PRIVATE INDOOR SWIMMING POOL

Creating an ideal indoor climate for sportsmen and wellness fans.

menerga
a systemair company

Good air means feeling good

The air quality in an indoor swimming pool determines how long guests remain in the pool – they won't stay long unless the pool air climate is comfortable and cozy. Muggy or cold air – or even drafts – quickly ruin any fun in a pool.

Reduce energy costs

Operating an indoor pool means expensive energy costs. The use of highly efficient technology lowers these costs and, in addition, makes a major, positive difference in assuring comfortable room climate.

Protect building substance

Poor thermal insulation, in conjunction with poorly installed moisture barriers, is the most frequent cause of damage when conditions fall below the dew point on the indoor side of a building shell. Over the long run, this leads to damage by condensation.

Hygienic coziness

When water evaporates from the surface of an indoor swimming pool, by products of disinfection enter the room air. These are substances created by disinfection of the water that can release unpleasant odors. An intelligent control system, together with a highly efficient recuperator, dehumidifies the indoor pool with outdoor air. The excess humidity is extracted along with the exhaust air from the pool, and with the smelly substances.

The feel-good factor makes the difference

AND THE AIR HANDLING UNIT PLAYS A KEY ROLE

Today, owing a private pool often combines the comfort of a wellness oasis and a fitness facility. This makes an indoor pool a pleasant place to retreat from the stress of everyday life.

Especially in a private swimming pool, the main focus is on the feel-good factor – and a cozy, comfortable indoor climate at the pool plays a key role. It is not only the interplay between room temperature and humidity that makes a major contribution here – air-flow distribution is also essential and must be perfectly coordinated with room conditions. Drafts and misted-over windows should be avoided. Air-flow control must ensure uniform air circulation around the pool. Air circulation is essential from two standpoints: first, properly circulated air passes warmth over all building components, which prevents condensation on the cooler elements. Second, uniform air movement over the pool enables by products of disinfection evaporated from the water to be extracted from the pool by the room ventilation system. Owing to uninterrupted evaporation from the water surface, dehumidification of the pool air must take place around the clock, even when the pool is not in use – to prevent damage to the shell and to other components of the building.

Swimming pool equipment that dehumidifies the air with outdoor air enables maintaining a comfortable pool atmosphere. Advanced control systems, in connection with an efficiently designed dehumidifier system, not only assure constant air conditions in the pool: they also contribute – with effectively controlled and demand-driven outdoor air handling – to a comfy and healthy room climate. Highly efficient heat recovery reduces energy consumption here to a minimum for dehumidification of the swimming pool.

TEMPERATURE AND ENERGY REQUIREMENTS

As a rule, **indoor pool water temperature** lies between 28 and 32 °C.

Pool air temperature is usually 2 to 4 °C higher than pool water temperature – but not higher than 34 °C. This slight temperature difference is virtually unnoticeable for the pool user. The partial-pressure difference resulting under these conditions keeps the amounts of water evaporated – and, in turn, the energy required for dehumidification – at a comparatively low level. The temperature and the relative humidity in an indoor pool are extremely important in determining the comfort experienced by the pool user. The absolute water content of the air in the indoor pool plays an essential role here: a level of 14.3 g water/kg air should not be exceeded for any lengthy period. This value represents the mugginess limit for an unclad person. Three variables basically determine the heat requirement of an indoor pool:

1. The **transmission heat requirement (Q_T)** describes the amount of heat required to compensate for the loss of heat through the building shell. Effective thermal insulation for the building can keep this heat requirement at a low level.
2. The **ventilation heat requirement (Q_V)** describes the amount of heat required to heat outdoor air to the desired indoor-pool air temperature. Employment of a high-efficiency recuperator can reduce the associated energy costs to an extremely low level.
3. The **evaporation heat requirement (Q_E)** describes the amount of heat required to compensate for the heat loss arising from evaporation of the pool water. Approx. 90 % of the heat required for this evaporation is extracted from the water, and approx. 10 %, from the air: heat which must be replaced by the customer's heating system. The same applies to the heat requirement for replenishment of the evaporated pool water and for heating it to the desired temperature. A heat pump with a water-cooled condenser, integrated in the heat pump, can recover part of this heat from the dehumidification process.

Indoor pool dehumidification

DIMENSIONING OF THE VENTILATION SYSTEM

The surface area of the water and the use of the pool are key factors in evaporation of the pool water. An additional, deciding influencing variable is the partial pressure difference: i.e., the difference in pressure between the saturation vapor pressure at pool-water temperature, and the partial pressure of the water vapor in the pool air. On the basis of these factors, guideline VDI 2089 sheet 1 of the Association of German Engineers describes the calculations for determining the water mass flow rate from evaporation during pool-swimming and idle modes. Water attractions – e.g., a counter-current unit – increase the amount of water evaporated. Calculation of dehumidification capacity must take into consideration the use of such attractions. Ideally, the calculated evaporative water mass flow will be extracted via the dehumidifier by outdoor air. The required amount of outdoor air is calculated with reference to a difference in absolute water content between the outdoor air (9 g/kg) and the extracted air (14.3 g/kg). This outdoor air mass flow required for dehumidification is converted, using the density of the air, into an outdoor air volume flow. This volume flow determines the capacity of the dehumidifier.


© T. Phillippi

Southern Germany

WELLNESS POOL

This private indoor pool seems to float over the roofs of the city.


© T. Phillippi

Southern Germany

WELLNESS POOL

A splendid home for wellness in luxurious ambience.


© fnoxx

Alsace, France

SPORT AND WELLNESS POOL

Private swimming pool with generous wellness zone.

Lower Rhine, Germany

WELLNESS POOL

This private pool offers ideal relaxation in a highly compact space.


© htarchitektur BDA

Münsterland, Germany

SPORT AND WELLNESS POOL

A combination of sports and wellness in a perfectly matched ambience.


