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**26 – 29 NOVEMBER 2017**  
**Dubai World Trade Centre**  
**11:00 – 19:00 Daily**  
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**HVACR**  
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**Workshops**

# EVAPORATIVE COOLING



# Workshop Agenda



## **Session 1 – 14:10 – 14:40**

State of the art evaporative cooling and latest European and Eurovent standards in this field

## **Session 2 – 14:40 – 15:10**

Case study: Combining evaporative cooling and water-cooled chiller system

Prayer Break

## **Session 3 – 16:30 – 17:00**

Trouble-Free HVAC Cooling Towers - A Maintenance Guide

## **Session 4 – 17:00 – 17:30**

In-depth introduction for consultants to the 'Eurovent Certified Performance' programme for cooling towers



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# State of the art evaporative cooling and latest European and Eurovent standards in this field

Jelle Wagelmans  
Sales Manager Middle East  
EVAPCO





# Evaporative Cooling Principles



- Open type systems (open cooling towers)





# Evaporative Cooling Principles



## Open cooling towers

- Packaged type of towers >< field erected towers
  - Cell size < 1250 ton : Packaged type
  - Cell size > 1250 ton : Field erected (typical 3000 – 5000 ton/cell)

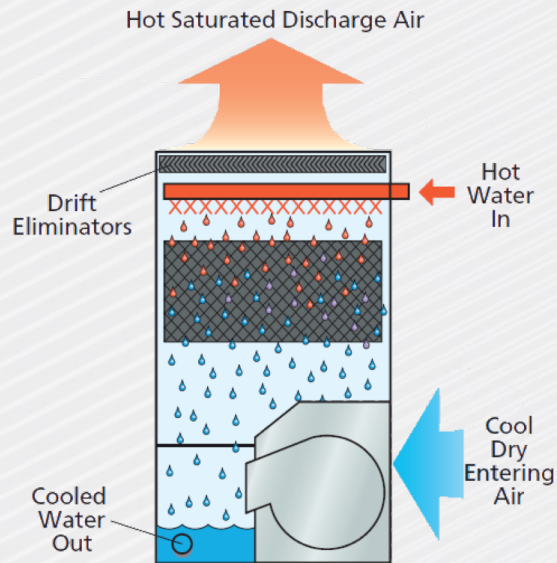


# Evaporative Cooling Principles

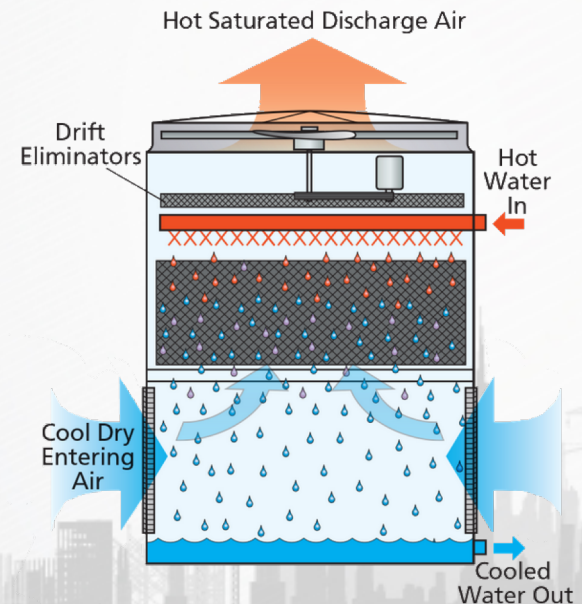


## Open cooling towers

- Packaged type of towers >< field erected towers
- Forced draft



## Induced draft



# Evaporative Cooling Principles



## Open cooling towers

- Packaged type of towers >< field erected towers
- Forced draft – Induced draft:
  - Forced draft (with centrifugal fans):
    - ☹ Energy consumption plus 70%  
Normally more costly units
    - 😊 Excellent for extreme low noise applications  
For indoor installations





# Evaporative Cooling Principles



## Open cooling towers

- Packaged type of towers >< field erected towers
- Forced draft – Induced draft:
  - Forced draft (with centrifugal fans)

- Induced draft:



Noise (?)

No indoor installation



Low energy consumption

Easy maintenance

Lower first cost

# Evaporative Cooling Principles



## Open cooling towers

- Packaged type of towers >< field erected towers
- Forced draft – Induced draft:
  - Forced draft (with centrifugal fans)
  - Induced draft
  - Counter versus cross flow

