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REHVA

Federation of European Heating, Ventilation and Air Conditioning Associations

The REHVA European HVAC Journal

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Special issue for ACREX India 2015 exhibition

European Certification of HVAC products

Cooling Towers

Heat Pump Systems

Residential Air Handling Units

EU standards on Energy Performance of Buildings Assessment

Indoor Environmental Input Parameters

Energy Performance of Ventilation and Cooling Systems

The REHVA European HVAC Journal
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Special issue for ACREX India 2015 exhibition

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From product to system and building performance declaration and certification.

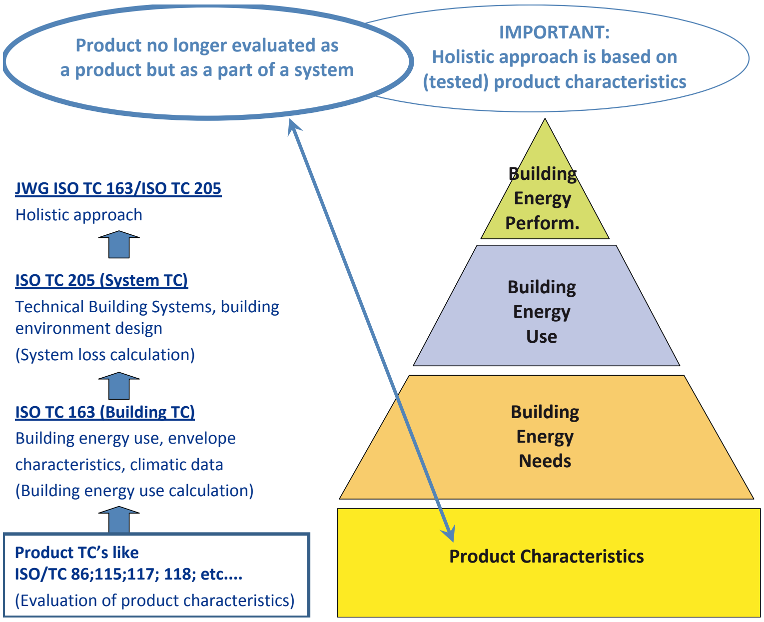
All new buildings after 2020 in Europe Nearly Zero Energy.

JAAP HOGELING
Editor-in-Chief

The main 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. The contents will give some information on European activities improving the of energy efficiency of products, information on commonly used voluntary product (energy) performance certification programmes and some background information on product performance testing.

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. Also, energy performance assessment procedures and the modern building performance simulation programmes need accurate performance data not only in design conditions but also in changing conditions with varying load.

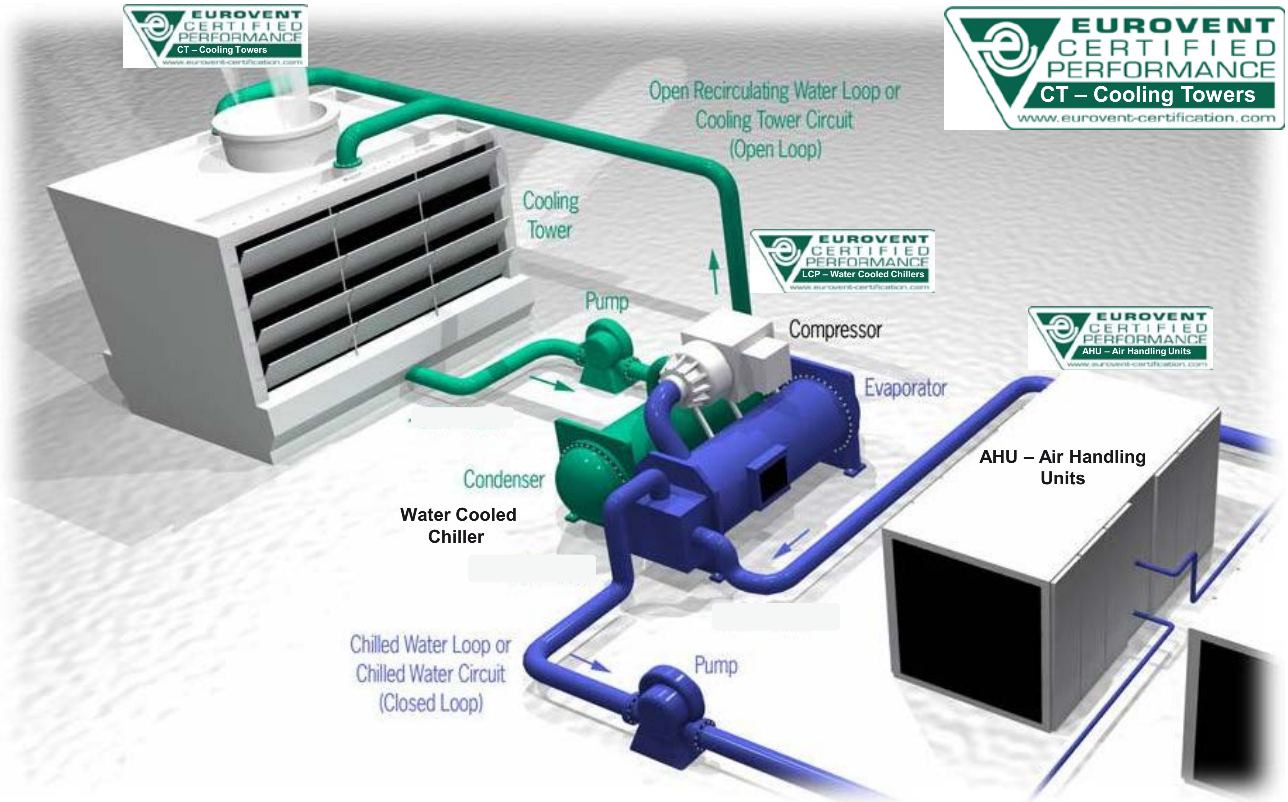
Continuity from the product to the system energy performance assessment



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 are examples of the strong commitment to reduce energy consumption of buildings and GHG emissions. ■



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.

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

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.

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

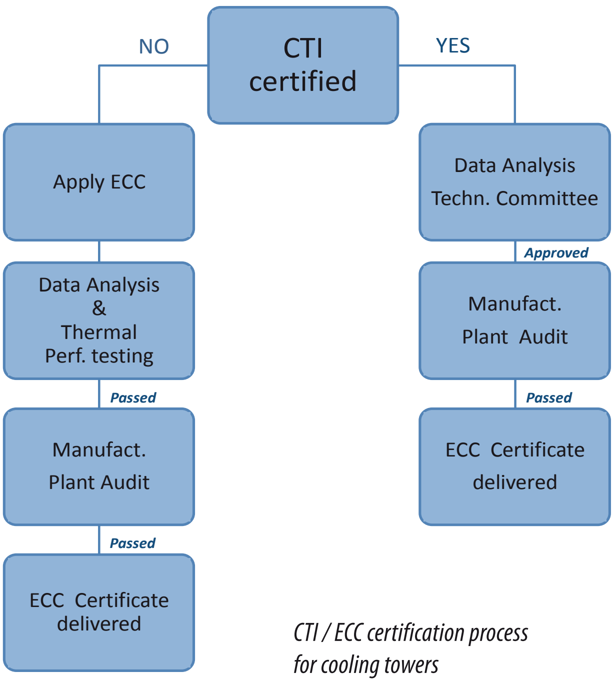
To facilitate the establishment of this programme a Memorandum of Understanding (MOU) was signed between Eurovent Certita Certification and the Cooling Technology Institute (CTI). This MOU describes the cooperation between both organizations where the Cooling Technology Institute provides the structure 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 know-how. 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

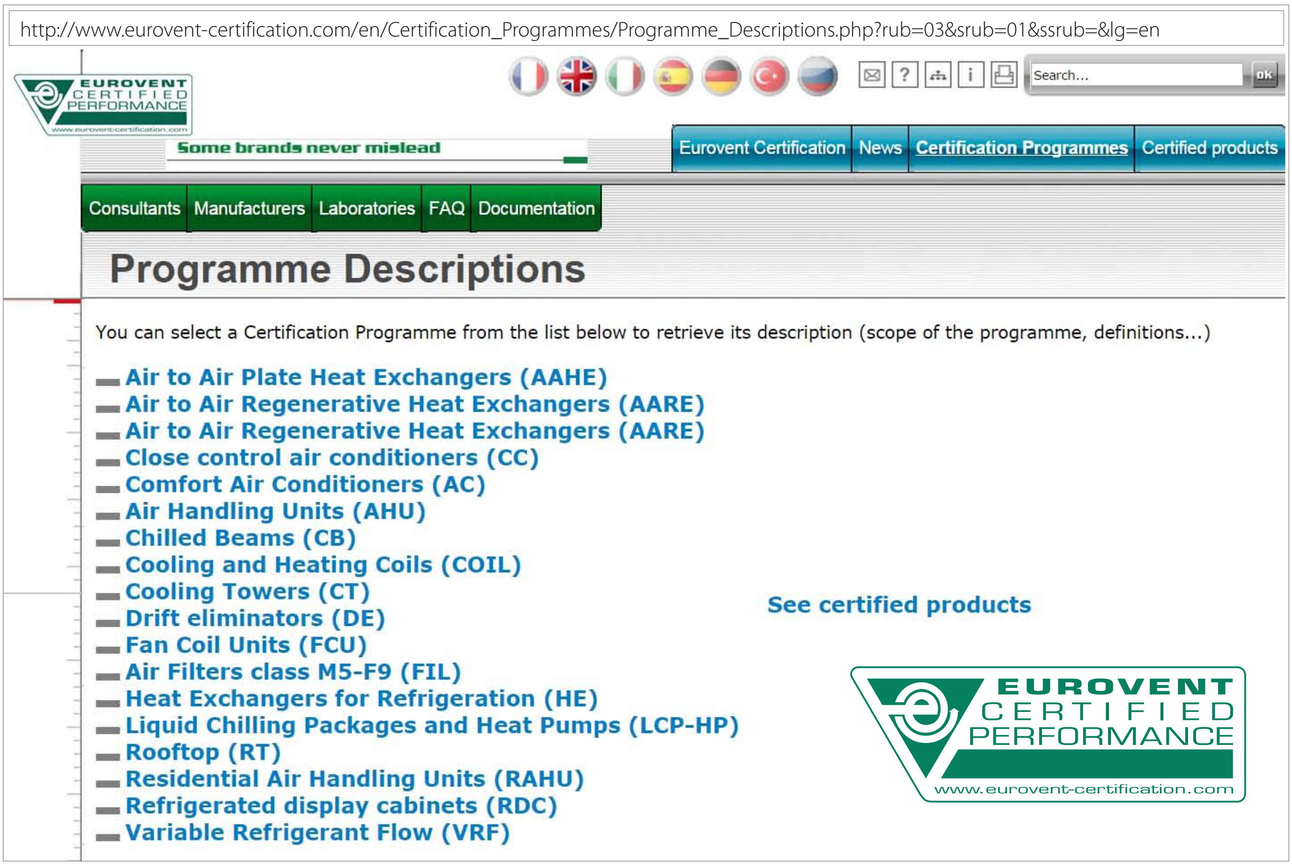
Owner/End-Users are the most important partners of thermal performance certification. They decide the key-requirements of the equipment for the consultant to specify. The end-user is the provider of the capital budget and pays the monthly energy bill of the cooling system. As stipulated in the previous 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.

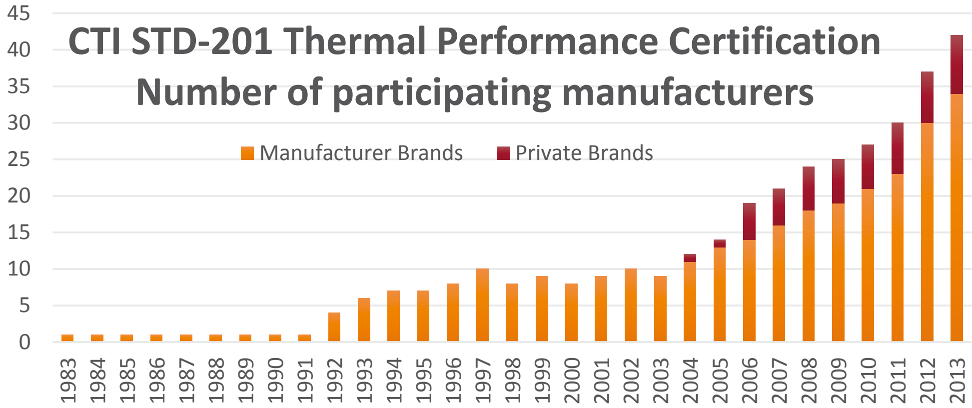
Eurovent represents 1015 companies in 13 European countries, employing 126 804 people who generate 21.3€ billion of annual output. Eurovent was initially founded in 1958 and has been functioning under its current name since 1964.

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

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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 ecodesign 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.

Using building simulation for moving innovations across the "Valley of Death"

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Key words: Research and development; building envelopes; energy efficiency; building performance simulation; innovation support.

Using building simulation for moving innovations across the "Valley of Death"

The *Valley of Death* is known as a metaphor for the lack of resources and expertise that impedes new ideas in their transition from lab to market. This gap also hinders innovation and adoption of new technologies for improved energy efficiency in buildings. This paper presents why and how building simulation can help close this gap, and shows some examples.

A need for innovations in building envelope materials and components is at the heart of many technology roadmaps for sustainable buildings and cities, such as those recently issued by the International Energy Agency [1] and the European Commission [2]. It is expected that breakthrough developments in new facade constructions can make substantial contributions in the transition towards cost-effective nearly-zero energy buildings (NZEB) with high indoor environmental quality (IEQ). In particular, the potential of buildings with adaptable facades is identified as promising [3].