© Klaus Bauer

Majorca, Spain

SPORT AND WELLNESS POOL

Stylish, Mediterranean facility in Spanish Majorca.

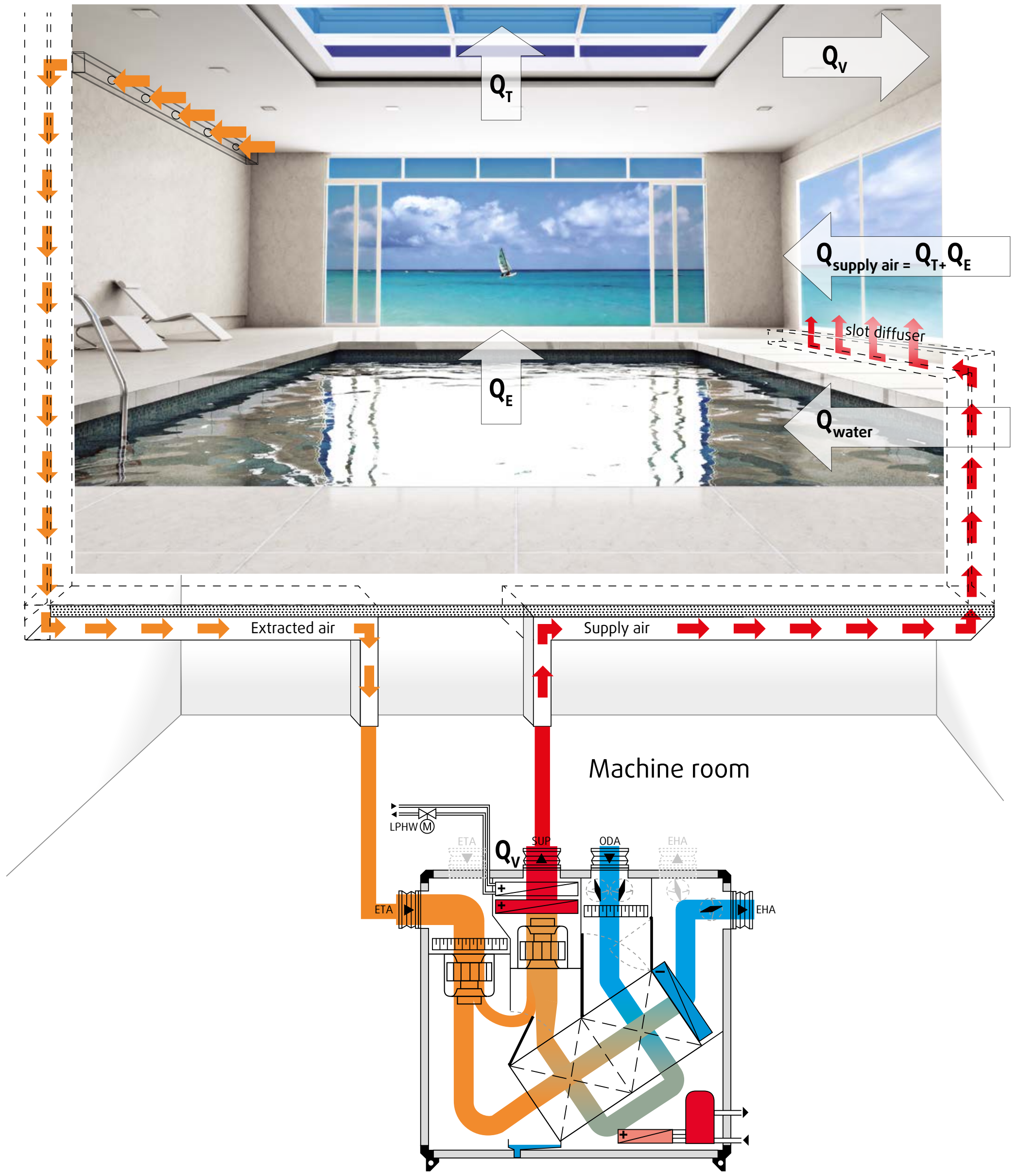
AHU in indoor swimming pools

AIRFLOW DISTRIBUTION, USER COMFORT, AND ENERGY DEMAND

The AHU used in an indoor pool combine several functions. The main function of airflow distribution consists of extracting moist air from the pool and feeding it to an air handling unit. At the same time, the drier supply air will be fed upward into the indoor pool via the duct system: as a rule, through diffusers in the vicinity of the windows. Inside the AHU, the outdoor air required for dehumidification will be mixed with the supply air. The required amount of moist extracted air, with heat removed by the recuperator, will be transported outside as outgoing air. The heat obtained in this matter will be transferred in the recuperator to the supply air.

The positioning of the air valves and diffusers in the indoor pool plays a primary role in determining user comfort. Air duffusers, in particular, must be arranged such that the zones occupied by pool users are free of drafts. The supply air must produce flow that assures effective air circulation in all areas of the pool. The effectiveness of these functions essentially depends on whether the fans at all operational points provide constant amounts of supply and extracted air. The position of the extract air valves must be located in the upper area of the pool such that it prevents a ventilation short-circuit between supply air and extracted air.

So-called disinfection by products can be produced in the indoor pool during pool cleaning and disinfection of the water. When the water evaporates, these by-products enter the air of the pool. If air distribution ensures transport of these disinfection by-products in the air extracted to the outside, this enhances pool user comfort.



Ecodesign Directive

ERP DIRECTIVE APPLYING TO AIR HANDLING UNITS IN INDOOR SWIMMING POOLS

The European Ecodesign Directive (ErP Directive 2009/125/EG) creates a European Legal Framework for the stipulation of requirements placed on ecologically harmonious design of products involving energy use. It went into effect in October of 2009. The purpose of this directive is to set minimum energy-efficiency requirements on various products under the category of products for energy use – and to eliminate inefficient products from the domestic European Union market, in order to achieve European climate-protection objectives. The stipulations for environmentally compatible design of ventilation systems were set forth in the EU Regulation 1253/2014, which went into effect in December of 2014.

