Air Handling Systems for Medical Applications

robatherm

the air handling company

Hygiene and Comfort for Efficient Healing.

A hygienically perfect and comfortable room climate supports and accelerates the healing process. Treatment times are reduced and costs saved.

The health care sector is marked by an increasing cost pressure on medical facilities. Hospitals, in particular, must reconcile the task of cutting costs with the need for improving the quality of their services in the face of increasing competition.

Hygiene in a hospital is a self-evident prerequisite to the quality of services. Avoiding hospital-acquired, or so-called nosocomial infections, is top priority.

During surgical interventions, wound contamination is caused by the patient's own flora (endogenous infection) or by pathogens from external sources (exogenous infection), such as the surgical staff.

Air handling systems are, therefore, indispensable for reducing or avoiding the introduction of airborne pathogens into the wound. They are designed to keep pathogens away from wounds, or at least dilute the pathogen concentration at the wound site to an unobjectionable level, by means of a flow of ultra-purified air.

Especially in aseptic interventions posing a very high risk of infection, as is the case in joint implantations and in trauma surgery, air handling systems have to meet the highest demands. A hygienically impeccable and comfortable room climate creates a medically safe and undisturbed treatment environment. Additionally, patients' treatment times are reduced to the minimum medically required, avoiding unnecessary long hospital stays. At the same time, the hospital's operation costs can be reduced, and the staff's work performance is maintained at a constant high level.

With regard to quicker recovery, enhanced comfort and a safe work environment, air handling systems for medical applications should be given particular attention.

Highest Demands on Air Handling Technology.

Many of factors need to be considered to meet the high demands on air handling systems while ensuring cost-effectiveness.

New concepts
Innovative heat recovery systems significantly reduce the primary-energy demand of an air handling system. A reversible heat pump, for instance, allows cooling the air in summer and heating the air in winter. Additionally, electrical energy for driving the fans is saved, because only one heat exchanger is required in the air supply. The supply- and extract-air flows remain separated, without any risk of contamination of the supply air.

Ensure comfort for patients and staff.

Clean air thanks to professional design and maintenance.

Operating times between 5,000 h and 8,760 h per year.

Integration of compressors in AHUs saves space, increases the COP and facilitates maintenance.

Primary-energy demand reduced, e. g. by using reversible heat pumps for heat recovery.

The main tasks of air handling systems include supplying a sufficient amount of oxygen, removing carbon dioxide and maintaining a comfortable room climate that is unobjectionable from the viewpoint of climate-physiology. In rooms having to meet special requirements, such as operating theatres, the supply air has further functions. The air handling system must also act as a barrier screening the specified protected area, reduce the concentration of microorganisms, provide temperature and humidity control and remove odours and contaminants.

Air cleanliness
Air cleanliness is of particular importance in hygiene applications. Air filters here fulfil a combination of several tasks: They protect patients and staff from infections, and air handling units (AHUs) and the ductwork from contamination. Scrupulous checking of filters for clogging prevents the ingress of dust and cuts the operating cost of the system as the pressure drop across filters is reduced.

Operation times
Depending on the medical facility, the operating hours of air handling systems may vary considerably: In hospitals, for instance, they range between 5,000 h/a and 8,760 h/a (non-stop operation). From the viewpoint of hygiene and energy consumption, but also for reasons of operational reliability, plug fans combined with frequency converters and energy-efficient motors are particularly convenient here. This combination offers highest efficiencies along with low operating costs.

Integrated chillers
Air conditioning by means of air handling units (AHUs) is required to create a comfortable room climate and a safe work environment. Ideally, the necessary refrigeration equipment is integrated directly into the AHU, which helps to save space in the engineering room. No further external devices are required, and considerably less sound is emitted to adjacent buildings. Also, the coefficient of performance (COP) of the refrigeration system is more favourable as the condensation temperature of exhaust-air-cooled condensers is lower than that of axial condensers installed outdoors. Moreover, the entire equipment is accessible for maintenance in one place, and its operation is more reliable compared to central external chilling.

