a fire panel will shut the cooler down. The EcoCooler will restart when the contact is closed.

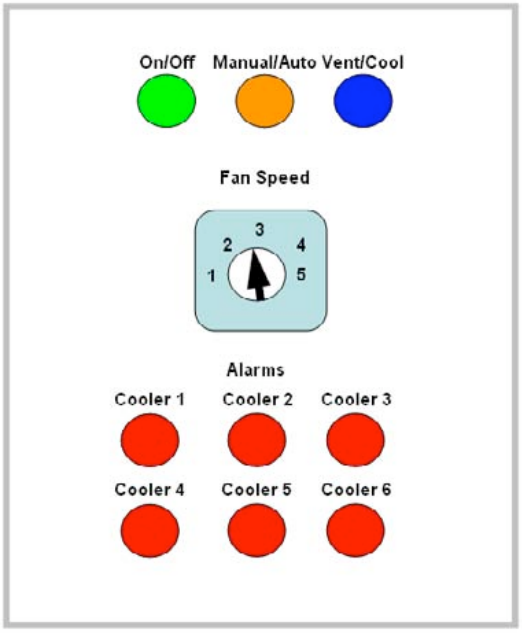
Automatic Start of Extract Fans; A contact is available in the main control panel to start an extract fan.

Drain Pump; A 240VAC supply is available to power a drain pump where gravity drain is not possible

LED Display; An LED on the main control board gives the following information:

- Alarm condition
- Thermostat/Humidistat status
- Timer Status
- Test sequence status

Group Control; Simple control panels can be built to control groups of coolers.



Link to other Control Systems; All functions can be controlled using volt-free contacts. The alarm signal is a pulsed 12VAC signal.

Sizing of Systems

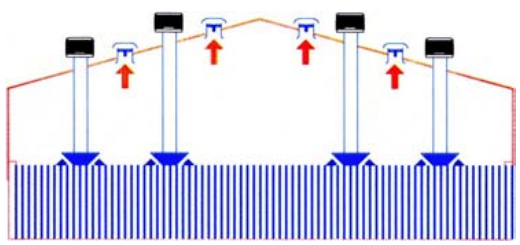
There are a number of methods of determining the number of coolers required. EcoCooling provides design tools to assist with this.

Air Changes Method
This is a method based on principles of ventilation. The volume of the building is calculated and a multiplier applied. This gives an hourly flow rate required from the cooler.

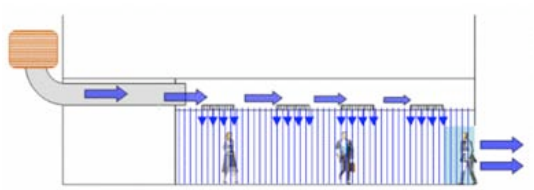
Typical air changes per hour are:

- Offices and Shops
  - 8 to 10 air changes per hour
- Light manufacturing e.g. Warehouse, packing area
  - 10-15 acph
- Normal manufacturing e.g. Machine shop, assembly area
  - 15-20 acph
- Heavy manufacturing e.g. Injection moulding, welding shop
  - 20-30 acph
- Extreme conditions e.g. Bakery, forge
  - 30-40 acph

For a warehouse or factory the working volume is that underneath the discharge of the plenum chambers as shown by the blue shaded area in the diagram below.



In smaller buildings, or where there is a low ceiling, the total volume of the building is used



Example calculation:
A bakery is 20m x 24m and it is proposed to fit external EcoCoolers external units with a plenum discharge height of 3.5m.

Volume of working area: 20x24x3.5= 1860m^3
Target acpr: 30
Target air flow/hour: 30 x 1680 = 50,400m^3/hr
Air flow rate of EcoCooler; 13,000m^3/hr
Nominal number of coolers required: 50,400 / 13,000 = 3.8 = 4 EcoCoolers

Therefore the proposal would be 4 EcoCoolers together with balanced extract to maintain a small positive pressure.

Energy Balance
If the cooling load is known within the building it is possible to calculate the mass flow rate of air, at a given temperature, required to maintain a set exhaust temperature. Local weather conditions must be known to perform this calculation.

An allowance can also be made for stratification in taller buildings.

Spot Cooling
The effect of a single cooler can be explained using similar principles to the air changes method. The rate of air changes can be calculated by considering a set of concentric circles with the cooled air entering the centre.

Discharge height; 4m
Cooler Type; ECP
Air Flow Rate; 12000cm/hr
Circular area covered by cooler at the stated air changes per hour

ACPH	Diameter of circle
5	152.8m
10	38.2m
15	17.0m
20	9.5m
25	6.1m
30	4.2m
35	3.1m
40	2.4m

Design Excel Spreadsheet
All of the above methods are included in a single Excel spreadsheet available to all installers and consultants.

Comfort and Humidity

The purpose of many EcoCooling installations is to improve the comfort of people. It is generally accepted that high temperatures lead to:

- Lower productivity
- Greater level of Errors
- Greater absenteeism

A correctly specified EcoCooling installation will improve conditions and can contribute to reducing these problems.