In addition to basic requirements placed on the design of ventilation systems, requirements involving efficiency criteria were formulated to go into effect in two stages: on 1 January 2016 and, with stricter requirements, on 1 January 2018.

Particular emphasis is placed here on the efficiency of the heat exchange system, as determined by the rules of EN 308. This body of regulations describes the test procedures for determining the efficiency of all recuperator systems, and thereby ensures intrasystem comparability.

An additional decisive factor for observance of the requirements of the European Ecodesign Directive is power consumption of the fans. If this consumption exceeds a reference value, the device concerned may not be marketed in the EU.

The goal of the ecological design requirements placed on ventilation systems is enhancement of primary energy savings of this product group by 60 % by the year 2025, compared to data in 2010.

Currently, indoor swimming pool dehumidification systems with a recuperator are subject to the energy requirements that are formulated by Ecodesign stipulations.

IMPORTANT STANDARDS AND DIRECTIVES

BUILDINGS

Energy Saving Ordinance (EnEG)
German law for saving energy in buildings

Building Energy Ordinance (GEG)
German ordinance for encouragement of renewable energy in heating areas. Directive on energy-saving heat insulation and energy-saving plant engineering in buildings

DIN V 18599
Calculation of useful, final, and primary energy requirements for heating, cooling, ventilation, potable hot water, and illumination of buildings

KOK Directives
Recognized basis and standard for planning and construction of indoor public swimming pools

Regulation on the construction and operation of public gathering facilities (VStättVO)
Legal regulation for the construction and operation of public gathering facilities (including open-air swimming pools with fencing, and indoor swimming pools with capacities of > 200 persons)

VDI 2050, Sheet 1-5
Planning and overall coverage of buildings and building facilities

AHU

Machine Directive 2006/42/EG

Ecological Design Directive 2009/125/EG
German directive for stipulation of requirements placed on the ecological design of products involving energy use

Directive 2014/68/EU
Directive on the electromagnetic compatibility of equipment

Pressure Equipment Directive 2014/68/EU

EN 378
Safety-engineering and environmentally relevant requirements for refrigeration systems and heat pumps

DIN EN 13779
Mechanical ventilation and climate control of non-residential buildings

DIN EN 15251
Input parameters for room climate, for design and analysis of the energy efficiency of buildings

DIN EN 12599
Testing and measurement procedures for the turnover of installed HVAC systems

VDI 2089
Technical building facilities in indoor swimming pools
Sheet 1 = Indoor swimming pools
Sheet 2 = Efficient use of energy and water

Directive for Ventilation Systems (LüAr)
German directive on technical fire-protection requirements for ventilation systems

Technical Guide for Noise (TA-Lärm)
German technical guide for protection from noise

DGNB Technical Regulations 60.07
Maintenance of technical systems in swimming pools: regulations of the German Society for Swimming Facilities

AMEV Directive for HVAC Facilities Construction
Application to public buildings

DIN EN 13053
Performance characteristics for HVAC equipment, components, and model sizes

DIN EN 13501 Part 1 (May 2007)
Fire behavior of construction materials and structural components

DIN EN 1886
Central HVAC systems – mechanical properties and measurement techniques

VDI 3803
Central HVAC facilities – constructional and technical requirements (VDI ventilation regulations)

DIN EN 1751 (June 2014)
Air-distribution equipment

VDI 6022
Hygienic regulations for AHU equipment

AHU Directive 01
General regulations for AHU equipment, published by the German Association of Manufacturers of AHU Equipment

RLT-TÜV-01
Testing directive issued by TÜV SÜD for energy efficiency

IMPORTANT LABELS

ErP Directive
This device conforms with Directive 2009/125/EG

EUROVENT
Certification programs for refrigeration and climate-control products

RLT A+, A, B
Certification of the efficiency and the quality of an AHU device

Project fundamentals

FROM THE ARCHITECT TO THE INDOOR POOL

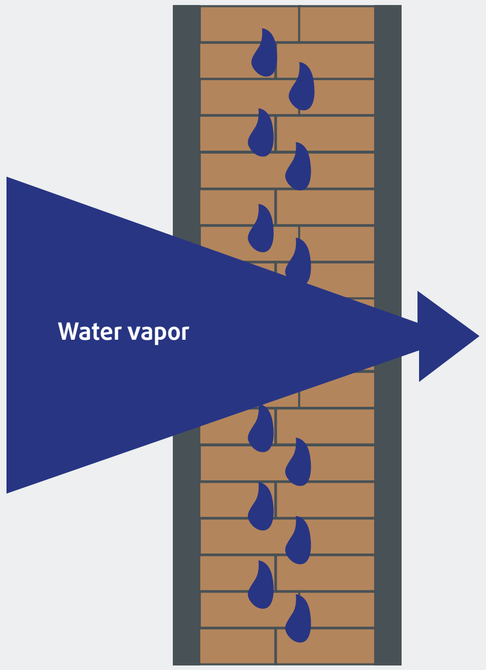
The dream of owning a private indoor swimming pool often arises from the desire for a quiet retreat to relax and to feel good. A great deal of effort is expended on the design of the pool, to make these dreams come true. The selection of luxurious fittings and surfaces is matched to individual wishes. Professional pool designers go to great lengths to realize your wishes and needs in the form of a solution where you really fit in. Before these wishes can be transformed into reality, however, project planners must enter the scene. Where to put the technical equipment? The water treatment system must be installed in the machine room, as must the pool hall dehumidifier. This mechanical equipment cannot be integrated into the luxurious design of the pool hall itself, where it would disturb the appearance of your quiet retreat. This arrangement has the advantage that placing the equipment in a machine room on the pool periphery, or next to the pool building itself, will provide acoustical separation of the equipment from the pool, and that the equipment in the machine room can be serviced separately and can more effectively be repaired in cases of malfunction. With predictive planning and concept preparation, equipment for air flow control can be integrated into your overall pool design so as to be hardly perceptible by pool guests.