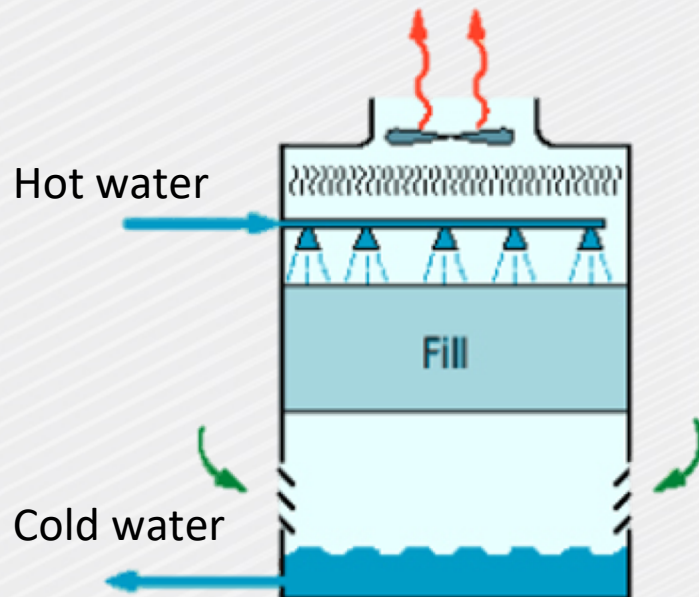


# Evaporative Cooling Principles

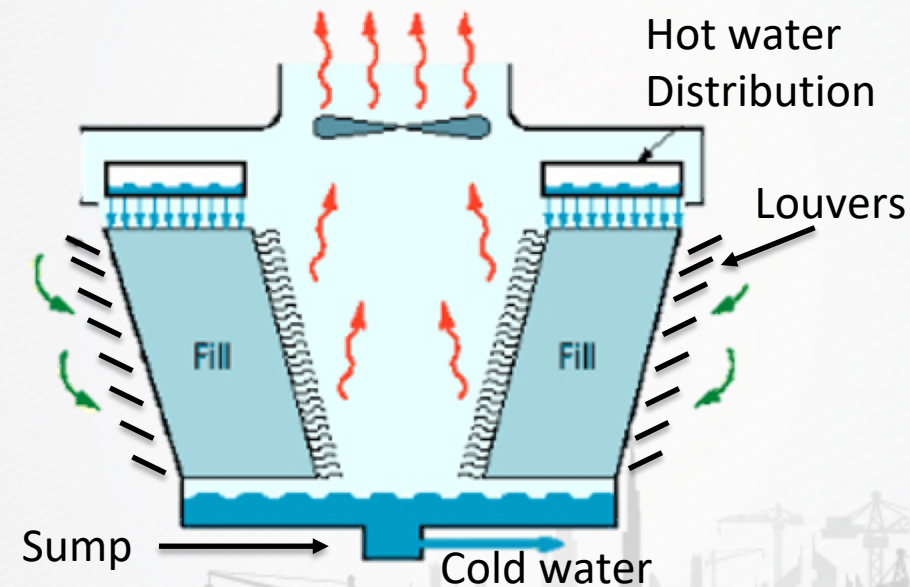


## Open cooling towers

Counter flow



Cross flow





# Evaporative Cooling Principles



## Open cooling towers

- Packaged type of towers or field erected towers
- Forced draft – induced draft
- Cross flow – counterflow arrangement
- Materials of construction:
  - Galvanized steel
  - Stainless steel
  - FRP



# Evaporative Cooling Principles



- Open type systems (open cooling towers)
- Closed type systems (closed circuit coolers)