Advances in material sciences open up a growing range of opportunities for new building envelope technologies. Examples include vacuum insulation, phase change materials, complex fenestration systems and facade coatings with advanced properties. Most of these concepts start off as small projects in research laboratories. Typically, academic research groups can develop such concepts from discovery up to a point with a low technology readiness level (TRL) (**Figure 1**).

The subsequent phases of technology transfer and commercialization into marketable products and services, however, tend not to be straightforward [4]. Several reasons can be identified for this challenging situation:

- Basic research is mainly done with public funding, whereas private investors are mostly interested in working towards commercial viability. This leaves a void in the middle.
- The investment required in this area is generally high, but the certainty of success relatively low. Only few technology concepts will develop into successful commercial products.
- There is a lack of tools that can provide insights into building-integration issues in an early R&D phase (TRL 1-5). This results in a mismatch between information need and availability and complicates decision-making.
- The process requires an interdisciplinary approach. The right combination of skills and expertise may not always be available.

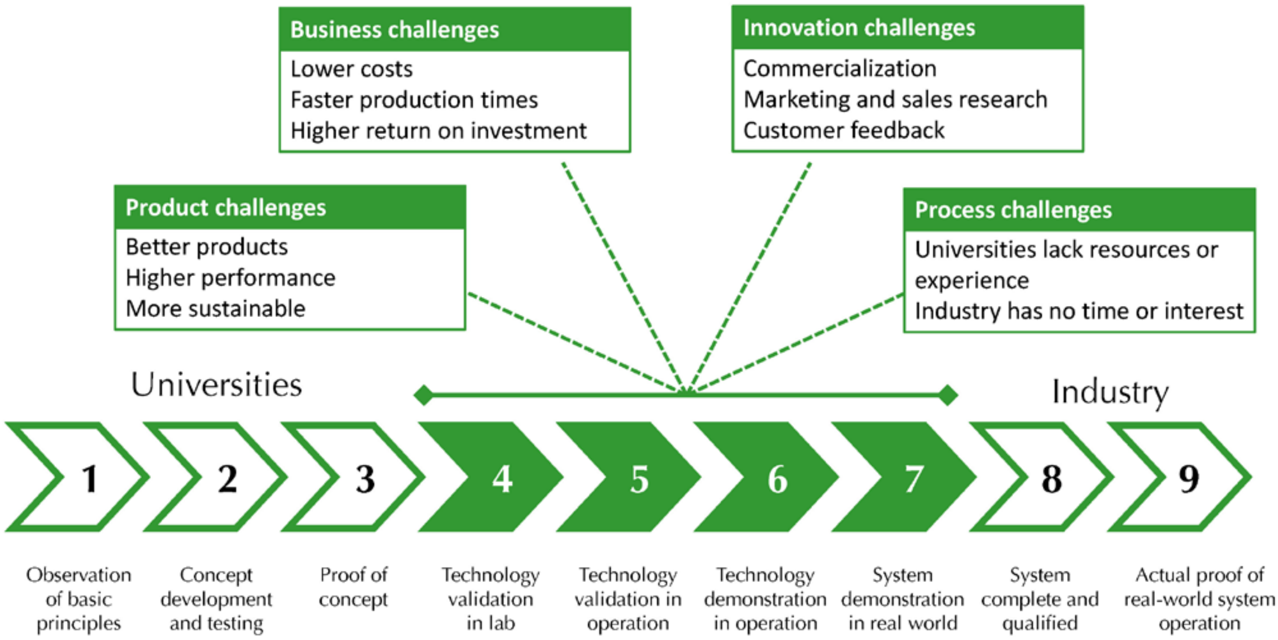

Figure 1. Overview of activities at different technology readiness levels (TRL). Details are given for some of the challenges at TRL 4 to 7.

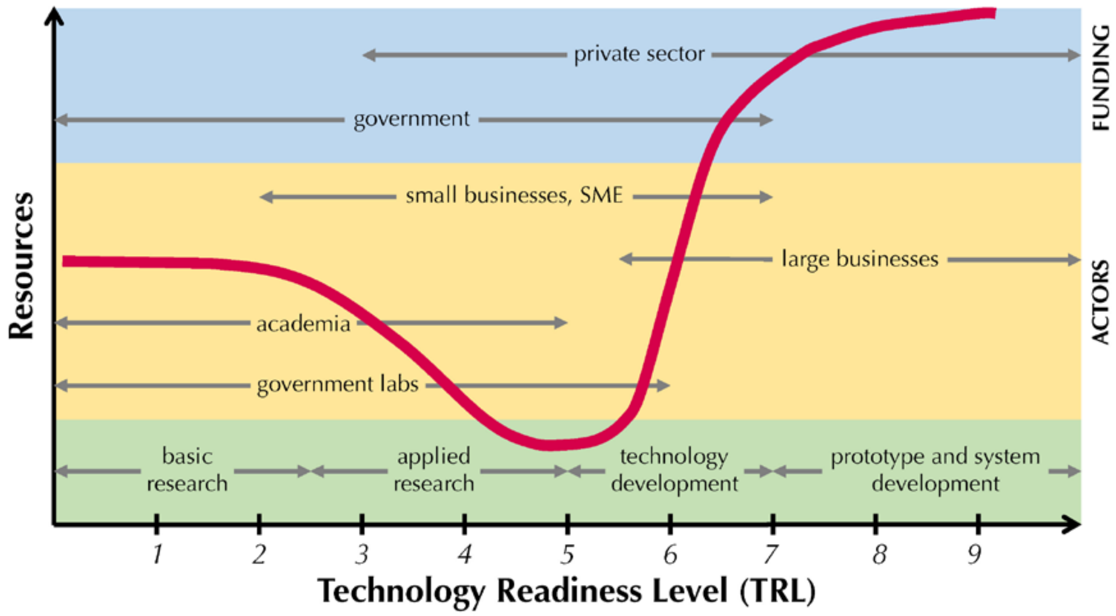

Figure 2. Availability of resources for new product development at various TRLs. The gap in the middle is sometimes referred to as "The Valley of Death"

The *Valley of Death* is sometimes used as an analogy to describe this discontinuity in innovation processes (**Figure 2**). Developing methods and tools that can bridge this valley is identified as an urgent stepping stone, and is therefore high on the agenda of policy programmes, such as Horizon 2020, the EU Framework Programme for Research and Innovation [2].

Building performance simulation

Over the last few decades, building performance simulation (BPS) has evolved to become a well-established design support tool in the construction and HVAC design industry. BPS takes into account the dynamic interactions between a building's shape and construction, systems, user behavior and climatic conditions, and is therefore used as a valuable resource in many building design processes [5]. Because of these attributes, BPS can also be used as a tool for supporting informed decision-making in the R&D phase of innovative building envelope components, but such possibilities have only been explored to a limited extent [6].

Through iterative evaluation of multiple product variants, the integration of simulation allows for strategic decisions that acknowledge high-potential directions in the development process. What-if-analyses can be performed to evaluate the robustness of a new technology in many different usage scenarios and operating conditions. Moreover, BPS can act as a virtual test bed to assess the potential of materials with not-yet-existing properties. All these analyses can be done on the basis of relevant performance indicators, and as such, the method may help creating competitive advantage by improving product performance or time-to-market in a cost-effective way. This article discusses various applications of the use of BPS in two product innovation processes, and shows how it may stimulate future product development.

Smart energy glass

Smart glazing systems, such as electrochromic or thermochromic windows, are identified as high-potential facade elements. By regulating the amount of daylight and solar gains they transmit, absorb and reflect, these windows offer options for improving energy performance and comfort conditions. A relatively high investment cost, but also technological issues, such the non-neutral colours, slow switching speeds and need for electricity supply, however, cause a relatively slow uptake in the market. To overcome these barriers, new switchable window systems, based on alternative physical principles are currently being developed. One of the emerging concepts is Smart Energy Glass (SEG) (www.peerplus.nl). SEG combines liquid crystalline materials together with window-integrated PV cells to create fast-switching, self-sufficient switchable glass (**Figure 3**).

Building simulations are embedded in ongoing efforts of scaling the technology from proof-of-principle to commercial building product, and focus on the whole-building integration issues of this high-tech product.

Figure 3. Smart Energy Glass – self-sufficient switchable windows.

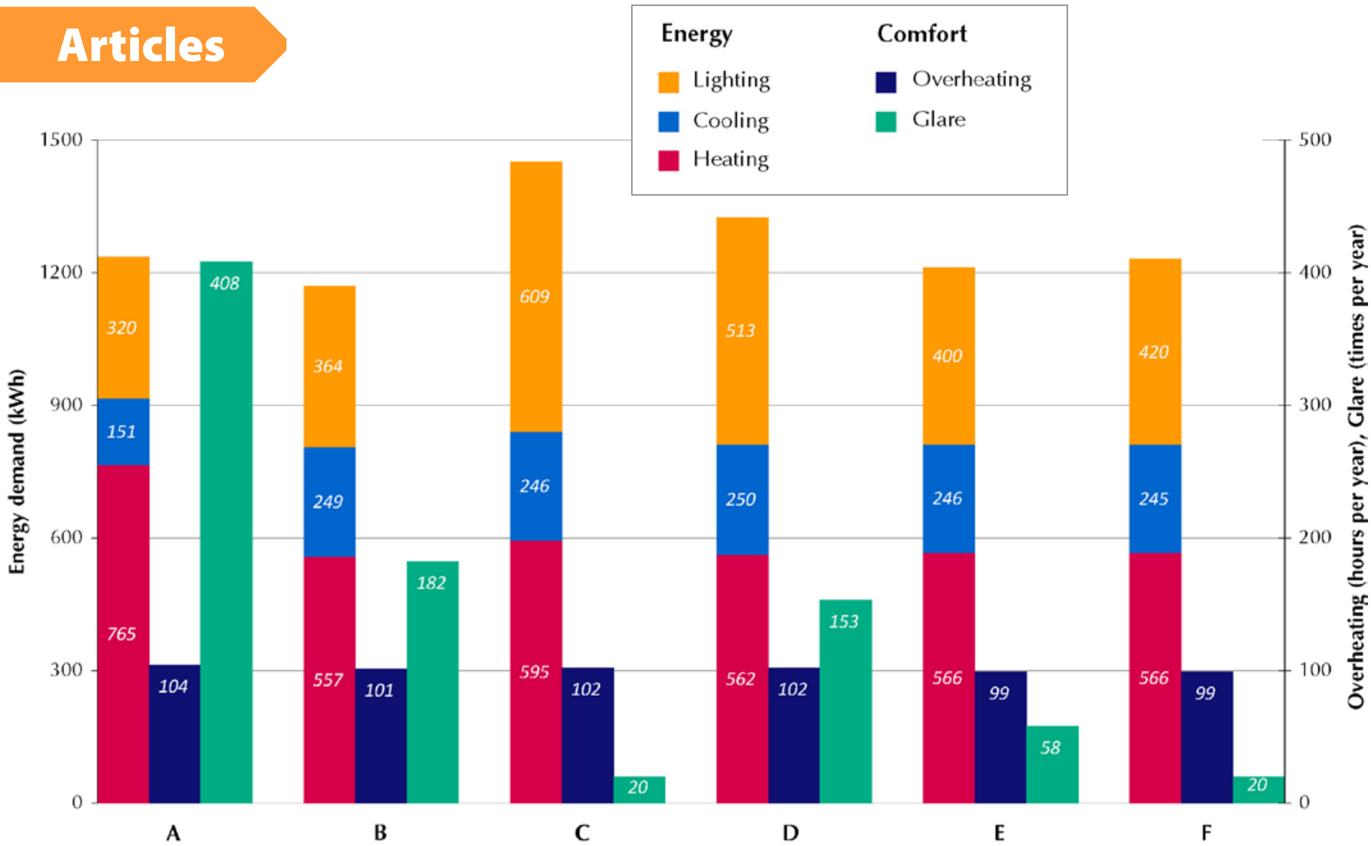

Figure 4. Performance of early-generation Smart Energy Glass (B-F) compared to a reference case (A). The different situations (B-F) show various types of control strategies.

The use of simulations started in a very early phase (TRL 2-3). At the time when the technology was only available in the form of small-scale samples, we used simulations to predict whole-building performance in terms of comfort and energy saving potential under a range of operating conditions and building use scenarios (**Figure 4**). Based on this information, benchmarks were set and specific material-level development targets were outlined. In addition, it served as justification for the decision to allocate more resources to the project.

In a later phase, we combined BPS together with sensitivity analyses and parametric studies. These structured design space explorations helped gaining information about the performance of a large number of possible product variants, without the need for having many prototypes. We identified, for example, that visual performance and glare discomfort are very important performance aspects. Development of switchable window coatings should take this requirement into account. In addition, the simulations showed that it is worthwhile to invest resources in the development of windows with properties that can be customized to the needs of specific cases. Sometimes it is needed to have high transparency in the bright state, whereas in other situations low light transmittance in the dark state is more important. Being able to adapt properties in response to case-specific requirements is the key to developing a successful product.

Finally, a dedicated software tool was developed, based on an extensive database of BPS outcomes. This web-based tool is used for communication with external stakeholders and potential clients. It stimulates discussion and facilitates decision-making, because the expected window performance can be visualized in a fast and easy way.

Architectural Facade Panels (Trespa)

Trespa BV is recognized worldwide as a leading developer of high-performance cladding systems and architectural facade panels. An own research and development centre helps Trespa to stay ahead with innovative and sustainable products and design solutions. Building simulations form an integral part of this R&D strategy.

