ISSN 1307-3729

REHVA

Federation of European Heating, Ventilation and Air Conditioning Associations

The REHVA European HVAC Journal

Volume: 52 Issue: 2 March 2015 www.rehva.eu

Towards nearly Zero Energy Buildings

Roadmap to nZEB

Building Automation & Control

Demand Controlled Ventilation

European Certification

Cooling Towers

Heat Pump Systems

Residential Air Handling Units

Our well-designed comfort modules are draught free, energy efficient and working in silence. Function and form in perfect harmony hardly noticeable. We have created well-balanced indoor climate for over 80 years and are represented in more than 40 countries. Learn more about our range of products at swegon.com

Parasol is a flexible comfort module with cooling, heating and ventilation. Through its 4 way spread it creates optimal indoor climate regardless of the installation placement in the room.

Swegon

The REHVA European HVAC Journal

www.rehva.eu

Volume: 52 Issue: 2 March 2015

Editor-in-Chief: Jaap Hogeling
jh@rehva.eu or j.hogeling@isso.nl

Associate Editor: Stefano Corgnati, Italy
stefano.corgnati@polito.it

General Executive: Süleyman Bulak

Editorial Assistant: Cynthia Despradel

REHVA BOARD

President: Karel Kabele

Vice Presidents:
Stefano Corgnati
Ioan Silviu Dobosi
Egils Dzelzitis
Frank Hovorka
Jarek Kurnitski
Manuel Carlos Gameiro da Silva

EDITORIAL BOARD - 2015

Francis Allard, France
Ahmet Arısoy, Turkey
Jan Aufderheijde, the Netherlands
Marianna Brodatch, Russia
Vincenc Butala, Slovenia
Francesca R. d'Ambrosio, Italy
Ioan Silviu Dobosi, Romania
Egils Dzelzitis, Latvia
Andy Ford, UK
Signhild Gehlin, Sweden
Jaap Hogeling, the Netherlands
Karel Kabele, Czech Republic
Jarek Kurnitski, Estonia
Eduardo Maldonado, Portugal
Livio Mazzarella, Italy
Renato Merati, Italy
Birgit Müller, Germany
Natasa Nord, Norway
Bjarne W. Olesen, Denmark
Branimir Pavkovic, Croatia
Dušan Petráš, Slovakia
Olli Seppänen, Finland
Jose Tadoro, Spain
Branislav Todorovic, Serbia
Maija Virta, Finland
Peter Wouters, Belgium

ADVERTISEMENTS

Ms Cynthia Despradel
cd@rehva.eu

SUBSCRIPTIONS and CHANGES OF ADDRESSES

REHVA OFFICE:
Washington Street 40
1050 Brussels, Belgium
Tel: 32-2-5141171, Fax: 32-2-5129062
info@rehva.eu, www.rehva.eu

PUBLISHER

TEKNİK SEKTÖR YAYINCILIĞI A.Ş.
Balmumcu, Barbaros Bulvarı Bahar
Sk. Karanfil Apt. No:2/9
Beşiktaş /İstanbul, Turkey

REHVA Journal is distributed in over 50 countries through the Member Associations and other institutions. The views expressed in the Journal are not necessarily those of REHVA or its members. REHVA will not be under any liability whatsoever in respect of contributed articles.

Cover photo: iStockphoto

Contents

Download the articles from **www.rehva.eu** -> REHVA Journal

Advertisers

Next issue of REHVA Journal

Instructions for authors are available at **www.rehva.eu**
(> Publications & Resources > HVAC Journal > Journal information)

Send the manuscripts of articles for the journal to Jaap Hogeling **jh@rehva.eu**


WE EMBRACE AND PRACTICE INDUSTRY CODE OF ETHICS
Innovative Products
For Sustainable Environment
Choose Friterm Class A
Products in Your Applications
Unit Cooler
"NH3 Ammonia and Glycol Coolers with Stainless Steel Tubes"
Horseshoe Heat Pipe
Heat exchanger for heat recovery systems
V Type Dry Cooler
Horizontal Type Air Cooled Condenser
EUROVENT CERTIFIED PERFORMANCE
www.eurovent-certification.com
CERTIFIED GEOMETRIES | ID No
M2522-3/8" | 14.06.001
F3228-12mm | 14.04.002
F3833-12mm | 14.04.003
F3833-15mm | 14.04.004
M4035-12mm | 14.04.005
M4035-15mm | 14.04.006
Our Events in 2015
✓ CLIMATE WORLD | 3-6 March | Moscow | Hall 2/B42
11th International Specialized Exhibition
✓ ISH | 10-14 March | Frankfurt | Hall 10.2/D82
The Bathroom Experience, Building, Energy, Air-conditioning Technology, Renewable Energies
✓ ICCI | 6-8 May | Istanbul | Hall 10/C-106
21th International Energy & Environment Fair and Conference
✓ POWER-GEN Europe | 9-11 June | Amsterdam
Renewable Energy World Conference & Expo
FRITERM®
since 1979
MEMBER OF EUROVENT
TEİD
rehva
SOSİAD
TSEK
CE
İSKİD
ISKAV
Head office / Factory:
İstanbul Deri Organize Sanayi Bölgesi Dilek Sokak
No:10 X-12 Özel Parsel Tuzla 34957 İstanbul / TURKEY
Tel: +90 216 394 12 82 (pbx) Fax: +90 216 394 12 87
info@friterm.com
www.friterm.com
twitter.com/friterm
facebook.com/friterm
linkedin.com/company/friterm

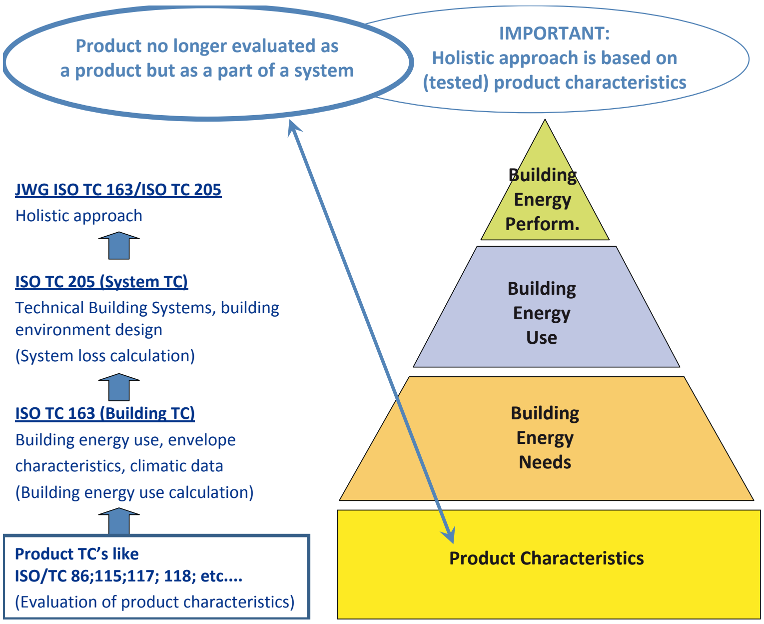
From product to system and building performance declaration and certification.

All new buildings after 2020 in Europe Nearly Zero Energy.

JAAP HOGELING
Editor-in-Chief

One focus of this issue of the REHVA Journal is on energy efficiency of air conditioning products, particularly how certified performance data can support high performance buildings. A second focus is on contributions to reach out to the nZEB. A roadmap towards nZEB and also related important attention to Building Automation and Controls (BAC), Commission of demand controlled ventilation systems and the impact of EU legislation on HVAC installations in buildings.

Continuity from the product to the system energy performance assessment



The building industry and product suppliers need to operate in a very rapidly changing environment. Product complexity is going up, but a new product and a new concept need to be properly characterized technically. The amount of technical data needed to describe material or product performance according to a new set of rules or conditions is increasing manifold. A large choice of design, materials, components and equipment being part of the ultimate solution, the quantity of alternative product and performance data to design has increased tenfold due to this wide and rich market offering.

Products cannot longer be considered as just parts from the shelf. Products are more and more be considered as sub-systems, as they are including control-devices, electronics, storage element, other auxiliary functions, etc. This means that a product performance declaration should include these elements or specify these integrated elements in such a detail that the EPB-assessment procedures can handle this. The set of EPB-standards (see REHVA Journal 2015-1) currently developed in Europe at CEN level and globally at ISO level (ISOTC163 and 205) indicate clearly which product data are required to assess the energy performance of buildings.

Energy efficiency is at the heart of the European Union's 2020 Strategy for smart, sustainable and inclusive growth and of the transition to a resource efficient economy. Improved energy efficiency is one of the most cost effective ways to enhance the security of energy supply, and to reduce emissions of greenhouse gases. In many ways, energy efficiency can be seen as Europe's biggest energy resource. This is why the Union has set itself a target for 2020 to save 20% of its primary energy consumption.

Substantial steps have been taken towards this objective. Directives and regulations to improve the performance of products for cooling and ventilation of building are an essential part of the EU's activities in this area. Eco-design regulations for energy related products, regulations for energy performance of buildings and the requirements for nearly zero energy buildings by 2020 and F-gas regulations are examples of the strong commitment to reduce energy consumption of buildings and GHG emissions. It is a challenge for all stakeholders, including those responsible for (national) building legislation and codes to harmonize all these actions. The ruling should allow for an flexible and transparent performance based approach giving all opportunities to product and system innovation avoiding barrier of trade within Europe and where achievable globally! ■

Roadmap to nearly Zero Energy Buildings in 2020

In 2014 a roadmap study has been performed for nearly Zero Energy Buildings (nZEBs) in the Netherlands. Current situation on nZEBs in the Netherlands and Europe were discussed; EU countries are at various stages of development on their nZEB definition. Existing Dutch nZEB show good technical potential; most promising building energy saving measures are ground source heat exchangers and aquifers systems (including heat pumps). The Dutch energy infrastructure (gas and electricity) is discussed, focusing on future policies and implications for nZEBs. Smart grids including local energy exchange will play a major role for nZEBs. The financial feasibility of three nZEB scenarios is compared to a reference scenario for a middle sized office building in a case study. Energy saving measures in the nZEB scenarios lead to an average primary energy consumption of 20 kWh/m²a. LCC (Life Cycle Cost) calculations including additional gains (increased productivity, reduced sick-leave) are executed to determine the cost-optimality of three nZEB scenarios. Results show that nZEBs are financially feasible when benefits are included.


KRISTIAN GVOZDENOVIĆ[1,2]
BSc

WIM MAASSEN[1,2,3]
MSc PDEng


WIM ZEILER[1]
Prof

HANS BESSELINK[2,3,4]
BSc

[1]Royal HaskoningDHV
[2]Eindhoven University of Technology (EUT)
[3]TVVL
[4]REHVA

This study was commissioned by Royal HaskoningDHV, TVVL and REHVA. The study was executed by Royal HaskoningDHV in cooperation with Eindhoven University of Technology. The aim of the study was to prepare a roadmap for nZEBs towards 2020 in the Netherlands. [1] TU/e student Kristian Gvozdenović contributed to this study with an internship at Royal HaskoningDHV. In April 2014 the nZEB project has been presented at the REHVA Technical Research Committee during the annual REHVA meeting. Kristian also competed with his work in the REHVA the Student Competition. [2] Master students from all over Europe presented their works, after which the students were assessed. The judge found the nZEB study very useful as it covered a wide range of topics. TVVL Magazine published a Dutch article on the nZEB Roadmap in September 2014.[3] On the 26th of January 2015 the study was also presented to the 63 state members of ASHREA Associate Society Alliances in Chicago. The full report is available at on TVVL website*.

Introduction

In 2010 the European Commission launched the EPBD-recast (Energy Performance on Building Directive) with the main targets to reduce CO_2 emissions with 90% by 2050 compared to CO_2 levels in 1990. The EPBD requires all newly built buildings to be nZEB in 2020 for different building functions. Existing buildings will also have to comply with this regulation towards 2050. [4]

* http://www.tvvl.nl/website/kennisnet/publicaties/technische-publicaties/i-06-roadmap-to-nearly-0-energy-buildings

In 2012 the Dutch government presented a plan to implement nZEB regulation for the coming years. [5] In the nearby future (2015/2017) building performance requirement will be stricter for residential buildings and non-residential buildings. In 2020 all newly build buildings have to comply to the nZEB regulation with an EPC close to zero.

To support future policy on energy performance, this study provides information which can be used to determine technical and financial feasibility of nZEBs in the Netherlands. The financial feasibility of building energy saving measures is the foundation to determine an nZEB definition in the Netherlands. Nowadays the main focus is on cost reduction; however when benefits of healthy buildings are incorporated in LCC calculations, it will stimulate innovations and make nZEBs far more attractive. In the study case on nZEB offices, LCC calculations are be performed to determine the cost-optimality for nZEB scenarios with benefits, concerning increased productivity and reduced sick leave.

nZEB definition

European Union member states have to define an nZEB definition for their country in the coming years. A preliminary definition on an nZEB is stated in the EPBD recast. [6] It is specified that by 31 December 2020 all new buildings shall be nZEB and governmental buildings, occupied and owned by public authorities, will have to be nZEB by 31 December 2018. The definition of nZEB is given in Article 9 of the EPBD:

> *"Nearly Zero Energy Building: Technical and reasonably achievable national energy use of > 0 kWh/(m²a) but no more than a national limit value of non-renewable primary energy, achieved with a combination of best practice energy efficiency measures and renewable energy technologies which may or may not be cost optimal."*

Currently no nZEB definition has been set by the Dutch government. The definition of 'nearby energy production' will be critical for buildings in urban areas, since high building density creates enormous challenges for on-site renewable energy production. In order to be able to contractually link a 'nearby' renewable energy production capacity to a building (site), it is a prerequisite to have fitting national legislation. This legislation should allow allocating new capacity to the building/development with a long term contract, assuring that investment on that new capacity will lead to a real addition to the grid or district heating or cooling mix. To ensure that future nZEB buildings and renovated buildings utilize as much on-site renewable energy as possible, instead of buying renewable energy from the grid, it is recommended to consider a legislative system were the amount of on-site sustainable energy yield is linked to the building density of the specific area. For example, a certain percentage of renewable energy may be contractually imported when a building is built in a dense area.

Current situation

In the Netherlands building energy performance is expressed in an EPC score, which includes energy performance of installations (heating, cooling, hot tap water, ventilation, and lighting) and levels of insulation (roof, walls, floor, and windows). The EPC for has been introduced in 1995 and been tightened onwards. Building companies have agreed with the Dutch government on further tightening of the requirements in the near future, in order to move towards nZEBs. The EPC requirement for the residential sector is scheduled to decrease to 0.4 in 2015. For the non-residential sector, EPC requirements are scheduled to be lessened by 50% in 2017 compared to the requirements of 2007. In addition to the EPC requirements, minimum requirements for building components (R_c-value and U-value) are in place.

Renovation of existing buildings plays an important role in obtaining an energy neutral building stock. The renovation depth and rate will have to be increased significantly to achieve the goals set in 2050 (all buildings nZEB) according to European studies. [7]

A "deep renovation track", focusing on energy efficiency with high use of renewable energy, is recommended because it can be considered as a financially viable route, meeting CO_2-targets. The renovation rate needs to be increased from the current rate of around 1% of total floor area renovated annually, to 2.5% – 3% annually from 2020 onwards. [8]

Examples of current nZEBs in the Netherlands show the technical feasibility of different buildings types. The nZEB designs are mainly based on the so called Trias Energetica approach: first reducing energy demand, than use renewable energy sources, and if necessary use fossil fuels as efficiently as possible. Example nZEB buildings have very good insulation (R_c-value up to 8 (m²K)/W), triple glass and are built extremely airtight. Common installations are ground source exchangers and aquifers (including heat pump), mechanical ventilation with heat recovery, and large scale solar systems (PV and solar collectors).

Energy infrastructure in the Netherlands

Energy infrastructure is of crucial importance for nZEBs because of the two-way supply/demand characteristic; this requires an advance network were energy exchange and storage is possible. The transition from a supply-demand system to smart grids is required; this is a major technical challenge that has to be overcome.

The Netherlands has an extensive gas infrastructure and the largest gas producer in the EU. The 'gas-roundabout' (the Netherlands as gas hub of Europe) and sustainable 'green gas' projects show a promising future for gas in the Dutch built environment.

The electricity grid in the Netherlands faces a major transition; from a supply-demand system (using mainly fossil fuels) towards a supply-dependent system (using fluctuating renewable energy sources). Electricity networks, 'smart grids' will play an important role in the future; the average energy consumer will also be an energy producer, storage systems and local energy exchange will be important for energy management systems.

Furthermore electrical vehicles and smart appliances will be implemented. Currently many smart grid projects are carried out; these projects range from local smart grids for residential areas and business parks, to initiatives to create an electrical storage system for electric taxi services.

nZEB potential in the Netherlands

The potential for nZEBs in the Netherlands is mainly determined by the availability of building energy saving measures. Currently, measures are applied according to the Trias Energetica method (**Figure 1**). An adapted version of the Trias Energetica method should be used in the future because of changing conditions for buildings. First of all, the focus should be on adapting the energy demand to the building user. Awareness should be raised and energy saving behaviour should be stimulated by the government. Another step that is added is the implementation of energy exchange and storage systems (smart grids): these become crucially important for nZEB because of the intermittent characteristics of most renewable energy sources.

Energy exchange has great potential for reducing energy demand, especially when buildings with a specific heat or cold demand are combined (e.g. nursing homes and ICT data centres). Currently a study is being performed, investigating the potential for direct (hourly) and indirect (seasonal) thermal energy exchange for buildings in urban areas. The calculation tool will allow to calculated energy performance of three buildings separate including a wide variability in energy exchange concepts including generation (centralized/decentralized), distribution (smart/ conventional thermal grid) and seasonal storage.

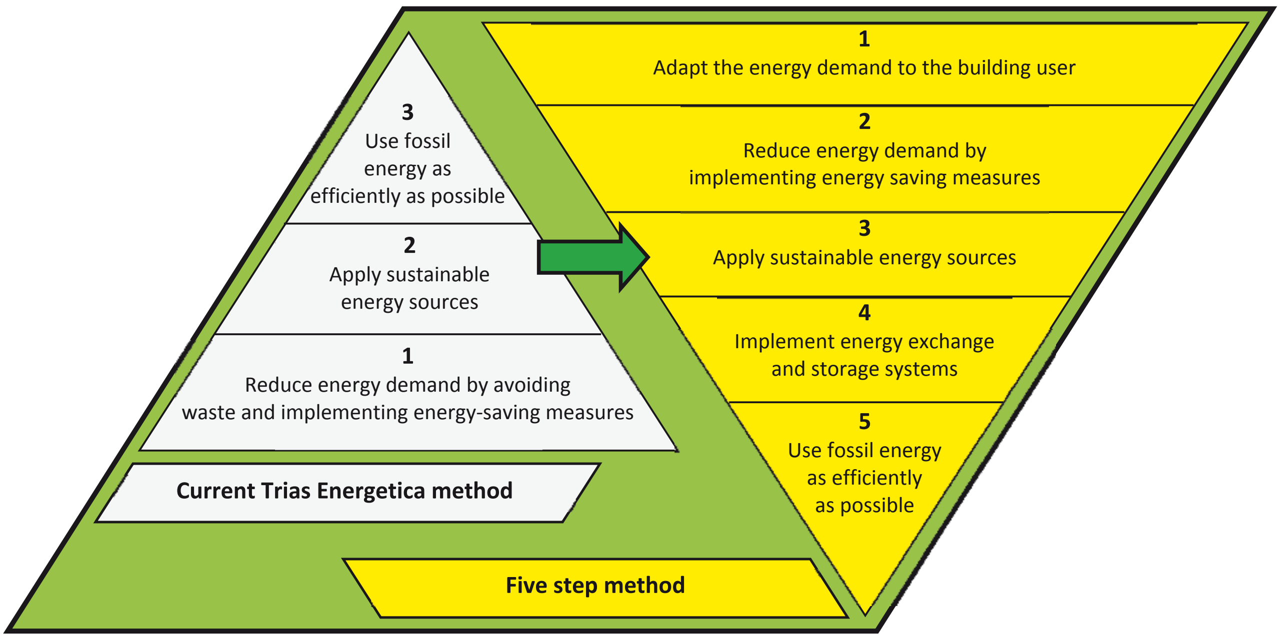


Figure 1. The Trias Energetica method and the Five step method.

Study case: cost optimality for Dutch nZEB scenarios

Financial feasibility of nZEBs in the Netherlands is demonstrated in a study case for a middle sized office building (3,000 m²). The goal is to show that energy saving measure can be cost effective when additional gains are included.

Figure 2 shows the Life Cycle Costs (LCC) versus the annual primary energy demand. Currently (2013) LLCs and primary energy demand are high. By applying building energy saving measures, buildings within the "cost optimal range" are already possible. By creating nZEBs (by applying more energy saving measures) LLCs rise. By including additional benefits of a healthy nZEBs (increased productivity, reduced sick leave) into the LCC calculation, LLCs of nZEBs are reduced.

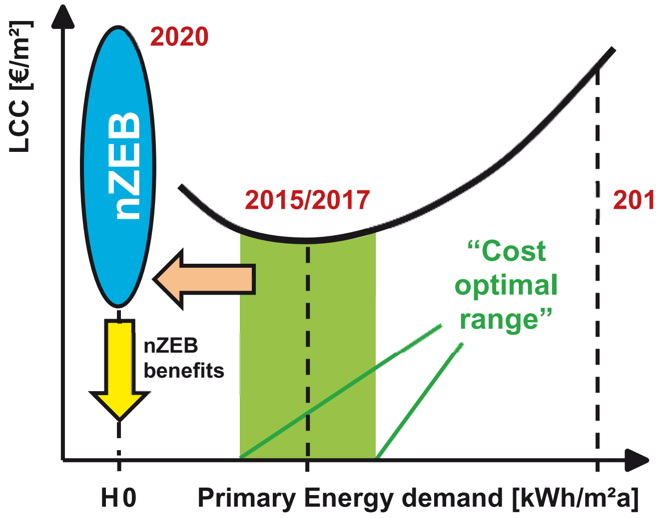


Figure 2. Schematic representation of LCC in current and future situation.

An LCC calculation with a period of 30 years is performed comparing three nZEB scenarios to a reference case. The calculation method is based on standard EU approach, using Dutch principles (from previous studies [9][10]) on cost optimality of energy saving measures.

The reference building has an energy performance that applies to coming EPC demands for office buildings (EPC = 0.7). The nZEB scenarios have been composed applying energy saving measures according the Five step method (**Figure 1**) and using solutions applied in existing nZEB projects. The nZEB scenarios are well insulated and built airtight reducing energy demand. Installations used are ground source heat exchanger heat pumps, aquifer heat pumps and large scale PV application. An average primary energy demand 18.5 kWh/m²a was obtained for the three scenarios.

Additional gains that have been included in the LCC calculation are increased productivity and reduced sick leave. Scientific research has proven that buildings with a healthy indoor climate (high ventilation rate) increase productivity and reduce sick leave. [11]

Results of the LCC calculation show that the nZEB scenarios are not cost effective yet without additional gains. Average additional costs for the energy saving measures are 15 to 50 €/m² higher (financial analysis) and 100 to 140 €/m² (macro-economic analysis) higher compared to the reference case. When additional gains are added, the total LCC cost drops significantly for both analysis (700 up to 1,100 €/m²). In the sensitivity analyses, the LCC gap between the reference building and the nZEB scenarios fluctuates for both analyses; however they do not influence the positive outcome of the LCCs for the nZEB scenarios.

Conclusion and recommendations

This study provides insight on current status, technical and financial feasibility of nZEB in the Netherlands.

Currently no nZEB definition is specified by the Dutch government; based on this study an nZEB definition is provided for middle sized office building. Requirements for such type of building should apply to a primary energy limit of 20 kWh/m²a. Energy saving measures that can be utilized to achieve this limit are: heat & cold storage systems (aquifer including heat pump) in combination with large scale PV cell application.

It is unattractive to become an energy producing building under current regulation, because of low energy tariffs for PV generation (if $E_{electricity\ production} > E_{electricity\ consumption}$). When current regulation on energy tariffs still applies in the future, it is recommended to define nZEB as buildings with a higher primary energy demand limit than EPC = 0: this can prevent energy efficient measures (e.g. PV panels) from becoming financially unattractive.

Energy infrastructure will play an important role to achieve nZEBs in the future. Smart grids will have to be adapted to on-site and nearby renewable energy production. Furthermore energy exchange and energy storage will be integrated in local networks.

Existing buildings will have to undergo a “deep renovation track” and the renovation rate has to be increased to 3% in order create a complete nZEB building stock in 2050.

For buildings in urban area (high building density), it is proposed to apply fitting legislation to stimulate on-site production and minimize the possibility to purchase nearby renewable energy (e.g. wind power) from distant locations. It is advised to consider a legislative system determining on-site sustainable energy yield depending on the building density.

Finally the Dutch EPC is a policy tool and does not represent the primary energy demand in a straightforward way. Energy saving measures, such as applying PV cells on large scale, can negatively influence the EPC score.

Future studies

Royal HaskoningDHV is currently working in cooperation with the Eindhoven University of Technology on a follow-up project on sustainable (re)development of urban districts with special focus on nZEBs. Kristian contributes to this project with his EUT graduation project on a Design methodology for energy positive buildings and communities. A method and a tool are being developed to assess and compare energy exchange, storage and generation concepts for several building functions in urban areas.

Furthermore the Eindhoven University of Technology is a partner in an EU wide consortium of Universities and Knowledge Institutes that submitted the EU Horizon 2020 research project proposal DeDeZEB (Development and Demonstration of ZEBs with reduced cost) in February 2015. The DeDeZEB project (proposal) is led by Prof Jarek Kurnitsky and focusses on solution development of large scale and beyond nearly zero buildings. This includes demonstration in districts and non-residential buildings showing cost reduction and realizing market uptake. ■

References

Gvozdenović K., Maassen W.H., Zeiler W., 2014, TVVL Roadmap to nearly Zero Energy Buildings in 2020

Gvozdenović K., 2014, Roadmap to nearly Zero Energy Buildings in 2020; REHVA Student competition summary, Dusseldorf 2014 (http://www.rehva.eu > news (http://tinyurl.com/l9lwde8)).

Gvozdenovic K., Maassen W.H., Zeiler 44 TVVL Magazine | 09 | 2014 ONDERZOEK W., 2014, Towards nearly Zero Energy Buildings in 2020 in the Netherlands, Proceedings World Renewable Energy Congress XIII 2014, August 2014, London

EPBD 2010, EPBD recast, Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast), Official Journal of the European Union, (2010) 18/06/2010.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

BENG, 2012, Nationaal Plan voor het bevorderen van Bijna-Energie Neutrale Gebouwen (BENG) in Nederland, september 2012.
http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2012/09/28/nationaal-plan-bijna-energieneutrale-gebouwen.html

REHVA, 2010, Journal of the European Union, (2010) 18/06/2010. Rehva Report - nZEB Technical Definition and System Boundaries for Nearly Zero Energy Buildings. (Federation of European Heating, Ventilation and Air Conditioning Associations) Report no. 4. (2013)

BPIE - A Guide Developing Building Renovation Strategies for Building Energy Renovation, delivering article 4 of the Energy Efficiency Directive. Published February 2013, ISBN: 9789491143076
http://www.bpie.eu/documents/BPIE/Developing_Building_Renovation_Strategies.pdf

Klinckenberg F., Forbes Pirie M. McAndrew L., 2013, The Policy Partners, Renovation Roadmap for Buildings
http://www.eurima.org/uploads/ModuleXtender/Publications/96/Renovation_Roadmaps_for_Buildings_PP_FINAL_Report_20_02_2013.pdf

Clocquet R., Maaijen H.N., Maassen W.H., 2013, EPC aanscherpingsmethodiek woningbouw en utiliteitsbouw, AgentschapNL Eindrapport proj.nr. 9X2344.G0, 16 mei 2013
http://www.rvo.nl/sites/default/files/2014/01/EPC%20aanscherpingsmethodiek%20woningbouw%20en%20utiliteitsbouw.pdf

Loos v.d. R.M.M., Kuijpers-van Gaalen I.M., 2013, Kostenoptimaliteit energieprestatie eisen Nederland. Verslaglegging kostenoptimaliteit voor EU. Rapport E.2012.1094.00.R001,11 maart 2013.
http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2013/03/20/verslaglegging-kostenoptimaliteit-voor-eu-definitief.html

Bergs J., 2010, The effect of healthy workplaces in the well-being and productivity of office workers
http://www.plants-for-people.org/eng/science/jbergs_symposium_paper.htm

Towards nZEB with BAC

JEAN DANIEL NAPAR
Chief Technology Officer
SIEMENS Building Technology
France
dan.napar@siemens.com
Convenor CEN/TC247/WG6

ROLAND ULLMANN
Innovation and Industry Affairs
SIEMENS Building Technology
Switzerland
roland.ullmann@siemens.com
President CEN/TC247

WAECHTER KLAUS
Global Standardisation Manager
SIEMENS Building Technology
Switzerland
waechter.klaus@siemens.com

The Energy Performance of Buildings Directive (EPBD recast) is a very important step in the effort of the European Union to improve the energy efficiency of the large building stock in Europe, and to establish Energy Performance levels requirements for the new buildings, opening the route towards nZEB, and reduction of CO_2 emission as well. This implementation of EPBD recast will lead to the final goal for the occupants of the buildings by offering a healthy and productive environment at their working places and in their homes. One of important issues raised in EPBD recast is the concept of nZEB. It is the intention of this article to describe ways to reach this goal and the contribution of BAC for Energy Performance of Buildings in general and for nZEB in particular. The focus of this article will be to show the place BAC in the EPB standards developed under EU Mandate 480, work carried out by CEN/TC247 in charge for BAC within this Mandate.

In this article: BAC stands for Building Automation and Control and nZEB stands for Nearly Zero Energy Building (as given by the EPBD (2010/31 / EU) in article 2)

Various indicators and requirements are to be combined to meet the definition of a building with energy use of almost zero (nZEB), a building that has a very high energy performance determined in accordance with Annex I of the EPBD.

Under Mandate 480 given to CEN, about 40 EN standards were updated, merged or developed to harmonize the energy calculation methods for buildings within Europe. This is to increase the transparency and coherence of the calculation methodology used today and tomorrow within the European countries. BAC (based on the standards developed by CEN/TC247) contributes with 7 standards and 7 Technical reports. The main standard is EN 15232 which includes a comprehensive and structured (for calculation methodology) list of BAC functions that are intended to be used in the whole EPBD Standards set. Where the contribution of BAC in all modules of the new MODULAR STRUCTURE OF EPBD Standards Set is applicable. BAC is identified as Module M10 and covers the modules M10-1, M10-5, M10-6, M10-7, M10-8, M10-9 and M10-10 vertically, but consistently will be present in ALL Modules Mx-5, Mx-6, Mx-7 and Mx-8.

Improved energy efficiency in buildings is a high priority among European decision makers, as well as building owners. Presently there is one European standard that assists building owners to ensure that a new building being built, or an existing building being refurbished, will have the best available BACS technology to save energy – i.e. the EN 15232 – Energy performance of buildings – Impact of Building Automation, Controls and Building Management standard. Two standards (EN 15500 and EN 12098-x) complete the set of functions of EN 15232 and give the CONTROL INPUT DATA for other modules. For BAC standards, the set is completed by new subjects: Contribution of Building Management System (or Technical Building Management TBM) to optimize the energy use of technical building systems and the Inspection for Building Automation and Control. BAC performance has a tendency to decline over time if not actively checked, maintained and adapted to the actual use of the building (independent of the building type).

However, there are no standards available that address the difficult challenge of building owners to ensure that their buildings keep performing as well over time, or better, comparing to the performance when they were first commissioned.

Insight nZEB

Different requirements are combined to a coherent assessment of a nearly Zero-Energy Building (nZEB).

A nZEB means a building that has a very high energy performance (very low amount of energy required associated with a typical use of the building including energy used for heating, cooling, ventilation, domestic hot water and lighting), taking into account:

- indoor environmental conditions;
- thermal characteristics of the building, building elements having a significant impact on the energy performance of the building envelope;
- HVAC installation, domestic hot water supply, built-in lighting installation, optimizing the energy use of technical building systems through BACS;
- active solar systems and other systems based on energy from renewable sources;
- district or block heating and cooling systems.

The very low amount of energy required by a nZEB shall be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

Globally, we could identify 3 requirements in the assessment methodology step by step 'from the energy needs to the overall energy performance expressed in primary energy use'.

Only if the requirement of each step is reached, then the building can be qualified at the end as 'nZEB'.

