

APPLICATION BROCHURE

Clean Rooms

***Spotless turn-key solutions
for industry***





CLEAN ROOMS

Clean Room technologies for system components, room airhandling, and air filters – offer flawless quality and meet highest demands for the cleanliness of working areas. They protect both people and products.

Energy-efficient packages for highest manufacturing standards

DencoHappel

As an internationally active technology group, DencoHappel concentrates on process technology and components for demanding production processes in a wide variety of end-user markets. Clean Rooms prove this quality and innovative strength.

Clean Rooms

Clean rooms and ultra-clean rooms represent some of the most complex challenges for air treatment. They demand absolutely top standards for competence as well as specific experience for reliable clean room and process air treatment. Clean Rooms satisfy all international clean room standards and ISO classifications. They far exceed conventional quality levels.

Clean rooms feature a controlled level of contamination that is specified by the number of particles per cubic meter for a specified particle size. For example, semiconductor manufacturing can require a minimum of ISO Class 3 which allows 35 particles per cubic meter at a size of range 0.5 micrometer. To give perspective, ambient air outside in a typical urban environment contains 35 million such particles.

Covering the entire process for turnkey solutions

DencoHappel customers profit from our comprehensive overall expertise in room-air handling and filter technology. In contrast to other providers, we cover the entire process of air treatment and air filtration for supply-air and extract-air systems. We understand the interrelationships and manage them down to the smallest detail. As a result, we can offer highly effective, process-dedicated package solutions with energy-efficient technology – optimized for your sector and applications. Efficient heat-recovery systems and reliable filter systems with low pressure drop assure considerable energy savings. We deliver turnkey solutions on a one-stop shopping basis: beginning with building elements such as ceiling grid modules, filter and panel ceilings, laminar-flow ceilings, clean room walls, wall paneling, windows and doors – including development and installation of your clean room facilities – and extending to after-sales service.



One-stop solutions:

- Room air handling
- Air filtration
- Clean room design software
- Ceiling, including lighting
- Partition-wall panels
- INWALL Click® covering panels
- Windows and doors
- Monitoring and documentation systems
- After-sales service



- Safe and hygienic environment
- Controlled air flow
- Tailor-made solutions from a single source
- Substantial manufacturing depth
- Easy maintenance and sanitation
- Optimized life-cycle costs
- Highly sensitive controls, 24/7 service

CLEAN ROOM SYSTEM SOLUTIONS

Maximum benefits with manageable investment

DencoHappel manufactures and delivers a comprehensive system of clean rooms, which enables a decrease in the number of undesirable airborne particles to a level suitable for industrial demands complying with the requirements of standard EN ISO 14644 and GMP guidelines. The DencoHappel portfolio includes wall panels, wall lining, doors, privacy-screen doors, ceilings, laminar fields, clean-air extensions, light fixtures, as well as air-handling and HVAC components. Clean rooms by DencoHappel meet or outperform strict requirements for working areas such as those for cleanability, air exchange, uniform airflow, and lighting.

Whether for work in research and development, in highly specialized mass production, or in countless other applications – clean air is essential for producing pharmaceutical tablets, filling liquids, grinding substrates, and processing hazardous materials. The objective: to protect staff from dangerous substances, and products from contamination.



SEMICONDUCTOR MANUFACTURING, NANOTECHNOLOGY

DencoHappel Clean Rooms meet challenging demands up to ISO Class 5 or even better to protect products from contamination.

BIOTECHNOLOGY, PHARMACEUTICALS, COSMETICS

Clean air, with a controlled level of airborne particles and without leaked undesirable substances or aerosols, is essential for the health and safety of men and women.

LABORATORIES, RESEARCH, AND DEVELOPMENT

Flawless air quality and cleanliness of these working areas is a prerequisite for faultless results.