The case we present here concerns the challenge of reconciling architectural flexibility with the wish to achieve energy savings in sunny climates. Solar reflective properties play an important role in a building's energy balance. Highly-reflective surfaces reduce cooling load, but the light and/or shiny appearance that usually comes with high reflectivity is not always desired. By developing a spectrally selective finishing, Trespa aims at developing a solution that helps reduce energy consumption while allowing designers to use darker colours (**Figure 5**). Integration of building performance simulations was of definitive importance in assisting the whole development process, from the early stages of development until marketing and information dissemination stages.

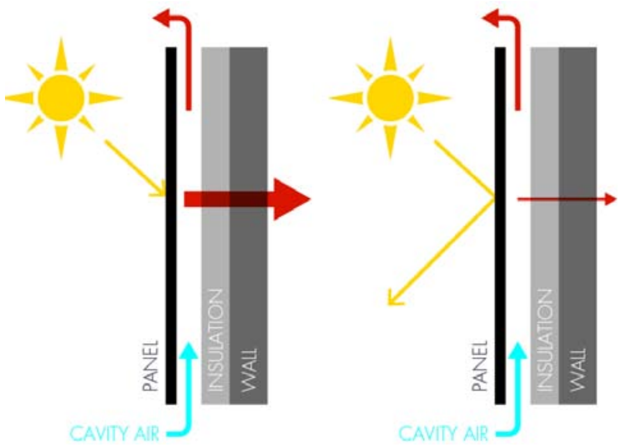

Figure 5. Conventional (left) and spectrally selective (right) facade coatings.

At an early stage of development, the reason for using building performance simulations was to evaluate the importance of various design parameters. By visualizing the governing performance trade-offs, this facilitated the selection among competing, potential product build-ups, based on their impact on a building's thermal load and economic feasibility.

Closer to commercial product launch, simulations also played a role. A study with a generic reference building was conducted to assess how the panels would perform in different locations all over the world. Based on the outcomes, and in consultation with the marketing team, the decision was made that the product is initially exclusively available for the Middle East and North African regions.

For a selected number of cases, more in-depth investigations of the energy saving potential of the new cladding system were made. These calculations served as input for financial calculations, to decide under which conditions application of the spectrally selective coating can be economically attractive. Afterwards, the results were correlated with the possibility of gaining credits related to energy savings, in popular green building certification schemes (LEED, ESTIDAMA). This is also valuable information for the customer and was included in the sales material.

Conclusions and Outlook

Through a number of use cases, we have demonstrated how the application of building performance simulation (BPS) can support product development of new building envelope components, in both start-up companies and large multinationals. BPS adds many favourable opportunities to the innovation process, because it:

- can be used to inform decision-making from early R&D phases all the way through to marketing and sales support;
- is able to uncover the relationships between relevant whole-building performance indicators, that go beyond component-level metrics such as U-value or g-value;
- generates useful inputs for many types of subsequent analyses, such as life cycle assessment and financial business models;
- allows for testing multiple *what-if* scenarios in a virtual, and thus relatively inexpensive, way.

This focus on whole-building performance adds an extra dimension to the R&D process. BPS can be a useful resource for managing risk and uncertainty in product development, and thus increases chances that promising concepts successfully make the transition from lab to the market. We therefore argue that BPS should get a more prominent role in future R&D processes. ■

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Articles

Calculation of the energy performance of ventilation and cooling systems

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In the present paper, an overview of the new calculation related standards from CEN TC 156 in the area of ventilation and cooling, the prEN 16798-family, is given.

An introduction to the content of the 3 standards on ventilation is given, where an hourly and a monthly calculation method are available in separate documents for the duct system and air handling unit parts.

For the cooling related standard, the content of the standards and the interconnection is shown based on the general part prEN 16798-9, which connects the calculation pieces of the other standards for emission, distribution, storage and generation to a complete system.

The standards revised under the lead of CEN TC 156 "Ventilation for buildings" have all been allocated a new number: prEN 15798, with different parts for the different areas.

This article described the standards of this family which deal with the calculation methods for the energy performance of ventilation, air conditioning and cooling systems. The parts 1, 3 and 17 of the prEN 16798 family are not covered in this article, since there are separate articles on the indoor environment parameters (prEN 16798-1, the revision of EN 15251, see [1]), the performance requirements of ventilation and room conditioning systems (prEN 16798-3, the revision of EN 13779, see [2]) and inspection of ventilation and air conditioning systems (prEN 17898-17, the revision of EN 15239 and 15240, see [3]), including their accompanying technical reports.

The calculation standards consist of the following parts:

prEN 16798-5-1: Energy performance of buildings – Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 – Ventilation for buildings – Calculation methods for energy requirements of ventilation and air conditioning systems – Part 5-1: Distribution and generation (revision of EN 15241) – method 1.

prEN 16798-5-1: Energy performance of buildings – Modules M5-6, M5-8 – Ventilation for buildings – Calculation methods for energy requirements of ventilation systems – Part 5-2: Distribution and generation (revision of EN 15241) – method 2.

prEN 16798-7: Energy performance of buildings – Module M5-5 – Ventilation for buildings – Calculation methods for energy requirements of ventilation and air conditioning systems – Part 7: Emission (determination of air flow rates, revision of EN 15242).

prEN 16798-9: Energy performance of buildings – Module M4-1 – Ventilation for buildings – Calculation methods for energy requirements of cooling systems – Part 9: General.

prEN 16798-11: Energy performance of buildings – Module M4-3 – Calculation of the design cooling load.

prEN 16798-13: Energy performance of buildings – Module M4-8 – Ventilation for buildings – methods for the calculation of the energy performance of cooling systems – Part 13: Generation.

prEN 16798-15: Energy performance of buildings – Module M4-7 – Calculation of cooling systems – Part 15: Storage – General.

The documents with the even numbers are the accompanying technical reports going along with the standards. As can be seen in the titles, the standards are designed to cover specific modules in the modular structure. This is also shown in **Table 1**.

Figure 1 shows a schematic view of a ventilation and cooling system with the areas that are covered by the different standards. It also includes reference to the two standards from CEN TC 228 which have been agreed to cover cooling issues: these are prEN 15316-2 for the emission of water based cooling systems and prEN 15316-3 for the distribution of water based cooling systems.

Ventilation standards

Emission

The ventilation related systems and standards are indicated in green in **Figure 1**. The start of the calculation of ventilation systems is in the occupied space and is described in prEN 16798-7, the former EN 15242. This standard was changed to fully cover module M5-5 "emission". For this, it was extended to include:

- the calculation of air flow rates also for mechanical ventilation system, including VAV systems;

- the required conditions of the supply air (depending on system type and control).

For required air flow rates there is a reference to prEN 16798-1 (EN 15251 rev.) and for the definition of the ventilation effectiveness to prEN 16798-3 (EN 13779 rev.). The parts on the leakage of distribution systems were moved to prEN 16798-5. The accompanying Technical Report and spreadsheet are available, see [4], [5].

Distribution and generation

In the course of development of prEN 16798-5, which is intended to cover a number of modules in the areas of distribution, i.e. the duct system, and "generation", which for the ventilation and air conditioning service is meant to be the air handling unit (AHU), including humidification and dehumidification, it was decided to divide the work item into two separate documents because the scope of the two calculation methods is different:

- Part 5-1 describes a detailed method for ventilation and air conditioning systems and uses an hourly calculation step. It is a comprehensive calculation of all aspects of AC systems. The accompanying TR is available [6].
- Part 5-2 is a simplified method for compact systems, based on a proposal from TC 156 WG 2 (the residential ventilation working group). It uses a monthly calculation step and includes heat generation (like air-to-air heat pumps) and domestic hot water heating. It does, on the other hand, not cover the full range of technologies which are contained in part 5-1. Although it is

Table 1. Areas of the modular structure covered by the CEN TC 156 standards.

Overarching		Technical Building Systems					
	Descriptions		Descriptions	Cooling	Ventilation	Humidification	Dehumidification
sub1	M1	sub1		M4	M5	M6	M7
1	General	1	General	prEN 16798-9	prEN 16798-3		
2	Common terms and definitions; symbols, units and subscripts	2	Needs				
3	Applications	3	Maximum Load and Power	prEN 16798-11			
4	Ways to Express Energy Performance	4	Ways to Express Energy Performance	prEN 16798-9	prEN 16798-3		
5	Building Functions and Building Boundaries	5	Emission & control		prEN 16798-7	prEN 16798-5	prEN 16798-5
6	Building Occupancy and Operating Conditions prEN 16798-1	6	Distribution & control		prEN 16798-5		
7	Aggregation of Energy Services and Energy Carriers	7	Storage & control	prEN 16798-15			
8	Building Partitioning	8	Generation & control	prEN 16798-13	prEN 16798-5	prEN 16798-5	prEN 16798-5
9	Calculated Energy Performance	9	Load dispatching and operating conditions				
10	Measured Energy Performance	10	Measured Energy Performance				
11	Inspection	11	Inspection	prEN 16798-17	prEN 16798-17	prEN 16798-17	prEN 16798-17

primarily dedicated to residential systems, the scope is intentionally not restricted to these, since there are many non-residential applications with smaller units of this type. A separate TR and a spreadsheet are available [8], [9].

Part 5-1 has a lot of options to be chosen, many of them being control options with a link to the building automation CEN TC 247, especially EN 15232 rev., which will be updated to reflect these options:

- Different air flow control types
- Supply air temperature and humidity control types
- Different types of heat recovery:
    - flat plate;
    - Rotary;
    - Pumped circuit.

  For the calculation there is a connection to product standards (EN 308, 13053), and it includes the aspects of
    - Control;
    - Frost protection;
    - Auxiliary energy consumption.
- Recirculation control
- Fan control
    - Several options, based on an input from CEN TC 247, different for single zone / multi zone systems; experience showed that this has a big impact on the fan energy consumption and was too optimistic in the current version of EN 15241;
    - Link to inputs from product standards (on fans, from WG 17 in TC 156).
- Ground preheating / -cooling
- Adiabatic cooling by humidification of extract air and heat recovery.

Figure 2 shows the scheme used for the explanation of the nomenclature in the standard, which is also used in the accompanying spreadsheet [7]. The latter is fully functional and covers all options offered in the standard. In order to ease its use, the options choices are given in drop down menus as shown in **Figure 2**.

Cooling calculation standards

General

The core of the cooling related calculation standards is prEN 16798-9, the "general" part, which is supposed to be the revision of the current EN 15243. However, not much of the content of the latter remained in the new draft: some parts were moved to other standards (such as the cooling load related issues to prEN 16798-11 or the generation related information, as far as normative, to prEN 16798-13). A big part of the content was in informative annexes, and some remaining part of this was moved to the accompanying prCEN TR 16798-10 [10].