Nevertheless, air flow control should enjoy key priority in pool design. On the one hand, humid air is extracted from the pool hall via the exhaust air system and is put into the dehumidifier unit. On the other hand, drier air is supplied to the indoor pool area. Entry of supply air here has proven especially effective when located in the areas of the windows: first, the supply air warms the windows, which can prevent condensation on them even during extremely cold winters. The large-area distribution of the supply air in the window zones assures a pleasant mix of dry air throughout the pool area and, in turn, uniform distribution of temperature over the entire room. Uniform temperature and relative humidity in the areas where guests gather around the pool is the basis for a comfy, feel-good experience. Such a satisfactory climate, however, is not the result of the dehumidifier unit and effective air-flow control alone: an additional essential factor is the building shell. Efficient thermal insulation not only reduces energy consumption by heating, but also makes a major contribution to coziness. The human body is always engaged in radiation exchange with its surroundings: which means that we shiver when contacting cold surfaces, and that we more acutely perceive this feeling in an ambience in which we typically wear only light clothing. In the implementation of thermal insulation, special attention must be paid to vapor impermeability. An effective moisture barrier – typically, sheeting impervious to water vapor – prevents water vapor from penetrating into walls. A moisture barrier that is not properly installed, or that does not exist at all, is frequently the cause of moist walls and even major building damage.

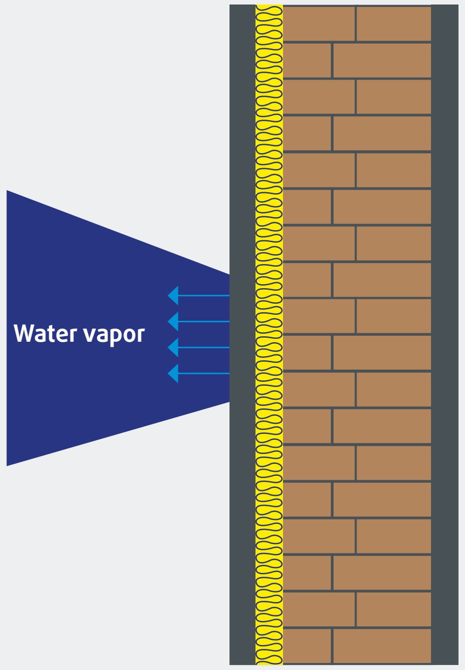
During the construction phase, it is essential to ensure prevention of thermal bridges: these are points in the building shell at which heat flows toward the outside faster than at the areas surrounding such points. Especially in cold months, thermal bridges have temperatures that are appreciably colder than the dewpoint temperature of the air in the pool building. This means that water from the air condenses at these cold points, and that moisture more rapidly penetrates these points. Corrosion or even failure of building components represents the worst possible resulting damage. If comfortable climate with an air temperature of 30 °C and relative humidity of 54 % prevails in an indoor pool, the dewpoint under such air conditions is 19.4 °C. In an indoor pool hall, therefore, no surface should be colder than 19.4 °C, to prevent condensation of humidity in the colder areas.

In transition areas between living zones and the indoor pool area, mixing often takes place of pool air with living-area: which frequently results in a slightly perceptible odor from the swimming pool. Humidity from the pool can likewise penetrate into living areas – an effect that can be lessened by the use of a door or similar solution. An intelligent dehumidifier, for example, can also allow the air-extraction fan to remove somewhat more air from the swimming pool than the supply air fan feeds into the pool area. In conjunction with a door, this arrangement can create slightly lower pressure in the pool than in the home, which prevents humidity and possible odors from entering living space. A dehumidifier for the recirculation air inside the swimming pool does not provide this function.

Outside wall WITHOUT thermal insulation or moisture barrier



Outside wall WITH thermal insulation and moisture barrier



Make the right choice!

SELECTION OF SYSTEMS AND COMPONENTS - RELIABLE THERMOCOND SOLUTIONS

Unit with recuperator and without heat pump

A unit with a recuperator achieves a large heat-recovery coefficient, which recovers a major share of energy from the swimming pool air. As a result, this significantly lowers ventilation heat loss and the energy requirement for dehumidification.

Dehumidification of pool air takes place exclusively with outdoor air: humidity is removed from the pool together with the extracted air, and drier, cooler outdoor air is mixed with the circulation air flow in the dehumidifier.

During high outdoor air temperatures in summer, the system maintains a pleasant temperature in the pool area by circumventing heat recovery via an integrated bypass valve integrated in the dehumidifier. This considerably reduces the risk of overheating in the pool area. Since the valid ErP directive stipulates a technical bypass in the unit, the heat recovery can be infinitely variably regulated to zero when necessary. The footprint of the unit is small, and its operating and maintenance costs are low.

Unit with recuperator and heat pump

Selection of a system with an integrated heat pump can prove effective, since the heat pump contributes to increasing the total efficiency of a swimming pool dehumidifier. Current dehumidifiers offer two operational modes:

<u>Idle mode:</u>

When the pool is not in use, dehumidification takes place in recirculation air mode. The air in the recuperator is pre-cooled here, and a evaporator cools the air below the dewpoint. The dried air is then passed through the recuperator again, where it is warmed. A condenser returns the heat from the process of evaporation, as well as from the work energy of the compressor, to the supply air.

This mode covers a major share of the transmission heat requirement and, in turn, relieves the load on the heating system.