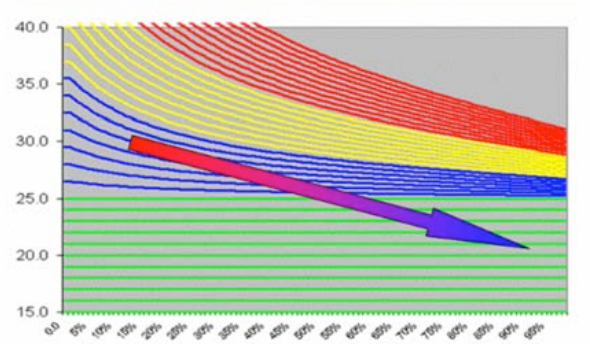
The theory of comfort can explain why the EcoCooler can create comfortable conditions Comfort is affected by the following:

- **Temperature;** An EcoCooler reduces the temperature so improves comfort level
- **Relative Humidity;** An EcoCooler increases the humidity level but because of the low temperatures this does not offset the improvement gained from the temperature reduction.
- **Air movement;** An EcoCooler increases air flow through a building and so improves comfort level
- **Work Rate and Clothing;** This is not affected by the installation

A common question is 'will the rise in humidity from the EcoCooler make it uncomfortable?'

The relationship between temperature and humidity can be explained using the concept of 'apparent temperature'. Dr RG Steadman created a formula to calculate the apparent temperature which is shown below. The arrow shows the change an EcoCooler makes.

Category	Apparent Temperature	Dangers
OK	Less than 26°C	OK
Caution	26°C – 32°C	More fatiguing than usual
Extreme Caution	33°C – 40°C	Heat cramps, exhaustion possible
Danger	Over 40°C	Heat stroke likely



Source: National Oceanic and Atmospheric Administration

A clear conclusion is that at air temperatures below 25C the RH has little effect on the apparent temperature. This is because the skin can sweat as normal. Higher temperatures together with higher RH can lead to stressful and even dangerous conditions

An EcoCooler creates more comfortable conditions by reducing the temperature. The increase in humidity levels does not create discomfort because the air temperature is below 25C.

Condensation

When air is cooled to its 'dew point' condensation will occur. A correctly designed and controlled EcoCooler installation will not create condensation provided the following is adhered to;

- The ventilation system must be balanced. Air from an EcoCooler must be ventilated fully either with mechanical extraction or appropriately sized vents.
- At the end of a period of cooling the system should run for a time in ventilation mode. In Automatic mode the last part of the sequence is always ventilation.
- Take care with buildings which have existing condensation problems. During hot periods an EcoCooler produces air which is a similar temperature to ambient conditions in Spring and Autumn where the RH is routinely above 90%. If a building currently has no problems during these periods then EcoCoolers will not create condensation.
- The EcoCooling Excel Design spreadsheet can model the dew point temperatures inside buildings. This can be used to evaluate the potential for condensation for cooler processes and buildings which are currently susceptible to condensation.

Carbon Trust Interest Free Loan Scheme

The Carbon Trust is an independent company funded by the Government. Its role is to help the UK move to a low carbon economy by helping business and the public sector reduce carbon emissions now and capture the commercial opportunities of low carbon technologies.

One activity is the **Interest Free Loan Scheme** which supports Small to Medium Enterprises (SMEs) to finance carbon saving projects.

An EcoCooler project can qualify because the energy consumed is normally only 15% of a refrigeration based system. The electricity savings results in significant carbon savings. It is normal to qualify for up to £5,000 of interest free loan per cooler based on a double shift operation.

The Loan

- Unsecured, Interest free loans from £5,000 to £100,000 to SMEs to fund carbon saving projects.
- Loan can cover the cost of equipment and installation.
- The loan can cover both new and replacement equipment.
- The maximum loan period is four years

Which companies are Eligible?

The scheme is open to SMEs in:

- England
- Wales
- Scotland

A SME is defined as:

- Fewer than 250 full time employee
- Less than £35 million turnover Or Less than £30 million assets
- Not owned by a larger organisation

Companies must have been trading for at least one year. Types of companies include

- Limited companies
- Charities
- Sole traders
- Partnerships
- Clubs
- Friendly Societies
- Voluntary Organisations

The scheme is open to all companies in Northern Ireland.

Which Companies are <u>NOT</u> Eligible?

Companies operating in agriculture, fisheries (including some parts of the food and drinks industry), transport (for funding of vehicles), or export-related activities are not eligible. The Carbon Trust Account Managers can give specific guidance on this.

What Projects are Eligible?