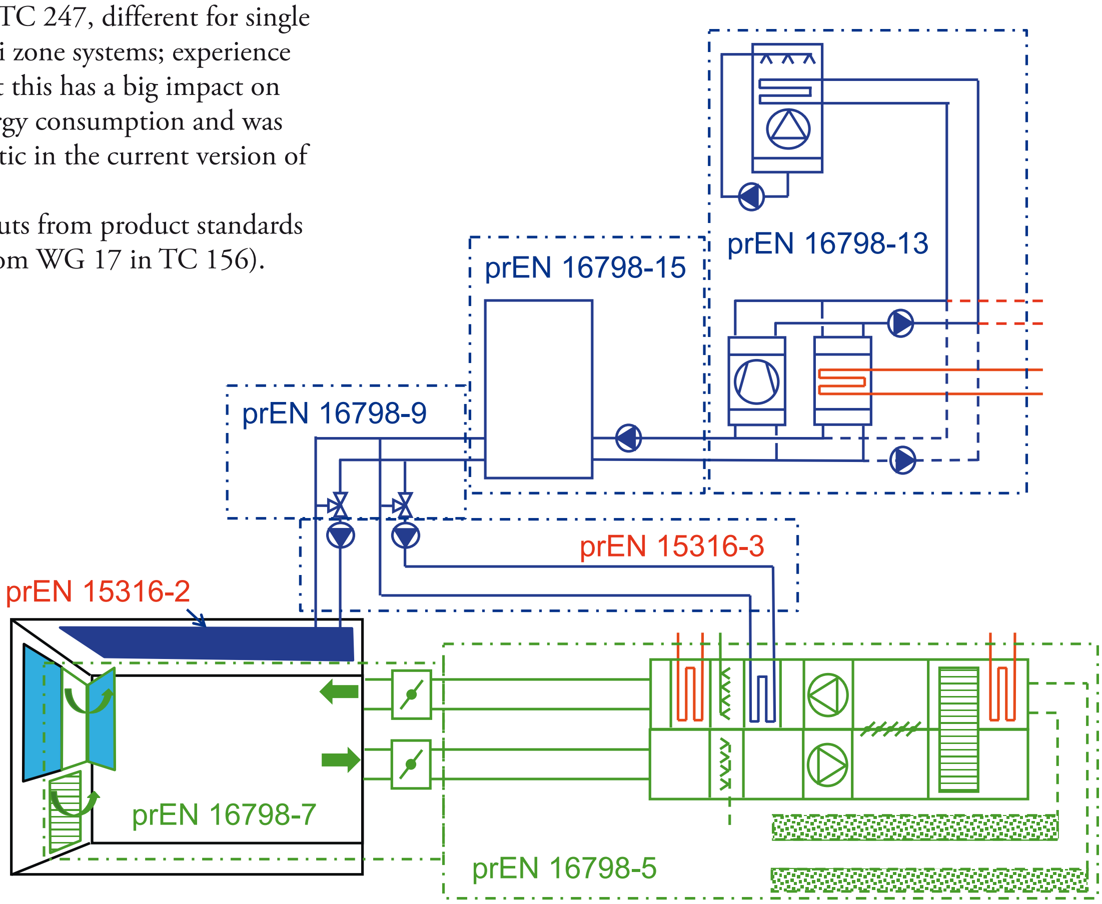


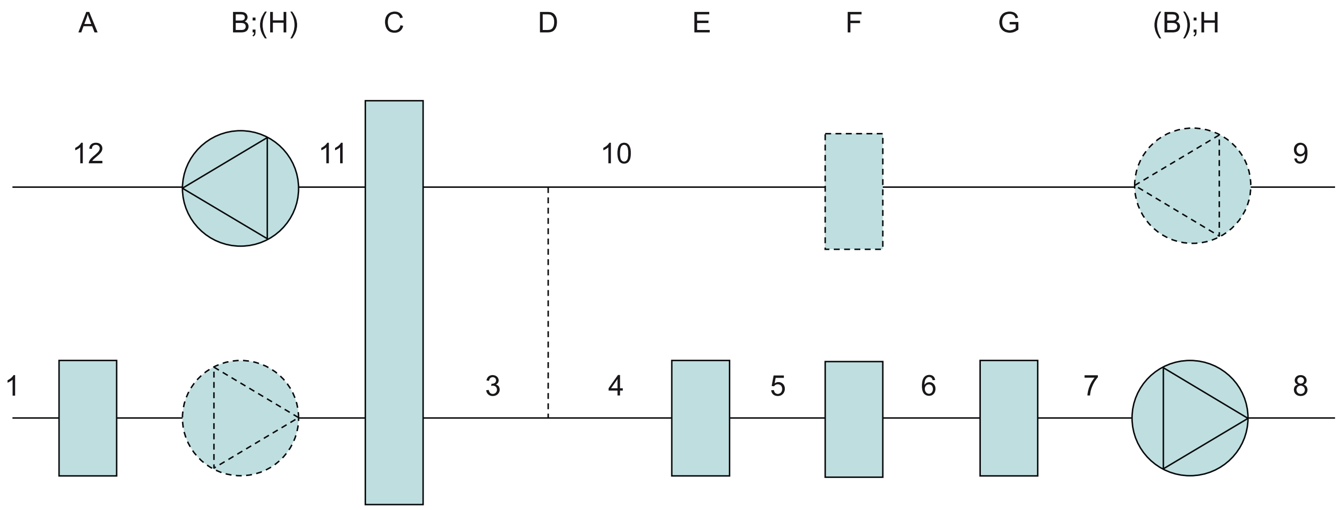
Figure 1. System schematic with the covered areas of the different standards.

Similar to prEN 15316-1, the general part of the heating and DHW calculation standards, part 9 connects the calculation pieces of the other standards for emission, distribution, storage and generation to a complete system, considering the flow rate and temperature control of the distribution branches and the load dispatching in case of insufficient energy supplied by the generation system. It follows (as the other parts do) the principle (agreed by the CEN TC 371 CTL), that a subsequent energy using module reports the **required** energy supply to the delivering module per calculation interval, and this in turn reports the energy **really delivered**, based on its operational conditions, back to the using module per calculation interval.

Figure 3 shows the schematic representation from the standard, illustrating the boundaries of the involved modules and the nomenclature used in the standard.

As already mentioned, modules M4-5 and M4-6 are supposed to be covered by the TC 228 standards prEN 15316-2 and 3. The (non-exhaustive) system shown in **Figure 3** with a generation, storage and two distribution branches, each serving two thermal zones and one air handling unit, is exactly represented in the spreadsheet going along with the standard [11]. In this spreadsheet, a full annual data set of hourly values is implemented to test the calculation. This also to test the partial performance indicator calculation as mentioned below. Apart from the water based systems shown above, the standard also addresses direct expansion (DX) systems. In this case the calculation becomes generally simpler. A schematic representation is given in the accompanying TR [10].

Part 9 also covers module M4-4 with two partial performance indicator proposals for cooling systems:



General	A	B	C	D	E	F	G	H
Volume flow rates Detailed	Frost protection / ground preheating/-coo-ling	Exhaust air fan	Heat recovery	Recirculation	Cooling / dehumidification	Humidification	Heating	Supply fan
Air handling unit localosation	Ground air preheating and -cooling	localisation	Heat recovery type			Humidifier type		Fan motor localisation
NC	else	DOWN_HR	ROT_SORBT	yes		CONTACT		OUTS_AIR
Supply air temperature control	Frost protection type		only for FLAT_PLATE and ROT_HYG	Recirculation control		humidifier control		System type for variable air volume flow rate fan energy calculation
ODA_COMP	PREH		-	VARIABLE		SPEED		SINGLE_ZONE
Control of the volume flow rate	Control of the frost protection		Control of the heat recovery device			Adiabatic cooling		Control of the fan
VARIABLE	INDIRECT		SPEED					DIRECT
								localisation
								DOWN_HR

Figure 2. Ventilation/AC-system scheme and technology choice options in prEN 16798-5-1.

The annual efficiency of the total cooling system can be calculated with **Equation (1)** and the annual efficiency of the cooling generation system with **Equation (2)**.

An issue of importance repeatedly mentioned by stakeholders is ventilative cooling, i.e. cooling by enhanced natural and/or mechanically assisted ventilation. This cannot be covered by one standard; since it involves the thermal zone calculation as well as flow rate calculations and control issues. Therefore, a description of the necessary procedure, the modules involved and the information flow is given in the accompanying TR [10]. The respective scheme is shown in **Figure 4**.

Generation

prEN 16798-13 is a new standard for the cooling generation calculation, which was until now covered only in an informative annex of EN 15243. It contains 2 Methods:

- Method A for an hourly calculation step;
- Method B for a monthly calculation step.

$$\eta_{C;tot;an} = \frac{\sum_{t_{ci}}\sum_{i}\left(\sum_{j} Q_{C;zt,j;i} + \sum_{k} Q_{C;ahu,out;k;i}\right)}{\sum_{t_{ci}}\left(E_{C;gen;el;in} + Q_{H;C;gen;abs;in} + W_{C;aux;gen} + W_{C;aux;sto} + \sum_{i} W_{C;aux;dis;i} + \sum_{i}\sum_{j} W_{C;aux;em;j;i}\right)} \quad \textbf{(1)}$$

$$\eta_{C;gen;an} = \frac{\sum_{t_{ci}} Q_{C;dis;in}}{\sum_{t_{ci}}(E_{C;gen;el;in} + Q_{H;C;gen;abs;in} + W_{C;aux;gen})} \quad \textbf{(2)}$$

Where:

t_{ci} = Calculation interval [h]
$E_{C;gen;el;in}$ = Electric energy input to the cooling generation [kWh]
$Q_{H;C;gen;abs;in}$ = Heat input to the absorption cooling generation [kWh]
$W_{C;aux;gen}$ = Auxiliary energy input to the cooling generation [kWh]
$W_{C;aux;sto}$ = Auxiliary energy input to the cooling storage [kWh]
$W_{C;aux;em;j;i}$ = Auxiliary energy input to the cooling emission in zone j of distribution system i [kWh]

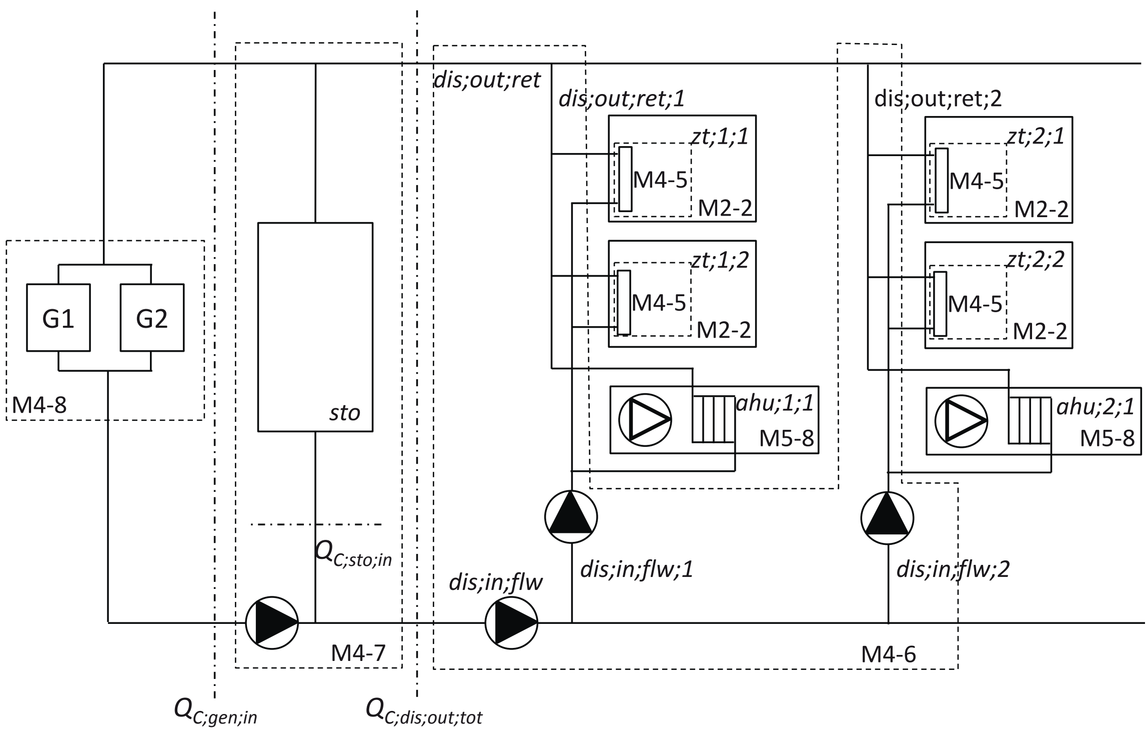


Figure 3. Cooling system scheme with module boundaries and nomenclature given in prEN 16798-9.

The technologies covered in both methods are

- Compression and absorption chillers;
- Place holder for "other" type of generator, being used for direct use of boreholes, ground or surface water;
- Multiple generators handling;
- "Free cooling" control option, i.e. direct cooling via heat rejection device
- Different Heat rejection types:
  - Air cooled condensers;
  - Dry, wet and hybrid heat recovery devices;
  - Control options for the heat rejection (e.g. switch between dry and wet operation for hybrid heat rejectors);

In method A, there is a connection to product standards for compression chillers: A performance map is used, which is generated on the base of the measurement points from EN 14511 tests, which are used in EN 14825 for the calculation of the SEER. However, the 4 measurement points are not sufficient; a fifth point outside the range of the four is needed. Discussions with manufacturers have shown that there is willingness in the industry that more data shall be made available.

An accompanying TR [12]and two separate spreadsheets for the two methods ([13] and [14]) are available for this standard.

Storage

A new standard prEN 16798-15 was developed for the calculation of cooling storage systems. This was done in close collaboration with TC 228, to ensure the same philosophy as for heating and DHW storage calculation. The method is applicable to any calculation time step and covers different storage types:

- Water tanks
- Ice storage
- Phase change materials (PCM)

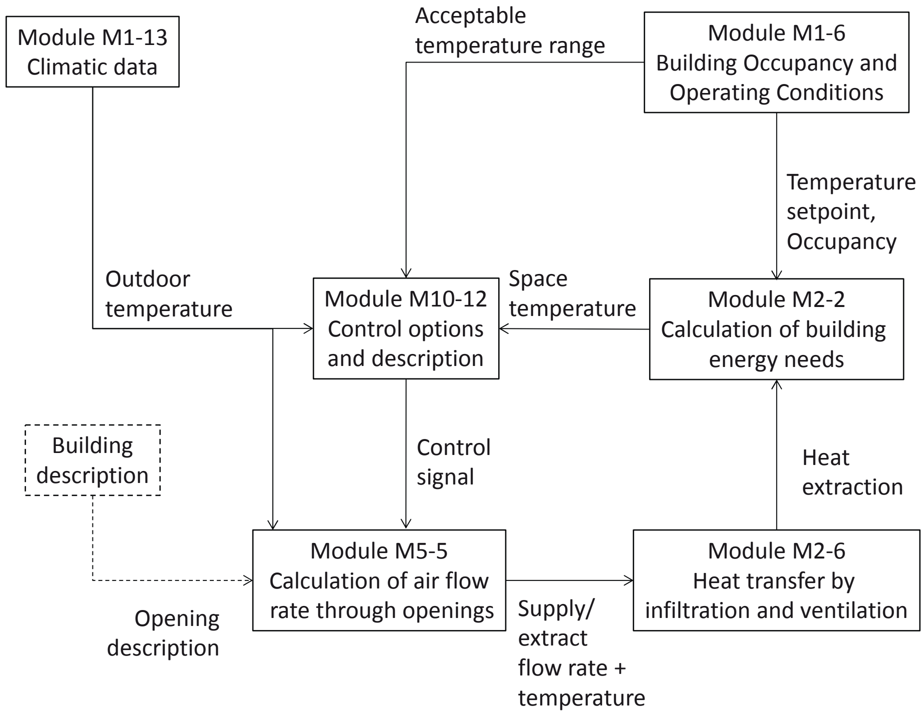


Figure 4. Scheme from prCEN TR 16798-10 for the calculation of ventilative cooling.

The calculation of the storage charging circuit is included in the standard, as shown in **Figure 3**. There is an accompanying TR [15] and a spreadsheet for PCM devices [16] available.