Important standards and guidelines pertaining to hospitals		
Requirements regarding buildings	**... regarding air handling systems**	**... regarding air handling units**
European Energy Performance of Buildings Directive (EPBD) Act on the saving of energy in buildings **Energy Savings Act (EnEG)** [1] National implementation of the EPBD **Renewable Energies Heat Act (EEWärmeG)** [1] Act on the promotion of renewable energies in the heating sector **Energy Savings Ordinance (EnEV)** [1] Ordinance on energy-saving thermal insulation and energy-saving installations in buildings **DIN V 18599** [1] Energy efficiency of buildings **DIN 13080** [1] Division of hospitals into functional areas and functional sections	**EN 13779** Ventilation for non-residential buildings **EN 15242** Calculation methods for the determination of airflow rates in buildings including infiltration **EN 15251** Indoor environmental input parameters for design and assessment of energy performance of buildings **EN 15780** Ventilation for buildings – Ductwork – Cleanliness of ventilation systems **DIN 1946-4** [1] Ventilation in buildings and rooms of health care **VDI 2081** [1] Noise generation and noise reduction in air-conditioning systems **Hygiene requirements for surgical and other invasive interventions** Commission for hospital hygiene and infection prevention (Robert-Koch-Institute)	**EN 13053** Rating and performance for units, components and sections **EN 1886** Mechanical performance and measurement methods **DIN 1946-4** [1] Ventilation in buildings and rooms of health care **VDI 3803** [1] Air conditioning systems – Structural and technical requirements **VDI 6022** [1] Hygienic requirements for ventilation and air conditioning systems and air handling units **AHU-Guideline 01** [1] Herstellerverband Raumlufttechnische Geräte e.V. – General requirements for air handling units

[1] Valid in Germany; deviating or additional national rules and regulation to be observed as well!

Hygiene Thanks to Well-directed Airflow Routing.

The selection of the system for supplying air into the operating field is determined by the room class and the subsequent hygiene requirements.

Specification of room classes performed by the hospital-hygiene specialist.

Conditioned supply air suffices to establish a protected area in the operating theatre.

Supply-air temperature below indoor temperature.

Positioning of extract- and recirculation-air openings in lower wall sections.

“Surgery mode” must be selectable by pushbutton in the operating theatre.

Scientific findings revealed, that pathogens transmitted through the air, so-called airborne microorganisms, pose but a minor risk of infection. The classification of rooms has, therefore, been revised. The required protected area is maintained only where absolutely imperative.

Room class Ia
Aseptic interventions subject to particularly strict requirements in terms of hygiene, as is the case e. g., in trauma surgery or orthopaedics.

Room class Ib
Medical interventions subject to high requirements in terms of hygiene, such as encountered in minimally invasive surgery or, in parts, in intensive-care wards.

Room class II
Other rooms and areas not allocated to room classes Ia or Ib, such as rooms ancillary to operating theatres, or anaesthetic recovery rooms, observation rooms and pre-operative rooms.

Special areas
Rooms where additional precautions are taken, such as isolation rooms (negative pressurisation with room-side H13 particulate extract-air filters), sterile-care rooms (positive pressurisation with room-side H13 particulate supply-air filters) or central sterilization units (packaging zone under positive pressure with respect to the cleaning zone).

Air flow rates
Given a passage velocity of 0.25 m/s, a unilateral-flow supply-air diffuser measuring 3.2 m x 3.2 m will yield a volume flow rate of approx. 9,200 m^3/h per operating theatre. Thus, at a minimum outdoor-air flow rate of 1,200 m^3/h, an additional supply of approx. 8,000 m^3/h will be required. For this reason, systems relying exclusively on outdoor air are no longer state-of-the-art equipment.

Supply-air temperature
A low-turbulence air curtain will only form if the temperature of the supply air is constantly below that of the indoor air. The greater the temperature difference, the more stable the protected area will be. An excessive temperature difference, however, will have an utterly adverse effect on the energy demand and on the surgical staff’s comfort and well-being. Static panel heaters must be provided. In room class Ia, however, underfloor heating is inappropriate as it counteracts the unilateral air flow.

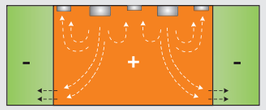
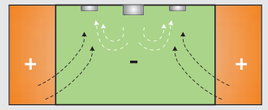
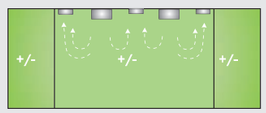
Air discharge openings
As a matter of principle, extract-air, recirculated-air and overflow openings should be located in the lower wall sections. Air will thus leave the room with the least possible turbulence (extract-air openings with lint screens).