Clean rooms:

- Minimal release of particles from surfaces
- Rounded inner corners and radius connection of wall partitions to the floors and ceilings
- Room tightness that guarantees the required positive and negative pressures in a room
- Easy maintenance, effective sanitation, and resistance to disinfectants
- Conformity with health and safety requirements
- Engineering design and production from a single source



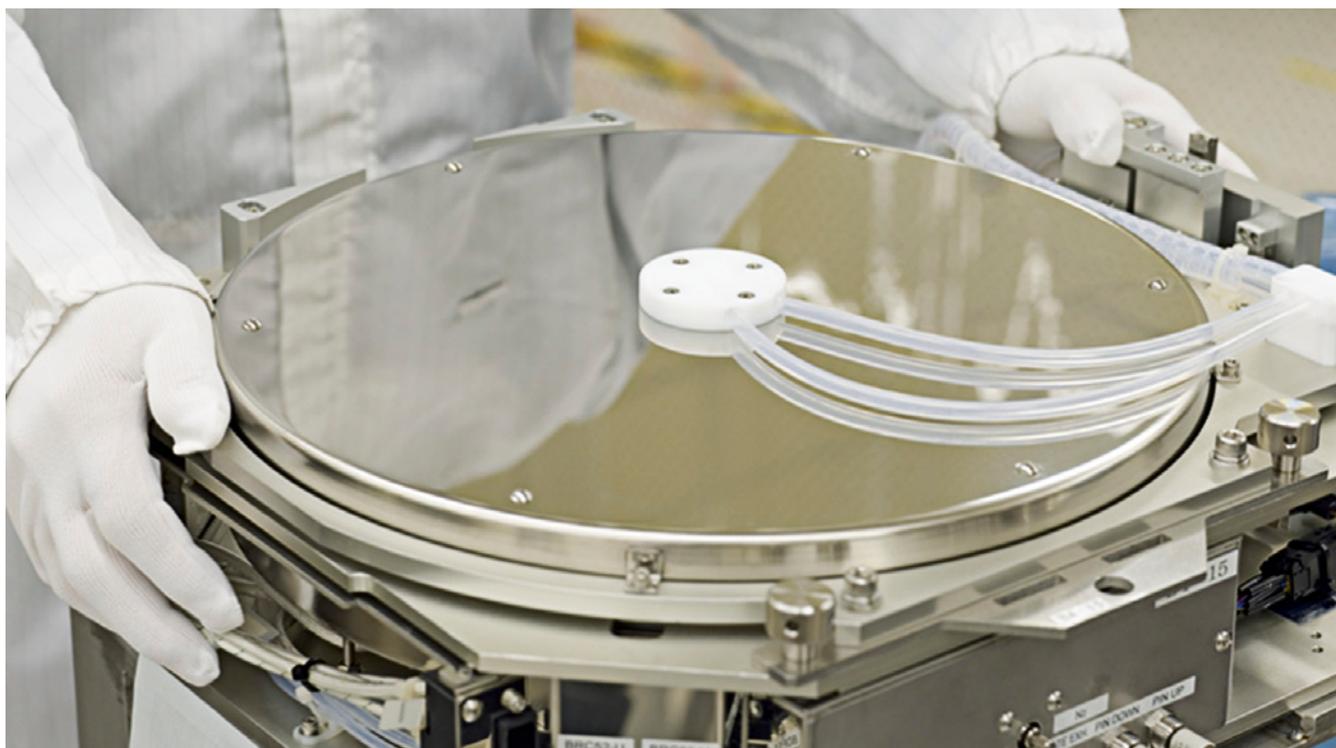
Packages according to all standards

- Both FS 209E and ISO 14644-1 assume log-log relationships between particle size and particle concentration.
- US FED STD 209E was officially cancelled by the General Services Administration of the US Department of Commerce in 2001, but is still widely used.
- Other standards are VDI 2083 in Germany, BS 5295 (1989) in Great Britain, and GMP EU classification.

DencoHappel Clean Rooms are designed according to international standards and their individual components satisfy ErP and EUROVENT guidelines. DencoHappel offers the complete range of components and services needed for a clean room. The one-stop DencoHappel solution includes planning, engineering design, production, assembly, commissioning, validation, and aftersales service. DencoHappel Clean Rooms ensure maintaining the required positive or negative pressure in the room. Rounded inner corners and radius connections of the wall partition to the floor and ceiling, smooth surfaces, and dismountable parts enable easy maintenance of DencoHappel Clean Rooms. Sanitation is hassle-free. Clean rooms assure particulate-free air through the use of either high-efficiency particulate air filters (HEPA) or ultra-low penetration air filters (ULPA), which implement laminar or turbulent air flow principles. DencoHappel air-handling units and filters enable low pressure loss. Electronically commutated (EC) motors and LEDs ensure energy savings and economic efficiency. Modular systems offer tailor-made solutions and manageable investments. Comprehensive service including projects, assembly, and validation can be taken for granted.