Outlook

All standards of the prEN 16798 family are in public enquiry until April 2015. ■

References

[1] See separate article from Bjarne W. Olesen in this issue.

[2] See separate article from Claus Händel in this issue.

[3] See separate article from Rémi Carrié in this issue.

[4] CEN/TC 371 N377 – CEN/TC 156 N1281 – prCEN TR 16798-8 WD.

[5] CEN/TC 371 N378 – CEN/TC 156 N1282 – prEN 16798-7 spreadsheet.

[6] CEN/TC 371 N379 – CEN/TC 156 N1283 – prCEN TR 16798-6-1 WD.

[7] CEN/TC 371 N380 – CEN/TC 156 N1284 – prEN 16798-5-1 spreadsheet.

[8] CEN/TC 371 N398 – CEN/TC 156 N1302 – prCEN TR 16798-6-2 WD.

[9] CEN/TC 371 N397 – CEN/TC 156 N1301 – prEN 16798-5-2 spreadsheet.

[10] CEN/TC 371 N381 – CEN/TC 156 N1285 – prCEN TR 16798-10 WD.

[11] CEN/TC 371 N382 – CEN/TC 156 N1286 – prEN 16798-9 spreadsheet.

[12] CEN/TC 371 N383 – CEN/TC 156 N1287 – prCEN TR 16798-14 WD.

[13] CEN/TC 371 d N384 – CEN/TC 156 N1288 – prEN 16798-13 method A spreadsheet.

[14] CEN/TC 156 WG21 N93–M4-8_ prEN 16798-13 –Cooling-generation-draft-method B spreadsheet.

[15] CEN/TC 371 N351 – CEN/TC 156 N1255 – prCEN TR 16798-16 WD.

[16] CEN/TC 156 N1241 – prEN 16798-15 PCM spreadsheet.

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

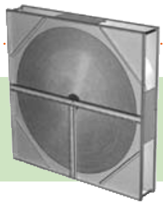
- Certification manual
- Operational Manual OM-8
- Rating Standard RS 8/C/001

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

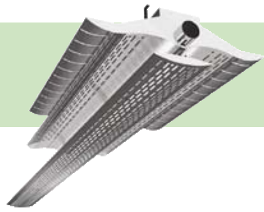
- Certification manual
- Operational Manual OM-10
- Rating Standard RS 8/C/002

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)
- Auxiliary 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 m³/s and a published external static duct pressure at 40 Pa maximum.
- Ducted units: Fan Coil Units up to 1 m³/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%

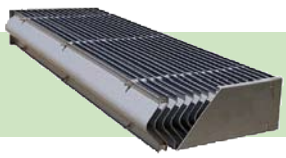
ECC Reference documents

- 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)

CERTIFY ALL

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

CERTIFY ALL

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

CERTIFY ALL

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

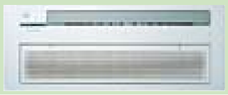
Thermal performance:

- 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

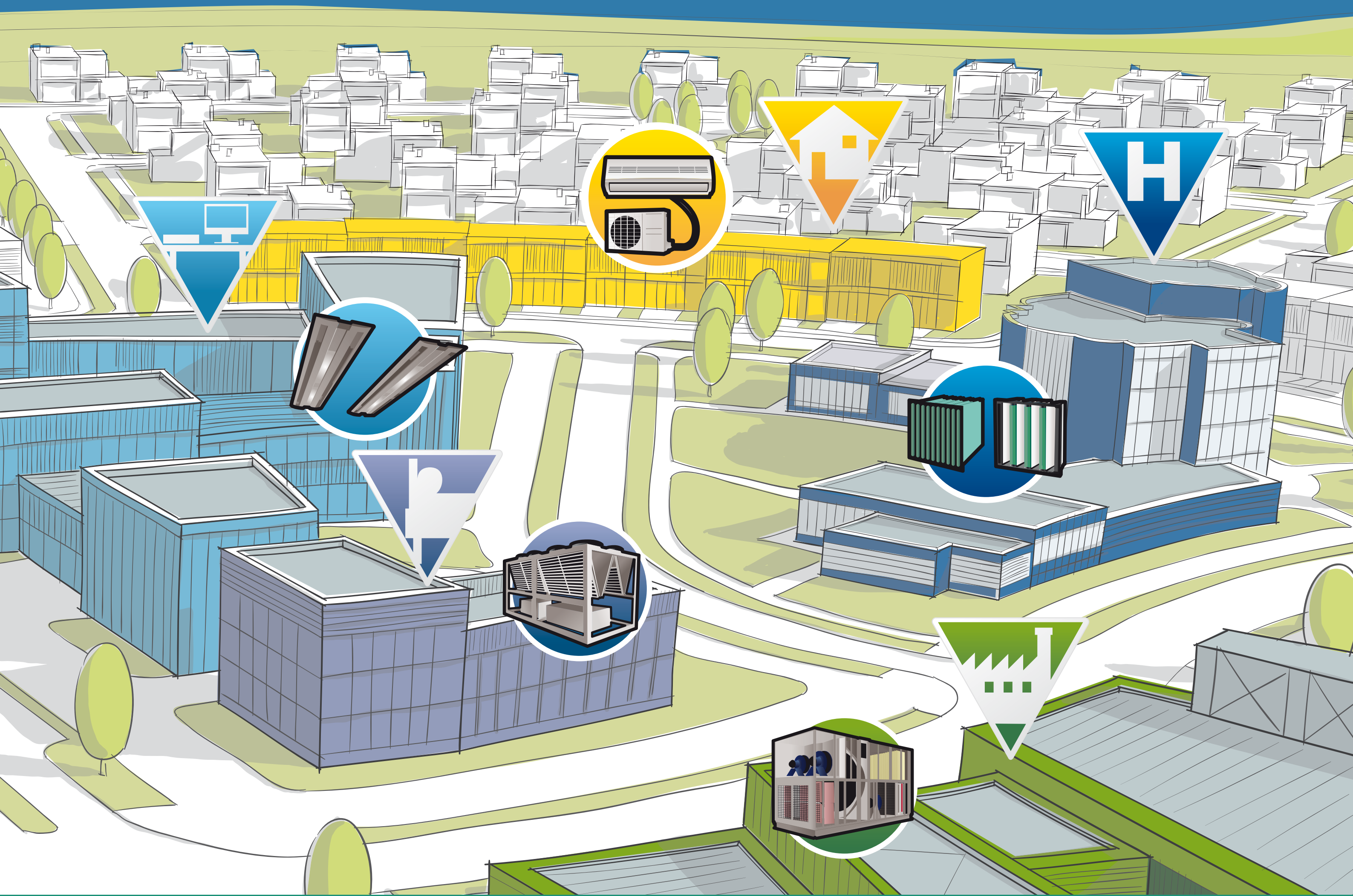
ECC Reference documents

- 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 ?



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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

Indoor environmental input parameters for the design and assessment of energy performance of buildings

The first international standard that dealt with all indoor environmental parameters (thermal comfort, air quality, lighting and acoustic) was published in 2007 as EN15251. This standard prescribed input parameters for design and assessment of energy performance of buildings and was a part of the set of standards developed to support the implementation of the Energy Performance of Buildings Directive in Europe. The standard has now been revised and issued for public comments with a new number: prEN16798-1.

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Besides the standard, a Technical Report 16798-2 is also being developed to support and explain the standard in more details. The standard is now written in normative language and should be clearer as all the informative text will be included in the technical report. The standard does include default criteria in 3-4 categories (**Table 1**) for the indoor environmental parameters, as described in this paper. It is however in a series of tables in an informative annex B. Individual countries can decide if they want to use these default values, only use one category, or use quite different values, which will be included in a normative national annex A with similar structure as annex B.

It is important to emphasis that the requirements and default criteria are based on the influence on the occupants and the standard do not set direct criteria depending on the type of system (mechanical or non-mechanical) used for conditioning the space.

Table 1. Description of the applicability of the categories used.

Category	Explanation
I	High level of expectation and also recommended for spaces occupied by very sensitive and fragile persons with special requirements like some disabilities, sick, very young children and elderly persons, to increase accessibility.
II	Normal level of expectation
III	An acceptable, moderate level of expectation
IV	Low level of expectation. This category should only be accepted for a limited part of the year

The draft technical report TR16798-2 will include guidance to the standard in similar sections as the standard. The TR includes also some additional sections and annexes with more voluntary concepts and methods as described in this paper.

In parallel two similar documents ISO-CD17772 and ISO-DTR17772 are being developed as almost identical documents. At a later stage it may be possible to combine these standards to one EN-ISO standard. The entire mentioned document will be available for comments during the first couple of months in 2015.

In the following section some of the highlights and especially what is new will be described.

Thermal Environment

The sections for thermal environment are almost identical to the existing standard. Criteria for both mechanical and non-mechanical heated, cooled and ventilated buildings are included. An addition is the criteria for local thermal discomfort based on EN ISO 7730 including draught, vertical air temperature differences, and radiant thermal asymmetry and floor surface temperatures. These criteria do not influence the calculation of energy performance; but will influence the design of the building and heating, cooling, and ventilation systems.

In the standard personalized systems have been introduced as a new part; but without any default criteria. However an annex in the TR gives some examples on how criteria for personalized systems could be expressed (see **Table 2**).

Table 2. Example criteria for personalized systems.

Aspect	Requirement
'Temperature' control winter	At workstation level, the (operative/equivalent) temperature is adjustable with a response speed of at least 0,5 K / minute within a range of 5 K, from 18 to 23 °C.
'Temperature' control summer	At workstation level, the (equivalent) temperature is adjustable (with a response speed of at least 0,5 K / minute within a range of 5 K, from 22 to 27 °C.
Fresh air supply control	Local fresh air supply (per workstation) is adjustable from around 0 to at least 7 l/s.
Delivered air quality	For requirements related to air cleaning technology: see Annex K.
Installation noise	Noise level - with the personalized system in the highest setting - should not be higher than 35 dB(A).

Air Quality

The standard does include some new aspects related to indoor air quality. Like in the existing standard the requirements to indoor air quality is mainly expressed as a required minimum ventilation rate. The general requirements for the designer regarding the indoor air quality is the same for residential and non-residential buildings.

Design parameters for indoor air quality shall be derived using one or more of the following methods:

- Method based on perceived air quality
- Method using criteria for pollutant concentration
- Method based on pre-defined ventilation air flow rates

Within each method, the designer shall choose between different categories of indoor air quality and define which building category is to be used. The method used shall be documented and it must be explained why the selected method is appropriate.

Method based on perceived air quality

The total ventilation rate for the breathing zone is found by combining the ventilation for people and building calculated from the following formula.

$$q_{tot} = n \cdot q_p + A_R \cdot q_B \qquad \text{Eq (1)}$$

Where

q_{tot} = total ventilation rate for the breathing zone, l/s
n = design value for the number of the persons in the room, –
q_p = ventilation rate for occupancy per person, l/s·per person
A_R = floor area, m^2
q_B = ventilation rate for emissions from building, l/s per m^2

The basic tables with default values are **Table 3** and **Table 4**. The perceived air quality levels are set for non-adapted persons. If in special cases the design will include adapted persons see TR16798-2. A new criteria is that the total ventilation rate must never be lower than 4 l/s per person.

A building is by default a low-polluting building unless prior activity has resulted in pollution of the building (e.g. smoking). In this case, the building shall be regarded as non-low polluting. The category very low-polluting

Table 3. Design ventilation rates for non-adapted persons for diluting emissions (bioeffluents) from people for different categories.

Category	Expected Percentage Dissatisfied %	Airflow per non-adapted person l/s per person
I	15	10
II	20	7
III	30	4
IV	40	2,5*

* Category IV is intended for the evaluation of IAQ in existing buildings where the space for installations are limited.

Table 4. Design ventilation rates for diluting emissions from different type of buildings.

Category	Very low polluting building l/s per m²	Low polluting building l/s per m²	Non low-polluting building l/s per m²
I	0,5	1,0	2,0
II	0,35	0,7	1,4
III	0,2	0,4	0,8
IV	0,15	0,3	0,6
Minimum total ventilation rate for health	4 l/s per person	4 l/s per person	4 l/s per person

requires that the majority of building materials used for finishing the interior surfaces meet the national or international criteria of very low-polluting materials. An example of how to define very low-polluting building materials is given in Annex B3 of the standard.

The technical report will show tables with default values based on the two tables above and an assumed density of occupants. An example is given here in **Table 5**.

As mentioned above the technical report is also discussing a possible design for adapted persons i.e. persons that have occupied the space for more than 15 minutes and then adapted to the odour level of bioeffluent from the occupants. This may be relevant for spaces like conference rooms and auditorium, where people enter at the same time. The odour level will increase (perceived air quality decrease); but at the same time the occupants adapt to the odour level in the space and the lower ventilation and level of perceived air quality acceptable. This is as example the basis for the minimum ventilation rates given in ASHRAE standard 62.1. In the present standard prEN16798-1 the criteria of a total ventilation of minimum 4 l/s person must be fulfilled. It can be seen in **Table 5** that only in a few cases the criteria of 4 l/s person will be used and only for category 4. On the other hand if the ventilation rate is designed for adapted occupants the criteria of minimum 4 l/s person is used in all cases except for Category I. The values in italics indicate situations where the calculated ventilation rate is lower than the minimum value of 4 l/s per person required for health.

