▶ Shopping Climate ▶▶

Comfort air conditioning systems boost consumption.

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 and manufacturing sophisticated components, units and systems for ventilation and air conditioning as well as for fire and smoke protection. Dedicated research and development have made TROX a global leader of innovation in these fields.

Air conditioning subsystem as the ideal controls solution.
Retail shops typically use a lot of energy due in large part to heavy footfall, abundant lighting and other power-consuming devices, and the high level of particulate matter pollution usually found in city centres. In light of this, ventilation and air conditioning systems have to adapt to constantly changing environmental conditions while continuing to run efficiently. Even more important, then, is the perfect interaction of the installed components, which have to monitor and record conditions and remain in constant communication with one another so that they can respond effectively to each individual situation.

To avoid interface problems in building automation systems, TROX has developed sophisticated solutions for managing air with an 'air conditioning subsystem'. It offers customers tailor-made, perfectly integrated complete solutions with a special focus on the control strategy.

Breuninger Land, Ludwigsburg, Germany – CityPalais, Duisburg, Germany

► Complete systems from a single source ►►

TROX offers complete ventilation and air conditioning solutions for sophisticated air management strategies: from air handling units, fans and volume flow controllers to an unmatched range of aerodynamic diffusers and filters, plus fire protection and smoke extract equipment tested to meet European standards. The benefits for specialist consultants and HVAC contractors are clear: Fewer interfaces mean less coordination work and hence lower costs.

The safety net.

When people enter a building, they want to be sure that it poses no threat to their personal safety. They want to rely on functioning fire and smoke protection systems that allow them to leave the building safely in an emergency. The key factor here is the perfect interaction between all safety-related building services. TROXNETCOM can provide this perfect interaction and communication, safely and reliably.

The following application brochures are also available:

- *Hotels*
- *Airports*
- *Office buildings*
- *Hospitals*
- *Clean rooms*
- *Labs*


ELB
GERBER

▶ Shopping climate ▶▶

Application-oriented air conditioning solutions for shops.
This application brochure deals with bespoke solutions for the retail sector, from ventilation and air conditioning equipment for small shops to components and systems for large retail areas in shopping malls.

Indoor air conditioning has to meet many and diverse requirements:

- Create comfortable conditions for both customers and retail staff.
- Provide demand-based and individual control functions for energy-efficient operation and a high level of thermal comfort.
- Supply air with as little turbulence and noise as possible to occupied zones.
- Remove particulate matter, pollen and other contaminants from the fresh air.
- Link components intelligently, thereby ensuring efficient system operation at all times.
- Provide utmost safety in the event of a fire.

Gerber, Stuttgart, Germany (2)

TROX covers the entire range of components and systems for ventilation and air conditioning:

- *Air entry – weather protection*
- *Air conditioning*
- *Air transport*
- *Air distribution*
- *Air shut-off – fire protection*
- *Airflow*
- *Air management – control systems*
- *Smoke extract and provision of additional fresh air*

▶ Consumer confidence and indoor air quality ▶▶

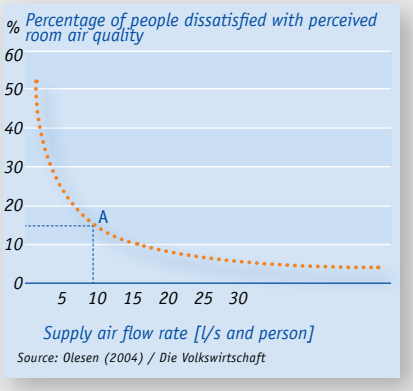
How significant indoor air quality actually is, even for a shopping centre, has been proven by a study which the EU initiated as part of the CommOn Energy project.

Focus on customers and staff.
Ventilation and air conditioning centre around people with their demands and needs. This includes both customers and retail staff in shopping centres. We at TROX are committed to developing comprehensive solutions for shopping centres, thereby providing maximum comfort and well-being.