Operating modes
A constant volume flow rate is prerequisite to the reliable formation of a protected area. In operating theatres with unilateral air flow supply-air diffusers, the operating modes “Surgery” and “Sustainment” are mostly used. It must be possible for the surgical staff to switch on the surgery mode by activating a pushbutton in the operating theatre. During sustainment mode, the unilateral air flow need no longer be maintained. Outside surgery times, less energy is thus required for heating and cooling as well as for the fan driving.

Design
Modern air-conditioning layouts for operating theatres are based on central conditioning of outdoor air plus a central or local treatment of recirculated-air. In case of indoor-air recirculation, central systems are beneficial because outdoor air and recirculation air will be completely homogeneously mixed. No cooling below dew point can occur inside the unilateral air flow diffuser. In addition, the permissible sound pressure levels are easier to observe. Furthermore, all components provide greater ease of access for maintenance.

Control
The nominal temperature must be selectable by a control element in the operating theatre. This nominal value is compared to the extract-air temperature. The temperature rise due to internal room loads is compensated by means of the supply air. The supply-air temperature is thus sure to be below indoor-air temperature.

Room classes and air routing systems [1]

Room class Ia	Room class Ib	Room class II
Rooms subject to **very strict** hygiene requirements	Rooms subject to **increased** hygiene requirements	Rooms subject to **general** hygiene requirements
	 	 
Dynamic screening of the protected area	**Static pressurisation**	**Overflow / air-mixing principle**
Ensuring the protected area around the operating table, surgical staff and medical instruments table by means of a stable top-to-bottom unilateral air flow. • Positive air balance. • Higher velocities in unilateral air flow centre improve protective effect. • Supply-air temperature below indoor-air temperature. • 3-stage filtration (at least F5/F9/H13).	Constant pressurisation with respect to ancillary rooms. Air intake by non-unilateral or unilateral air flow. Directed overflow of at least the volume of the minimum outdoor-air fraction. Introduction of particles by humans or through open doors cannot be prevented. • Positive air balance. • No separate protected area. • 3-stage filtration (at least F5/F9/H13).	Air intake can be based on the overflow principle or on the air-mixing principle with a neutral air balance. For these areas, provide an airflow pattern that ensures high ventilation effectiveness and quick removal of any contaminants from the emission source. • For hygienically relevant areas, the requirements of VDI 6022	1 apply. • 2-stage filtration (at least F5/F9).

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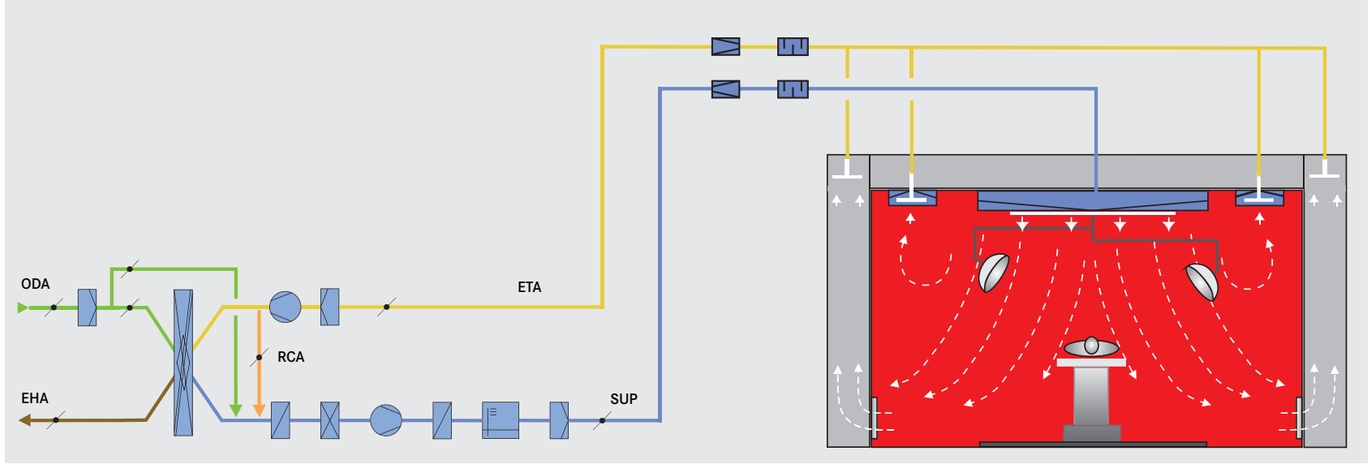
Design. Cornerstone of Success.