<u>Swimming mode:</u>

During swimming mode, the control system automatically switches to dehumidification with outdoor air. This allows the heat pump to increase the heat recovery by the recuperator. Via the plates of the recuperator, this process transfers to the outdoor air the sensible energy stored in the air that is extracted from the swimming-pool. This offers a major benefit, especially in swimming-pool dehumidification: substances from the extracted air cannot be transferred to the outdoor air. As a result, these substances cannot enter the supply air, even at low outdoor air temperatures at which water condenses from the air extracted from the swimming pool.

Unit with 100 % recirculation air mode

In selection of an effective system, it is absolutely necessary to assure that supply of outdoor air and removal of odorous air extracted from the pool are possible via the extract air. Units that dehumidify exclusively in recirculation air mode cannot satisfy essential criteria for good air hygiene: e.g., the extraction in extract air of disinfection by products, creation of sub-atmospheric pressure, or the prevention of overheating in the swimming pool.

In addition, a unit that dehumidifies the swimming pool in recirculation air mode transfers to the pool area the total energy that is extracted from the air during dehumidification, as well as from the electrical work of the compressor. This situation can lead to overheating of modern and well insulated swimming pools in transitional-season periods, and to doubtful cases in which dehumidification must take place by temperature control.

ThermoCond heat recovery technology

Our ThermoCond heat recovery systems have been especially developed for energy-optimized dehumidification of private indoor swimming pools.

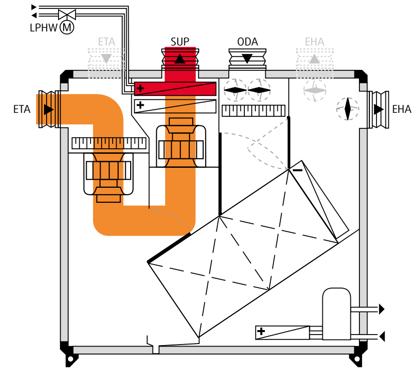
At a glance:

- These units feature a highly efficient and hygienic recuperator made of polypropylene, which can easily be cleaned down to the core of the unit
- Highly efficient, output-controlled motors drive the fans
- The unit has a self-supporting casing 45 mm thick
- The mineral-wool insulation reduces heat transmission that prevents condensation on casing parts and that also provides excellent sound insulation
- All the sheet-metal parts are corrosion-protected by powder coating
- The cabling of the unit does not contain halogen
- The integrated control principle always enables the operating point with the least-possible energy requirement, with reference to dehumidification and heating performance

All Menerga solutions feature an operator control panel and an integrated control concept.

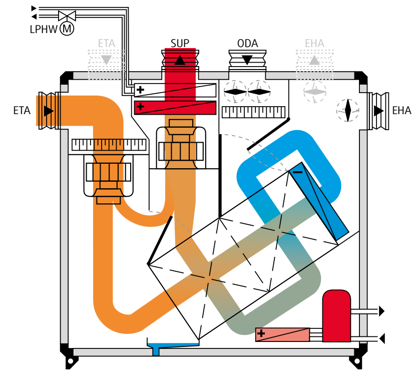
Idle mode without dehumidification

If, during idle mode, no requirements are placed on temperature control and dehumidification, the system operates in pure recirculation air mode with reduced air volume. This assures sufficient air circulation in the pool area. With a heating requirement, the extract air is heated by the low pressure hot water heating coil up to the supply air temperature.



Idle mode with dehumidification

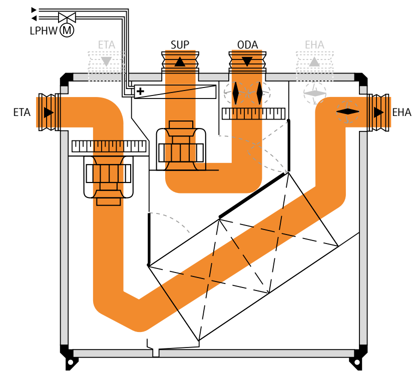
The air is dehumidified in the evaporator of the heat pump. This process is supported by upstream installation of the recuperator. The already cooled and dehumidified air is preheated in the recuperator by the air extracted from the swimming pool. Here, the heat transfer to the other side of the recuperator pre-cools the moist-warm extract air extracted from the swimming pool air, up to the dewpoint limit. The pre-heated, dehumidified air is next mixed with a share of untreated recirculation air, then warmed by the heat extracted from the dehumidification process, and finally returned as supply air into the swimming pool air. The heat pump is optimally designed with a dehumidification energy requirement of less than 0.25 kWh/kg. As required, the supply air is after-heated in the low pressure hot water heating coil.



All images show ThermoCond solutions with a heat pump.

Swimming mode summer

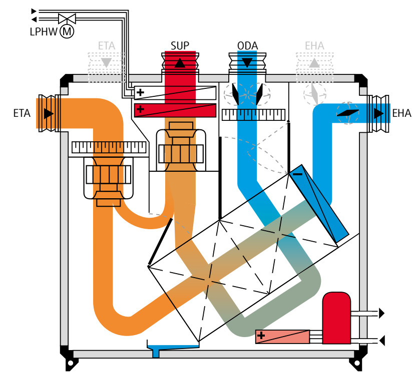
With increasing outdoor air humidity, the recirculating air damper is closed as required, up to the point of complete closure. The system then operates in 100 % outdoor air/exhaust air mode via the recuperator.



Swimming mode winter

Solution 1: The swimming pool is dehumidified by a mixture of outdoor and circulation air flow. The ratio of outdoor air is automatically and continuously adapted, depending on momentary water evaporation (i.e., current occupancy of swimming pool) and on the outdoor air humidity. If heat recovery is not sufficient to achieve the required supply air temperature, the supply air is after-heated in the water heating coil.

Solution 2: The cross-counterflow recuperator and evaporator remove from the extract air most of the sensible and latent heat, which is then transferred to the supply air. If the heat output of the heat pump is not sufficient, the supply air is after-heated in the low pressure hot water heating coil. Surplus heat can be transferred to the pool-water condenser (available as an option), which contributes to warming the pool water.