The three requirements are:

- The building fabric (Energy needs) reflecting the performance of the building fabric characterised by the energy needs. The energy needs are based on local conditions and the designated function of the building and the need to guarantee adequate indoor environmental conditions in order to avoid possible negative effects such as poor indoor air quality (due to lack of ventilation) or hydrothermal problems (such as mould).
- The total primary energy use The second requirement is reflecting the performance of the technical building systems (HVAC installation, domestic hot water supply, built-in lighting installation, BAC) characterized by the energy use.

Technical buildings systems are linked to one or more energy carrier (e.g. gas boiler; auxiliary consumption). To add the different energy carriers in a coherent manner the second requirement is expressed in total primary energy.

- Non-renewable primary energy use without compensation between energy carriers

The third requirement is reflecting the contribution of energies from renewable sources (e.g. active solar systems or other systems based on energy from renewable sources, district or block heating and cooling systems) characterized by the non-renewable primary energy consumption

Insight BAC

The key-role of Building Automation and Control and BMS is to insure the balance between the desired use of a zone, human comfort and desired productivity of humans working/living in zones - which must be optimal, and energy used to obtain these goals - which must shall be minimal!

The scope of BAC and TBM covers in accordance with their role from one side all installed and involved Technical Building Systems (where the effect of the BAC is used in the calculation procedures) and from another side the global overall optimization Energy Performance of a Building.

We could identify several categories of controls:

a) Technical Building Systems specific controls; these controllers are dedicated to the physical chain of transformation of the energy, from Generation, to Storage, Distribution and Emission. We find them in the modular structure of EPBD Standard Set matrix starting with the Modules M3-5 to M9-5 and finishing with M3-8 till M9-8. We could consider that there exist one controller per module or several modules. More often, these controllers are communicating between them via a standardized open bus, such as BACnet, KNX or LON. Control functions may reside in products or components which are described in EN ISO 16484-2, -3 and -4.

b) BAC controls function to coordinate among different building services like BAC used for all or several Technical Building Systems who do multidiscipline (heating, cooling, ventilation, DHW, lighting…) optimization and complex control functions. For example, one of them is

   – INTERLOCK, a control function who avoids heating and cooling in same time

   – COORDINATION of "light & blind & HVAC" control systems that can result in optimization of light emission in zones (mix of daylight and artificial light)

   – ENABLING users to access set point adjustments that avoid infringements between e.g. heating and cooling set points

c) If all Technical Building System are used in the building, we have (depending of the size of the building) a Technical Building Management System. Specific global coordination functions are implemented, necessary to reach the key-role mentioned above. Usually, in this case, an interrelation with the Building as such (Module M2) will occur, mainly to take in consideration the building needs; for example due to outside temperature, taken into account the inertia of the building when the control will reach the set point in a room.

In a Control System dedicated to a Building, who is BAC and TBM we can distinguish three main characteristics:

1° CONTROL ACCURACY which is the degree of correspondence between the ultimately controlled variable and the ideal value in a feedback control system. The controlled variable could be any physical variable such as a temperature, humidity, pressure, etc. The ideal value is in fact the SET POINT established by the user (occupant) when he determines his level of comfort. It is clear that the entire control loop is concerned with all its active elements, such as sensors, valves and actuators. Specific equipment will require a specific controller. For hydronic systems, like the energy carrier hot water, an important issue is the balancing of the hydraulic circuits. For that purposes, balancing hydraulic valves are needed.

The Control Accuracy for a temperature is defined by two components: The temperature Control Accuracy (CA) is dependent upon Control Variation (CV) and Control Set point Deviation (CSD) as described in the main text of the standard prEN 15500:2014. The compliance with CA is also defined in the standard. This is an important input for prEN 15316-2, where the effect of the control for heating, cooling and ventilation is taken into account. The same standard (prEN 15500:2014) describes also the 4 operations modes who deal with the levels of temperatures: Comfort, Pre-comfort, Economy and Frost Protection. These 4 predefined operation modes are parameters that could be set by the users (occupant) – the temperature allocate to each operation mode. These operations modes are important for the control strategy used for intermittence, which will be described below.

2° CONTROL FUNCTION is the ability of a controller (or set of communicative controllers) to perform a determined task(s) – as described in ISO 16484 series of standards. Usually the functions implemented in the controllers are parametrable or free programmable. The functions could be performed by a single controller or by a set of communicative controllers. A controller could perform several functions.

The CONTROL FUNCTIONS present in a BAC or TBM, are present in prEN 15232:2014 Table 1 in prEN15232 starts with Heating Emission, Distribution, Storage and Generation (M3-5, M3-6, M3-7, M3-8) follow by Domestic Hot Water, Cooling, Ventilation and Lighting (M9-5, M9-6, M9-7, M9-8). Each function is described in detail, in accordance with the type (level) of the function: from the lower type (NO AUTOMATIC CONTROL Type=0) to most advanced types. For each function, an IDENTIFIER who is the software language for BAC and TBM is also defined, as the destination of the module where the control function gives his effect.

An example is given in **Table 1**, as abstract from prEN 15232:2014:

Table 1. Example of the CONTROL FUNCTIONS organized in the matrix given by Modular Structure of EPB standards.

Automatic control		
1	**Heating control**	
1.1	**Emission control**	HEAT_EMIS_CTRL_DEF M3-5
		The control system is installed at the heat emitter at room level (radiators, fan-coil unit, indoor unit), for case 1 one system can control several rooms
	0	No automatic control of the room temperature
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098-1 or EN 12098-3
	2	Individual room control: By thermostatic valves or electronic controller
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature set point)
	4	Individual room control with communication and presence control: Between controllers and BACS; Demand / Presence control performed by occupancy

For practical reasons, four different BAC efficiency classes (A, B, C, D) of functions are defined both for non-residential and residential buildings. This is the fastest way to specify a BAC or a TBM.

- Class D corresponds to non-energy efficient BAC. Building with such systems shall be retrofitted. New buildings shall not be built with such systems.
- Class C corresponds to standard BAC.
- Class B corresponds to advanced BAC and some specific TBM functions.
- Class A corresponds to high-energy performance BAC and TBM.

Having a poorly performing building/installation due to a lot of reasons, and mainly due to the inconsistency between the key phases of the construction (retrofit) a building which is design, commissioning and use, we have to realise that the BAC and TBM cannot change a bad building service design into an efficient operation!

Unfortunately (and this happens too often), the worst case (**Figure 1**) is when:

- What was DESIGNED
- What was INSTALLED
- What was planned as USE

ARE DIFFERENT FROM ONE STEP TO ANOTHER!

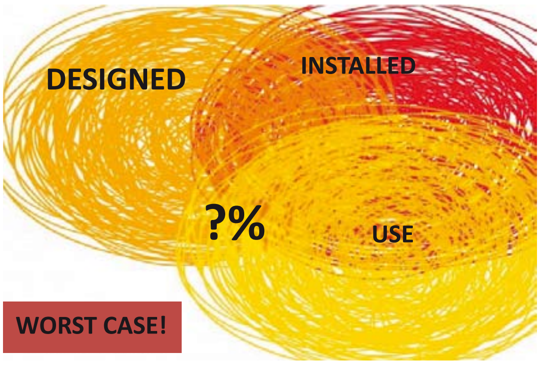


Figure 1. The worst case.

3° CONTROL STRATEGY is the set of methods employed to achieve a given level of control to reach a goal. Optimal control strategies deliver a desired level of control at a minimum cost. A CONTROL STRATEGY could consist by a CONTROL FUNCTION or a group of CONTROL FUNCTIONS.

An example of a CONTROL STRATEGY consist by a CONTROL FUNCTION is OPTIMUM START, OPTIMUM STOP, Night SET BACK described in the standards prEN 12098-1 and prEN 12098-3. The Timer function is described in prEN 12098-5.

Another example of a CONTROL STRATEGY realized by a group of CONTROL FUNCTIONS is the CONTROL STRATEGY used by INTERMITENCE. This function uses several CONTROL FUNCTIONS, OPERATION MODES, OPTIMUM START-STOP and TIMER FUNCTIONS the same time. All elements together are called either Building Profile or User Pattern. Usually, to implement such Building profile, a TBM is a prerequisite.

The most important CONTROL STRATEGY described and implemented in prEN 15232:2014 is DEMAND ORIENTED CONTROL. Usually these strategies implement the sense of the energy flow (from GENERATION to EMISSION) with flow of calculation (from building needs to delivered energy). Usually for this complex CONTROL STRATEGY, a TBM is necessary with a distributed specific control for each Technical Building System who communicates in system architecture via a communication standardized bus such as BACnet, KNX or LON.

More clear, this Demand Oriented Control works as follows:

- when the comfort is reach in the Emission area, the controller from the Emission sent the message to the controller in charge of Distribution to stop to distribute energy, who sent the message to the controller in charge of Storage either to store the energy and if the Storage cannot store more energy sent the message to the controller in charge with the Generation to stop to generate more energy.

Another important Control Strategy is the control strategy for multi generators either from same type (e.g. several boilers) or different types (e.g. a boiler and heat pump) including also the Renewable Energy Sources. The strategy could be based as follow:

  – Priorities only based on running time
  – Fixed sequencing based on loads only: e.g. depending on the generators characteristics, e.g. hot water boiler vs. heat pump

- Priorities based on generator efficiency and characteristics: The generator operational control is set individually to available generators so that they operate with an overall high degree of efficiency (e.g. solar, geothermic heat, cogeneration plant, fossil fuels)
- Load prediction based sequencing: The sequence is based on e.g. efficiency & available power of a device and the predicted required power

The standards enabling to calculate the effect of BACS and TBM functions on energy consumption use different approaches to calculate this impact:

- direct approach;
- operating mode approach;
- time approach;
- temperature approach (control accuracy);
- correction coefficient approach.

Implementation of the BAC standards by BAC industry

NSB's (National Standardization Body's) disseminate the BAC-EPB standards, the BAC manufacturers are heavily influence their own R&D programs and production to implement the CEN/TC247 standards across Europe and worldwide. The BAC standards are rolled out to the market place and which supports the transparency and visibility of the whole building construction chain starting with specifications for design, commissioning and use. This should be done for the full buildings live cycle starting with new constructions and existing buildings, using upgrading, evolution, and retrofit techniques for the BAC Systems.

Industry associations such as Syndicat ACR in France or eu.bac (European Building Automation and Control Association) in Europe support this action and have dissemination programs for the implementation for the usage of these standards to fulfil the requirements of the EPBD recast and National Regulation. This also means that there a strong wish of the BAC Industry that the activities such as regulation, standardization, certification and labeling use the same references to describe BAC Systems. This means in practice that the BAC standards could be used and referenced in National Regulation and also be a bases for EU Certification and EU Labeling.

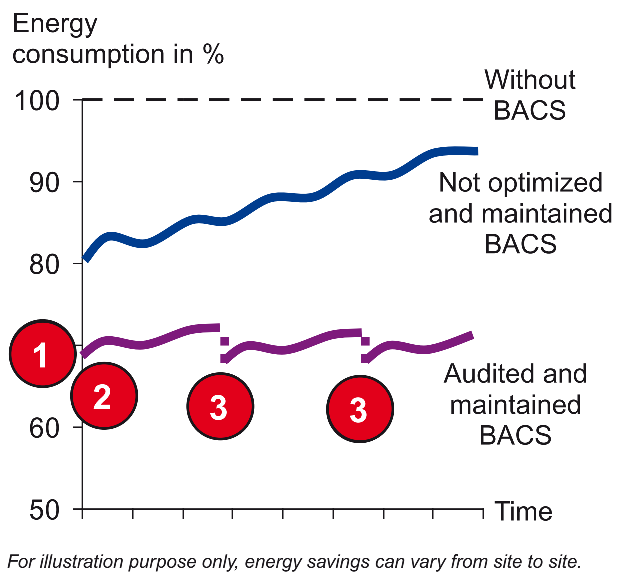
We could mention two important initiatives of eu.bac on EU level who is the eu.bac Certification and Labeling Scheme (in place from 2005 with more than 200 public domain certificates based on EN 15500) and eu.bac system based on EN 15232.

A small description of the goals of eu.bac system and the relation between EPB and BAC systems are shown in **Figure 2**.

Conclusion

This article explains the assessment of a nZEB building (the 3 levers who must be reached all at same time) and the key-role of BAC for EPB with his techniques. The BAC Standards issued by CEN/TC247 will be rolled out in Europe. The BAC Industry Associations have dissemination programs to implement the standards as support of regulation, certification and labeling.

nZEB is a challenge of a near future (2020). The use of the holistic approach of EPB Standard Set (including the BAC standards) is an eminent approach. Higher performance requirements regarding the building fabric, the technical building systems and the use of



1 Standardized, energy efficient BACS functionality
- Optimal BACS specification
- Improved cost-benefit ratio

2 Functional verification
- Check ordered and installed functionality in first audit
- Standardized commissioning report

3 Verification of sustainable operation
- Assure equipment availability and system functionality
- Meet comfort requirements
- Check parameterization
- Meet specified energy performance class

Figure 2. A small description of the goals of eu.bac system and the relation between EPB and BAC systems.

energy mix that will include more renewable energy. This means that the building becomes more and more interactive with his external environment and changes its traditional behaviour from a "passive consumer" to an active partner to the grids. The building becomes "intelligent or smart" interacting with "intelligent or smart grids". With this evolution from both sides, the target of nZEB could be reached where BAC is considered to be the key element.

So, we could conclude that towards nZEB we must more and more pay attention to BAC! ■

References

CEN/TC247 document prEN15500:2014

CEN/TC247 document prEN12908-x:2014

CEN/TC247 document prEN15232:2014

CEN/TC247 document BMS

CEN/TC247 document Inspection

www.eubac.org

www.eubaccert.eu

www.acr-regulation.com

REHVA Annual Conference on – *"Advanced HVAC & Natural Gas Technology"*

May 8-9, 2015, Radisson BLU Hotel Latvija Conference Centre, Riga, Latvia

- **Energy efficient Cooling systems**
- **Advanced Heating and Ventilation systems**
- **Sustainable buildings**
- **Efficient and clean Natural Gas technologies**

Contact E-mail: elina.purviske@btgroup.lv
More information: www.hvacriga2015.eu

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

LSGŪTIS

Strong impact of EU legislation on HVAC installations in buildings

Over the past decade several types of EU legislation came into force affecting the HVAC sector in Europe, both Regulations (which are automatically applicable in member states) as well as Directives (which have to be transposed into the national legislation of member states). Over the last five years several of these regulations and directives have been reviewed. Most of these legislations have the target to reduce the energy consumption, stimulate the use of renewable energy and reduce the CO_2 equivalent emissions in order to minimize the global warming impact.

HENK KRANENBERG
Senior Manager, environment
research center Daikin Europe NV
kranenberg.h@daikin.nl

Sometimes directives can be implemented by member states with a lot of national "freedom", a typical example is the Energy Performance of Buildings Directive, which is implemented for example in France as RT2012 and in the Netherlands as NEN7120. **Figure 1** is showing an overview of the most important directives and the level of interaction.

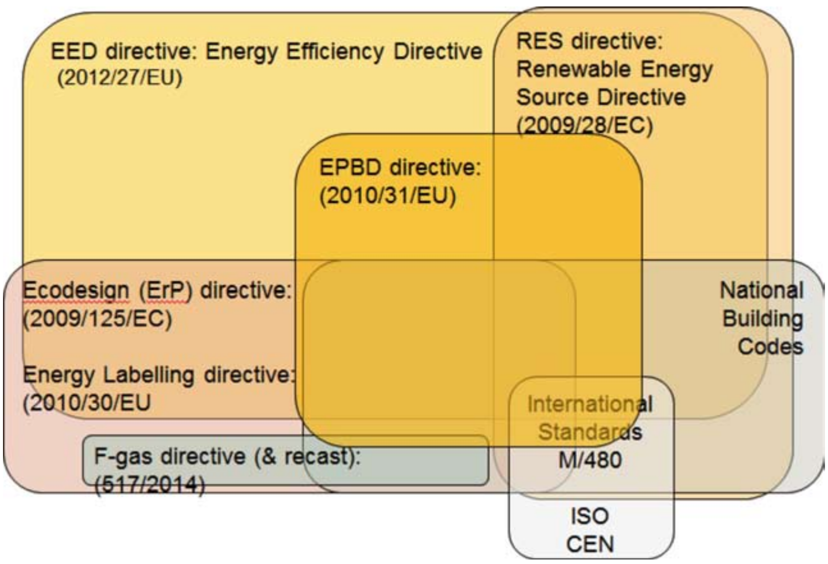


Figure 1. Effect of EU legislation in building sector.

Reduction on the use of f-gases

One of the latest legislation getting into force was the revision of the f-gas Regulation in order to reduce the emissions of f-gases, expressed in CO_2 equivalents. Whilst the original 2006 F gas regulation mainly focused on reduction of emissions through certification of installers, regular inspection of systems and logbooks, the revised F gas regulation adds an important additional measure : a gradual reduction of HFC consumption (also in CO_2 equivalents) by imposing quota on producers and importers of bulk HFCs. In addition, the revised F gas regulation adds a number of product bans, eg. HFCs with the highest global warming potential (GWP ≥ 2.500) will be banned in stationary refrigeration systems from 2020 , HFCs with a GWP ≥ 150 will be banned in domestic refrigerators and freezers from 2015 and in commercial domestic refrigerators and freezers from 2022. The GWP150 limit will also apply to multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more, except when they use cascade systems where the primary refrigerant circuit is limited to a GWP below 1500.. Another example, starting from 2025, small single split air conditioning systems with less than 3kg of refrigerant should use refrigerants not exceeding a GWP of 750. It is important to understand that the main driver towards refrigerants with a lower GWP value compared to today will not come from the bans but from the imposed "consumption phase down" – the quota system for importers and producers of HFCs.

Global warming impact, have to look beyond GWP

The phase down on consumption of HFCs can be achieved with a combination of measures, some applications may be able to use non-HFC refrigerants, while others will change to HFCs with a lower GWP value. It is also beneficial to reduce the refrigerant charge amount, as the phase down is based on CO_2 equivalents, so kgxGWP, not only GWP. And finally, the phase down applies only to new HFCs placed on the market, so recovering and reusing existing HFCs will also become very interesting in the future.

There is no one-size-fits all solution regarding the future refrigerants to be used. Each manufacturer will have to evaluate the options, taking into account not only GWP or kgxGWP but also looking at energy efficiency, safety and economic affordability.

In the air conditioning and heat pump sector, the refrigerant R32 has promising characteristics. The energy efficiency is higher compared to the commonly used R410A, whilst the GWP is only 1/3rd of R410A. In addition, for the same capacity output, the refrigerant charge amount can be reduced.

Point of attention in certain member states may be: the mild flammability of R32. Although very well controllable, certain member states have ruling in their building codes that certain buildings may not contain any flammable refrigerant at all. A good example how different directives, local building codes and industry innovations are not supporting each other but in fact could work contra-productive. It is obvious, it is important to watch continuously if one legislation or ruling is not conflicting with another one and to avoid double work.

Growing market

Heat pumps, reversible air conditioning systems are more and more seen as sustainable systems to realize energy savings in the built environment. In today's newly built offices and large renovations, the use of heat pumps with heating and cooling functions in one integrated system are more standard than exception. Besides real estate sector realizes a good climate system is important to improve the health, well-being , thus productivity of people working, residing in these buildings. Taking a higher productivity into consideration, an investment in a heat pump solution, using renewable energy, is often earned back in an acceptable time period. The market for heat pumps with cooling function, or in other words a reversible air conditioning is growing and fitting with the different European targets in terms of energy reduction, CO_2 reduction and use of renewable energy. Was cooling seen as "luxury" in the past, in todays, new well insulated buildings cooling is as important as heating to secure the well-being of people.

As this technology is still rather new for stakeholders like: architects, installers, investors, but also for building codes and standards developers, a proper training is required, but also an understandable integration in building codes and standards.

Last but not least, investors should have the opportunity to see and experience the best practises in the market and not feel frustrated about the lack of know-how among other stakeholders in the building industry chain. **Figure 2** is giving an example of a low energy multi-functional building.

Figure 2. Need for innovative systems.

Never ending attention to educate skills

The demand for qualified people will grow strongly. In the future, after 2020 we may expect every new building and/or renovated building will make use of (reversible) heat pump technology. Today the capacity to fulfil this demand is far from sufficient. Not only on the installation level but also on level of design and engineering. Strong focus on education has to be made to succeed in the ambition making all newly build buildings energy neutral by 2020. Every company in the building sector will have to pick-up its own responsibility to invest in increasing the know-how level on low energy buildings and integrating smart systems to allow energy neutral buildings.

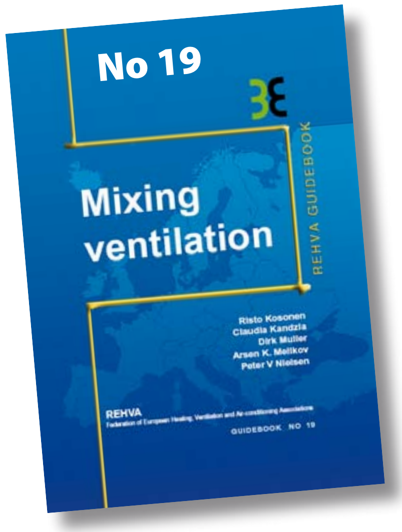
New concepts

This period allows to come with innovations in the building industry. Not only because of the f-gasregulation, but also because of the focus on energy saving, the awareness besides energy saving also health and well-being in buildings are important. Technological innovations will follow in the field of smart grids , phase change materials, ventilation and air quality, user interfaces etcetera. A central role is expected for (reversible) heat pumps as they address all targets set by the EU in terms of energy efficiency, CO_2 reduction and use of renewable energy.

The challenge is up to the building industry to review the building process to give sufficient space for innovations to make energy neutral buildings while keeping a high level of comfort, safety and health. Current best available technologies are already available. Now it is up to the mind-set of the people involved in the building process and the flexibility of the persons involved in standards and rules to allow best available technologies. ■

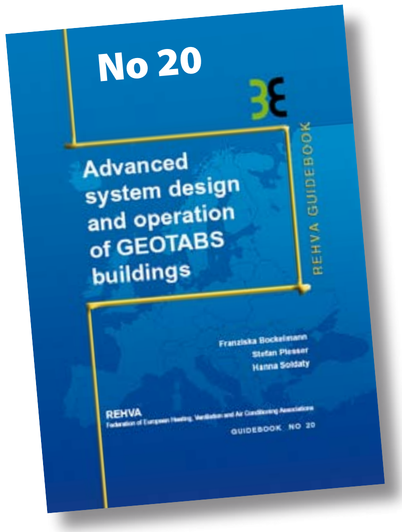
REHVA Guidebook on Mixing ventilation

Mixing ventilation is the most common ventilation strategy in commercial and residential buildings. Introduced will be the new design guide that gives overview of nature of mixing ventilation, design methods and evaluation of the indoor conditions.
The Guidebook shows practical examples of the case-studies.



REHVA Guidebook on GEOTABS

This REHVA Task Force, in cooperation with CEN, prepared technical definitions and energy calculation principles for nearly zero energy buildings requi-red in the implementation of the Energy performance of buildings directive recast. This 2013 revision replaces 2011 version. These technical definitions and specifications were prepared in the level of detail to be suitable for the implementation in national building codes. The intention of the Task Force is to help the experts in the Member States to define the nearly zero energy buildings in a uniform way in national regulation.



REHVA - Federation of European Heating, Ventilation and Air Conditioning Associations

www.rehva.eu ● info@rehva.eu ● REHVA Office: 40 rue Washington, 1050 Brussels—Belgium ● Tel + 32 2 514 11 71 ● Fax +32 2 512 9062

REHVA Guidebooks are available at www.rehva.eu

Commissioning for energy-optimal Demand-Controlled Ventilation

MADS MYSEN
SINTEF Building and Infrastructure
Norway
mads.mysen@sintef.no

PETER G. SCHILD
SINTEF Building and Infrastructure
Norway

AXEL CABLÉ
SINTEF Building and Infrastructure
Norway

JOHN WOOLLETT
Swegon Air Academy
Sweden

Demand-Controlled Ventilation (DCV) must become more reliable to close the gap between theoretical and real energy-performance. This paper addresses the following critical control points during commissioning of a DCV:

- energy-efficient and accurate DCV system
- balancing procedures
- handover procedures

Keywords: Energy use, Demand-Controlled Ventilation, Specific fan power.

Introduction

When correctly implemented, Demand-Controlled Ventilation (DCV) can reduce the energy consumption of ventilation by more than 50 % (Maripuu, 2009). However, evaluation of real energy use demonstrates that the energy saving potential is seldom met (Mysen et al., 2010). DCV-based ventilation systems must become more reliable to close the gap between theoretical and real energy-performance. These unfortunate experiences with DCV have many causes, including: inadequate specifications and handover documentation, balancing report not suitable for DCV, communication errors and lack of knowledge about DCV systems among decision makers. Based on this experience from case-studies, an expert group has developed new requirements and handover documentation (Mysen and Schild, 2013). The work is carried out in the Norwegian R&D-project reDuCeVentilation (http://www.sintef.no/Projectweb/reDuCeVentilation/).

DCV systems are ventilation systems in which the airflow rate is controlled automatically according to a measured demand at room level. This means that DCV systems must have a feedback control, for instance a sensor in the room giving a continuous measurement of the indoor air quality. This signal is then used to control the airflow rate according to the desired indoor air quality level.

VAV stands for Variable Air Volume. It is a broader term than DCV, as it encompasses all systems with variable airflow rate, irrespective of the type of control. Only VAV systems that control the airflow rate according to a measured demand in the room, and not according to a preset value, are considered as DCV in this paper. Normal VAV dampers in DCV systems are denoted by DCV damper in this paper.

The commissioning, balancing, and control of a DCV system consist of the following work steps presented in **Figure 1**.

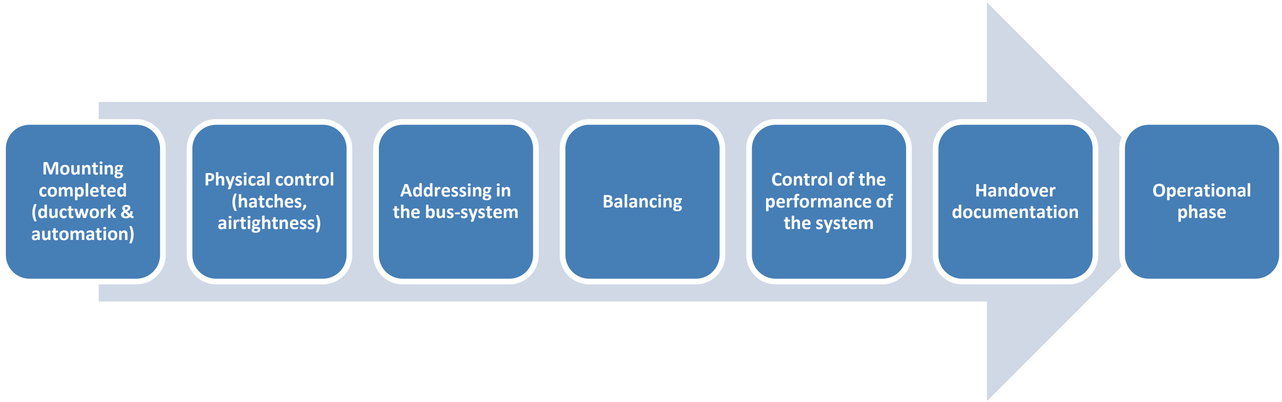


Figure 1. Recommended work steps subsequent to the mounting of the ventilation system.

This paper addresses the following critical control points during the commissioning of a DCV:

- energy-efficient and accurate DCV-system
- balancing procedures
- handover procedures

Energy-efficient and accurate DCV system

Specific Fan Power (SFP) is normally required and controlled at maximum airflow rate. However, a DCV system will typically have airflow rates between 30 and 80% of the maximum airflow rate, depending on diverse factors for dimensioning and on the minimal ventilation rate. At maximum airflow rate, there are only small differences between the system's SFP depending on the control strategy (**Figure 2**, r = 1), but at lower airflow rates (**Figure 2**, r < 1), there are major differences depending on the control strategy. It is important to require a maximum SFP-value for two operating scenarios: maximum airflow rate and reduced airflow rate, in order to ensure an energy efficient control strategy.

The most important control points are presented in **Figure 2**.

Airflow rate accuracy should be controlled. A variation of the airflow rate in any room should correspond to approximately the same variation of the total airflow rate through the air-handling-unit (AHU). This test will reveal whether a pressure-controlled DCV system redistributes part of the airflow rate because of insufficient precision or wrong placement of the pressure sensor.

Critical components such as CO_2-sensors should be checked on-site. One control point for CO_2-sensors is to check whether they all give the same CO_2 concentration (ppm-results) when the building is empty during the evening/night.

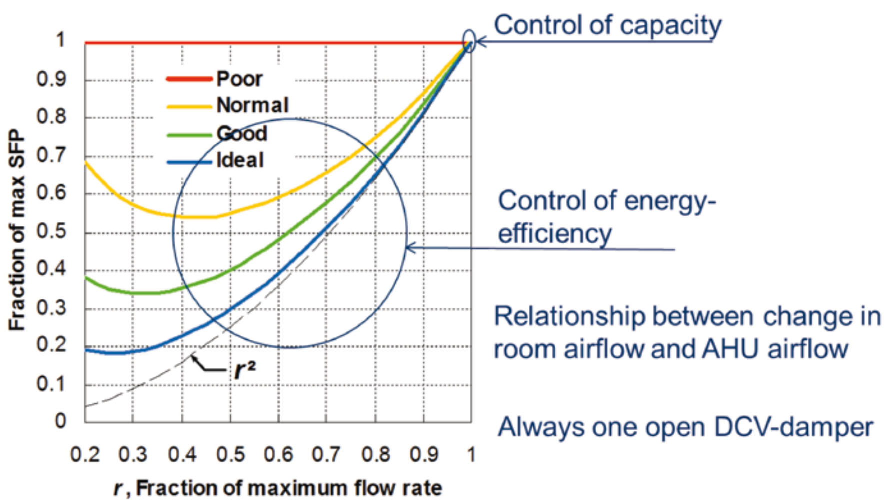


Figure 2. The most important control points. Measurement of SFP with partial load, control of the compliance between airflow rate at room level and total airflow rate, and control that there is always one DCV damper in max open position with the help of the Building Management System (Schild&Mysen, 2009).

Deviations during commissioning are normal and should be expected. Unfortunately, there is seldom time planned ahead to improve the system. A better solution is to, in advance, agree upon a model for economic compensation to take into account the deviations from the requirements which affect the energy consumption. Economic compensation caused by deviation between required and measured SFP-value, has been tested in Norway.

A DCV system is a dynamic system and should be tested and tuned-in for both summer and winter conditions. There should be an inspection, function test and review of the DCV- system after a period of normal operation, e.g. 1 year.

Balancing procedure for different DCV systems

There are several DCV systems and these principles are defined and described by Mysen (Mysen and Schild, 2011). Some of the DCV principles require special balancing procedures; this paper addresses "Pressure Controlled DCV" and "Damper optimised DCV".

Pressure controlled DCV

Pressure-Controlled DCV (PC-DCV) correspond to the traditional DCV systems (**Figure 3**). The purpose of static pressure-control is to indirectly control the airflow rates by controlling the pressure in a strategic duct position. PC-DCV requires installation of active DCV units controlling supply and exhaust airflow rates to each DCV room/zone. Controlling fan speed to maintain a constant static fan pressure rise, will result in unnecessary throttling along the critical path during most of the AHU's operating time, and therefore unnecessary fan energy use. The duct path with the greatest flow resistance from the AHU to any terminal is called the 'critical path', and is used to dimension the necessary fan pressure rise.

One unfortunate experience concerning PC-DCV systems, is that minor changes in room demand just redistribute the airflow rate in the duct system, while the airflow rate in the AHU remains more or less constant. The consequence is that no energy saving is achieved, or that the amount of supply air is insufficient. This is normally caused by inadequate precision or wrong placement of the pressure sensor, for example a placement to close to the AHU or next to a branch. A rule of thumb is to place it ¾ out in the main duct.