Solution-oriented job implementation.



Example: single room at recirculation air operation

Boundary conditions to be defined at an early stage of design.

A specification sheet forms the basis of a contract.

Experience joins rules of technology to facilitate design.

Design guidance [1, 2]

In general	Air handling systems
Analysis stage • Actual-state inventory and assessment of building project. • Basic evaluation including process description. Planning of available resources. Identification of infrastructure and drafting of job description. • Compilation of current standards. • Analysis stage finalized upon signature of the declaration of intent for drafting a requirements specification. **Goal-definition stage** • Analysis of utilization requirements (utilization concept, intended range of surgical services, comfort conditions, deadlines, design data, occupancy, additional internal loads, periods of use, etc.). • Drafting of a requirements specification on the basis of current standardization (hygienic acceptance test of unilateral air flow system, specification of cleaning procedure, etc.). • Approval of project requirements specification at the beginning of the design stage. **Design stage** • Implementation of design in accordance with the specification sheet. Implementation of design in terms of hygiene (cleaning), maintenance (accessibilities), safety concepts (redundancy, self-closing dampers, etc.) and any specific requirements. • Coordination of the initial, and all further, hygiene inspections by qualified specialists (VDI 6022, Category A). • Updating of the standards list upon finalization of the design stage.	• Outdoor-air intakes at least 3 m above ground level. • Outdoor air taken in without interference from emission sources. Provide openings for drainage and cleaning. • No outdoor-air intakes along the main wind direction; for roof intakes, observe a minimum distance to the surface of 1.5 x snow height. • Exhaust-air discharge via the roof. • Install silencers, heat exchangers and dampers in the AHU (for ease of maintenance). • Volume flow controllers and shutoff dampers to be installed in the mechanical equipment rooms, where possible. • Position and size of inspection openings must be indicated in the ground plan. • Inspection openings in air ducts. • Both sides: heat exchangers, silencers, heat recovery. • One side: dampers, fire dampers, volume flow controllers. • Flexible air ducts only permissible for connections to air terminal units (L_{max} = 1.0 m). • Max. permissible specific leakage of air ducts must correspond to Class C as defined in DIN EN 13779. • Localized emissions to be removed directly. • Prefer pressure regulation where constant volume flows are ensured by volume flow controllers. • Make sure that AHU allows access on both sides (half a unit width at rear, full unit width at front).

Design parameters [1, 2]

Outdoor		Indoor	
Temperature		**Indoor-air temperature** [2, 3]	
Winter:	- 16 °C to +12 °C	**Winter:**	
Summer:	28 °C to 35 °C	OP theatres (Classes Ia, Ib):	19 °C to 26 °C
		(selectable from inside the operating theatre)	
Humidity		Intervention rooms (Class II):	22 °C to 26 °C
Summer:	37 % r. h. to 64 % r. h. (12 g/kg to 14 g/kg)	Intensive-care area:	22 °C to 26 °C
		Standard-care rooms:	22 °C
(temperature and humidity depending on climatic conditions)		Baby-care rooms:	24 °C
		Examination rooms:	22 °C
		Kitchenettes, corridors:	20 °C
		Sterilization:	20 °C
		Storerooms:	18 °C
Sound pressure level (TA-Lärm) | 1			
Daytime (6h-22h):		**Summer:**	
Residential areas:	55 dB (A)	OP theatres (Classes Ia, Ib):	19 °C to 26 °C
Mixed-use areas:	60 dB (A)	Intervention rooms (Class II):	22 °C to 26 °C
Commercial areas:	65 dB (A)	Intensive-care unit:	22 °C to 26 °C
Industrial areas:	70 dB (A)	Standard-care rooms:	26 °C
		Baby-care rooms:	26 °C
Night-time (22h-6h):		Examination rooms:	26 °C
Residential areas:	40 dB (A)	Kitchenettes, corridors:	28 °C
Mixed-use areas:	45 dB (A)	Sterilization:	28 °C
Commercial areas:	50 dB (A)	Stores:	depending on goods stored
Industrial areas:	70 dB (A)		
		Indoor humidity	
		Intensive-care rooms:	30 % r. h. to 60 % r. h.
		(mandatory year-round)	
Minimum outdoor-air rate		Other rooms:	
Operating theatres:	1,200 m^3/h	Winter:	≥ 25 % r. h. [5]
Intervention rooms:	40 $m^3/(h \cdot pers.)$ or 150 $m^3/(h \cdot patient)$ where anaesthetic gases are used	Summer:	≤ 60 % r. h. [5] or max. 12 g/kg [5]
Intensive-care area:	40 $m^3/(h \cdot pers.)$ or > 100 $m^3/(h \cdot patient)$	**Sound pressure level** [4]	
Other rooms, corridors (intensive care):	5 $m^3/(h \cdot m^2)$	Operating theatres:	48 dB(A)
		Wards:	25 dB(A) to 35 dB(A)
		Bedrooms:	25 dB(A) to 35 dB(A)
		Corridors:	35 dB(A) to 45 dB(A)