Method using criteria for pollutant concentration

The ventilation rate required to dilute a pollutant shall be calculated by this equation:

$$Q_h = \frac{G_h}{C_{h,i} - C_{h,o}} \cdot \frac{1}{\varepsilon_v} \qquad \text{Eq (2)}$$

Where:

Q_h = the ventilation rate required for dilution, in litre per second;

G_h = the pollution load of a pollutant, in micrograms per second;

$C_{h,i}$ = the guideline value of a pollutant, see Annex B6 , in micrograms per m³;

$C_{h,o}$ = the supply concentration of pollutants at the air intake, in micrograms per m³;

ε_v = the ventilation effectiveness

NOTE. $C_{h,i}$ and $C_{h,o}$ may also be expressed in ppm (vol/vol). In this case the pollution load G_h has to be expressed in l/s.

To calculate the design ventilation air flow rate from Eq. (2), the most critical or relevant pollutant (or groups of pollutant) shall be identified and the pollution load in the space shall be estimated. When this method is used it is required that CO_2 representing the pollutant emission from people (bio effluents) shall be used as one of the gases. Values depending on the category of indoor

Table 5. Non-adapted persons. Examples of recommended ventilation rates for non-residential buildings with default occupant density for three categories of pollution from the building.

Type of building or space	Cate-gory	Floor area m² per person	q_p	q_p	q_B	q_{tot}		q_B	q_{tot}		q_B	q_{tot}	
			minimum ventilation rate										
			l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person
			for occupancy only		for very low-polluted building			for low-polluted building			for non-low polluted building		
Single office	I	10	1	10	0,5	1,5	15	1	2,0	20,0	2	3,0	30
	II	10	0,7	7	0,35	1,1	11	0,7	1,4	14,0	1,4	2,1	21
	III	10	0,4	4	0,2	0,6	6	0,4	0,8	8,0	0,8	1,2	12
	IV	10	0,25	2,5	0,15	0,4	4	0,3	0,6	5,5	0,6	0,9	9
Land-scaped office	I	15	0,7	10	0,5	1,2	18	1	1,7	25,0	2	2,7	40
	II	15	0,5	7	0,35	0,8	12	0,7	1,2	17,5	1,4	1,9	28
	III	15	0,3	4	0,2	0,5	7	0,4	0,7	10,0	0,8	1,1	16
	IV	15	0,2	2,5	0,15	0,3	5	0,3	0,5	7,0	0,6	0,8	12
Confe-rence room	I	2	5	10	0,5	5,5	11	1	6,0	12,0	2	7,0	14
	II	2	3,5	7	0,35	3,9	8	0,7	4,2	8,4	1,4	4,9	10
	III	2	2	4	0,2	2,2	4	0,4	2,4	4,8	0,8	2,8	6
	IV	2	1,25	2,5	0,15	(1,4) 1,8	(3) 4	0,3	(1,6) 2	(3,1) 4	0,6	1,9	4
Audito-rium	I	0,75	13,3	10	0,5	13,8	10	1	14,3	10,8	2	15,3	12
	II	0,75	9,3	7	0,35	9,7	7	0,7	10,0	7,5	1,4	10,7	8
	III	0,75	5,3	4	0,2	5,5	4	0,4	5,7	4,3	0,8	6,1	5
	IV	0,75	3,3	2,5	0,15	(3,5) 4.7	(3) 4	0,3	(3,6) 5,3	(2,7) 4	0,6	(3,9) 4,7	(3) 4

Table 6. Adapted persons. Examples of recommended ventilation rates for non-residential buildings with default occupant density for three categories of pollution from building itself.

Type of building or space	Cate-gory	Floor area m² per person	q_p		q_B	q_{tot}		q_B	q_{tot}		q_B	q_{tot}	
			Adapted q_p according to table B1										
			l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person	l/s per m²	l/s per m²	l/s per person
			for occu-pancy		for very low-polluted building			for low-polluted building			for non-low polluted building		
Confe-rence room	I	2	1,75	3,5	0,5	2,25	4,5	1	2,75	5,5	2	3,75	7,5
	II	2	1,25	2,5	0,35	1,60	(3,2)4	0,7	1,95	(3,9)4	1,4	2,65	5,3
	III	2	0,75	1,5	0,3	1,05	(2,1)4	0,4	1,15	(2,3)4	0,8	1,55	(3,1)4
	IV	2	0,50	1	0,25	0,75	(1,5)4	0,3	0,80	(1,6)4	0,6	1,10	(2,2)4
Audito-rium	I	0,75	4,67	3,5	0,5	5,17	(3,9)4	1	5,67	4,3	2	6,67	5,0
	II	0,75	3,33	2,5	0,35	3,68	(2,8)4	0,7	4,03	(3,0)4	1,4	4,73	(3,6)4
	III	0,75	2,00	1,5	0,3	2,30	(1,7)4	0,4	2,40	(1,8)4	0,8	2,80	(2,1)4
	IV	0,75	1,33	1	0,25	1,58	(1,2)4	0,3	1,63	(1,2)4	0,6	1,93	(1,5)4

air are defined for CO_2 in Annex B2 of the standard. Threshold values, based on WHO, for other sources are listed in Annex B6. Emission rates and outdoor concentrations for the gases considered shall be defined based on material testing or certification (see Annex B3 of the standard) and local ambient air quality values.

Method based on pre-defined ventilation air flow rates

This is a method to determine certain pre-defined minimum ventilation air flow rate estimated to meet requirement for both perceived air quality and health in the occupied zone.

The pre-defined ventilation air flow rates shall be expressed by one or more of the following parameters:

- total design ventilation for people and building components (q_{tot});
- design ventilation per unit floor area (q_{m^2}); design ventilation per person (q_p);
- design air change rates (ach); design opening areas (A_{tot}).

Default values are presented in Annex B2 of the standard.

Design ventilation rates in residential buildings

Pre-defined ventilation air flow rates can be given on national level based on one or more of the following criteria: total air change rate for the dwelling, supply air flows for specific rooms, exhaust air flows from specific rooms. In Annex B2 of the standard the default values for the three criteria is shown (see **Table 7**). It is assumed that air is supplied in living rooms and extracted from wet rooms. Both the total air flow rate for the entire dwelling and the exhaust air flow rate from wet rooms shall be calculated. The higher of the two shall be used. In the technical report several examples on default ventilation rates in residential buildings are presented.

The standard is also describing concepts for natural ventilated building, where the criteria based on CO_2 could be used. In annex B2 a methodology for defining default design opening areas for natural ventilation systems in dwelling is presented (see **Table 8**). The opening areas must be provided as supply/extract grilles, stack ducts, window grilles, or similar system.

Table 7. Default criteria based on pre-defined ventilation air flow rates: Total ventilation (1), Supply air flow (2) and (3) supplemented by exhaust air flow.

Category	Total ventilation including air infiltration		Supply air flow per. person	Supply air flow based on perceived IAQ for adapted persons		Supply air flow for bedrooms	Exhaust air flow Peak or boost flow for high demand l/s		
	(1)		(2)	(3)		(4)			
	l/s per m²	ach	l/s per person	q_p l/s per person	q_B l/s per m²	l/s per person	Kitchen (3a)	Bath-rooms (3b)	Toilets (3c)
I	0,49	0,7	10	3,5	0,25	10	28	20	14
II	0,42	0,6	7	2,5	0,15	8	20	15	10
III	0,35	0,5	4	1,5	0,1	4	14	10	7
IV*	0,23	0,4				2,5*	10	6	4

Column 3 and 4: The ventilation air flow rates must be available when the rooms are occupied. The design can take into account that not all bedrooms are occupied at the same time, e.g. during daytime. The number of persons in bedroom depends on the size according to design criteria and building regulations.

* Category IV is intended for the evaluation of IAQ in existing buildings where the space for installations are limited.

Supply air flow for method 3 is based on eq (1).

Table 8. Default design opening areas for dwellings. Values for bedrooms and living rooms may be given per m² floor area or as fixed values per room.

	Extract Kitchen, bathrooms and toilets (cm²)	**Supply** Bedrooms and living rooms (cm²)
Default design opening area	100 per room	60 per room

Filtration and air cleaning

The standard is also setting up some requirements regarding the use of filtration and air cleaning. The influence of position of outdoor air intakes, filtration and air cleaning shall be considered according to prEN 16798-3 (revised EN13779) and the draft technical report TR 16798-2. If filtration and air cleaning is used the following points shall be considered:

- Reducing the amount of airborne pollutants (pollens, molds, spores, particles, dust) from the outdoor air intake by circulating the air through a filter.
- Circulating secondary air through a filter or other air cleaning technology to reduce the amount of pollutants in the air
- Reduce the concentration of odours and gaseous contaminants by circulating the secondary air or recirculating the return air (gas phase air cleaning)

Design guidelines on air cleaning and filtration are given in prEN16798-3 and ISO DIS 16814. How to partially substitute outside air by air cleaning is described in draft TR16798-2.

Lighting

To enable people to perform visual tasks efficiently and accurately, appropriate lighting shall be provided. The degree of visibility and comfort is wide ranging governed by activity type and duration of required lighting criteria for work places as specified in EN12464-1 and for sports lighting in EN 12193. For some visual tasks in buildings and spaces the required lighting default criteria are presented in Annex B4 to the standard. The design illuminance levels shall be obtained by means of daylight, electric light or a combination of both. For reasons of comfort and energy in most cases the use of daylight is preferred. This depends on factors like standard occupancy hours, autonomy (portion of occupancy time during which there is enough daylight), location of the building (latitude), amount of daylight hours during summer and winter, etcetera.

A new thing is the inclusion of a table with default values for daylighting as shown in **Table 9**.

Noise

Guidance for evaluation of noise at the design stage is found in EN 12354-part 5. The noise from building service systems may disturb the occupants and prevent the intended use of the space or building. The noise in a space shall be evaluated using A-weighted equivalent sound pressure level, normalized with respect to reverberation time to take into account the sound absorption of the room. Default values for three categories are then listed in the informative annex to the standard.

Occupant schedules for energy calculations

For energy calculations the result will depend very much on how the occupant schedules will be assumed. In this way it may be very difficult to compare same type of building if different occupant schedules have been used. Therefore the standard prEN16798-1 list several recommended occupant schedules for different type of spaces like residential, offices, schools, restaurant, meeting room, department store, etc. The schedules include criteria for the indoor environment based on the default values, time and level of occupancy and internal loads from other equipment. The criteria used for room temperatures, ventilation, and humidity are based on Category II and very low-polluted building. The internal loads from appliances are based on recent values from a study by REHVA.

Table 9. Daylight availability classification as a function of the daylight factor DCa,j of the raw building envelop opening and DSNA EN15193.

Vertical Facades Daylight factor DCa,j	Roof lights Daylight factor DSNA	Classification of daylight availability
DCa,j ≥ 6%	7% < DSNAa	Strong
6% > DCa,j ≥ 4%	7% > DSNA ≥ 4%	Medium
4% > DCa,j ≥ 2%	4% > DSNA ≥ 2%	Low
DCa,j < 2%	2% > DSNA ≥ 0%	None

a Values of DSNA > 10% should be avoided due to danger of overheating

Additional sections in the technical report

The following sections from the existing standard have all been moved to the technical report with only a few changes.

- Evaluation of the indoor environment and long term indicators
- Inspections and measurement of the indoor environment in existing buildings
- Classification and certification of the indoor environment.

Conclusions

With this revision a more concise standard will be available together with guidance in a technical report.

All criteria listed given as categories in an informative annex are default values. Individual countries may select other values or one category following the concept of the way the default values are expressed.

The inclusion of default occupant schedules will make the calculated energy performance more comparative between buildings. ■

References

[1] CEN/TC156/WG19/N84: prEN16798-1 Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics.

[2] CEN/TC156/WG19/N89: draft prCEN/TR 16798-2 WD :Guideline for using indoor environmental input parameters for the design and assessment of energy performance of buildings.

[3] prEN16798-3: Energy performance of buildings - Part 3: Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems; see also article Claus Händel.

Residential Air Handling Units

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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.

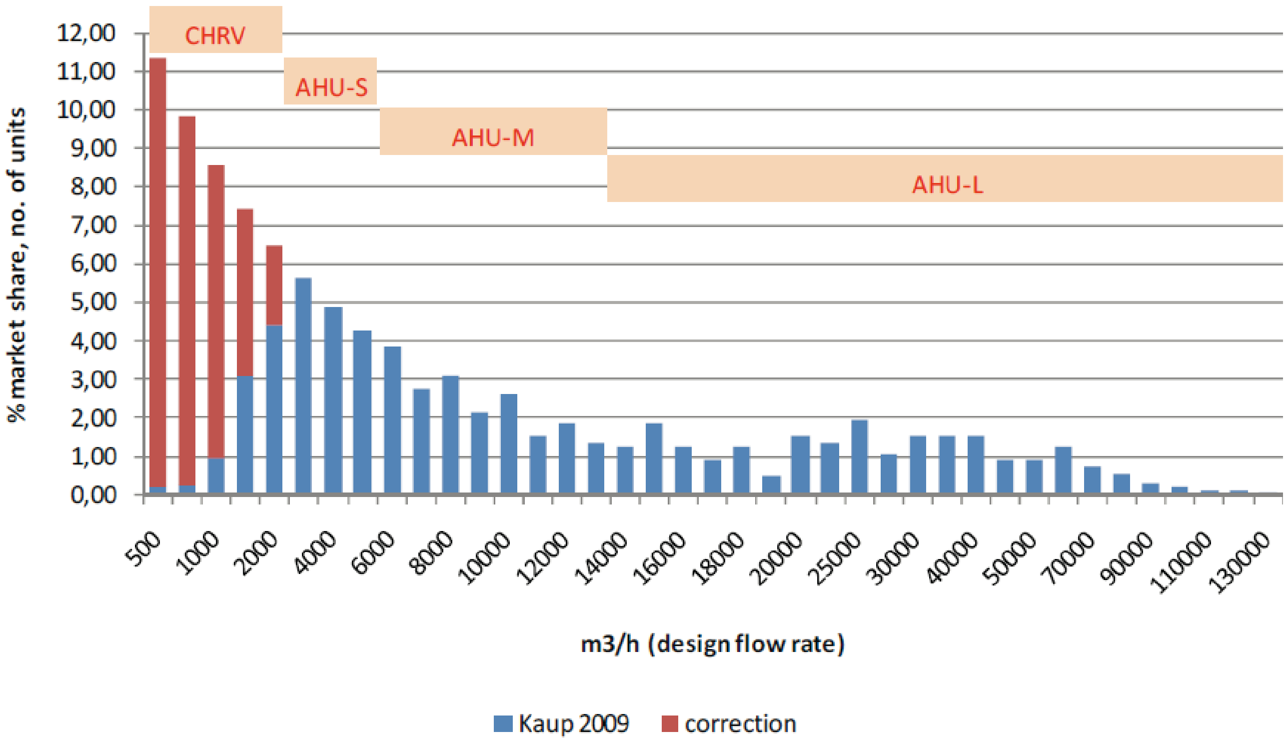

Figure 1. EU 2008 sales size distribution (from Fig 2-2 p21 in [1]).