Get customers to stay longer.
There can be no question that a good indoor air quality plays a major part in keeping customers in shops longer and in stimulating increased consumption, and studies have confirmed this. This means that indoor air conditioning systems must provide high degrees of both air quality and thermal comfort, i.e. maintain pleasant temperature and humidity levels. Aerodynamically optimised diffusers quietly provide a draught-free supply of fresh air, while air-water systems efficiently dissipate the heavy thermal loads typical of department stores.

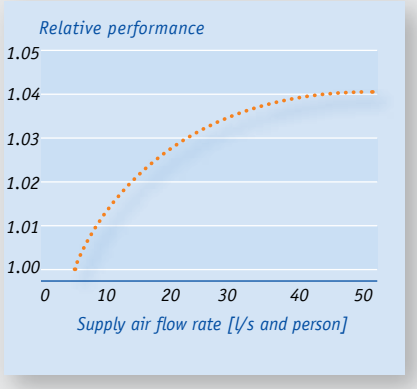
Leave retail staff highly satisfied.
Employees are more productive in a comfortable environment. This, too, has been shown by international studies. Though no specific data for shopping centres exists, the information available for office buildings shows that room air quality has an enormous impact on job satisfaction and performance. Clean, filtered air also helps to prevent illness, thereby significantly reducing absences. Filtering out pollen and germs results in fewer allergies and infections. And removing particulate matter prevents adverse health effects in the long term. This is why effective filter systems are incredibly important especially for shopping centres, given the high numbers of people going in and out.

Percentage of dissatisfied employees based on ventilation rate

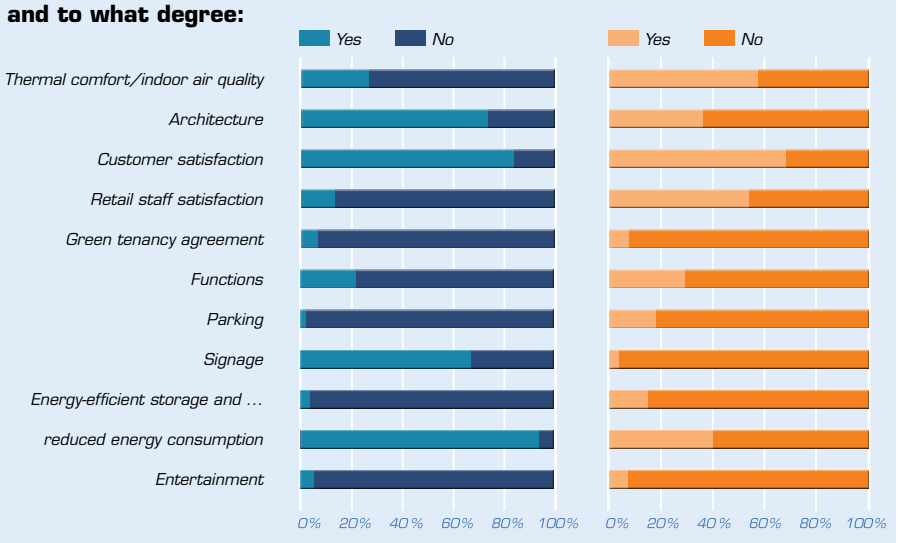


How to read the graphic: With a supply air flow rate of 10 l/s, 15% of people perceive the air quality as not satisfactory.

Relation between ventilation and performance



What shopping mall owners and tenants consider important, and to what degree:



Hauer Sweet Shop, Budapest, Hungary


GERBER
GERBER
URBAN OU

▶ Particulate matter pollution in city centres ▶▶

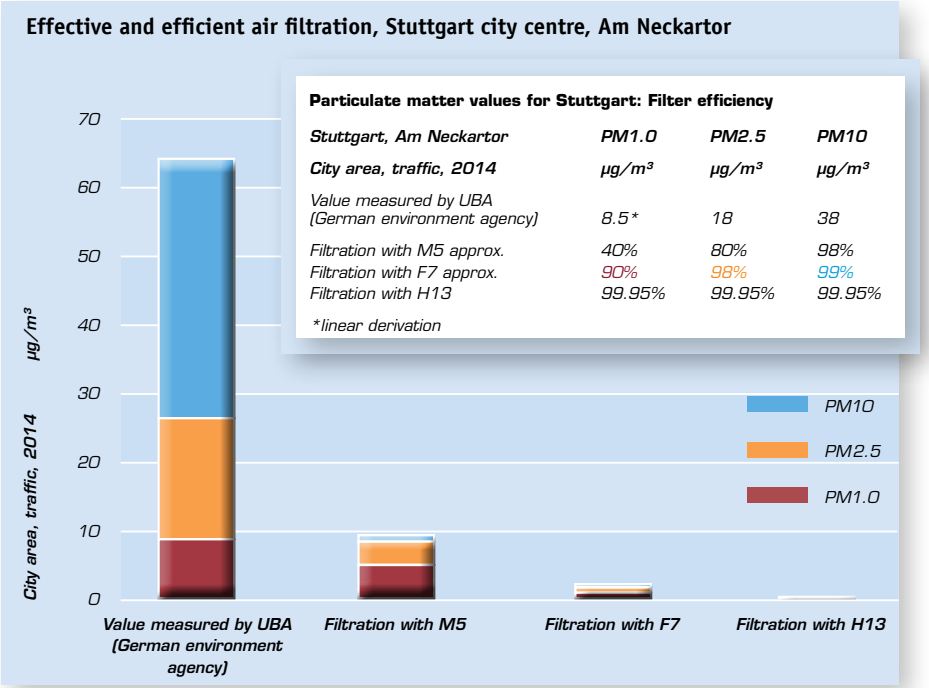
Most shopping centres are located in urban environments and are therefore exposed to significant particulate matter pollution due to the high traffic volume.

Air pollution places enormous demands on filter systems.
Nowhere are the measured values for particulate matter higher than in city centres, such as in Stuttgart, the capital of the southern German state of Baden-Württemberg. In Stuttgart's case, this air pollution can be attributed to the city's topography. Stuttgart is situated in a basin and protected by the Black Forest and several other low mountain ranges; this results in fairly low wind velocities in the basin. It also means, however, that the wind doesn't just blow away the dust like it does in other cities. On up to 89 days per year, a particulate matter concentration of more than 50 micrograms per cubic metre of air is measured. On 35 days, this concentration violates EU laws.

It should come as no surprise that shopping centres, such as the Gerber building in Stuttgart, require particularly efficient filter systems to keep the hazardous fine dust away from building occupants and visitors. The issue of particulate matter is also finding its way into international standards. While filter classification to EN 779 was based on a particle size of 0.4 µm in the past, filter efficiency is now tested using three different particle sizes ranging from 0.3 to 10 µm. This is an important step towards avoiding particulate matter pollution.

TROX has developed effective and efficient filter systems to handle the high levels of particulate matter found in city centres.

Effective and efficient air filtration, Stuttgart city centre, Am Neckartor



Particulate matter values for Stuttgart: Filter efficiency

Stuttgart, Am Neckartor City area, traffic, 2014	PM1.0 µg/m³	PM2.5 µg/m³	PM10 µg/m³
Value measured by UBA (German environment agency)	8.5*	18	38
Filtration with M5 approx.	40%	80%	98%
Filtration with F7 approx.	90%	98%	99%
Filtration with H13	99.95%	99.95%	99.95%