Project cost must be

- greater than £5,000
- less than £100,000
- Projects must save 1.43Kg CO2 per £1,000 of loan
- Projects must save at least £1,000 per year of energy

Application Procedure

1- Check eligibility of customer by completing and submitting Eligibility Checklist.
2 - Complete and submit the Application Form. EcoCooling provides detailed support in the calculation of the energy saving of an EcoCooler installation compared to conventional refrigeration based systems. The information required to complete this analysis is:

- Electricity costs per kWHr – day and night rates
- Water cost per cubic meter
- Shift pattern of operation
- Location of project

3 - The Carbon Trust will then forward this to a consultant who will review the application in detail.
4 - The Carbon Trust then makes a formal loan offer to the customer – normally within 3 weeks of the application being submitted.
5 - The customer then signs the loan offer and has 3 months to complete the project.

Carbon Trust Details

Web: www.thecarbontrust.co.uk/loans
Helpline: 0800 58 57 94

For detailed support contact either EcoCooling or the regional Carbon Trust Supplier Account Managers:

Scotland, North England, down to South Yorks & NW Derbyshire

Ewan Addison 07802 465555
ewan.addison@carbontrust.co.uk

Wales, The Midlands, down to Gloucester and Norfolk

Mark Brewin 07802 465556
mark.brewin@carbontrust.co.uk

Home Counties, Northampton, Suffolk and everything South of this

David Puttick 07802 465557
david.puttick@carbontrust.co.uk

Legionnaires Disease

Background
Legionnaires' disease is a potentially fatal form of pneumonia caused when very small droplets of water contaminated with legionella bacteria are inhaled.

It is estimated that there are 20 million evaporative cooling systems in the Western world [1]. There has never been a documented case of Legionnaires' disease associated with a wetted media evaporative cooler [2].

Specific Legislation Relating to Legionnaires' Disease
In addition to the Health and Safety at Work Act (HSWA), the Control of Substances Hazardous to Health Regulations (COSHH) and the Management of Health and Safety at Work Regulations (MHSWR) the Health and Safety Commission (HSC) produce an ***Approved Code of Practice (ACOP) Legionnaires' Disease: The control of legionella bacteria in water systems L8***.

It is the legal duty of employers and the responsibility of the managers of premises to comply with the above by completing a risk assessment on all water systems.

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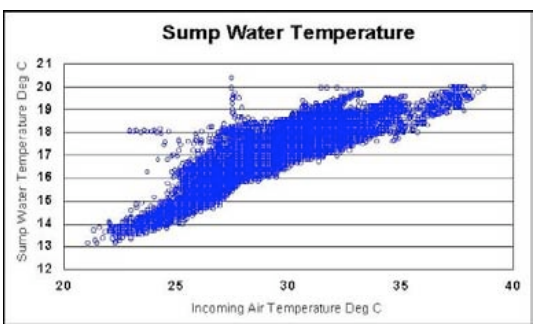
Why EcoCoolers are Safe

When a risk assessment is performed according to ACOP L8 there are 6 critical elements which must be addressed:

1 - Avoidance of stagnant water: No dead legs exist in the system no stagnation occurs during normal operation of an EcoCooling cooler. When a unit is switched off the system automatically drains.

2 - Low water operating temperature: The temperature of the water circulating in the evaporative cooler is approximately the "wet bulb temperature" of the air passing over the filters. In practice this means that, in a temperate climate, the water temperature rarely goes above 20C as shown even when the ambient air temperature exceeds 35C. It is generally accepted that Legionella is not a risk with water temperatures less than 20C

3 - Avoidance of corrosion and scaling: To prevent corrosion all water contact surfaces are plastic. To control scale an EcoCooler measures the quantity of water supplied. When a concentration factor is reached the sump empties automatically and replenishes with fresh water. This has the effect of preventing scale and removing contaminants filtered from the air.
4 - Use of Biocide (optional): Growth of organisms filtered from the air is suppressed by supplying the evaporative cooler with water with a low level of biocide from a brominator.
5 - No production of aerosols: The design of EcoCooling coolers is such that only pure water evaporation without any production of droplets occurs as the air passes over the filters. This removes the mechanism for the transmission of infections such as Legionnaires' disease.
6 - Maintenance: By the implementation of a programmed maintenance system, the standards of hygiene are continued to provide a safe and secure system.



EcoCooler control systems have a comprehensive set of alarms to validate all of the key aspects of water process control an in particular remove any possibility of stagnation.

- Slow water fill
- Slow drain
- Slow evaporation
- Water probe logic failure

Generic Risk Assessment

When the above are subject to a risk assessment then it is normal for an EcoCooler to be classified as Low Risk. This is dependent upon installation, commissioning and routine maintenance being performed according to EcoCooling procedures.

[1] - Evaporative Air-Conditioning: Applications for Environmentally Friendly Cooling by Ebel Dijkstra , Gert Jan Bom , Marja Tummers
[2] - ASHRE Guideline 12-2000 Minimising the Risk of Legionellosis Associated with Building Water Systems

Notification of Cooling Towers and Evaporative Condensers
A wetted media evaporative cooler does not have to be registered with regard to the Notification of Cooling Towers and Evaporative Condensers Regulations as a wetted media evaporative does not fit into the classification of a Cooling Tower or Evaporative condenser.

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