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.

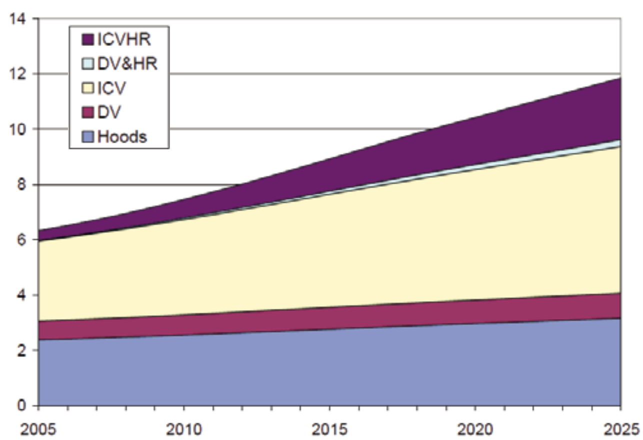

Figure 3. Projections to 2025, consumption estimate EU 25 for residential ventilation products Energy Consumption of ventilation systems in EU residential dwellings – Estimations (TWh) (from Fig 2-7 p58 in [2]).

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.

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 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.

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).

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

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.

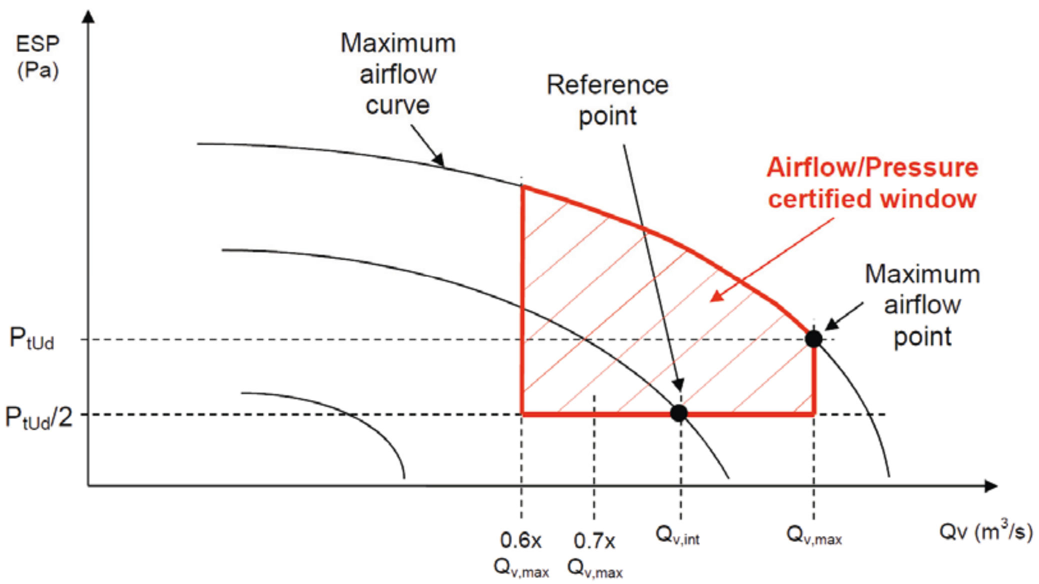

Figure 5. Definition of the airflow/pressure certified window.

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].

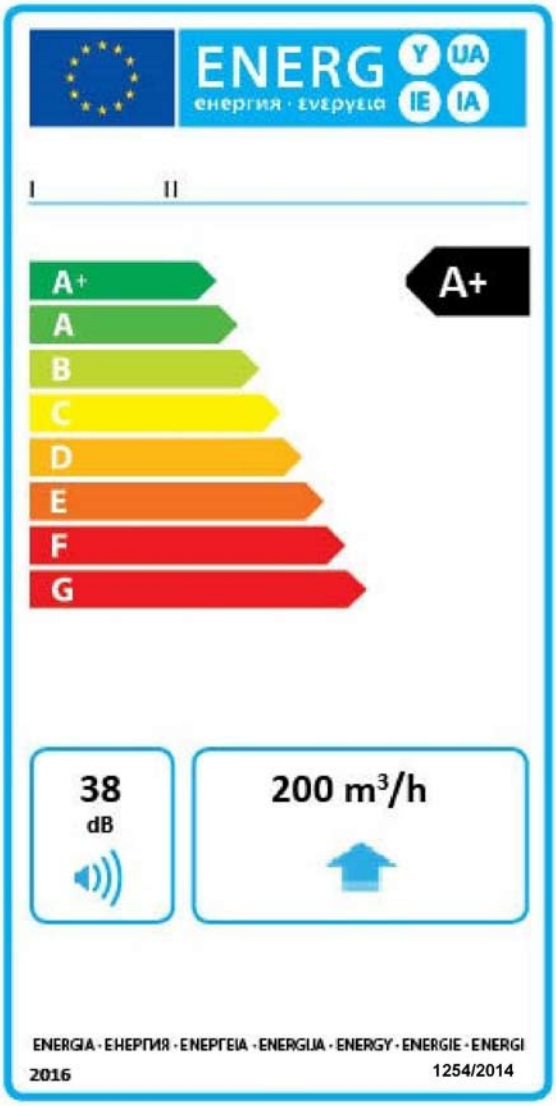

Figure 8. Label for balanced ventilation units after 1 January 2016 according to Energy labelling regulation No 1254/2014 [5].

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.

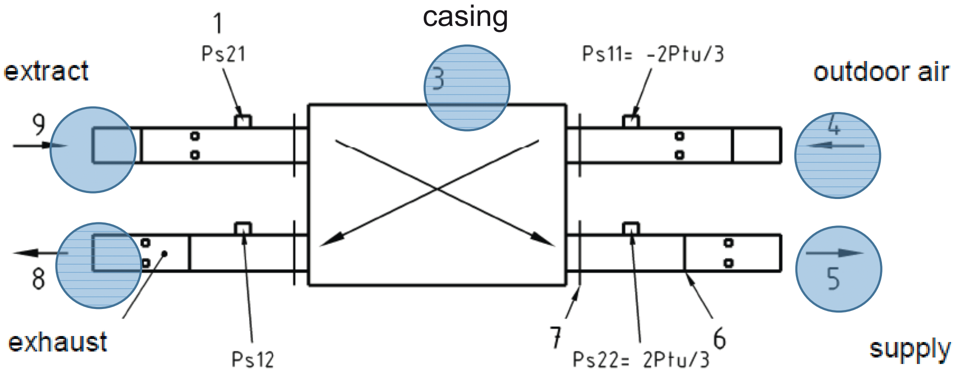

Figure 9. Sound power levels certified: Extract, Exhaust, Outdoor air, Supply and Casing.

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. ■

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[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.

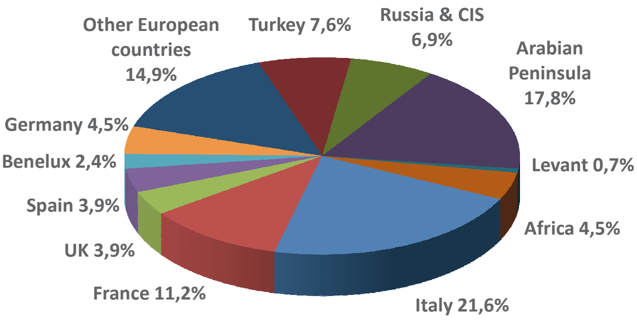
The HVAC&R market in the EMEA region in 2013/2014

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

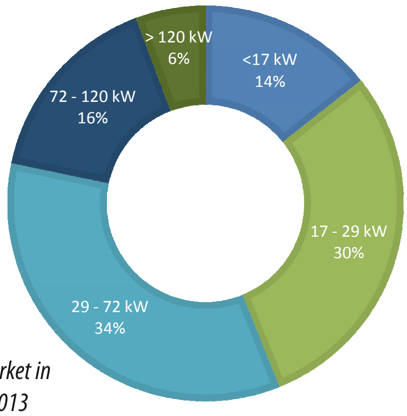
sales have remained modest, each with a market share of approximately 5%.

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

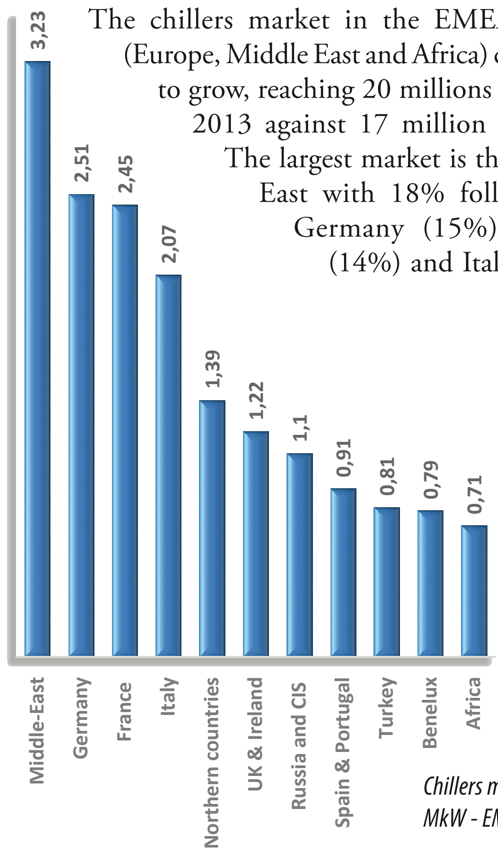
The rooftops market in the EMEA region amounts to about 60,000 units sold in 2013, that is 5% more than the previous year. The Middle East is still leading the way with more than 80% of the market share, then Africa coming in a distant second with 4.2% of the market. Within Europe, the market distribution 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

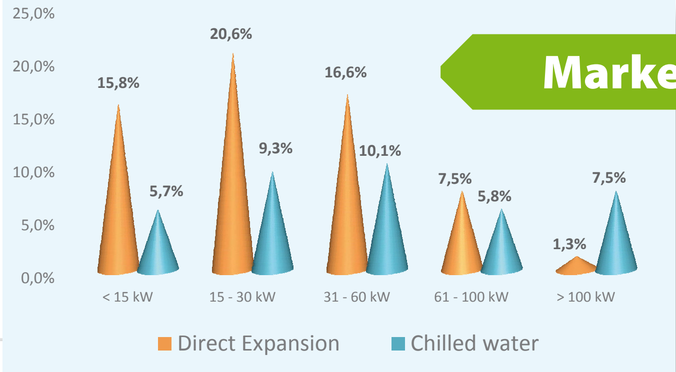
In the small-capacity category of under 50 kW, the majority of sales were concentrated in the South of Europe. Italy has played its card right with a market share reaching 45% and is followed by France with 13% and the Iberian Peninsula with 6%. A little further North is Germany, which has a respectable 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

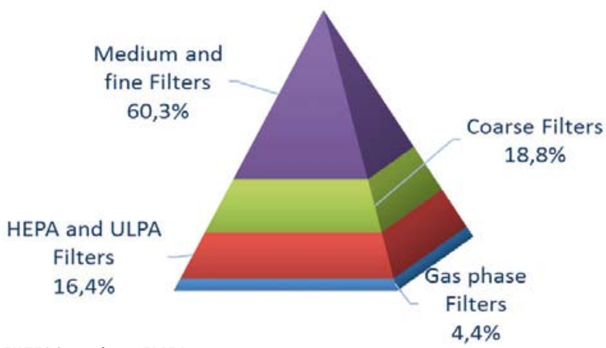
AHU market - EMEA 2013

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.