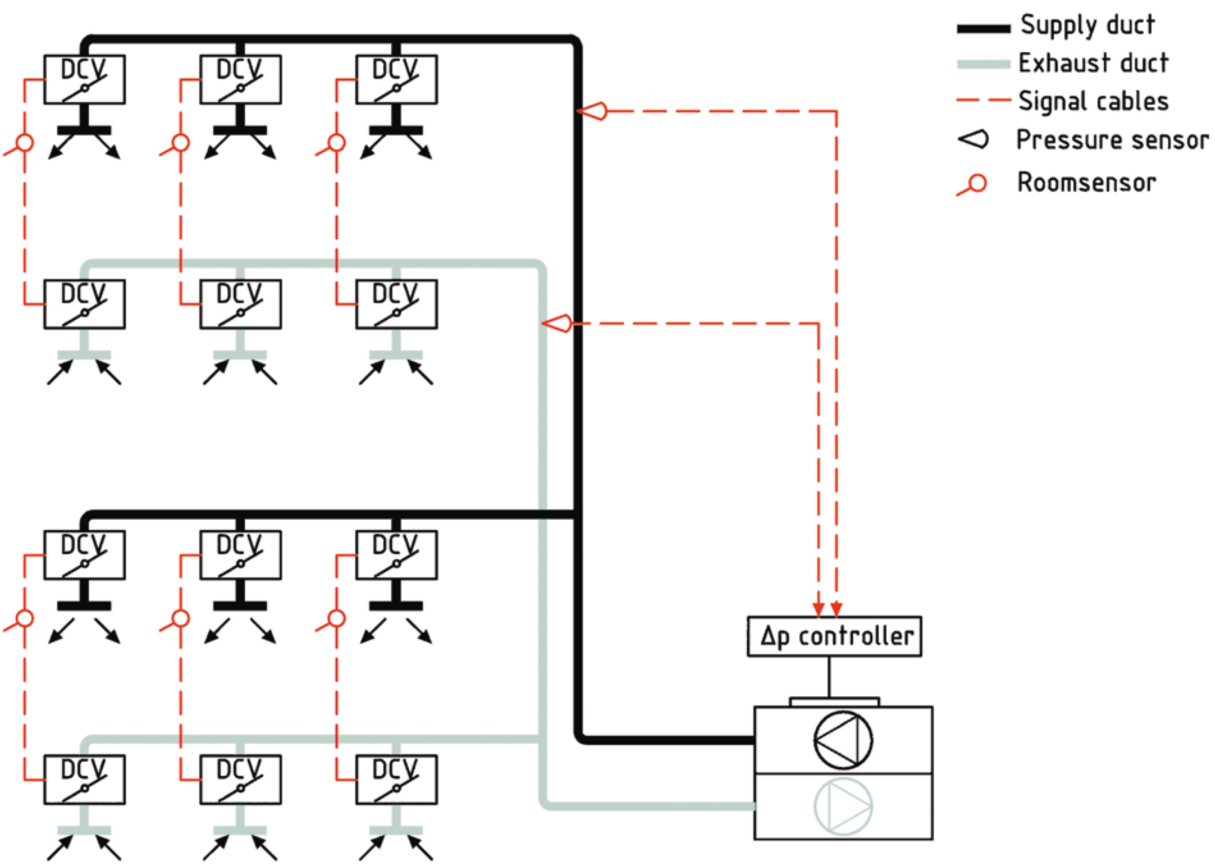


Figure 3. Pressure-controlled DCV system. The fan speed is controlled to keep the static pressure in the main ventilation duct constant, at the location of the pressure sensor.

The main purposes when balancing a PC-DCV system are:

- controlling the placement of the pressure sensor
- setting the right pressure set point

In addition, the balancing will reveal connection and communication errors.

Balancing of a PC-DCV system consists of the following steps:

- Control that all the DCV units have supply voltage and no polarity error
- Control that the pressure sensor is mounted on a location with stable static pressure or uniform velocity profile, by performing measurements over the duct cross section with a Pitot-tube or a hot-wire anemometer.
- Select a pressure set point which is slightly higher than necessary. This can be deduced from pressure drop calculations, or empirically.
- Program the actual maximum and minimum airflow rate values (V_{max} and V_{min}) on each DCV damper and set the dampers to automatic mode. Control that all the DCV dampers get the maximum airflow rate, and read the opening rate. Find the index damper, which is the damper with the highest opening rate.
- Adjust the pressure set point until the index DCV damper gets the maximum airflow rate without throttling (about 80 % opening rate). You have then found the energy optimal pressure set point, which is the lowest pressure set point which provides the right airflow rates according to the designed values.
- Complete the VAV control form. The completed control form should be included in the documentation of the ventilation system.

Damper-optimized DCV

Damper-optimised DCV consists in controlling the airflow rate in the main duct according to the position of the dampers, such that at least one of the dampers is in a maximum open position (**Figure 4**). The purpose is to ensure minimum fan energy consumption by looking for a minimum pressure rise over the fan. This is achieved if one duct path (critical path) is always open. With damper-optimised DCV, the required airflow rate, the supplied airflow rate as well as the damper angle are recorded for all the DCV dampers. This information is sent to a controller which regulates the fan speed.

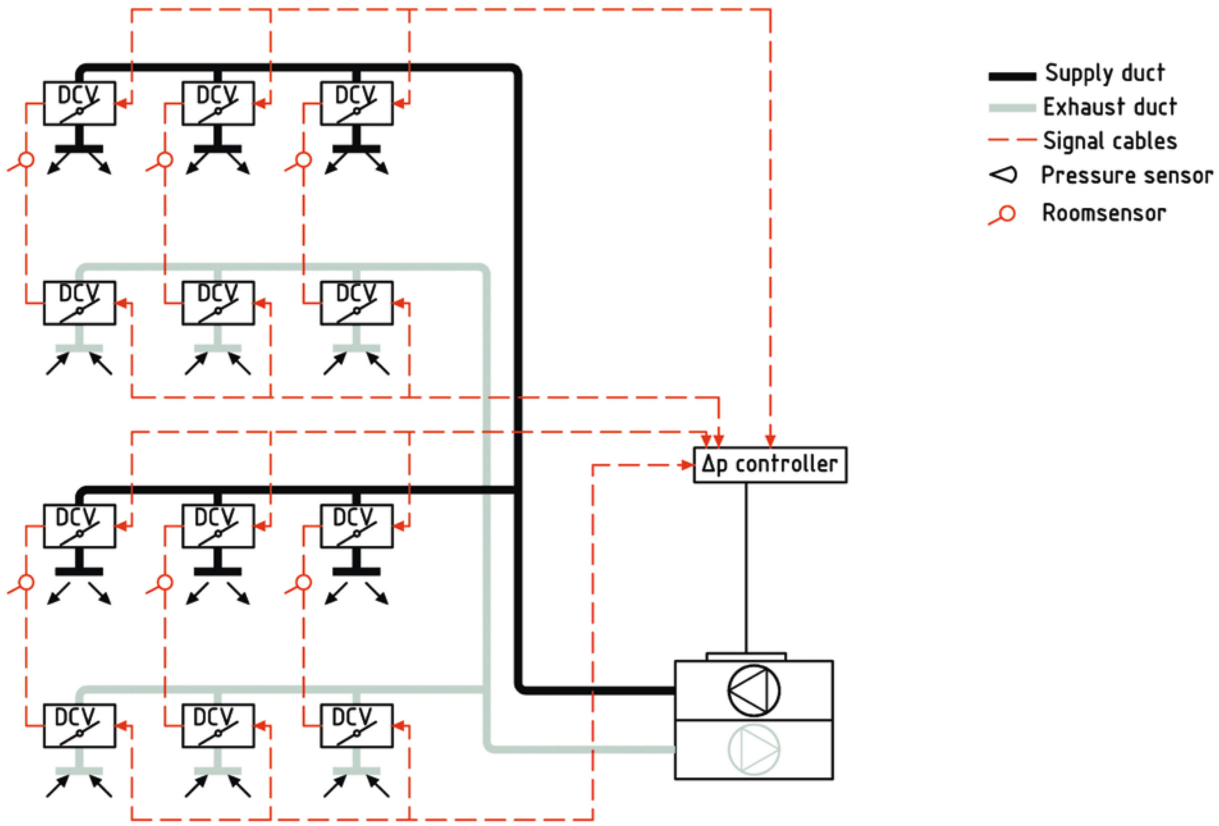
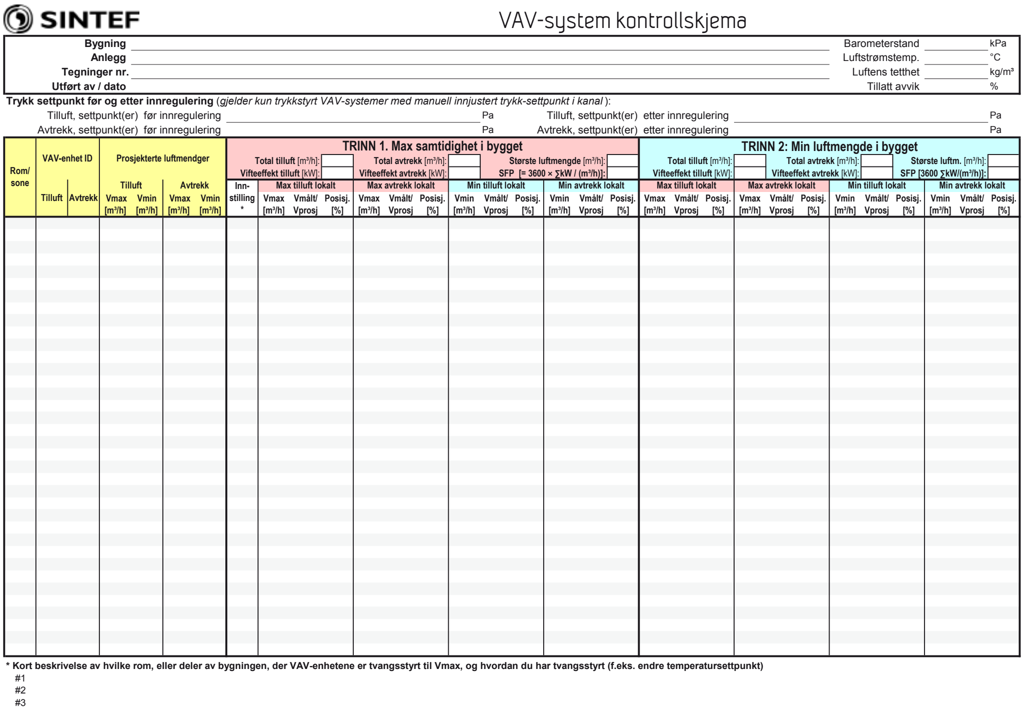


Figure 4. Damper-optimised DCV system.

Balancing of DCV units in damper-optimized systems is very simple, and consists in specifying minimum and maximum design airflow rate for each DCV unit. This can be done either through the bus-system or by connecting a programming device directly on the DCV units. Various programming devices are used by the different suppliers.



SINTEF VAV-system kontrollskjema

Bygning ______ Barometerstand ______ kPa
Anlegg ______ Luftstrømstemp. ______ °C
Tegninger nr. ______ Luftens tetthet ______ kg/m³
Utført av / dato ______ Tillatt avvik ______ %

Trykk settpunkt før og etter innregulering (*gjelder kun trykkstyrt VAV-systemer med manuell innjustert trykk-settpunkt i kanal*):
Tilluft, settpunkt(er) før innregulering ______ Pa Tilluft, settpunkt(er) etter innregulering ______ Pa
Avtrekk, settpunkt(er) før innregulering ______ Pa Avtrekk, settpunkt(er) etter innregulering ______ Pa

Rom/ sone	VAV-enhet ID		Prosjekterte luftmengder					TRINN 1. Max samtidighet i bygget												TRINN 2: Min luftmengde i bygget											
								Total tilluft [m³/h]: / Vifteeffekt tilluft [kW]:			Total avtrekk [m³/h]: / Vifteeffekt avtrekk [kW]:			Største luftmengde [m³/h]: / SFP [= 3600 × ∑kW / (m³/h)]:						Total tilluft [m³/h]: / Vifteeffekt tilluft [kW]:			Total avtrekk [m³/h]: / Vifteeffekt avtrekk [kW]:			Største luftm. [m³/h]: / SFP [3600 ∑kW/(m³/h)]:					
			Tilluft		Avtrekk		Inn-stilling *	Max tilluft lokalt			Max avtrekk lokalt			Min tilluft lokalt			Min avtrekk lokalt			Max tilluft lokalt			Max avtrekk lokalt			Min tilluft lokalt			Min avtrekk lokalt		
	Tilluft	Avtrekk	Vmax [m³/h]	Vmin [m³/h]	Vmax [m³/h]	Vmin [m³/h]		Vmax [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmax [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmin [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmin [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmax [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmax [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmin [m³/h]	Vmålt/ Vprosj	Posisj. [%]	Vmin [m³/h]	Vmålt/ Vprosj	Posisj. [%]

* Kort beskrivelse av hvilke rom, eller deler av bygningen, der VAV-enhetene er tvangsstyrt til Vmax, og hvordan du har tvangsstyrt (f.eks. endre temperatursettpunkt)
#1
#2
#3

Figure 5. Recommended VAV control form (http://www.sintef.no/Projectweb/reDuCeVentilation/)

Balancing of a damper-optimised DCV system consists of the following steps:

- Control that all the DCV units, room sensors/ room regulators etc. have supply voltage and no polarity error.
- Program the actual maximum and minimum airflow rates values (V_{max} and V_{min}) on each DCV damper and set the dampers to automatic mode.
- If the DCV units do not give the expected response, check the polarity on the supply voltage.
- Complete the VAV control form. The completed control form should be included in the documentation of the ventilation system.

Hand-over documentation

VAV control form

Problems during operation occur most often for maximum or minimum airflow rates. Tests should therefore be carried out for these two operating situations. For each of these situations, it is necessary to consider each DCV unit and to override the control signal from the room sensor (*e.g.* temperature) in order to force the DCV unit to respectively max and min airflow rate, and to document both the airflow rate and the opening rate. The opening rate tells whether the DCV units work within a favorable range (40 to 80%) and whether the pressure set point is balanced.

This requires four control measurements per DCV unit. Such a control procedure is particularly relevant for DCV systems with pressure-control and limited control possibilities from the BMS.

A special VAV control form is designed for this purpose (**Figure 5**).

Procedures for load tests at maximum and minimum loads/airflow rates have been developed (Mysen and Schild, 2013).

Automated load test

Manual load test are time consuming, and it has proven to be very difficult to override DCV units during a load test. One should therefore strive to automate the load test completely by programming it in the control panel, or in the BMS. This has several advantages: it can be a complete test (not spot-checking) with all combinations of overriding, it reduces costs significantly, and can be repeated as often as needed (one time per year during normal operation, or after changes in the system). ■

References

MARIPUU, M.-L. 2009. Demand controlled Ventilation (DCV) systems in commercial buildings: functional requirements on systems and components, Göteborg, School of Electrical and Computer Engineering, Chalmers tekniska högskola.

MYSEN, M. & SCHILD, P. G. 2011. Requirements for well functioning Demand Controlled Ventilation. *REHVA European HVAC Journal*, 48, 14-19.

MYSEN, M., SCHILD, P. G. & DRANGSHOLT, F. 2010. Robustness and True Performance of Demand Controlled Ventilation in Educational Buildings – Review and Needs for Future Development. *31st Air Infiltration and Ventilation Centre Conference 2010 : (AIVC 2010) : low energy and sustainable ventilation technologies for green buildings : Seoul, South Korea, 26-28 October 2010.* Seoul: International Network for Information on Ventilation and Energy Performance.

Residential Air Handling Units

SYLVAIN COURTEY
Head of the Ventilation Department,
Eurovent Certita Certification
s.courtey@eurovent-certification.com

DELFINE SALVADOR
Project Engineer
Eurovent Certita Certification
d.salvador@certita.fr

Eurovent Certita Certification launched in 2014 the 1st European wide certification programme for Residential Air Handling Units (RAHU)[1]. After nearly two years the Eurovent Launching Committee for RAHU – composed by six European manufacturing companies – finalized the Operational Manual and rating Standard for RAHU. The scope of this programme includes all supply and exhaust residential ventilation units equipped with heat recovery system (including heat-pumps) up to 1 000 m³/h nominal airflow. This programme relies on the latest European testing standards [3] and European regulations (Ecodesign [4], Energy Labelling [5]). This certification programmes aims to become the reference tool for all European consumers regarding the compliance checking of RAHU.

[1] These products are also known as "Balanced Ventilation Units (BVU)", "heat recovery units" or "Residential Ventilation Units (RVU)".

Background of the European Market on RAHU

The market share of RAHU can be estimated to be approximately 30% of the units sold in Europe (see **Figure 1**) thus representing a significant market share.

The distribution of ventilation units in terms of types (balanced, exhaust, etc.) and depending on the country highlights the fact that the situation is very different. **Figure 2**, despite representing the status in 2007, provides interesting information on this matter.

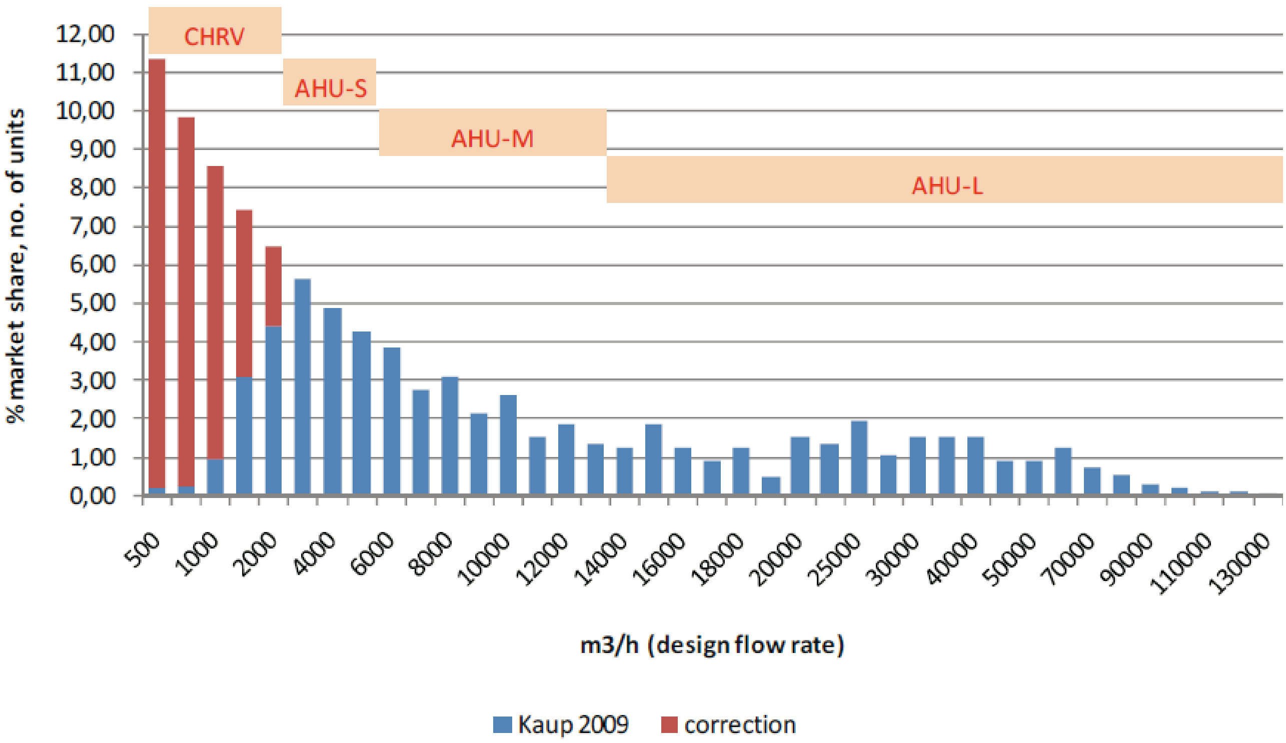


Figure 1. EU 2008 sales size distribution (from Fig 2-2 p21 in [1]).

Ventilation systems in new buildings:

	FI	UK	NL	DK	IT	PL	FR
Supply and exhaust	90% (house), 30% (coll)	<1%	60%		YES	5%	5%
Exhaust only mechanical ventilation	10% (house), 70% (coll)	<1%	40%	Flats	YES, env 5% (5)	7%	95%
Natural ventilation	0	40%		Houses	NO	87%	0%
Local ventilation	0	20% (1)			YES	1%	0%
Airing (window)	0	100% (3)			Most common	–	0%

Ventilation systems in existing buildings:

	FI	UK	NL	DK	IT	PL	FR
Supply and exhaust	30% (house), 5% (coll)	<1%	10%		Few	1%	1%
Exhaust only mechanical ventilation	30% (house), 75% (coll)	≈ 10%	50%	Flats <15 year (4)	YES	5%	40%
Natural ventilation	<40% (house (1)), 20% (coll)	2%	30%	Houses	NO	93%	19%
Local ventilation	<10% (house (2)), 0% (coll)	20% (1)	10%		YES	1%	30%
Airing (window)	0	100% (3)		Flats >15 Year (4)	Most common	–	10%

Figure 2. Ventilation systems in new and existing buildings in Europe, from (Ledean, 2007) cited in [2].

In Nordics countries for instance, balanced ventilation units with heat recovery systems covers the large majority of the systems newly installed and an already significant part of the systems installed in existing buildings (approximately 30%). In Southern Europe, airing and local ventilation systems are the most common systems installed even in new buildings. In France, mechanical ventilation is widely used however balanced units remains a very small part of the newly installed systems, the majority of the system being central exhaust mechanical ventilation. In Eastern Europe, natural ventilation seems to be the most common way in both new and existing buildings.

If we look at the evolution of the market it can be seen that in an overall increasing market for ventilation units, the market of balanced units with heat recovery systems is the most dynamic (see ICVHR – central ventilation systems with heat recovery in **Figure 3**).

The introduction in European countries of thermal building regulations provides an impulse for this system. Indeed on one side the increase of the air tightness of the building envelops obliges building consultants to rely on mechanical ventilation systems to ensure that the demanded air exchange rate within the building is met. On the other side the increase of the thermal insulation of building envelops required to meet the best standards in terms of energy use leads to the situation where the heat losses due to the renewal of the fresh air inside the building represents a significant share of the total heat loss (up to 40% in some cases). As a consequence the recovery of the heat of the exhaust air seems to be more and more a must.

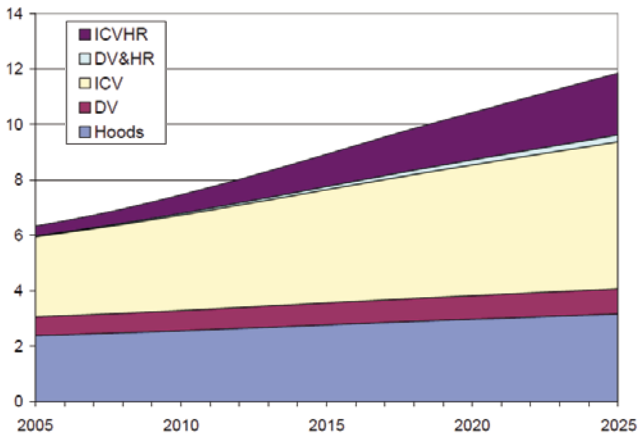


Figure 3. Projections to 2025, consumption estimate EU 25 for residential ventilation products Energy Consumption of ventilation systems in EU residential dwellings – Estimations (TWh) (from Fig 2-7 p58 in [2]).

Background of the Compliance Schemes in Europe

Several schemes exist in Europe (mandatory local regulations or voluntary schemes) but they are all valid only in one country or one region of Europe.

From one scheme to another the technical characteristics checked and the testing standards used may vary a lot. Finally different minimum requirements may be applied from one scheme to another.

The great diversity of the different schemes found in Europe may be linked to the different national or local regulations and/or building codes regarding residential ventilation.

In this context the European Regulations on Ventilation units recently published (Ecodesign regulation defining minimum efficiency requirements [4] and Energy Labelling regulation defining energy efficiency classification for residential ventilation units [5]) are a good start to harmonize the way RAHU are rated in Europe. However, despite the European regulation provides a new framework regarding the way performances are rated and classified, it may not be sufficient. Indeed these regulations are based on manufacturer's self-declaration and market surveillance activity has been very poor so far when dealing with energy efficiency checking[2]. Market surveillance activity in Europe is currently the duty of each member state. The priority is obviously put on safety and health regulations. With limited means the European Market Surveillance bodies have difficulties to check all the products covered by Ecodesign and Energy Labelling regulations.

Introducing a European wide, voluntary and third party certification scheme based on these new regulations will allow European consumers to rely on the performances of the products sold on the European market.

2 More information on European Market Surveillance activity can be found at http://ec.europa.eu/enterprise/policies/single-market-goods/internal-market-for-products/market-surveillance/index_en.htm

3 See the Eurovent RAHU programme description at http://www.eurovent-certification.com/en/Certification_Programmes/Programme_Descriptions.php?lg=en&rub=03&srub=01&select_prog=RAHU

4 See the complete list of Air Handling Unit manufacturers Eurovent certified and the description of the programme at www.eurovent-certification.com.

The new Eurovent Certified Performance programme for Residential Air Handling Units

The description of this programme and the reference documents can be found on the Eurovent Certified Performance website www.eurovent-certification.com[3].

1. Scope

Ventilation units covered by this new certification programmes are ventilation units:

- With supply and exhaust (balanced)
- up to 1 000 m³/h nominal airflow
- with a heat-recovery system (plate heat exchanger, rotary heat exchanger or heat-pump)

These units are intended for small to medium residential buildings (single dwellings or small collective dwellings). It is to be noted that a Eurovent certification programme for units with higher nominal airflows already exists and covers more than 80 manufacturers in Europe, Middle-East and Asia[4].

2. Certified Characteristics

All characteristics useful to the end users are certified. They are coming from either European Standards [3] or European regulations ([4] and [5]).

2.1. Leakage

The leakage class as defined in the European standard EN 13141-7:2011 is certified. This class takes into account both internal and external leakages. **Figure 4** provides the definition of the different classes for the pressure method used for plate heat exchangers. For rotary heat exchangers the tracer gas method shall be used.

Class	Pressurization test		
	Internal leakage (at 100 Pa)		External leakage (at 250 Pa)
A1	≤ 2 %	and	≤ 2 %
A2	≤ 5 %	and	≤ 5 %
A3	≤ 10 %	and	≤ 10 %
not classified	> 10 %	or	> 10 %

Figure 4. Leakage classification for the pressure method for supply and exhaust ventilation units as defined in EN 13141-7:2011.

2.2. Airflow

Airflow performances of the unit are certified. **Figure 5** describes the airflow/pressure certified window. This window aims to cover the most common working points of the unit.

The maximum airflow is in particular certified and published on the ECP website.

2.3. Electrical consumption

The effective power input at reference point and the specific power input (SPI) at reference point are also checked and certified. The SPI is the ration between the effective power input at reference point and the nominal airflow as given in Equation (1).

$$\mathrm{SPI} = P_e / q_v,\ [\mathrm{W/(l.s^{-1})}] \qquad (1)$$

2.4. Heat recovery efficiency

The efficiency of the heat recovery systems is given by either:

- The temperature ratio on supply side for plate and rotary heat exchangers, or
- The COP/EER for heat-pump heat recovery systems.

Figure 6 provides the testing conditions of the temperature ratio.

Application mode	Standard test			Cold climate test[a]
Point Number	1	2	3	4
Heat exchanger category	I and II (mandatory point)	I (optional) and II (mandatory)	I and II (optional)	I and II (optional)
Extract air				
Temperature θ_{11}	20°C	20°C	20°C	20°C
Wet bulb temperature θ_{w11}	12°C	15°C	12°C	10°C
Outdoor air				
Temperature θ_{21}	7°C	2°C	−7°C	−15°C
Wet bulb temperature θ_{w21}	–	1°C	−8°C	–
[a] additional test for cold climates				

Figure 6. Testing conditions of the temperature ratio for plate (I) and rotary (II) heat exchangers ([3]).

The efficiency at cold climate conditions is also checked for units intended to be used at outside temperature down to −15°C.

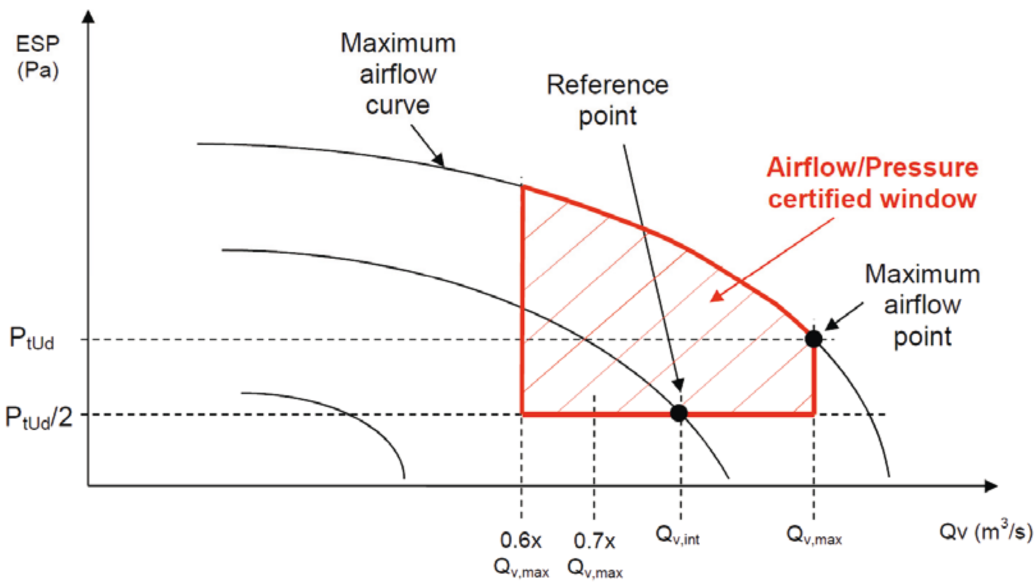


Figure 5. Definition of the airflow/pressure certified window.

2.5. Energy efficiency

The Specific Energy Consumption (SEC) in kWh/(m².year) is the way used in the European regulations to assess the energy efficiency of residential ventilation units. This performance aims to evaluate the yearly energy consumption (if positive) or energy supply (if negative) of residential ventilation units per square meter. It takes into account the energy consumption of the fans and of the defrost system as well as the energy recovered due to the heat recovery system (see Equation (2)).

SEC = *Fans electrical consumption – Energy recovered due to the heat recovery device + Electrical consumptions during defrost mode* (2)

The SEC basically derives from the electrical power input at reference point and the temperature ratio. It is to be noted that the SEC is defined only for plate and rotary heat exchangers and not for units with heat-pumps heat exchangers.

The complete and detailed formula for SEC can be found in [4] and [5].

Energy Labelling No 1254/2014 [5] defines also the corresponding energy efficiency classes based on SEC (see **Figure** 7).

This regulation defines also the way this energy efficiency class has to be labelled on the unit (see **Figure 8**).

2.6. A-weighted global sound power levels [dB(A)]

Finally up to 5 different sound power levels are certified (**Figure 9**). This allows assessing the overall impact of the unit in terms of sound emission.

3. Rating Standards

All certified performances are defined according to the latest European standards ([3]) and European Regulations ([4] and [5]).

4. Overview of the main characteristics of the Eurovent Certification programme for RAHU

The Eurovent certification programme for RAHU is part of the accredited scope of Eurovent Certita Certification[5]. This accreditation means that it is managed according to ISO 17065 standard which

SEC class	SEC in kWh/a.m²
A+ (most efficient)	SEC < –42
A	–42 ≤ SEC < –34
B	–34 ≤ SEC < –26
C	–26 ≤ SEC < –23
D	–23 ≤ SEC < –20
E	–20 ≤ SEC < –10
F	–10 ≤ SEC < 0
G (least efficient)	0 ≤ SEC

Figure 7. Definition of the energy efficiency classes for residential ventilation units from 1st January 2016 according to Energy labelling regulation No 1254/2014 [5].

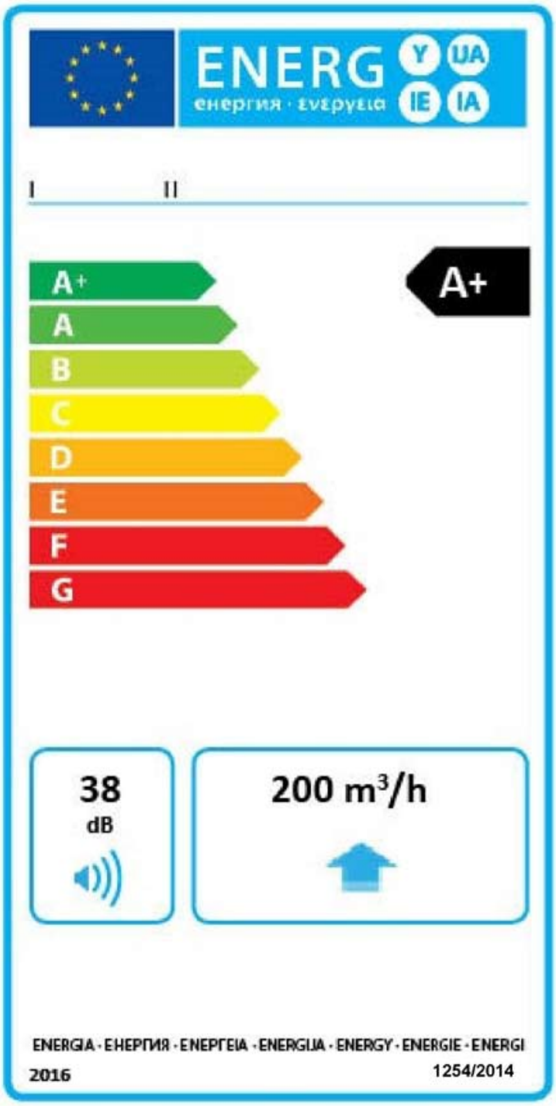


Figure 8. Label for balanced ventilation units after 1 January 2016 according to Energy labelling regulation No 1254/2014 [5].