[1] Valid in Germany; deviating or additional design parameters to be observed in accordance with the national requirements!
[2] For further information, also on the design of buildings and the use of air handling systems, see DIN EN 13779 and DIN 1946-4.
[3] Values correspond to the operative temperatures.
[4] Details concerning indoor-air temperatures and permissible sound pressure levels are to be found in the table issued by Deutsche Gesellschaft für Krankenhaushygiene.
[5] Recommendation based on DIN EN 15251, Category II.

Safety and Hygiene. Solutions Made by robatherm.

AHU concepts specifically optimized to suit your application.

Custom-built and optimized for your needs.

High hygiene standard and high product quality.

Certified energy efficiency in accordance with EUROVENT and German AHU manufacturers' association.

Integrated control- and refrigeration technology.

Excellent hygiene characteristics of the robatherm AHUs were tested and certified by the TÜV Nord. Proper operation and maintenance provided, our hygiene AHUs will ensure hygienically impeccable air quality. Moreover, the operating costs of the optimally configured AHUs have been reduced to a minimum.

High variability
With its outstanding versatility and the broad throughput range from 1,000 m^3/h to 320,000 m^3/h, the robatherm product line meets a wide variety of customer requirements. Restrictions in available space or particular installation conditions are taken into account at the project design stage.

Excellent hygiene
Periodic maintenance ensures hygienic conditions throughout the life time. The maintenance-friendly robatherm AHUs ensure impeccable cleaning as all components are arranged in the unit to be easily accessible.

Proven mechanical stability
The rugged and proven construction of the AHUs includes, among others, powder-coated galvanised sheet as a standard. Stainless steel is available as well.

Antimicrobial
The antimicrobial powder coating of air handling units inhibits the growth even of multiresistant germs. Its high and sustained effectiveness has been tested and confirmed in a long-term study.

Low heat losses
A panel construction with thermal break guarantees very high thermal insulation and high air tightness. The energy demand is minimized, as is the tendency of condensation inside the casing.

Easy assembly
The modular design of the robatherm AHU means a minimum of sections to be assembled. This significantly saves time at site. Sturdy internal casing connections facilitate assembly even further. In particular, the factory integration of control and refrigeration components and chillers that contributes to expediting installation and commissioning of the AHUs. Shorter standstill times are thus achieved, above all in case of replacements.

Low energy demand
The top efficiency classes are reached as a result of smart dimensioning and the use of optimized built-in components. Our AHUs are certified in accordance with the energy-efficiency classes of the Herstellerverband Raumlufttechnische Geräte e.V. and the guideline of the European certification body EUROVENT.

The physical characteristics
of the AHU casing as specified in DIN EN 1886:

- Thermal transmittance: Class T2
- Thermal bridges: Class TB1
- Casing leakage: Class L1 (M), L2 (R)
- Filter bypass leakage: Class F9
- Casing deflection: Class D1/D2

Detailed Optimization. Controls and Cooling Combined Logically.

Customized, factory-integrated control systems and chilling equipment allow you to make the most of potential savings.

Everything
from a single source.

On-site
installation work and cost reduced.

No distribution
and standstill losses.

Integrated
refrigeration without external units.

Reversible
heat pump.

