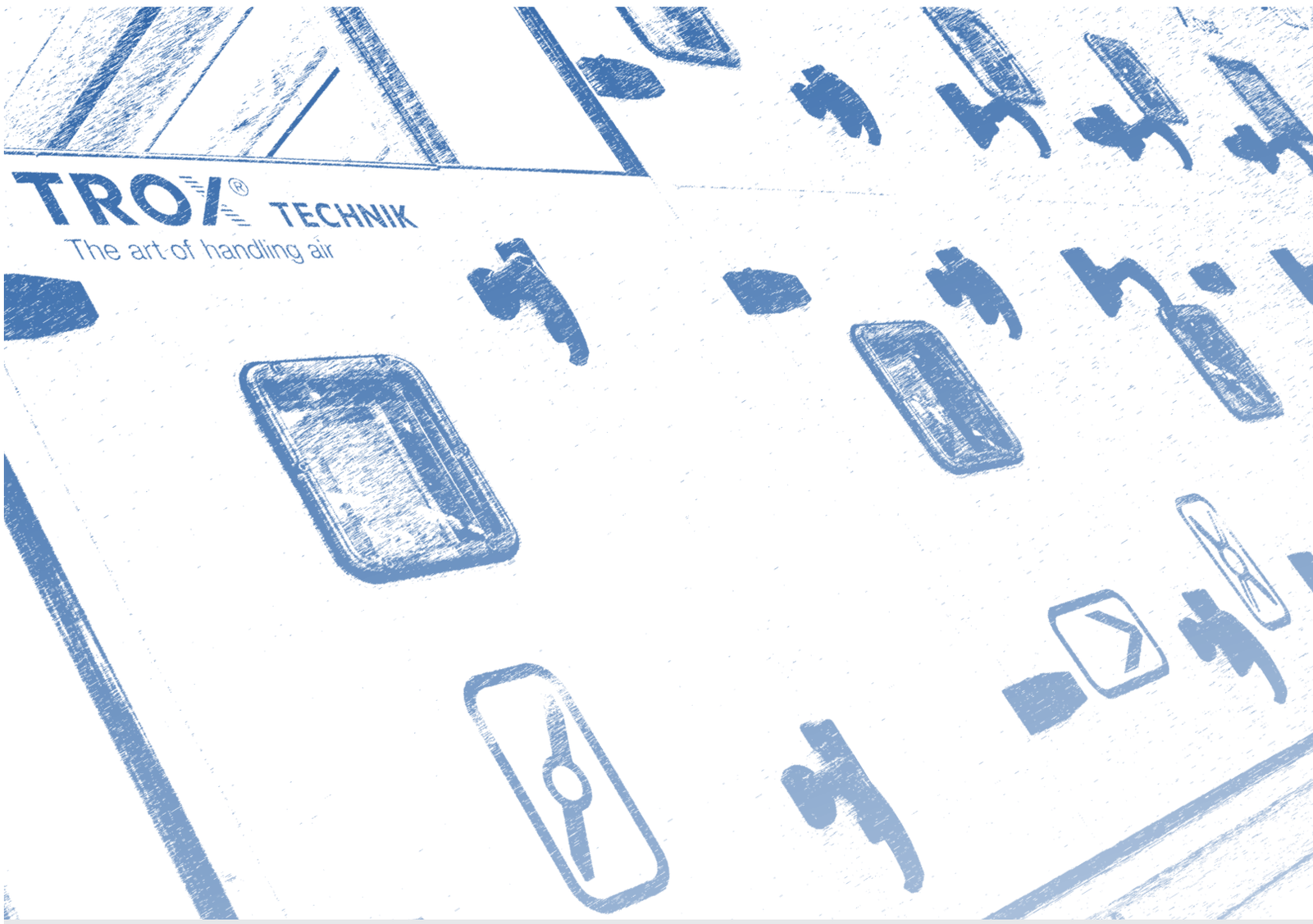
XCUBE

Air handling units from TROX

Design manual



TROX® TECHNIK
The art of handling air

▸The art of handling air▸▸

TROX understands **the art of handling air** like no other company. Since its foundation in 1951, TROX has been developing sophisticated components and efficient systems for ventilation and air conditioning as well as for fire and smoke protection. Dedicated research has made TROX a leader of innovation in these fields.

TROX has developed from a mere component manufacturer and systems supplier to a 'one-stop shop'.
The level of interaction between technical building services can make or break the whole system. This is why TROX offers everything from a single source. Air handling units and ventilation components and systems complement each other perfectly. This results in maximum energy efficiency while the coordination effort during the design and installation stages for a project is reduced to a minimum.

With the introduction of the innovative X-CUBE, TROX set the benchmark for air handling units as the X-CUBE represents the highest levels of quality, energy efficiency, flexibility of configuration, functional reliability and hygiene. The suggested solution raises the bar in the areas of production quality, energy efficiency, flexibility of the device configuration, and reliability in functioning and hygiene. The same high standards apply to all product types and the entire product portfolio.

Contents

System quality from a single source

With the X-CUBE air handling units, TROX continues to set new standards. TROX offers air handling units and all other components of an air conditioning system from a single source and ideally complementary to one another.
The extensive know-how and expertise of TROX in the fields of acoustics, fire and smoke protection, and filter technology, to name but a few, have been incorporated in the X-CUBE. Customers benefit through less coordination effort and the opening up of new and exciting opportunities in room air conditioning.

Production facility in Anholt, Germany

Construction variant in accordance with ErP Directive 2009/125/EC

High energy efficiency

Energy efficiency was the guiding concept in the development of the X-CUBE. Construction, insulation, low leakage, heat recovery, energy-efficient motors, and intelligent control systems have resulted in a level of energy efficiency which not only meets but already exceeds the existing and future requirements of the EC directive on energy-related products.

Unparalleled hygiene

With the special shape of the casing, the smooth surfaces, and the way in which the components are installed, the X-CUBE complies with the VDI 6022 guideline. Even the high-quality standard version meets the very critical hygiene requirements of the DIN 1946/4 standard. A special hygiene unit that complies with AHU Guideline 01 is available for the most demanding requirements.

Easy installation and maintenance

The modular structure and the low level of wiring required – a result of the extensive use of field bus technology – help to save installation and maintenance costs since all work can be carried out quickly and easily. Work safety is another important aspect as, for example, there are no sharp edges anywhere.

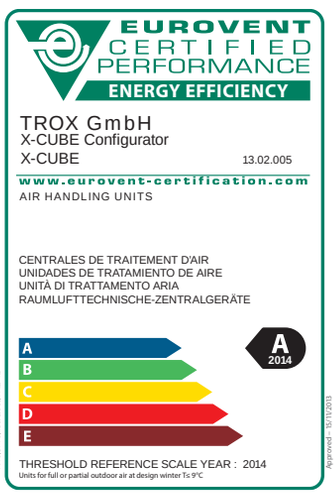
Intuitive operation

X-CUBE units can be operated safely and comfortably using the touch panel. Virtually all status information is available at a glance. Operating errors are eliminated.

Seamless integration with modern building management systems

With their modular, expandable controls, X-CUBE air handling units can be integrated into almost all modern building management systems using various bus systems.

Certification according to the energy efficiency label of the German Association of AHU Manufacturers



Highest energy efficiency class according to Eurovent

The whole picture

TROX air handling units benefit from the company's decades of experience and attention to detail. All components ideally complement each other. All components ideally complement one another. TROX engineers look beyond the actual air handling unit; they take the whole ventilation and air conditioning system into account. Its own test laboratories allow TROX to optimise the acoustic, energy-related or aerodynamic characteristics of a unit and all its components. TROX is the only German manufacturer of air handling units whose know-how extends to filters, fire and smoke protection, sound attenuators, and to all other components and systems.

TROX service from design to commissioning

TROX is a solution provider. Service starts with the design of air handling units, encompasses commissioning, and goes on to the training of engineers and maintenance staff. It is a level of service which TROX customers have come to expect.

Competent sales team

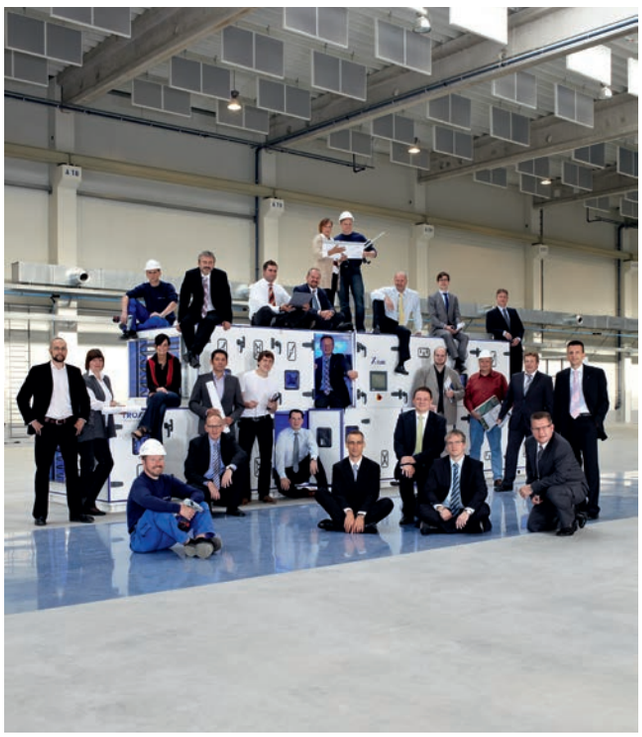
With its 70 members, the sales team for components and systems is the largest in the ventilation and air conditioning sector in Germany and is available to TROX customers for all questions in this field. An additional 15 expert sales engineers provide high-profile consultancy services. Outside of Germany, expert staff in all European subsidiaries is at customers' service to provide excellent and reliable advice on air handling units.

Customised delivery

X-CUBE air handling units can be delivered as modules, i.e. partly assembled for assembly on site, or they can be supplied pre-assembled if the maximum length does not exceed 12 m. As usual, TROX guarantees on-time delivery.

Model box thermal imaging

Delivery and installation of a weatherproof X-CUBE



The X-CUBE expert team

X-CUBE air handling units

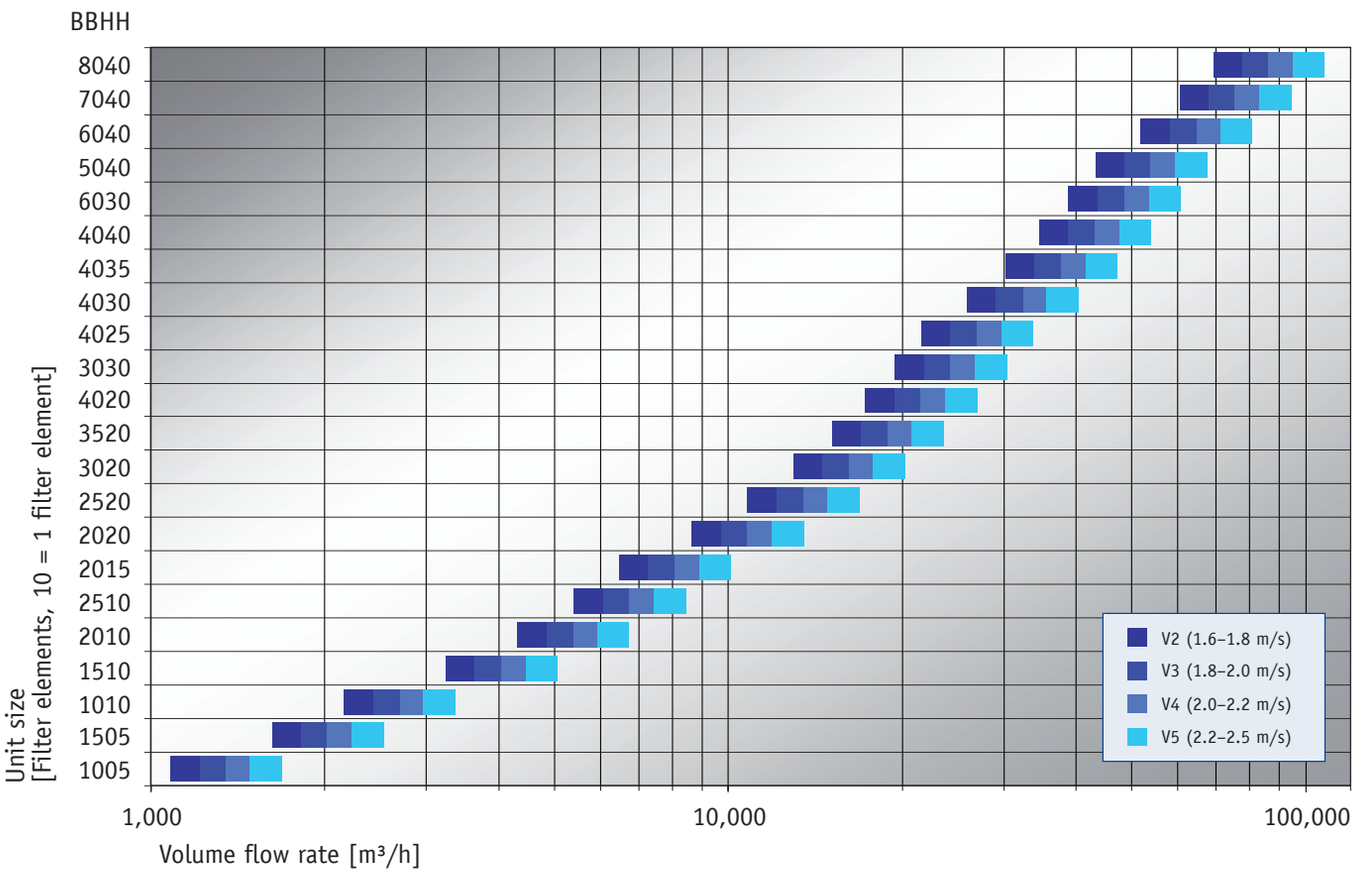
Every building is different, and buildings are used in many different ways, which means that air handling units have to meet the most diverse air treatment requirements. This applies not only to the overall range of functions of air handling units and their volume flow rates but also to the performance range of each functional unit.
An X-CUBE can handle volume flow rates of up to 27,780 l/s (100,000 m³/h).

X-CUBE

Configurable X-CUBE air handling units give users the greatest degree of flexibility. Each unit can be configured to meet project-specific requirements. TROX provides the best solution for virtually every application situation.

Variants
- Combi units – with individual supply air and extract air units either stacked or arranged side by side
- Constructions for indoor or outdoor use
- Standard version and hygiene version

Functions
- Heating
- Cooling
- Humidifying
- Dehumidifying
- Heat recovery
- Air filtration



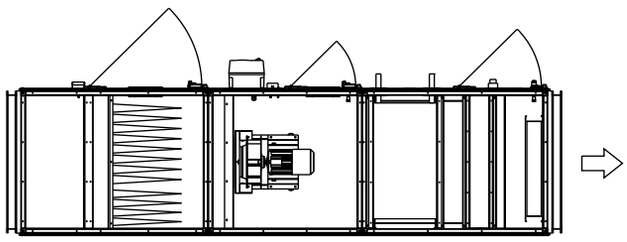
Volume flow rates and unit sizes according to EN 13053 (intermediate sizes not shown)

X-CUBE for different types of buildings

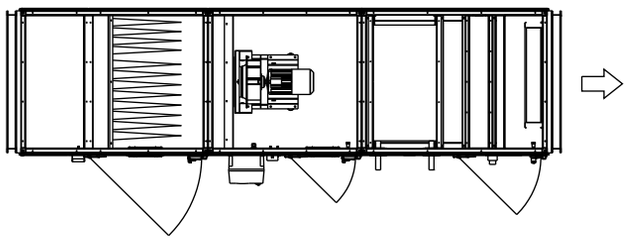
Applications	Construction features
Office buildings	– Humidification and dehumidification – Aerodynamically optimised sound attenuators in the unit or in the ventilation duct – Complete sound insulation – Rotary heat exchanger, plate heat exchanger or run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS
Schools and universities	– Demand-based ventilation – Aerodynamically optimised sound attenuators in the unit or in the ventilation duct – Halogen free – Rotary heat exchanger, plate heat exchanger or run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS
Museums	– Humidification and dehumidification – Aerodynamically optimised sound attenuators in the unit or in the ventilation duct – Integral bus-based control system with an interface to the central BMS
Shops	– Flexible construction – Rotary heat exchanger, plate heat exchanger or run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS
Kitchens	– Activated carbon filter – Metal mesh filters for extracting the grease – Encased fans – Plate heat exchanger or run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS
Industry	– Silicone free – Halogen free – Flexible construction – Rotary heat exchanger or plate heat exchanger for heat recovery – Integral bus-based control system with an interface to the central BMS
Hospitals and laboratories	– Construction to DIN 1946-4 – Stainless-steel floor – Steam humidification – Two filter stages – Plate heat exchanger or run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS
Airports	– Flexible construction – Activated carbon filter – Plate heat exchanger and run around coil system for heat recovery – Integral bus-based control system with an interface to the central BMS

Operating side

Determining the operating side is a crucial decision when designing an air handling unit. The operating side provides access to the unit for inspection and maintenance. The components of an air handling unit can usually only be accessed from one side. Accessing components from both sides should, however, be considered for particularly wide and flat units.



Operating side on the left



Operating side on the right

Size

A four-digit combination representing width (B) and height (H) is used to define the size of air handling units. The interior dimensions depend on the standard dimensions of a filter cell.

Unit size = BBHH

$$B = \frac{BB}{10} \times 612\ mm$$

$$H = \frac{HH}{10} \times 612\ mm$$

Example

Size 1005

B = 10 ÷ 10 × 612 mm

B = 612 mm

H = 05 ÷ 10 × 612 mm

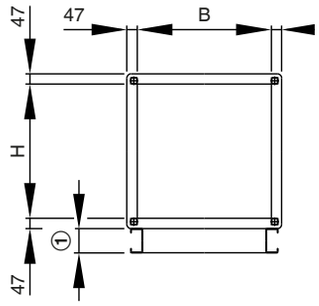
H = 306 mm

B / H	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
05		■	■	■												
10		■	■	■	■											
15		■	■	■	■	■	■	■								
20		■	■	■	■	■	■	■	■	■	■					
25		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
30			■	■	■	■	■	■	■	■	■	■	■	■	■	■
35				■	■	■	■	■	■	■	■	■	■	■	■	■
40				■	■	■	■	■	■	■	■	■	■	■	■	■

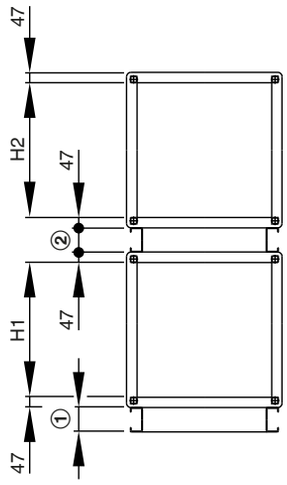
X-CUBE sizes

Overall dimensions

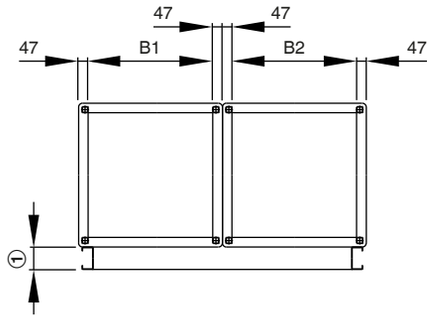
The overall dimensions are a result of adding the interior dimensions to the thickness of the panels (47 mm) and the height of the base frame ① (110, 200 or 300 mm); if there is an intermediate frame ②, it must also be accounted for (110, 200 or 300 mm).



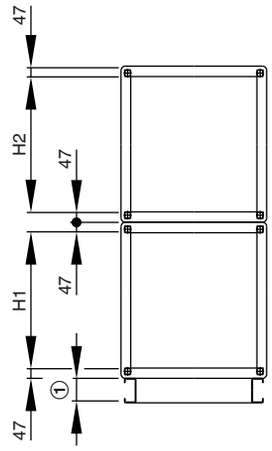
Single unit



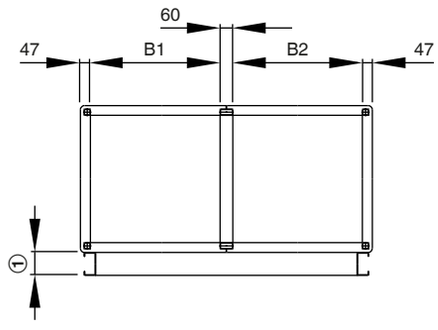
Combi unit with supply and extract air units stacked, intermediate frame



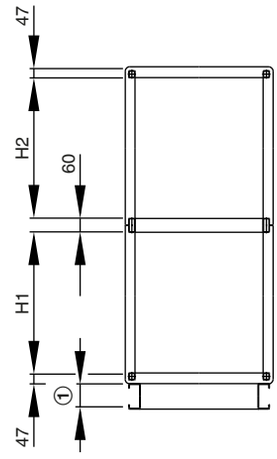
Combi unit with supply and extract air units arranged side by side, separate panels



Combi unit with supply and extract air units stacked, separate panels, up to a max. depth of 25



Combi unit with supply and extract air units arranged side by side, intermediate side panel, up to a max. depth of 80



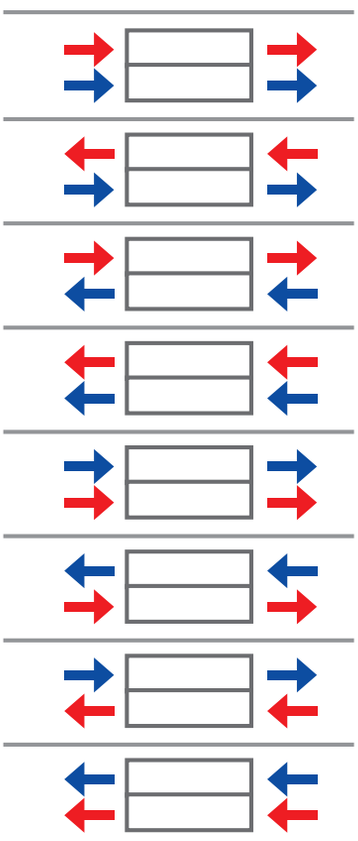
Combi unit with supply and extract air units stacked, intermediate floor panel, up to a max. depth of 20

Configurable X-CUBE combi units offer a maximum of flexibility. A combi unit is a combination of two individual units, a supply air unit and an extract air unit, which can be stacked or arranged side by side.

X-CUBE with rotary heat exchanger

Stacked

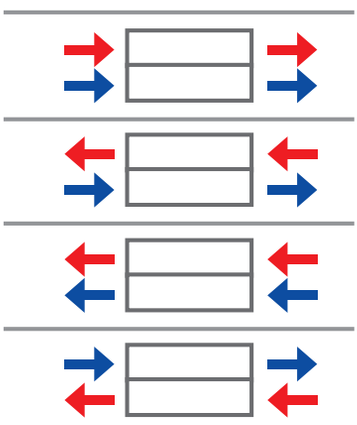
- The supply air unit is either on top of or underneath the extract air unit.
- The airflow in the supply air and extract air units is from right to left or vice versa.
- Either parallel flow or counter flow.
- The different vertical arrangements and airflow directions result in eight variants.



Selection of airflow direction and arrangement

Side by side

- The supply air unit is to the left or to the right of the extract air unit.
- The airflow in the supply air and extract air units is from right to left or vice versa.
- Either parallel flow or counter flow.
- The different horizontal arrangements and airflow directions result in four variants. Rotating the units provides another four options.



Selection of airflow direction and arrangement

Indoor installation

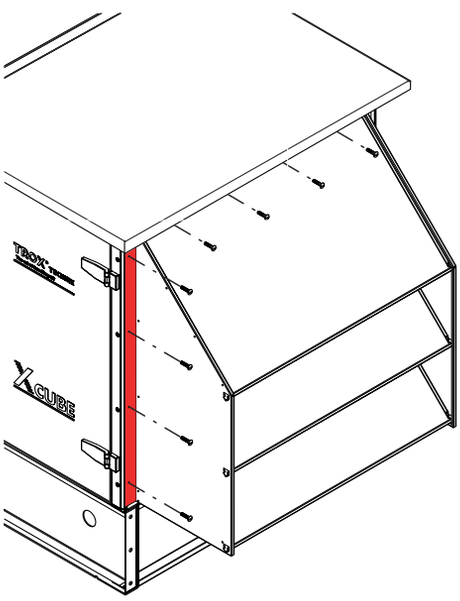
Standard X-CUBE air handling units are designed to be installed indoors, in plant rooms. Even the standard version fulfils the requirements of the VDI 6022 guideline (hygiene requirements for ventilation and air-conditioning systems and units).
260 mm square inspection windows and LED illumination allow for easy inspection of each functional unit.
All panels are powder-coated on both sides, and a perimeter plastic section provides thermal insulation. This special construction also gives the unit excellent acoustic properties.
Inspection access doors or removable inspection access panels allow for accessing the interior of the units.
The high-quality, lab tested duplex powder coating of the panels, doors and frame ensures maximum corrosion protection to ISO 12944-2, IEC protection class C4 (K). The powder coating makes the surfaces also smooth and easy to clean.