5 Eurovent Certita Certification is accredited by COFRAC, see scope and validity at www.cofrac.fr. This accreditation is compliant with the European co-operation for Accreditation (EA) also member of International Accreditation Forum (IAF) with mutual recognition agreement.

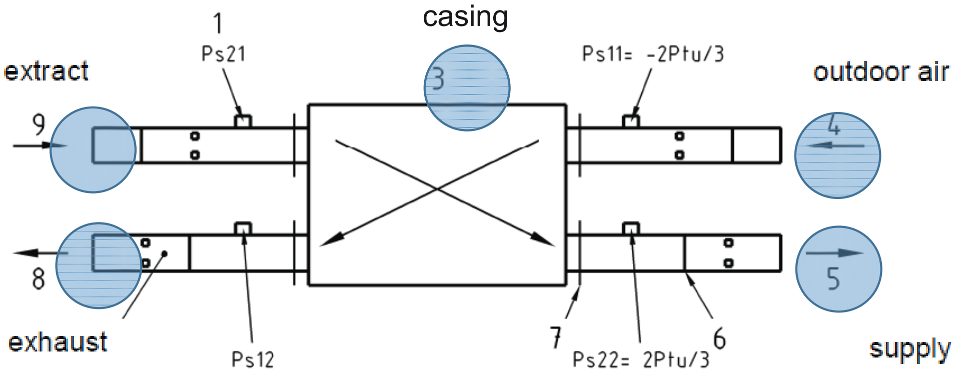


Figure 9. Sound power levels certified: Extract, Exhaust, Outdoor air, Supply and Casing.

insures the quality of the third party certifier regarding its impartiality and competence.

Moreover all compliance tests are performed by European laboratories accredited according to ISO 17025. Tests are performed according to the same procedures thus insuring the reliability of the test results.

Finally the products tested in independent laboratories are directly purchased on the market through an anonymous process.

Conclusion

With increasing regulations related to the energy efficiency of buildings, systems and products in Europe, and the up-coming increase of regulations regarding indoor air quality, there is a strong need to have energy efficient ventilation products in residential buildings. In order to provide to European end-users a transparent way to compare one product with each other and to get useful information on the final energy consumption, European regulations have been published in July 2014 with application on 1st January 2016.

In order to provide to the end users confidence in the published performances of such products Eurovent Certita Certification proposes a new certification programme:

- Based on the latest European standards and European regulations
- Managed according to the best practices in terms of third party certification processes.

This certification programme aims to become the reference tool for European Market Surveillance bodies as well as European consumers regarding the compliance checking of RAHU. ■

References

[1] P. Rivière et al., (2012), Ventilation systems, Task 2: Market on Ventilation Systems for non residential and collective residential applications Economic and Market Analysis. In final project report for the DG ENTR of the European Commission. Sustainable Industrial Policy – Building on the Ecodesign Directive – Energy-Using Product Group Analysis/2, Lot 6: Air-conditioning and ventilation systems. Contract No. ENTR / 2009/ 035/ LOT6/ SI2.549494. July 2012. Available online at http://www.ecohvac.eu.

[2] P. Rivière et al., (2009), Preparatory study on the environmental performance of residential room conditioning appliances (airco and ventilation), Contract TREN/D1/40-2005/LOT10/S07.56606, Study on residential ventilation - Final report February, 2009, after SH comments.

[3] EN 13141-7:2011 - Ventilation for buildings, Performance testing of components/products for residential ventilation, Part 7: Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings.

[4] COMMISSION REGULATION (EU) No 1253/2014 of 7 July 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units. Available online at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1253&from=EN.

[5] COMMISSION DELEGATED REGULATION (EU) No 1254/2014 of 11 July 2014 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of residential ventilation units. Available online at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1254&from=EN.

Influence of the Dry Cooler Capacity on the Efficiency of Chillers

HANNS CHRISTOPH RAUSER
Dipl. -Ing.
HCR CONSULTING
Germany
Christoph.Rauser@HCR-Consulting.com

STEFANO FILIPPINI
Technical Manager
LÛVE

Keywords: Chiller, Dry Cooler, Energy efficiency, Certification

Increased energy efficiency through certification

Energy efficiency is currently one of the most important subjects in the HVAC&R industry. When using a certified chiller with a separately installed condenser or recooler, it is very advisable also to use a certified product in order to reach the maximum energy efficiency.

Eurovent Certita Certification (ECC) started the Certification Programme for Liquid Chilling Packages (Chillers) in 1996. The programme applies to standard chillers used for air conditioning and refrigeration. In 2006 the ESEER -European Seasonal Energy Efficiency Ratio - was implemented. By the publication of the certified data on the ECC website **www.eurovent-certification.com** the average chiller efficiency is comparable.

Chiller Construction Types

Water cooled chillers are built with plate and tube bundle heat exchangers as condensers. Hereby the heat is being dissipated into the ambient air by a recooler in the secondary cycle. If the heat is being dissipated directly into the ambient air by a condenser, the system is called air cooled chiller. These are classified as either compact chiller for outdoor use with integrated air cooled condenser or chiller split system with an air cooled condenser for outdoor installation. Today, in most cases compact air cooled chillers are used.

Chiller Market

Most chillers are certified by Eurovent Certita Certification . Currently 33 chiller manufacturers participate in the Certification Programme. The chillers' sales evolution in the EU in the past 9 years is shown in **Figure 1**.

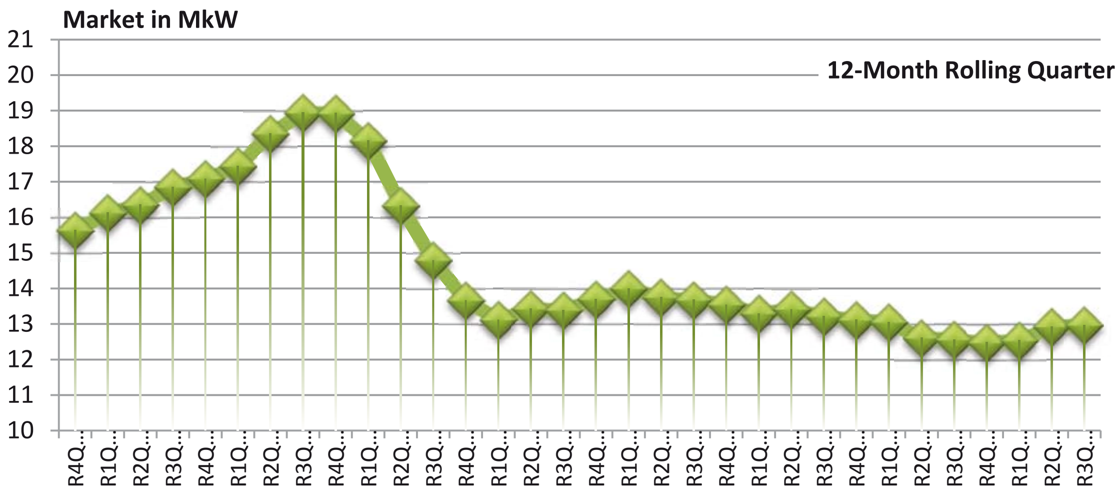


Figure 1. Chiller's sales evolution in MkW, EU 28 – 2014.

The EU sales proportion according to construction type and size is shown in **Figures 2 and 3** [1].

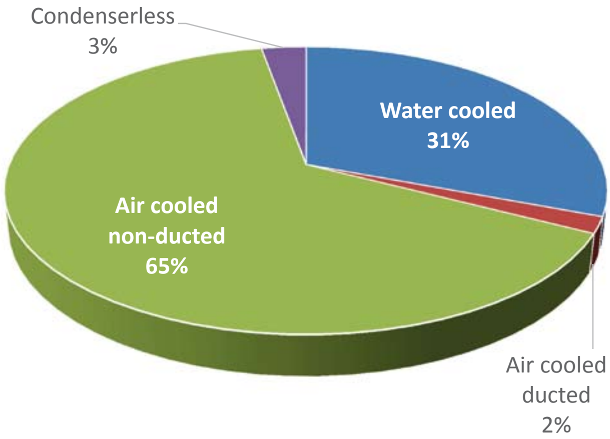


Figure 2. Chillers' sales by construction type (shares in cooling capacity, kW), EU 28 – 2013.

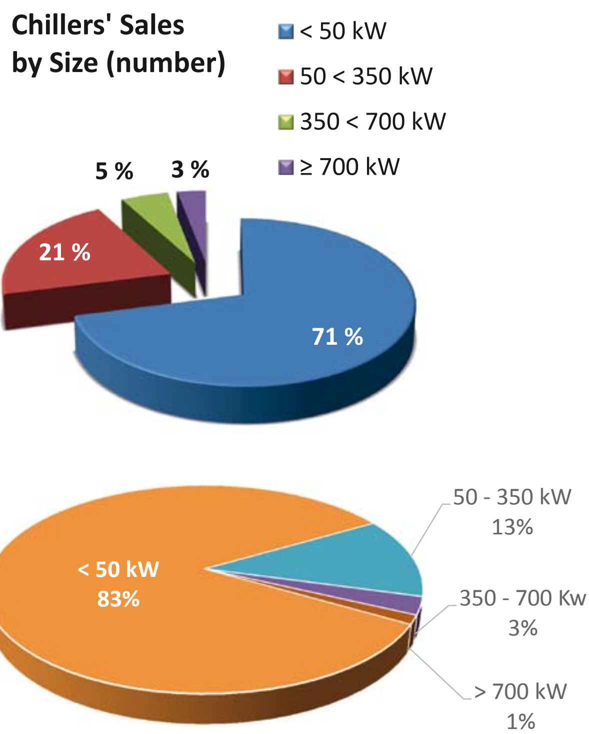


Figure 3. Chillers' sales by cooling capacity (shares in number), EU 28 – 2013.

In the following the energy consumption of the complete system water cooled chiller plus dry cooler is considered. Thereby the influence of the dry cooler's capacity on the energy efficiency of the complete system is shown.

On the initiative of the ECC certified heat exchanger manufacturers, the performance of 9 heat exchangers manufactured by 7 European companies not participating in the Eurovent certification programme was tested in an independent test facility between 2004 and 2008. A comparison of the performance data tested with the values published in the manufacturers' product literature resulted in a capacity reduction up to 37% [2].

Calculation Model

A Eurovent certified water cooled chiller of Eurovent energy efficiency class B used for air conditioning (cooling only) is considered. The cooling capacity of 1000 kW at full load and ambient temperature 35°C is provided by two screw compressors using refrigerant R134a. The evaporator is cooling down water from 12°C to 7°C. In the simplified model it is assumed that the temperature difference between condensing temperature and ambient temperature is fixed 12 K. The condenser is heating up the secondary fluid which is recooled by a dry cooler. In the dry cooler the secondary fluid is cooled down by 5 K to a temperature which is 5 K above the ambient temperature. The pump power of the secondary fluid is not considered. The study is comparing the efficiency of the chiller plus certified dry cooler with the chiller plus a non-certified dry cooler having a capacity gap of 25%. At full load the non-certified dry cooler is causing a 2.5 K higher condensing temperature of the chiller. At 75%, 50% and 25% part load operation the AC fans' speed of the non-certified dry cooler is raised to achieve the same condensing temperature as when using the certified dry cooler. By the calculation of the ESEER value of the complete system the energy efficiency is compared.

Results

The dry cooler fan power consumption is within the range of 10% and 20% of the total system's power consumption at the different load conditions (**Figure 4**).

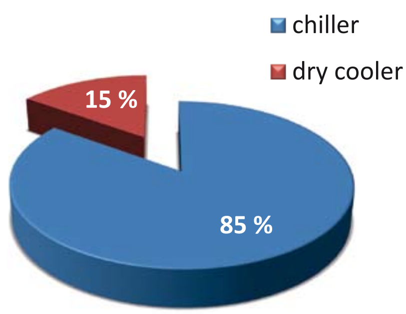


Figure 4. Power consumption of the total system chiller plus dry cooler (kW).

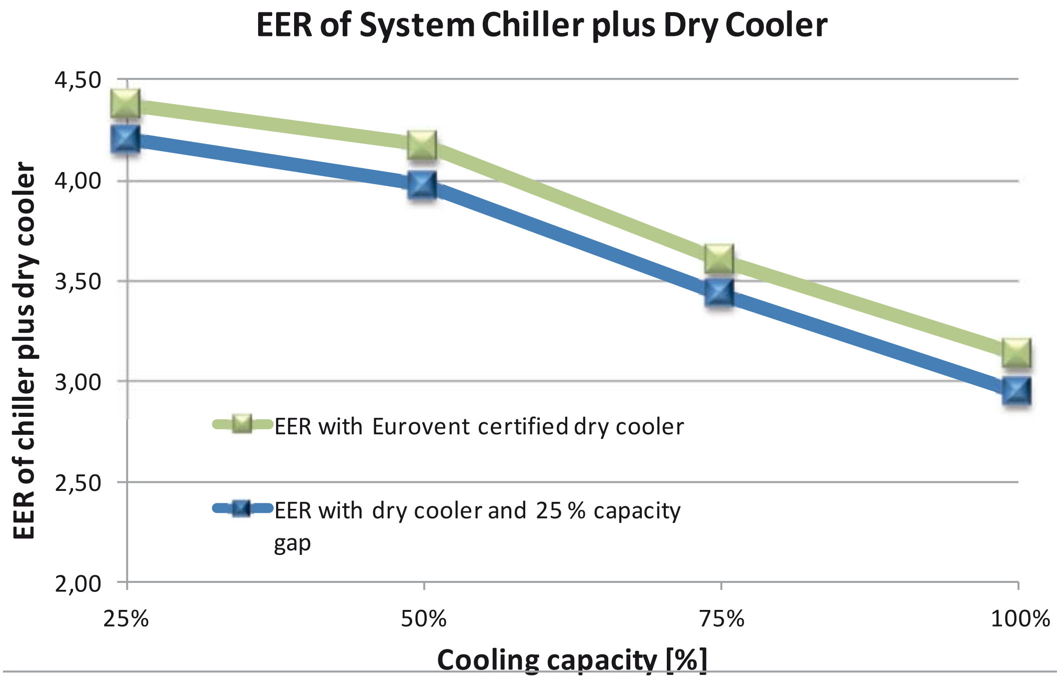


Figure 5. EER of system chiller plus dry cooler at different load.

Figure 5 shows the EER of the total system with the two different dry coolers. The ESEER value of the system using a dry cooler with capacity gap is 4.6% lower due to the higher power consumption of the chiller at full load and the higher power consumption of the fans of the dry cooler at part load operation.

For the City of Milan the annual energy saving of the chiller system using a dry cooler obtaining the designed capacity is around 20 000 kilowatt-hours at calculated 3 542 operating hours. At energy costs of 0.15 € per kilowatt-hour the saving in energy costs will be around 3 000 € per year. Assuming that a non-certified dry cooler may be 10% cheaper the payback time is less than 1.7 years and every year annual savings in operating costs will be achieved. Additionally capacity gains or benefits when for example operating with free cooling are possible. For chillers with longer operating hours or chillers designed for process cooling the payback time will be even shorter.

Conclusions

The paper showed how important it is to use certified components and systems. Correct performance data for heat exchangers are absolutely essential, because they influence the energy efficiency of the entire system. In the study a water cooled chiller recooled by a dry cooler with a capacity gap of 25% was causing 4.6% higher energy costs. ■

References

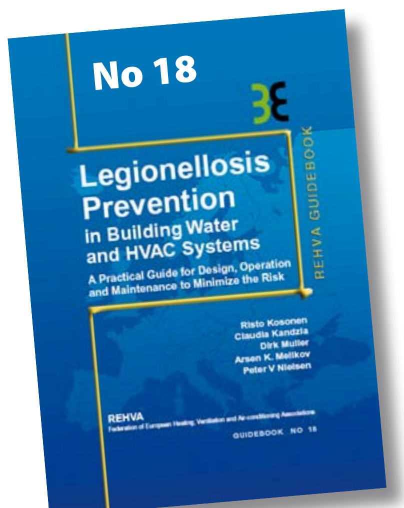
[1] Eurovent Market Intelligence: Chillers' Sales Data. E-mail January 2015.

[2] Eurocent Certita Certification: Flyer July 2013.

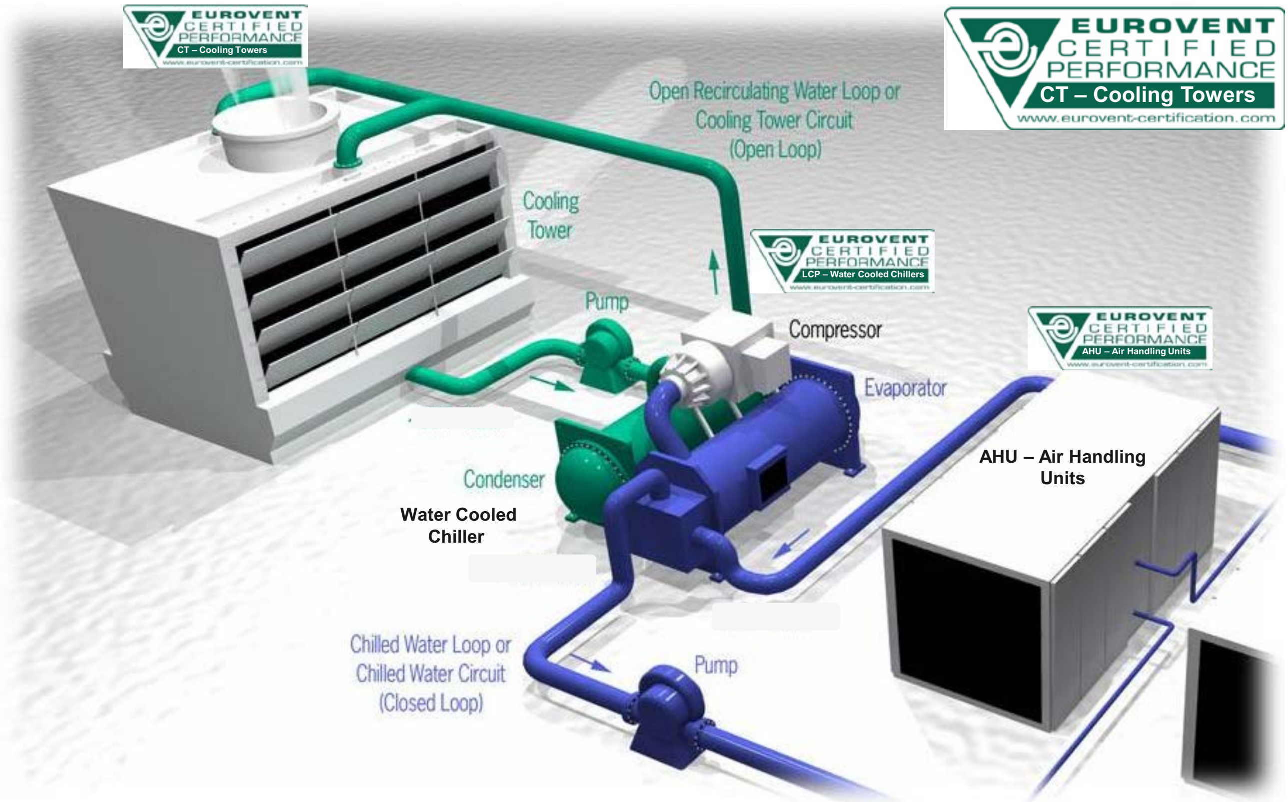
REHVA Guidebook on
Legionellosis prevention

Legionellosis Prevention in Building Water and HVAC Systems

A practical guide for design, operation and maintenance to minimize the risk of legionellosis in building water and HVAC systems.



REHVA - Federation of European Heating, Ventilation and Air Conditioning Associations
www.rehva.eu ● info@rehva.eu ● REHVA Office: 40 rue Washington, 1050 Brussels—Belgium ● Tel + 32 2 514 11 71 ● Fax +32 2 512 9062
REHVA Guidebooks are available at www.rehva.eu



Adding to System Design Performance / Efficiency Cooling Towers Joins the Certified Product Performance Programme from Eurovent Certita Certification

Eurovent Certita Certification (ECC) & Cooling Technology Institute (CTI) together provide industry certification of Cooling Towers and Closed Circuit Coolers covering the world

ROB VANDENBOER
Subgroup Marketing Strategy Chairman
Cooling Tower Compliance Committee

IAN BUTLER
M.Sc - Project Manager
Eurovent Certita Certification

Performance certification is the basis for End-users, Consultants, Contractors, Manufacturers and Government to ensure correct investment in quality products.

The basic requirement of evaporative cooling equipment …

… is rejecting the heat to the atmosphere of the process that needs to be cooled. At first sight an obvious statement, BUT it is not. By using the right methodology, an amount of heat can be rejected to the atmosphere. However knowing exactly how the evaporative cooling equipment rejects the heat is a challenge. Accurate determination of the heat rejection capability is of utmost importance for the **End-user**, **Designer**, **Manufacturer** and the **Government** to determine the efficiency of the heat rejection methodology.

Ultimate quality

Evaluating the quality of a product usually concentrates on the evaluation of functionality, maintenance, longevity, durability, safety and even physical appearance. However, the most fundamental aspect of quality for every machine is the ability to fulfil its design function. For evaporative cooling equipment this mission is proper heat rejection.

Quantifying the temperature level at which heat is rejected accurately is a challenge that requires expertise and know-how. National and International Standards for thermal performance testing of cooling towers have been prepared in cooperation with engineering societies, associations and institutes. These standards focus on performance testing as a part of the commissioning process of a specific installation. Manufacturers however have a need for thermal performance testing programs that certify the performance for an entire product line and guarantee to third parties the correct performance in accordance with published data. Depending on the manufacturing locations, a manufacturer also might wish to guarantee consistent and identical reproduction of the base design with a consequential transferrable performance guarantee to the alternate production locations.

For the European HVAC industry, Eurovent Certita Certification plays a major role in establishing a level playing field for manufacturers to certify the performance and guarantee the fundamental integrity of their product lines. The Eurovent Certified Performance logo indicates that this quality requirement has been fulfilled and should not require the need to be re-proven after the customer's decision and after the manufacturer's production process. Eurovent certification eliminates the age old practice of including; safety margins, upward rounding of the design loads, wet bulb temperature & flow rate and the budget for capital investment.

Green Value or Brown Discount?
Value of sustainability will vary over time. Guaranteeing long term performance in use will be crucial to protect long term value!

Eco-design

The European Parliament and the council of the European Union have established the climate and energy package which is a set of binding legislation aiming to ensure the European Union meets its ambitious climate and energy targets for 2020. These targets, known as the "20-20-20" targets, set three key objectives for 2020 for the EU:

- A 20% reduction in greenhouse gas emissions from 1990 levels
- Raising the share of energy consumption produced from renewable resources to 20%
- A 20% improvement in energy efficiency.

To achieve these targets, the Union has published Directive 2005/32/EC that sets a framework for the eco-design requirements of energy-using products (EUP). Directive 2009/125/EC is a recast of the 2005/32/EC and extents the scope of application to energy related products (ERP). Finally, the directive 2012/27/EC establishes a common framework of measures for the promotion of energy efficiency within the European Union in order to achieve the Union's objectives for 2020 and to ensure less dependence on energy imports from outside the European Union.

The above directives have paved the path for a multitude of specific eco-design directives for machinery. These directives are applicable for setting energy performance requirements for technical building systems, in particular for testing and calculating energy efficiency of the **Energy Using Products** as described in the Directive 2010/31/EU on the energy performance of buildings.

According to **Mr. Frank Hovorka**, Director of Sustainable Real-Estate at Caisse-de-Depots in Paris:

"Energy efficiency is rapidly gaining importance to evaluate the value of a building. Real estate managers recognize the importance of sustainable construction and search for well definable parameters to differentiate quality products with proven energy efficiency". Thermal performance certification is crucial in the process to have an upfront guidance in determining the current and future value of the investment.

It is obvious that the ambitious energy efficiency targets set forth by the EU will only be met if manufacturers keep the performance promises they make for their products. Thermal performance certification for cooling towers ensures that the promised performance data are actually reached and therefore certification helps to meet the EU energy targets.

Thermal performance certification for Europe

Thermal performance certification has remained a recurring item on the agenda of Eurovent Associations "Project Group 9, Cooling Towers". The rapidly changing European legislation, the drive for sustainable Eco-design buildings and the awareness that certified cooling tower will improve the credibility of a naturally top-energy efficient evaporative cooling circuit, convinced the cooling tower manufacturers to re-start a certification program.

Crucial for a successful new certification program were

- Use of generally accepted certification standards for full product line certification
- Equal accessibility to the program for European as well as International manufacturers
- Global acceptance to support the export oriented European market
- Certification through laboratory as well as field-testing for increase program participation flexibility by all manufacturers

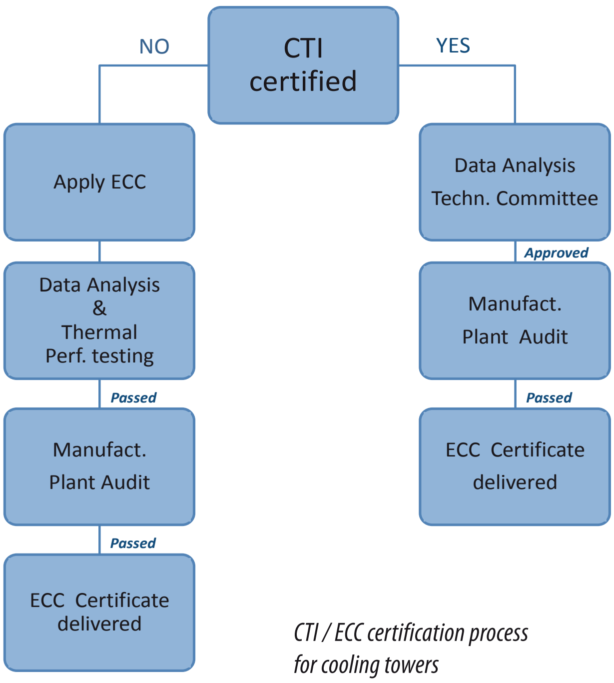
To facilitate the establishment of this programme a Memorandum of Understanding (MOU) was signed between Eurovent Certita Certification and the Cooling Technology Institute (CTI). This MOU describes the cooperation between both organizations where the Cooling Technology Institute provides the structure and know-how for thermal performance certification and Eurovent Certita Certification (ECC) provides the administration to ensure consistency of the certified products and promote the certification program in Europe. CTI's strong international reputation and recognition supported by ECC's solid administration guarantees a top quality effective certification program.

Certification process

The procedures as described in the documents "OPERATIONAL MANUAL OM-4-2014 for the CERTIFICATION of COOLING TOWERS" and the "RATING STANDARD FOR COOLING TOWERS RS 9C/001-2014" are applicable.

In accordance with OM-4-2014, the certification process starts with the **application** for certification. The manufacturer submits to ECC all relevant documentation for each applied product range and also declares to accept the general rules as written in the General Eurovent Certification Manual. The most important document to provide is the Data of Record (**DOR**) that defines technically the exact construction of the cooling equipment models to be thermally certified.

The qualification procedure follows a successful application. The manufacturer qualifies a product line by executing an initial thermal performance test in accordance with Eurovent RS 9C-2014 and executed by the CTI licensed thermal certification performance test agency. This rating standard RS 9C-2014 refers directly to the CTI STD201 (OM/RS) – Thermal Performance Certification of Evaporative Heat Rejection Equipment & Performance Rating of Evaporative Heat Rejection Equipment. Cooling tower lines that already are CTI-certified transpose this CTI certification into the Eurovent certifying framework. In order to guarantee exact duplication of construction of the transposed equipment, Eurovent OM-4-2014 defines a factory audit procedure: basically all DOR entries of a randomly selected cooling



CTI / ECC certification process for cooling towers

tower manufactured in the European facility are audited and confirmed identically compared to the product that has been CTI-certified outside of Europe. A successful thermal performance test in accordance with CTI STD 201(RS/OM) and a successful factory audit result in a Eurovent certification.

Repetition is crucial to guarantee consistence of performance and construction. CTI STD201, and as per consequence also OM-4-2014, define an annually recurring reverification test executed by the CTI licensed thermal certification performance test agency. Positive performance test and factory audit reports result in a renewal of the Eurovent certification. However performance tests and factory audits might conclude with a less than satisfactory result. Failure treatment is therefore an integral part of OM-4-2014 and clear procedures are described on how to implement corrective measures and consequences. Failure treatment can be activated during the qualification and re-verification procedure and as a result of a customer complaint.

Failure treatment cannot be taken lightly by the manufacturer. Unsatisfactory results can bring the certification of the entire product line into question and can lead to revocation of this product line from the Eurovent Certita Certification and CTI website and notification of the failure to the entire CTI membership and to the industry.

Certification versus independent field testing

The purpose of certification is to set forth a program to assure users of evaporative cooling equipment that all models from a product line of a specific manufacturer are thermally performing in accordance with the published ratings. The manufacturer is assured that the thermal performance testing as the basis for the certification of the product line responds to the rules of honest competition on a level playing ground. Certification does stand for voluntary participation to thermal performance testing and factory audits applying identical rules for all participating manufacturers. In order to guarantee accurate undisputable test results, all equipment utilized for an initial qualification or re-verification test shall be owned by CTI or the CTI licensed thermal certification test agency and be approved by the CTI Thermal Certification Administrator. Calibration schedules and instrument accuracies are also stipulated.

Only a limited number of CTI licensed certification test agencies have the authority to execute thermal certification qualification and verification tests. All licensed certification test agencies are carefully selected and often can count on decades of experience. They use identical procedures for thermal certification testing and all forward the thermal test results to the CTI Certification Administrator for consistent evaluation of the results.

In Europe, due to the absence of an industry wide participation to a certification program for many years, owners and consultant used to accept manufacturer's performance declarations. In some cases testing in accordance with standards like "EN13741 Thermal performance acceptance testing of mechanical draught series wet cooling towers" is required. The use of inexperienced, non-licensed test agencies could however result in questionable results, and with undesirable statistical addition of tolerances coming from inaccurate readings taken with contestable equipment to adjust the result.

The independent thermal performance field test is mostly part of the commissioning process and therefore executed immediately after completion of the technical installation. However due to the nature of a building project, the cooling requirements at that stage seldom reaches design conditions. In most cases, achieving a stable operating condition is already a challenge on its own. A valid thermal performance field test, requiring stable fluid flow and process temperatures and a stable wet bulb temperature, is often challenging in the majority of situations. Tests and re-tests can be required, sometimes by an alternative test agent with different measuring equipment, techniques and knowhow. On top of these challenges, a limited time slot for a good thermal performance test (typically during mid-summer) complicates it further.

On top of all of that there is the extra cost to the owner of the acceptance test for commissioning. All this demonstrates clearly the benefit of a thermal performance certification program.

Certification of evaporative cooling equipment guarantees thermal performance prior to shipment of the equipment and at no cost for the owner! The installation of underperforming equipment is prevented and consequential costs for corrective measures or continuous payment of energy consumption penalties over the life of the equipment are avoided.

According to **Mr. Roi Wanders**, Mechanical Engineer at Jacobs Engineering in Belgium: "The importance of thermal performance certification lies in the fact that it establishes great confidence in the product and prevents distress and unexpected design flaws once the installation is being commissioned or operated by the end-user".

Consequences of underperformance

A deficiency in cooling tower performance often goes unnoticed in many installations. The evaporative cooling equipment is a part of a cooling circuit, often combining multiple components. Each of the components of this cooling circuit influences the other linked components and the efficiency of the system is dependent on the strength of the weakest link.

Lack of thermal performance of the evaporative cooling equipment has a limited effect on the energy consumption of the evaporative cooling equipment itself, what is often more important is the energy consumption of the overall system which the evaporative cooling equipment serves. For example in a conventional HVAC cooling system the fan (and

pump) power of the evaporative cooling equipment is small compared to the electrical power of the chiller (often by a factor of 10). However, the compressor power is directly related to the condensing temperature of the chiller and this condensing temperature is directly defined by the performance of the evaporative cooling equipment. The ambient temperature at which an HVAC-system can switch to free cooling also decreases. This dramatic effect of underperforming evaporative cooling equipment on the electrical power of the chiller goes far beyond the few percentage points of gain that a chiller manufacturer can offer by installing highly efficient electrical motors (as required by the EU directive 640/2009/EC). The operating cost impact is equally dramatic and results in a yearly recurring increased electricity invoice. Additionally, the tower must work harder to satisfy the expected thermal performance, resulting in the use of even more electrical power.