Accessories

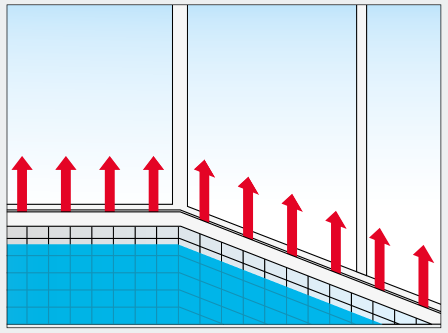
SLOT DIFFUSERS

Slot diffusers are outlets through which supply air is blown into the indoor pool.

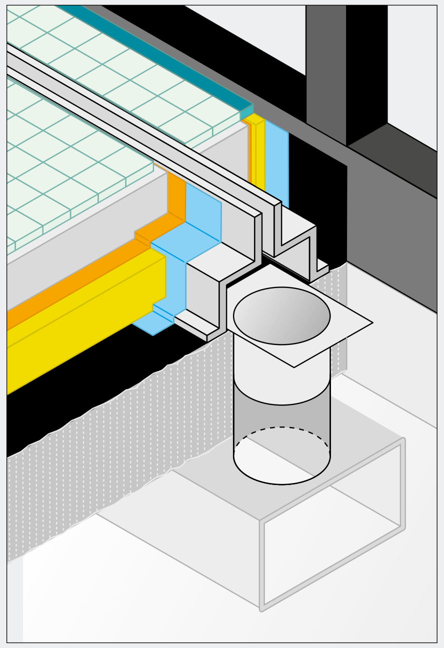
The slot diffusers should be dimensioned such that the supply air covers the entire window surface.

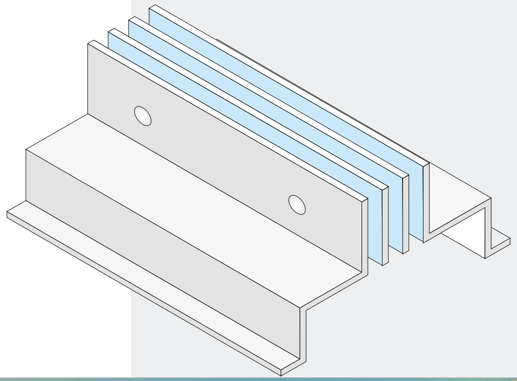
As a rule, these diffusers are installed on floor level, in front of window surfaces in indoor swimming pools. They can be effectively integrated in the floor structure. In addition, they satisfy currently valid health and safety regulations with respect to structural aspects.