Highlights

- Fulfils the hygiene requirements of VDI 6022
- Square inspection windows
- LED illuminated interior
- Complete thermal insulation
- Outstanding acoustic properties
- Inspection access doors or removable inspection access panels
- Lab tested duplex powder coating on both sides of the panels, doors and frame
- Smooth, easy to clean surfaces

X-CUBE for indoor installation

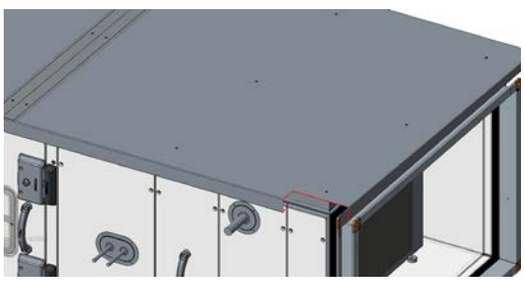
Weatherproof X-CUBE air handling units are designed for outdoor installation, e.g. on roofs, and they have been modified accordingly. Compared to the standard version, these units come with some modifications to meet the requirements of outdoor conditions.
The units have a powder-coated roof with overhang and drip edge to ensure that rainwater runs off.
Special weather hoods prevent the fresh air and exhaust air openings from the ingress of rain. The robust, powder-coated hood is mounted directly to the duct connection of the outdoor unit. The function of the hoods complies with class A (≤ 0.75 (l/h)/m²), described in EN 13030:2001-10 (performance testing of louvres subjected to simulated rain).
The fresh air intake chamber contains a stainless steel tray to safely divert away any raindrops that may have entered.
The inspection access doors are fitted with hold open devices to keep them open during maintenance work and prevent them from being slammed shut in strong winds.
The powder coating is the same as the one used for the standard version as this already offers outstanding corrosion protection and resistance against continuous UV radiation.



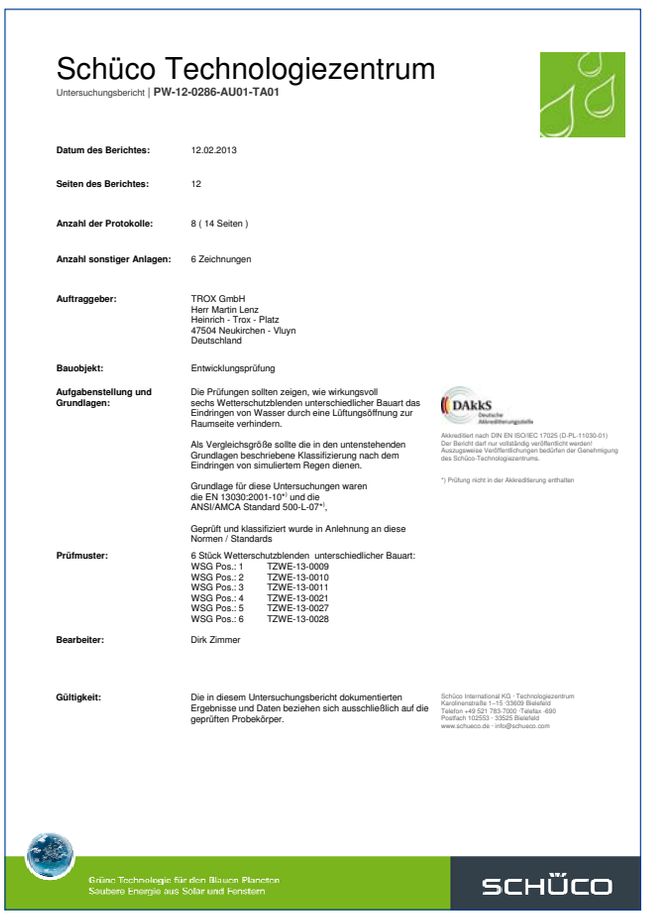
Weather hood

Highlights

- Roof with overhang and drip edge
- Robust weather hood
  – Mounted directly to the unit
- Tested weather hoods
- Fresh air intake chamber with stainless steel tray
- Inspection access doors with hold open devices



Roof



Schüco Technologiezentrum

Untersuchungsbericht | **PW-12-0286-AU01-TA01**

Datum des Berichtes:	12.02.2013
Seiten des Berichtes:	12
Anzahl der Protokolle:	8 (14 Seiten)
Anzahl sonstiger Anlagen:	6 Zeichnungen
Auftraggeber:	TROX GmbH Herr Martin Lenz Heinrich - Trox - Platz 47504 Neukirchen - Vluyn Deutschland
Bauobjekt:	Entwicklungsprüfung
Aufgabenstellung und Grundlagen:	Die Prüfungen sollten zeigen, wie wirkungsvoll sechs Wetterschutzblenden unterschiedlicher Bauart das Eindringen von Wasser durch eine Lüftungsöffnung zur Raumseite verhindern. Als Vergleichsgröße sollte die in den untenstehenden Grundlagen beschriebene Klassifizierung nach dem Eindringen von simuliertem Regen dienen. Grundlage für diese Untersuchungen waren die EN 13030:2001-10*) und die ANSI/AMCA Standard 500-L-07*), Geprüft und klassifiziert wurde in Anlehnung an diese Normen / Standards
Prüfmuster:	6 Stück Wetterschutzblenden unterschiedlicher Bauart: WSG Pos.: 1 TZWE-13-0009 WSG Pos.: 2 TZWE-13-0010 WSG Pos.: 3 TZWE-13-0011 WSG Pos.: 4 TZWE-13-0021 WSG Pos.: 5 TZWE-13-0027 WSG Pos.: 6 TZWE-13-0028
Bearbeiter:	Dirk Zimmer
Gültigkeit:	Die in diesem Untersuchungsbericht dokumentierten Ergebnisse und Daten beziehen sich ausschließlich auf die geprüften Probekörper.

DAkkS Deutsche Akkreditierungsstelle

Akkreditiert nach DIN EN ISO/IEC 17025 (D-PL-11030-01)
Der Bericht darf nur vollständig veröffentlicht werden! Auszugsweise Veröffentlichungen bedürfen der Genehmigung des Schüco-Technologiezentrums.

*) Prüfung nicht in der Akkreditierung enthalten

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Weather hood test report

Hygiene version

DIN 1946-4 defines the increased hygiene requirements for air handling units used in buildings and rooms of health care. Even the X-CUBE standard version fulfils many of the requirements specified in DIN 1946-4. There is, however, a special hygiene construction that meets particularly critical requirements.
It differs from the standard version in that the floor panels are made of stainless steel. A unit with all internal surfaces made of stainless steel is available upon request.
Multileaf dampers facing the room are of leakage class 4.
Fresh air dampers must be galvanised and coated or made from aluminium or stainless steel and must close automatically in the event of a power failure (power off to close).
With increased hygiene requirements, filters must be changed on the upstream side for rooms with air classification Ia or Ib.
Heat exchangers must have a stainless steel frame. The same applies to droplet eliminator frames.
These and other features will default if 'increased hygiene' is selected in the X-CUBE Configurator. This ensures that a unit meets the high requirements of DIN 1946-4.

Inner skins made of stainless steel

Highlights

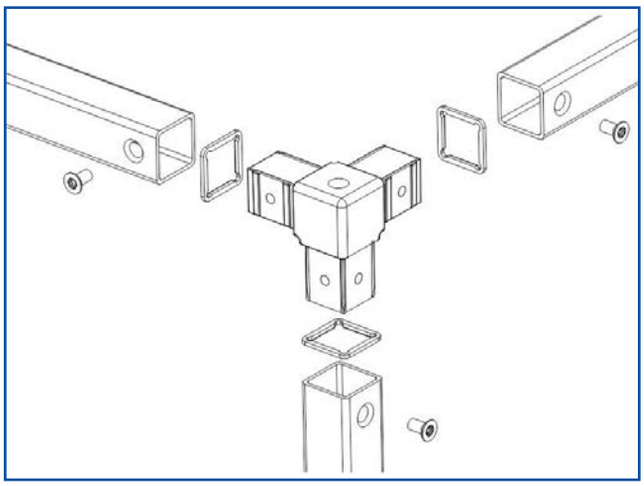
- Special hygiene version to comply with DIN 1946-4 (health care)
- Floor panels made of stainless steel
- All internal surfaces made of stainless steel (optional)
- X-CUBE Configurator ensures compliance with DIN 1946-4

The construction of the casing, along with the selection of the components, is extremely important when it comes to achieving the high levels of efficiency that the X-CUBE air handling units are capable of. Hygiene considerations must also be taken into account.
The special shape of the casing, the smooth surfaces and the way in which the components are installed ensure the best possible results.

Casing interior

Frame

The skeleton of each air handling unit is a robust frame construction. Special square tubes and connectors for the corners provide maximum stability. The frame construction is completely covered by the panels.

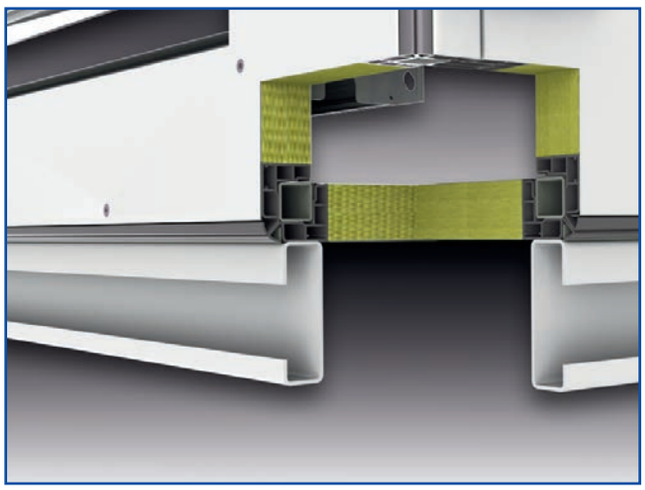


Connecting elements

Panels

The double skin panels are made of galvanised 1 mm sheet steel with a 45 mm mineral wool infill. The steel sheets are powder-coated on both sides, the colour is similar to RAL 9016. Other colours are also available. The mineral wool is non-combustible and complies with DIN 4102, material classification A.
A perimeter plastic section separates the inner skin from the outer skin and eliminates thermal bridging. The outstanding thermal and acoustic properties of the casing are largely due to this sandwich construction.
The panels completely cover the frame construction, meaning that the inner surfaces are smooth and easy to clean. In addition, all panels are fitted with a perimeter closed cell foam seal, which is free of silicone, resistant to disinfectants and non-ageing. Due to the only very small clearance between the square tubes and the steel sheets no other sealants are required. The casing is therefore guaranteed to be almost air-tight.
Metric screws are used to fix the panels. No special tools are required for assembly.

Powder-coated frame



Double skin panels

Inspection access doors

The inspection access doors have the same thermal and acoustic properties as the panels.
In accordance with the relevant guidelines, doors that allow access to a hazard area can only be opened with a tool. Additionally, doors on the positive pressure side are fitted with safety catches (cannot be deactivated) that prevent a sudden uncontrolled and violent opening of the door.

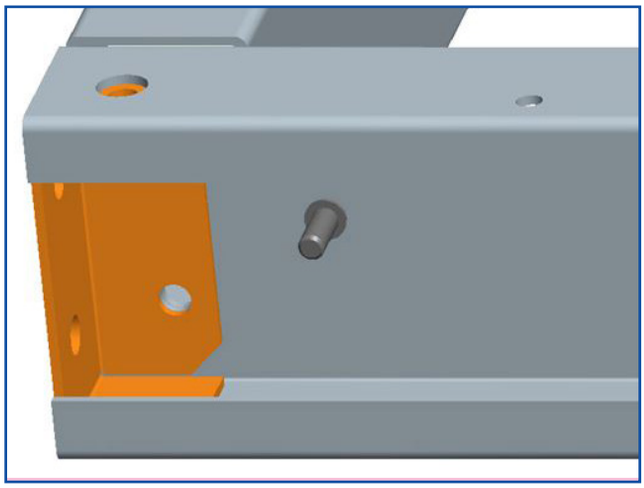
Adjustable external hinges

Highlights

- Robust frame construction made from square tubes
  - Special connectors for the corners
  - Frame construction completely covered by panels
- Double skin panels
  - 1 mm sheet steel, powder-coated on both sides
  - 45 mm mineral wool infill (to DIN 4102, material classification A, non-combustible)
  - No special tool required for assembling the panels
- Inspection access doors
  - Same thermal and acoustic properties as the panels
  - Doors in hazard areas can only be opened with a special safety key
  - Doors on the positive pressure side are fitted with safety catches
  - Adjustable hinges and door handle contact pressure
  - External seals
- Casing
  - Perimeter plastic section between inner skin and outer skin eliminates thermal bridging
  - Outstanding acoustic properties
  - Inner surfaces are smooth and easy to clean
  - No additional sealant required
  - Perimeter closed cell foam seal, silicone free, resistant to disinfectants, non-ageing
  - Metric screws for mounting the frame and panels

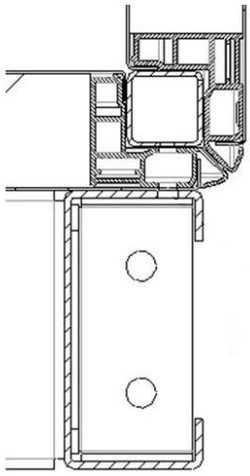
Base frame

As the name suggests, the base frame is the principal and lowest structural part of an air handling unit. It is made from hot-dip coated sheet steel (3 mm), formed into C-shaped sections and powder-coated.
Base frames come in different heights, 110, 200 or 300 mm, to suit different applications.
Weatherproof air handling units (i.e. for outdoor use) have a drain hole in the base frame.
The base frame not only carries the load of the air handling unit, but is also used for equipotential bonding. There is a rivet for this on the operating side.



Terminal point for equipotential bonding

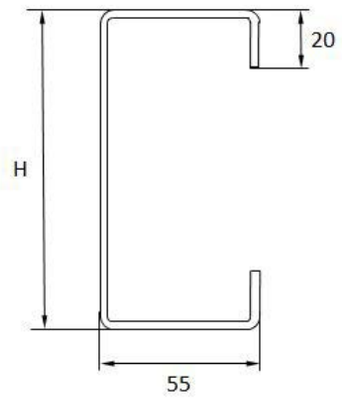
The frame of the air handling unit is fixed to the base with standard socket cap head screws, which are screwed into the square tube.



Connection between casing and base frame

Standard base frame

To facilitate transport of very heavy units with a crane, the base frame can be manufactured with openings for the insertion of transport tubes. The supplied transport tubes can be pushed through these holes to make it easier to fix a hoist to the base frame.

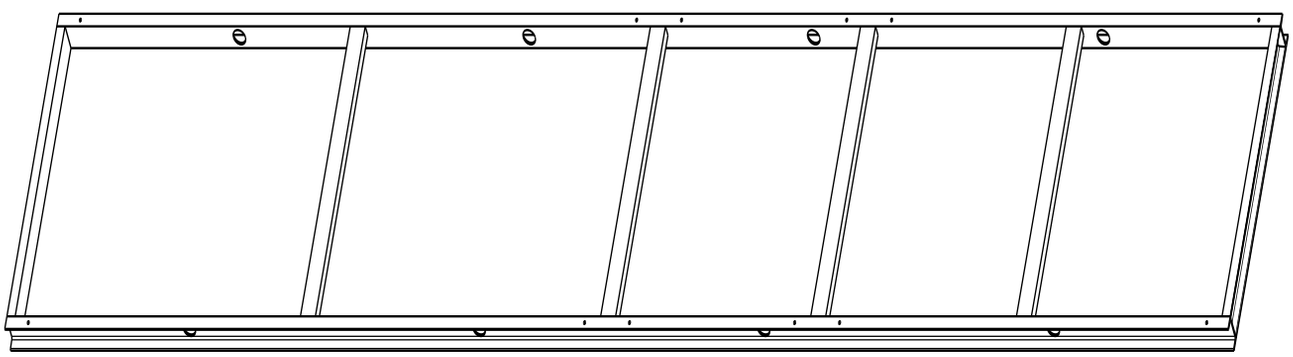


Cross section

Standard base frame

Base frame to DIN standard

A welded base frame made from standard U-channel sections (to DIN 1026-1) is available upon request. This frame is designed to support the weight of the respective air handling unit and provides a high level of stability, even with heavy casings. As standard, the DIN base frame has openings for transport tubes so that these air handling units can be transported fully assembled.



Welded base frame to DIN standard

Highlights

- Base frame
  - C-shaped frame sections
  - Terminal point for equipotential bonding
- Base frame height of 110, 200 or 300 mm
- Outdoor units with a drain hole in the base frame
- Base frame with optional openings for transport tubes (supplied), for transport with a crane
- Welded base frame made from sections to DIN standard
  - U-channel sections to DIN 1026-1
  - Precisely designed to support the weight of the air handling unit
  - High level of stability even for heavy components
  - As standard, the DIN base frame has openings for transport tubes
  - Galvanised and coated base frame

Duct connection

Each air handling unit is equipped with noise insulating connectors to which the ducting is connected. The noise insulating connectors are fitted with a vibration damping EPDM element that prevents the transmission of noise and vibrations from the air handling unit to the ducting. The actual connection is made to a U-section frame (90 × 30 mm) in galvanised sheet steel, powder-coated on request.

Noise insulating connector

Earth connection

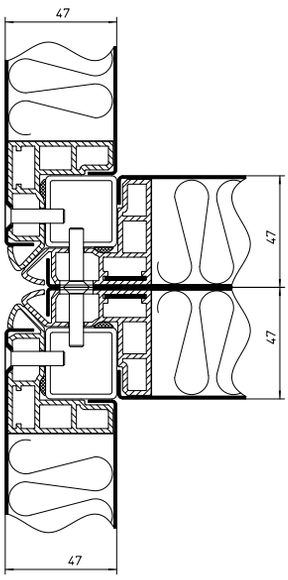
Separation between combined supply air and extract air units

Separate panels

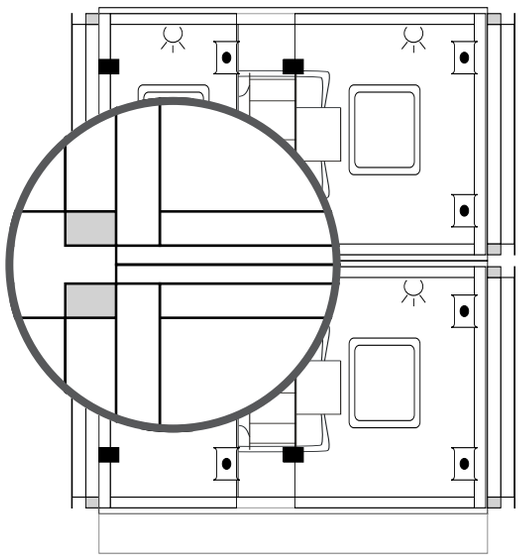
For combi units weighing up to 1,500 kg and measuring up to 1,624 mm in width, no particular or extra separating element is required. The floor panel of the upper unit rests on the ceiling panel of the lower unit. This is why the supply air unit is usually placed at the bottom.

Various aspects, such as the size of the access opening to the installation location, need to be considered with regard to unloading the units and taking them to the actual installation location. Unloading with a forklift truck is possible only if the components of the upper unit are supplied on transport pallets or similar. Lifting eyes fitted to the top of each unit enable the unit to be moved using a crane.

This type of separation is generally possible for units arranged side by side.



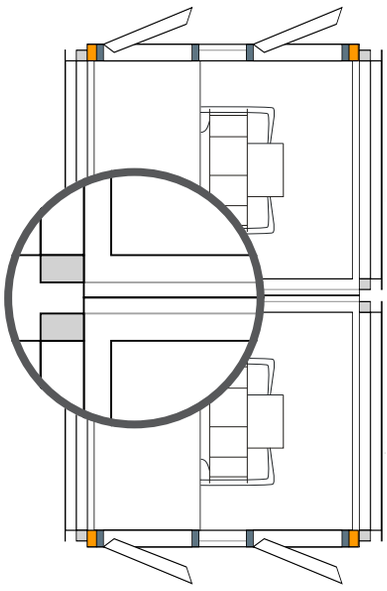
Separate panels



Stacked

Highlights

- Maximum casing weight: 1,500 kg
- Maximum unit width: 1,624 mm
- Floor panel of the upper unit rests on the ceiling panel of the lower unit
- Lifting eyes facilitate transport with a crane

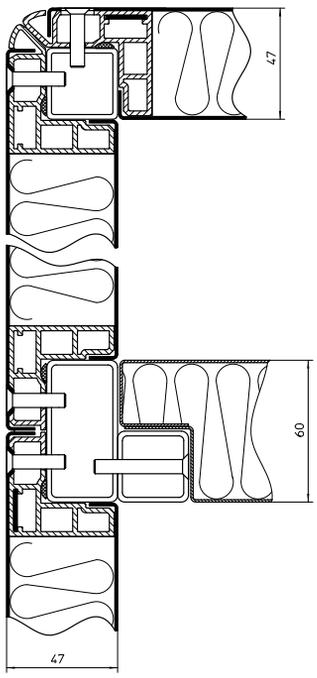


Side by side

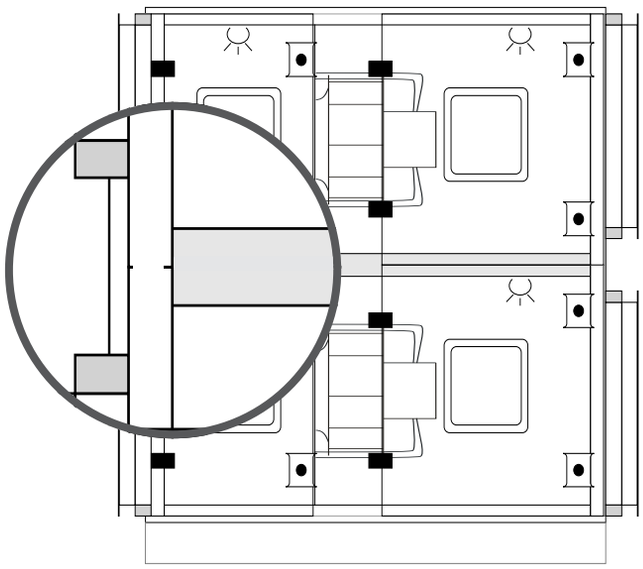
Highlights

- Maximum unit height: 2,448 mm
- Lifting eyes facilitate transport with a crane

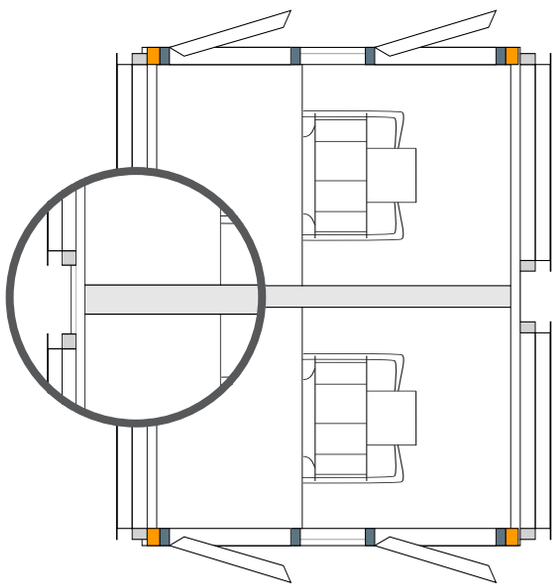
Intermediate floor panels and intermediate side panels
An intermediate floor panel (for stacked units) or intermediate side panel (for units arranged side by side) is particularly suitable for small, compact units.
If necessary, an intermediate floor panel can be made of stainless steel.
An intermediate floor panel is 60 mm thick and can accommodate a stainless steel condensate drip tray, which is then flush with the surface. The flat condensate drip tray is sloped in all directions so that any condensate can run off safely.
An intermediate floor panel can be used up to a clear unit width of 1,224 mm (i.e. unit size 20). The unit height is not critical.



Intermediate floor panel


Stacked

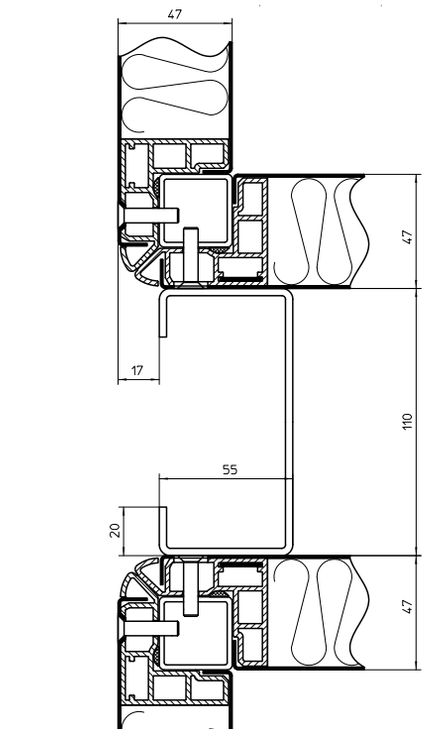
Highlights
- Preferably for for small, compact units
- Maximum unit width: 1,224 mm
- Stainless steel intermediate floor panel (optional)
- Intermediate floor panel can accommodate condensate drip tray


Side by side

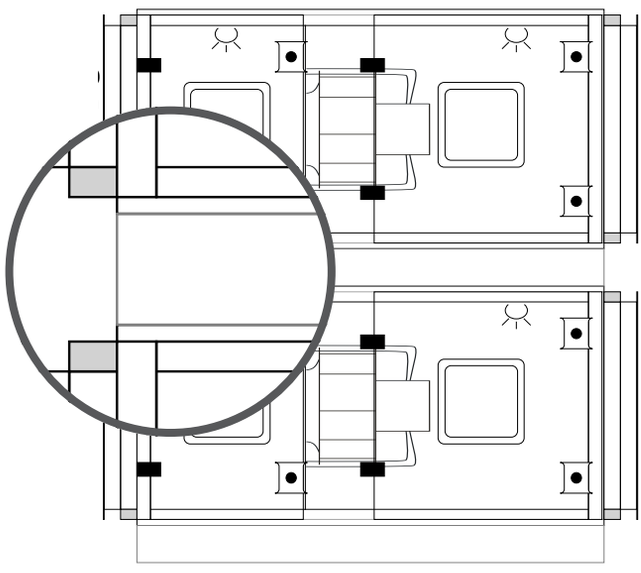
Highlights
- Preferably for for small, compact units
- Maximum unit height: 2,448 mm

Intermediate frame

An intermediate frame can be universally used to stack units on top of one another. If an intermediate frame is used, the upper unit can have a condensate drip tray.
It is a good idea to split a combi unit into several compact packaging units if there are large, heavy components or only small access openings to the installation location.



