Ventilation and air conditioning

Public swimming pool halls

Of course ErP-compliant!
3. Evaporation heat requirement: Heat requirement for compensation of the heat loss resulting from the evaporation of the pool water. The amount of heat required for this evaporation is extracted to a level of 90% from the water and 10% from the air and has to be covered by a customer-provided heating installation or a heat pump integrated into the dehumidification unit. In addition there is the amount of heat which is required to replenish the quantity of water that has evaporated and heat it up to the pool water temperature.
**Indoor swimming pool dehumidification**

**REQUIREMENTS OF SPECIFIC TYPES OF INDOOR SWIMMING POOLS**

The pool surface area and depth, as well as the type of pool use, are decisive for the evaporation of the water at the pool surface. Another important influencing variable is the partial pressure difference between the saturated vapour pressure at the pool water temperature and the partial pressure of the water vapour of the swimming pool hall air. With these factors, the evaporating water mass flow is designed for bathing and stand-by mode in accordance with VDI 2089 sheet 1. A higher amount of evaporation by existing water attractions is also taken into account.

The determination of the amount of air required during bathing activities based on... and outside air, results in the amount of outside air required for dehumidification and thus the size of the respective dehumidification unit can be selected.

**Ventilation in swimming pool halls**

**BASIC PRINCIPLES OF AIR DISTRIBUTION**

The air distribution system in a swimming pool hall performs several tasks. The main task is to discharge the most return air from the hall and feed it to the dehumidification unit. At the same time, the drier supply air is fed from the bottom up into the swimming pool hall through the duct system, normally via air outlets in the area of the windows. The position of the air inlets and outlets in the hall make an important contribution to the comfort of the bathers. The air inlet, in particular, must be arranged such that the common area is draught-free for bathers. The supply air helps to generate an air flow that ensures air circulation in all areas of the swimming pool hall. The successful performance of this task mainly depends on whether the fans provide a constant quantity of supply and return air at all operating points. The position of the air outlet at the top of the swimming pool hall is selected in such a way that an air-side short circuit between the supply air and return air is ruled out.

By-products which find their way into the swimming pool hall air are formed during the cleaning and disinfection of the pool water. A further task of the air distribution system is to actively prevent a concentration of these substances.

In general, 4 to 5 air changes per hour have proven effective for the fulfillment of all tasks.

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**Kantrida Rijeka, Croatia**

**SPORTS POOL**

Focus on training, 50-metre lanes. Competition venue with stands. Temperature: 26/28°C (water/air). Roof can be opened.

**Lippebad Lünen, Germany**

**LEISURE POOL**


**Lasko Thermal Baths, Slovenia**

**ADVENTURE POOL**

Strong orientation on leisure activities, many water attractions, slides, etc. Temperature: 28/30°C (water/air). Connection to the outdoor pool.

**Terme di merano, Italy**

**SALTWATER POOL**

Brine water promotes health. Temperature: 30/32°C (water/air). Very corrosive air.

**Hotel Bell Rock in Rust, Germany**

**HOTEL POOL**


**Hotel Edelweiss in Wagrain, Austria**

**HEALTH SPA**

Swimming pool, e.g. for health treatments. Temperature: 28/30°C (water/air). First hotel passive house swimming pool.

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Example of an optimal air distribution system based on a recuperative system. Introduction of the air on the window facades, extraction at the top. The amount of supply and return air is constant.
Ecodesign Directive

ERp ALSO APPLIES TO VENTILATION UNITS IN SWIMMING POOL HALLS

European Directive 2009/125/EC (ErP or "Ecodesign Directive") provides a European legal guideline for the establishment of requirements for the environmentally friendly design of energy-related products and came into effect in October 2009. The objective of this directive is to provide minimum requirements regarding the energy efficiency of various product groups which fall under the category of energy-related products and therefore drive inefficient products from the Single European Market in order to achieve the European climate protection targets. The requirements for the eco-design of ventilation plants were established in EU Regulation 1253/2014, which came into force in 2014. Besides the basic requirements for the design of the ventilation unit, efficiency criteria are being formulated in two steps for 1 January 2016 and - with increased requirements - 1 January 2018. Particular focus is on the efficiency of the heat recovery system according to the rules of EN 308. These rules describe the test method in order to determine the efficiency of all heat exchanger systems and ensure cross-system comparability.