Depending on the application, underperformance of evaporative equipment can also lead to an increased temperature in a building and depending on the building purpose the consequence can be acceptable for a short period only or simply be unacceptable. However, underperformance of evaporative cooling equipment for industrial application (whether or not with a chiller in the cooling circuit) can lead to significant production loss and operational danger and is usually unacceptable.

Capacity deficiencies can lead to risk for a continuous operation and are most of the time difficult to detect prior to commissioning. Most of the time these deficiencies go undetected and are a continuous energy penalty that must be paid by the owner. Conservative assumptions in building load calculations, reduced building occupancy, off peak ambient conditions and the use of higher than design wet bulb temperatures will often cover effects of undersized evaporative cooling equipment, but the negative effects to the owner/end-users will remain. Oversized systems often perform poorly as compared to properly sized cooling systems.

How to specify thermal performance certification

Thermal Performance and Efficiency:

The cooling tower shall be capable of cooling ______ l/s of water from _____ °C to ______ °C at a design entering air wet-bulb temperature of ______ °C.

The thermal performance shall be ECC certified in accordance with ECC and CTI certification standards. Equipment without ECC certification will be subject to a field or factory acceptance thermal performance test executed by a qualified independent third party testing agency in accordance with a recognized standard.

Specification Value

Certification assures the buyer that the tower is not intentionally or inadvertently undersized by the manufacturer. Certification alone is not sufficient to assure you that the tower will perform satisfactorily in a particular situation. Certification is established under relatively controlled siting conditions, as defined in manufacturer's literature, but towers aren't always installed under such circumstances. They can be affected by nearby structures, machinery, enclosures, effluent from other cooling towers, etc. Designers and owners must therefore take such site-specific effects into consideration in selecting the tower to assure full thermal performance, but the buyer must insist by the written specification (including description of those siting conditions) that the designer/manufacturer be responsible to guarantee this "real world" performance. Nevertheless the installation of a certified product gives the owner assurance that the product itself provides the performance he has paid for. Manufacturers publish layout guidelines, installation manuals, and operating and maintenance manuals, all of which should be followed for a successful installation.

Conclusion and benefits of thermal performance certification

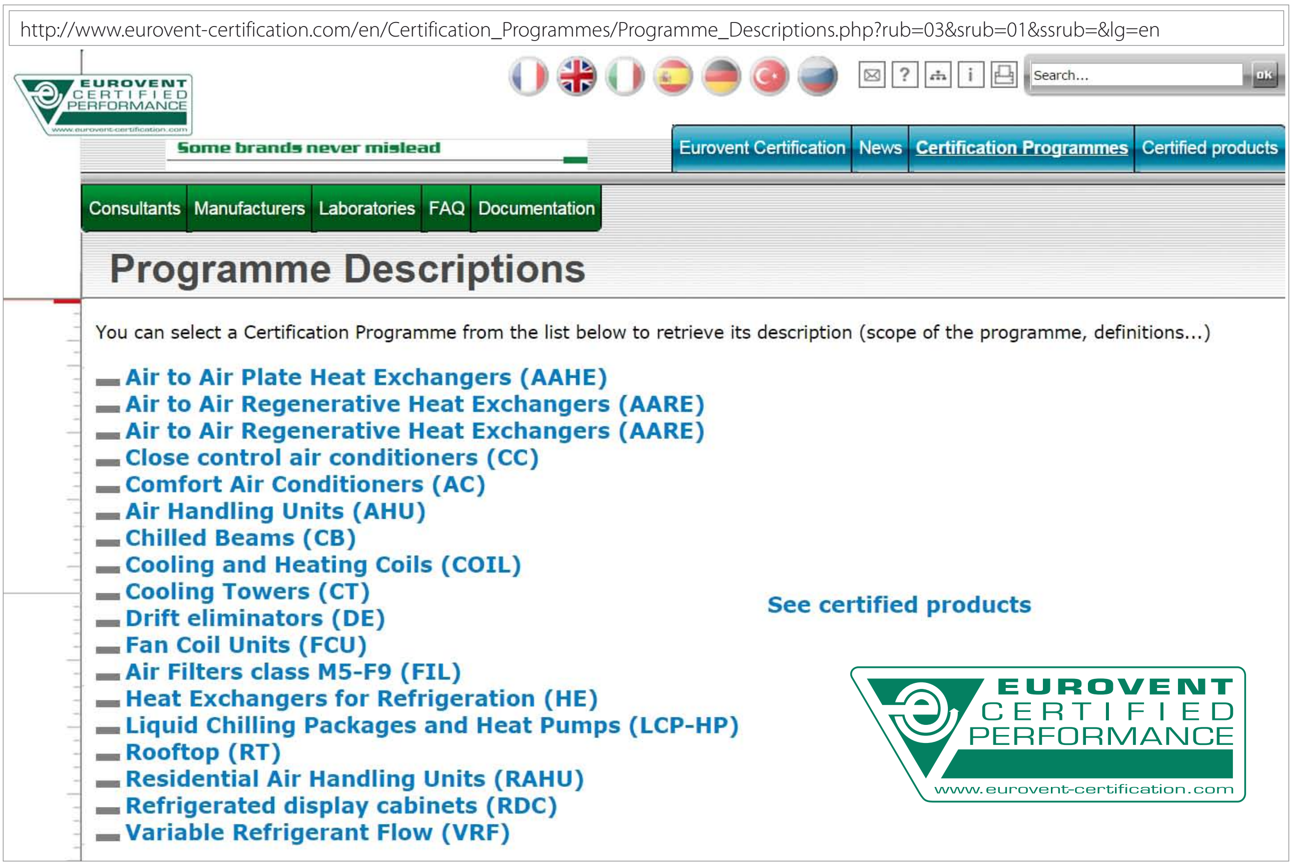
Owner/End-Users are the most important partners of thermal performance certification. They decide the key-requirements of the equipment for the consultant to specify. The end-user is the provider of the capital budget and pays the monthly energy bill of the cooling system. As stipulated in the previous paragraph, the performance of the cooling tower is essential for the performance of the entire cooling system. This is a crucial factor in the evaluation of the sustainability and long term value of the real estate and industrial facilities.

Below you can find a summary that lists the specific benefits of Eurovent-CTI thermal performance certification for cooling towers and closed circuit coolers.

- **Owners and end-users:** Thermal performance guarantee of the equipment at no additional cost. Installation of equipment that is rated and evaluated on equal terms enabling honest evaluation of competing offers on a level playing ground with a 100% thermal capacity return for the investment.
- **Government, EU regulators:** Reliable independent basis for the efficiency evaluation of the energy using product. Full scale program accessible for all manufacturers in a global market.
- **Design engineers:** Reliable standards to specify and avoid deficiencies attributed to the design of the cooling system. Similar as for the owner/end-user, thermal performance certification is a key decision making factor that guarantees honest comparison of suppliers at no additional cost for the owner/end-user.
- **Contractors:** No costly call back due to capacity deficiencies. Exclusion of capacity doubts for the certified components in case of cooling system underperformance due to third party issues. Basic requirement to build relationships with trustworthy suppliers.
- **Cooling tower manufacturers:** Honest competition based upon standards established by evaporative cooling experts resulting in faster product development and sustainable innovation.

Thermal performance certification is a basic element of a successful, sustainable design and offers significant benefits to all segments of the industry. ■

Eurovent



Eurovent Association represents, promotes and defends the industry to relevant European, national and international bodies and cooperates with other European umbrella associations. Over the years Eurovent has become a well-known and respected stakeholder in all industry-related matters and, in particular, in climate change and energy efficiency. To fully support this task, Eurovent Association develops product certification programs for the entire industry through Eurovent Certita Certification with the aim to establish the required credibility and leverage towards legislative Europe.

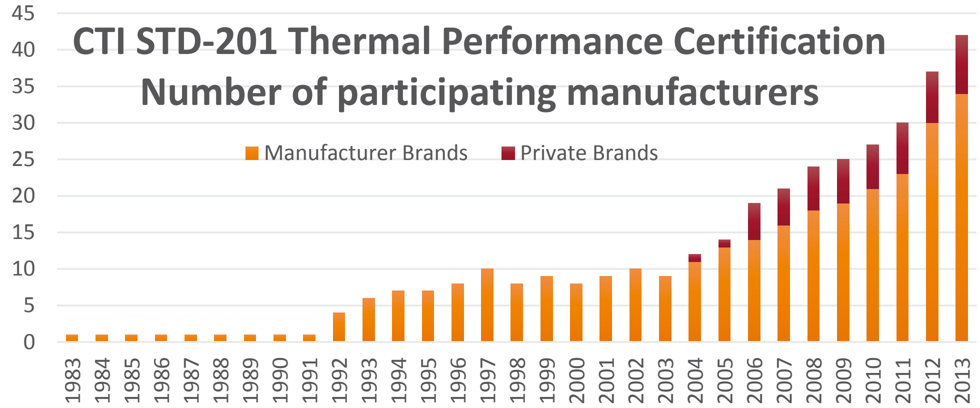
Eurovent represents 1015 companies in 13 European countries, employing 126 804 people who generate 21.3€ billion of annual output. Eurovent was initially founded in 1958 and has been functioning under its current name since 1964.

The main objective of the **Eurovent Certita Certification** (ECC) programme is to certify cooling equipment (and/or components) independently from Eurovent Association. ECC has its own dedicated Technical, Marketing, Sales and Legal department and is structurally independent from Eurovent Association. Eurovent Certita Certification is widely established and well known in the European Cooling industry and defends a strong position of being a credible well organized and trustworthy partner focusing on a mutual European approach establishing a level playground amongst all players on the European market. Currently, 17 performance certification programs are active and monitored by dedicated auditors and program managers.

Eurovent Certita Certification established the first cooling tower certification programme during the early 90's. The Eurovent 9.2 manual "Thermal Performance Acceptance Testing of Mechanical Draught Standardized Water Cooling Towers" was created by all main cooling tower manufacturers in Europe at that time. However, the program suffered from lack of participation and did not succeed to gain leverage in the market. At the beginning of 2012, ECC has established its new certification programme for Evaporative Heat Rejection Equipment in collaboration with CTI. The programme is in its 3rd year with manufacturer participation covering a substantial percentage of the European market.

For additional information of the Eurovent Certita Certification programme for Cooling Towers, visit www.eurovent-certification.com website or contact Mr. Ian Butler MSc. (ECC Programme Manager for Cooling Towers).

Cooling Technology Institute (CTI)



The Cooling Technology Institute (CTI) is a non-profit, self-governing technical association of manufacturers, suppliers, owners, operators and designers. Membership is open to all parties with an interest in heat rejection technology. Among CTI's stated objectives are a dedication to the advancement of technology, design and performance of heat rejection equipment, the prevention of water and air pollution, and the conservation of water as a natural resource.

CTI was founded in 1950 and has provided a medium of information and data exchange among manufacturers and users of Evaporative cooling equipment and associated products for over sixty years. CTI meets semi-annually to conduct business, technical paper presentations and advance committee work on CTI guidelines, standards, codes, and white papers. It also develops standardized testing codes and standards and engages in and supports research. A key objective of CTI has been to establish and promulgate the use of codes, standards, and specifications aimed at obtaining uniformly good quality in heat rejection technology.

For over sixty years, the CTI also provided cooling tower performance testing services to members and non-members. Starting in January 1993, the CTI has provided these testing services through multiple testing agencies, each examined, qualified, and licensed by the CTI to conduct such tests. The documents establishing the program, and under which it currently operates, are developed by a task force under the auspices of the CTI Board of Directors.

The mission of CTI is to advocate and promote the use of environmentally responsible Evaporative Heat Transfer Systems (EHTS), cooling towers and cooling technology for the benefit of the industry by encouraging education, research, standards development and verification, government relations, and technical information exchange

CTI Objectives:

- Maintain and expand a broad-base membership
- Identify and address emerging and evolving issues
- Encourage and support cooperative research
- Assure acceptable minimum quality levels and performance
- Establish standard testing and performance analysis systems and procedures
- Communicate with and influence governmental entities
- Encourage and support forums and methods for exchanging technical information

CTI published their first STD-201, the "Certification Standard for Commercial Water Cooling Towers" in 1962. Later this standard became the "Standard for Thermal Performance Certification of Evaporative Heat Transfer Equipment". The latest revision created an OM & RS as mentioned previously. Initially, this standard described an extensive matrix of tests to qualify. Similar to the first Eurovent Cooling Tower Certification program, the initial CTI program also required substantial resources that many manufacturers could not justify. After a period of evaluation and revisions of STD-201, the participation to the program started in 1981. The program started to grow significantly from 1992 onward as seen in the graphs below. Currently, 34 manufacturers and 8 private brands are listed with one or more CTI certified product lines.

For additional information on the CTI, visit www.cti.org or contact Mrs. Virginia A. Manser, CTI Administrator at vmanser@cti.org.

Development of Heat Pump System Certification

SANDRINE MARINHAS
Head of Thermodynamics Department
Eurovent Certita Certification

FRANÇOIS-XAVIER BALL
General Manager
Eurovent Certita Certification

The main Certification Contributors

In a European context where current or future regulations, such as those on eco-design, are effectively based on the declaration of product performance by the manufacturers themselves, voluntary certification provides reliable product data, and helps organise the market.

The publication of certified performance by an independent and accredited body ensures that the design offices, installers, and users in general have a consistent, reliable, and continuously up -o-date database at their disposable, and manufacturers to enhance the best features of their products.

In a highly competitive market, product certification plays a key role in ensuring fair trade and establishing trust between operators.

In addition, transparency and availability of certified performance constitutes a very effective tool in promoting new product development and ever more effective technical solutions. Either directly when the certification standards introduce performance thresholds, or only indirectly through free competition. Over the years, it was possible to observe a steady increase in COP values for certified heat pumps.

Finally, it should be noted that certifications, such as those granted by Eurovent Certita Certifications, are developed closely with the professional sectors involved, which ensures consistency with market expectations and developments. Examples include the introduction, in consultation with AFPAC, in the size certified characteristics and the acoustic specifications relating to heat pump noise. Researching consistency with market expectations also signifies anticipating future developments in support of manufacturer and industrial developments. In particular, this is what is implemented in the NF PAC and Eurovent Certified Performance certifications, as the application of Eco-design regulations will dramatically shake up the current situation.

Since 2013, the trademarks "Eurovent Certified Performance" (**Figure 1**), "NF PAC - Heat Pumps" (**Figure 2**) and "NF Multi-Energies" (**Figure 3**) have been issued by a single certification body: "Eurovent Certita Certification" [1, 2]. These trademarks, which have an impact on French and European level and are also globally renowned, cover all types of heat pumps

Figure 1. ECP trademark.

Figure 2. NF PAC trademark.

Figure 3. NF Multi-energy trademark.

in their various functions, a scope which is described later in this document. In a complex context, where the thermal regulation of buildings RT2012 [3] specific to France, in addition to regulations on marketing products with European texts that are gradually being written, certification will showcase in a more understandable manner energy efficient products to prescribers and final users, products which have an acceptable acoustic performance. The development of this trademark certification is presented below.

Current status of heat pump certification

October 2014, marked the 20th anniversary of Eurovent Certification activities. On the other hand NF exceeded its thousandth heat pump certification, and a new reference document appendix for the Multi-energy standard dedicated to hybrid systems is available, which combines heat pumps and boilers. On this occasion we can review the road we have gone down and the status on the current type and number of certified reference documents. (**Table 1**).

Faced with market statistics available from Eurovent Market Intelligence and Clim'Info, this data support the assertion that the coverage of certified Heat Pumps on the European market is very high.

From "Standard" performance to "Seasonal" performance

Energy performance characterisation for eat pumps is gradually migrating from EER and COP nominal performance EN 14511 [4]) to seasonal performance (EN 14825 [5]), whose recent developments, and those to come, will cover more and more types of products.

Whilst the industry has implemented ESEER (European Seosonal Efficiency Ratio), certified since 2007, recently published regulations or those in the process of being published talk about seasonal coefficient of performance (SCOP) in heating mode, and its equivalents SEER and SEPR in cooling mode (see **Table 2**).

In order to compare the heating solutions between different technologies, the seasonal effectiveness is defined in primary energy etas (η_s). In order to respond to these developments, Eurovent Certita Certification suggests that manufactures certify this new performance. Since the 2013 revision of the reference document "AC1" (Air Conditioners ≤ 12 kW - Luxury Air Conditioning Units), manufacturers are required to declare the SEER, covered by eco-design 206/2012 [6] and labelling 626/2011 [7] regulations. Products which do not fall within the thresholds of the regulation are excluded. Since revision 8 of the reference document NF PAC published in the autumn of 2014, manufacturers can certify SCOP and seasonal energy efficiency for the heating premises η_s, covered by regulations 813/2013 [8] 811/2013 [9], as an option. Since the 2015 revision of the reference document LCP-HP (Liquid chilling packages and heat pumps), published December 2014, manufacturers are required to declare the SCOP and η_s, data that will be published in the autumn of 2015.

In the 2016 or 2017 revision of the reference documents AC2, AC3 (Air-Condition Units<=100 kW) and RT (Rooftop Units), manufacturers shall declare the SCOP, SEER and/or the etas, knowing that the regulation was passed in April 2014 but the unreleased documents have not been published in the official EU journal yet, and the mandate to meet the harmonised standards on the needs and regulatory testing methods is in its early stages.

Sanitary Hot Water

Present in the source document NF PAC since August 2012, the certification of dual service heat pumps producing hot sanitary water evolved in its 7th revision, which was published at the end of June 2014 to ensure the further certification of heat pumps and storage tanks with a reference simulation tool.

Regarding future developments, a work group has been meeting since September 2014 to introduce by the summer of 2015, the possibility of certifying

Table 1. Distribution of Certified Products (June 2014).

Type of Heat Pump	NF Heat Pump	Eurovent Certified Performance
Air/air	/	2835
Air/Water	1845	10417 of which 1512 x 100 kW
Water/Water	258	3068 of which 560 x 100 kW
Glycol Water/Water	471	/
Sanitary Hot Water	192	/
Swimming Pool	34	/
Gas	6	/
Variable Refrigerant Flow	/	20

Table 2. Summary Term Table (in English) and the principal equations on the seasonal performance characterisation of Heat Pumps.

Terms	Cooling mode	Heating mode	unit
reference design conditions reference temperature conditions cooling mode: 35°C dry bulb (24°C wet bulb) outdoor and 27°C dry bulb (19°C wet bulb) indoor heating: for average: -10°C, colder : -22°C and warmer: +2°C climates	$T_{designc}$	$T_{designh}$	°C
load or demand load of the building at certain temperature conditions	P_c	P_h	kW
full load load at reference design conditions	$P_{designc}$	$P_{designh}$	kW
part load ratio load divided by the full load	PLR		%
capacity capacity a unit can deliver at certain conditions	DC		
capacity ratio load divided by the declared capacity	CR		
bin hours duration at a given temperature for a specific location	h_j		h
bivalent temperature (CR=100%) lowest outdoor temperature where capacity is equal to the load		$T_{bivalent}$	°C
operation limit temperature lowest outdoor temperature where the unit still delivers capacity		T_{OL}	°C
reference annual demand(s) representative annual demand(s)	Q_c	Q_h	kWh
efficiency (energy efficiency ratio and coefficient of performance) capacity divided by the effective power input at standard conditions: at conditions of EN 14511	EER	COP	kW/kW
at part load: at conditions of EN 14825 (degraded for fixed stage units)	EER_j	COP_j	
electric back up heater (below Tbivalent) supplementary electric heater, with a COP of 1		elbu	kW
thermostat off corresponding to the hours with no load	TO		
standby unit partially switched off but reactivable by a control device or timer	sb		
off unit completely switched off	off		
crankcase heater (to limit refrigerant concentration in oil at compressor start) where a crankcase heater is activated	CK		
auxiliary power consumptions $\sum h_{aux}.P_{aux} = h_{TO}.P_{TO} + h_{sb}.P_{sb} + h_{CK}.P_{CK} + h_{off}.P_{off}$	TO, sb, off, ck		kWh
degradation coefficient for fixed stage units (same equations for COPj) efficiency loss due to the cycling of respectively chillers and ACs $EER_j = EER.\frac{CR}{C_c.CR+(1-C_c)}$; $EER_j = EER.\left(1 - C_d.(1-CR)\right)$ = *EER.(Part Load Factor)*	Cc / Cd		% kW/kW
reference seasonal efficiency [reference: EN 14825, 2013] seasonal efficiency calculated for the reference annual demand $SEER = \frac{Q_c}{\frac{Q_c}{\frac{\sum h_j.P_{c,j}}{\sum h_j.\left(\frac{P_{c,j}}{EER_j}\right)}}+\sum h_{aux}.P_{aux}}$; $SCOP = \frac{Q_h}{\frac{Q_h}{\frac{\sum h_j.P_{h,j}}{\sum h_j.\left(\frac{P_{h,j}-elbu_j}{COP_j}+elbu_j\right)}}+\sum h_{aux}.P_{aux}}$	SEER	SCOP	kWh/kWh
active seasonal efficiency seasonal efficiency excluding auxiliary consumptions	$SEER_{on}$	$SCOP_{on}$	kWh/kWh
European seasonal energy efficiency ratio [reference: Eurovent Certification, 2008] Antecedent term used for SEER before European standard was issued $ESEER = 0.03.EER_{100\%} + 0.33.EER_{75\%} + 0.41.EER_{50\%} + 0.23.EER_{25\%}$	ESEER	-	kWh/kWh
integrated part load value [reference AHRI, 1998] (EER in kW/Ton) First equivalent to ESEER, with weighting coefficients related to the United States $IPLV = 0.01.EER_{100\%} + 0.42.EER_{75\%} + 0.45.EER_{50\%} + 0.12.EER_{25\%}$	IPLV	-	kW/Ton

collective sanitary hot water, with or without the 2000L capacity limit.

A new and truly European certification for heat pumps

The "European Heat Pump" certification program is a bridge between the NF programme and the ECP trademark. The first certificates shall be distributed at the beginning of 2015 and the data shall be available online at the end of winter.

Multi-Energy Systems

Concerning the NF Multi-Systems trademark, it does not concern the enhancement of each component, but the enhancement of the system's performance as a whole.

The first appendix of the multi-energy reference document is dedicated to hybrid heat pumps (hybrid heaters). In this case specifically, it concerns the enhancement of the performance regulation system that can be optimised in such a way so as to use fossil fuels or electricity in the most favourable conditions during the key operating points of the product. It can also be for consumers using electricity during off-peak rather than peak periods

The first certificate was published in November 2015. The trademark committee also addressed it in 2014 to introduce seasonal performance in certified data in 2015 or 2016, while the taking into account these systems in the EN 14825 standard has not been resolved in the next version of the standard, but is in the process of being defined in the following version.

European Eco-Label

To promote the most environmentally friendly products, the Eco-Label Directive [10] completes the eco-design and labelling guidelines. For heat pumps, the criterion for the attribution of the co-label, initially published 9 November 2007 [11] and valid until 31 October 2014, were updated by the decision of the committee' dated 28 May 2014 [12]. Note that the eco-label had been attributed to a handful of product lines in France, Belgium and Germany.

An extension of the scope of the text on hybrid devices is amongst the latest advances, including the emergence of a Total Equivalent Warming Impact (TEWI), based on the Global Warming Potential (GWP) of the refrigerant used with conventional end-of-life leakage rate fixed at 35% and the seasonal energy effectiveness for the heating of premises η_s.

Conclusion

In a changing regulatory and normative context, the offer of certification by Eurovent Certita Certification may be adapted to the heat pump market, therefore ensuring a guarantee to the final client a better understanding of performance thanks to the collaborative work including all stakeholders, while covering as extensively as possible existing solutions and technologies. ■

References

[1] www.eurovent-certification.com

[2] www.certita.org

[3] http://www.rt-batiment.fr/

[4] EN 14511 - Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.

[5] EN 14825 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors for space heating and cooling - Testing and rating at part load conditions and calculation of seasonal performance.

[6] Commission regulation (EU) No 206/2012 of 6 March 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for air conditioners and comfort fans.

[7] Commission delegated regulation (EU) No 626/2011 of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners.

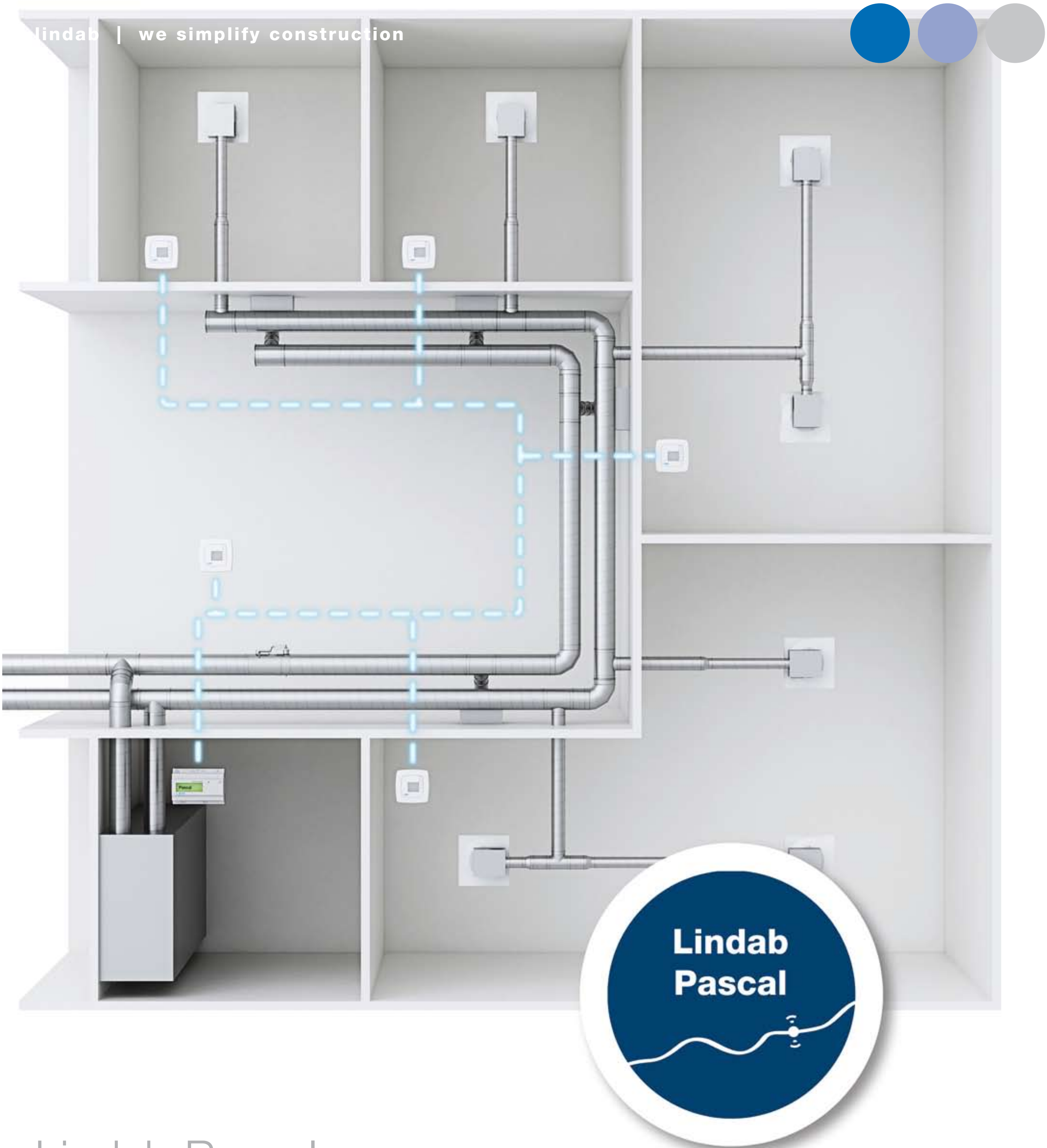
[8] Commission regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters.

[9] Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device Text with EEA relevance.

[10] http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html.

[11] Commission decision 2007/742/CE of 9 November 2007 establishing the ecological criteria for the award of the Community eco-label to electrically driven, gas driven or gas absorption heat pumps.

[12] Commission Decision 2014/314/EU of 28 May 2014 establishing the criteria for the award of the EU Ecolabel for water-based heaters.



Lindab Pascal

Simplified VAV solution with full potential…

Lindab is now launching the next generation of VAV system with the purpose of simplifying and optimizing all phases of the building construction from design to operation. This solution saves you for unnecessary energy use, regulation equipment in the ducts and a complicated installation. Lindab Pascal, the most simplified solution on the market with all you need for an optimized VAV system.

Lindab – We simplify construction…

Lindab
www.lindab.com

20 years of European Certification of HVAC&R products

EUROVENT CERTITA CERTIFICATION is a major European certification body in the field of HVAC-R, operating 35 certification programs and generating about € 9 million in turnover. Eurovent Certita Certification is offering various certification schemes tailored to the needs of manufacturers and stakeholders on their specific markets. It focuses on certifying product performances as well as data needed to implement regulations. The main quality marks currently proposed are the marks "Eurovent certified performance", NF, CSTBat, and the European Keymark.

On a market ever more demanding in terms of energy performances and environmental challenges, Eurovent Certita Certification is fit for supplying certified data at a European level and providing the needed confidence on the playing field.

With this special issue of REHVA Journal we welcome the opportunity to present you 20 years of third party performance certification expertise and know-how, applied to more than 400 manufacturers, 35 HVAC-R product ranges and more than 100 000 product references.

ERICK MELQUIOND
President
Eurovent Certita Certification

Certification schemes proposed for both domestic & industrial facilities:

Thermodynamics:	Heat pumps, air conditioners, liquid chilling packages, VRF, rooftop, …
Comfort appliances:	Radiators, fan coils, solar collectors and heaters, heating appliances using liquid or solid fuels, mobile liquid fuel heaters, chilled beams, …
Cooling & refrigeration:	Cooling and heating coils, cooling towers, heat exchangers, milk coolers, condensing units, compressors, refrigerated display cabinets, …
Ventilation:	Mechanical ventilation, air handling units, fans, flue pipes, filters, heat recovery, …

Certification Programmes

- Air Filters Class M5-F9 *
- Air Handling Units*
- Air to Air Plate Heat Exchangers*
- Air to Air Rotary Heat Exchangers *
- Chilled Beams*
- Close Control Air Conditioners*
- Comfort Air Conditioners*
- Cooling & Heating Coils
- Cooling Towers
- Drift Eliminators
- European Heat Pumps
- Fan Coils Units*
- Heat Exchangers *
- Heat Pumps*
- Liquid Chilling Packages *
- Remote Refrigerated Display Cabinets
- Residential Air Handling Units (RAHU)
- Rooftop (RT)*
- Variable Refrigerant Flow (VRF)*

* All models in the production has to be certified

Air Handling Units

Swegon has participated in the program for Air Handling Units from the start. The first priority at that time, and still is, was to find a way for fair competition. This is a long term struggle were we try to cover all aspects from manufacturing to software performance predictions and its agreement with tests. We discuss and take decisions about mandatory performance in software printout, rules for the energy labelling, how to test and what to apply in the, on site, auditor check. Customers should go for Eurovent certified products, to get reliable data, and then they can cut the main cost and take care of the environment by minimising the use of energy.

Committee chair:
Mr Gunnar Berg
Development Engineer, Swegon

Scope of certification

This Certification Programme applies to selected ranges of Air Handling Units.

Participants shall certify all models in the selected product range up to the maximum stated air flow.

A range to be certified shall include at least one size with a rated air volume flow below 7 m³/s (25 000 m³/h).

Certification requirements

For the qualification procedure: the selection software will be verified by our internal auditor. A visit on production site will be organized. During that visit, the auditor will select one real unit per range, as well as several model boxes that will cover all mechanical variations.

The selected units will be tested and performances delivered by the selection software will be compared to the performances measured in an independent laboratory.

For the repetition procedures, the auditor will annually check the software conformity against the production data, and tests will be repeated every 3 to 6 years.