Prepared for future challenges

Semiconductor manufacturing is a major driving force for future demands that exceed even the strictest ISO Class 1. DencoHappel Research and Development Engineers are prepared to meet these extreme requirements for so-called mini-environments, which must be virtually pollutant-free.



Clean room classes according to ISO 14644-1

Class	Particles per m ³					
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm
ISO 1	10	2	-	-	-	-
ISO 2	100	24	10	4	-	-
ISO 3	1,000	237	102	35	8	-
ISO 4	10,000	2,370	1,020	352	83	-
ISO 5	100,000	23,700	10,200	3,520	832	29
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO 7	-	-	-	352,000	83,200	2,930
ISO 8	-	-	-	3,520,000	832,000	29,300
ISO 9	-	-	-	35,200,000	8,320,000	293,000

European Standard for HEPA, and ULPA Filters

Filter Classification	Efficiency (%) at the MPPS		Penetration (%) at the MPPS	
	Overall Value	Local Value	Overall Value	Local Value
E10	≥ 85	-	15	-
E11	≥ 95	-	5	-
E12	≥ 99.5	-	0.5	-
H13	≥ 99.95	99.75	0.05	0.25
H14	≥ 99.995	99.975	0.005	0.025
U15	≥ 99.9995	99.9975	0.0005	0.0025
U16	≥ 99.99995	99.99975	0.00005	0.00025
U17	≥ 99.999995	99.9999	0.000005	0.00001

- Filters in classes E10, E11, and E12 do not require verification of local penetration.
- Filters in classes H13 and H14 may, as an alternative, be verified by the visual oil-smoke oil thread test (previously known as DIN 24.184), which is accepted as equivalent or better than specified local penetration.
- U17 is an exception to the rule. In this case, local penetration may not exceed 20 x the overall penetration value.
- MPPS: Most penetrating particle size