Another decisive factor for compliance with the requirements of the Ecodesign Directive is the power consumption of the fans. If this exceeds a reference value, the device may not be placed on the market within the EU. The objective of the eco-design requirements for ventilation systems is to increase the primary energy savings of this product group to 60% before 2025 relative to 2010.

IMPORTANT STANDARDS AND DIRECTIVES

BUILDINGS

Energy Conservation Act (EnEG)
Law on saving energy in buildings

Renewable Energies Heat Act (EEWärmeg)
Law for the promotion of renewable energies in the heat sector

Energy-saving Regulation (EnEV)
Regulation on energy-saving thermal insulation and energy-saving installation engineering for buildings

DIN V 18599
Calculation of the energy needs, delivered energy and primary energy for heating, cooling, ventilation, domestic hot water and lighting of buildings

KOK Directives
Recognised basis and benchmark for the planning and construction of public swimming pool halls

Regulation on the Construction and Operation of Places of Public Assembly (VSAtatVO)
Ordinance on the construction and operation of public assembly places (among other things open-air swimming pools with fencing, swimming pool halls with a volume > 200 people)

VDI 2050, Sheet 1-5
Planning and Holistic View of Buildings and Technical Building Equipment

DIN EN 13779
Mechanical Ventilation and Air-Conditioning of Non-Residential Buildings

DIN EN 15251
Input Parameters for the Room Climate for the Design and Assessment of the Energy Efficiency of Buildings

DIN EN 12599
Testing and Measuring methods for the Operation of Installed HVAC Plants

DIN EN 12599
Building Services in Swimming Baths; Sheet 1 = Indoor pools; Sheet 2 = Efficient Use of Energy and Water

LüAr - Ventilation Plant Directive
Directive on the technical fire safety requirements for ventilation systems

IMPORTANT LABELS

Ecodesign Directive
Device complies with Directive 2009/125/EC

ErP Certification Programmes
for Cooling and Air-Conditioning Products

Eurovent Certification Programme
for Efficiency and Quality of an HVAC System

RLT-TÜV-01
Test Guideline of TÜV-Süd for Energy Efficiency

IMPORTANT LABELS

Ecodesign Directive
Device complies with Directive 2009/125/EC

ErP Certification Programmes
for Cooling and Air-Conditioning Products

Eurovent Certification Programme
for Efficiency and Quality of an HVAC System

RLT-TÜV-01
Test Guideline of TÜV-Süd for Energy Efficiency
## Design Parameters

### FOR PUBLIC SWIMMING POOL HALLS

#### Important Design Parameters
- Pool surface, pool depth
- Water temperature
- Air temperature and humidity
- Type and number of attractions
- Operating hours
- Type of use

#### Design
- Provide for multiple use of the air
- Operate wet areas in low pressure compared to dry areas
- Air distribution system must ensure air exchange in the swimming pool hall

#### Planning
- Early examination of building statics and possible access openings
- When setting up the device and planning the channels, take the minimum space for maintenance work into account
- Exhaust air channel: Air lines for the dehumidification unit as short as possible
- Cleaning opportunity and discharge for any penetrated water
- Inspection opening at chamber or return air duct in order to turn off system in the event of fire automatically
- According to VDI 2089, weight-loaded overpressure relief valves must be provided in order to protect the duct system.
- Adjustment depending on the room temperature and room humidity, or alternatively depending on the room temperature and pool temperature
- Only exceed absolute humidity in the hall of 143 g/kg if DA humidity exceeds >9 g/kg
- Reduction of the minimum external volume flow from 30% to 15% is permissible if the pool water trihalomethanes are permanently <0.020 mg/l

#### Design parameters

<table>
<thead>
<tr>
<th>Type of structure</th>
<th>Volume flows</th>
<th>during the day</th>
<th>at night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational pools</td>
<td>Entrance area</td>
<td>5 m³/hm²</td>
<td>5 m³/hm²</td>
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<tr>
<td>Warm pools</td>
<td>Single changing rooms</td>
<td>15 m³/hm²</td>
<td>15 m³/hm²</td>
</tr>
<tr>
<td>Group changing rooms</td>
<td>20 m³/hm²</td>
<td>20 m³/hm²</td>
<td></td>
</tr>
<tr>
<td>Supervisory rooms</td>
<td>25 m³/hm²</td>
<td>25 m³/hm²</td>
<td></td>
</tr>
<tr>
<td>First aid rooms</td>
<td>25 m³/hm²</td>
<td>25 m³/hm²</td>
<td></td>
</tr>
<tr>
<td>WCs (per seat)</td>
<td>100 m³/h</td>
<td>100 m³/h</td>
<td></td>
</tr>
<tr>
<td>Showers (per shower)</td>
<td>220 m³/h</td>
<td>220 m³/h</td>
<td></td>
</tr>
</tbody>
</table>