Intermediate frame (detail)



Stacked

Highlights

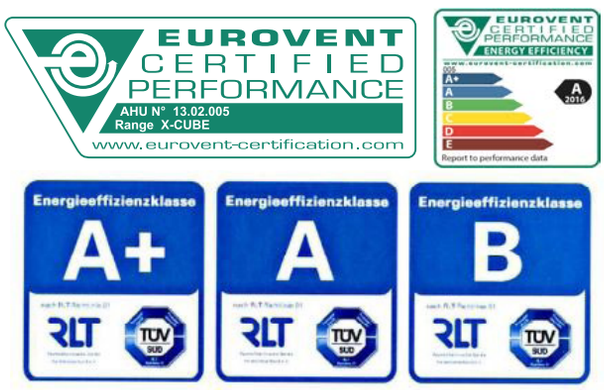
- Available for all unit sizes

Certified casing properties

TÜV Süd tested the X-CUBE casing to EN 1886, using a model box, and has confirmed the technical data. The results:

Thermal transmittance class:		T2
Thermal bridging class:	TB2	
Casing air leakage (–400 Pa):		L1 (M)
Casing air leakage (+700 Pa):		L1 (M)
Mechanical strength (–1,000 Pa):	D1 (M)	
Mechanical strength (+1,000 Pa):	D1 (M)	
Filter class:	F9	

In addition, the X-CUBE air handling units are tested to EN 13053 by recognised certification bodies. This includes testing by Eurovent and certification in accordance with the German Association of AHU Manufacturers.



Certified energy efficiency

All dampers for the X-CUBE are made by TROX. This means that air handling units and multileaf dampers are perfectly matched to one another.
Only opposed action dampers are used. Depending on the purpose, either shut-off dampers or control dampers are used; control dampers can be either mixing dampers or by-pass dampers.

Multileaf damper with actuator

Function

Multileaf dampers with gears can only have opposed action blades.
The internal gears transfer the synchronous rotational movement from the drive arm to the individual blades.

Design

Depending on the application, shut-off dampers made of various materials and of leakage class 2 or 4 (EN 1751) may be used.
Aluminium dampers can measure up to 1,500 × 1,500 mm. The blades are extruded aluminium sections and either powder-coated or anodised. The gears are made of special anti-static plastic; if encased, they achieve leakage class 4.
Galvanised steel or stainless steel dampers can measure up to 2,000 × 2,000 mm. The blades of these dampers are moved by an external linkage. The linkage is more durable than gears as the material is not subject to abrasion. The blades also move more smoothly as with gears since there is no play.
If a larger damper area is needed than the maximum damper size, several dampers can be combined.
A distinction is made between cold and warm dampers. Cold dampers are placed in the fresh air or exhaust air and should be installed inside the unit in order to prevent condensation. Warm dampers are in the supply air and extract air and may be installed either inside or outside the unit.

Low-leakage multileaf damper

Highlights

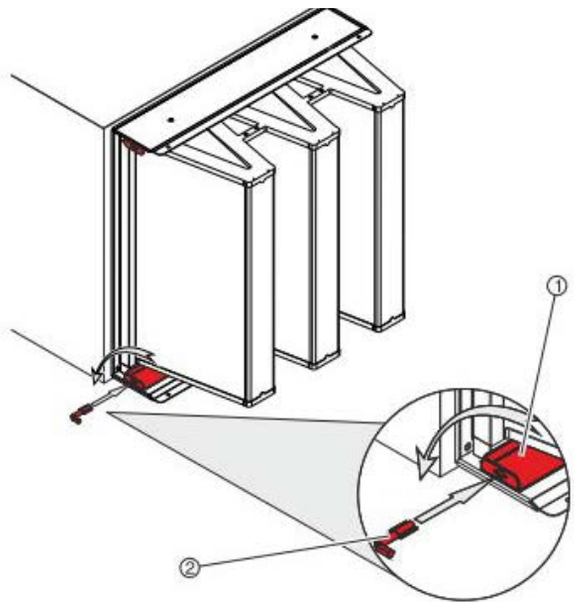
- Ideal combination of components
  - TROX multileaf dampers
- Only opposed action dampers
  - Control dampers and shut-off dampers
  - Leakage classes 2 and 4 to EN 1751
- Aluminium dampers
  - 1,500 × 1,500 mm max.
  - Extruded aluminium sections
  - Powder-coated or anodised
  - Gears made of special anti-static plastic (encasing of leakage class 4)
- Galvanised steel or stainless steel dampers
  - 2,000 × 2,000 mm max.
  - External linkage
  - Increased durability
- To cover larger areas than the maximum damper size
  - Required area is achieved by combining several dampers
- Optional extension inside or outside

Filters are among the most important functional units in an air handling unit. A filter protects all downstream components and separates contaminants from the air, which means that the air quality increases considerably with a suitable filter.
It is necessary to determine the air quality that is to be achieved, and the required classes of filters, as part of the design process. EN 13779 lists filters to be used as first filter stages for air handling units.
For more details on filter media and their technical characteristics refer to the technical leaflets available on our website.

Filter inserts in an air handling unit

First filter stage in a supply air unit

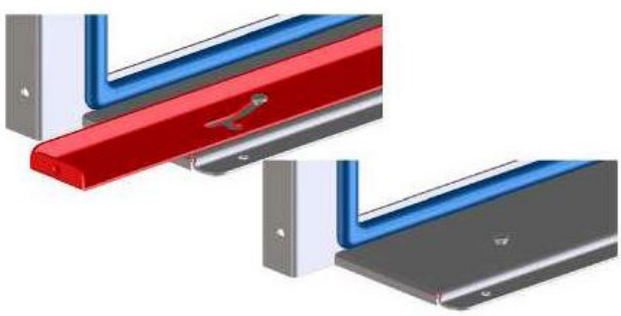
Fresh air quality	Recommended	Minimum requirement
ODA 1 (clean air)	F8	F7
ODA 2 (dust)	M5 + F7	F7
ODA 3 (gases)	F8	F7
ODA 4 (dust and gases)	M5 + F8	F7
ODA 5 (very high concentrations)	M5 + gas filter + F9	M5 + F7



Mounting rail

Filter fitting

Withdrawable mounting rail for filters
For units up to size 20, filters can be fitted onto a space saving, withdrawable mounting rail. The mounting rail for pocket filters and filter inserts can be withdrawn from the side. To unlock the mounting rail and withdraw the filter or filter insert, a special TROX safety key is required.
Once the mounting rail with the filter has been inserted, the filter is firmly pressed against the sealing surfaces by way of a drilled hole in the mounting rail.



Drilled hole

Filter wall

Filter walls are available for air handling units of all sizes. A filter wall is basically a grid of individual filters of a standard size. Each filter element is fitted into a frame and secured with quick release fasteners, hence firmly pressed into the frame. The frame may be powder-coated or stainless steel.

Quick release fasteners allow for a quick and easy filter change on the upstream side.

Detail without filter

Detail with filter

Quick release fasteners simplify filter changes

Highlights

- Withdrawable mounting rail for filters
  - For units up to width 20
  - Pocket filters and filter inserts can be withdrawn from the side
  - Mounting rail with the filter is unlocked with a special TROX safety key
  - Secure seating of the filter by way of a drilled hole
- Filter wall
  - For all unit sizes
  - Fixing with quick release fasteners
  - Secure and tight seating of the filter element
  - Powder-coated or stainless steel frame
  - Easy filter change from the upstream side

Filter elements

Pocket filters

X-CUBE air handling units can be fitted with Eurovent-certified pocket filters of filter classes M5, M6, F7 or F9. As standard, each filter (including frame) measures 592 × 592 mm; if only half this width or height is required, filters of 592 × 287 mm or 287 × 592 mm are also available.

Pocket depths of 600 and 700 mm are available for areas of different sizes.

The standard filter classes are achieved by using non-woven glass fibres as a filter medium. Pocket filters of class M6, F7 or F9 made of NanoWave® meet more critical requirements of dust holding capacity and low initial differential pressure. NanoWave pocket filters have a pocket depth of 600 or 700 mm.

Pocket filters made of NanoWave®

Highlights

- Eurovent certification
- Filter classes
  - Non-woven glass fibres: M5, M6, F7, F9
  - NanoWave®: M6, F7, F9
- Filter frame standard sizes
  - Pocket filter standard depths: 600 and 700 mm

Mini Pleat filter inserts

Just as pocket filters, Mini Pleat filter inserts of filter classes M6, F7 and F9 are certified by Eurovent and come in the standard size of 592 × 592 mm. Half-sized filter cells are also available.

These filter inserts are characterised by their low installation depth of 292 mm. The filter medium consists of pleated, moisture-resistant glass fibre paper. Pleating allows for the largest possible filter area in the smallest space.

Filter insert

Highlights

- Eurovent certification
- Pleating allows for the largest possible filter area in the smallest space
- Filter classes
  - Moisture-resistant glass fibre paper: M6, F7, F9
- Filter frame standard sizes
  - Pocket filter depth: 292 mm

Z-line filters

Z-line filters are very compact, and the air handling unit can hence be shorter than with other filters. This type of filter is available in the usual standard sizes and for filter classes G4 and M5.

Z-line filters come in two different depths: 48 and 96 mm. The filter medium are special synthetic fibres in a plastic frame.

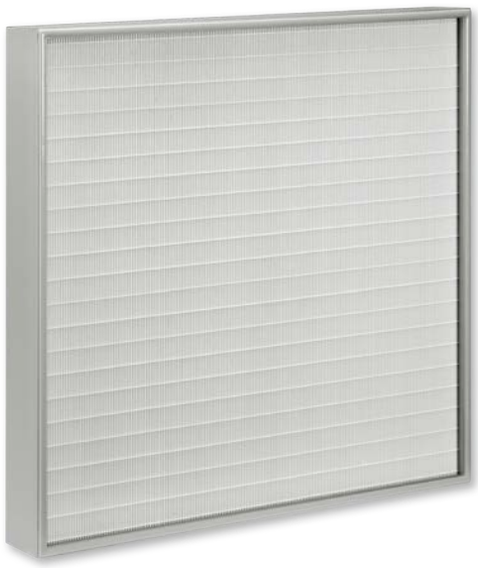
Z-line filters

Highlights

- Filter classes
  - Non-woven synthetic fibres: G4 and M5
- Filter frame standard sizes
  - Standard filter depth: 48 or 96 mm
  - Compact construction
  - Plastic frame

Filter panels

Class H14 particulate filters (HEPA) are high efficiency filter elements that separate the smallest particles from the air. Viruses, bacteria or toxic dusts are separated from the air with an efficiency of > 99.995 % for the most penetrating particle size, or MPPS (EN 1822). These high-efficiency filters are used in air handling units as final filter stage to ensure germ-free supply air in areas such as research centres or medical and pharmaceutical facilities. The filter medium is moisture-resistant glass fibre paper, specially folded to obtain a large filter area in order to achieve the efficiency level described above. Mini Pleat filter panels are fitted in an aluminium frame with a perimeter seal that prevents leakage between the filter element and the mounting frame. Each filter element is subjected to a factory filter scan test that verifies its quality.
As well as achieving the tested efficiency level to EN 1822, the filter panels fulfil all requirements for use in the hygiene sector. For example, they meet the requirements of VDI 6022, DIN 1946-4, ÖNORM H 6021 and ÖNORM H 6020 standards.



Filter panel

Highlights

- High-efficiency filter H14
  - Separation of viruses, bacteria. toxic dusts, etc.
  - Efficiency of > 99.995 % to EN 1822
  - Used as a final filter stage to ensure germ-free air
- Areas of application
  - Research centres, medical or pharmaceutical facilities
- Filter medium
  - Moisture-resistant glass fibre paper
  - Special folding technique ensures stated efficiency
  - Filter panels in an aluminium frame with perimeter seal
- Requirements
  - Automatic filter scan test performed on each filter in the factory, with test report
  - Meets hygiene requirements of VDI 6022, DIN 1946-4, ÖNORM H 6021 and ÖNORM H 6020

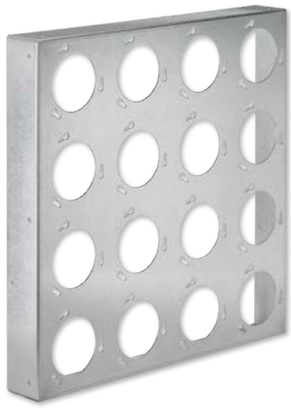
Activated carbon filter

Activated carbon filters as cartridges are used for the adsorption of gaseous odorous substances or contaminants, such as hydrocarbons and traces of inorganic compounds. The time it takes for the air to pass through an activated carbon filter depends on the volume of activated carbon and on the length of the cartridge, which can be 250, 450 or 600 mm. The longer the cartridge, the longer the air takes to pass it.

Filter cartridges are fitted in a special mounting plate. A bayonet with three fixing points and a flat seal ensures a secure fit. As filter cartridges can weigh up to 5 kg, they are supplied in a separate package. An abrasion of carbon dust may occur during transport. This dust should be removed by lightly tapping the filter cartridges. In the event that carbon dust escapes from the cartridges during commissioning or operation, the downstream chamber should be cleaned.

Each mounting plate can accommodate 16 cartridges. Cartridges are made of galvanised sheet steel, stainless steel or plastic, depending on the requirements. The mounting plate is made of galvanised sheet steel, with powder coating as an option.

Activated carbon filter cartridge



Mounting plate

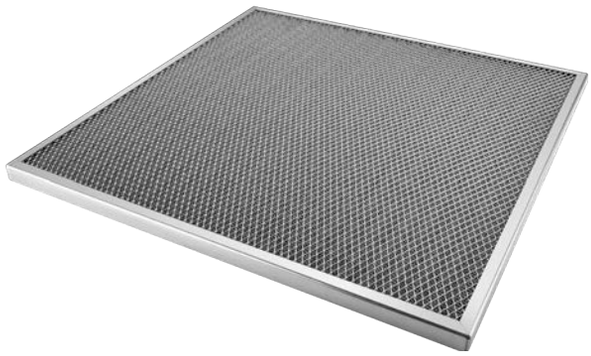
Highlights

- Fitting of filter cartridges
  - Dedicated mounting plate
  - Secure fit due to bayonet fixing and flat seal
- Filter cartridges
  - Weight: 5 kg
  - Cartridge length: 250, 450 or 600 mm
  - Each mounting plate accommodates 16 cartridges
- Filter cartridge characteristics
  - Galvanised sheet steel, plastic or stainless steel
  - Cartridge mounting plate made of galvanised steel, with powder coating as an option
  - Additional post filtering in F8 is required according to DIN EN 13779!

Metal mesh filter

Metal mesh filters are used to separate grease from the air, particularly in commercial kitchens. These filters protect downstream components from greasy deposits. Metal mesh filters are also used as prefilters for the separation of coarse particles.

The special metal mesh provides a large surface – with low differential pressure. This surface acts as a condensation surface. The water vapour which has absorbed the grease condenses on the metal mesh, leaving the grease on the surface.



Metal mesh filter

Digital pressure monitor

Measuring devices for the display and monitoring of differential pressures for gaseous, non-aggressive media

Digital pressure monitor

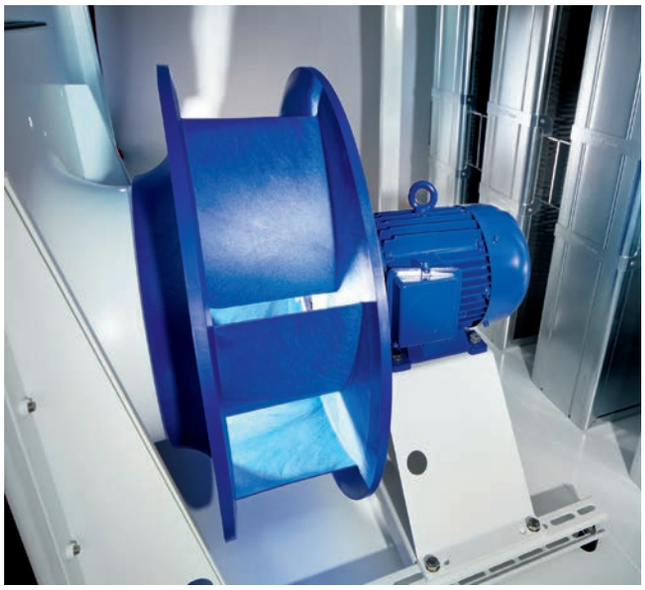
Highlights

- With digital display according to DIN 1946 Part 4 and VDI 3803
- Continuous adjustment for the pressure differential limit
- Optical signal when the limit is reached
- Volt-free signal output for integration into the central BMS
- Illuminated display with warning function

Filter elements for separating dust

	Pocket filters	Filter insert	Z-line filters	Filter panels
Application	Prefilter, main filter	Main filter	Prefilter, main filter	Main filter, final filter stage
Filter classes	M5, M6, F7, F9	M6, F7, F9	G4, M5	M5, M6, F7, F9, E11, H13, H14
Filter medium	Non-woven glass fibres, NanoWave®	Glass fibre paper	Non-woven synthetic fibres	Glass fibre paper
Certification	Eurovent	Eurovent	Eurovent	Eurovent

The fan is the centrepiece of every air handling unit. It creates the required airflow and is strong enough to overcome all pressure losses in the air distribution ductwork and in the air handling unit. Only direct drive fans with backward curved blades are used for the X-CUBE.



Fan unit

IE2 - IE3 - and IE4 fans

Fans with motors of efficiency class IE2 (since 2011 the minimum requirement for uncontrolled motors) are generally used. According to EN 60034-30 (2009), these are high-efficiency motors.
The fan unit consists of an installation subframe, motor, impeller and bellmouth inlet.
These fan units can overcome a total differential pressure of up to 2,300 Pa.

IE3 fan

Highlights

- High-efficiency motors
  - In IE 2 or IE 4
  - Can overcome up to 2,300 Pa total differential pressure
- Application
  - Suitable for large systems
  - Twin fans
  - Run and standby, or for partial load operation
- Complete unit
  - Installation frame, motor, impeller and bellmouth inlet
  - Anti-vibration mounting in the X-CUBE
  - Special panel construction allows for floor mounting

IE4 fans

Apart from the proven IE2 and IE3 motors for fans, an increasing number of motors fulfil the requirements for efficiency class IE4.

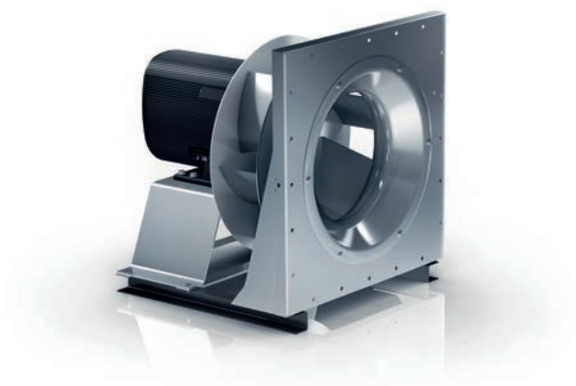
EC IE4 fans

For compact air handling units with volume flow rates of up to 3,335 l/s (12,000 m³/h) per fan, EC fans are usually used and mounted to the fan mounting plate with a support bracket. The electronically commutated (EC) motors receive conventional signals and do not require a frequency inverter. The controls are an integral part of the fan unit.

EC fan with support bracket

PM IE4 fans

This construction is similar in design to fan units of efficiency classes IE2 and IE3. Instead of an EC motor, the fans have a brushless DC motor. The controls are either part of the assembly or installed externally.
To expand the range of applications, all of the fan units mentioned can also be used in a twin fan arrangement.



Fan with PM motor

Highlights

- High-efficiency motors
  - >97 % when in operation
- Twin fans can be used
- EC IE4 variant
  - Can be used in compact units
  - Up to 3,335 l/s (12,000 m³/h)
  - Mounted to the fan mounting plate with a support bracket
  - No frequency inverter required
  - The control input signal is a conventional voltage signal (integrated)
- PM IE4 variant
  - With brushless DC motors
  - External or integral controls

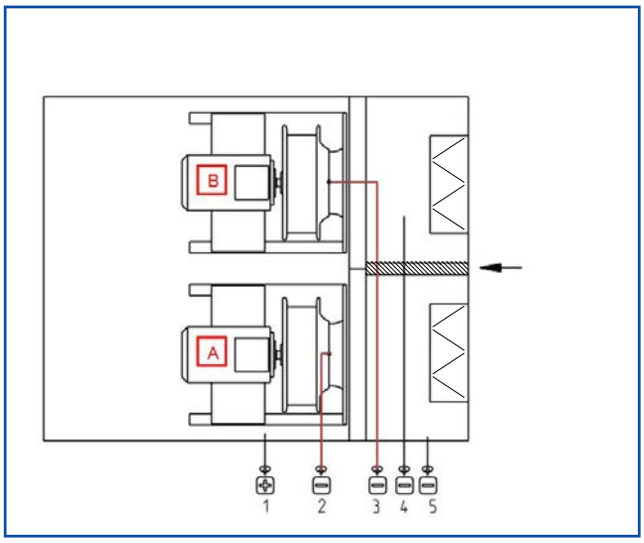
Vibration damping

The fan unit is installed in an X-CUBE air handling unit in such a way that vibrations are reduced. Special floor panels allow for mounting the fan unit onto the floor without the need for a frame or bracket. The floor surface remains even and smooth, making it easy to clean.

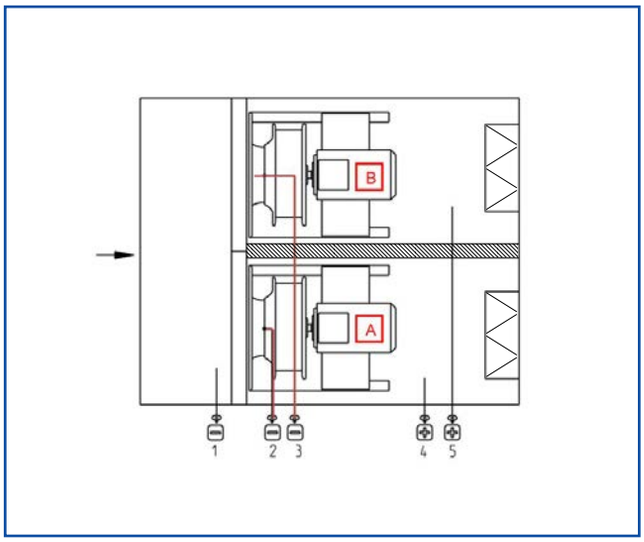
Anti-vibration element

Twin fans

Twin fans, or run and standby fans, are used particularly in large air handling units to achieve uninterrupted operation in the event of a failure or to achieve a high level of efficiency when fans are operated at partial load. Depending on the requirements and concept, a 100% redundancy or partial redundancy is therefore possible. For standby operation, each fan is provided with at least one damper (on the intake side or discharge side), which remains closed when that particular fan is not in operation.



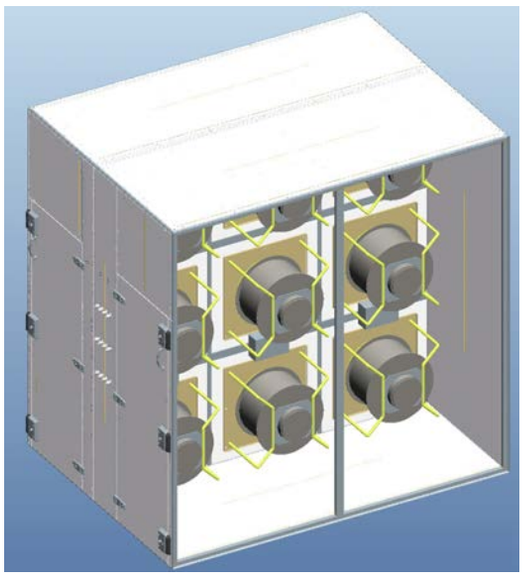
Damper arrangement on the intake side



Damper arrangement on the discharge side

FanArray

The FanArray expands the idea of twin fans further. In this case, several fans are operated in parallel. These are highly efficient EC IE4 fans, which are mounted to the framework with support brackets.
As the total volume flow is split across several small fans, the overall length of the fan chamber can be reduced considerably.
Should a fan fail, the system can continue operating without suffering a great drop in performance.
All fans in the FanArray are controlled with one signal.