*linear derivation

Gerber, Stuttgart, Germany

TROXNETCOM *monitors and controls fire protection and smoke extract functions.*

The safety net

X-AIRCONTROL master

AS-i controller and repeater

Duct smoke detector

Fire prevention and smoke extract components

▶ Safety first ▶▶

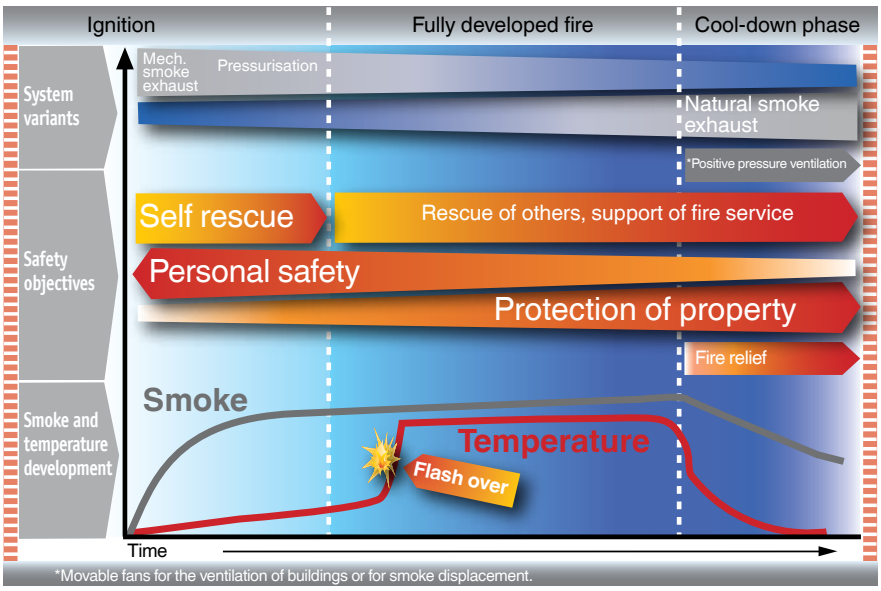
Wherever thousands of people stroll through shopping arcades on a daily basis, a reliable fire prevention strategy is critically important. The prime objective in the event of a fire is to avert danger, i.e. to save lives and protect property. When a fire breaks out, fire and smoke protection dampers close off ducts and prevent the spread of fire and smoke to adjacent fire compartments.

Pressure ventilation systems provide smoke free escape routes in stairwells by producing positive pressure. Mechanical smoke exhaust systems create different layers of air. These layers are kept free from smoke if there is a sufficient flow of fresh air. Special fans are linked to smoke control dampers such that deadly toxic gases are led out of the building whereas fresh air is led into the building.

Smoke free layers are a necessity in places of assembly and retail locations.
Since people who use retail premises are usually not familiar with the layout, suitable mechanical smoke exhaust systems must be present to keep the air free from smoke in the event of a fire. In addition, fire dampers isolate unaffected areas from the fire. Shopping centres are a prime example of a place where the interior layout and furnishings change constantly. And there is no way of knowing whether the people present are young or old, whether they are disabled or with limited mobility.

An integrated system means more safety.
TROX components and systems for ventilation, fire protection or smoke extract are perfectly complementary to one another and provide safety in hazardous situations. TROXNETCOM can be used to control integrated fire dampers and smoke control dampers up to SIL2.

Safety objectives in the course of a fire.



► Energy-efficiency is the order of the day ►►

Shopping centres are among the more wasteful consumers of energy. Their energy requirements – electricity, heating and cooling – account for an increasingly large portion of operating costs. This demand can mainly be attributed to conventional lighting systems and their high cooling loads (up to 200 W/m²), which need to be dissipated by ventilation and air conditioning systems. In light of the growing number of shopping centres and their considerable energy requirement, developing sustainable ventilation and air conditioning schemes for this type of building is an absolute necessity.

This is the subject of a joint research project of TROX with the E.ON Energy Research Center of RWTH Aachen University and the IEK of Leibniz University in Hannover, Germany.

The supply air requirement of a retail location is often the result of cooling loads, rather than the fresh air flow rate necessary for hygiene-related reasons. For this purpose, the air quality in shops with specific goods was tested, namely goods that emit a certain odour, such as shoes, books or clothing; the air quality tests were based on how test persons rated it on a reference scale (acetone percentage in the air). It has then been determined that the air change rates could be reduced by up to 50% without any negative effect on the shopping centre air quality or comfort level. The thermal load can then be dissipated by energy-efficient air-water systems, for example.

Demand-based volume flow control.
The occupancy of shops varies greatly and continuously. This is why demand-based control of ventilation and air conditioning is necessary for energy-efficient operation. The VOC level, measured with a sensor, indicates whether many or few people are present in a room; if only few people are present, a certain portion of air can be recirculated into the ventilation system. As more people enter the room, the portion of recirculated air is reduced, and the portion of fresh air is increased. With heating mode during the night, the supply air is 100% recirculated air.