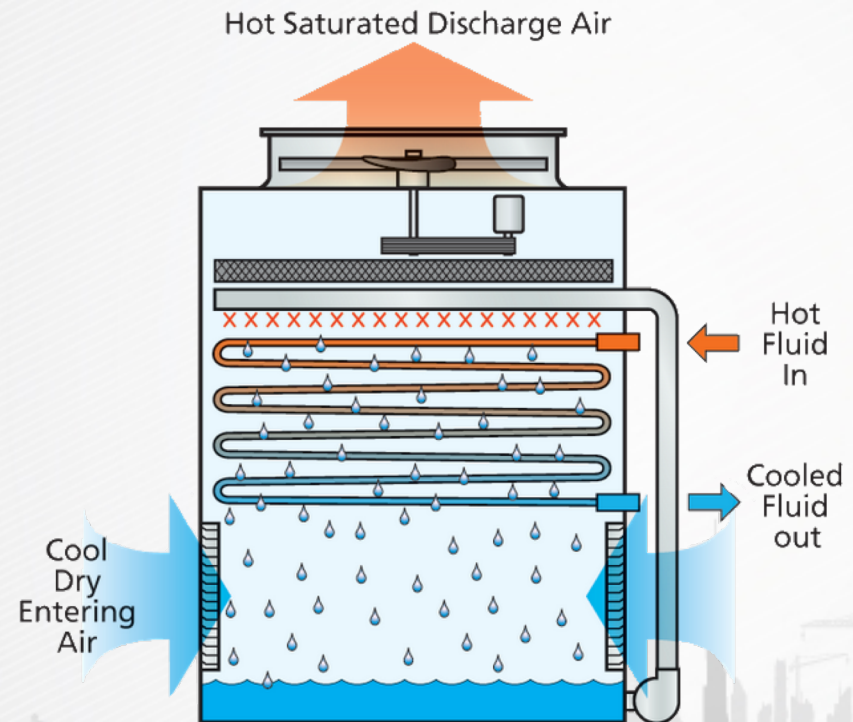


# Evaporative Cooling Principles



## Close Type Coolers

- Principle of operation



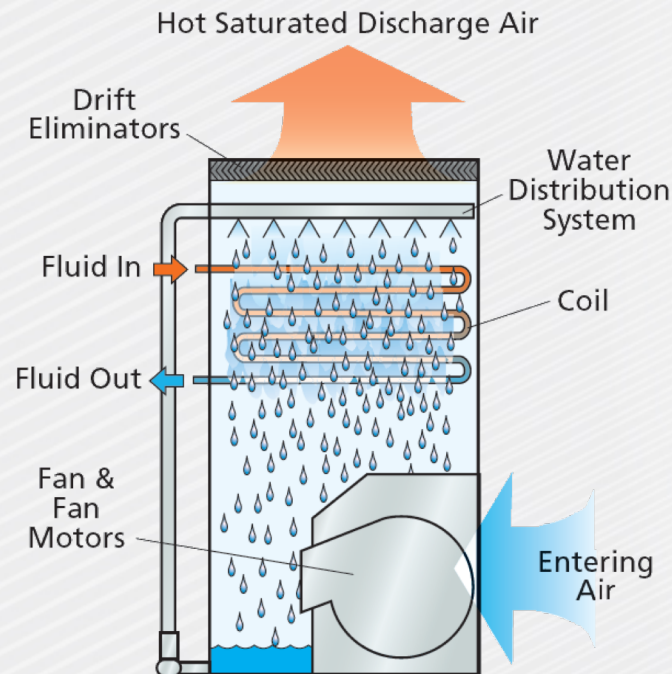


# Evaporative Cooling Principles

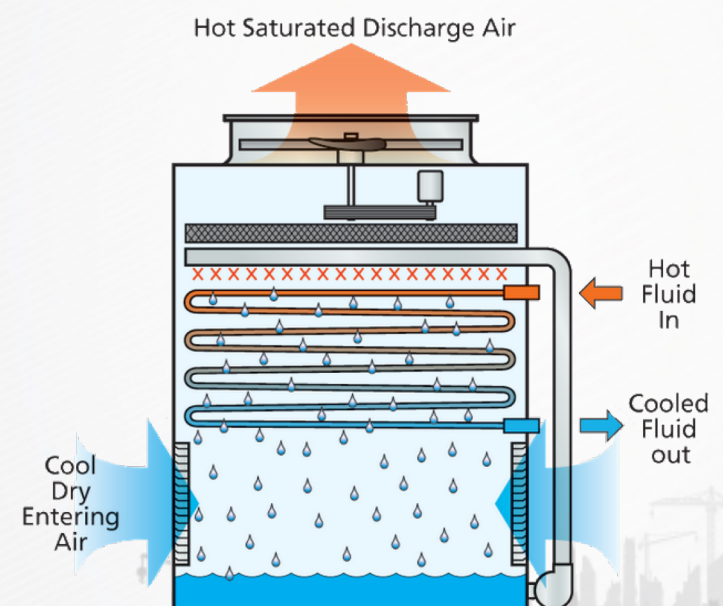


## Close Type Coolers

### Forced draft



### Induced draft



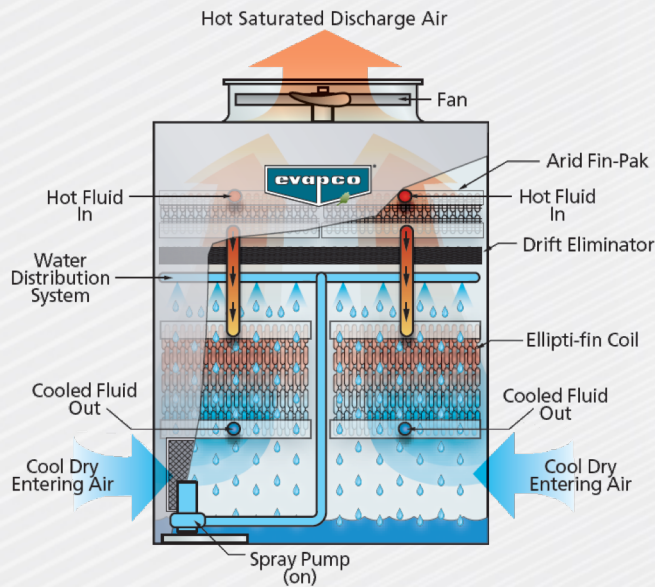
# Evaporative Cooling Principles



## New Developments

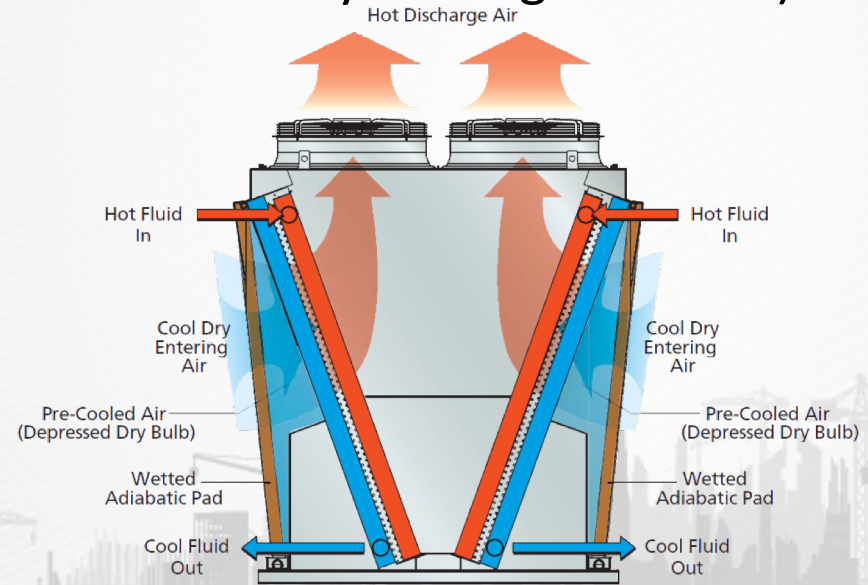
### Hybrid solutions

Save water and plume abatement



### Adiabatic solutions

Save water and energy (compared to 100% dry cooling solutions)



# European Standards: Eco-Design



## Climate and Energy package

- A set of binding legislation to meet the energy targets of 2020 (=the “20-20-20” targets).