FanArray with nine fans

Highlights

- Several fans can be arranged in parallel
- Use of EC IE4 fans
  - Mounted to the framework with support brackets
  - Total volume flow can be split across several fans
  - Compensation for fan failure (no major drop in performance)
  - Fan chamber can be shorter
- All fans in the FanArray are controlled with one signal

Fan overview

	Fans			
	IE2	IE3	EC IE4	PM IE4
Motor efficiency	76 - 94 %	80 - 95 %	83 - 93 %	83 - 95 %
Motor rating	0.75 – 75 kW	0.75 – 75 kW	0.45 – 75 kW	1.3 – 15 kW
Total pressure increase	Up to 2,300 Pa	Up to 2,300 Pa	Up to 1,800 Pa	Up to 2,000 Pa
Volume flow rate (single fan)	Up to 95,000 m³/h	Up to 95,000 m³/h	Up to 12,000 m³/h	Up to 30,000 m³/h
	Up to 26,400 l/s	Up to 26,400 l/s	Up to 3,335 l/s	Up to 8,335 l/s
Installation	Anti-vibration mounting	Anti-vibration mounting	Support bracket on the fan mounting plate	Anti-vibration mounting
Impeller material	Composite/powder-coated steel	Composite/powder-coated steel	Aluminium/powder-coated aluminium	Powder-coated steel
Control unit	External frequency inverter	External frequency inverter	Integral controls	External or integral controls
Twin fans	+	+	+	+
FanArray	–	–	+	–

Sound attenuators are used to minimise fan noise and noise created by the airflow. When sizing a sound attenuator, the entire frequency spectrum from 63 Hz to 8 kHz should be taken into consideration. This spectrum is divided into the following octave bands: 63, 125, 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz.

Sound attenuator splitter with distance pieces

Design

The aerodynamically profiled frame is made of galvanised sheet steel, powder-coated sheet steel or stainless steel. The non-combustible mineral wool is faced with glass fibre fabric as a protection against abrasion through airflow velocities of up to 20 m/s. The mineral wool is hygienically safe according to the German TRGS 905 (Technical Rules for Hazardous Substances) and EU directive 97/69/EC.
The attenuator module has an inspection access such that the splitters can be removed for cleaning. Distance pieces hold the splitters in their position; they double as handles to facilitate splitter removal.
The splitter frames have **plastic sliders** at the bottom to facilitate assembly. These also help to protect the surfaces, e.g. from scratches.
The maximum air resistance must not exceed 80 Pa; it will usually be far below this limit.
Sound attenuators should always be placed next to the fans, never downstream from a dehumidifying cooling coil.
To achieve the most effective airflow, it requires an upstream section (1 × splitter width) and a downstream section (1.5 × splitter width). The length of these sections is measured from one sound attenuator splitter to the next component.
The width of the splitter and distances for optimum attenuation can be freely configured to pre-defined lengths.

Distance piece (detail)

Plastic slider (detail)

Function

Sound attenuator splitters with resonating panels
The attenuation effect of the MKA splitters is due to absorption and resonance.
The splitters have a mineral wool infill as absorption material. Part of the splitter surface that runs parallel to the airflow is covered with resonating panels. These panels start oscillating due to the sound (resonance) and hence absorb sound energy. Resonance works best in the frequency range of critical fan noise.
There is a higher attenuation across a wider frequency range when compared to mere absorption splitters. This is why these splitters are chosen for most X-CUBE air handling units.

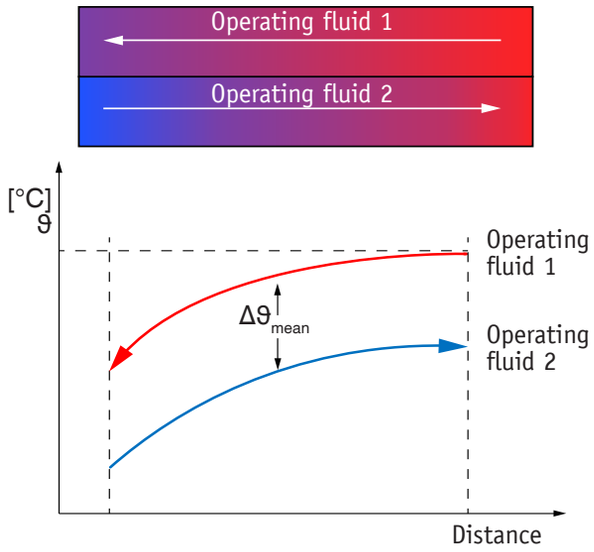
Sound attenuator splitter with resonating panels

Sound attenuator splitters without a resonating panel
The attenuation effect of the XKA splitters is due to absorption.
The splitters have a mineral wool infill as absorption material.

Sound attenuator splitter without a resonating panel

Highlights
- Use of the entire frequency spectrum
  - 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 Hz
- Variants
  - Splitters with offset resonating panels
  - Sound attenuator splitters without a resonating panel
- Materials
  - Galvanised sheet steel, powder-coated sheet steel or stainless steel
  - Absorption material is non-combustible mineral wool
  - Faced with glass fibre fabric as a protection against abrasion
  - Hygienically safe according to TRGS 905 and EU directive 97/69/EC
- When installed in an X-CUBE
  - Inspection access for cleaning work
  - Maximum air resistance of 80 Pa
  - Distance pieces ensure exact position
  - Correct upstream section and downstream section are ensured

Heating and cooling are the basic thermodynamic air treatment processes in an air handling unit. Heat exchangers in an air handling unit make use of the output of an external unit, e.g. a boiler or a water chiller, to condition the air as required.
As well as changing the temperature, cooling coils can also dehumidify the air.
To achieve the most effective heat transfer and the rated performance when in operation, heat exchangers must be connected in a counter flow arrangement. Counter flow refers to the fluid in the heat exchanger on one hand, and the air on the other hand.



Counter flow heat transfer

Design

The basic design of heating and cooling coils is identical. They usually consist of copper tubes with press-fitted aluminium fins as this construction increases the transfer surface. The copper tubes are interconnected and form individual circuits. These circuits lead to a manifold, which supplies the fluid.
The number of tube rows and the spacing between them when viewed in the direction of airflow determine the depth of the heat exchanger. The number of tube rows can be determined by counting the tubes in airflow direction. Heating coils and cooling coils must be constructed differently to meet the requirements stated in standards.

Heating coils

Heat exchangers which are placed before the first filter stage to pre-warm the fresh air are exposed to a high level of contamination and must hence have wide-spaced fins (at least 4 mm). If this minimum requirement does not apply, fin spacing can be anything between 2.0 and 10.0 mm.
The frames of heating coils are usually made of galvanised sheet steel. If heat exchangers are used in harsh conditions which require a high level of corrosion resistance, a stainless steel frame with epoxy-coated aluminium fins can be used.
The fin spacing determines the installation depth of heat exchangers; this is to ensure that a heat exchanger can be cleaned down to its core and is hence hygienic. This ensures that cleaning is possible right through to the core of the heat exchanger.

Air to water heat exchanger

Cooling coils

If a cooling coil is also used for dehumidification, the fin spacing must be at least 2.5 mm; otherwise, 2.0 mm are sufficient. Without dehumidification, 2.0 mm are also permitted.
Fin spacing is not the only criterion for cooling coils; another requirement is a corrosion-resistant frame, usually stainless steel.

Highlights

- Identical design of heating coils and cooling coils
  - Use of copper tubes
  - Aluminium fins increase the transfer surface
  - Copper tubes are connected to form individual circuits
  - Circuits lead to manifolds (fluid supply)
  - Installation depth depends on the number of tube rows and their spacing
- Fin spacing
  - From 2.0 mm to 4.0 mm unless there is a different requirement
  - Fin spacing for cooling coils is at least 2.5 mm (2.0 mm in exceptional circumstances)
  - For pre-warming fresh air, fin spacing of at least 4.0 mm
- Construction variant
  - Cooling coil: corrosion-resistant frame (stainless steel)
  - Heating coil: frame made of galvanised sheet steel
  - In aggressive conditions: stainless steel frame with epoxy-coated aluminium fins
- Fin spacing determines the installation depth of the heat exchanger
  - Heat exchanger can be cleaned right down to its core

Heat exchangers – technical details

Application	Fin spacing [mm]	Frame
Heating coils		
Preheaters	4	Galvanised sheet steel
Reheaters	2 – 4	
Cooling coils		
Dehumidifying cooling coils	2.5	Stainless steel
Cooling coils (dry)	2	

Hydraulic circuits

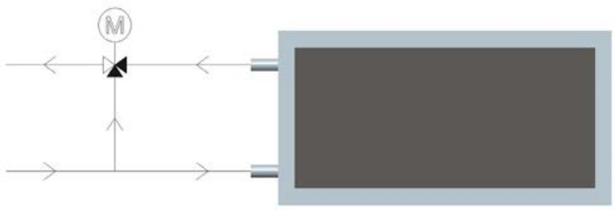
The temperature of the air downstream of a heating or cooling coil is controlled by adjusting the operating fluid. This adjustment can be achieved by three different hydraulic circuits; which one is used depends on the conditions and the functional requirements.

Diverting circuit

With regard to the control components required, a diverting circuit is the most simple option as it requires only a 3-way control valve in the return flow of the heat exchanger.

The output is controlled by adjusting the mass flow; the temperature at the entry to the heat exchanger is the same as the flow temperature.

In air conditioning systems this circuit is mostly used to control reheaters or dehumidifying cooling coils. As the mass flow in the primary circuit can be controlled to be between 0 and 100 %, the return flow temperature increases when the bypass is open until it reaches the flow temperature. This is why a diverting circuit is not recommended when buildings are heated by district heating, a condensing boiler or a heat pump.



Diverting circuit

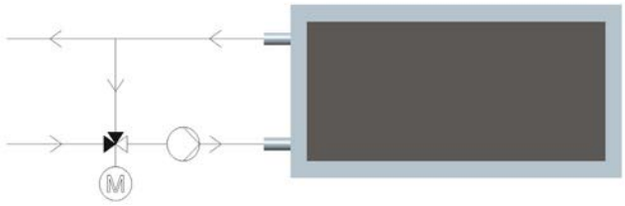
Mixing circuit

In contrast to a diverting circuit, a mixing circuit requires a pump for the secondary circuit, and the 3-way control valve is in the medium flow rather than in the return. In a heating system with several secondary circuits, the primary circuit must have the main pump. The secondary circuits each have their own pump. In this case, an open manifold must be provided, which balances the primary and secondary circuits.

The secondary circuit pumps provide a constant flow of water. The 3-way control valve controls the actual output; when it closes the bypass, the temperature in the secondary circuit rises.

For sizing the secondary circuit pump, only the differential pressure of the heat exchanger needs to be taken into consideration; this is convenient when the primary network is not known.

To control the temperature in central air handling units, a mixing circuit is usually used for heating coils, but may also be used for cooling coils without dehumidification function.



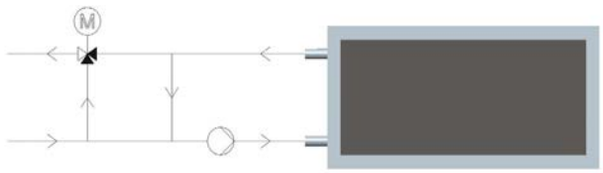
Mixing circuit

Injection circuit

Injection circuits are more complex when it comes to the required control components, but they do offer some advantages.

Both the primary circuit and the secondary circuit are operated with a constant water flow rate. The primary circuit pump is used to overcome the differential pressure of the primary circuit and the pressure loss of the actuating element. The secondary circuit pump overcomes the differential pressure of the heat exchanger.

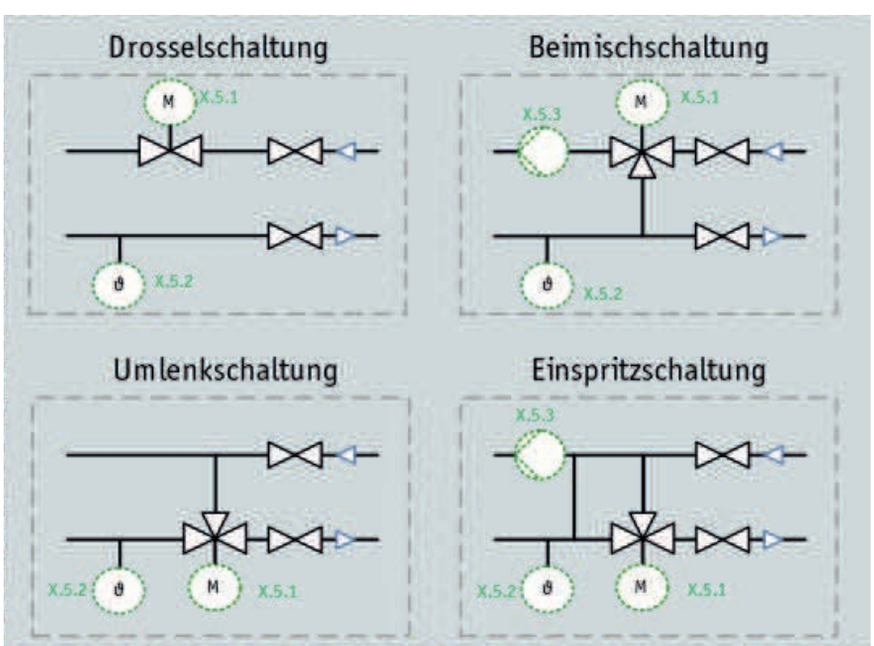
As with a mixing circuit, the heat exchanger output can be controlled by changing the temperature in the secondary circuit flow. Depending on the valve setting, more or less fluid from the primary circuit is 'injected' into the secondary circuit at the second mixing point.



Injection circuit

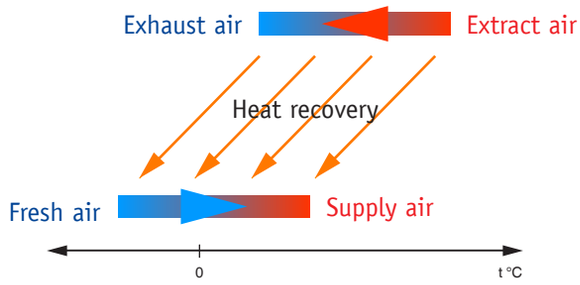
Hydraulic circuits

	Diverting circuit	Mixing circuit	Injection circuit
Characteristics			
Primary circuit water flow	Constant	Variable	Constant
Secondary circuit water flow	Variable	Constant	Constant
Water temperature at heat exchanger inlet	Same as flow temperature	Variable	Variable
Permanent water flow in the primary circuit (no dead time)	Yes	No	Yes
Circulator pump in secondary circuit	No	Yes	Yes
Advantages	– Constant differential pressure with regard to primary circuit (hydraulic balancing)	– Easy to control	– Very easy to control – Actuating element and heat exchanger can be at some distance from each other
Limitations of use	– District heating – Condensing boilers – Heat pumps	– Actuating element and heat exchanger can be at some distance from each other	– District heating – Condensing boilers – Heat pumps
Application			
Preheaters	–	+	+
Reheaters	+	+	–
Dehumidifying cooling coils	+	–	–
Cooling coils (dry)	–	+	+



Hydraulic circuits

Heat recovery reduces the amount of energy required from external sources to treat air in air handling units. The temperature difference between the extract air and the fresh air is used to heat or cool the fresh air. With up to 80 % of heat being recovered, heat recovery systems can make air conditioning an incredibly energy-efficient process.



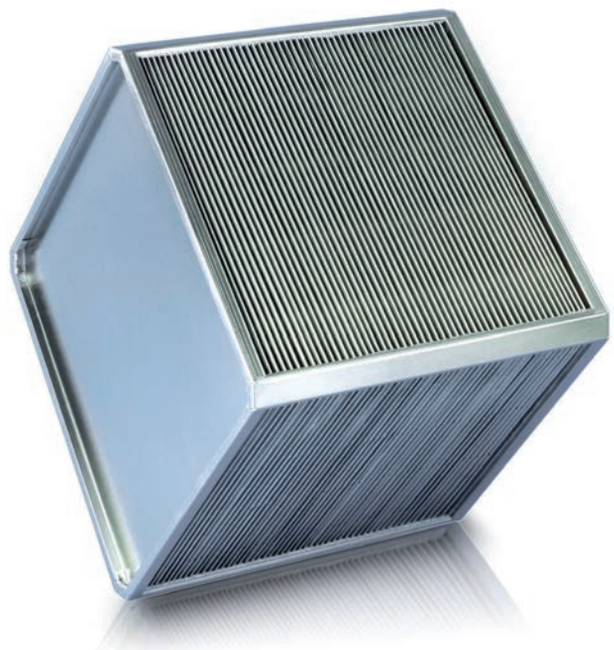
Heat recovery principle

Plate heat exchangers

Function

Plate heat exchangers in air handling units are used for heat recovery, namely to reduce the amount of heating capacity required in winter by recovering the warmth from the extract air. Plate heat exchangers are recuperative heat recovery systems. This means that the heat is transferred from one airflow to another airflow (counter flow) via a surface in between.

The routeing of the airflow is crucial for maintaining the function of the plate heat exchanger and for protecting it from damage due to freezing. There is a risk of freezing at the fresh air inlet and at the exhaust air outlet. When there is a risk of freezing, a damper opens the bypass and another damper linked to it closes the inlet of the heat exchanger so that no fresh air can flow through it. The warm exhaust air keeps flowing through the heat exchanger so that any ice, which may have developed, thaws. An optional recirculation damper can be fitted between the extract air and supply air.



Cross flow plate heat exchanger

Design

Plate heat exchangers can only be used in combi units as the airflows must be brought together in one component. With simple cross flow plate heat exchangers, a thermal efficiency of up to 70 % can be achieved.

There are several factors that need to be considered when sizing the plate heat exchanger – these are all covered by the X-CUBE Configurator. When you specify the space available, the size of the plate heat exchanger is determined automatically; a shortlist is then created once you enter the fresh air and extract air data.

Rotary heat exchangers

Function

Rotary heat exchangers are regenerative systems used for heat recovery in air handling units. Extract air and fresh air are alternately led past a rotating storage mass. The storage mass picks up part of the heat in the extract air and transfers it to the fresh air.

The storage mass is rotated by a motor that is connected to a V-belt. A control unit controls the speed of the heat wheel (storage mass) and the energy supply to the motor. Rotary heat exchangers can achieve heat recovery efficiencies of up to 80 %, and the pressure loss is low compared to that of a plate heat exchanger.

While a rotary heat exchanger offers obvious advantages, such as a high heat recovery efficiency with relatively low pressure losses, flexibility, functions and ease of control, these have to be weighed against the disadvantages. Since the wheel comes into contact with both airflows, there is always some unwanted mixing of air. This means that there is always a possibility of substances and smells being transferred. Rotary heat exchangers are therefore not suitable for systems with extract air from kitchens or toilets. They are equally unsuitable for applications where moisture transfer could cause problems.

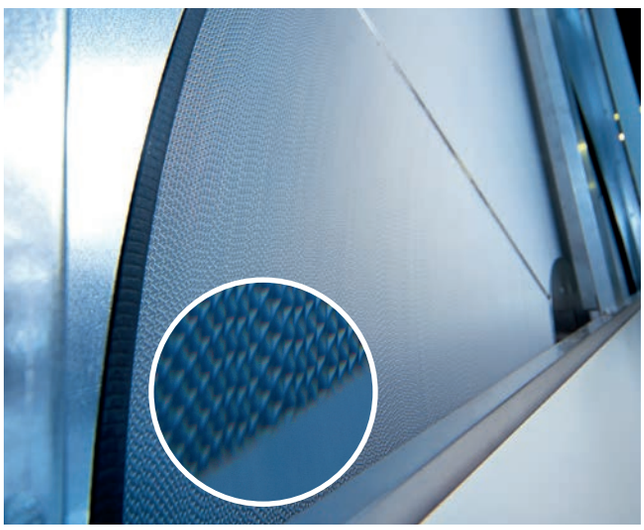
They can only be used with combi units.

Design

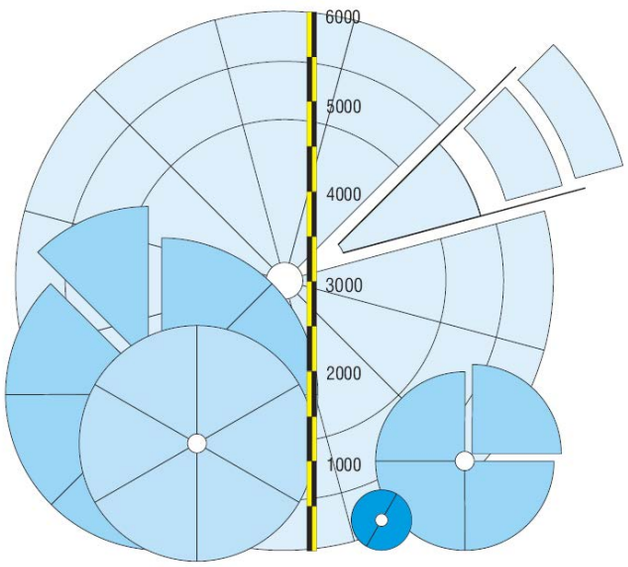
The storage mass consists of alternate layers of smooth and corrugated foil which make up a very large transfer surface. The folds give this heat recovery component its self-cleaning properties.

The material used for the casing may vary depending on the application. In general, a salt water resistant aluminium frame that clips together is used. Alternatively, the frame can come in galvanised steel. There is a choice of materials for both the casing and storage mass such that the rotary heat exchanger can be adapted to different applications. An epoxy coating will increase the resistance to corrosion. Special hydrophilic coatings improve the moisture transfer by the rotary heat exchanger.

Large wheels can be delivered unassembled so that they are easier to transport and bring into the building. The wheel is divided into sectors. The number of parts depends on the diameter of the wheel. The composition of the storage mass is to be designed by a specialist company according to the specifications of the wheel manufacturer.



Storage mass

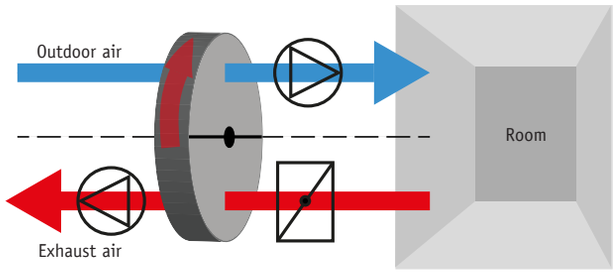


Wheel sectors

Placement in air handling units

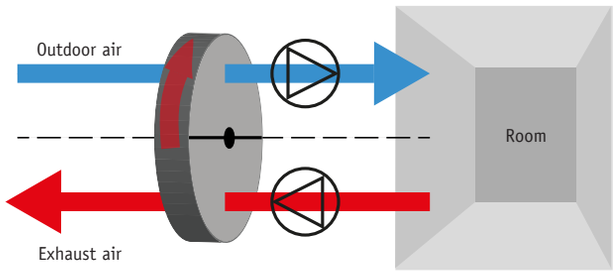
Leakage between the sub-units cannot be avoided completely, but it can be influenced by the arrangement of the fans.

There is only minimal leakage when the intake sides of both fans face the rotary heat exchanger. Since leakage occurs in the exhaust air flow, contamination of the supply air is virtually excluded.



Most favourable fan arrangement

Another fan arrangement is to have the intake side of the supply air fan and the discharge side of the extract air fan face the rotary heat exchanger. With this arrangement, the balance of both airflows is just as it should be at all times during operation; there is, however, always a certain percentage of recirculated air. The placement of the extract air fan results in an increase of the extract air temperature, which benefits heat recovery.



Most common fan arrangement

Highlights

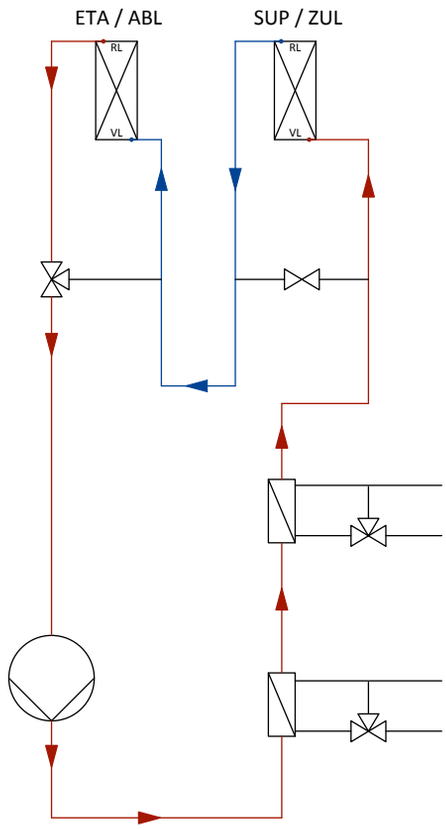
- Regenerative heat recovery system
  - Picks up the heat in the extract air flow
  - Rotating wheel turns from the extract air side to the supply air side
  - Contaminants and odours are transferred
  - Moisture transfer and air exchange between extract air and supply air (up to about 10 %)
- Construction variant
  - V-belt-driven with motor
  - Control unit for modulating the speed
  - Transport: Depending on the wheel diameter (up to 3,000 mm), the wheel may be divided into sectors
- Thermal efficiency
  - Up to 80 % as standard
  - Lower pressure losses than with plate heat exchanger
- Frame materials
  - Standard construction: Salt water resistant aluminium frame (clips together)
  - Wheel d > 3,000 mm: Welded casing made of galvanised sheet steel
- Storage mass
  - Standard construction: Aluminium
  - For corrosion resistance: Epoxy coating
  - Moisture transfer: Special hydrophilic coating
- Leakage between the supply air and the extract air depends on the fan arrangement and is between 3 - 15 %.
- The following storage masses are available:
  a. Condensation wheel for thermal energy transfer
  b. Condensation wheel with coating for cooling support via adiabatic humidification of extract air
  c. Enthalpy wheel with improved moisture recovery
  d. Sorption wheel for optimum moisture and temperature recovery
  e. Drying wheel for process technology

Run around coil systems

Run around coil systems (RCS) are regenerative heat recovery systems which are becoming more and more important. As the airflows are completely separated, an RCS is particularly suitable for applications where the extract air must not or should not come into contact with the supply air, such as in hospitals, the food industry or the pharmaceutical industry. Run around coil systems can also be used when the supply air unit and the extract air unit are placed at some distance from each other. This also applies when several supply air and extract air units are connected.