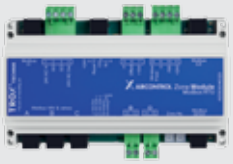
Further energy savings potential is opened up by aerodynamically optimised diffusers, energy-efficient air-water systems that dissipate high heat loads, and heat recovery systems that make use of the energy of waste air.

Energy-efficient fans.
Fans move air from one location to another. To do so, they need energy. That's why fans, just like all other energy-consuming products, are subject to the so-called 'ecodesign directive' for energy-related products (ErP). The objective of the ErP Directive 2009/125/EC is to lower the energy requirement of products such as fans by an environmentally friendly design. X-FANS products are tested on a certified test rig (to the ISO 5801 test standard) to ensure their energy-efficient operation.

MyZeil, Frankfurt, Germany

Demand-based control

- VOC sensors measure the indoor air quality
- Airflows are adjusted to actual demand



Requirements for energy-efficient operation:

- Demand-based treatment and distribution of supply air
- Only minimal losses in air treatment processes and distribution network
- Integration of individual components into an efficient control system
- Combination of areas with the same or similar use into groups with the same ventilation requirements
- Maintenance of comfort room conditions such as temperature, humidity and air quality during the times of use
- Utilisation of energy gains in internal spaces (solar gain, internal loads)
- Central monitoring: Capturing of parameters such as energy consumption, and signalling in case any setpoint values are exceeded
- Use of regenerative energy resources
- Energy-optimised components


LIFT

▶ Factors in selecting an air conditioning system ▶▶

The air conditioning strategy for a shopping centre depends on many factors. It begins with structural conditions such as architecture, building envelope, location and orientation, and the layout and size of rooms. Next, occupancy, loads to be dissipated, and the usage and equipment of retail areas all play an important role. And finally, the air conditioning design depends on whether it is a new building or a refurbishment project. Existing buildings, i.e. refurbishment projects, do obviously not provide the same degree of planning freedom as new builds.

The wide spectrum of air conditioning systems, units and components puts TROX into a unique position: being able to provide a bespoke solution for the different conditions and requirements in any shopping centre. The sheer number of proven solutions, and the extensive expertise that TROX engineers have built up over the years and by working on the most diverse projects all over the world, provide our customers with tailored air conditioning systems and hence a very good indoor air quality. The prestigious reference projects we introduce in this brochure are proof of that.

H&M, Berlin, Germany

Coordinated approach

Perfectly integrated ventilation and air conditioning.

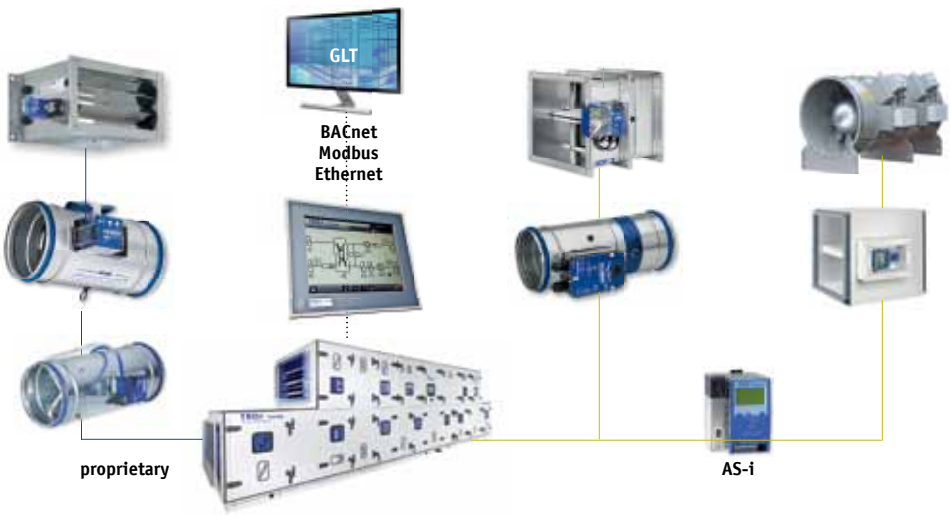
Shopping malls are complex buildings. They require the highest levels of safety and comfort, both of which can only be guaranteed by perfectly integrated systems and components.