Certified characteristics & tolerances

- External Pressure: 4% or 15 Pa
- Absorbed motor power: 3%
- Heat recovery efficiency: 3%-points
- Heat recovery pressure drop (air side): max. of 10% or 15 Pa
- Water coil performances (heating/cooling): 2%
- Water coil pressure drop (water side): max. of 10% or 2 kPa
- Radiated sound power level casing: 3 dB(A)
- Sound power level unit openings:
  - 5 dB @ 125 Hz
  - 3 dB @ 250 – 8 000 Hz

ECC Reference documents

- Certification manual
- Operational Manual OM-5
- Rating Standard RS 6/C/005

Testing standards

- EN 1886: "Ventilation for buildings – Air handling units – Mechanical performance"
- EN 13053: "Ventilation for buildings – Air handling units – Rating & performance for units components and sections"

Air to Air Plate Heat Exchangers

CERTIFY ALL

Scope of certification

This Certification programme applies to selected ranges of Air to Air Plate Heat Exchangers. Participants shall certify all models in the selected range, including:

- cross flow, counter-flow and parallel flow units
- all sizes
- all materials
- all airflow rates
- all edge lengths
- plate heat exchanger with humidity transfer

Heat Exchangers with accessories such as bypass and dampers shall not be included.

Manufacturers shall declare production places and provenance of products is randomly chosen. The programme does not cover other types of Air to Air Heat Exchangers like Rotary Heat Exchangers or Heat Pipes. Combination of units (twin exchangers) are also included in the scope of the program.

Certification requirements

For each range to be certified, 3 units for qualification and 1 for yearly repetition will be selected by Eurovent Certita Certification and tested in an independent Laboratory.

Certified characteristics & tolerances

- Dimensions: ± 2 mm
- Plate spacing: ± 1% or ± 1 plate
- Temperature efficiency Dry: −3 percentage points
- Temperature efficiency Wet: −5 percentage points
- Humidity efficiency: -5%
- Pressure drop: +10%, minimum 15 Pa

ECC Reference documents

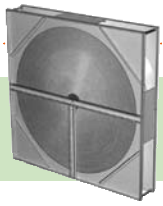
- Certification manual
- Operational Manual OM-8
- Rating Standard RS 8/C/001

Testing standards

- EN 308

Air to Air Rotary Heat Exchangers

CERTIFY ALL



Scope of certification

This Certification Programme applies to all ranges of Air to Air Regenerative Heat Exchangers (RHE) including sealing systems. Units sold without casing and sealing systems are also included. Participants shall certify all models in the ranges, including:

- all classes: condensation (non hygroscopic, non enthalpy) RHE, hygroscopic enthalpy RHE, hygroscopic sorption RHE
- all RHE geometry (wave height, foil thickness)
- all sizes (rotor diameters and rotor depths and surface areas of Alternating Storage Matrices - ASM)
- all materials
- all airflow rates
- all different types of sealing (if available)

Certification requirements

For the qualification procedures 1 unit per class of rotor will be selected and tested by an independent laboratory. For yearly repetition, 1 unit will be selected.

Certified characteristics & tolerances

- Temperature Efficiency: −3% points
- Humidity Efficiency: −5% points (min. tolerance 0.2 g/kg in absolute humidity of leaving supply air)
- Pressure Drop: +10% (min 10 Pa)
- Outdoor Air Corrrection Factor (OACF): 0.05
- Exhaust Air Transfer Ratio (EATR): +1% point

ECC Reference documents

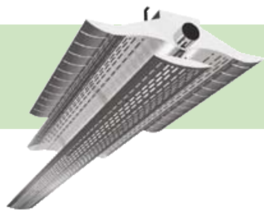
- Certification manual
- Operational Manual OM-10
- Rating Standard RS 8/C/002

Testing standards

- EN 308
- ARI 1060

Chilled Beams

CERTIFY ALL



Scope of certification

This Certification Programme applies to all Active and Passive Chilled Beams. Chilled Beams are presented by ranges but all ranges must be certified. This applies to all product ranges which have either catalogue leaflets with product details including technical data or similar product information in electronic format.

Certification requirements

For the qualification procedure (yearly): 3 units are selected from regular production and tested in the independent Laboratory selected by Eurovent Certification.

For the repetition procedures: the number of units selected is limited to 1 unit/range.

Obtained performances shall be compared with the values presented in the catalogues or electronic selection from manufacturer's website..

Certified characteristics & tolerances

Cooling capacity: 3 conditions are required.

- Active: 80 – 100 – 120% of the nominal air flow rate (for 8°C temperature difference)
- Passive: 6 – 8 – 10°C temperature difference

ECC Reference documents

- Certification manual
- Operational Manual OM-12
- Rating Standard RS 2/C/007

Testing standards

- EN 14518: "Testing and rating of Passive Chilled Beams"
- EN 15116: "Testing and rating of Active Chilled Beams"

Close Control Air Conditioners

CERTIFY ALL

Scope of certification

This Certification Programme applies to factory-made units intended for Close Control Air Conditioning. This programme includes units with cooling capacities up to 100 kW under the specified test conditions.

Participating companies must certify all production models within the scope of the programme.

Certification requirements

For the qualification & repetition procedures: 10% of the units declared will be selected and tested by an independent laboratory.

Certified characteristics & tolerances

Air-Cooled and Water-Cooled Close Control Air Conditioners

- Total cooling capacity : –8%
- Sensible cooling capacity :–8%
- EER : –8%
- A-weighted sound power level : +0 dB

Chilled-Water Close Controls Air Conditioners

- Total cooling capacity : –8%
- Sensible cooling capacity : –8%
- Effective power input : +8%
- A weighted sound power level : +0 dB
- Water pressure drop :+10%

ECC Reference documents

- Certification manual
- Operational Manual OM-1
- Rating Standard RS 6/C/001
- Rating Standard RS 6/C/004
- Rating Standard RS 6/C/006

Testing standards

- EN 14511
- EN 12102 - EUROVENT 8/1

Comfort Air Conditioners

CERTIFY ALL

Scope of certification

This certification programme includes:

- AC1: comfort air cooled AC and air to air HP with cooling capacity up to 12 kW, except double duct and single duct units.
- AC2: comfort units with cooling capacity from 12 to 45 kW
- AC3: comfort units with cooling capacity from 45 to 100 kW

This programme applies to factory-made units intended to produce cooled air for comfort air conditioning (AC1, AC2, AC3). It also applies to units intended for both cooling and heating by reversing the cycle. For the AC1 programme units out of Regulation 206/2012 are excluded.

Participating Companies must certify all production models within the scope of the programme they enter. However concerning multi-split air conditioners, only systems with maximum two indoor units are included, same mounting type, capacity ratio 1+/- 0.05.

Certification requirements

For the qualification & yearly repetition procedures: AC1 : 8% of the units declared are selected and tested by an independent laboratory, and 30% of the selected units are tested at part load conditions. AC2 & AC3 : 10% of the units declared are selected and tested by an independent laboratory.

Certified characteristics & tolerances

- Capacity (cooling and heating) –5%
- Efficiency (EER and COP) –8%
- Seasonal Efficiency (SEER and SCOP): –0% (the product is downgraded (or rerated) as soon as partload efficiency is out of tolerance
- A-weighted sound power level +0 dB (A)
- Auxialiary power +10%

ECC Reference documents

- Certification manual
- Operational Manual OM-1
- Rating Standard RS 6/C/001 - RS 6/C/001A - RS 6/C/006

Testing standards

- EN 14511 • EN 14825 • EN 12102

Fan Coils Units

CERTIFY ALL

EUROVENT CERTIFIED PERFORMANCE ENERGY EFFICIENCY CHECK ENERGY CLASS ON www.eurovent-certification.com

Scope of certification

This Certification Programme applies to Fan Coil Units using hot or chilled water. It concerns both non ducted and ducted fan coils:

- Non ducted units: Fan Coil Units with air flow less than 0.7 m^3/s and a published external static duct pressure at 40 Pa maximum.
- Ducted units: Fan Coil Units up to 1 m^3/s airflow and 300 Pa available pressure.
- District cooling units and 60 Hz units can be certified as an option

Participating companies must certify all production models within the scope of the programme. Selection tools (software) are checked.

Certification requirements

Repetition procedure: the number of units to be tested each year will be proportional to the number of his basic models listed in the Directory, in an amount equal to 17% for Fan Coil Units with a minimum of one test.

Certified characteristics & tolerances

- Capacity* (cooling, sensible, heating): –5%
- Water pressure drop*: +10%
- Fan power input*: +10%
- A-weighted sound power: +1 / +2 dB(A)
- Air flow rate: –10%
- Available static pressure 0 Pa for medium speed and –5 Pa for other speeds
- FCEER & FCCOP
- Eurovent energy efficiency class

(*) At standard and non standard conditions

ECC Reference documents

- Certification manual
- Operational Manual OM-1A
- Rating Standard RS 6/C/002
- Rating Standard RS 6/C/002A

Testing standards

- Performance testing: Eurovent 6/3, 6/11, 6/10
- Acoustic testing: Eurovent 8/2, 8/12

Cooling Towers

The importance of air conditioning and industrial cooling is constantly increasing in modern architecture and industrial process cooling. The human perception of comfort and the new challenges to reduce the electrical power consumption and CO2 footprint have designers striving for optimal system performances with the highest possible efficiencies. Reliable thermal performances are crucial to ensure these best efficiencies which are typical for cooling circuits driven by evaporative cooling equipment. On a yearly basis, one random picked cooling tower of each Eurovent-CTI certified product line will be full scale thermal tested by applying the CTI standard 201.

Eurovent Certita Certification guarantees the consistency of thermal testing and manufacturing of European and non-European companies that subscribe to the program.

Committee chair:
Mr Rob Vandenboer
Product Manager, Quality Manager
Evapco Europe, BVBA

The first ECC / CTI collaborative certification program for Cooling Towers

The Eurovent Certification Company (ECC, Brussels, Belgium) is pleased to announce the Certification programme for cooling tower thermal performance developed in cooperation with the Cooling Technology Institute Est.1950 (CTI, Houston, Texas, USA). The scope of the program includes standardized model lines for open circuit cooling towers, typically factory assembled. Standardized model lines are composed of individual models that are required to have published thermal rating capacities at corresponding input fan power levels.

Thermal performance certification via this program offers a tower buyer assurance that the capacity published for the product has been confirmed by the initial and ongoing performance testing per the requirements of the program using CTI STD-201. It also offers for regulators of energy consumption related to cooling towers, that the capacity of the towers has been validated. Minimum energy efficiency standards such as ASHRAE 90.1, which requires cooling tower energy efficiency validation by the CTI certification process, are used by governments and by green building certification programs such as LEED™.

Scope of certification

This Certification Programme for Cooling Towers applies to product ranges (or product lines) of Open-Circuit series and Closed Circuit Cooling Towers that:

- Are manufactured by a company whose headquarter or main facility are located in Europe, Middle-East, Africa or India. After getting the Eurovent Certification, the CTI certificate could be requested.
- Have already achieved and hold current certification by the Cooling Technology Institute (CTI) according to CTI STD-201.

Certification requirements

For the qualification & yearly repetition procedures our internal auditor visits the production place and reviews the conformity of Data of Records. One unit per range is selected and tested by an independent test agency.

Certified characteristics & tolerances

- Certified characteristic shall be per CTI STD-201
- Entering wet bulb temperature: –12.8°C to 32.2°C (55°F to 90°F)
- Cooling range > 2.2°C (4°F)
- Cooling approach > 2.8°C (5°F)
- Process fluid temperature < 51.7°C (125°F)
- Barometric pressure:
  –91.4 to 105.0 kPa (27" to 31" Hg)

ECC Reference documents

- Certification manual
- Operational Manual OM-4-2013
- Rating Standard RS 9/C/001-2010

Testing standards

- CTI STD-201 RS
- ECC OM-4-2013

Cooling & Heating Coils

Heating Cooling Coils (HCCs) which enable the conditioning of different zones and flexibility in application in buildings are generally employed in compact and central station AHU. To meet the required extra capacity in various processes, they are also used as heating or cooling devices.

With the application of these coils to high energy efficient heat recovery systems, the entire system becomes more compact as well as it avoids occupation of large spaces. Besides, they can be applied to Variable Air Volume (VAV) systems used for conditioning of hospitals, shopping centers and convention facilities.

The Certification programme for the HCCs has increased integrity and accuracy of the industrial performance ratings which provides clear benefits for end users who can be confident that the product will operate in accordance with design specifications. Also, by means of this certification programme users can collect reference data on the fundamental characteristics of the HCCs, such as capacity, pressure drop, mass flow complying with the standard of EN 1216.

Committee chair:
Engin Söylemez
R&D Test Engineer, Friterm A.Ş

Scope of certification

The rating standard applies to ranges of forced circulation air cooling and air heating coils as defined in EN 1216.

Certification requirements

- Qualification and repetition procedures: units declared will be selected and tested by an independent laboratory.
- The number of units will depend on the variety of coil material configurations and their applications for the applied range.
- The selection software will be verified in comparison with the test results.

Certified characteristics & tolerances

- Capacity: –15%
- Air side pressure drop: +20%
- Liquid side pressure drop: +20%

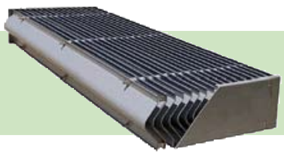
ECC Reference documents

- OM-9
- RS 7/C/005

Testing standards

- EN 1216

Drift Eliminators



Scope of certification

The Certification Programme for Drift Eliminators applies to Drift Eliminators used for evaporative water-cooling equipment.

Certified characteristics & tolerances

The following characteristics shall be certified by tests:

- For counter-flow and cross-flow film fill, the average drift losses of the two tests at 3.5 m/s are less than 0.007% of circulating water flow rate.
- For cross-flow splash fill, the average drift losses of the two tests at 3 m/s are less than 0.007% of circulating water flow rate.

No tolerance will be applied on the average drift losses.

ECC Reference documents

- Certification manual
- Operational Manual OM-14
- Rating Standard RS 9/C/003

Testing standards

- CTI ATC-140

Air Filters Class M5-F9

Today, people spend most of the time inside of buildings. Hence, indoor air quality is a key factor to human health. Air filters removing fine dust from the air stream are the key component in building heating, ventilation and air conditioning systems to supply air of the required cleanliness and to ensure a high level of indoor air quality. With the air filter certification program, reliable and transparent filter data are ensured to customers. On a yearly base, four different filters are selected out of the product range of each participant for testing at independent laboratories according to EN 779:2012, verifying the initial pressure drop, the filter class and the initial and minimum efficiency, as well as the energy efficiency class to Eurovent document 4/11. Additionally, with the new energy efficiency label, Eurovent provides valuable data to enable users to select the most energy efficient air filters.

Committee chair:
Dr. Thomas Caesar
Head of Filter Engineering Industrial Filtration Europe
Freudenberg Filtration Technologies SE & Co. KG

Scope of certification

- This Certification Programme applies to air filters elements rated and sold as "Medium or Fine Air Filters M5-F9" as defined in EN 779:2012 and with a front frame size of 592 x 592 mm according to standard EN 15805.
- When a company joins the programme, all relevant air filter elements shall be certified.

Certification requirements

- For the qualification procedures: 6 units will be selected and tested by an independent Laboratory selected by Eurovent Certification.
  Then each year 4 units will be selected & tested

Certified characteristics & tolerances

- Filter class: no tolerance.
- Initial pressure drop: +10% + 5 Pa (minimum 15 Pa)
- Initial efficiency for F7 to F9: 10% – point
- Discharge efficiency for F7 to F9: 10% – point
- Annual energy consumption +10% +60 kWh/a

ECC Reference documents

- Certification manual
- Operational Manual OM-11
- Rating Standard RS 4/C/001

- Testing standards
- EN 779:2012
- Eurovent 4/21

Residential Air Handling Units (RAHU)

Scope of certification

This programme applies to balanced residential AHUs (supply and exhaust) with heat recovery systems such as:

- Air-to-air **plate** heat exchangers
- Air-to-air **rotary** heat exchangers
- **Heat-pumps** with a nominal airflow below 1 000 m³/h.

Certification requirement

- Qualification test campaign: 1 test per heat recovery type.
- Repetition test campaign: 1 test every 2 years for each heat recovery type.
- Units are sampled directly from selling points.

Certified performances

- Leakage class
- Aeraulic performances
- Airflow/pressure curves
- Maximum airflow [m³/h]
- Electrical consumption [W]
- Specific Power Input SPI [W/(m³/h)]
- Temperature efficiency / COP
- Performances at cold climate conditions
- SEC (Specific Energy Consumption) in [kWh/(m².a)]
- A-weighted global sound power levels [dB(A)]
- AEC (Annual Electricity Consumption) in kWh/a
- AHS (Annual Heating Saved) in kWh/a

Tolerances

- Leakage class 0
- Airflow +/-10%
- Temperature efficiency –3%-point
- Temperature efficiency at cold climate –6%-point
- COP / EER –8%
- A-weighted global sound power levels +2dB(A)
- Electrical consumption +7%
- Specific Power Input SPI +7%

ECC Reference documents

- Certification manual
- Operation manual OM-16
- Rating standard RS 15/C/001

Testing standards:

- European standard EN 13141-7:2010

Heat Exchangers

Air coolers for refrigeration

Dry coolers

Air cooled condensers

The purpose of the Eurovent "Certify-All" certification programme for heat exchangers is to encourage honest competition and to assure customers that equipment is correctly rated.

The programme covers 3 product groups:

- Unit Air Coolers
- Air Cooled Condensers
- Dry Coolers

The "Certify-All" principle ensures that, for heat exchangers, all models in the three product categories are submitted for certification, not just some models chosen by the manufacturer.

A product energy class scheme has been incorporated into the certification programme, based on 7 classes from "A++" to "E" in order to provide a guide to the best choice of product: this enables the user to minimize life-cycle costs, including running costs which account for a much superior sum than the initial investment cost.

Committee chair:
Stefano Filippini
Technicalmanager - LUVE

Scope of certification

The Eurovent Certification Programme for Heat Exchangers applies to products using axial flow fans as follows :

- 50 Hz DX air coolers from 1.5 kW at SC2
- Air cooled condensers from 2 kW at DT1 = 15K
- Products using refrigerants listed in the reference document.

Future developments

Certification for CO_2, Heat Exchangers.

Certification requirements

- Qualification: units selected by Eurovent Certification shall be tested in an Independent Laboratory selected by Eurovent Certification.
- Repetition procedure: units selected from regular production shall be tested on a yearly basis.

Certified characteristics & tolerances

- Standard capacity –8%
- Fan power input +10%
- Air volume flow ±10%
- External surface area ±4%
- Energy ratio R
- Energy class

For Dry Coolers:

- Liquid side pressure drop +20%

For Air Cooled Condensers and Dry Coolers:

- A-weighted sound pressure level: +2 dB(A)
- A-weighted sound power level: +2 dB(A)

ECC Reference documents

- Certification manual
- Operational Manual OM-2
- Rating Standard RS 7/C/008

Testing standards

- Thermal Performance EN 328
- Thermal Performance EN 327
- Thermal Performance EN1048
- Acoustics EN 13487

Liquid Chilling Package & Heat Pumps

Certification is a strong way to supply safe information in the right language

Offering guaranteed performances to customers has always been a fundamental benefit thanks to the accredited independency of this certification program. Today the need for certified performances is emphasized by several directives and it is essential for customers to:

- demonstrate the high performance efficiency of their buildings,
- compare safety performances of the products selected with the requirements of the regulations implementing ERP Ecodesign & labelling directives,
- be sure of the return of their investment or energy savings,
- have the ability to compare fairly between chillers, heat pumps or other type of heaters.

In addition to being certified, performances must be seasonal, in line with the new regulations, and assessed according to the new harmonized standards as soon as they apply.

This program is also a great opportunity for fruitful exchanges between independent laboratories, certification body and manufacturers. It also facilitates the understanding and application of new regulations or standards in a regulatory context in perpetual evolution.

A certification is a guarantee of fair competition (for customers/manufacturers). It also helps increase the number of applications using RES, and represents a commitment in the reduction of consumption and emissions.

Didier Perales
Manager of Technical Relations & Concept Projects
CIAT Group France

Scope of certification

- This programme applies to standard chillers and hydronic heat pumps used for heating, air conditioning and refrigeration.
- They may operate with any type of compressor (hermetic, semi-hermetic and open) but only electrically driven chillers are included.
- Only refrigerants authorised in EU are considered. Chillers may be air cooled, liquid cooled or evaporative cooled.
- Heating-only hydronic heat pumps, 60 Hz units and Higher capacities for air-cooled units (between 600 kW and 1500 kW) can be certified as an option.

Certification requirements

Qualification and repetition: a certain number of units will be selected by Eurovent Certification and tested every year, based on the number of ranges and products declared.

Certified characteristics & tolerances

- Cooling & heating capacity and EER & COP at standard conditions
- Cooling Seasonal Efficiency ESEER: 0%. The product is rerated as soon as part load efficiency is out of tolerance
- Heating Seasonal Efficiency SCOP & η_s: -0%, the product is rerated as soon as part load efficiency is out of tolerance
  § Note: Data published on Sept 2015 and for relevant units with a Design Capacity below 70kW.
- A-weighted sound power level: > +3 dB(A)
- Water pressure drop: +15%

ECC Reference documents

- Certification manual
- Operational Manual OM-3
- Rating Standard RS 6/C003 - RS 6/C/003A

Testing standards

- Performance testing: EN 14825
- Sound testing: EN 12102

Rooftop (RT)

CERTIFY ALL

The Eurovent rooftop certification (RT) program covers air-cooled and water-cooled packaged rooftop units below 100 kW in cooling mode, with an option to certify units from 100 kW to 200 kW. The Rooftop program participants represent the five main European rooftop manufacturers.

Eurovent certifies indoor and outdoor sound levels, cooling and heating capacity and efficiency. Certified performances provide transparency and fair comparison between manufacturers. It is also the basis for the reliable study of HVAC system energy performance.

Currently the program evolves towards part load efficiency (SEER, SCO P) and certification of performance simulation tool data. Current work done on EN 14825 aims to address rooftops in the calculation hypothesis. The software certification is a key item to comply with existing and coming certification of building energy calculations in the EU countries.

Committee chair:
Mr Philippe Tisserand
Product Manager for rooftop & commercial unitary for Trane EMEIA – Chairman of Eurovent Rooftop program compliance committee

Scope of certification

- This Certification Program applies to air-cooled and water cooled rooftops rated below 100 kW.
- Models with cooling or heating capacity ranging from 100 kW to 200 kW can be certified as an option.
- Models of rooftops using gas burners for heating shall be only certified for cooling.

Certification requirements

- For the qualification and repetition procedures (yearly) between 1 & 3 units are selected and tested by Eurovent Certification, depending on the number of products declared.

Certified characteristics & tolerances

- Capacity (Cooling or Heating): –5%
- EER or COP: -8%
- Condenser water pressure drop: +15%
- A-weighted Sound Power Level: +3 dBA.
- Eurovent Energy Efficiency class (cooling and heating)

ECC Reference documents

- Certification manual
- Operational Manual OM -13
- Rating Standard RS 6/C/007

Testing standards

- EN 14511 for Performance Testing
- EN 12102 for Acoustical Testing

Remote Refrigerated Display Cabinets

Remote refrigerated display cabinets (RRDC) are the appliances for selling and displaying chilled and/or frozen foodstuff to be maintained within prescribed temperature limits.

Typically, food and beverage retailers are the direct customers of the refrigeration industry while the supermarket's customers are the end users of food and beverage retailers.

Food and beverage retailers ask for food safety and also for appliances with high-energy efficiency, supermarket's customers ask for food safety. Refrigeration industry has to face the hard challenge of satisfying both needs.

How is it possible to assure that the refrigeration appliances perform accurately and consistently to the reference standards? How is it possible to assure that what is rated by the manufacturer is properly rated?

There is only one way: It is necessary to join a globally recognized and industry respected certification program.

Eurovent Certita Certification program for RRDC is the only certification program in Europe that can assure that performance claims have been independently measured and verified. The factory audits and the product's performances tested in an independent and third-party laboratory make the difference!

Since 2011, Eurovent Certita Certification has also launched a voluntary energy label certification scheme, anticipating what only nowadays EC DG Energy is doing in the framework of Ecodesign and Energy Label Regulations. What better way to rate RRDC's energy consumption and to promote their energy efficiency?

What would you trust more: a self declaration by the Manufacturer or what an independent, globally recognized and forerunner certification program is able to assure? Which one is better?

Francesco Scuderi
Innovation & Patent Engineer
EPTA S.p.A. – MILANO (ITALY)

Scope of certification

- 100 basic model groups divided in 5 categories of remote units : semi-verticals and verticals (with doors); multi-deckers; islands; service counters; combi freezers.
- At least two references per basic model group representing 80% of sales shall be declared.
- One Bill of Material for each declared reference.

Certification requirements

- Qualification: sampling and test of one unit & Audit of one factory.
- Repetition test of one unit per brand every 6 months & Annual audit of each factory.

Certified characteristics & tolerances

- Warmest and coldest product temp. ±0.5°C
- Refrigeration duty (kW) 10%
- Evaporating temperature –1°C
- Direct elec. Energy Consumption (DEC) +5%
- Refrigeration elec. Energy Cons (REC) +10%
- M-Package Tclass : ±0.5°C
- Total Display Area (TDA) –3%

ECC Reference documents

- Certification manual
- Operational Manual OM-7
- Rating Standard RS 14/C/001

Testing standards

- EN ISO 29953 and amendments

European Heat Pumps

Scope of certification

- Electrically driven heat pumps for space heating (incl. cooling function)
- Electrically driven heat pumps used for heating swimming pool water (outdoors or inside)
- Dual-mode heat pumps, i.e. designed for space heating and domestic hot water production,
- Gas absorption heat pumps (incl. cooling function)
- Engine-driven gas heat pumps (incl. cooling function).

Certification requirements

- Qualification campaign : 1 audit/factory + tests depending on products declared
- Repetition campaign : 2 machines/year + 1 audit/year/factory

Main certified characteristics and tolerances

- Heating and/or Cooling capacities *Ph* and/or *Pc* [kW], Electrical Power inputs *Pe* [kW] and Coefficient of performance *COP*
- Design capacity *Pdesignh*, Seasonal Coefficients of Performance *SCOP*, $SCOP_{net}$ and Seasonal efficiency η_s
- Minimum continuous operation Load Ratio *LRcontmin* [%], *COP* at LRcontmin and Performance correction coefficient at LRcontmin *CcpLRcontmin*
- Temperature stabilisation time *th* [hh:mm], Spare capacity *Pes* [W], Performance coefficient in domestic hot water production mode COP_{DHW} or Global performance coefficient for a given tapping cycle COP_{global}, Reference hot water temperature θ'_{WH} and Maximum effective hot water volume V_{MAX} [l]
- Sound power levels *Lw* [dB(A)]

ECC Reference documents

- Certification manual
- Operational manual OM-17
- Rating standard RS 9/C/010

Main testing standards

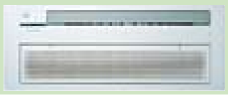
Thermal performance:

- Heat pumps with electrically driven compressors
- Space heating & cooling: EN 14511-1 to 4; Seasonal performance: EN 14825
- Domestic hot water: EN 16147
- Direct exchange ground coupled heat pumps: EN 15879-1
- Gas-fired heat pump : EN 12309-1 to 5

Acoustics:

- Heat pumps and dehumidifiers with electrically driven compressors: EN 12102
- ISO 3741: Reverberant rooms or ISO 9614-1: Sound intensity, measurements by points

Variable Refrigerant Flow (VRF)



VRF systems have shown the highest growth amongst cooling systems during the past 10 years and indeed the highest potential for the next 10 years.

Until recently, VRF systems were the only type of direct expansion cooling system that was not covered by a dedicated Certification programme.

The Eurovent Certification scheme was therefore critical.

It was my privilege to Chair the Launching committee from the first meeting to its introduction. Whilst it took 2 years to complete, I believe it was worth the time and effort.

We at Toshiba are pleased as a manufacturer to work with Eurovent Certification Company as they guarantee the consistency of thermal testing and they increase the integrity of the products on the market.

Nick Ball
Toshiba EMEA
Engineer Director

Scope of certification

The certification programme for Variable Refrigerant Flow (VRF) applies to:

- Outdoor units used in Variable Refrigerant Flow systems with the following characteristics:
- Air or water source, reversible, heating-only and cooling-only.

Heat recovery units are included in the scope but the heat recovery function is not certified.

High ambient systems are included in the scope but tested under standard conditions as specified in RS 6/C/008.

Certification requirements

- Qualification: units are selected on a basis of 8% of basic model groups (= number of declared outdoor units) and tested by an independent laboratory.
- Repetition procedure: units selected from regular production shall be tested on a yearly basis.

Certified characteristics & tolerances

- Outdoor Capacity (cooling and heating): –8%
- Outdoor Efficiency (EER, COP): –10%
- A-weighted sound power level: 2 dB

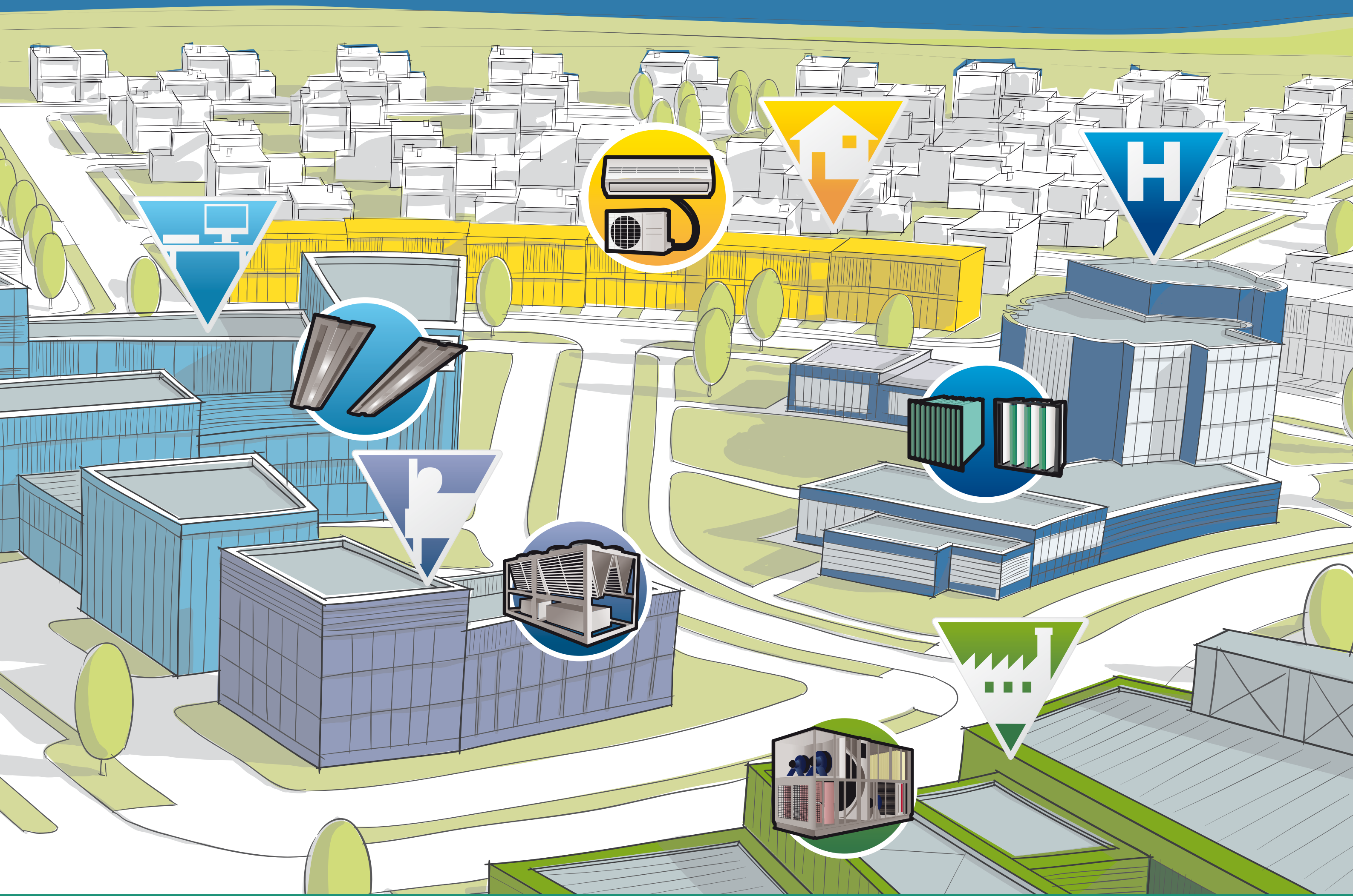
ECC Reference documents

- Certification manual
- Operation manual OM-15
- Rating Standard RS 6/C/008

Testing standards

- EN 14511
- EN 12102

LOOKING FOR **HVAC-R PRODUCTS**
FOR YOUR BUILDING ?