- Key objectives for 2020:
  - A 20% reduction in EU greenhouse gas emissions from 1990 levels
  - Raising the share of EU energy consumption produced from renewable resources to 20%
  - A 20% improvement in the EU's energy efficiency.



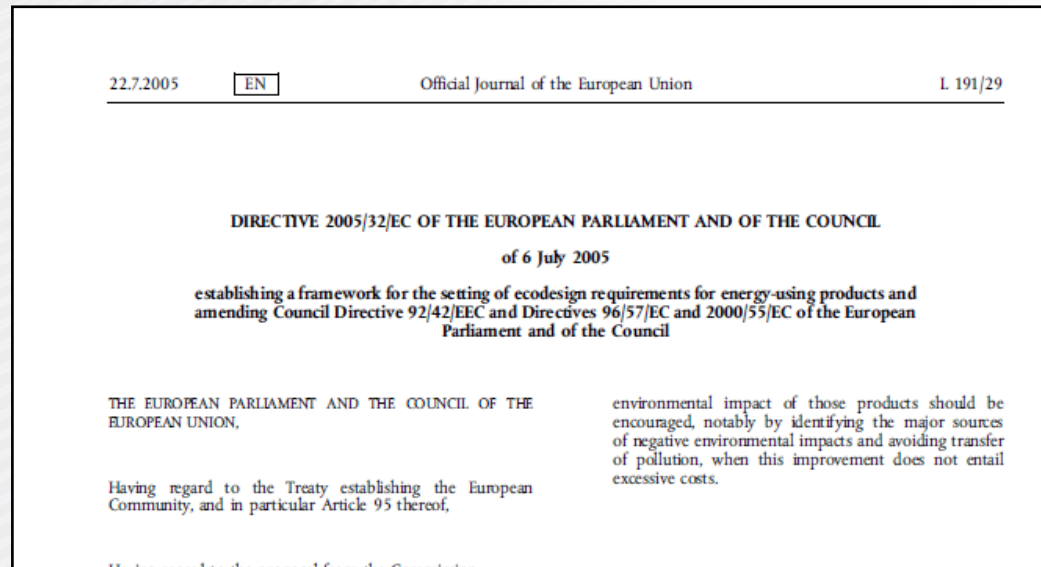


# European Standards: Eco-Design



## Achievement the targets

- Publication of Directive 2005/32/EC:  
A framework for the eco-design requirements of energy-using products (EUP)





# European Standards: Eco-Design



## Achievement the targets

- Publication of Directive 2009/125/EC:  
Recast of the 2005/32/EC and extends the scope of application to all energy related products (ERP).