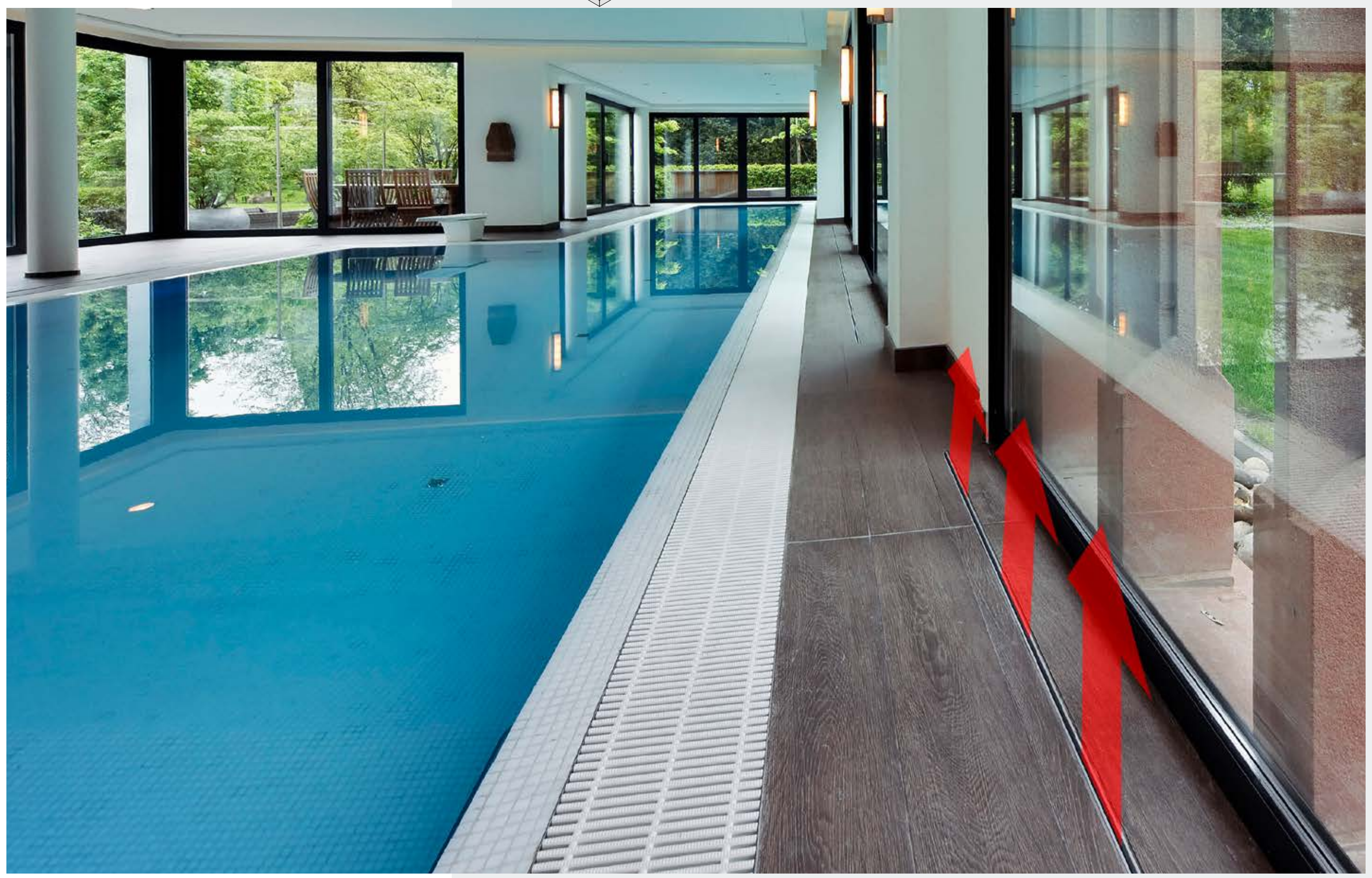
Application in an indoor pool hall

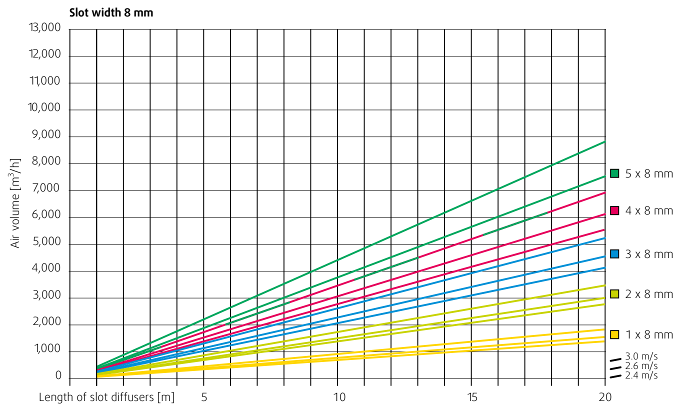


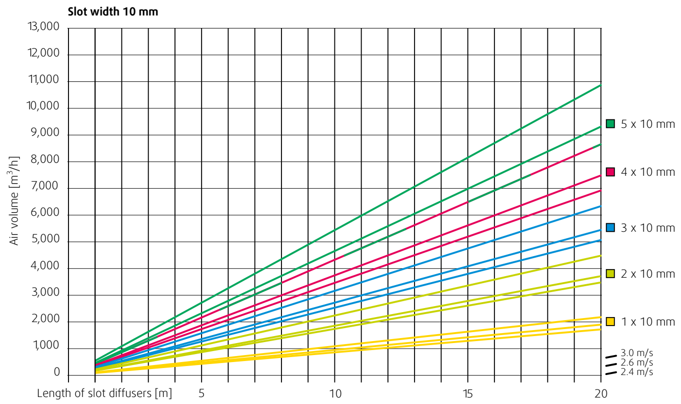
Example of installation

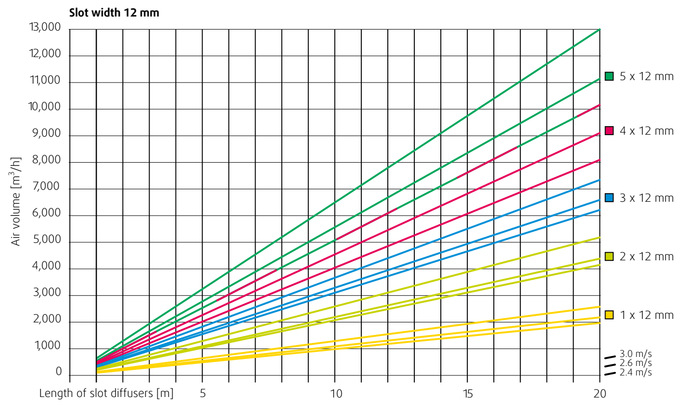




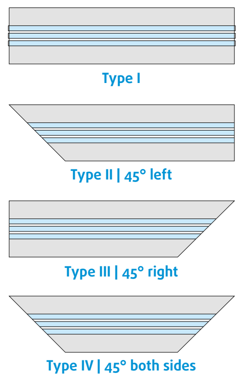




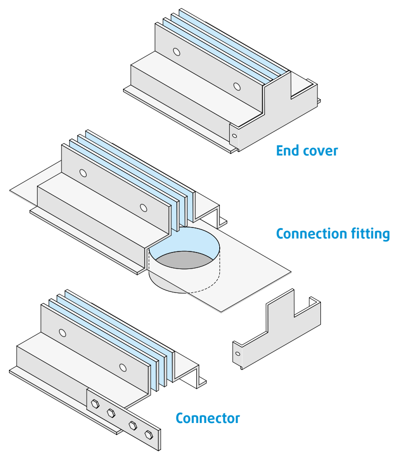




Possible miter cuts



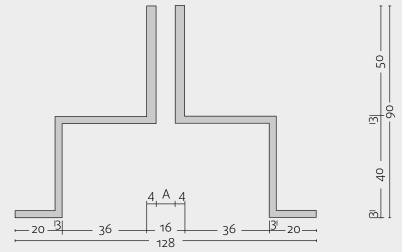
Accessories



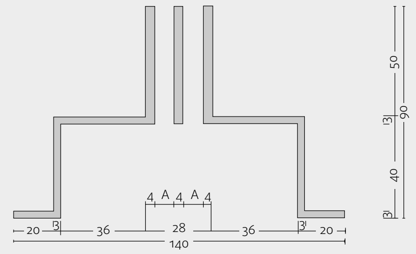
Lengths and cross-sections

Lengths of 500 to 6,000 mm are available, with accuracy to 10 mm. Important: take expansion into consideration while installing.