At a glance



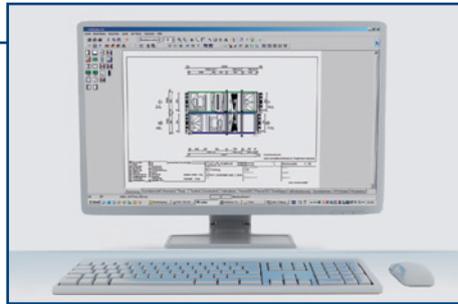
Air Handling Units



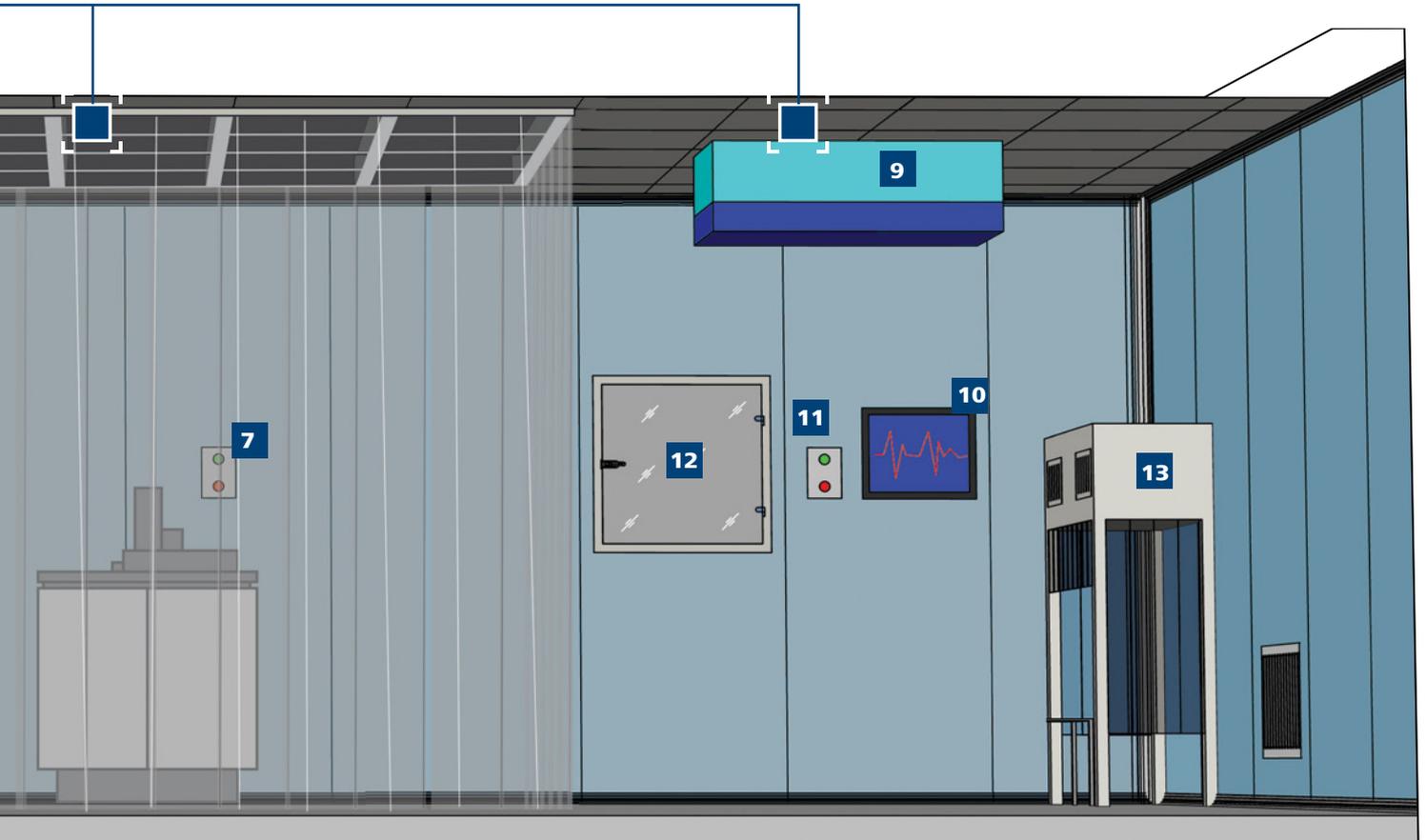
Chillers



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| 1 Wall panels | 6 Air shower | 11 Signalization of door opening |
| 2 Ceiling grid modules | 7 Laminar flow field | 12 Pass through boxes |
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closed working environment |
| 4 Ceilings | 9 Fresh Breeze fan-filter unit | |
| 5 Windows | 10 Monitoring | |



Systems for documentation and control



Highlights from the product range



INWALL covering panels

The panels are made for covering existing walls in clean room standard, realized with a drywall work.

INWALL Click® covering panels consist of a maximum number of prefabricated components, available in smart design with various color shades and combinations. Joints are sealed with permanently elastic sealant. Easy fixation and suitability for all applications make them universal.

INWALL OT covering panels for operating rooms have a T-profile rubber sealant in the joints for easy dismantling. These panels can be used as a partition thanks to a separate fixation to floor and suspension to ceiling. Building a double wall with different fillings, insulation and cables is possible.

INWALL OT+ covering panels have a similar construction as INWALL OT, but the joints are sealed with permanent elastic silicone - absolutely hermetic and used in higher classes of clean rooms.



Ceilings

All suspended ceilings feature a tight construction. An integration of lights or HVAC modules is possible.

Light ceiling for lower classes of clean rooms feature lightweight construction, although overpressure is possible. It shows an absolutely flat surface, as the suspending grid is hidden above the modules and enables easy cleaning.

Coffered ceiling is designed for higher classes of clean rooms and feature a rigid construction. This allows high over- and underpressure in the room.

Panel ceiling is made up of sandwich panels, which are tightly connected and suspended on the roof. This ceiling is suitable for all clean room classes and should be used in locations where an accessible ceiling is needed (e.g. for maintenance of HVAC components).