#### Attractions:
- Overview of the parameters of the relative field amplification according to VDI 2089 Sheet 1.

#### Details for the calculation according to VDI 2089 are available on request from your sales partner.

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**Photo: Helmuth Rier**

Terme di merano; Merano
Make the Right Choice!
SYSTEM AND COMPONENT SELECTION

EQUIPMENT SELECTION

Recuperative heat recovery systems transmit the sensitive energy stored in the swimming pool hall return air to the outside air. Substances contained in the air are not transmitted from the return air to the outside or supply air. With low OA temperatures in which water condenses out of the return air, this cannot enter the supply air. Only the quantity of outside air which is necessary for dehumidification is used.

Recuperative: Device with counter-flow heat exchanger, without heat pump

Devices with counter-flow heat exchangers achieve the highest-possible heat recovery rates. Modern control systems provide the quantity of outside air required for dehumidification continuously and consistently. The ventilation heat requirement is reduced to a minimum. This solution is ideal for well-insulated swimming pool halls in which the transmission heat loss is very low.

Recuperative: unit with cross-flow heat exchanger and heat pump

Combination of recuperator and down-stream heat pump. Here, the exhaust air is further cooled with the help of the evaporator after the recuperator in outside air mode. The sensitive latent energy in the supply air is transferred to the supply air. The electrical capacity of the compressor is transferred to the swimming pool hall as additional heat gain through the supply air. That way, a large-share of the transmission heat requirement is covered and the heating system can be sized smaller. This solution is ideal for energetically refurbished swimming pool halls.

Recuperative: Device with rotary heat exchanger; Heat wheels

For regenerative heat recovery via a rotary heat exchanger, substances from the swimming pool hall air can be transferred in addition to the sensitive heat. Moisture recovery results due to the design if the dew point is not reached, since the condensate produced by a heat wheel gets in the outside air flow with the help of the rotation. This moisture recovery increases the absolute water content in the supply air and has to be compensated for with a greater quantity of outside air. The significantly higher fan input power results in higher energy requirements in addition to the driving power of the heat wheel.

COMPONENTS

Pool water condenser

A pool water condenser can emit heat to the pool water during the transitional period.

Energetic examination of recuperative and regenerative heat recovery

How it works...
COUNTER-CURRENT HEAT EXCHANGER VS. HEAT PUMP

Device with counter-flow heat exchanger, without heat pump

Stand-by mode

No requirement for temperature or dehumidification, device operates solely in re-circulation mode. The air is air circulation with reduced performance of the fans.

Recirc Air Heating Operation

Heating in accordance with requirements for each heating coil. The OA and EA dampers are closed.

Dehumidification at the device with counter-flow heat exchanger

Dehumidification of the swimming pool hall air through demand-based mixing of outside air (in bathing mode in accordance with VDI 2089 minimum required amount of outdoor air) for the recirculated air flow if required. Reheating of the supply air.

Dehumidification of the device with heat pump

The return air is cooled to below the dew point in the evaporator of the heat pump, reinforced by the recuperator. Outside air with a low moisture content is preheated in the heat exchanger, then mixed with an amount of untreated recirculation air, heated at the condenser and routed into the hall as supply air. If necessary, further heating is carried out with the help of heating coils. During swimming pool mode, the minimum required amount of outdoor air is added as needed.

Outside Air Exhaust Air Mode

In the case of rising OA humidity, the recirc air damper is continuously closed as required. During high OA humidity, the flap closes completely, the device operates in outside air-exhaust air mode.

Defrost Mode

Recuperative heat exchangers tend to ice up if the OA temperatures are low. This is prevented by opening the return air-exhaust air bypass.

Heat exchanger bypass

The proportion of the air guided through the heat exchanger and the bypass can be regulated up to free ventilation.
Quality Factors

YOU CAN RECOGNISE A GOOD HVAC DEVICE BY THESE PARAMETERS.

Control and regulation
Control and regulation is part of any energy-efficient device. The device can be connected to BACnet and other systems and can be operated and analysed by remote control and remote monitoring (vicomo).