WE CONTRIBUTE TO
HIGHER ENERGY EFFICIENT PROJECTS

SELECT EUROVENT CERTIFIED PRODUCTS AND **CHECK PERFORMANCE ON LINE**

The Eurovent Certification label is a guarantee that the energy level indicated is based on certified performances. Eurovent Certification certifies the thermal and acoustic performance of air conditioning, ventilation, heating and refrigeration equipment tested at independent ISO 17025 accredited laboratories. The certification protocol includes sampling of the units to be tested, annual test campaigns, downgrading of indicated performance levels in the event of test failure and subsequent publication of data.

www.eurovent-certification.com

EUROVENT CERTIFIED PERFORMANCE

ECC 12-2013 / Photo: iStock

**Accreditation # 5-0517 Products and Services Certification - According to EN 45011:1998 - Scope and validity at www.cofrac.fr - International recognition EA/IAF*

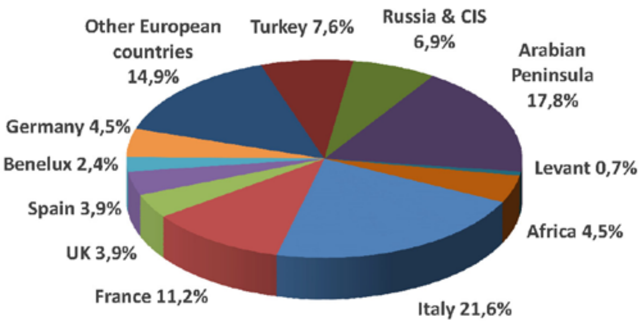
The HVAC&R market in the EMEA region in 2013/2014

Fan Coil Units - a stagnant market with reduced progress

GHITA BOUDRIBILA & YANNICK LU-COTRELLE

EUROVENT Market Intelligence

The fan coil unit market in the EMEA region has sales of some 1.45 million units that is as much as in 2012. As in previous years, European sales represent approximately three-quarters of the market. Within the European Union, Italy is still ahead of the pack with a quarter of all sales, followed a little further behind by France with a 14% market share. Insofar as Germany and the United Kingdom are concerned,



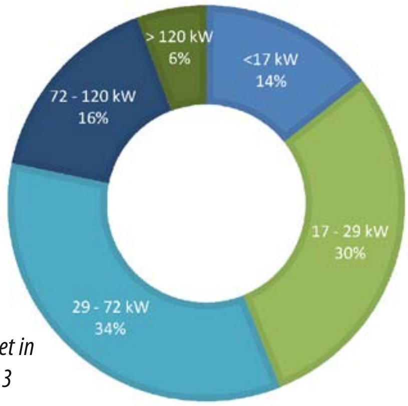
FCU market in units - EMEA 2013

sales have remained modest, each with a market share of approximately 5%.

Outside of the EU, it is Turkey which stands out with its continued steady growth and a market share close to 10% this year against 7% the previous year, thus leaving Russia behind it with 7% of sales in the EMEA region. Lastly, the Middle East retains its place as second largest player in the EMEA region with approximately 260,000 units sold in 2013. Compared to 2012, Italy continues its decline with a contraction of about 10%. Conversely, the Turkish market is still in full expansion, showing a record growth of almost 30%. Changes of course occurred this year for Spain and Portugal which recorded respective rises of 8% and 3%. However, the tides have turned for Poland and the Northern countries, which have dropped to –10% and particularly for Russia which experienced a sharp decline of –4% after two years of growth.

From a technological viewpoint, changes are minimal. The 2 pipe fan coil units still represent three-quarters of the market except in Turkey and the Benelux countries where the ratios are the same. On the design side of things, fan coils with casing and without casing each represent 30% of the market. The remaining market is split in equal parts between “Cassette” type models and “Ducted” type models. In terms of forecast, the year 2014 should achieve the same level as 2013 in the EMEA region with perhaps some slight growth of around 1.5%. The forecasts remain positive for already dynamic areas like Russia and Spain. However, they are gloomier for Italy which began the year with falls varying from –3 to –10%.

Rooftops - Europe registers slight growth in the face of a market still dominated by the Middle East



ROOFTOP market in kW - EMEA 2013

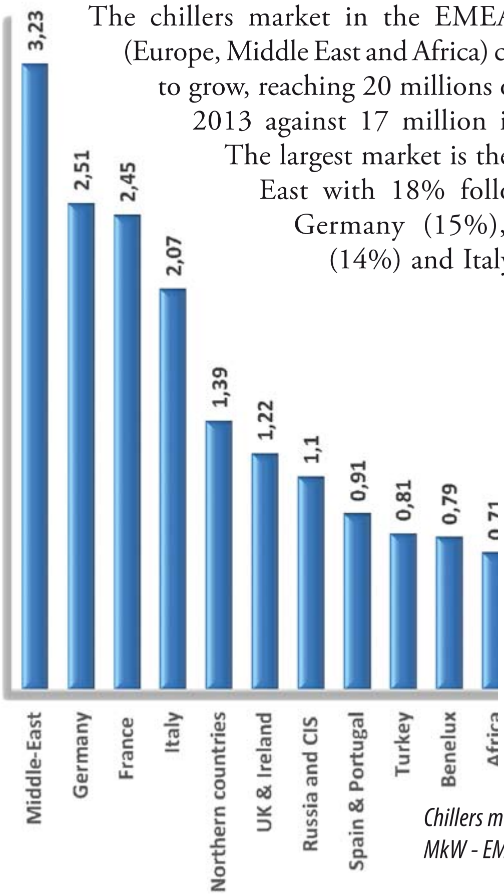
The rooftops market in the EMEA region amounts to about 60,000 units sold in 2013, that is 5% more than the previous year. The Middle East is still leading the way with more than 80% of the market share, then Africa coming in a distant second with 4.2% of the market. Within Europe, the market distribution is more even. Ahead of the pack are the France/Spain duo with market shares nearing 20%. Then come Turkey, the United Kingdom and Italy with approximately 10% each. The rooftops market remains a dynamic market unlike others, with considerable 2012–2013 growth and upward 2014 forecasts. Contrary to previous years, it is in Europe that the highest growth rates have been recorded and particularly in the United Kingdom recording +30%, as well as Spain and Turkey with increases of up to +20%. As for France, growth is also visible but it is more subdued with a 4% increase. By contrast, the market has experienced a serious setback in Italy with a drop of approximately −15% this year.

In general, the most sold rooftop unit-types in the EMEA region are the medium-capacity units, of between 17 and 72 kW and representing approximately two-thirds of total sales. For further accuracy, the small-capacity units of under 30 kW are on the rise in the Middle East, but it is the units of over 30 kW, which remain easily the most sold in the rest of the EMEA region.

In terms of technology and given the very high temperatures of the region, we found that cooling units were sold exclusively in the Middle East alone. Conversely, nine tenths of units sold in Europe and in Africa were reversible models (classic and gas models).

Chillers - Turkey continues to affirm its dynamism in contrast to the European Union, which had a rather gloomy year 2013

The chillers market in the EMEA region (Europe, Middle East and Africa) continues to grow, reaching 20 millions of kW in 2013 against 17 million in 2012. The largest market is the Middle East with 18% followed by Germany (15%), France (14%) and Italy (12%).



Chillers market in MkW - EMEA 2013

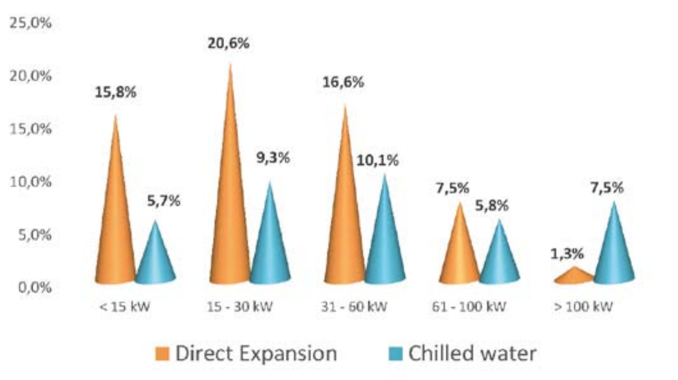
In the small-capacity category of under 50 kW, the majority of sales were concentrated in the South of Europe. Italy has played its card right with a market share reaching 45% and is followed by France with 13% and the Iberian Peninsula with 6%. A little further North is Germany, which has a respectable market share nearing 9%. For medium-power machines, once again we have the leading trio Italy/France/Germany with respective market shares of 16%, 14% and 10%, which accounts for almost half of the total European market. Then we have the Benelux countries, the Nordic countries, the United Kingdom and Spain, which fluctuate around 6%. Conversely, for high-power machines (above 700kW) it is the Middle East which leads the way with 25% of the market share. Coming in second position, are Turkey and Russia with 8% of the market and then the usual trio France/Germany/Italy with respective market shares ranging from 6 to 7.5%.

Compared to 2012, there has been a market stagnation for machines of over 50kW in the EMEA region. This stagnation is balanced primarily thanks to the significant increases in Scandinavia and Turkey, which respectively reached 14% and 8%, thus eclipsing the negative trends in other countries. Indeed, looking at the 28-member European Union, the year has been less than buoyant. The fall has been most significant for the United Kingdom/Ireland duo with −9%, followed by France with its −6%. In the Iberian Peninsula, in Germany and in Italy small contractions in the market may be reported ranging from −3% to −0.5%. Furthermore, the number of chillers has also fallen in Africa. This is primarily due to the Republic of South Africa, which recorded more than 20% fall between 2012 and 2013 due to social conflicts slowing market growth.

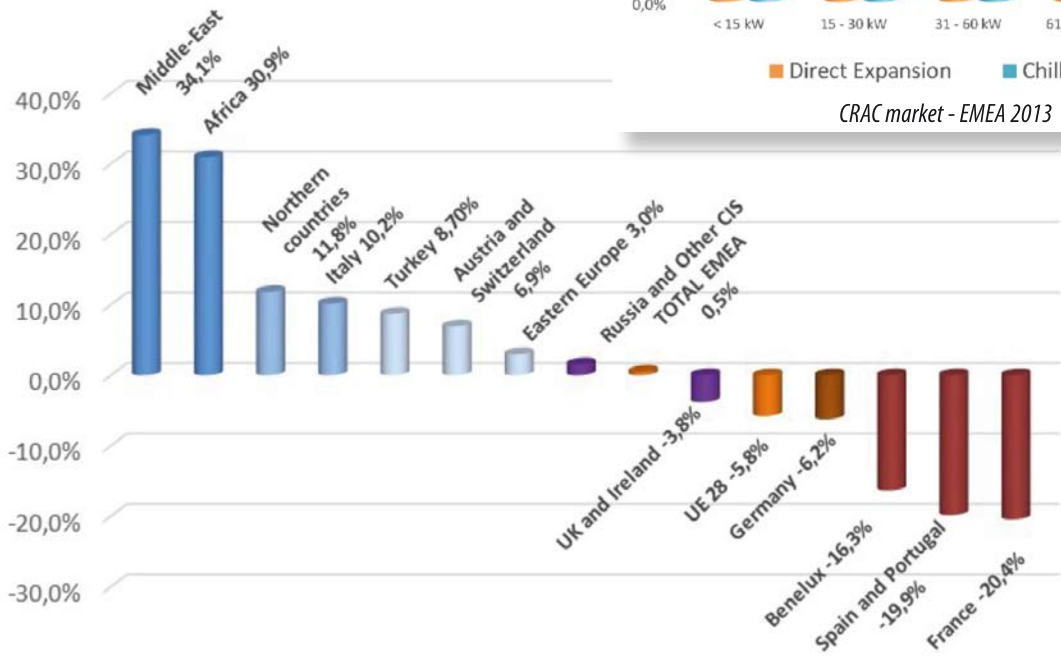
Over three-quarters of chillers sold in the EMEA region are air-cooled not water-cooled. Only 10% of sales are for water-cooled units. In terms of refrigerants, it is the R410A which is comfortably in the lead, given that it is found in 80% of all units. The R134A comes next with 14%.

Computer Room Air-Conditioners (CRAC) - A sluggish year 2013 for the European Union; Africa and the Middle East are booming

Of the approximately 30,000 units sold in 2013, over 25,000 units were sold in Europe. In the EMEA region, the market leader remains Germany with 12.5% of the market share followed very closely behind by the United Kingdom with 11%. Russia and its ex-satel-



CRAC market - EMEA 2013



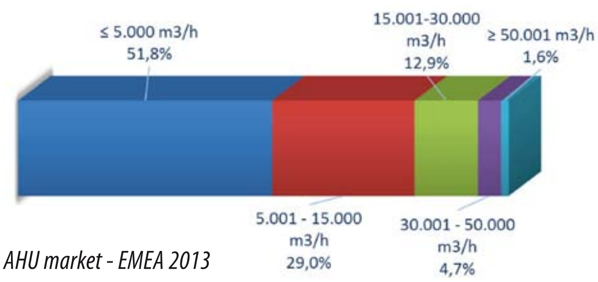
CRAC market growth 2012/2013 - EMEA

lites continue to hold third place on the market with 10.5%, which is approximately 3,200 units sold. As for the Middle East and Africa, their respective shares are 9.5% and 6.5%.

The CRAC market had a weak year in 2013 in the EMEA region, almost stagnating around 0.5%. Within the European Union, the market declined sharply (–6%) with drops of up to –20%. It is in France, the Benelux countries and Spain that the market has suffered the most with drops ranging from –16% to –20%. Germany was also affected with a contraction in the region of –6%, the same goes for the United Kingdom/Ireland duo with –4%. Only Italy and the Scandinavian countries have seen their market shares grow by 10%. The EMEA region, the Middle East and Africa record the highest increases with approximately +30%, followed by Turkey and the Austria/Switzerland duo with +8% and Eastern Europe with +3%.

Two-thirds of the units sold in the EMEA region are direct expansion units and the remaining third consist of chillers. Concerning chillers, the medium-capacity machines (between 15 and 60kW) represent half of all sales. The distribution is more even for direct expansion machines as sales include almost as many small-capacity (under 15 kW) as medium-capacity machines.

Air handling units - a slow-down in growth and a reduction in the number of market players



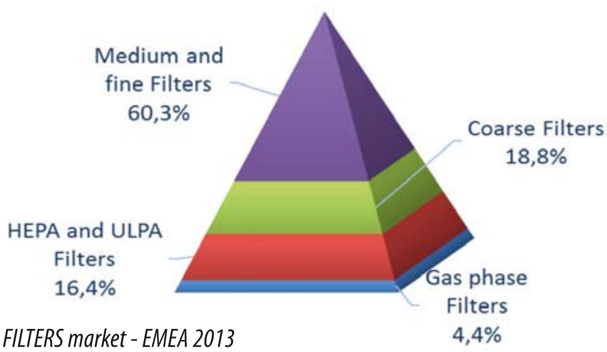
AHU market - EMEA 2013

This year once again, the air handling unit market has fared relatively well, with a rise of 2.8% in 2012–2013 in the European Union, and an increase of over 10% in the Middle East. The main driver behind this rise is still Germany, which totals nearly 20% of all sales in the EMEA region with a market share estimated at €356M in 2013, and an annual growth rate of +10%. Although the other heavyweight in the region, Scandinavia, with its 15% market share, saw its sales stagnate in 2013 compared to 2012, substantial progress has again been made by Russia and Turkey, which respectively recorded +17% and +46%, between them totalling over 13% of the market in 2013. To a lesser extent, Spain and the Czech Republic have seen an increase of 8%, respectively reaching €40.1M and €21.2M in 2013, and France saw its market share rise by 4% with approximately €112M in 2013.

As for disappointments, we have Italy which underwent a small market contraction (–2.6%) and particularly Portugal which went down to €6.1M in 2013 after a fall of 20%. Insofar as regards air-flow power, it is the units of under 5000m³/hr which continue to be the most sold with 52% of the market share in the EMEA region against only 6.3% for units of over 30,000 m³/hr. Regarding the development of the European market, a small contraction is forecast for 2014 since the first two quarters have already ended with a fall of –2% for Q1 and –3% for Q2. At the same time, we are witnessing a reduction in the number of market players, too high as there are several hundred in Europe, a few small ones are disappearing or are being taken over by larger ones.

The air filters market continues to stagnate

The air filters market was quite depressed in 2013 with a contraction of 0.7% for the European Union and almost stagnating at –0.4% for the rest of the EMEA region, stabilising at around 1.08 billion euros. This lower growth rate may be explained by an extension of the lifetime of the filters in place or the increasing importance of external supplies, such as China or India. Germany, the biggest market with €208M of sales in 2013, grew moderately by about 4%, while France, the second largest market, saw its market stagnate at around €121M. The Scandinavian countries, which represent between the four of them approximately 15% of the EMEA region, saw their market decrease by about 5%, as did Switzerland, while Italy and Spain saw their sales increase by 6% for the first quarter and over 15% for the second. Among the products most sold in the EMEA region, the market share of fine and medium filters has continued to increase these last few years, achieving 60% of the market in 2013. Next in line are the coarse filters with 19%, and then the HEPA–ULPA filters with 16%. Gas-phase filters barely represent 5% of sales.



FILTERS market - EMEA 2013

Cooling towers - a declining European market

The cooling towers market experienced a contraction of around 7% in the EMEA region, falling to €229.5M in 2013, that is a level even lower than that of 2011. Topping the sales charts is still Germany with over €38.4M, followed by Russia and its ex-satellites, which have almost €23.4M. Italy, France and the United Kingdom are still the main secondary players with 8% of the market each. Among those with the greatest growth, we have Russia with +23% along with Poland which achieved €8.2M in 2013 by means of an increase of over 30%. Conversely, those with the largest declines were France and the United Kingdom brushing the –20% mark. In the EMEA market in 2013, much more open than closed cooling towers were sold in a ratio nearing 65/35.

A good year for heat exchangers

The heat exchangers market increased to €809M in 2013 in the EMEA region, which is approximately 15% more than in 2012. Aside from Germany with its 17% market share, the main players are Russia and Italy with 10%, France and the United Kingdom with 8% and the Middle East with 7%. Leading the way with highest growth are the Benelux countries, Russia, the Middle East and the Scandinavian countries, recording rises over 20%. Conversely, Italy experienced a small contraction in its market share, while Germany and the United Kingdom saw some growth of around 5%.

Adiabatic coolers - an emerging market

For some years now, we have increasingly been seeing the comeback of a technology as old as the hills - that of adiabatic coolers. It is a technology which consists, in the context of heat exchangers, of facilitating heat exchange between ambient air and liquid to be cooled by increasing the degree of humidity in the surrounding air. This can be done using nozzles which spray water directly onto the batteries, or through a permeable media positioned in close proximity and which is humidified (water which is used for humidifying may be recuperated or not). Above all, it is a backup used temporarily when the summers become too hot, and this is why this technology is still barely used in the North of Europe and is absent in the Middle East. Its main markets are currently in countries with temperate climates like Germany, France, Switzerland and Eastern Europe.

For further information, please do not hesitate to contact Eurovent Market Intelligence at statistics@eurovent-marketintelligence.eu ■

ISH China & CIHE 2015
Asia's largest HVAC, plumbing and sanitation exhibition

13-15 May 2015
Beijing, China

ISH China & CIHE, Asia's largest HVAC, plumbing and sanitation exhibition, will be held at the New China International Exhibition Center in **Beijing from 13 – 15 May 2015**. Organised by Messe Frankfurt (Shanghai) Co Ltd and Beijing B&D Tiger Exhibition Co Ltd, the three-day event expects to host over 1,100 exhibitors, span over 90,000 sqm across seven halls. Amongst is a new hall showcasing comprehensive collection of intelligent and energy-efficient HVAC solutions. Concurrent events play an important role in ISH China & CIHE's success. In 2015, the reputable Sino-European HVAC Congress will officially be renamed to "China International HVAC Congress", focusing on renewable energies, intelligent HVAC technologies, floor heating, ventilation and indoor air quality, and heat pump technologies. Moreover, rainwater harvesting and utilization, as well as grease separation technology will be discussed at the second edition of the China International Building Water Supply & Drainage Forum. **www.ishc-cihe.com**

FOR THERM
The largest building industry event in the Czech Republic

15 -19 September 2015
Prague – PVA EXPO Letnany

FOR THERM is an annual Czech trade fair which is held in Prague together with four concurrent fairs – FOR ARCH, FOR WOOD, FOR WASTE&WATER and BAZÉNY, SAUNY & SPA. This set of construction-related fairs is the single most attended and most important building event in the Czech Republic. In 2014, more than 74,000 visitors have attended and 830 exhibitors from 15 different countries have participated in this exhibition. Due to its location in Prague, an important centre of Central-European business, FOR THERM is a unique opportunity for both domestic and foreign exhibitors to present their services and products within an international competition. If you want to address the Czech region, FOR THERM is the one place you need to meet new partners, dealers, suppliers and customers.

The main topic of the 2015 FOR THERM is **efficiency of heating.** The event is organized under the auspices of the President of the Czech Republic, REHVA and the Association of Building Entrepreneurs of the Czech Republic. A rich program will accompany the trade fair. **www.for-therm.cz/en**

FOR THERM conference topics:

- BOILERS, FIREPLACES, FIREPLACE INSERTS, STOVES, BURNERS
- HEATING SYSTEMS
- TECHNOLOGY FOR THE HEATING OF DOMESTIC HOT WATER
- MEASUREMENT AND REGULATION TECHNOLOGY
- RENEWABLE AND ALTERNATIVE ENERGY RESOURCES
- CHIMNEY SYSTEMS, FLUE GAS EXHAUST SYSTEMS
- AIR HANDLING, VENTILATION, AIR CONDITIONING SYSTEMS, CENTRAL EXHAUST SYSTEMS
- SAFETY EQUIPMENT FOR HEATING SYSTEMS
- SERVICES

Ingersoll Rand

Ingersoll Rand Family of Brands

Club Car Ingersoll Rand. THERMO KING TRANE

EcoWise™

Ingersoll Rand introduces the EcoWise™ portfolio of products as step to achieve its global climate commitment

Company endorses refrigerant-bearing products designed to lower environmental impact with next generation, low global warming potential refrigerants.

Ingersoll Rand (NYSE:IR), a world leader in creating comfortable, sustainable and efficient environments, is pleased to announce another milestone in achieving its climate commitment, a roadmap to significantly reduce the environmental impact from its operations and product portfolio by 2030.

Ingersoll Rand has created the EcoWise™ portfolio of products for its climate and industrial refrigerant-bearing products that are designed to lower environmental impact with next generation, low global warming potential (GWP) refrigerants and high efficiency operation. These products are compatible with and can use next generation low GWP refrigerants, reduce environmental impact by lowering greenhouse gas (GHG) emissions, and maintain or improve safety and energy efficiency through innovative design.

"The Ingersoll Rand EcoWise portfolio is a demonstration of our commitment to reducing the impact on the environment, and providing more sustainable product choices for our customers – particularly as they make the transition to products using next generation, low GWP refrigerants," said Didier Teirlinck, executive vice president for Climate businesses of Ingersoll Rand. "In addition to the series of products we are announcing today, the company will continue to introduce commercial, residential and transport HVAC, and transport refrigeration products that achieve the criteria for the EcoWise endorsement." The first products to earn the EcoWise endorsement are:

Trane Sintesis™ air-cooled chiller is energy efficient and quiet, and offers customers the choice of operating with a next generation, low GWP refrigerant -- DuPont™ Opteon® XP10 (R-513A) or with R-134a. Following the company's announcement* on January, 26th 2015 that Trane Sintesis™ with the option of the new refrigerant would be available in North and Latin America for June 2015, this will now also be an option available in Europe, the Middle East and Africa from July 2015.

Trane Series E™ CenTraVac is a large-capacity chiller that uses the same low-pressure design on which current CenTraVac chillers were based, and uses a next generation, low GWP refrigerant, Honeywell Solstice™ zd (R-1233zd(E)). It is up to 10 percent more energy efficient than the next available centrifugal chiller available today, and is available in Europe, the Middle East and other 50hz markets including Japan.

Ingersoll Rand EcoWise Portfolio – 2

Thermo King truck and trailer refrigeration products sold in Europe and global marine refrigeration units are safe, reliable and efficient, and use DuPont™ Opteon® XP44 (R-452A) refrigerant which has about 50 percent less GWP than current refrigerant. New SLXe™ trailer units with next generation refrigerant will be available in February 2015. New factory units and retrofit kits will be available in the European Union in 2015.

About our Climate Commitment

Ingersoll Rand is helping to solve some of the world's most pressing challenges – including the unsustainable demand for energy resources and its impact on the environment.

To create a sustainable future, Ingersoll Rand announced a profound climate commitment in September 2014 – a roadmap to significantly increase energy efficiency and reduce our environmental impact from our operations and product portfolio by 2030 (with milestones at 2020). Our climate commitment has three prongs and includes:

- 50 percent reduction in the direct GHG potential for our HVAC products by 2030
- 35 percent reduction in GHG footprint of our own operations by 2020
- $500 million investment in product-related research and development over the next five years to fund the long-term reduction of GHG emissions

This commitment benefits customers and the climate by creating more sustainable product choices for customers, improving our operating footprint globally, and continuing to develop lower GHG emissions options in areas where none exist today. This commitment will result in the avoidance of approximately 20,850,000 metric tons of CO2e globally by 2020, which is equivalent to the energy used by nearly two million homes for one year. ■

Further details of Ingersoll Rand's commitment are now publicly available on the website http://company.ingersollrand.com/ircorp/en/index.html

Contact: Mike Hall, Ingersoll Rand
+32-475-34-34-63, MikeA.Hall@irco.com

* http://www.trane.com/commercial/north-america/us/en/about-us/newsroom/press-releases/-trane-showcases-commercial-building-solutions-at-ahr-expo-that-.html

Product news

Compact domestic hot water heater from CIAT

SANICIAT 2 is a compact, packaged domestic hot water heater that operates in instantaneous, semi-instantaneous or storage mode. Designed for the collective housing, hotel, healthcare, industrial and service sectors, it is delivered ready for connection, and is intended for installation in mechanical rooms. Certified ACS (Certificate of Sanitary Conformity) and SANICIAT 2 is equipped as standard with an anti-legionella treatment system and is also available in an optional HEE (High Energy Efficiency) version.

Firstly, SANICIAT 2 is set apart from the competition thanks to its very small footprint, which is the result of the integration of the new model of ITEX plate heat exchanger developed by CIAT. Particularly compact, it optimises heat transfer coefficients and enables the system to reduce its volume by around 15% compared to previous models.

SANICIAT 2 is available in 23 sizes. It produces DHW flows at rates of up to 12.3 m^3/h (55°C for a primary circuit temperature of 90°C). The DHW temperature can be adjusted to up to 65°C and the maximum allowable temperature for the primary circuit is 100°C. The maximum allowable pressure is 10 bar on the primary circuit and 7 bar on the DHW circuit.

SANICIAT 2 is particularly easy to install. The water circuit comes supplied with standard couplings and there is no need to open the electrics box to connect the module to the power supply. Simply connect the 1.2 m cable with terminated ends extending from the electrics box. What is more, the module is delivered with blanking plates and protective netting on the threaded rods.

As with the previous model, the SANICIAT 2 DHW module is equipped as standard with an anti-legionella treatment system. The controller features a setting that can be activated to establish the duration and frequency of treatment. The treatment causes a rapid rise in the temperature of the water in either the storage tank and the distribution loop or, in the case of models used in instantaneous mode, directly in the distribution loop.

SANICIAT 2 features a new controller that is particularly easy to operate and set. Navigating through the front-panel interface is both very simple and completely intuitive. The clear-text display indicates information such as the date and time, the DHW setpoint temperature, the measured DHW temperature, the opening percentage of the three-way valve, etc. It is therefore easy to adjust a number of settings daytime and night-time setpoint temperatures, high and low temperature alarms, daily set-back temperature periods, anti-legionella treatment with customisable settings (frequency, times, days), and feedback of information to two dry contacts for remote management (operation and faults). A list of the 20 most recent faults and a runtime counter for the accelerator pumps can also be viewed.

A BMS (Building Management System) connection using the Modbus RTU RS485 protocol is also supplied as standard. Four on/off information feedback inputs for remote control via an NO contact (connection with AQUACIAT 2 HYBRID) and 0-10 V/4-20 mA/Pt100 multipurpose inputs and outputs are available.

Advantages:

- *Ultra-slim packaged unit takes up little floor space*
- *Can be used with all types of domestic water with all degrees of hardness*
- *Capacity can be increased by adding plates (single size)*
- *Anti-Legionnaires' disease function included*
- *Excellent transfer coefficient, reduced surface area*
- *Easy to install and maintain*
- *Very low pinch-point temperature possible*
- *Easy-adjust electronic control*
- *Safety devices: DHW temperature, valve, single or dual primary accelerator pumps with automatic switching to avoid seizures (increased service life)*
- *High resistance to corrosion (all parts in contact with the primary fluid and DHW are made from noble materials)*
- *Low-capacity circuits*
- *Numerous option*

If the HEE option is selected, the module is equipped with a primary accelerator pump driven by a permanent-magnet motor to eliminate joule losses. When combined with speed control, power consumption is reduced by as much as 50% depending on the models and usage scenarios.

SANICIAT 2 is part of the CIAT Hysys range and is particularly suited to operation in combination with AQUACIAT 2 HYBRID, the first range of packaged, outdoor, reversible hybrid heat pumps containing an integrated natural-gas-powered condensation boiler module.

Many options are available, such as single or double accelerator pumps with (for DHW) cast-iron bodies and submerged rotors or stainless-steel bodies with fan-cooled motors, a three-way valve actuator with fail-safe function, and thermally insulated heat exchangers.

More information: Jean-François Boutet.
Tel: 00 33 4 79 42 42 08. **email**: jf.boutet@ciat.fr

REHVA Annual Meeting and Conference 2015

REHVA

Federation of European Heating, Ventilation and Air Conditioning Associations

LSGŪTIS

6–9 May 2015
Riga, Latvia

AHGWTEL, the Association of Heat, Gas and Water Technology Engineers of Latvia is proud to host the REHVA Annual Meeting 2015 which will be held in Riga, Latvia from 6th to 9th May 2015. This event will bring together leading experts from the international heating, ventilation and air condition community. More than 150 visitors are expected, when AHGWTEL welcomes the members, supporters and guests of REHVA, the Federation of European Heating, Ventilation and Air Conditioning Associations.

REHVA Standings Committee Meetings and the REHVA General Assembly will be held in close connection to the REHVA conference the "*Advanced HVAC and Natural Gas Technologies*".

This conference will serve as start base for practical implementation of innovative ideas and future practical application of modern technologies. The REHVA Annual Conference will be held on the May 8th and 9th 2014 at the Radisson BLU Latvia Conference Centre. The conference language is English.

The Conference "*Advanced HVAC and Natural Gas Technologies*" will provide an excellent opportunity for industry, students and academia to meet each other and create mutually beneficial contacts. In order to highline future trends in buildings' energy efficiency and safe energy supply, special working platforms for the representatives of industry and decision makers will be organized in scope of workshops and meeting.

The conference programme consists of technical tours, learning courses, presentations by keynote speakers such as Professors **Jarek Kurnitski** and **Hendrik Voll** of Tallinn University of Technology and Professor **William P. Bahnfleth** of the Pennsylvania State University. Thematic workshops targeted on developments in advanced HVAC and natural gas technologies will also be organised.

This time apart from traditional emphasis on developments in the field of building engineering there will be a special focus on promotion of student engagement and better awareness of international research cooperation and professional networking. The special student sessions "*REHVA conference special students sessions*" will be organized in scope of conference "*Advanced HVAC and Natural Gas Technologies*".

For more detailed information on conference topics, registration, application deadlines and travel information, please see **www.hvacriga2015.eu**.

ASHRAE recognizes outstanding industry achievements

REHVA's past president and honorary fellow **Dusan Petras** (Slovakia) and actual REHVA Board Member **Egils Dzelzitis** (Latvia), were elevated to the grade of AHSRAE fellow, in recognition for their distinction in the arts and sciences of heating, refrigeration, air conditioning and ventilation. The ceremony took place during ASHRAE's Winter meeting in Chicago, 24 January 2015.

ASHRAE President Thomas H. "Tom" Phoenix and Dusan Petras.

Tom Phoenix and Egils Dzelzitis.

Very successful REHVA seminar during the ASHRAE Winter Conference 2015

In a full Honore Ballroom in Palmer House/ Chicago, with even attendees sitting on the ground, REHVA presented its seminar with title: 'Operation of Energy Efficient Buildings'. Over 120 persons listened to the papers presented by Karel Kabele, president of REHVA and chair of this seminar; Stefano Corgnati and Manuel Gameiro da Silva, the latest two both vice-president of REHVA. As buildings are becoming more complex, including more systems and their respective controls, the objective of this seminar was to present an updated vision of the best solutions and new ideas to improve energy efficiency considering the interaction with occupants. Karel Kabele gave an overview, 'Heating of Energy Efficient Buildings'; followed by the presentation of Stefano Corgnati, 'Effect of Occupant Behavior in Energy Operation of Buildings', and the paper of Manuel Gameiro da Silva on 'Managing Ventilation and Infiltration Rates in NZEBs'. If the number of questions, raised after the presentations is an indication of success fullness, REHVA did a good job!