Partition-wall panels

The sandwich wall construction is available with various filling: e.g., mineral wool or polystyrene. All connections are prefabricated, and the panels can include ducts for wiring. The panel surface appears in either stainless steel or RAL colors. Higher fire-resistance and X-ray protection is optional.

R-Type panels feature an aluminium frame on the perimeter which enables an easy and fast installation and dismantling.

E-Type panels offer a wide range of variants which special characteristics for different applications.



Doors

DencoHappel Clean Room doors are available with single or double leaf and come with stainless steel door fittings and aluminum door frames. Sandwich or safety glass construction is selectable. For automatic operation, sliding doors offer door drives, and hinged doors come with actuators. They can be equipped with an automatic seal rail. All components come from market leaders in door equipment. The doors are available with the DencoHappel Interlock System to avoid air contamination. Also, X-ray protection is optional.

D-Type doors are made from a sandwich construction. They can be equipped with windows, which keep the flatness of the surface.

T-Type doors are made from glass and are mainly used for pass-through boxes.



Windows

Windows are available with single or double "Pharma"-glazing and feature aluminum window frames. The window glass is flush with the frame and surrounding panels for easy cleaning. Boxes and sliding windows are available as variants. Also, X-ray protection is optional.

CRW for E-Type panels

CRWM for E-M-Type panels

CRWR for R-Type panels

CRWW for Inwall covering panels



Staff Airlock Air Shower

The Air Shower is designed for one person and is an efficient method of removing contamination from the clothes of personnel (or the surfaces of materials) entering (or leaving) a cleanroom using a high-velocity jet of clean air. It is featured with HEPA filters and operates in economical recirculation mode. Air showers are an integral part of clean rooms' access control systems. The access is controlled by the DencoHappel Interlock system.



Air Handling Units

If the state of the room air is in the close comfort range, we feel well. However, the right climate is affected by many aspects and a very important factor for various industries. Air conditioning can differ depending on type of the room and/or its use. A regular fresh air supply is important. This requirement is fulfilled by the DencoHappel Air Handling Units.

DencoHappel offers optimized room air handling units for air flow of 950 to 115,500 m³/h, with design for maximum installation flexibility. The equipment features a range of components ideal both for clean room and process applications such as completely tight louvers. These systems do not only condition room air, but process air to high hygienic standards.



Chillers / Dry Cooler

The wide product range of DencoHappel Chillers offers the right model for almost every requirement. Irrespective of whether your requirement is for indoor or outdoor installation, air or water-cooled, there is a vast variety of equipment and an extensive spectrum of accessories available to you within the capacity range of 4.9 to 2,749 kilowatts.

Precise control, quiet operation, and low operating cost as a result of high thermal efficiency are key features of DencoHappel Chillers. You can get air cooled models for outdoor installation with or without freecooling function as well as for indoor installation with duct connectors. Water cooled units were conceived exclusively for indoor installation. With DencoHappel chillers and heat pumps with reversible circuit, you can provide energy not only for cooling, but also for heating. And if you require a compressor/condenser unit or desire to have a system with external condenser, our programme includes the suitable unit for you even here.



Safety Duct-Air Filter MultiSafe

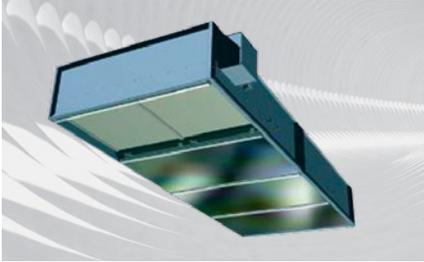
MultiSafe was developed especially for work in fields such as gene and clean room technology, nano-technology, and nuclear power engineering. MultiSafe conforms to strict air-purity stipulations, with filtration efficiency that can be monitored and documented.

People and the environment are protected at the very highest level. The modular configuration of MultiSafe allows air flows up to 32,000 m³/h.

Nominal air flow: 1,000 – 32,000 m³/h

Filter classes: F5 – U15 / activated carbon

Accessories: extensive standard



Laminar Flow Field Fresh Heaven MAXX (Power)

This air supply unit facilitates an unidirectional vertical, low turbulent air-flow for the strictest clean room classes. Low initial pressure drop and integrated linear LED lamps provide high energy-efficiency. Stainless steel casing is available in fresh air or recirculation models, designed to accept for HEPA filters. Optional, the air can be conditioned by an integrated chilled water coil. Laminarisators further improve air flow uniformity.