Function

A run around coil system consists of at least one heat exchanger for each airflow. The heat exchangers are hydraulically connected.
The heat transfer fluid is usually a mix of ethylene glycol and water. In the food industry, propylene glycol may be required. Unlike ethylene glycol, propylene glycol is non-toxic, but it does have a lower heat capacity and can cause higher pressure losses in the circuit due to its viscosity.
The concentration of the mix depends on the assumed lowest temperature of the system.
Run around coil systems achieve heat recovery efficiencies of up to 80 %. This is possible when several heat exchangers are connected in series. The heat exchangers are separated to meet the cleaning requirements specified in EN 13053. Due to the transfer area required, relatively high pressure losses both on the operating fluid side and on the air side can be expected when compared to other heat recovery systems, heating coils or cooling coils.
Unlike with other heat recovery systems, it is not important how the airflows relate to each other (parallel flow or counter flow) in a run around coil system, but heat exchangers and airflow must be arranged in counter flow, only then will a constant temperature profile be achieved between the air and the fluid in the heat exchanger.



1:1 run around coil system

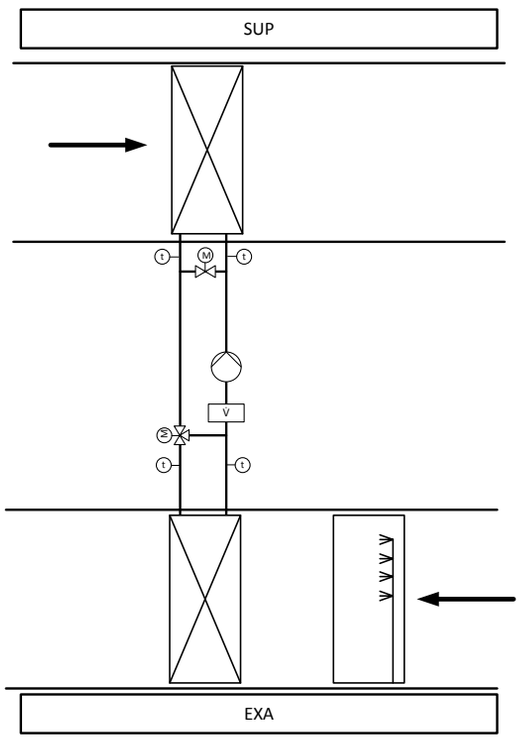
SUP: supply air, EXA: extract air

Operation

- Winter
  In winter, a run around coil system is used to preheat the supply air. It can also perform other thermodynamic functions. Such functions may include treatment of the supply air (e.g. reheating) or the integration of energy flows from other processes (e.g. waste heat). These systems provide the options to use multiple components in multiple ways and to connect several heat sources and heat sinks within a building.
- Summer
  In summer, a run around coil system is used to reduce the power required for cooling. For this purpose, the fin spacing of the heat exchangers in the supply air has to be 2.5 mm; a condensate drip tray may also be required. The cooling effect can be increased by humidification and evaporative cooling (adiabatic). Summer operation allows also for other thermodynamic functions, such as the conditioning of supply air (e.g. re-cooling and dehumidification) or the integration of energy flows from other processes (e.g. free cooling).

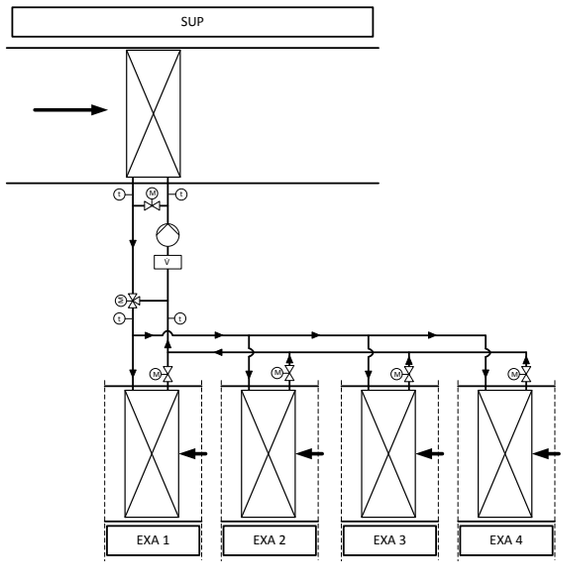
Systems

- 1:1 system
  A 1:1 system consists of one supply air unit and one extract air unit.
- 1:n system and n:1 system
  As the supply air unit and the extract air unit can be installed in different locations, it is also possible to have 1:n systems (1 supply air unit, any number of extract air units) or n:1 systems (any number of supply air units with 1 extract air unit).
- n:m system
  As the supply air unit and the extract air unit can be installed in different locations, it is also possible to have n:m systems (any number of supply air units with any number of extract air units).



1:1 run around coil system with evaporative humidifier in the extract air unit

SUP: supply air, EXA: extract air



1:4 run around coil system

SUP: supply air, EXA: extract air

Highlights

- Regenerative heat recovery system
  - Picks up the heat in the extract air flow
  - Airflows are completely separated
  - At least one heat exchanger for each airflow
- Application
  - Examples include hospitals, the food industry and the pharmaceutical industry
  - When the supply air and extract air units are in different locations
- System variants
  - 1:1 system = 1 supply air unit, 1 extract air unit
  - 1:n system = 1 supply air unit, n extract air units
  - n:1 system = n supply air units, 1 extract air unit
  - n:m system = n supply air units, m extract air units
- Characteristics
  - Several components of the same type and several heat sources and heat sinks can be connected within a building
  - Efficiency of up to 80 %

Hydraulic units

The optional hydraulic unit includes all components and integral controls required for an efficient run around coil system.

A 2-way control valve in the bypass between the flow and return flow of the supply air heat exchanger protects the extract air heat exchanger from freezing. If, in case of low outside temperatures, the flow temperature in the extract air heat exchanger falls below a set level, the pump speed is increased. This results in an increase of the return flow temperature in the supply air heat exchanger and of the flow temperature in the extract air heat exchanger. If the temperature remains very low, the control valve gradually opens the bypass; this results in a mixed temperature, which prevents frost from developing in the extract air heat exchanger.

A 3-way control valve can be used in the extract air heat exchanger flow to adjust the system output. This is also controlled according to the pump speed. If the output at minimum speed is still too high, the 3-way control valve opens the bypass, which results in a reduction of the extract air heat exchanger output.

The flow of the water glycol mixture is adjusted based on the supply air flow and as a result of a signal that varies with the airflow. Based on the type of glycol and its concentration, the system calculates the operating fluid flow required to achieve a thermal capacity ratio of 1. The pump speed is adapted accordingly.

Hydraulic unit for run around coil systems with heating/cooling energy feed

Working range of the hydraulic unit

DEXC-RCS-		15 50	50 80	80 120	120 150	150 350
Volume flow rate – water glycol mix	m³/h	1.5 – 5.0	5.0 – 8.0	8.0 – 12.0	12.0 – 15.0	15.0 – 35.0
	l/s	0.045 – 1.389	1.39 – 2.22	2.22 – 3.33	3.33 – 4.17	4.17 – 9.73
Volume flow rate	m³/h	5,000 – 16,000	16,000 – 26,000	26,000 – 39,000	39,000 – 50,000	50,000 – 100,000
	l/s	1,390 – 4,445	4,445 – 7,220	7,220 – 10,835	10,835 – 13,890	13,889 – 27,778

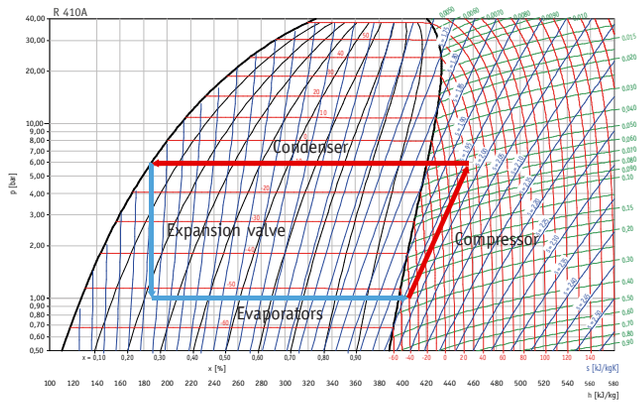
Highlights

- Construction variant
  - Integral controls
  - Pump speed adjustment
  - Volume flow rate measuring unit
- 2-way control valve
  - Bypass between the flow and return flow of the supply air heat exchanger
  - Extract air heat exchanger protected against freezing
- 3-way control valve
  - Between the flow and return flow of the extract air heat exchanger, used to adjust the output

Heat recovery

	Rotary heat exchangers	Cross flow plate heat exchanger	Run around coil systems
Efficiency	Up to 80 %	Up to 70 %	Up to 80 %
Pressure loss	Up to 120 Pa	Up to 250 Pa	Up to 350 Pa
Type of heat recovery	Regenerator	Recuperator	Regenerator
Moisture transfer	+	–	–
Combi unit	+	+	+
Single units	–	–	+
Materials			
Fins or storage mass	– Aluminium – Aluminium with epoxy coating – Special coating for moisture transfer	– Aluminium – Stainless steel – Aluminium with epoxy coating	– Aluminium – Aluminium with epoxy coating – Copper
Frame	– Aluminium – Galvanised steel	– Aluminium – Stainless steel – Aluminium with powder coating	– Galvanised steel – Stainless steel

There are two different ways of cooling and dehumidifying the air in air handling units: either with a cooling coil which is fed by an external water chiller, or with an evaporator. The evaporator is part of a refrigeration circuit. This refrigeration circuit is either an integral part of the air handling unit, or the evaporator is operated with split units.



Ideal cycle

Evaporators and condensers in air handling units are heat exchangers in which a refrigerant is used (e.g. R410A). A refrigeration circuit needs at least one evaporator and one condenser. The arrangement varies, as either both the evaporator and the condenser are integral parts of the air handling unit, or just one of the two. In the latter case, the second heat exchanger is installed outside the air handling unit.

Evaporators

The design of an evaporator is different from that of a conventional heat exchanger. However, the operating fluid and air must also flow in a counter flow arrangement. An evaporator has a Venturi-type distributor on the operating fluid entry side such that the refrigerant is distributed evenly to the individual circuits of the coil. This ensures that only vaporous refrigerant leaves the evaporator.

Venturi-type distributor in the evaporator

Evaporators

Condenser

A condenser does not need a Venturi-type distributor to function correctly. If reversible operation is required, sizing must be based on an evaporator. If the evaporator is used as a heating coil, the Venturi-type distributor collects the liquid refrigerant. This leads to increased pressure loss. As far as material requirements are concerned, all standard versions of conventional heating coils and cooling coils can be used as evaporators or condensers. They are usually made from copper tubes and aluminium fins.

Condenser in an air handling unit

Highlights

- Evaporators
  - Venturi-type distributor to ensure the refrigerant is distributed evenly to the circuits
  - Only vaporous refrigerant leaves the evaporator
- Condenser
  - For reversible operation: Sizing should be based on evaporator
- Materials
  - Standard versions of conventional heating coils and cooling coils are available
  - Use of copper tubes
  - Aluminium fins increase the transfer surface

Apart from conventional cooling coils which are fed by a water chiller, an evaporator can be used for cooling the supply air. With an integral refrigeration system, the condenser required to dissipate the heat is installed in the exhaust air. A compact compressor unit, which includes all other components for a refrigeration circuit, is installed next to the evaporator in the extract air unit.

Compressor in the air handling unit

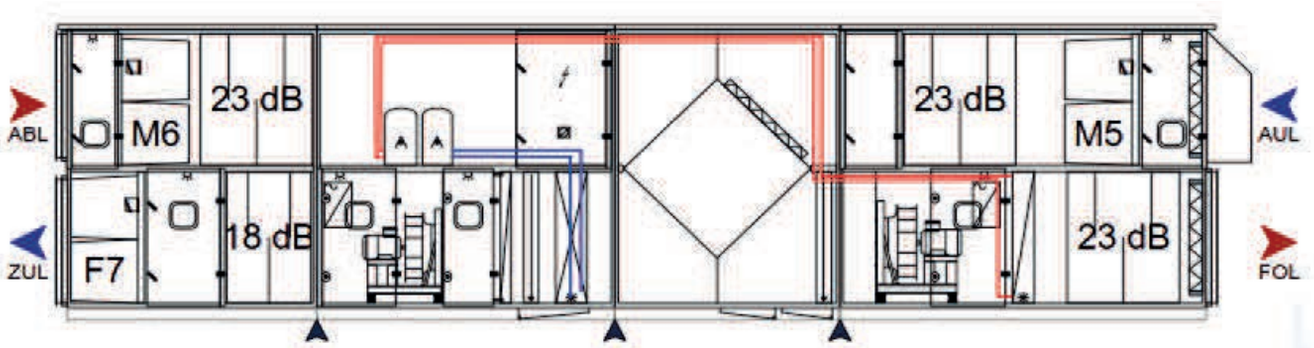
Integral refrigeration system

A compact compressor unit, which includes all other components for a refrigeration circuit, is installed next to the evaporator in the extract air unit. Due to this integration of the entire refrigeration circuit there is no need for external refrigeration, which in turn reduces the time and effort that would be required for the installation of refrigeration components. With all components in the air handling unit, the pipe length for the refrigerant and hence the refrigerant charge can be reduced, such that transfer losses are minimal.

When sizing the condenser it is important to remember that it must dissipate the heat from both the evaporator and the compressor. Selecting components that are compatible with one another and using the provided automatic functions for sizing the heat exchangers ensures a high level of operational reliability. Reliability is also ensured by the entire refrigeration system being factory assembled and factory tested.

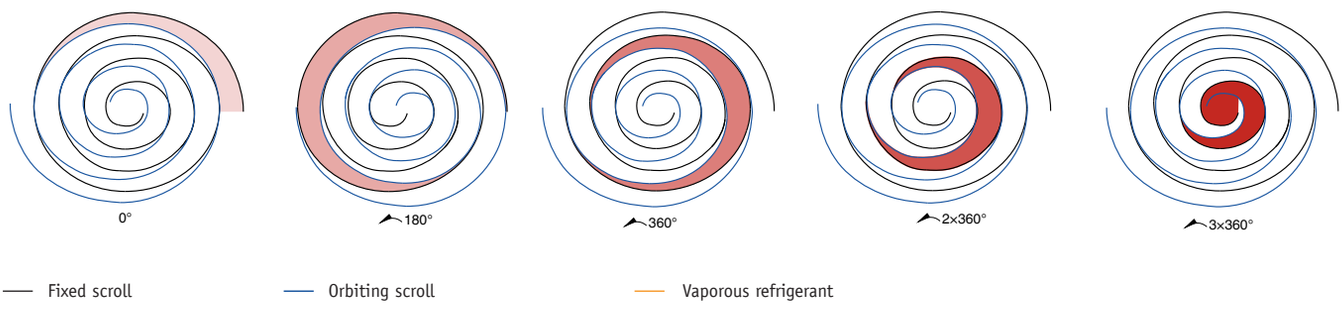
Highlights

- Evaporators
  - Fresh air cooling and dehumidifying
- Condenser
  - Placed in the exhaust air
  - Must dissipate the heat from both the evaporator and the compressor
- Compressor unit
  - Installed in the extract air unit
- Special features
  - No need for external refrigeration
  - Less time required for installing refrigeration components and less refrigerant required
- Refrigeration system is factory tested



Compressor unit

The compressor unit includes digital scroll compressors that can be operated with refrigerant R410A.
For a cooling capacity of up to about 40 kW (with t_0 = 5 °C and t_c = 50 °C), a single compressor is used. For higher capacities, two scroll compressors are used (tandem operation), a digital scroll compressor and a fixed speed compressor. Here, a digital scroll compressor and a fixed speed compressor is always used. With this combination, it is possible to achieve capacities of up to 80 kW (with t_0 = 5 °C and t_c = 50 °C).
Either a bus protocol or conventional voltage signals (0 – 10 V) can be used to control the compressor unit. With the dedicated X-CUBE Control, no external control system is required.



Function of a scroll compressor

Highlights

- Compressor unit
  - Digital scroll compressor
  - Refrigerant R410A
- Refrigeration capacity (with t_0 = 5 °C and t_c = 50 °C)
  - Single compressor: 7 kW to 40 kW
  - Tandem compressor: 45 kW to 80 kW
- Compressor unit control
  - Bus protocol
  - Voltage signal (0 – 10 V DC)
  - X-CUBE Control system

Single-split out-door units

Integrated into the air handling unit is a heat exchanger that can be operated as an evaporator and as a capacitor, and this is connected with up to 6 single-split outdoor units in cascade in order to generated the required cooling and heating capacity.

The heat exchanger is designed so that each outdoor unit can supply an internal cooling circuit in the heat exchanger.

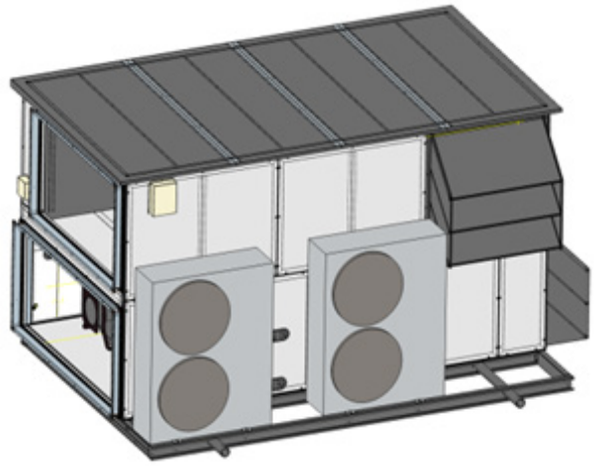
Thanks to the internal nesting of the cooling circuits, an even temperature is possible, even with a partial load.

The outdoor units include all the other components needed to operate the cooling circuit.

With a cascade connection, the capacity requirements are split – optimised according to the operating time – between the individual outdoor units.

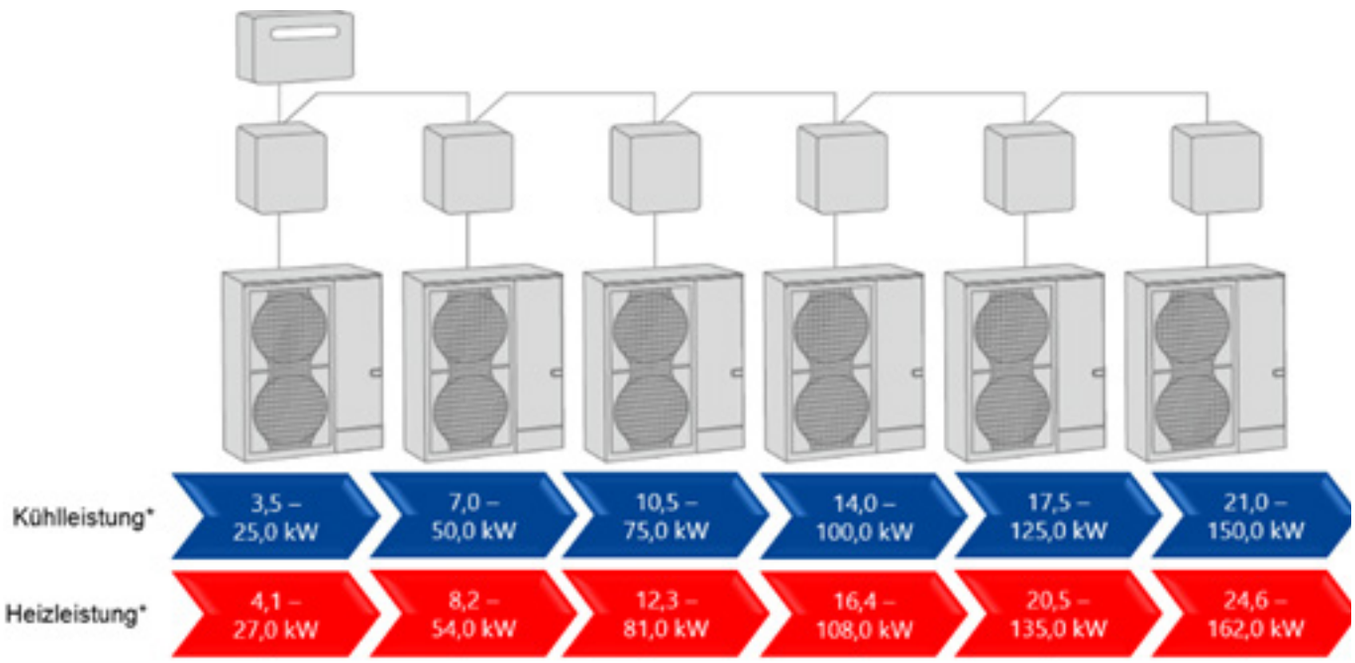
If, in heating mode, one of the outdoor units is in defrost mode, the missing heating capacity is compensated for by the internal control with an increase in the capacity of the remaining outdoor units.

Depending on the installation, the outdoor units can be provided with an air handling unit. With respect to air handling units for outdoor installation, the single-split outdoor units can be directly mounted on a prepared base frame on the air handling unit. If all the single-split outdoor units are on the base frame on the evaporator casing unit, the entire system can be delivered from the production facility so that it is ready for operation. If components need to be separated, the system can be prepared for simple assembly on site. With AHU indoor units, the outdoor units come with the air handling unit for assembly by others.



Highlights

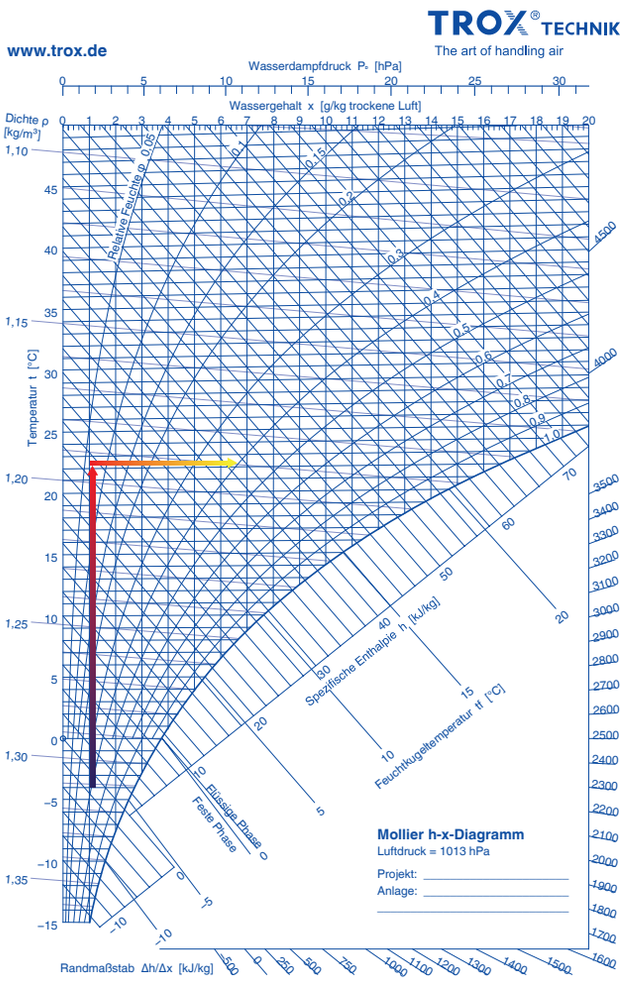
- Cooling capacity: 3.5 - 150 kW
- Heating capacity: 4.1 - 162 kW
- Splitting of capacity, optimised in accordance with the operating time, with a partial load
- Compensation for missing heating capacity in defrost mode if more than two outdoor units are connected
- Flexible delivery options
  - Ready for operation ex-production facility
  - Mounted on a base frame and prepared for commissioning
  - Supplied loose for assembly by others



There are two types of humidifiers for air handling units; they are distinguished according to their function. Adiabatic humidifiers, such as evaporative humidifiers and high-pressure spray humidifiers, are characterised by an almost isenthalpic state change. These humidifiers include evaporative and high-pressure spray humidifiers. Other humidifiers used in air handling units, such as steam humidifiers, are isothermal humidifiers. As the effects achieved by these two variants of humidifiers are fundamentally different, these differences have to be considered for humidifier control.

Humidification chamber

Steam humidification

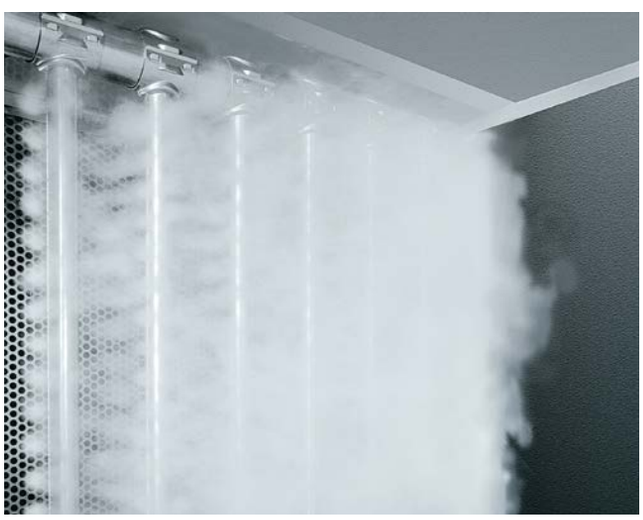


State change due to steam humidification

Steam humidifiers

Steam humidifiers are used to increase the moisture content of the room air and are hence installed in the supply air unit.