Typical values for the most critical parameters in selected areas of a shopping centre, based on VDI 2082 and EN 15251	General	Strong odours	High heat emission	Low footfall	Baked goods	Meat products, cheese, fish	Restaurants	Administration: Cellular offices	Administration: Toilets (extract air)	Other: Underground or enclosed car park	Other: Stairwell	Other: Lift for fire and rescue service	Notes
Occupancy, standard value: [people/m²]	0.15	0.10	0.10	0.05	0.40	0.10	0.60	0.1	< 0.5				
Occupancy [people/m²]	0.1 to 0.2	0.05 to 0.1	0.05 to 0.1	0.01 to 0.05	0.2 to 0.4	0.05 to 0.15		0.1 to 0.15					
Min. fresh air flow rate* [m³/(h m²)], cat. II	11	16	9	10	21	21	21	5	15	6			EN 15251
Min. fresh air flow rate* [l/(s m²)], cat. II	3.1	4.4	2.5	2.8	5.8	5.8	5.8	1.4	4.2	2			EN 15251
Min. fresh air flow rate* [m³/(h m²)], cat. III	6	9	5	4	6	12	12	3	9				
Min. fresh air flow rate* [l/(s m²)], cat. III	1.7	2.5	1.4	1.1	1.7	3.3	3.4	0.8	2.4				
Design room temperature [°C]													
Operative room temperature when heating (winter)	19 - 22	19 - 22	20 - 24	19 - 22	19 - 24	18 - 22	20 - 23	20 - 24	20				
Operative room temperature when cooling (summer)	22 -26	22 - 26	22- 28	22 - 26	22 - 26	18 - 22	22 - 26	22 - 26	26				
Sound pressure level / typical range [dB(A)]													
Design value	40 - 55	40 - 50	40 -50	40 -50	40 -50	40 -50	35 - 50	30 - 40	35		45		
Air handling and transport													
Air handling units	•	•	•	•	•	•	•	•	•	•			
Ventilation fans										•			Centrifugal, axial, duct, wall and roof fans
Filters	•	•	•	•	•	•	•	•	•				
Sound attenuators	•	•	•	•	•	•	•	•	•	•			
Control systems													
Volume flow controllers	•	•	•	•	•	•		•	•				
AHU control	•	•	•	•	•	•	•	•	•				
Ventilation systems													
All-air system, mixed flow	•	•	•	•	•	•	•	•	•	•			
All-air system, displacement flow	•	•	•	•	•	•	•	•					
Air-water systems	•	•	•	•	•	•	•	•					
Smoke extract / fire protection / smoke control													
Smoke extract by dilution	•	•	•	•	•	•				•			Engineered solutions
Creation of layers and smoke extract	•	•	•	•	•	•	•		•	•			DIN 18232, part 2 (natural systems) and part 5 (mechanical systems)
Smoke exhaust with jet ventilation system										•			VDI 2053 Air conditioning – Car parks
Pressurisation systems											•	•	EN 12101, part 6 MHHR – Guideline for high-rise buildings
Components of smoke pressurisation systems													
TROXNETCOM with AS-i or LON Modbus	•	•	•	•	•	•	•		•	•	•		
Smoke exhaust fans	•	•	•	•	•	•	•		•	•	•		F600, F400, F200* Axial, roof, centrifugal, wall fans
Smoke control dampers	•	•	•	•	•	•	•		•	•	•		EN 12101, part 8
Fire dampers	•	•	•	•	•	•	•		•	•	•		EN 15650
Smoke detectors	•	•	•	•	•	•	•	•	•	•	•		EN 54-7
Duct smoke detectors	•	•	•	•	•	•	•		•	•	•		EN 54-27

* Installation in the fire zone, outside of the fire zone, or in a ventilated room; EN 12101, part 3

▶ The TROX system ▶▶

Specialist consultants think in terms of integrated systems. They don't want to deal with interface issues between technical building services. Hence the market demand for comprehensive solutions in the field of indoor air conditioning and, specifically, for the systems that control them. To meet this demand, TROX has developed subsystems where an air handling unit acts as the centre of the automation network.