Central multifunctional AHUs
are ready for plug in.

The control system is optimally adjusted at the factory. The various thermodynamical requirements to be met by a central AHU can thus be fulfilled along with optimizing the operating cost. For this reason, robatherm has developed the DDC software "Smart Control".

Control technology
Instrumentation and control are integrated into the AHUs at the robatherm factory. All that remains to be done is parameterizing the function blocks of the control system. The commissioning cost is, therefore, minimal.

Integrated maintenance management
The maintenance management included in Smart Control records immobilization and operating times of the components and automatically generates inspection reports which are displayed in plain text. Appropriate descriptions of the components are also given.

Particularly in AHUs for hygiene applications, the maintenance management ensures increased operational reliability and hygienically impeccable conditions.

Communicative and open
Various communication options are at your disposal, such as:

Cost-effective "Remote Terminal":
Operating, monitoring and parameterizing of up to 15 AHUs via a dedicated local network.

Open communication:
Communication with higher-level building automation systems via Modbus, BACnet or LON.

Refrigeration equipment can be integrated at the robatherm factory. The AHU, the control and cooling equipment will then form an optimal unit. Central AHUs with integrated compressors and exhaust-air condenser have proven the ideal all-in-one solution for architectural reasons as well as in terms of operating cost and operational reliability.

Integrated cooling technology
AHUs with integrated cooling technology have an edge over central water chillers because of less space requirement and less distribution losses. These cooling devices are overall systems optimized in themselves, featuring high coefficients of performance (COP). Also from the viewpoint of redundancy, integrated systems are advantageous where several AHUs are used, for in the event of fault, it is never the entire cooling equipment that fails.
Further savings ensue from less piping work being required and from the fact that standstill and distribution losses do not occur. In winter, the use of the heat carried by the extract air has additional synergistic effects. The chiller will then operate as a reversible heat pump.

Advantages
Easy installation and fast commissioning are vital in the health care sector, particularly where existing buildings are concerned. Medical facilities being subject to continual extension, conversion or renovation, intelligent all-in-one solutions clearly have an edge here. In the case of all-in-one solutions, commissioning is performed by robatherm. A connection to a higher-level building automation can be established at the same time.

robatherm supplies everything from a single source: central multifunctional AHUs, weatherproof or for indoor installation, completely assembled and parameterized in short: ready for hook-up.

Long-standing Experience. Proven AHU Concepts.

AHU concepts specially for medical applications.

TrueBlue evidence of efficiency.

Benefit from our know-how, also in the medical sector.

We offer AHU concepts specifically optimized for medical applications. The AHU concepts provide you with quick, specific and competent information concerning the design of a unit and its performance data – optimized in terms of performance, function and price. And all this tailored to your individual requirements. You require further details or the documented "TrueBlue" evidence of efficiency? We will be glad to give you competent advice!

Equipment features

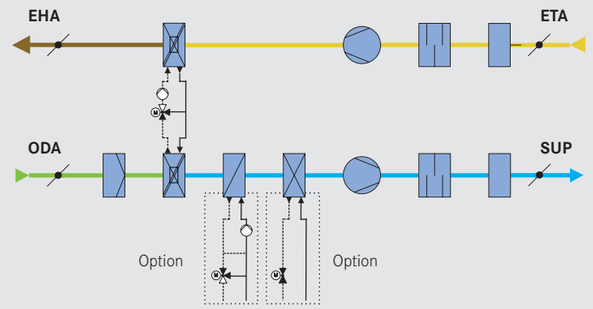
- AHU designed for outdoor installation (weatherproof)
- Rotor heat recovery
- Cross-flow plate heat exchanger
- Heat recovery loop
- Free-wheeling fan
- High-efficiency electric motor
- Controls integrated into AHU
- Direct refrigeration integrated into AHU
- Reversible heat pump integrated into AHU
- Hydraulic set integrated into AHU
- Steam humidifier integrated into AHU
- Silencer integrated into AHU

Optimization features

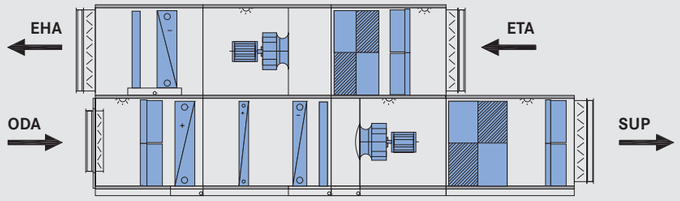
- Low investment cost
- Reduced operating cost
- High energy efficiency
- Compact design
- Easy-to-install
- Easy-to-maintain