The humidifier unit consists of two separate components: the steam generator and the steam distribution system. An electrode heating system uses electrical power to generate steam. Due to the high humidity levels, there is a condensate drip tray in the floor of the humidification chamber. When steam is required, voltage is supplied to the electrodes in the boiler and an inlet valve opens such that water flows into the steam cylinder. As soon as the electrodes come into contact with the water, a current flows between them, the water temperature rises, and the water evaporates as a consequence. The more the electrodes become immersed, the higher the current, and the more steam is generated. A steam distribution pipe placed in the airflow to be humidified supplies steam to the air. Steam generation can be either modulated or controlled using an on-off control (with external humidity sensor).

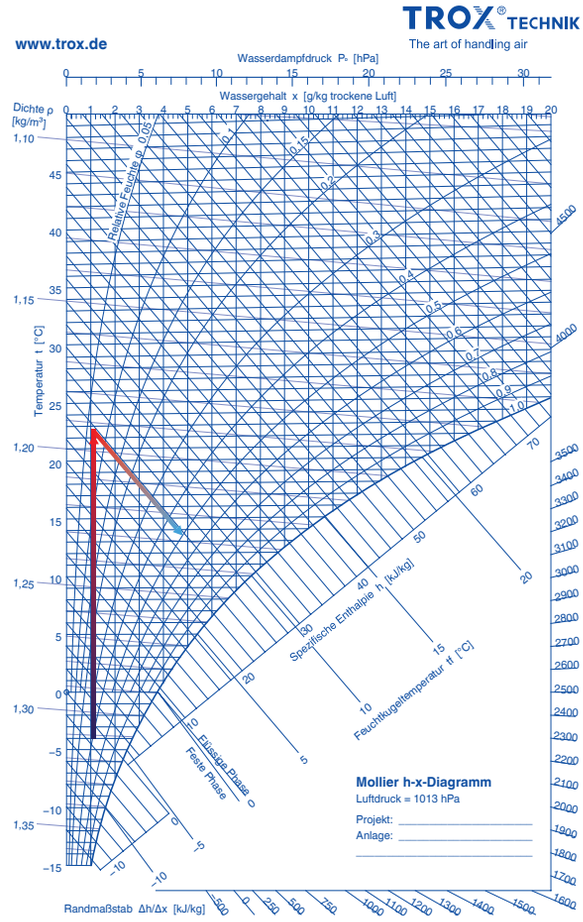


Steam humidifiers

Highlights

- Supply air humidification with steam humidifiers
  - Infinitely variable steam generation
  - Steam generation is started with an an on-off signal (with external humidity sensor)
- Construction features
  - Steam distribution pipes
  - Condensate drip tray in the floor of the humidification chamber
- Principle of operation
  - Voltage is supplied to electrodes following 'steam request' signal
  - Water inlet of the steam cylinder opens
  - Electrodes come into contact with water, steam is generated as a consequence
  - Water inlet valve closes when the required quantity of steam has been generated

Adiabatic humidification



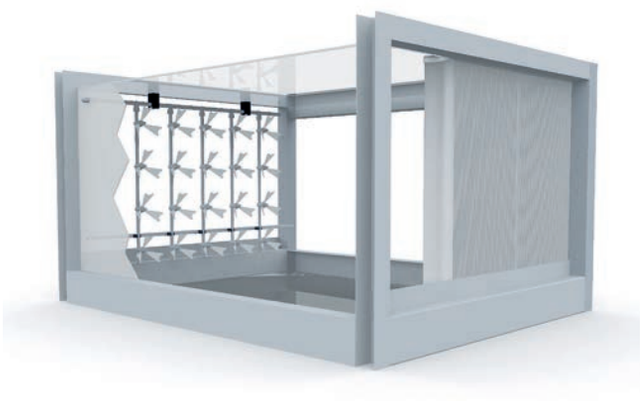
State change due to adiabatic humidification

High-pressure spray humidifiers

When adiabatic humidification is required to humidify the supply air, a high-pressure spray humidifier may be used. High-pressure spray humidifiers are fitted with a grid of spray nozzles that atomise fresh water, thereby creating a fine mist in the humidification chamber.

High-pressure spray humidifiers require some sort of water treatment, e.g. a reverse osmosis system, which in turn eliminates the need for other hygiene measures such as UV radiation or silver ions. This is why high-pressure spray humidifiers are also acceptable in air handling units that meet the critical hygiene requirements of DIN 1946-4.

The humidification chamber and all humidifier components are made of stainless steel to withstand the constant exposure to water.



High-pressure spray humidifiers

Highlights

- Supply air humidification with high-pressure spray humidifiers
  - Water spraying
  - Reverse osmosis system for water treatment
- Humidification chamber
  - Chamber in stainless steel
  - Humidifier components made of stainless steel
- Acceptable for units that comply with DIN 1946-4

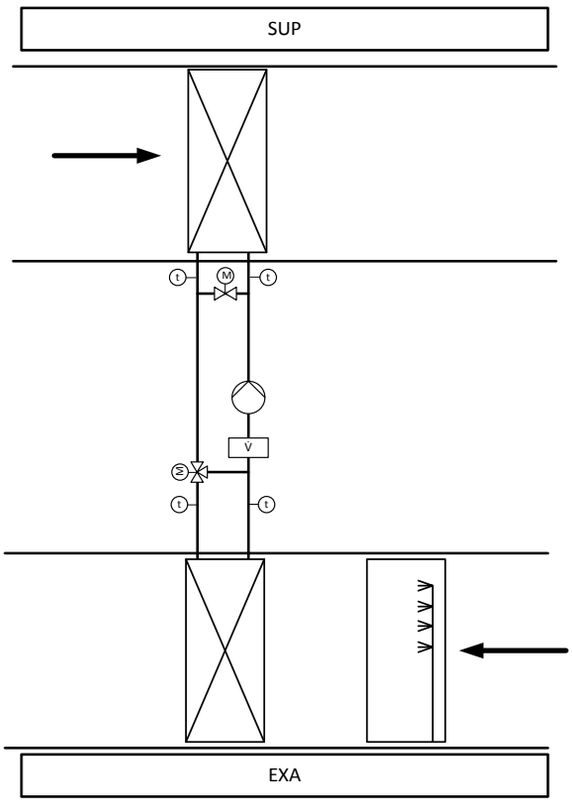
Evaporative humidifiers

Evaporative humidifiers are mostly used for evaporative cooling of the extract air (adiabatic cooling). There are two different procedures, with recirculated water or without it (flow-through).

The water in both cases may be drinking water, soft water, partially softened water, reverse osmosis permeate and fully demineralised water. From an economic point of view, we recommend using treated, fully demineralised water or reverse osmosis permeate. With these types of water it will take much longer for deposits to develop in the honeycomb structure, meaning that the pressure loss and therefore the required fan capacity will not increase too much.

Profiling the material creates the humidifier's characteristic honeycomb structure and increases its surface and hence the evaporation effect. Profiling creates the humidifier's characteristic honeycomb pattern. The aim is to increase the moisture content until the air is almost saturated. Extract air adiabatic cooling requires only an on-off signal to activate the humidifier.

Evaporative humidifiers



Placement of the evaporative humidifier, e.g. in the extract air unit
Water quality in accordance with VDI 3803 or the manufacturer's specifications

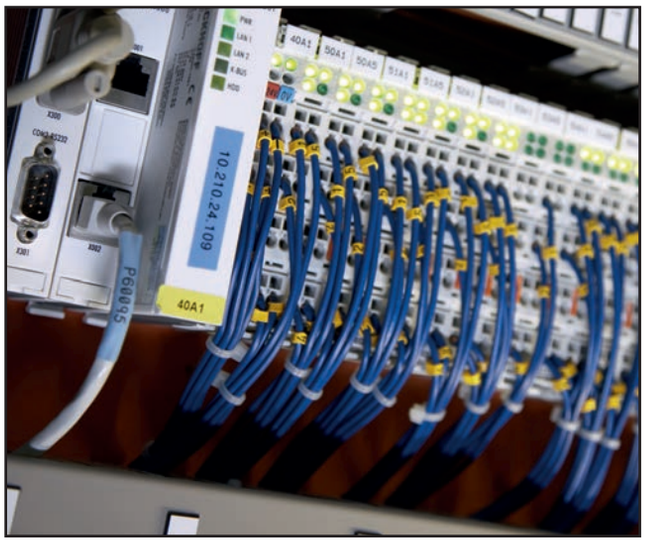
Highlights

- Used for indirect evaporative cooling (extract air adiabatic cooling)
- Construction variants
  - Flow-through operation
  - Recirculation
- Suitable types of water
  - Drinking water (compliant with the German Drinking Water Ordinance)
  - Soft water
  - Partially softened water
  - Reverse osmosis permeate (economical)
  - Fully demineralised water (economical)
- Construction features
  - Surface area for evaporation: Profiled material (for a better evaporation effect)
  - Profiling creates the humidifier's characteristic honeycomb pattern

Humidifiers

	Steam humidifiers	High-pressure spray humidifiers	Evaporative humidifiers
Application	Isothermal humidification of supply air	Adiabatic humidification of supply air	Adiabatic humidification of extract air
Hygiene	For air handling units that comply with DIN 1946-4	For air handling units that comply with DIN 1946-4 (but not for operating theatres)	
Medium	– Steam generated by heating electrodes	– Water from a reverse osmosis system	– Drinking water – Soft water – Partially softened water – Reverse osmosis permeate – Fully demineralised water

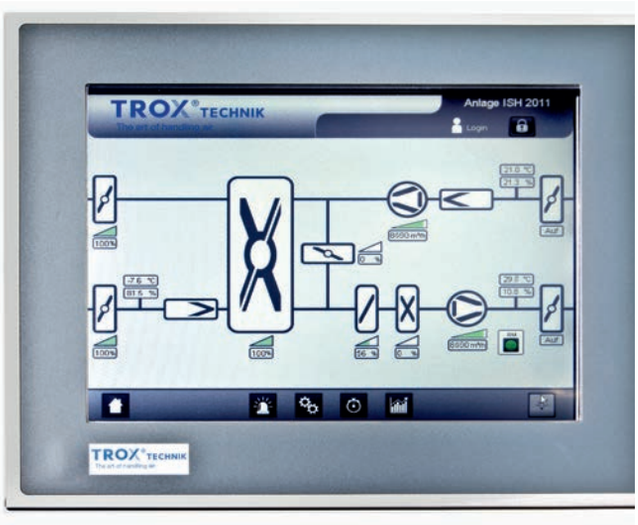
The functional units of an air handling unit work best with an integral control system. Setting parameters for the various applications and integrating all functions into an overall system ensure the most efficient modes of operation and excellent operational reliability. X-CUBE Control provides intuitive navigation with a touch panel.



Modular and expandable controls

X-CUBE Control

X-CUBE Control is an integral system for the control of all functional units. All components are clearly depicted on the start screen and can be individually selected. Users can then get status information or set parameters for a component.



Schematic depiction on the touch panel

Highlights

- Integration with all common building management systems via Modbus TCP or BACnet/IP.
- Bus communication allows for permanent data exchange between the participating components.
- Quick and error-free wiring due to patch panels and coded plug-in cables.
- Integration of field devices which are installed in the air distribution system (e.g. fire dampers, volume flow controllers and air duct sensors).
- The integral cable duct (optional) and the straightforward cabling of the components are a hygienic solution which helps the X-CUBE meet the hygiene requirements of the VDI 6022 guideline.
- To provide the control input signal for fire dampers
- To provide the control input signal for TROX volume flow controllers

Operating modes

Operating modes can be set using the touch panel.

Automatic

Automatic mode means timer control according to the set control strategy. Safety-related functions remain active even in standby mode.

Off

The system is off. All safety-related functions remain active.

Manual control

The system is in operation; manual control overrides any set control strategy or timer program. Each component can be switched on as required. All safety-related functions are active.

Extending the operating time

Selecting an operating time extension switches the system on regardless of any timer program. It is possible to set a time limit for the extension; the control strategy is maintained during the extension period. After the set period has elapsed, the system returns to automatic mode.

Control strategies

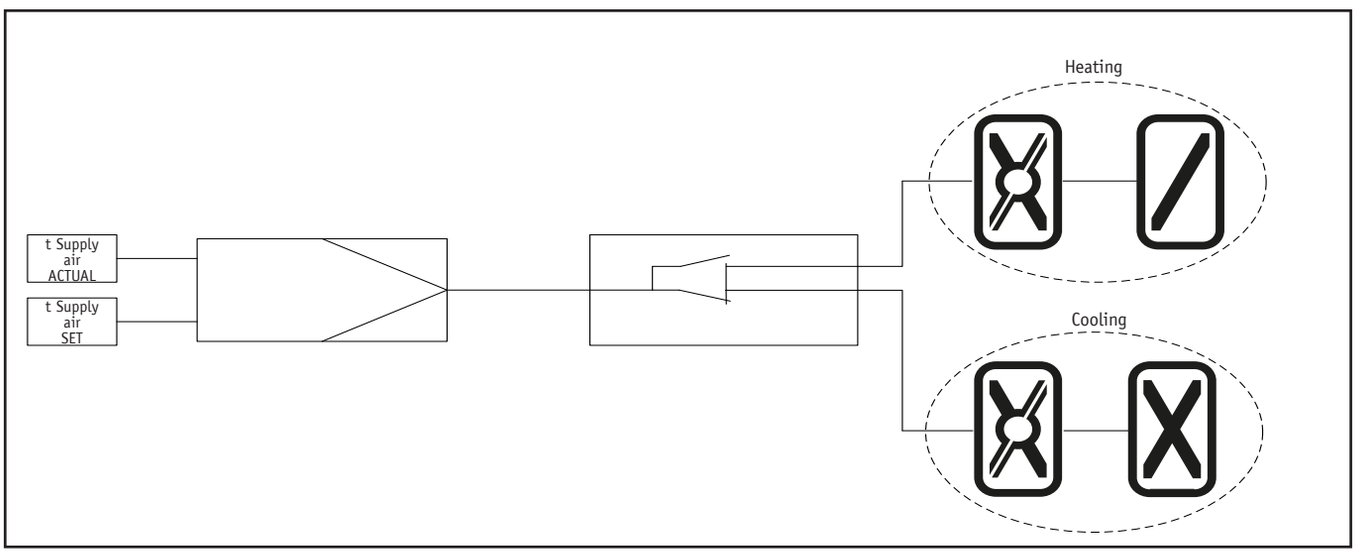
Different control strategies are available and may be combined depending on the application. The control strategy can be selected on the touch panel as part of commissioning. It is possible to change or adjust a selected control strategy or function if required.

- Temperature control
- Humidity control
- Constant pressure control
- Constant volume flow rate control
- Air quality control

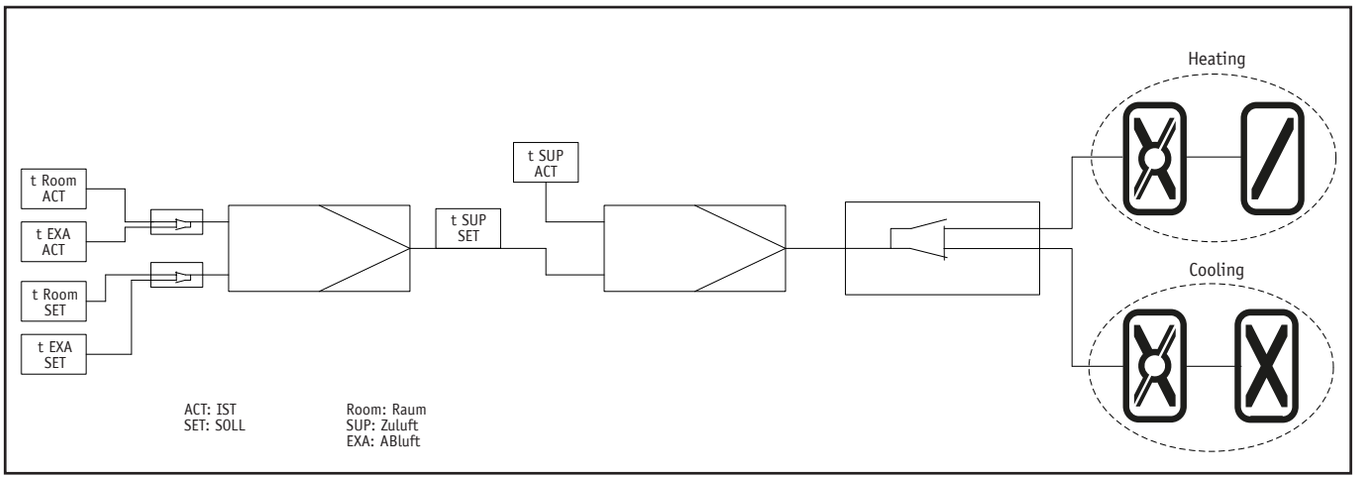
Temperature control

Temperature control may be based on one of various reference inputs.

Temperature sensors placed in the airflows allow for constant supply air temperature control based on a comparison of setpoint and actual temperature values. By setting a minimum and a maximum temperature and by measuring the room temperature or extract air temperature it is possible to optimise temperature control and achieve energy efficient results.



Constant supply air temperature control

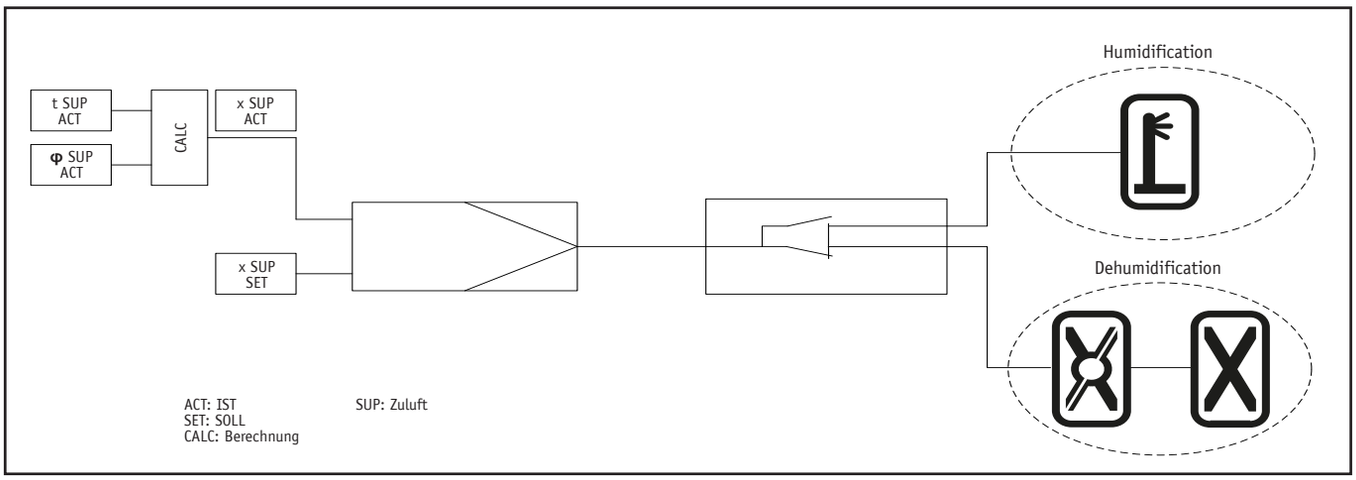


Cascade control – room or extract air temperature

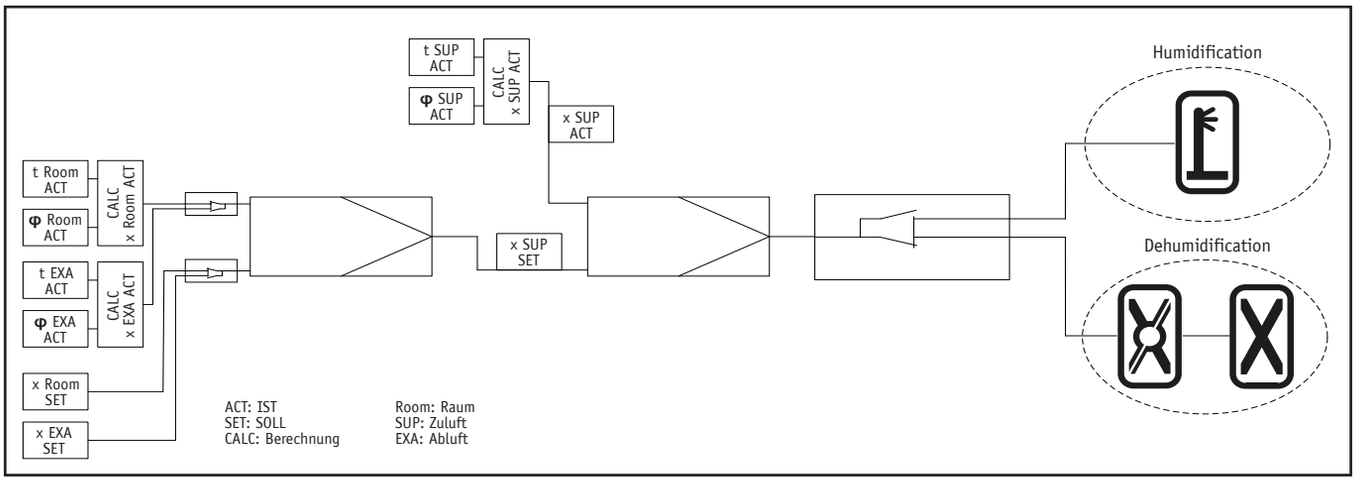
Humidity control

It is common practice to control the humidity in addition to the temperature. While humidity control is generally an important factor in achieving high comfort levels, it may actually be critical for certain applications.

As with temperature control, one option is to maintain a constant humidity level of the supply air. This requires a humidity sensor in the supply air flow. The desired humidity level is then maintained based on a constant comparison of the actual and setpoint values. Another option is extract air led humidity control whereby the humidity level of the room air or extract air is measured. Based on that value the humidity level of the supply air is controlled within a certain range.



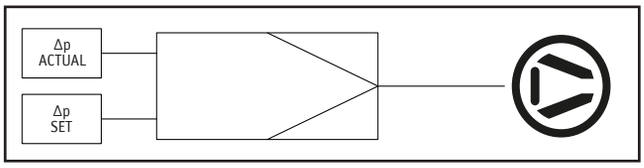
Constant control of the supply air humidity



Cascade control – room or extract air humidity

Constant pressure control

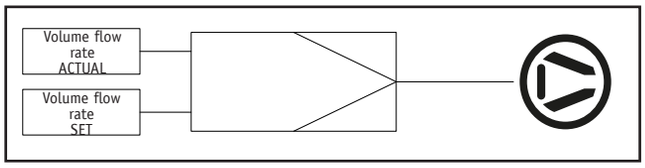
Constant pressure control requires pressure sensors in the respective air system. It is, hence, possible to achieve constant pressure control for supply air, extract air or combined supply air and extract air. In all these cases an actual value is compared to a setpoint value. The internal controller provides the control input signal for the fan such that the setpoint value is achieved or maintained.



Constant pressure control

Constant volume flow rate control

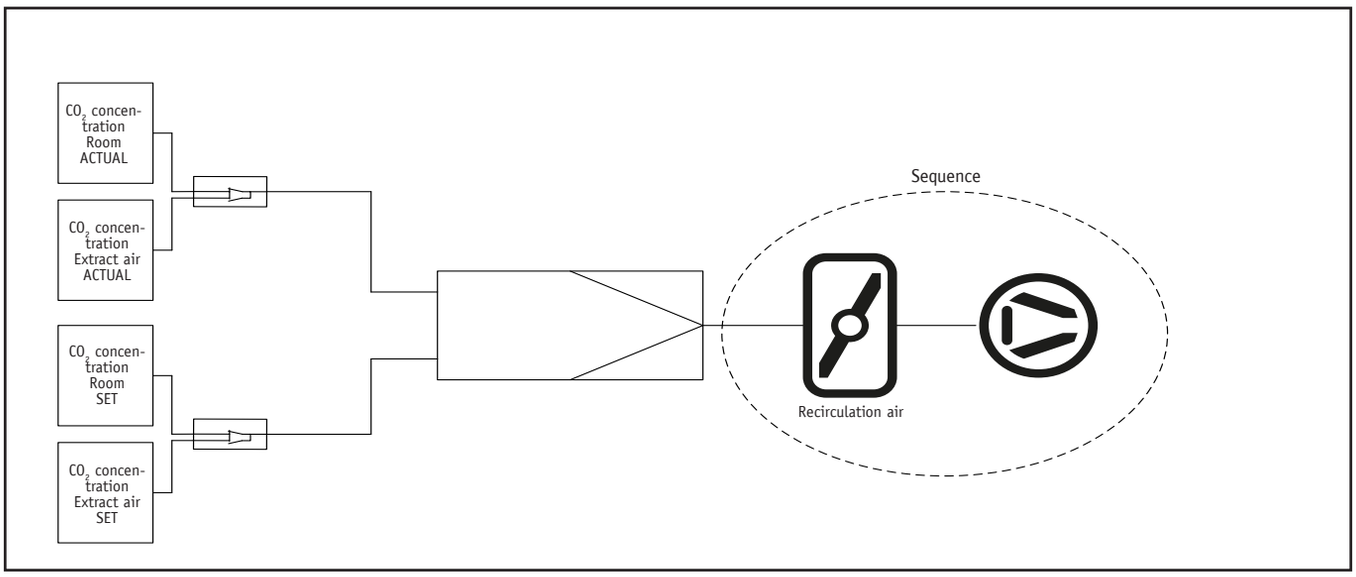
Constant flow rate control is an alternative to constant pressure control. The actual value is calculated from the effective pressure of the fan and the K value of the bell-mouth inlet and is then compared to the setpoint value. The controller provides the control input signal for the fan unit such that the setpoint volume flow rate is achieved or maintained.