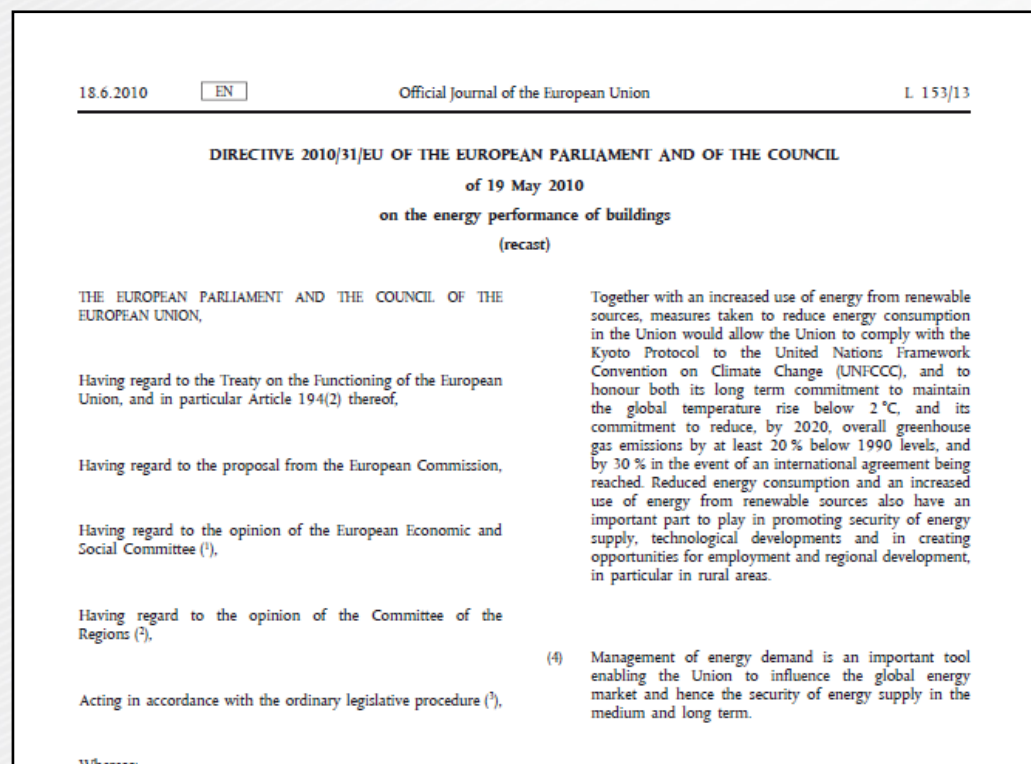


# European Standards: Eco-Design



## Application example: Buildings

- Energy performance requirements for technical building systems as described in the Directive 2010/31/EU



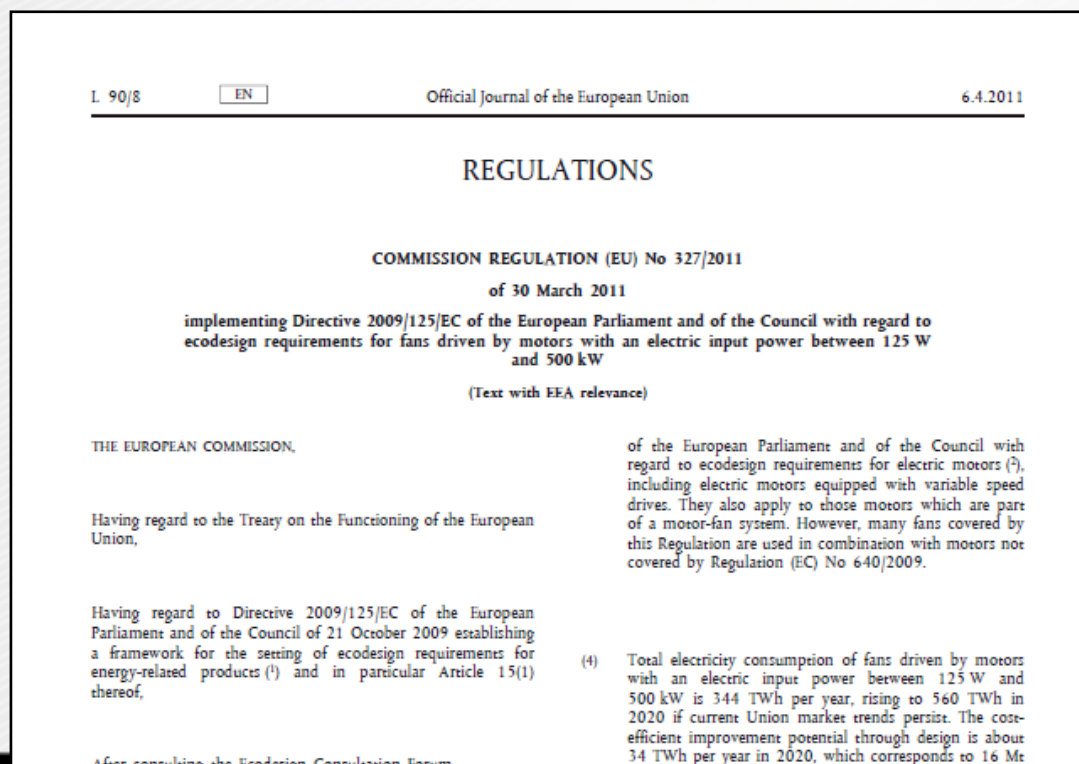
# European Standards: Eco-Design



## Application example:

### Multitude of specific eco-design directives for machinery: Fans

- Commission regulation (EU) No 327/2011: eco-design requirements for fans driven by motors with an electric input power between 125W and 500kW = cooling tower fans