Unit structure
The unit design ensures the durability of a device, as well as simple, secure integration. Menerga units are based on a long-lasting, robust frame structure.

Thermal insulation
A good HVAC device is based on a comprehensive thermal insulation concept. It has a solid construction with sufficient rigidity in conjunction with a unit cover designed as sandwich panels. The thermal insulation shell reduces heat losses and hence energy consumption. Thermal isolation is ensured by design. This means best possible avoidance of thermal bridges, and no condensation on the outside of the unit. This is very important when used in the swimming pool hall area.

Cleaning and maintenance
A unit design according to VDI 6022 ensures the high hygiene standard of HVAC units. This includes the possibility of thorough cleaning of all components, in particular the heat exchanger. This has to be made possible already at the design stage.

Highest efficiency confirmed
Menerga is a member of the German AHU Manufacturers Association and certified by them and by EUROVENT. The basis for this is measurements and tests which have been created by independent institutes such as TÜV or DMT. With these we ensure design and production according to standard market quality and efficiency criteria.

Extra corrosion design
If the swimming pool hall air is particularly corrosive, for instance in the case of brine baths, units have to be provided with increased corrosion protection.

All components are complete with corrosion-resistant coatings or polypropylene panels. This ensures a long lifespan.

Polypropylene recuperator
Polypropylene (PP) is a thermoplastic material which is ideal for use in air-conditioning and ventilation technology. It is non-toxic and neutral to ground water. Polypropylene possesses a high level of resistance to many types of acids, alkalis, salts and solvents and is resistant to corrosion and to ageing. The material cannot be metabolised microbiologically and provides no basis for the growth of germs or lime scale and algae deposits. During production, significantly fewer CO₂ emissions are produced compared to aluminium. Furthermore, the weight is five times less.
Comparison of Operating Costs

COMPARISON OF THREE SOLUTIONS FOR DEHUMIDIFICATION

Design conditions
- Pool size: 25 x 12.5 m
- Pool water temperature: 28°C
- Condition of the air in the swimming pool hall: 30°C/54% r.h.
- Swimming pool mode: 8 a.m. – 9 p.m.
- Electricity price: EUR 0.165/kWh
- Heating price: EUR 0.05/kWh
- Air quantity: 15,800 m³/h

Calculation according to VDI 2089.

Specification of all costs in euros

**SYSTEM COMPARISON: SWIMMING POOL HALL WITH EXCELLENT THERMAL INSULATION**
- Requirement: coverage of ventilation heat requirements

**SYSTEM COMPARISON: SWIMMING POOL HALL WITH POOR THERMAL INSULATION**
- Requirement: coverage of ventilation and transmission heat requirements

Accumulated investment, operating and maintenance costs,
Period: 15 years

### Graphs

#### Operating Costs

<table>
<thead>
<tr>
<th>System 1</th>
<th>System 2</th>
<th>System 3</th>
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</thead>
<tbody>
<tr>
<td>Operating costs</td>
<td>17,600</td>
<td>24,500</td>
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<tr>
<td>Maintenance</td>
<td>2,000</td>
<td>3,000</td>
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</table>

#### Investment Costs

<table>
<thead>
<tr>
<th>System 1</th>
<th>System 2</th>
<th>System 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td>71,000</td>
<td>75,000</td>
</tr>
</tbody>
</table>

**Photo:** National Zwemcentrum de Tongelreep, Netherlands
Saving energy with waste water

HEAT RECOVERY FROM WASTE WATER

Not only the waste water in the showers of the swimming pool hall, but also the fresh water in the swimming pool to be supplied per visitor offers great energy potential for swimming pool halls.

Per visitor, 30 litres of fresh water has to be supplied during standard swimming pool operation. This means that 30 litres of pool water brought up to the right temperature must be exchanged for unheated fresh water. Hence, heat recovery from waste water is a good solution for older swimming pool halls, including refurbishment cases. The crucial point for efficient operation is a continuous accumulation of waste water, for instance by using a tank.

**HOW IT WORKS:**
Heat recovery from waste water with fully automatic recuperator cleaning.

The combination of a recuperative counter-flow coaxial recuperator with a heat pump provides the highest possible heat recovery. The warm waste water flows through the recuperator and then through the evaporator of the heat pump. In counterflow and physically separated, the same volume of fresh water first passes through the recuperator, and then through the condenser of the heat pump.