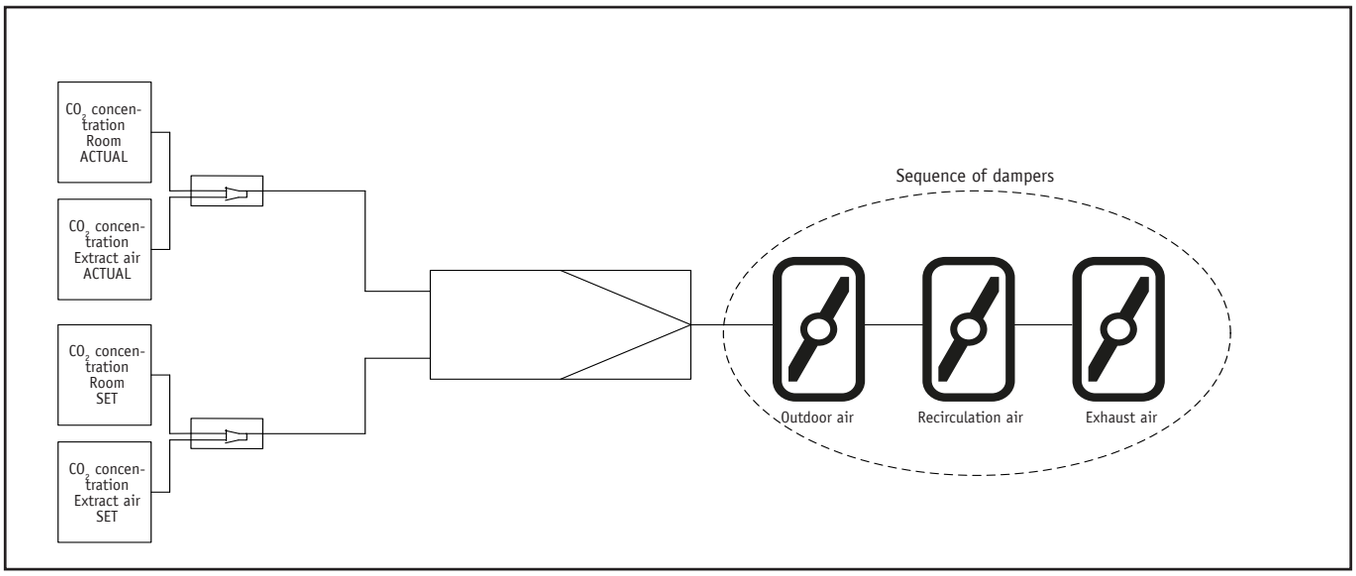
Constant volume flow rate control

Air quality control

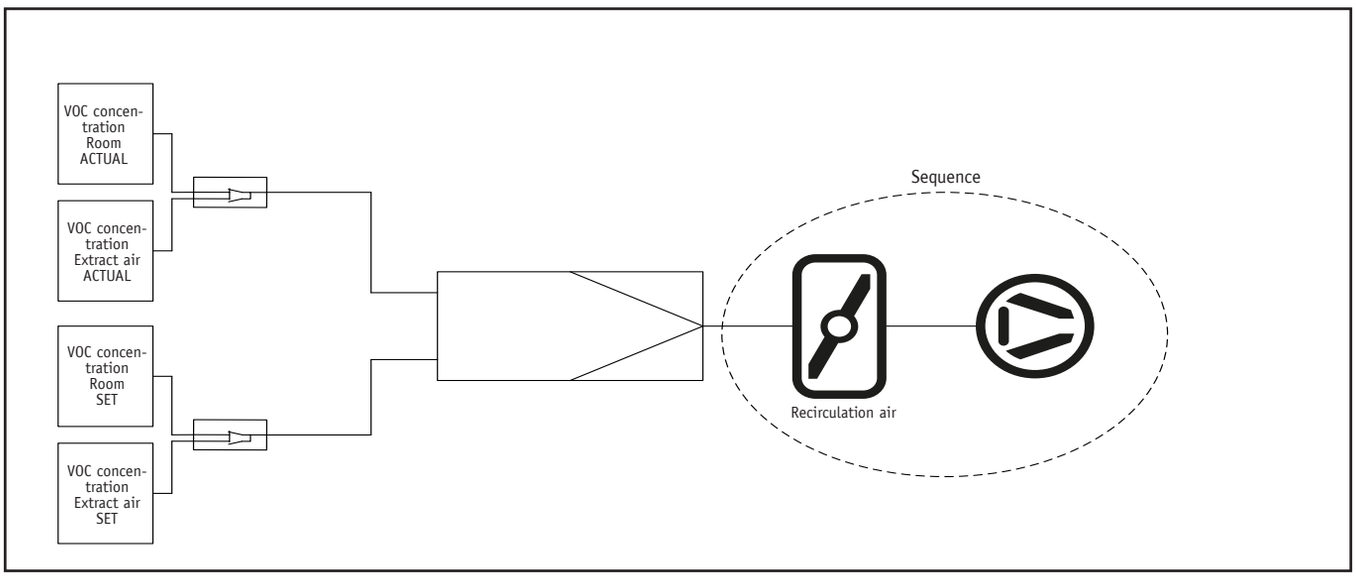
There are two ways to change the CO_2 content and the VOC value of the room air – either by varying the volume flow rate created by the fan, or by opening or closing the internal dampers.



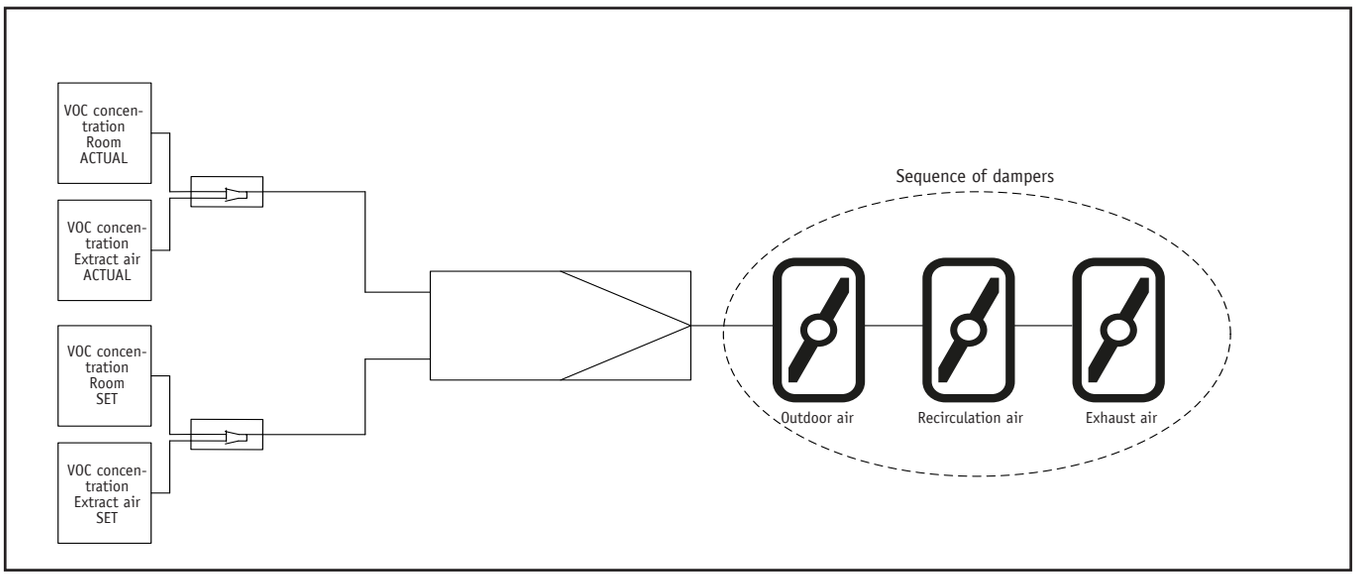
Air quality control based on CO_2 – recirculation damper and fan



Air quality control based on CO_2 – sequence of dampers



Air quality control based on VOC – recirculation damper and fan



Air quality control based on VOC – sequence of dampers

BMS communication

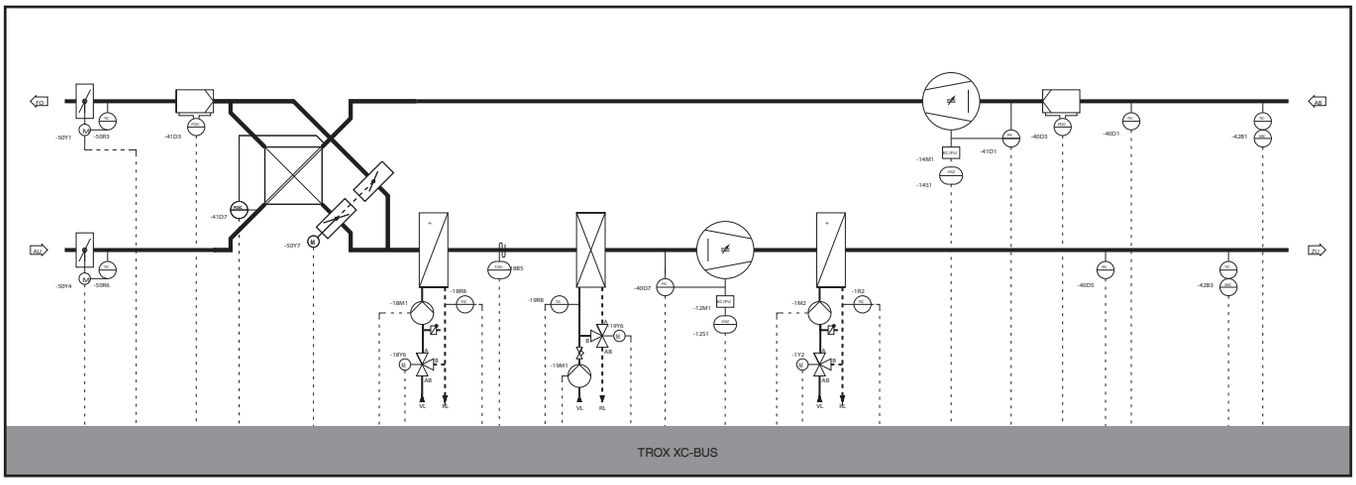
The X-CUBE and the X-CUBE Control software can be integrated with the usual central building management systems via Modbus TCP or BACnet/IP. Bus communication allows for permanent data exchange between the participating components.

Integral cable management

Quick and error-free wiring due to patch panels and coded plug-in cables. The integral cable duct and the straightforward cabling of the components are a hygienic solution which helps the X-CUBE meet the hygiene requirements of the VDI 6022 guideline.
It is also possible to integrate other components installed in the air distribution system, such as fire dampers, volume flow controllers or duct sensors. These include fire dampers, air terminal units and air duct sensors.

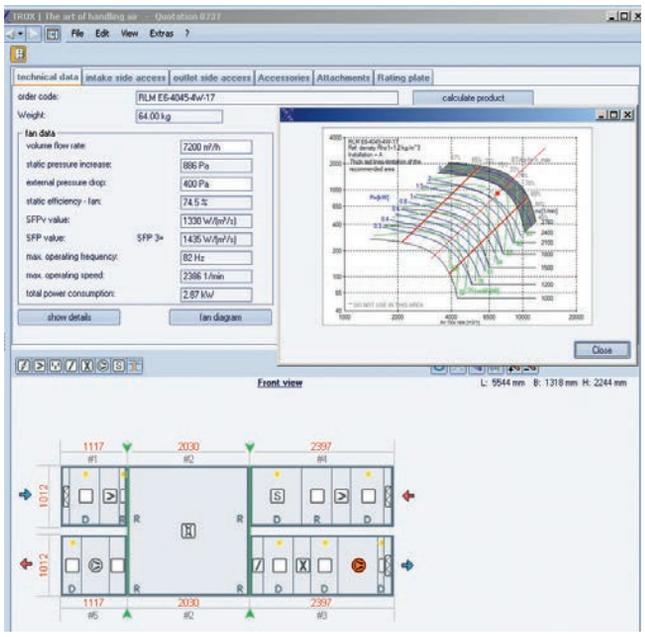
Patch panel

Cable duct



Control diagram

X-CUBE air handling units offer maximum flexibility and can easily be configured to each application situation. For sizing purposes, TROX sales engineers use the X-CUBE Configurator, a software solution developed by TROX. TROX customers can, in fact, have everything.

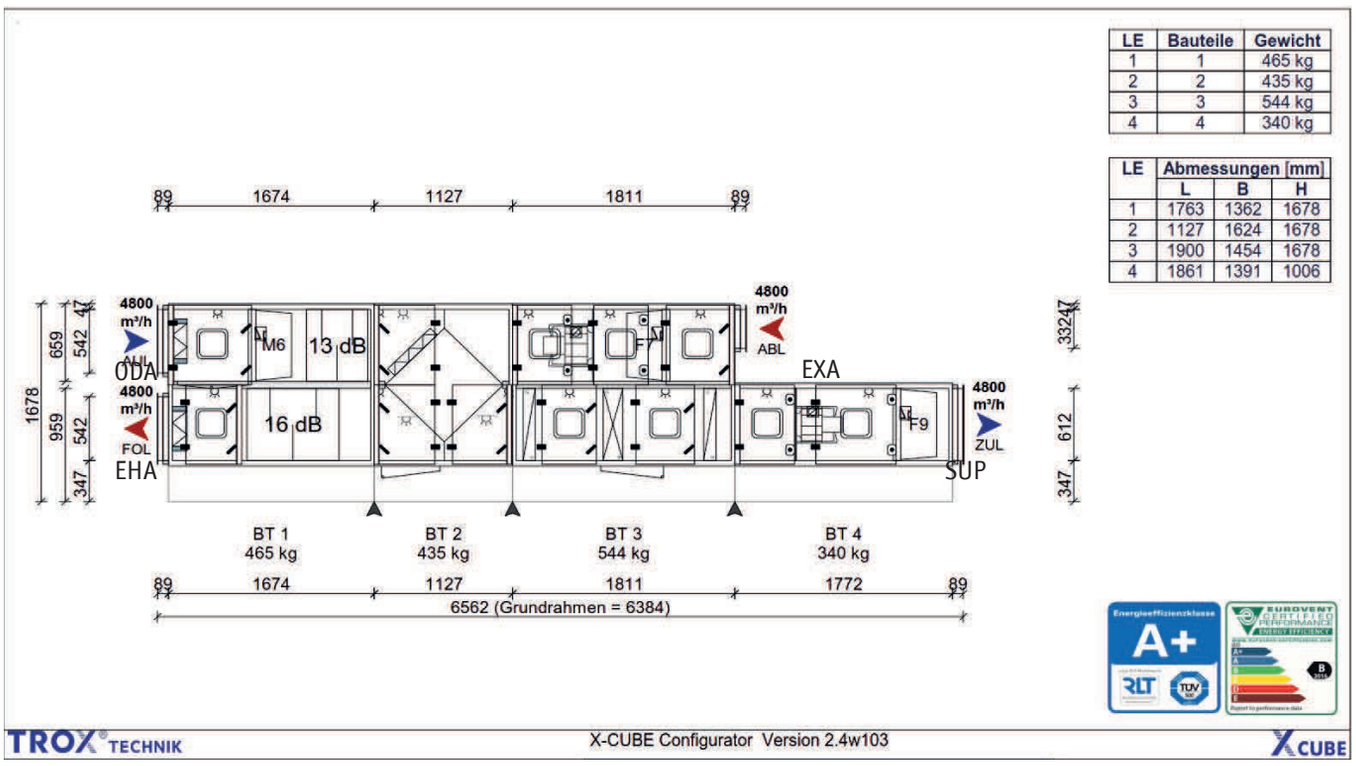


Configuration of air handling units with the X-CUBE Configurator

The X-CUBE Configurator design programme is a dedicated tool and helps to find the perfect technical solution for each customer and project. Once the configuration procedure for the air handling unit and all functional modules has been completed, the software creates all relevant documents including design details:

- A schematic illustration of each configured unit, including weight and dimensions
- Drawings in DWG format
- Specification texts
- Technical data for all components

All documents are available in German, English and many other European languages.



Schematic illustration

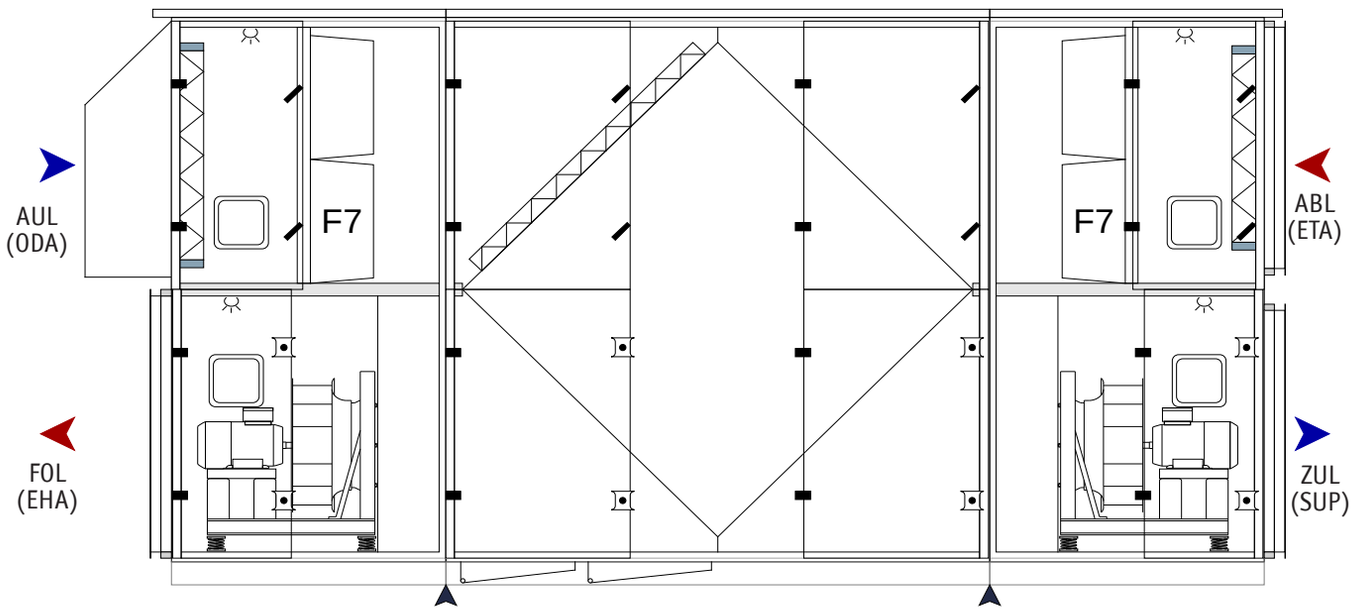
Combi unit with plate heat exchanger

This air handling unit with a recuperative plate heat exchanger is designed for outdoor installation. The central unit can provide zone modules with air. This construction meets the requirements of VDI 6022 and achieves a heat recovery efficiency level that corresponds to class H2, EN 13053.

Air volume	W	H	L
3000	1012	1488	3200
5000	1012	2100	3900
10000	1930	2100	4100
15000	2236	2856	5200
20000	2542	2856	5500
25000	3154	2856	6200
30000	3154	3468	6500

Selected configuration

Installation	Outdoors/supply air unit and extract air unit stacked	
Separation of the airflows	Intermediate floor panel	
Outdoor air opening	Aluminium damper, leakage class 2 Weather hood	
Supply air connection	No damper Noise insulating connector (EPDM)	
Extract air connection	Aluminium damper, leakage class 2 Noise insulating connector (EPDM)	
Exhaust air opening	No damper Noise insulating connector (EPDM)	
Outdoor air filter	Mini Pleat filter inserts	F7
Extract air filter	Mini Pleat filter inserts	F7
Plate heat exchangers	Bypass	At the side
	Efficiency class	H1
Supply air fan	Plug fan with standard motor – Powder-coated – Anti-vibration mounting	
	P class	P1
	Motor efficiency class	IE2, 3 or IE4
Extract air fan	Plug fan with standard motor – Powder-coated – Anti-vibration mounting	
	P class	P1
	Motor efficiency class	IE2, 3 or IE4
Application	– To provide zone modules with air – Heat recovery with additional, conventional heating system – To ensure the required air change rate	



Combi unit schematic illustration (side view)

Combi unit with rotary heat exchanger

This air handling unit with a rotary heat exchanger for heat recovery is designed for indoor installation. The two filter stages in the supply air unit improve the air quality enormously.

The integral heating and cooling coils ensure that the required supply air temperature is achieved.

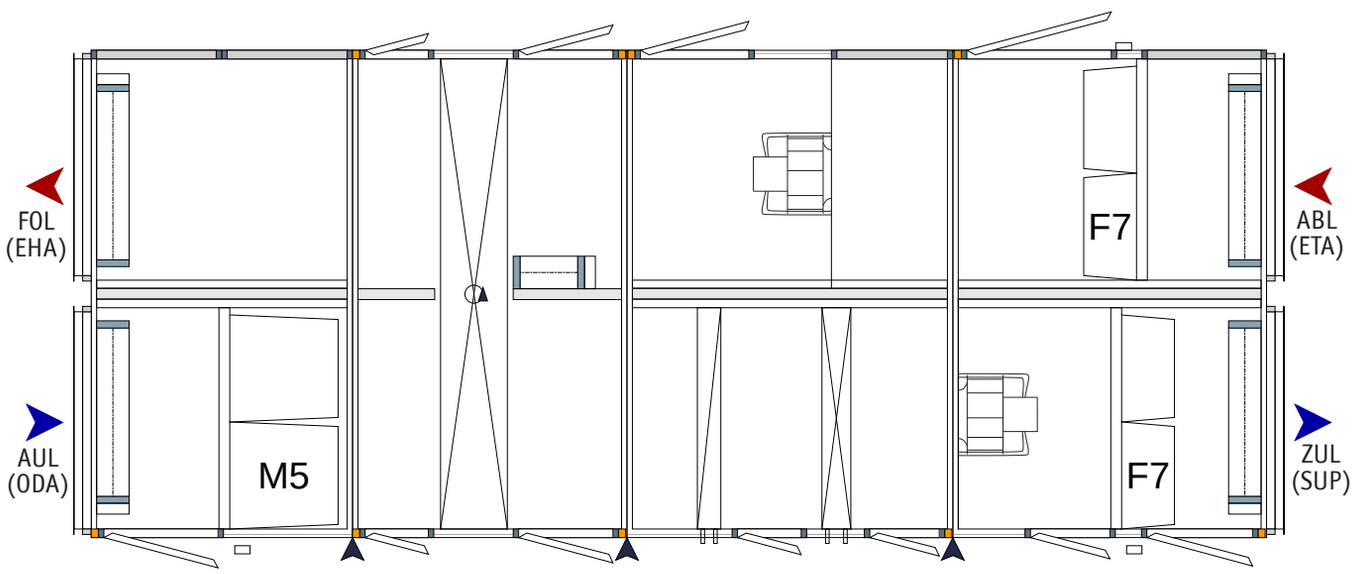
This construction meets the requirements of VDI 6022 and achieves a heat recovery efficiency level that corresponds to class H1, EN 13053.

The selected fans, arranged as a FanArray, increase the operational reliability and the efficiency of the unit.

Air volume	W	H	L
3000	1365	1122	5000
5000	1365	1468	5000
10000	1977	2040	5500
15000	2589	2346	5800
20000	2589	2652	6000
25000	3201	2958	6500
30000	3813	2958	6800

Selected configuration

Installation	Indoors with the supply air unit and extract air unit arranged side by side	
Separation of the airflows	Intermediate side panel	
Outdoor air opening	Aluminium damper, leakage class 2 Noise insulating connector (EPDM)	
Supply air connection	Aluminium damper, leakage class 2 Noise insulating connector (EPDM)	
Extract air connection	Aluminium damper, leakage class 2 Noise insulating connector (EPDM)	
Exhaust air opening	Aluminium damper, leakage class 2 Noise insulating connector (EPDM)	
Outdoor air filter	1st filter stage: pocket filters	M5
	2nd filter stage: Mini Pleat filter inserts	F7
Extract air filter	Mini Pleat filter inserts	F7
Rotary heat exchangers	Recirculation damper without spigot	
	Efficiency class	H1
Supply air fan	Plug fan with EC motor – Powder-coated – Arranged in a FanArray – Three fans stacked	
	P class	P1
	Motor efficiency class	IE2, 3 or IE4
Extract air fan	Plug fan with EC motor – Powder-coated – Arranged in a FanArray – Three fans stacked	
	P class	P1
	Motor efficiency class	IE2, 3 or IE4
Application	– Offices – Production facilities – Schools	



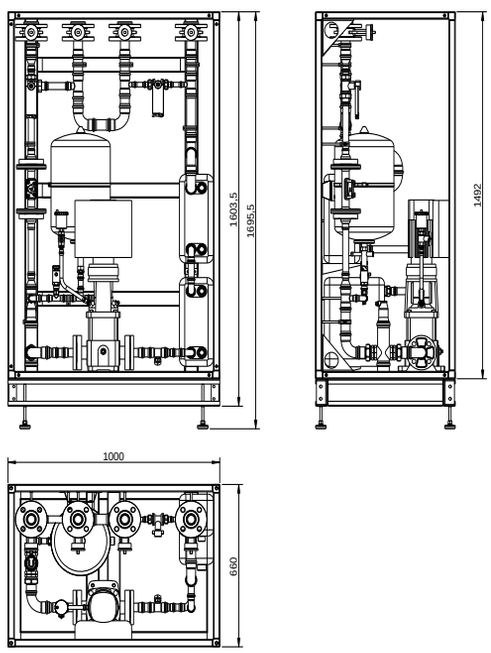
Combi unit schematic illustration (top view)

Supply air unit and extract air unit with run around coil system

The supply air unit and extract air unit are installed in different locations. Energy-efficient heat recovery is achieved with a run around coil system. This construction meets the increased hygiene requirements of DIN 1946-4.