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# What is Eurovent



- Eurovent Association:
  - Keep members informed of relevant legislation
  - National trade associations for each country
  - Development of product certification programs
- Eurovent Certification Company (E.C.C.)
  - Independent from Eurovent Association
  - Certification of cooling equipment / components

# ECC-CTI Partnership



## ECC-CTI Memorandum of Understanding Mutual recognition Eurovent-CTI

“CTI and ECC endeavor to work together in the area of cooling tower certification in an effort to advance the certification programs of both groups, be it therefore resolved, that CTI and ECC pledge to work cooperatively on all matter of mutual interest in the area of cooling tower certification”

Europe / Middle East / India

### CONTRACT BETWEEN COOLING TECHNOLOGY INSTITUTE AND EUROVENT CERTIFICATION COMPANY

Whereas Cooling Technology Institute (CTI) and Eurovent Certification Company (ECC) endeavor to work together in the area of cooling tower certification in an effort to advance the certification programs of both groups, be it therefore resolved, that CTI and ECC pledge to work cooperatively on all matters of mutual interest in the area of cooling tower certification. Further, CTI and ECC pledge to resolve any reasonable differences in the most professional and timely manner possible.

This contract is entered into this day, month, year, by and between the CTI whose address is 2611 FM1960 West, Suite A-101, Houston, Texas 77068, United States of America and ECC, whose registered address is La Kenweverstraat 21, 1050 Brussels, Belgium and whose office address is 62 Boulevard de Sebastopol, 75003 Paris, France.

Once significant interest is indicated by the above companies requesting the cooling tower certification program, the program will commence per the agreement indicated below.

In consideration of the promises of the parties contained in this contract, the parties agree as follows:

1. CTI and ECC each agrees, under the conditions specified herein, to cooperate with the certification of the other party with respect to covered product.
2. For the purposes of this Agreement:  
(a) Covered product means all products covered for certification in ECC publication OM-4-2008, which is a subset of the products covered in CTI STD-201.
3. Both CTI and ECC desire to affiliate per this contract. The ECC cooling tower certification program involves certification of published ratings on covered products by CTI. ECC will, in addition to the certification of published ratings using the CTI program, institute a complementary program to validate manufacturing according to the CTI official product data of record in the manufacturing facilities that may produce product for delivery or sale in Europe.

Many benefits will be derived by all parties including the following:

- Identical standards for cooling tower certification will be in use throughout the world.

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# Scope of the Certification



## General Purpose

- Encourage honest competition
- Assure correctly rated equipment on the market
  - Separate and specific certification programs for each product type
  - Product performance tests through an independent third-party
  - Application and participation open to all manufacturers



# Scope of the Certification



- ECC Rating Standard (RS):
  - Reference to CTI STD-201
  - CTI STD-201 will be used for thermal performance testing





# Scope of the certification



## Important steps in operational manual

- Thermal Performance Testing:
    - Manufacturers own lab - Independent test agency (lab / on site)
    - CTI approved test equipment
  - Factory Audits:
    - Verify the equipment is built conform as per registered data
    - Identity issues which may arise with regard to differences in regional sourcing of components
- ⇒ Audit agency will send audit report to ECC:
- Compliance
  - Non-compliance

# Eurovent Certification Program



## Value add

- Honest and fair competition
- Correctly rated equipment on the market
- Enables accurate energy comparison calculations
- Enforceable, specifiable and available for all manufacturers
- Energy consumption of the system. Underrated cooling towers will result in higher condensing temperature and increased power consumption

# Standards and Recommendation



- Eurovent thermal performance certification for open and closed type cooling towers

# Standards and Recommendation



- Eurovent thermal performance certification for open and closed type cooling towers:
  - Not applicable and available yet for adiabatic solutions
  - Not applicable and valid for field erected towers!!