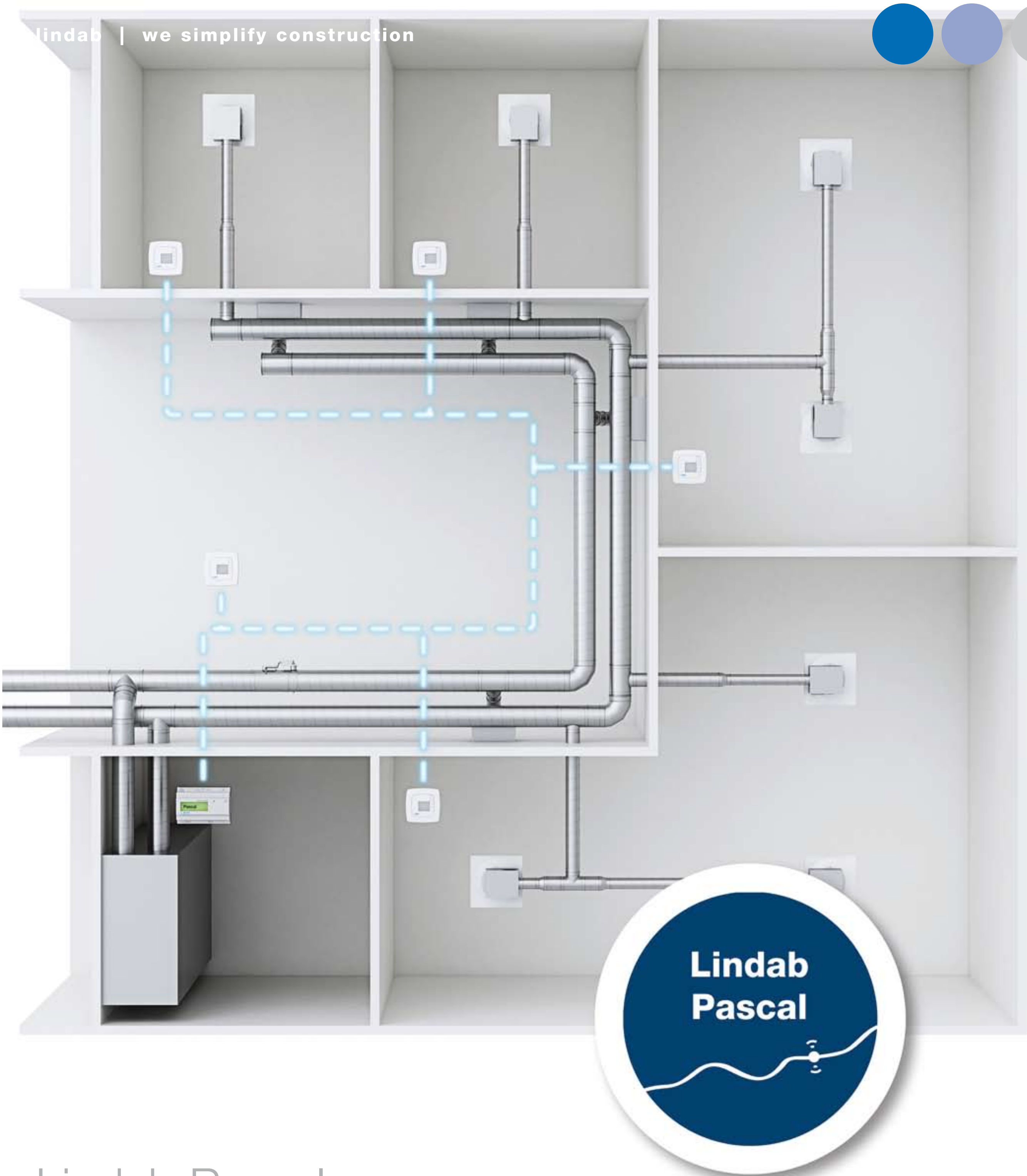
A good year for heat exchangers

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 ■



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…

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

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**.

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 CO_2e 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

ebtc

European Business and Technology Centre

A Platform for EU-India cleantech collaborations

The **European Business and Technology Centre (EBTC)** supports EU-India cleantech business and research collaborations in four key focus sectors – **Biotechnology, Energy, Environment** and **Transport,** with a presence pan India in the cities of **New Delhi, Mumbai, Bengaluru and Kolkata.**

A prime toolbox for EU and Indian businesses, researchers, clusters, and policy makers, EBTC has a portfolio of services to support cross-border collaboration at all levels – from comprehensive market information to help overcome market access issues including an IPR Helpdesk, to project and partner identification, strategic advisory services, business and technology incubation at the **European Technology Experience Centre (ETEC)**, and more. EBTC is also the lead consortium partner for the **Enterprise Europe Network India**.

Energy opportunities in India:

- India has set an ambitious target to reduce the energy intensity of its GDP by 20 to 25 % by 2020 through the National Mission on Enhanced Energy Efficiency (NMEEE).
- The Ministry of Power (MoP) estimates 23% is the potential to improve energy efficiency in the industrial & agricultural sectors.
- Trade Energy Savings Certificates (ESCerts) through the Perform-Achieve-Trade (PAT) Scheme covers 563 designated consumers across 8 industry sectors that consume 60% of the total energy, thus boosting energy efficiency measures.

EU technology collaborations facilitated by EBTC in India:

- **Aqua-Q AB (Sweden):** *A real time water quality monitoring device.*
- **Rafako (Poland):** *Circulating Fluidised Bed Boilers.*
- **NewEn (Italy):** *A software tool for energy efficiency applications.*
- **Ciel et Terre (France):** *A patented floating solar PV platform: The Hydrelio System.*
- **A series of EU-India Livestream events with CleanTuesday (France):** *A platform for technology pitches to audiences in Europe and India.*

Interested in energy opportunities in India? Connect with EBTC:

www.ebtc.eu | *info@ebtc.eu* | *@EBTC_EU*

EBTC.EU | *EBTCIndia* | *European Business and Technology Centre (EBTC)*

EBTC is a programme co-funded by the European Union and coordinated by EUROCHAMBRES

VDI- Standards published in December 2014

D VDI 2050/1.1 "Requirements for technical equipment rooms; Space for service shafts")

The standard VDI 2050 Part 1.1 arose because of the importance of an economic and a technically correct execution of installations of the systems of building services in the vertical circulation of the building. Problems arise often between the various trades in the planning, preparation of specifications for the design, the correct statement of the tendered services in consideration of legitimate requirements for additional remuneration due to increased assembly costs. For object planners the basic evaluation for the planning of buildings and their technical facilities are often lacking detail on minimum gross area requirements and/or minimum net area requirement of the installation areas. Therefore, necessary clearance for the use of tools, or to be considered measures of handling and for brackets in addition to the insulated pipe cross section often result to supplements in the assembly planning because of more difficult working conditions. Compensating for this, spaces for shafts are specified in this standard. The application of this standard helps to ensure a reasonable space planning in accordance with the acknowledged rules of technology.

C VDI 2053/1 "Air conditioning; Car parks; Exhaust ventilation"

This standard applies to ventilation and air-conditioning for garages. Garages are buildings, or parts of buildings, which are dedicated to the parking of motor vehicles. Medium-sized (100 square metres, up to 1000 square metres) and large garages (above 1000 square metres) with a closed building envelope require sufficient ventilation to ensure operation without health hazards. The application of this standard ensures that pollutant concentrations do not exceed the limits which are deemed acceptable. The described required protection is intended for short-term exposure only. The standard does not apply to automated garages, open garages and rooms where extended occupation by persons is intended.

D VDI 3805/17 "Produkt data exchange in the building services; Drinking water system assemblies"

Based on VDI 3805 Part 1, the standard describes a manufacturer and IT system independent and unified data format for the exchange of product data for drinking water system assemblies used in building services.

D VDI 6008/1.2 "Barrier-free buildings; Trainings"

This standard defines requirements for training, training contents and the training documentation with reference to the series of standards VDI 6008 "Barrier-free environments". Thus, it gives a quality-standard for trainings of executive craft, technical planners, architects/civil engineers and interested persons.

The standard thus provides a training concept for all experts who are active in the planning and execution.

D Draft Guideline

C VDI Ventilation Code of Practice

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/

REHVA Guidebook on

Active and Passive Beam Application Design Guide

For Global Application

Editors: John Woollett and Julian Rimmer

Co-Chairs of Authoring Committee: Peter Simmonds, Darren S. Alexander, Jonathan Chan, Ken Loudermilk, Chris Lowell, Jonas Akesson, Carlos Lisboa, Rafael Urculo, Maija K. Virta, Thomas Wolters and Risto Kosonen

This design guide is a revision of the REHVA Chilled Beam Application Guidebook, which was published in 2004. ASHRAE and REHVA decided to collaborate on a revision of the guidebook and enlisted experts from both organizations to revise the document.

This new guide is aimed at consulting engineers, architects, owners, and contractors who are involved in the design, operation, and installation of active and passive beam systems.

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. Online tools can be found at ashrae.org/beamcalc.

This is a global Guide for Designing Chilled-Beam SystemsThe Active and Passive Beam Application Design Guide is the result of collaboration by worldwide experts to give system designers a current, authoritative guide on successfully applying active and passive beam technology. Active and Passive Beam Application Design Guide provide energy-efficient methods of cooling, heating, and ventilating indoor areas, especially spaces that require individual zone control and where internal moisture loads are moderate. The systems are simple to operate, with low maintenance requirements.

This book is an essential resource for consulting engineers, architects, owners, and contractors who are involved in the design, operation, and installation of these systems. Building on REHVA's Chilled Beam Application Guidebook, this new guide provides up-to-date tools and advice for designing, commissioning, and operating chilled-beam systems to achieve a determined indoor climate, and includes examples of active and passive beam calculations and selections. Dual units (SI and I-P) are provided throughout.

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 in hard copies and PDF format at www.rehva.eu.

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.

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.

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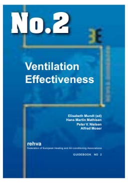
REHVA

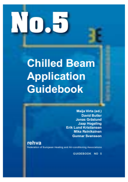
Federation of European Heating, Ventilation and Air Conditioning Associations

REHVA GUIDEBOOKS

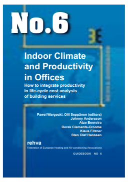
REHVA Guidebooks are written by teams of European experts



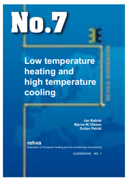
Ventilation Effectiveness. Improving the ventilation effectiveness allows the indoor air quality to be significantly enhanced without the need for higher air changes in the building, thereby avoiding the higher costs and energy consumption associated with increasing the ventilation rates. This Guidebook 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.



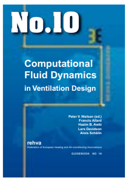
Chilled Beam Cooling. Chilled beam systems are primarily used for cooling and ventilation in spaces, which appreciate good indoor environmental quality and individual space control. Active chilled beams are connected to the ventilation ductwork, high temperature cold water, and when desired, low temperature 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.



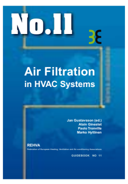
Indoor Climate and Productivity in Offices. This Guidebook shows how to quantify the effects of indoor environment on office work and also how to include these effects in the calculation of building costs. Such calculations have not been performed previously, because very little data has been available.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



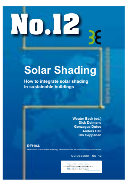
Low Temperature Heating And High Temperature Cooling. This Guidebook describes the systems that use water as heat-carrier and when the heat exchange within the conditioned space is more than 50% radiant. Embedded systems insulated from the main building structure (floor, wall and ceiling) are used in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



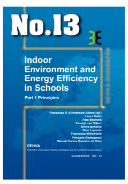
Computational Fluid Dynamics in Ventilation Design. CFD-calculations have been rapidly developed to a powerful tool for the analysis of air pollution distribution in various spaces. However, the user of CFD-calculation should be aware of the basic principles of calculations and specifically the boundary 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.



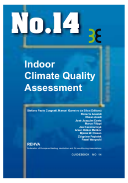
Air Filtration in HVAC Systems. This Guidebook will help the designer and user to understand the background and criteria for air filtration, how to select air filters and avoid problems associated with hygienic and other conditions at operation of air filters. The selection of air filters is based on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



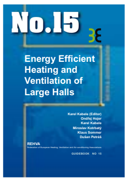
Solar Shading – ***How to integrate solar shading in sustainable buildings.*** Solar Shading Guidebook gives a solid background on the physics of solar radiation and its behaviour in window with solar shading systems. Major focus of the Guidebook is on the effect of solar shading in the use of energy 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.



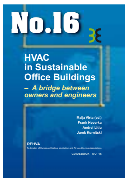
Indoor Environment and Energy Efficiency in Schools – ***Part 1 Principles.*** School buildings represent a significant part of the building stock and also a noteworthy part of the total energy use. Indoor and Energy Efficiency in Schools Guidebook describes the optimal design and operation of schools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



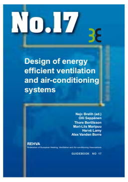
Indoor Climate Quality Assessment. This Guidebook gives building professionals a useful support in the practical measurements and monitoring of the indoor climate in buildings. Wireless technologies for measurement and monitoring have allowed enlarging significantly number of possible applications, especially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



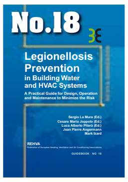
Energy Efficient Heating and Ventilation of Large Halls. This Guidebook is focused on modern methods for design, control and operation of energy efficient heating systems in large spaces and industrial halls. The book deals with thermal comfort, light and dark gas radiant heaters, panel radiant heating, 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.



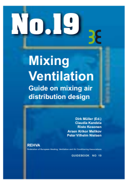
HVAC in Sustainable Office Buildings – ***A bridge between owners and engineers.*** This Guidebook discusses the interaction of sustainability and heating, ventilation and air–conditioning. HVAC technologies used in sustainable buildings are described. This book also provides a list of questions to be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



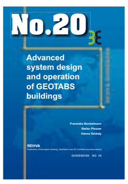
Design of energy efficient ventilation and air-conditioning systems. This Guidebook covers numerous system components of ventilation and air-conditioning systems and shows how they can be improved by applying the latest technology products. Special attention is paid to details, which are often overlooked 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.

REHVA nZEB Report. In this REHVA Report in cooperation with CEN, technical definitions and energy calculation principles for nearly zero energy buildings required in the implementation of the Energy performance of buildings directive recast are presented. 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.

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