The X-CUBE air handling unit acts as the centre of the automation network and controls and monitors all ventilation and air conditioning components: volume flow controllers are controlled via Modbus, for example, while fire dampers, smoke control dampers and process air fans are controlled using the proven AS-i system.

The table on the fold-out page provides an overview of the most relevant air conditioning parameters to consider for the different areas of a shopping centre.

Gerber, Stuttgart, Germany

Relevant standards and guidelines:

German ordinance on sales outlets and places of assembly

VDI 2082 (07/2010)
Air Conditioning – Sales Outlets (VDI ventilation code of practice)

VDI 6039 Managing of building commissioning

VDI 6026-1 Documentation in the building services

EnEV 2014 – German Energy Saving Ordinance

EN 13779 Ventilation for non-residential buildings

EN 15251 Indoor environmental input parameters – indoor air quality, thermal environment, lighting and acoustics

EN 15239 Guidelines for inspection of ventilation systems

EN 15240 Guidelines for inspection of air-conditioning systems

VDMA 24188 Smoke protection measures for stairwells – Smoke removal, smoke dilution, smoke control

EN 12101-2,3,6,7,8 Smoke and heat control systems (product and test standards)

EN 15650 Ventilation for buildings – Fire dampers

EN 13501-3,4 Fire classification of construction products and building elements

Note: All EN standards are still valid, but some will be replaced by EN 16798, parts of which are to be released before the end of 2016.

Shopping concepts

Creating efficient indoor air strategies together.

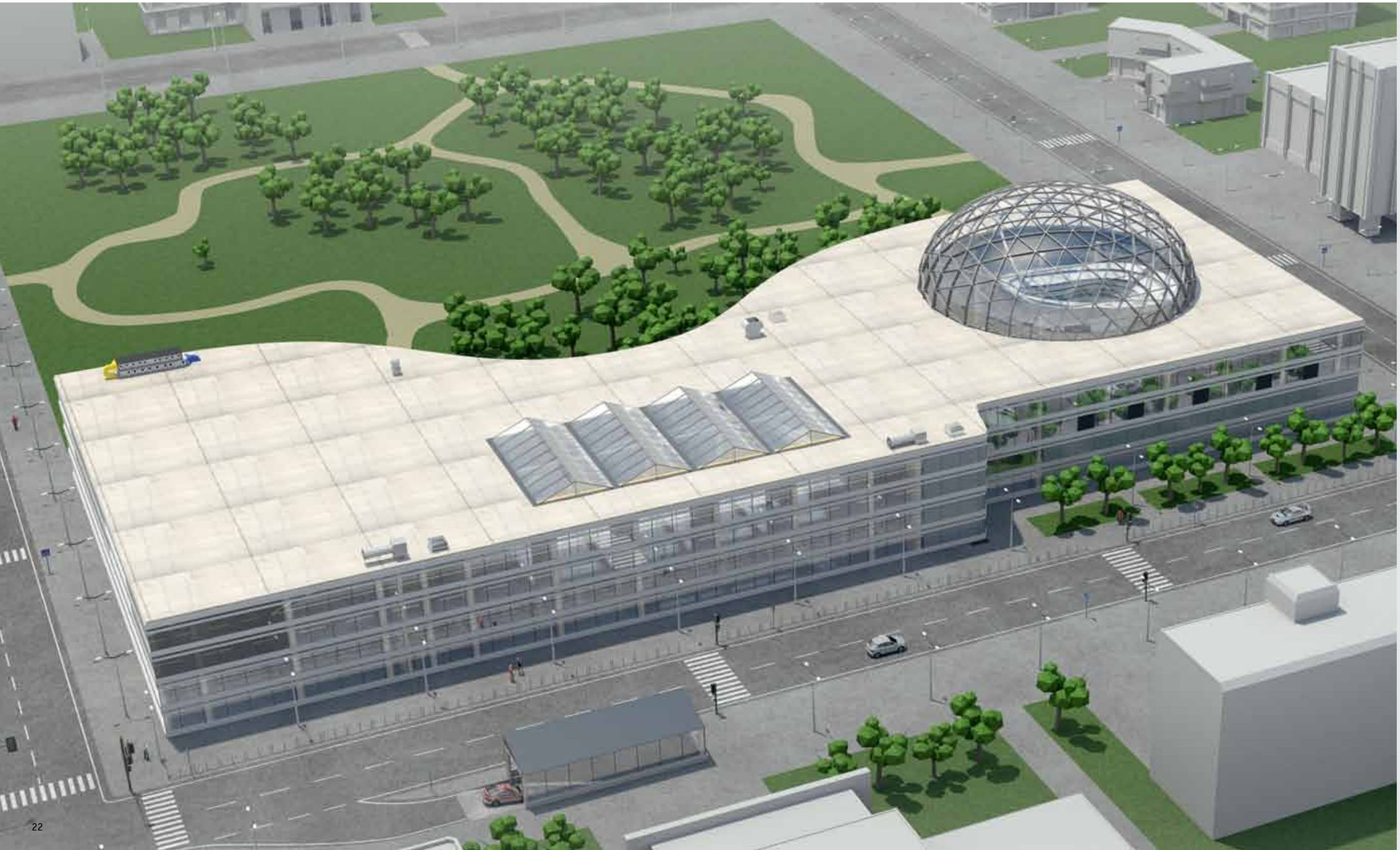
Developing and implementing a comprehensive indoor air conditioning strategy that meets the most critical safety, efficiency and comfort requirements is only possible through the close cooperation of specialist consultants, HVAC contractors, system owners and manufacturers, and then from the beginning, i.e. from the design stage onwards.