# Drift Eliminator Efficiency



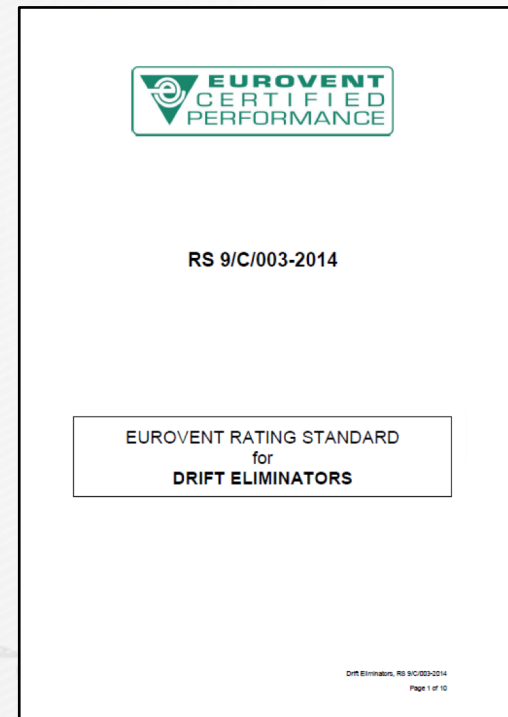
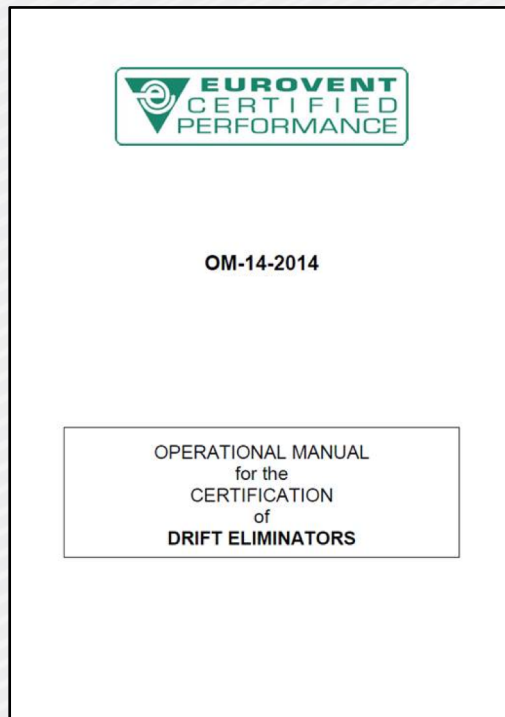
- Eurovent certification program for Drift Eliminators Efficiency:
  - Drift losses are a concern with regard to spread of **Legionella** bacteria
  - Eurovent set up a certification program for DE efficiency
  - Details: RS 9/C/003 & OM-14

# Drift Eliminator Efficiency



## Scope of the Certification

- Eurovent has a certification program for:

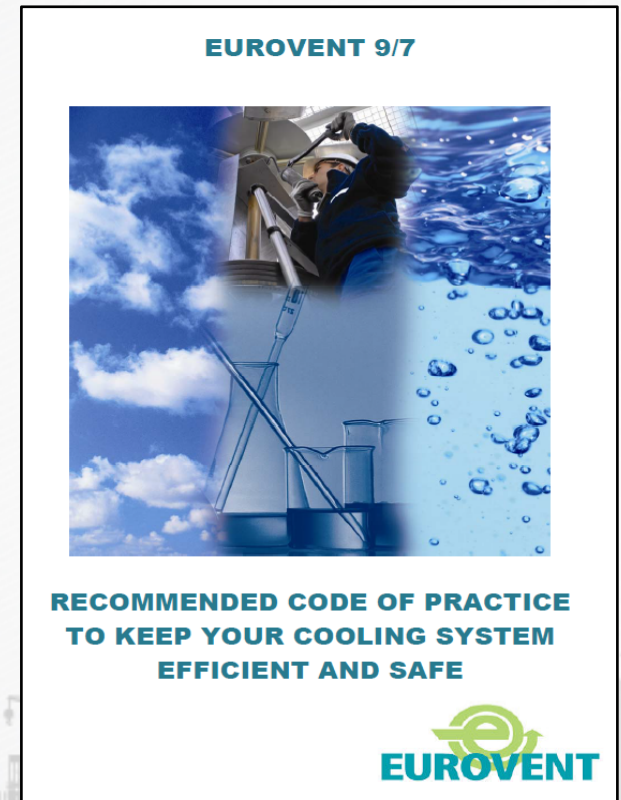


# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

- Recommended code of practice to keep your cooling system efficient and safe
- This guideline gives specific recommendations to operate the cooling tower safe with regard to Legionella





# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

Specific recommendations with regard to evaporative cooling equipment:

1. Access for inspection and maintenance:
  - Drift eliminators, water distribution system, drives, air inlet louvers, basin, strainers, fill, sound baffles and bleed lines.
  - Appropriate sized access doors or hatches min. 500 x 500 mm or min. 600 mm dia.
  - Larger equipment: Interior walkways, platforms, ladders and handrails.

# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

Specific recommendations with regard to evaporative cooling equipment:

### 2. Access for cleaning:

- Mechanical cleaning of the basin should be possible.
- Access to basin through access door or air inlet louvers.
- Easy flushing basins to one or more central points : **sloped basin design (no flat basins)**
- Mechanical cleaning water distribution system: Removable nozzles are preferred.

# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

Specific recommendations with regard to evaporative cooling equipment:

### 3. Design tower without water stagnation:

- Tower casing:
  - Should avoid stagnation
  - No slopes opposite water flow direction
- Water distribution: Drain when water circulation is stopped
- Basins: Have a drain connection in the lower part
- Piping: No deadlegs and (self)drainable



# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

Specific recommendations with regard to evaporative cooling equipment:

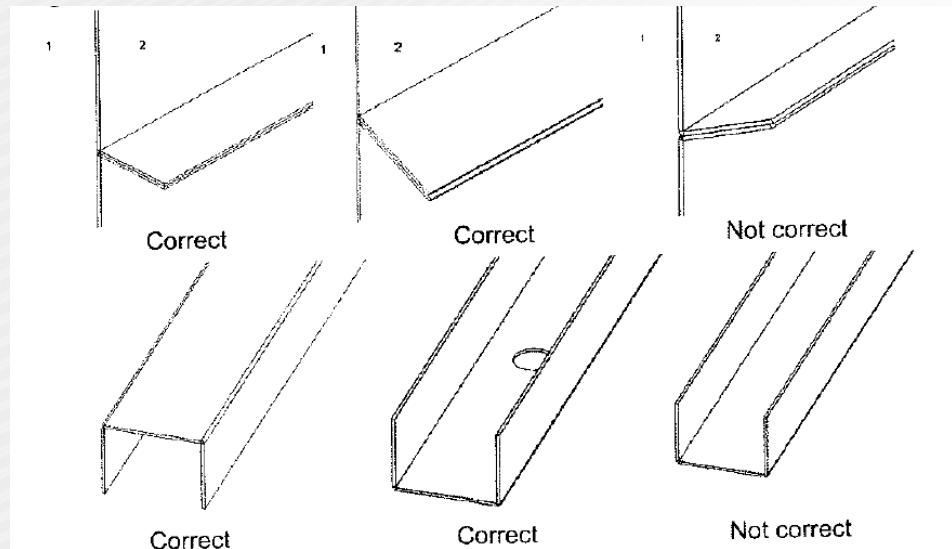
3. Design tower without water stagnation (cont'd):
  - Equalizing lines:
    - With sufficient shut off valves to isolate individual basins
    - Should have a drain connection
    - If possible the blow down should be installed in equalizing line to ensure regular flow through the piping

# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

3. Design tower without water stagnation (cont'd):
  - Casing: Shall comply with the below figures (theory)



Legend:

1 = external panel

2 = internal panel

Internal assembly of the tower's vertical panels

# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

3. Design tower without water stagnation (cont'd):
  - Casing: Shall comply with the below figures (in practice)



External panel



# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

3. Design tower without water stagnation (cont'd):
  - Casing: Shall comply with the below figures (in practice)



Internal panel



# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

3. Design tower without water stagnation (cont'd):
  - Water distribution:
    - Self drainable
    - Maximum 0.5 bar operating pressure
    - Nozzles selected for large water droplets, low pressure nozzles
    - Efficient drift eliminators



# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

4. Design tower shielding from sunlight and other external influences:
  - Exposure to sunlight enhances the development of many bacteria in particular algae
  - Development of algae, which is a nutrient for Legionella, needs to be avoided at all cost
  - Casing: Must be impervious for sun rays

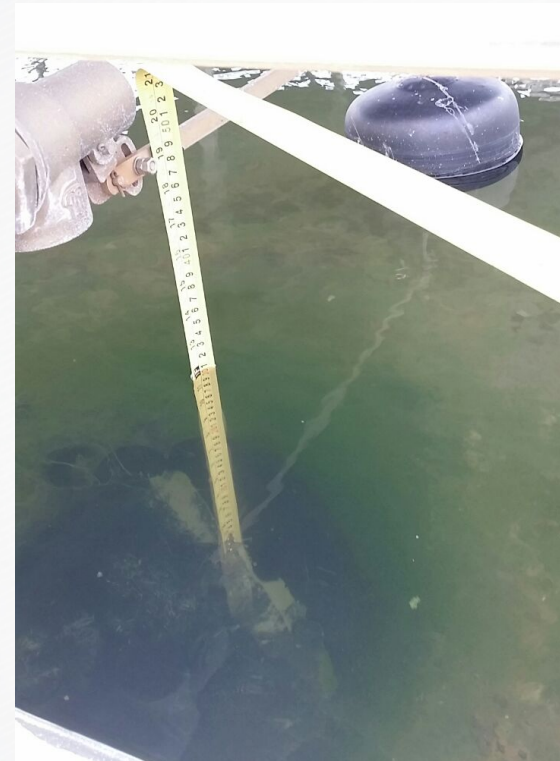


# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

4. Design tower shielding water from sunlight and other external influences (cont'd):
  - The basin should be shielded from exposure of direct sunlight by the use of louvers



# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

5. Small droplets create a risk for Legionella to be spread out:
  - Water spray system: Avoid high pressure, small droplet nozzles
  - Material drift eliminators : PVC or PP
  - Drift eliminators: To be high efficient and air velocity not to exceed the breakthrough velocity of the eliminator (3.5 – 6.0 m/sec)
  - Drift rate : certified by Eurovent
  - Achievable drift loss rates : 0.01 % of circulation rate

# Standards and Recommendation



## Eurovent 9/7 Guideline (2011)

### 6. Splash out:

- Splash droplets are usually thick and cannot be inhaled.
- Less concern for Legionella proliferation.
- Splash should be avoided:
  - Louvers
  - Windwalls
  - Situation with pump On and fans Off to be avoided





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