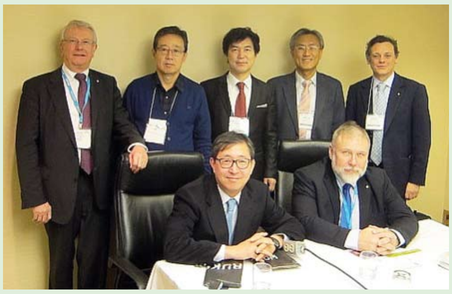
REHVA cocktail at the ASHRAE 2015 winter meeting

The – meanwhile traditional – REHVA cocktail on Monday afternoon, at the ASHRAE winter meeting was again very successful. The size of the reception room, with over 120 REHVA friends and other distinguished VIP's all over the world, was obvious too small, the CO_2 concentration too high but never mind, you could perfectly stay with your glass outside the room in one of the Palmer House' corridors. REHVA's President Karel Kabele and his spouse Jitka, Jan Aufderheijde, Secretary General and the board members Manuel Gameiro da Silva, Egils Dzelzitis and Stefano Corgnati welcomed on behalf of REHVA our guests. 'Repeat and repeat' is a well-known advertisement slogan, and so REHVA did, and the latest REHVA journal, REHVA leaflets and information regarding the World Sustainable Energy Days, from 25-27 February 2015 in Wels/ Austria, were available to take away on the many tables. We wish to say 'thank you' to ASHRAE for their operational support and VDI-GBG and AHGWTEL/LATVAC, 2 REHVA members, for their financial support. REHVA hop (3x).

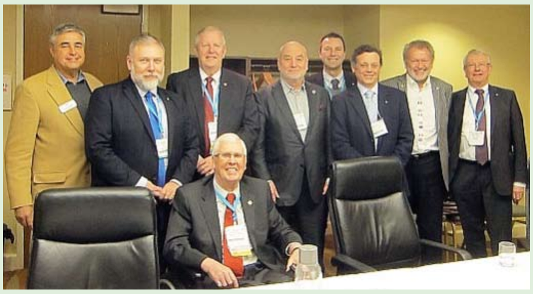
REHVA refreshed cooperation with our MoU partners

During the latest ASHRAE winter meeting 2015, REHVA invited her sister organizations with an existing Memorandum of Understanding (MoU) and present in Chicago, to evaluate the past and to discuss about future options for collaboration. In this series, there were talks with ASHRAE; IIR; ISHRAE (India); SAREK (Korea) and SHASE (Japan). As part of the REHVA delegation, also two representatives of the next REHVA congress, CLIMA 2016 in Aalborg/Denmark (Prof. Per Heiselberg [Aalborg Univ.] and Jørn Flohr Schultz [DANVAC]) were attending these meetings, to be able to inform as much as possible about this upcoming worldwide congress of REHVA. REHVA announced to its partners the idea of a 'REHVA World Student Competition' for Master students, champions in such a competition in their own country starting with such a competition during the Clima 2016 in Aalborg. In all these meetings there was a very positive approach to participate into this REHVA initiative. Other items on the agenda were REHVA's efforts regarding the REHVA Dictionary, the online glossary of REHVA, with around 12000 terms in the field of building services in 14 languages, and the series of REHVA Guidebooks both exertions of REHVA volunteers, 'from professionals for professionals'. Discussed was: 'How to translate a REHVA guidebook in our national language, or how to add our language as a Dictionary language?

Prof Kato, SHASE President and Prof Kabele REHVA President.



REHVA and SAREK representatives.



ASHRAE and REHVA Representatives.

AASA meeting in Chicago

It was not only overcrowded during the REHVA cocktail, but the same happened during the AASA (ASHRAE Associate Society Alliance). On the invitation of ASHRAE, always many HVAC societies worldwide come together to meet and discuss under the leadership of Tom Watson, past president of ASHRAE, on global issues. All the representatives are challenged to present 'news' from their country/society in the field of HVAC related research or sustainability policy in general. During this meeting too, DANVAK had the opportunity to inform all representatives about the next REHVA Clima 2016. A very good presentation was given by UNEP. And last but definitely not least, Hans Besselink, member of REHVA-COP, presented the results of TVVL research work, financially supported by REHVA, regarding the "TVVL roadmap to nZEB" (for the full report see article "***Roadmap to nearly Zero Energy Buildings in 2020***" in this issue and visit TVVL website*.

* www.tvvl.nl/website/kennisnet/publicaties/technische-publicaties/i-06-roadmap-to-nearly-0-energy-buildings).

ASHRAE Winter conference and AHR EXPO 2015 Chicago overview

The Conference held January 24-28, 2015 featured papers and programs for eight tracks, which address trends in the industry and also are relevant to the design community in the area.

- Systems and Equipment: The proper selection of HVAC&R for a job is critical. This track covers considerations for a proper functioning system.
- Fundamentals and Applications: Basic HVAC&R principles are key in any project. Knowing what they are helps to apply in specific projects. This track covers a broad array of pertinent information.
- Industrial Facilities: Manufacturing and processes can have different requirements for HVAC&R. This track explores design and practices for industrial buildings.
- Large Buildings: Mission Critical Facilities and Applications: Facilities like data centres have different characteristics. This track looks at what is required for these unique applications.
- Energy Efficiency: Energy efficiency is on everyone's mind as energy costs continue to rise. This track covers an array of considerations to help drive toward net zero energy.
- Life Safety: This encompasses egress, sprinklers, alarms, emergency lighting, smoke barriers and special hazard protection. This track provides the tools for all the factors to consider in life safety and lessons learned.
- Design of Energy and Water Efficient Systems: The trend is to green sustainable buildings. This track looks at what works and what doesn't to attain these efficient systems.
- Hospital Design and Codes: Healthcare design takes into account some unique aspects. This track explores design and code requirements to ensure patient comfort.

Attendance:

The number of participants at this conference was 3,018, which is a record attendance from 60 different countries.

For ASHRAE, a major item of note at the Conference was recognition by the Green Building Initiative (GBI) on ASHRAE achieving the highest rating, of four Green Globes, on their international headquarters. Through a months-long process, GBI's Green Globes Assessor worked with ASHRAE staff to document the building's sustainable management practices. Only 3 percent of projects assessed by GBI achieve four Globes certification.

Also taking place was launch of ASHRAE's and the United Nations Environment Programme (UNEP) Ozone Action's fourth biennial work plan for 2015-2016, based on a global cooperation agreement signed in 2007. The ASHRAE-UNEP cooperation agreement was developed to achieve several international goals, including the sustainable phase-out of ozone depleting substances in refrigeration and air-conditioning applications; maximizing the climate benefits of using low-global warming potential alternatives including aspects of energy saving in buildings; as well as facilitating the transfer and adoption of sustainable and feasible technologies to developing countries.

Publications new to the ASHRAE Bookstore were sold at the Conference, including Load Calculation Applications Manual, 2nd ed.; the Chilled-Beam Design Guide with REHVA; Geothermal Heating and Cooling: Design of Ground-Source Heat Pump Systems; and Data Center Design and Operation: ASHRAE Datacom Series CD.

The 2015 ASHRAE Annual Conference will take place in Atlanta, Ga., June 27-July 1, 2015. The 2016 ASHRAE Winter Conference takes place Jan. 23 - 27, Orlando, Fla., with the AHR Expo being held Jan. 25-27 2016.

Visitors to the AHR EXPO 2015.

About the AHR EXPO 2015

ASHRAE reported a record setting AHR Expo. There were 2,120 exhibiting companies occupying 45,000 net m^2 of exhibit space. That's the largest AHR Expo ever held in connection with the ASHRAE Winter Conference in Chicago. Of those 2,100 exhibitors, 594 (about 1 in 4) were from outside the U.S. and 390 were exhibiting at the show for the very first time. Number of visitors – 42,400.

Comparing with the ISH (Frankfurt 10-14 March 2015) claiming to be the world's leading trade fair on The Bathroom Experience, Building, Energy, Air-conditioning Technology, Renewable Energies is not possible as the scope of the ISH is much wider. But an increasing participation and attractiveness of the AHR EXPO was noticed. The last years the exhibitors seem to invest more in their display, information service and hospitality competing with shows on the European continent.

The AHR EXPO is an excellent opportunity for companies seeking business in USA and globally and it is no surprise that leading European based companies have been participating. ■

DEFINING A **WORLD OF COMFORT** WITH PURMO

ONE SUPPLIER, MULTIPLE BENEFITS
In a world of choice, few things are simple. As an contractor, architect or specifier, you are faced with countless decisions every day, as you work to ensure your plan comes perfectly to life. Thankfully, there is one decision we can help you with— which supplier to choose when you're working on how best to provide the perfect indoor comfort for your project.

LONG HISTORY OF RELIABILITY
Purmo is part of Rettig ICC, a global leader in radiators and underfloor heating. One supplier, with a vast array of products and an international logistics network to make sure they reach you on time, every time.

PROVEN AND TRUSTED
When you choose Purmo, you choose a reliable partner with over 60 years of experience. We pride ourselves in being the first choice for architects and specifiers the world over. They keep coming back because of our quality, reliability and service.

Take a look at what we offer on our website **www.purmo.com**

°CLEVER
LOW TEMPERATURE RADIATORS

bsi. ISO 9001 Quality Management

PURMO
clever heating solutions

Rettig Lämpö Oy, PL 16, Tupakankatu, FI-68601 Pietarsaari, Finland Tel. 06-786 9111 info@purmo.fi www.purmo.fi

VDI- Standards published January – February 2015

January 2015

C VDI 2047/2 "Open recooler systems; Securing hygienically sound operation of evaporative cooling systems (VDI Cooling Tower Code of Practice)"

Recooling systems can become sources of airborne pathogens. The owner/operator is obligated to minimize the risk ensuing from such installations. This standard provides guidance for hygienically sound operation of recooling systems. The standard applies to existing and new evaporative cooling installations and apparatus where water is trickled or sprayed or can in any other way come into contact with the atmosphere with the exception of natural-draught cooling towers with power dissipations of more than 200 MW. Whether the cooling water is itself the cooling medium in the process or takes over the heat via a heat exchanger from a primary cooling circuit is negligible. Installations where the formation of condensate is possible due to their falling below the dew point are not covered; this is true, e.g., for cold-water aggregates. The standard does not apply to dry-running heat exchangers.

D VDI 3811 "Refurbishment of heating installations" ***(Draft Standard)***

This standard applies to the refurbishment of existing heating installations so as to enable their operation in accordance with current regulations and economic efficiency. It applies to installations for the generation of space heating and potable-water heating. The standard describes the inventory taking, planning, methods, actions to be taken and quality management as well as the actual process of upgrading or deconstruction.

VDI 6010/3 "Technical safety installations for buildings; integrated system test and system interaction test"

The series of standards VDI 6010 applies to safety devices in buildings. This standard gives information about the organization, implementation and documentation of integrated system tests in buildings. The standard is intended in particular to prove the public requirements in initial tests, periodical tests and tests after an important modification. It can also be used to verify the fulfillment of private agreements.

D Draft Guideline

C VDI Ventilation Code of Practice

February 2015

D VDI 2164 "PCM energy storage systems in building services" ***(Draft Standard)***

This standard defines the fundamentals for the use of latent-heat storage systems in building services. Recent developments in the field of phase-change-materials (PCMs) open the way to new systems and components allowing energy savings and increases in energy efficiency. As the use of regenerative energies expands, demand and generation no longer coincide, requiring the temporary storage of energy in the building. Based on the fundamentals specified in this standard, PCM systems are described, their planning and calculation explained, and performance parameters are identified. The standard comprehensively covers: passive surface heating and cooling systems (such as building materials, components), active surface heating and cooling systems (such as chilled ceilings), local ventilating systems for cooling purposes, centralized ventilating systems for heating and cooling, energy storage systems.

VDI 3813/3 "Building automation and control systems (BACS); Application examples for room types and function macros of room automation and control"

The standard deals with the macro functions for room automation (RA macros) and its application in room types. The standard gives examples of room types and the realized automation with function macros. The function macros are composed of the basic functions according to VDI 3813 Part 2 and can be used in practice. The standard aids to optimize the working methods in planning and execution of room automation.

VDI 7001/1 "Communication and public participation in planning and building of infrastructure projects; Training for work stages of engineers"

The standard applies for training with the aim of qualification of interested persons in "communication an public participation" in planning and building of infrastructure projects. The training deals with the contents of standard VDI 7001. It follows the work phases of the German Fee Structure for Architects and Engineers (HOAI) and is addressed mainly to engineers as project sponsors, general design contractors, planners, project managers, executing companies, representatives of the authorities, representatives of associations or civic initiatives.

Active and Passive Beam Application Design Guide

The idea of a cooperative project between ASHRAE and REHVA first came up as an idea during the Clima 2010 conference. A few months later a joint team was assembled and we met in Stockholm for the first of many meetings. As with most things in life, it is the journey not the destination, but I think I speak for the entire group in saying that it was a relief to finally get the guidebook published.

There were many twists and turns along the way, concerning everything from how much detail about beam design and performance is useful to share, should a chilled beam be called that, seeing as they heat as well, is that not miss-leading? How much system design and comparisons do we want to included?

The general feeling was that the existing REHVA book was full of good information, but it just needed updating and giving a slightly more application focus. Personally I always found the existing guidebook useful to dip into if I had a question which I needed more insight into, but I found it difficult to read through. This I felt was important if, especially as North America was waking up to the potential and curious about beam technology. This I think we have achieved.

So, what are the highlights of the guidebook? For me the real highlight is the case studies and the way these are laid out. Not only do we take different cities from around the world (this was a discussion in its self. The conclusion from the group was, "beams don't care where in the world they are and what the climate is outside, because modern buildings should be fairly air tight and measured to ensure this, so it is the job of the central plant to provide the correct conditions for the beams." But because there will always be someone who thinks it won't work in their climate, we spread out the examples around the globe.

We have also chosen different applications; if you want to do a commercial office, lab, hotel or patient room, to name but a few, no problem, examples are provided. We offer selection notes and comments on the design, just to help out in the beginning. Feel free to draw your own conclusions.

The examples are based on a spreadsheet which is available for download in both SI and IP, so there are no excuses. This idea of laying out the examples only came up about half way through the project, so the book would not have been as good if we'd have finished earlier.

In short, the focus has been on giving a good introduction to curious design engineers who want to understand more about beam technology. It takes skill and understanding to design a beam climate system, but the benefits are in terms of comfort and life cycle costs (energy and maintenance).

I recommend this publication to all who are curious or have an existing interest in beams. The book may not be perfect, but I believe it has raised the game in terms what guidance is available. If you have any ideas how to improve the book for the next revision, don't hesitate to volunteer!

Lastly I need to thank everyone involved, ASHRAE and REHVA staff, and the entire working group, particularly Julian Rimmer for being my co-chair, but above all Peter Simmonds and Carlos Lisboa without whom the guidebook would have been completed.

JOHN WOOLLETT
CEng, Fellow REHVA, Member ASHRAE, Fellow CIBSE

Send information of your event to Ms Cynthia Despradel cd@rehva.eu

Events in 2015 - 2016

Conferences and seminars 2015

March 25 – 27	4th International Congress 2015 - Mechanical Engineer Days	Vodice, Croatia	www.hkis.hr
April 16-18	International Conference Ammonia and CO2 Refrigeration Technologies	Ohrid, Republic of Macedonia	www.mf.edu.mk/web_ohrid2015/ohrid-2015.html
April 27-28	37th Euroheat & Power Congress	Tallinn, Estonia	www.ehpcongress.org/registration/
May 6-7	REHVA Annual Meeting	Riga, Latvia	www.hvacriga2015.eu
May 8-9	REHVA Annual Conference "Advanced HVAC and Natural Gas Technologies"	Riga, Latvia	www.hvacriga2015.eu
May 18-20	Healthy Building 2015 Europe	Eidhoven, The Netherlands	www.hb2015-europe.org
June 14-17	International Building Physics Conference	Torino, Italy	http://ibpc2015.org/
August 16 – 22	IIR International Congress of Refrigeration	Yokohama, Japan	www.icr2015.org
September 10-11	CLIMAMED	Juan Les Pins, France	http://aicvf.org/blog/actualites/climamed-congress-juan-les-pins-10-et-11-septembre-2015/
September 23-24	36th AIVC- 5th TightVent- 3rd venticool	Madrid, Spain	www.aivc2015conference.org
October 20-23	Cold Climate HVAC	Dalian, China	www.coldclimate2015.org
October 26-28	11th International Conference on Industrial Ventilation	Shanghai, China	www.ventilation2015.org

Exhibitions 2015

February 26-28	ACREX India	Biec, Bangalore, India	www.acrex.in
March 10-14	ISH	Frankfurt, Germany	http://ish.messefrankfurt.com
March 18-21	AQUATHERM St.Petersburg	St. Petersburg, Russia	www.aquatherm-spb.com/en/
May 13-15	ISH China & CIHE	Beijing, China	www.ishc-cihe.com
September 23-25	ISH Shanghai & CIHE	Shanghai, China	www.ishs-cihe.hk.messefrankfurt.com
November 2-6	Interclima+Elec	Paris, France	www.interclimaelec.com

Conferences and seminars 2016

May 22-25	12th REHVA World Conference - CLIMA 2016	Aalborg, Denmark	www.clima2016.org
July 3-8	Indoor Air 2016	Ghent, Belgium	twitter @IA2016

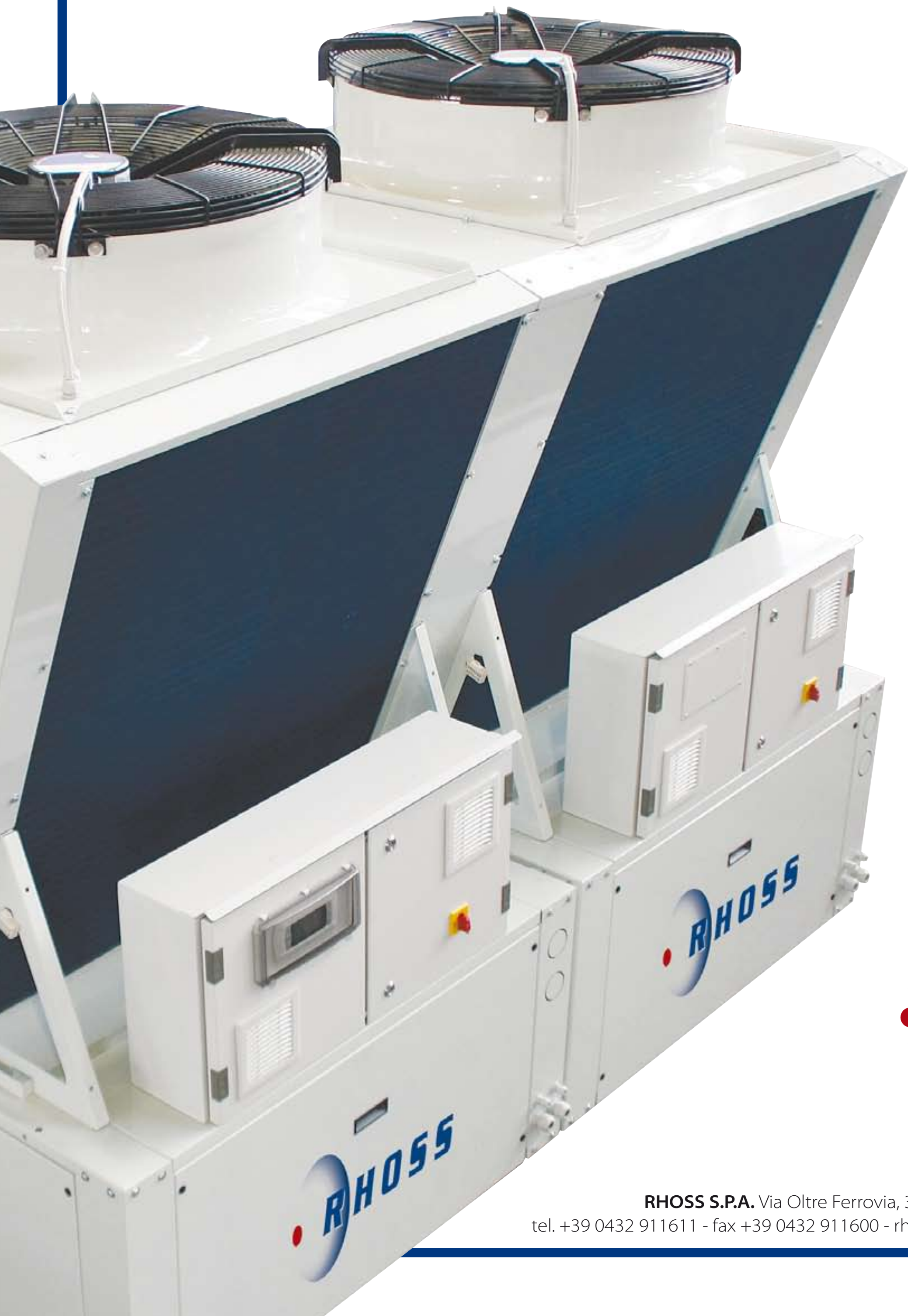
Exhibitions 2016

January 25-27	2016 AHR Expo	Orlando, Florida, USA	www.ahrexpo.com
March 1-4	AQUATHERM Prague	Prague, Czech Republic	www.aquatherm-praha.com/en/
March 13-18	Light and Building	Frankfurt, Germany	http://ish.messefrankfurt.com
March 15-18	Mostra Convegno Expocomfort	Milan, Italy	www.mcexpocomfort.it/
October 12-14	FinnBuild	Helsinki, Finland	www.messukeskus.com/Sites1/FinnBuild/

POKER

HEAT PUMPS

THE WINNING HEAT PUMP SILENT, FLEXIBLE, EFFICIENT



POKER is the innovative range of Rhoss modular heat pumps, which combines key features like silent operation, flexibility and efficiency.
The units can match the requirements of all plant types, minimizing, in every architectural context, noise issues and granting unique performance.

POKER is composed by independent modules with 34 kW heating capacity each, which can be connected together to reach 137 kW maximum total heating capacity.
Each module is a reversible heat pump for outdoor installation, equipped with tandem scroll compressors with liquid injection, hydrofilic treated coils and R410A refrigerant.

RHOSS
CREATING YOUR COMFORT

RHOSS S.P.A. Via Oltre Ferrovia, 32 - 33033 Codroipo (UD) - Italy
tel. +39 0432 911611 - fax +39 0432 911600 - rhoss@rhoss.it - www.rhoss.it - www.rhoss.com

REHVA
Federation of European Heating, Ventilation and Air-conditioning Associations
SUPPORTER

REHVA SUPPORTERS

A REHVA supporter is a company or an organization that shares the same objectives as REHVA. Our REHVA supporters use the latest European technologies to make their products. The REHVA Supporters are also members of reHVAClub. For more information about REHVA supporters' program, please contact info@rehva.eu or call +32 2 5141171.

- AAF International
- AERMEC air conditioning
- Air Trade Centre – Durable HVAC Solutions
- BELIMO
- camfil
- CIAT
- CLIMESPACE GDF SUEZ
- KRIOMEC SA Galati Romania
- DAIKIN
- Demark Construct – confortul de partea ta
- DONPER
- Doset Impex
- eneko
- EPEE – European Partnership for Energy and the Environment
- ES-SO – European Solar Shading Organization – Energy Savings & Comfort
- EUROVENT CERTIFIED PERFORMANCE – www.eurovent-certification.com
- evapco
- FläktWoods
- FRITERM – Termik Cihazlar Sanayi ve Ticaret A.Ş.
- GEA
- Granlund
- GRUNDFOS
- Halton
- Hidria
- Lindab
- LIFA AIR
- RETTIG
- RHOSS – Creating your comfort
- SKANSKA
- SMAV
- Smits van Burgst
- somfy
- Swegon
- systemair
- TANGRA
- TROX TECHNIK – The art of handling air
- uponor
- zehnder

The REHVA European HVAC Journal

Register now for 2015!

To maintain the quality of the technical content of the REHVA European HVAC Journal, as of January 2015, REHVA will review its income structure and has decided to charge for a subscription to the REHVA journal. This will allow us to keep original format without including too many advertisements.

This is the result of the increasing cost of shipping and printing due to the high success of the journal. Furthermore, as of 2015, the REHVA Journal issues will be available in a restricted section of the website which incurred development costs. The current subscribers are offered two options:

1. Continue to receive the paper copy for the cost of 60€ per year for REHVA Members or 70€ per year for others and read the eJournal online in the restricted area.

2. Read the eJournal online in the restricted area for 30 € for REHVA Members or 40€ per year for others.

PLEASE SIGN ME UP FOR:

- ☐ 1 YEAR SUBSCRIPTION PAPER COPY AND ACCESS TO RESTRICTED AREA ON REHVA WEBSITE
- ☐ 1 YEAR SUBSCRIPTION PDF FORMAT (ACCESS TO RESTRICTED AREA ON REHVA WEBSITE ONLY)

Company:	Department:
Last name:	First name:
Address:	
Postal Code:	City:
Country:	
E-mail:	
REHVA-Member/National HVAC association name:	
Signature:	Date:

Please, return the subscription form to REHVA office by mail, fax or email.

REHVA – Rue Washington, 40 - 1050 Brussels - Belgium
Telephone: +32 2 514 11 71 - Telefax: +32 2 512 90 62
e-mail: info@rehva.eu - website: www.rehva.eu

Payment

Via online secure credit card payment area: http://www.rehva.eu/publications-and-resources/guidebooks-shop/

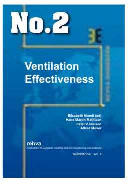
Via bank transfer: ABN AMRO Bank – Account number: 41.68.61.814 - IBAN: NL07ABNA0416861814 - BIC: ABNANL2A

REHVA

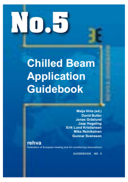
Federation of European Heating, Ventilation and Air Conditioning Associations

REHVA GUIDEBOOKS

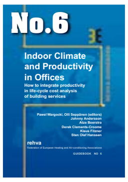
REHVA Guidebooks are written by teams of European experts



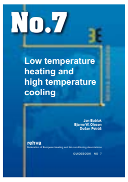
Ventilation Effectiveness. Improving the ventilation effectiveness allows the indoor air quality to be significantly enhanced without the need for higher air changes in the building, thereby avoiding the higher costs and energy consumption associated with increasing the ventilation rates. This Guidebook provides easy-to-understand descriptions of the indices used to measure the performance of a ventilation system and which indices to use in different cases.



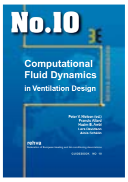
Chilled Beam Cooling. Chilled beam systems are primarily used for cooling and ventilation in spaces, which appreciate good indoor environmental quality and individual space control. Active chilled beams are connected to the ventilation ductwork, high temperature cold water, and when desired, low temperature hot water system. Primary air supply induces room air to be recirculated through the heat exchanger of the chilled beam. In order to cool or heat the room either cold or warm water is cycled through the heat exchanger.



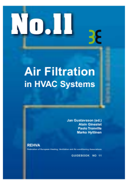
Indoor Climate and Productivity in Offices. This Guidebook shows how to quantify the effects of indoor environment on office work and also how to include these effects in the calculation of building costs. Such calculations have not been performed previously, because very little data has been available. The quantitative relationships presented in this Guidebook can be used to calculate the costs and benefits of running and operating the building.



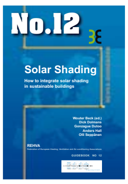
Low Temperature Heating And High Temperature Cooling. This Guidebook describes the systems that use water as heat-carrier and when the heat exchange within the conditioned space is more than 50% radiant. Embedded systems insulated from the main building structure (floor, wall and ceiling) are used in all types of buildings and work with heat carriers at low temperatures for heating and relatively high temperature for cooling.



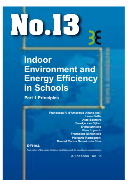
Computational Fluid Dynamics in Ventilation Design. CFD-calculations have been rapidly developed to a powerful tool for the analysis of air pollution distribution in various spaces. However, the user of CFD-calculation should be aware of the basic principles of calculations and specifically the boundary conditions. Computational Fluid Dynamics (CFD) – in Ventilation Design models is written by a working group of highly qualified international experts representing research, consulting and design.



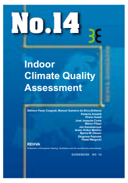
Air Filtration in HVAC Systems. This Guidebook will help the designer and user to understand the background and criteria for air filtration, how to select air filters and avoid problems associated with hygienic and other conditions at operation of air filters. The selection of air filters is based on external conditions such as levels of existing pollutants, indoor air quality and energy efficiency requirements.



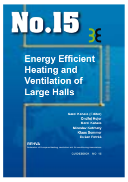
Solar Shading – *How to integrate solar shading in sustainable buildings.* Solar Shading Guidebook gives a solid background on the physics of solar radiation and its behaviour in window with solar shading systems. Major focus of the Guidebook is on the effect of solar shading in the use of energy for cooling, heating and lighting. The book gives also practical guidance for selection, installation and operation of solar shading as well as future trends in integration of HVAC-systems with solar control.



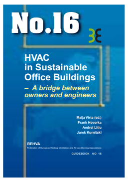
Indoor Environment and Energy Efficiency in Schools – *Part 1 Principles.* School buildings represent a significant part of the building stock and also a noteworthy part of the total energy use. Indoor and Energy Efficiency in Schools Guidebook describes the optimal design and operation of schools with respect to low energy cost and performance of the students. It focuses particularly on energy efficient systems for a healthy indoor environment.



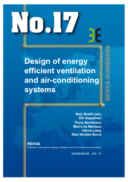
Indoor Climate Quality Assessment. This Guidebook gives building professionals a useful support in the practical measurements and monitoring of the indoor climate in buildings. Wireless technologies for measurement and monitoring have allowed enlarging significantly number of possible applications, especially in existing buildings. The Guidebook illustrates with several cases the instrumentation.



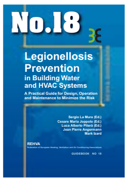
Energy Efficient Heating and Ventilation of Large Halls. This Guidebook is focused on modern methods for design, control and operation of energy efficient heating systems in large spaces and industrial halls. The book deals with thermal comfort, light and dark gas radiant heaters, panel radiant heating, floor heating and industrial air heating systems. Various heating systems are illustrated with case studies. Design principles, methods and modelling tools are presented for various systems.



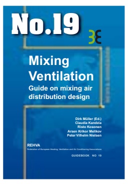
HVAC in Sustainable Office Buildings – ***A bridge between owners and engineers.*** This Guidebook discusses the interaction of sustainability and heating, ventilation and air–conditioning. HVAC technologies used in sustainable buildings are described. This book also provides a list of questions to be asked in various phrases of building's life time. Different case studies of sustainable office buildings are presented.



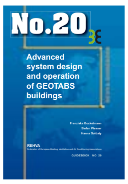
Design of energy efficient ventilation and air-conditioning systems. This Guidebook covers numerous system components of ventilation and air-conditioning systems and shows how they can be improved by applying the latest technology products. Special attention is paid to details, which are often overlooked in the daily design practice, resulting in poor performance of high quality products once they are installed in the building system.



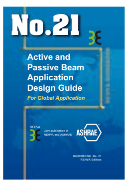
Legionellosis Prevention in Building Water and HVAC Systems. This Guidebook is a practical guide for design, operation and maintenance to minimize the risk of legionellosis in building water and HVAC systems. It is divided into several themes such as: Air conditioning of the air (by water – humidification), Production of hot water for washing (fundamentally but not only hot water for washing) and Evaporative cooling tower.



Mixing Ventilation. In this Guidebook most of the known and used in practice methods for achieving mixing air distribution are discussed. Mixing ventilation has been applied to many different spaces providing fresh air and thermal comfort to the occupants. Today, a design engineer can choose from large selection of air diffusers and exhaust openings.



Advanced system design and operation of GEOTABS buildings. This Guidebook provides comprehensive information on GEOTABS systems. It is intended to support building owners, architects and engineers in an early design stage showing how GEOTABS can be integrated into their building concepts. It also gives many helpful advices from experienced engineers that have designed, built and run GEOTABS systems.



Active and Passive Beam Application Design Guide. This design guide is a revision of the REHVA Chilled Beam Application Guidebook. ASHRAE and REHVA decided to collaborate on a revision of the guidebook and enlisted experts from both organizations to revise the document. This book provides tools and guidance to design, commission, and operate active and passive beam systems to achieve a determined indoor climate. It also presents examples of active and passive beam calculations and selections.

REHVA – Rue Washington, 40 – 1050 Brussels – Belgium
Telephone: +32 2 514 11 71 • Fax + 32 2 512 9062 • E-mail: info@rehva.eu • website: www.rehva.eu