Navigator	Equipment features	Optimization features

Plant flow diagram



AHU schematic



Front view

AHU equipment

Design:	indoor installation; AHU inside: walls powder-coated / floor 1.4301	Cooler:	t_E=32 °C, φ = 40 % r.h., h_E=62.8 kJ/kg, t_A= 18 °C, φ = 85 % r.h., media: PCW 7/13°C + 30% glycol
Filters:	Supply-air pre-filter: G4 (flat type) Supply-air main filter: F7+F9 (pleated type) Extract-air main filter: F7 (pleated type)	Dampers:	Aluminium with external linkage, tightness class 2, tightness class 4 towards room
Heat recovery:	Constant-volume heat recovery unit with built-in hydraulic set	Accessories:	Filter differential pressure indicator (for main filters without sealing liquid) Frequency converter with service switch, Lights in all relevant areas
Heater:	t_E ≈ 0°C, t_A =26°C, media: water 70/50°C		

AHU description

Favourable investment cost, most easy to maintain.

Compact dimensions thanks to modular and stacked design.

4 sections due to combined AHU design, plus hydraulic set.

Suitable for room classes Ia, Ib and II. For room class I, terminal filters of at least H13 quality are to be provided by the customer.

Supply- and extract-air totally separated.

Pleated filters (classes F7 + F9) ensure long-term compliance with the required supply-air quality.

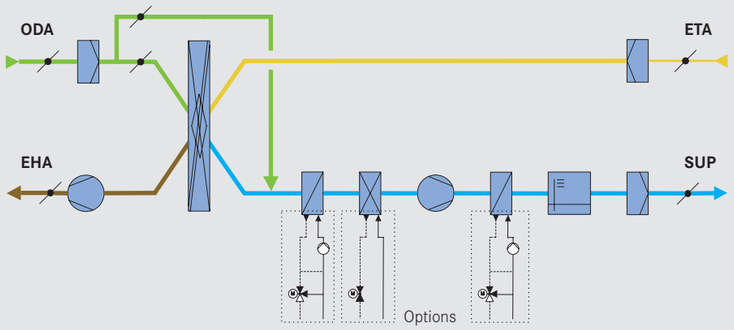
Direct-drive fans allow trouble-free operation.

Frequency converters are factory-installed, wired and parameterized.

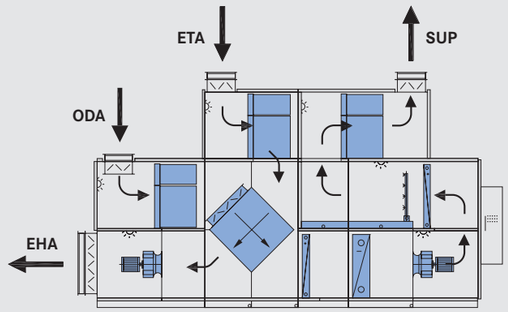
Abbreviations for types of air (as specified in DIN EN 13779): ODA=outdoor air, SUP=supply air, ETA=extract air, EHA=exhaust air, RCA=recirculation air

Navigator	Equipment features	Optimization features

Plant flow diagram



AHU schematic



AHU equipment

Design:	indoor installation AHU inside: wall powder-coated / floor 1.4301	Dampers:	Aluminium with external linkage, tightness class 2, tightness class 4 towards room
Filters:	Supply-air: F7 (biostatic) /F9 Extract-air: F7	Humidifier:	Steam lances including built-on electric steam humidifier $t_{E\,min}$ = 22° C; Δx_{max} = 6 g/kg
Heat recovery:	Plate heat exchanger with integrated bypass damper	Control:	AHU control in separate control cabinet incl. 5 m cable
Heater:	$t_E \approx 7°C$, $t_A = 26°C$, Fluid: PWW 70/50°C	Accessories:	Filter differential pressure indicator (without sealing liquid) Frequency converter with service switch Lighting in all relevant areas
Cooler:	t_E = 32 °C, φ = 40 % r.h., h_E=62.5 kJ/kg, t_A = 17 °C, $\varphi \approx$ 88 % r.h., media: PCW 7/13°C + 30% glycol		

AHU description

Favourable investment cost, easy to maintain.