Air velocity: 0.12 – 0.45 m/s

Dimensions: As required

Material: AISI 304 stainless steel

Diffusors: Perforated stainless steel/
single-layer PES fabric

Accessories: soft-wall; illumination



Air diffuser Ceiling air outlet (CGx)

DencoHappel Air Filtration Systems reliably filter suspended solid particles, flue gas, sooty particles, bacteria, viruses, and spores from room air. Filter media for clean rooms (HEPA, ULPA) are available. Germ nests and dirt accumulation are basically prevented by filter design. An integrated damper ensures contamination-free filter exchange.

Nominal air flow: 260 – 1,400 m³/h

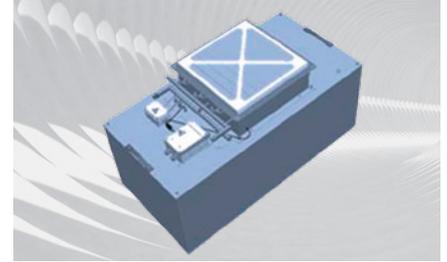
Filter classes: E11 – H14

Various filter seals

Various air outlets for turbulent flow

Optional: automatic shut off flap for filter exchange without contamination

Also available: CGO for air extraction



Fan-Filter Unit Fresh Breeze (BOXX)

The Fresh Breeze fan filter system is a circulation sub-ceiling unit. It is designed to locally supply filtered and cooled air in a clean room with requirement for laminar flow. The unit conditions the air which it intakes from the clean room, and it can be connected to a supply of air from an airconditioning unit.

DencoHappel Fresh Breeze BOXX allows operations requiring maximum protection of processed materials from particle and bacterial contamination. The air flow in this mini-environment can be either vertical or horizontal.

Dimensions: 600 x 1200 mm or
1,200 x 1,200 mm

Nominal air flow: 1,200 – 2,400 m³/h

Motor: EC

Accessories: soft-wall made of PV strips; illumination

Optional: pre-filter and/
or chilled-water coil

Always at your side



Our services at a glance

- Own heat exchanger production
- Use of certified products and components
- Use of components from well-known component manufacturers
- Short delivery times for spare parts
- Commissioning of new facilities
- Periodic servicing
- Maintenance
- Factory trial run
- Upgrading and optimisation of old facilities
- Maintenance agreements

Economical from the beginning

The technical developments of DencoHappel represent state-of-the-art swimming pool climate control. Our systems support diverse applications that optimally conform to current criteria of cost effectiveness, safety and sustainability. Our products and services go far beyond pure technology. They are integrated into a comprehensive and in every respect customised service package. This programme includes not only conventional services such as spare part delivery, maintenance, and repair. It unites the consulting and engineering of a technology leader with customised after-sales service and rapid response times. And this not only for installing new equipment. This service also applies for upgrading and optimising old equipment and provides you with perfect support in all project phases. The functionality of the system is secured over its entire service life.

International service und support in experienced hands

Wherever you need us, we will be there for you in the shortest time. All over Europe, our own customer service ensures that you are able to make optimal use of our units' advantages at all times. Many technicians are ready on-call in Germany alone for rapid deployment. All services are designed for absolute safety and reliability. For example, an on-site function check is a part of our delivery service, conducted by an experienced DencoHappel technician together with the installer. This way we directly and personally pass on our functional know-how built up over many years. In this context we should also mention the training we offer in the technology of our climate control systems. Such training is a beneficial instrument for ensuring the lasting functionality and availability of the systems.

A decision for quality

A high quality standard is the basis and principle for all our services. All our service specialists are highly experienced and devote themselves to their work with great diligence. Technically and personally convincing: this is what you can expect from us.



- Initial installation
- Maintenance and servicing
- Assembly services
- Spare parts
- Customer service
- Consulting
- Refurbishing
- Training

DencoHappel is a globally operating company with great expertise in air treatment, air conditioning and filtration technology.

Our nearest consulting and service teams will be glad to discuss ideas and develop creative and effective solutions with you.