Consistent pipe cross-sections ensure that flow rates are constant. If the waste water is organically contaminated, bacteria growth and organic sludge formation will possibly adhere to the exchange surfaces. These are removed by the fully automatic cleaning. At regular intervals, cleaning pellets are carried along the waste water paths.

Consistent pipe cross-sections ensure that flow rates are constant. If the waste water is organically contaminated, bacteria growth and organic sludge formation will possibly adhere to the exchange surfaces. These are removed by the fully automatic cleaning. At regular intervals, cleaning pellets are carried along the waste water paths.

**Frequency of cleaning:**
- Quantity of flow: 0.8 – 5.4 m³/h
- Heat pump system with fully sealed suction gas-cooled coolant compressor, mounted on vibration dampers
- Ready-to-connect complete device

**Options:**
- Additional prefiltering of the waste water
- Designed as a safety heat exchanger
- Recuperator bypass

---

**Technical data of a swimming pool hall, 1,500 visitors per day**

- Number of swimmers/day: 1,500
- Fresh water quantity/day: 45 m³
- Electricity price: EUR 0.165/kWh
- Heating price (gas): EUR 0.05/kWh
- Fresh water temperature: 10 °C
- Hot water temperature: 35 °C
- Fresh water/person under DIN 19643-1: 30 litres

**Daily operating costs for the necessary fresh water heating**

1. with gas: €65.36/day
2. with heat recovery: €18.87/day
Savings: €46.49/day

**Investment costs**

- Heat recovery device: €44,000
- Installation: €20,000

Amortisation of the conversion: 3.7 years
Energy Costs through Refurbishment

Even partial refurbishment can provide savings of 30%

Our device technology is designed for permanent energy-efficient operation. Many devices which we installed during the first few years of the company still are or will be in running order today. Nevertheless, it pays to check a complete installed system regularly with respect to optimisation opportunities.

A complex system such as a dehumidification plant should be checked every five to ten years. The reason for this is not that there may be possible faults in terms of function or technology, but rather the fast pace of progress and the increasing air-conditioning requirements. Something that was impossible five years ago is state-of-the-art today. And may save you a good deal of money. Have changes turned up in the overall structure? Has a ChP plant been incorporated whose waste heat can be used for heating the swimming pool hall? We always factor the "big picture" into our assessment!

There is also a good deal that can be optimised with respect to regulation of the plant. From 1994 to 2013 each Menerga unit came with an A/B-DDC control system. Since 2009, A-DDC has only been used as a replacement, as has B-DDC since 2012. We modify old devices continuously and you benefit from the much improved technological status, e.g. communication via BacNet, visualised remote access, long-term data recording, lower energy requirements, connection of other components which can also be managed and much more. This pays off in many ways.

A modern public swimming pool consists not only of the swimming pool hall, but also of many other areas which place various requirements on the ventilation and air-conditioning. The areas have to be considered separately from one another to a large extent.

Entrance area
The business card of a swimming pool hall. If it smells of chloroform here and is stiflingly hot, it will make a bad impression. Temperature recommendation at least 20 °C.

Toilets, showers
In these areas, the bather is lightly dressed. The temperature in the shower and sanitary rooms should be between 26 and 34 °C.

Changing rooms
In the changing rooms the visitor is either lightly dressed or fully dressed. The air temperature in this area is maintained between 22 and 28 °C so that the guest neither freezes nor sweats.

Staff and first aid rooms
The people here tend to be lightly dressed. The ideal air temperature is between 22 and 26 °C.

Fitness areas
In order to avoid putting additional stress on the body during exercise, an air temperature of between 18 and 26 °C is recommended.

Wellness complex
In the wellness complex, the people are mostly lightly dressed, but not wet. Depending on the form of use, the air temperatures are usually between 26° and 30°C.

Restaurant
According to the German building regulations for restaurants, the room air temperature in a restaurant is supposed to be between 19 and 26 °C.

Kitchen
In the kitchen area the room air temperature should be at least 17 °C and preferably not above 26 °C. It should be borne in mind that a high fat content can occur in the return air, for which an encapsulated ventilation unit is required.

Sauna
Heat can be recovered in the sauna area - however, the supply of fresh air must also be ensured. Recommended air temperature: 22° - 26°C.

Hotel, conference rooms and more
Currently, leisure oases are being created worldwide with an adjoining hotel, business rooms etc. We also provide the appropriate air-conditioning for these additional applications.

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