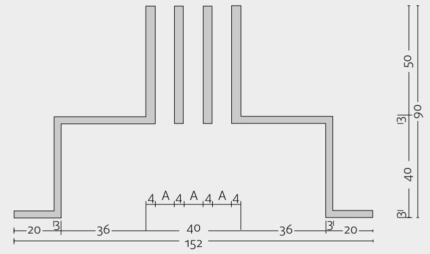
Type A = slot width = 8 mm
Type B = slot width = 10 mm
Type C = slot width = 12 mm



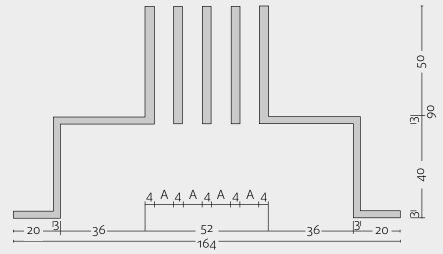
Type A1 = 1 × 8 | Type B1 = 1 × 10 | Type C1 = 1 × 12



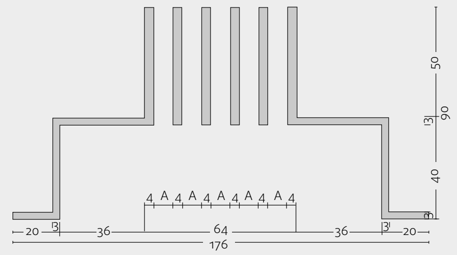
Type A2 = 2 × 8 | Type B2 = 2 × 10 | Type C2 = 2 × 12



Type A3 = 3 × 8 | Type B3 = 3 × 10 | Type C3 = 3 × 12



Type A4 = 4 × 8 | Type B4 = 4 × 10 | Type C4 = 4 × 12



Type A5 = 5 × 8 | Type B5 = 5 × 10 | Type C5 = 5 × 12

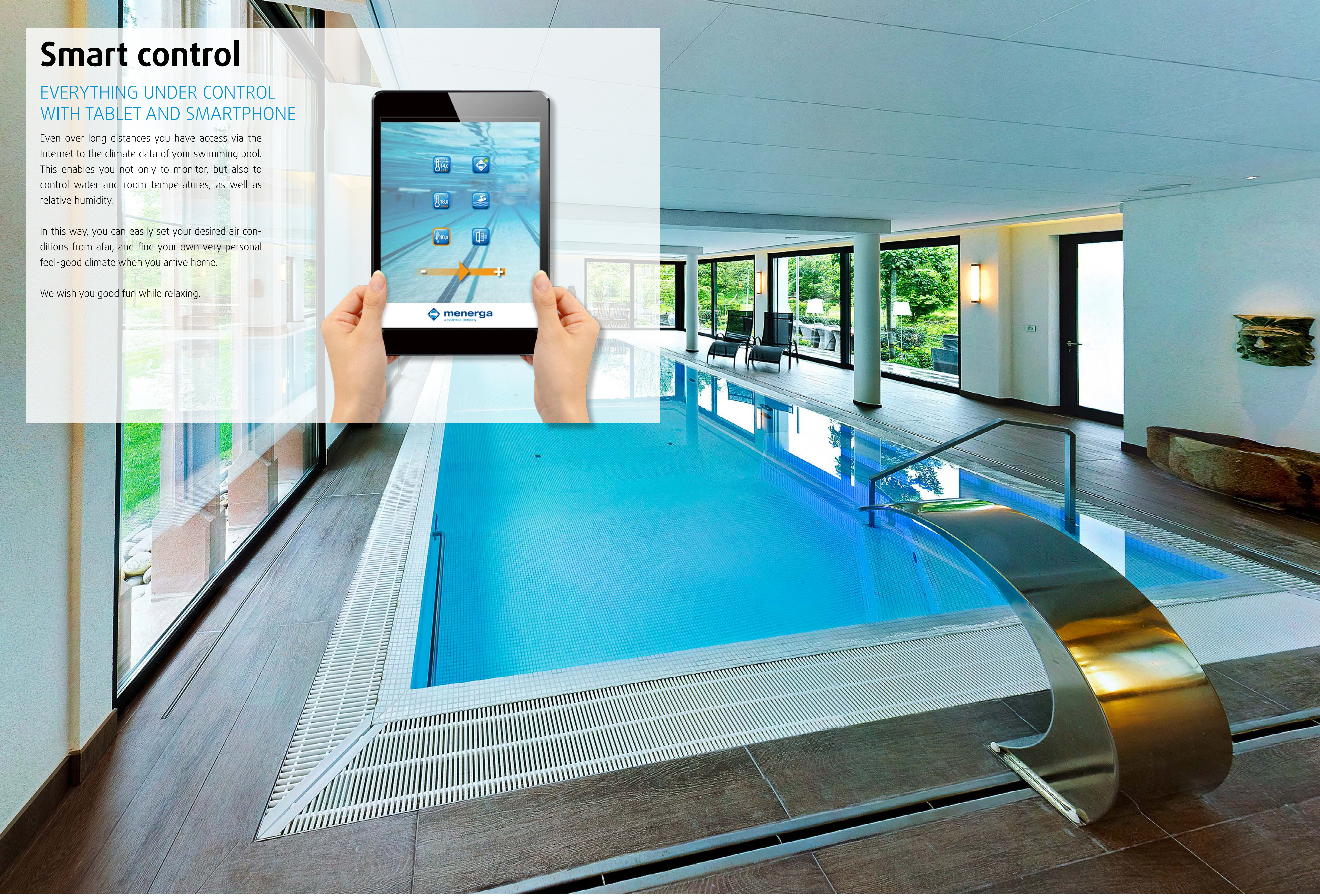
Smart control

EVERYTHING UNDER CONTROL WITH TABLET AND SMARTPHONE

Even over long distances you have access via the Internet to the climate data of your swimming pool. This enables you not only to monitor, but also to control water and room temperatures, as well as relative humidity.

In this way, you can easily set your desired air conditions from afar, and find your own very personal feel-good climate when you arrive home.

We wish you good fun while relaxing.



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