The required supply air temperature and humidity are ensured by the humidifier and by the cooling and heating coils.

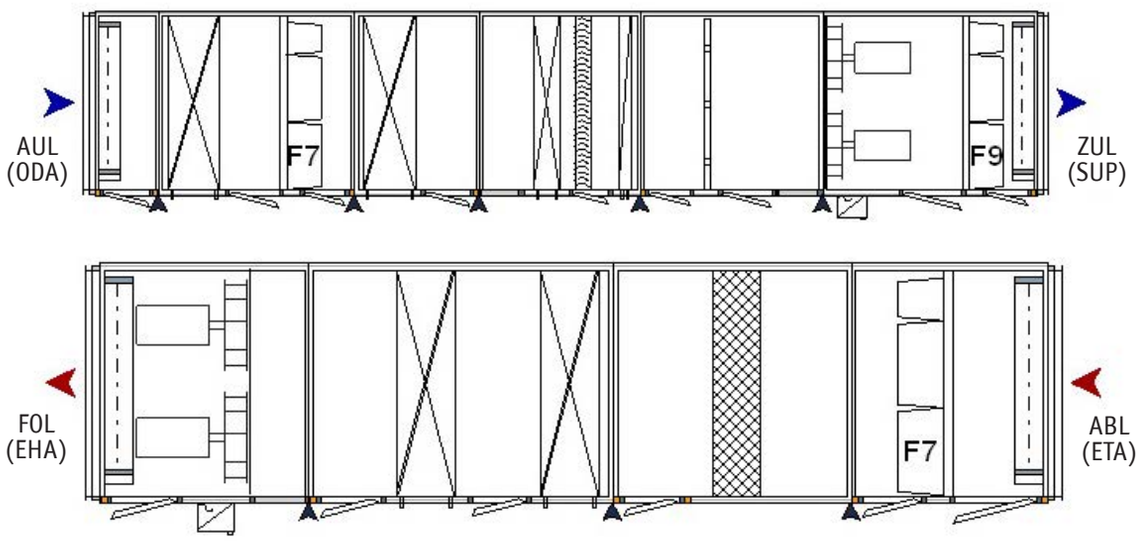
Twin fans ensure energy-efficient operation even with partial load.



Hydraulic units

Selected configuration

Installation	Separate installation locations	
Construction variant	For increased hygiene requirements to DIN 1946-4	
Outdoor air opening	Stainless steel damper, leakage class 4 Noise insulating connector (EPDM)	
Supply air connection	Stainless steel damper, leakage class 4 Noise insulating connector (EPDM)	
Extract air connection	Stainless steel damper, leakage class 4 Noise insulating connector (EPDM)	
Exhaust air opening	Stainless steel damper, leakage class 4 Noise insulating connector (EPDM)	
Outdoor air filter	1st filter stage: Mini Pleat filter inserts	F7
	2nd filter stage: Mini Pleat filter inserts	F9
Extract air filter	Mini Pleat filter inserts	F7
Run around coil systems	With hydraulic unit	
	Heat recovery efficiency to EN 308	73 %
	First heat exchanger – Filter preheating by 3 to 5 K – Fin spacing 4 mm	
Supply air fan	Plug fan with standard motor – Powder-coated – Arranged as twin fans – Two fans side by side	
	P class	P1
	Motor efficiency class	IE2
Extract air fan	Plug fan with standard motor – Powder-coated – Arranged as twin fans – Two fans side by side	
	P class	P1
	Motor efficiency class	IE2
Application	– Hospitals/operating theatres – Pharmaceutical industry – Clean rooms – Laboratories	



Drawing of unit (plan view), dimensions on request

X-CUBE compact

The X-CUBE compact is a ready-to-operate solution that includes all the advantages of the proven X-CUBE technology, and the same excellent quality, in a compact unit. With two heat recovery options and volume flow rates up to 1,670 l/s (6,000 m³/h), this unit provides energy-efficient air treatment for small and medium-sized systems.
The unit is configured with the Easy Product Finder design programme, The Easy Product Finder is available for download (free or charge) on our website (www.troxtechnik.com, under 'Services', 'Planning').

X-CUBE compact

Variants
- Rotary heat exchanger or plate heat exchanger for heat recovery
- Operating side can be on the right or left and can be changed later on site

Heating/cooling coil module

Functions
- Heat recovery
- Air filtration
- Integral control system, can be integrated with the central BMS via LON, BACnet or Modbus
- Additional functions with modular accessories

Accessories
- Heating coils
- Cooling coils
- Weatherproof roof
- Control accessories
- Water valves with circulator pumps
- Miscellaneous accessories

Heating coil module

Electric air heaters

Volume flow rates
- Up to 1,670 l/s (6,000 m³/h) with rotary heat exchanger
- Up to 1,250 l/s (4,500 m³/h) with plate heat exchanger

Easy Product Finder
- Unit sizing
- Selection and sizing of accessories
- Specification texts and technical data
- The Easy Product Finder is available on our website

Control panel

Highlights
- Fulfils the hygiene requirements of VDI 6022
- Heat recovery, EC fan and F7 filter insert as standard
- Additional functions with expansion modules
- Short delivery times thanks to pre-configured units and modular accessories
- Selection and sizing with the TROX Easy Product Finder design programme
- Integral control system, can be integrated with the central BMS via LON, BACnet or Modbus
- High degree of flexibility
  – Operating side can be changed later

X-CUBE CROFCU

The X-CUBE CROFCU air handling units ensure and maintain the essential conditions for all classes of clean rooms. Used as secondary units for comfort air conditioning, they dissipate high thermal loads and supply the room with centrally conditioned fresh air. The units are typically installed in false ceilings.
The standard version fulfils the requirements for clean rooms as specified in DIN 1946-4 and – when fitted with particulate filters – ISO 14644-1.
For sizing purposes, TROX sales engineers use the X-CUBE Configurator, a software solution developed by TROX.

X-CUBE CROFCU

Variants
- Volume flow control
- Room pressure control
- Nominal sizes of the volume flow controller: 100, 125, 160, 200, 250
- Fine dust filter: F6, F7, F9
- Particulate filter: H10, H11, H13

Size
- Width: 1,012 mm
- Length: 2,440 mm
- Height: 816 mm

Functions
- Cooling
- Air filtration
- Integral control (plug and play)

Accessories
- Duct sound attenuator for supply and extract air

Volume flow rates
- Recirculation air volume flow rate: up to 1,670 l/s (6,000 m³/h)
- Fresh air addition: 14 – 555 l/s (50 – 2,000 m³/h)
- Flexible arrangements since several units can be connected

Clean room

Highlights
- Integral cooling coil
  - Dissipation of high thermal loads, small fresh air requirement
- For all clean room strategies
- Construction meets increased hygiene requirements
  - Internal surfaces made of stainless steel
  - Cooling coil with stainless steel frame
  - Stainless steel condensate drip tray
- Special features
  - High-efficiency EC fan (efficiency class IE4)
- Easy to commission thanks to integral controls
  - Factory acceptance test
  - Plug and play
  - BMS communication via Modbus

TROX® TECHNIK
The art of handling air

Hygiene-Konformitätserklärung

Raumlufttechnische Geräte
Serie X-CUBE

Gegenstand der Prüfung

Die Fa. TROX GmbH, Heinrich-Trox-Platz, D-47504 Neukirchen-Vluyn bestätigt, dass die Hygieneanforderungen aus den folgenden Normen und Richtlinien von den raumlufttechnischen Geräten der Serie X-CUBE eingehalten werden.

- Europäische Norm
  – EN 13779 (09/2007)
- Deutsche Normen
  – VDI 6022, Blatt 1 (07/2011)
  – VDI 3803 (10/2002)
- Österreichische Normen
  – ÖNORM H 6021 (09/2003)
- Schweizer SWKI-Richtlinien
  – VA104-01 (04/2006)

Zur Erstellung der vorliegenden Konformitätserklärung wurde jeweils ein Mustergerät der oben genannten Serien im Werk der Fa. TROX GmbH, Heinrich-Trox-Platz, 47504 Neukirchen-Vluyn geprüft sowie die verschiedenen Datenblätter, technische Dokumentationen und Prüfberichte ausgewertet.

Zusammenfassung des Prüfergebnisses

Die Prüfung der oben genannten Gerätemuster sowie die Sichtung der vorhandenen Unterlagen ergaben, dass die Hygieneanforderungen der genannten Regelwerke von den geprüften Serien eingehalten werden.

Die Übereinstimmung der raumlufttechnischen Geräte der Serie X-CUBE mit den Hygieneanforderungen der genannten Regelwerke wird daher bestätigt.

Neukirchen-Vluyn, den 01.12.2011

HYGIENE – TESTED TROX® TECHNIK VDI 6022

B.Eng. Michael Schulze Greiving
geschult nach VDI 6022 Kategorie A
Produktmanagement

Dipl.-Ing. Jan Heymann
Leiter Qualitätsmanagement

Zertifikat

Eurovent Certita Certification S.A.S. - 48/50, rue de la victoire - 75009 PARIS FRANCE
R.C.S. PARIS 513 133 637 - NAF 7120B

Certification Diploma N° : 13.02.005

Eurovent Certita Certification certifies that

Air Handling Units

from

TROX GmbH

Located at

Heinrich-Trox-Platz
47504 NEUKIRCHEN-VLUYN, Germany

Range

X-CUBE

Software for calculation of performances

Xcube Configurator 2.3

Trade name

X-CUBE

have been assessed according the requirements of following standard

OM-5-2017

The list of certified products is displayed at :

http://www.eurovent-certification.com

Manufacturing places

Isselburg/Anholt, Germany

TROX GmbH

is authorised to use the EUROVENT CERTIFIED PERFORMANCE mark

in accordance with the rules specified in the Operational Manual

OM-5-2017

Erick MELQUIOND

President

Approval date : 2013/02/26

Re-checked on : 2017/10/17

Valid until : 2019/03/31

Claris version: Prod 6.3c (25/08/2017)

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD
Industrie Service

Wir bestätigen der Firma

TROX GmbH
in
D-47504 Neukirchen-Vluyn

aufgrund der mit positivem Ergebnis abgeschlossenen Prüfungen der

RLT-Geräteauslegungs-Software
X-CUBE Configurator
Version 2.xx

dass die Anforderungen gemäß dem Prüf- und Zertifizierungsprogramm „RLT-RICHTLINIE Zertifizierung" der TÜV SÜD Industrie Service GmbH erfüllt sind.

Der Hersteller ist berechtigt folgende Prüfzeichen zu benutzen:

Das Zertifikat ist gültig bis einschließlich 31.12.2017

Zertifikat-Registrier-Nr.: 08/10/12

Zertifizierungsstelle für Produkte
Kälte- und Klimatechnik
München, den 13.05.2016

TÜV SÜD Industrie Service GmbH

Dieses Zertifikat gilt nur in Verbindung mit der folgenden Anlage, bestehend aus einer Seite.

TÜV SÜD INDUSTRIE SERVICE GMBH, WESTENDSTRASSE 199, D-80686 MÜNCHEN
klima@tuev-sued.de

TÜV®

TÜV NORD

ZERTIFIKAT
CERTIFICATE

Interne Fertigungskontrolle mit überwachten Druckgeräteprüfungen in unregelmäßigen Abständen nach Richtlinie 2014/68/EU

Internal production control plus supervised pressure equipment checks at random intervals according to directive 2014/68/EU

Zertifikat-Nr.: 07/202/1411/Z/0398/17/D/
Certificate No.:

Name und Anschrift des Herstellers: TROX® TECHNIK
Name and address of manufacturer:

TROX GmbH
Heinrich-Trox-Platz
47504 Neukirchen-Vluyn

Der Hersteller ist nach Prüfung der Voraussetzungen berechtigt, die von ihm im Rahmen des Geltungsbereichs des Moduls hergestellten Druckgeräte mit dem abgebildeten Zeichen zu kennzeichnen:
After having examined the preconditions, the manufacturer is entitled to mark the pressure equipment produced within the range of the ambit of the module with the following mark:

CE 0045

Geprüft nach Richtlinie 2014/68/EU: Tested according to directive 2014/68/EU:	**Modul A2** module A2
Prüfbericht-Nr.: Test report No.:	**1411/P/0398/17/D/**
Beschreibung des Druckgerätes: Description of pressure equipment::	**Baugruppen der Kategorie II mit Kältemittel R 410A der Gruppe A1 nach EN 378-1, X-CUBE** **Assemblies Categorie II with refrigerants R 410A of group A1 according to EN 378-1, X-CUBE**
Fertigungsstätte: Place of manufacture:	**TROX GmbH** **Genderinger Straße 85** **46419 Isselburg-Anholt**

Das Zertifikat ist nur in Verbindung mit dem jährlichen Prüfbericht über die überwachten Druckgeräteprüfungen gültig.
This certificate is only valid in connection with the annual report of the supervised pressure equipment checks.

Duisburg, 08.08.2017

notified body TÜV NORD 0045 TÜV NORD Systems

Notifizierte Stelle/ Notified Body, 0045
für Druckgeräte
for pressure equipment

Frank Gröning

TÜV NORD Systems GmbH & Co. KG,
Große Bahnstraße 31, D-22525 Hamburg

Anlage: Prüfbericht

Region: Duisburg
Meidericher Str. 14-16
D-47058 Duisburg

Tel. +49-(0)203-304-241
Fax +49-(0)203-304-247
E-mail duisburg@tuev-nord.de

Mitglied der
Member of CEOC
CONFÉDÉRATION EUROPÉENNE D'ORGANISMES DE CONTRÔLE

A2_Überwachung Druckgeräteprüfungen_deu/eng Rev. 05/07.16

A 51 05.07 gbe

Bezirksregierung Düsseldorf

Zertifikat

gemäß § 6 Chemikalien-Klimaschutzverordnung

Gemäß § 6 Abs. 1 der Chemikalien-Klimaschutzverordnung (ChemKlimaschutzV) vom 02. Juli 2008 in Verbindung mit der EG-Verordnung 303/2008, Kategorie I vom 02. April 2008 wird dem Betrieb

TROX GmbH

Heinrich-Trox-Platz

47506 Neukirchen-Vluyn

die Anerkennung, Az.: - 56.3-ZCK 18/13-Leh - als zertifizierter Betrieb erteilt.

Der Betrieb ist berechtigt, gemäß der EG-Verordnung 303/2008, Kategorie I zertifizierungspflichtige Tätigkeiten wie Dichtheitskontrollen, Kältemittelrückgewinnung, Installation, Instandhaltung und Wartungen an allen ortsfesten Kälteanlagen, Klimaanlagen und Wärmepumpen durchzuführen.

Mönchengladbach, den 25.11.2013
Im Auftrag

P. Lehmann

(P. Lehmann)

Bezirksregierung 111 Düsseldorf

(Dienstsiegel)

Zertifikat

Prüfungsnorm **ISO 9001:2015**

Zertifikat-Registrier-Nr. **01 100 3320**

Unternehmen:

TROX® TECHNIK
The art of handling air

TROX GmbH
Heinrich-Trox-Platz
47506 Neukirchen-Vluyn
Deutschland

mit den Standorten gemäß Anlage

Geltungsbereich: Entwicklung, Konstruktion, Produktion und Vertrieb von Komponenten und Systemen für die Lüftungs- und Klimatechnik Brandschutz- und Rauchabzugsklappen, Luft-Wasser-Systeme, Luftdurchlässe, Luftfilter, Volumenstrom- Regelgeräte, Schalldämpfer, Systemtechnik, zentrale und dezentrale Lüftungssysteme

Durch ein Audit wurde der Nachweis erbracht, dass die Forderungen der ISO 9001:2015 erfüllt sind.

Gültigkeit: Dieses Zertifikat ist gültig vom 05.03.2018 bis 28.02.2021.
Erstzertifizierung 1994

15.03.2018

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

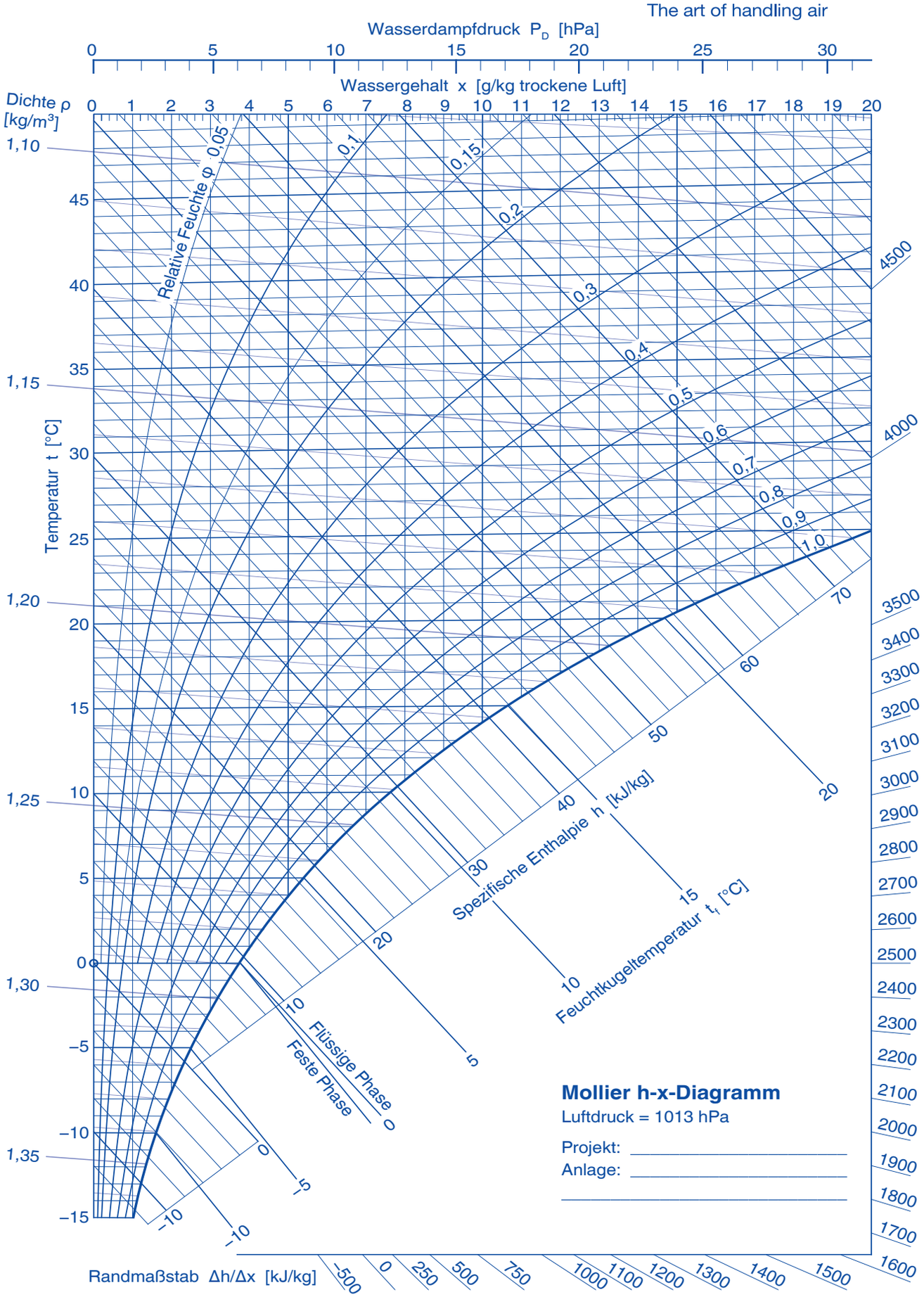
www.tuv.com

DAkkS Deutsche Akkreditierungsstelle D-ZM-16031-01-00

TÜVRheinland®
Genau. Richtig.

www.trox.de

TROX® TECHNIK
The art of handling air



Mollier h-x-Diagramm
Luftdruck = 1013 hPa

Projekt: _____
Anlage: _____
_____

Germany

Office and administrative buildings
Elbarkaden, Hamburg
Telekom, Meerbusch
IHK Duisburg, Duisburg
Sparkasse Olpe, Olpe
Hesse state parliament, Wiesbaden
IHK Arnsberg, Arnsberg

Education and research
Ruhr University, Bochum
Ostfalia University of Applied Sciences, Wolfenbüttel
KIT Campus, Karlsruhe
Düsseldorf University of Applied Sciences, Düsseldorf
Cusanus Grammar School, Erkelenz
Julius Stursberg Grammar School, Neukirchen-Vluyn

Exhibition and convention centres
CityCube Berlin, Berlin

Health care
Evangelical Hospital, Wesel
Haema blood donation centre, Leipzig
Aachen University Hospital
Ostalb Hospital, Aalen
St. Hedwig Hospital, Berlin
Neuwerk Hospital, Mönchengladbach
Oberlausitz Hospital, Bautzen
LVR group of hospitals, Düsseldorf
Evangelical Hospital, Unna
Lung Hospital, Hemer
KMG Hospital, Kyritz
Bethanien-Höfe Eppendorf, Hamburg
HELIOS St. Elisabeth Hospital, Oberhausen
Caritas, Olpe
Capio Mathilden-Hospital, Büdingen

Hotels
Kolpinghaus, Cologne
Steigenberger Hotel Am Kanzleramt, Berlin

Industry
Daimler, Düsseldorf
Leica Park, Wetzlar
Miele, Gütersloh
Gerresheimer, Düsseldorf
Herta Greenfield, Herten
Porsche AG, Stuttgart
Schaeffler, Cologne
Tetra Pak, Berlin
Novelis, Nachtersted
Silesia, Neuss
Ford, Cologne
Beyer Analytik, Jena
Volvo, Hameln
Siemens HQ, Munich
LEWA, Attendorn

Leisure facilities, department stores and retail
Buchholz Galerie, Buchholz
Aquazoo Löbbecke Museum, Düsseldorf
Magic Mountain indoor climbing centre, Berlin
Mühlenberghalle, Wipperfürth
Cultural centre, Arnsberg
Metro, Mainz-Kastel
Klier music shop, Nuremberg
Würzbach theatre, Calw
Geroldsauer Mill, Baden-Baden
House of culture and education (HKB), Neubrandenburg

Mall of Berlin, Berlin


Evangelical Hospital, Wesel

Arla Foods drying unit, Pronsfeld

KEUCO exhibition centre, Hemer, Germany

Marienhospital, Osnabrück

Arkaden shopping centre, Hamburg

International

Office and administrative buildings
Gemeentehuis, Bierbeek, Belgium
Centrum Bankowo Finansowe, Warsaw, Poland
Bridge Randstad, Dessel, Belgium
Competentiecentrum, Antwerp, Belgium

Education and research
Geneva English School, Genthod, Switzerland
Institut Florimont, Petit-Lancy, Switzerland
Bredeschool Martin Luther King, Amstelveen, Netherlands
Federal school centre, Feldbach, Austria
Helix, Wageningen, Netherlands
Andreasschool, Voorhout, Netherlands
Maria Theresiacollege, Leuven, Belgium
Fontys Hogeschool, 's Hertogenbosch, Netherlands
Graz University of Technology, Graz, Austria

Health care
Medical Center Twente, Enschede, Netherlands
LKH University Hospital and Dental Clinic, Graz, Austria
Emergency hospital, Deva, Romania
Algemeen Ziekenhuis Campus Rooien, Duffel, Belgium
FILIP II private hospital, Skopje, Macedonia
Bona Dea Hospital, Baku, Azerbaijan

Hotels
Weisses Rössli, Staad, Switzerland

Industry
Grotex LLC, St. Petersburg, Russia
Sky-Frame, Frauenfeld, Switzerland
SoliPharma B.V., Oudenbosch, Netherlands
Ospelt Food AG, Sargans, Switzerland
Erber Group headquarters, Getzersdorf, Austria
AVL List, Graz, Austria
Zeelandia International, Zierikzee, Netherlands
Prolong Pharmaceuticals, South Plainfield, New Jersey, USA

Leisure facilities, department stores/retail
Theatre des Galleries, Brussels, Belgium
TKKF Stilon Gorzów Wielkopolski, Poland

Sky-Frame, Frauenfeld, Switzerland

Pancras Square, London, UK


Medical centre, Enschede, Netherlands


Hospital, Deva, Romania

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The art of handling air

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