Compact dimensions thanks to modular and stacked design.

6 sections units due to combined AHU design, plus control cabinet.

Only suitable where recirculation between rooms is permissible, or where recirculated air is returned to the same room with functionally related ancillary rooms (same room class).

Reduced pressure losses allow efficient application of free cooling of buildings (e. g. at night).

Electric steam humidifier completely built onto AHU and piped ready for connection.

Integrated control, separate control cabinet, provided with cable.

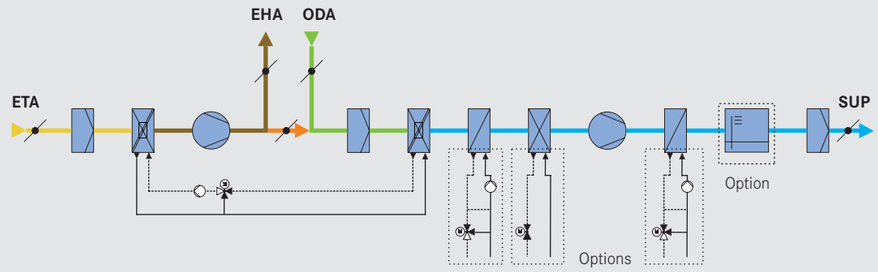
Plug fans allow trouble-free operation.

Frequency converters are factory-installed, wired and parameterized.

Abbreviations for types of air (as specified in DIN EN 13779): ODA=outdoor air, SUP=supply air, ETA=extract air, EHA=exhaust air, RCA=recirculation air

Navigator	Equipment features	Optimization features

Plant flow diagram



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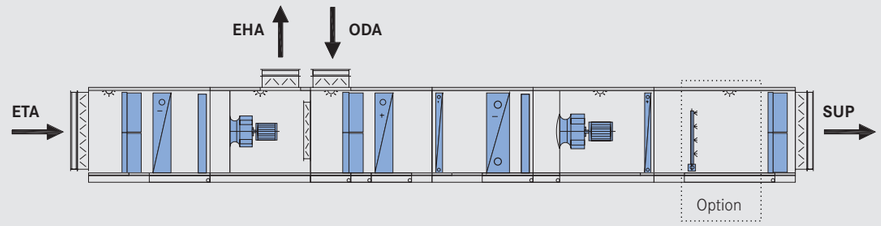

AHU equipment

Design:	indoor installation AHU inside: wall powder-coated / floor 1.4301	Dampers:	Aluminium with external linkage, tightness class 2, tightness class 4 towards room
Filters:	Supply-air pre-filter: G4 (flat type) Supply-air main filter: F7+F9 (pleated type) Extract-air main filter: F7 (pleated type)	Humidifier:	Empty chamber for customer's steam humidifier Option: steam lances with or without electric steam humidifier
Heat recovery:	Constant-volume heat recovery unit with built-in hydraulic set	Accessories:	Filter differential pressure indicator (for main filters without sealing liquid) Frequency converter with service switch Lights in all relevant areas
Heater:	$t_E \approx 0°C$, tA HE 1=26°C, t_A HE 2 = 26°C, Fluid: PWW 70/50°C		
Cooler:	t_E=32 °C, $\varphi \approx$ 40 % r.h., h_E=62.8 kJ/kg, t_A= 13 °C, $\varphi \approx$ 96 % r.h., media: PCW 6/12°C + 30% glycol		

AHU description

Favourable investment cost, easy to maintain.

Easy to assemble thanks to only 6 sections plus hydraulic set.

Only suitable where recirculation between rooms is permissible, or where recirculated air is returned to the same room with functionally related ancillary rooms (same room class).

Supply- and extract-air totally separated

Pleated filters (classes F7 + F9) ensure long-term compliance with the required supply-air quality.

Direct-drive fans allow trouble-free operation.

Frequency converters are factory-installed, wired and parameterized.

Abbreviations for types of air (as specified in DIN EN 13779): ODA=outdoor air, SUP=supply air, ETA=extract air, EHA=exhaust air, RCA=recirculation air

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Best references.

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That is why many well-known companies favor robatherm‘s solutions.

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