Complete solutions

One point of contact = less coordination effort

On the following pages we show you, as an example, a shopping mall with an underground car park and with different ventilation and air conditioning equipment in the various areas.

Follow the way of the airflow through a shopping mall, from the air handling unit to the air terminal devices. Fire protection and smoke extract systems are in place to ensure the safety of people.



Our service – your benefit:

- Expert consultancy and support throughout all stages of a project: from the design stage to handing over the system, and also after installation
- Comprehensive service support: commissioning, system integration, maintenance, modernisation
- Easy connection to higher-level systems due to standard interfaces
- Maximum data transparency due to open systems such as LonWorks®, Modbus and BACnet
- Air management system solutions from a single source reduce the number of necessary interfaces
- Reduced fire load thanks to bus systems that require significantly less wiring
- Support of flexible building usage: systems can easily be adapted to meet new requirements
- Rapid amortisation of investment costs due to reduced operating costs
- Energy savings due to optimised systems operation
- High level of operational reliability due to system self-monitoring

1 **X-CUBE air handling units**
handle volume flow rates of up to 100,000 m³/h (28 m³/s) for the ventilation and air conditioning of rooms – including filtration, heating, cooling, heat recovery, and humidifying and dehumidifying.

2 **Filters**
are used in ventilation and air conditioning systems to separate contaminants from the air. High efficiency filters trap even the tiniest particles and micro-organisms.

3 **Splitter sound attenuators**
reduce noise; their attenuation effect is due to absorption, and their aerodynamically shaped frames help to increase energy efficiency.

4 **Air terminal units combined with zone control**
provide demand-based volume flow rate control to ensure the best possible indoor air quality and comfortable temperatures while they help to save energy at the same time. An optional air consumption measuring unit allows for consumption-based billing.

5 **Ceiling swirl diffusers and other ceiling diffusers**
with optimised acoustic and aerodynamic properties come in a wide range of designs and constructions to suit every architectural requirement. They can be installed in suspended ceilings or just below the ceiling, where they are visible.

6 **Slot diffusers** (non-visible)
provide efficient air discharge and can be subtly integrated into suspended ceilings.

7 **X-BEAM active chilled beams**
are air-water systems and represent energy-efficient solutions for the ventilation and air conditioning of rooms. Ceiling mounted units can be fitted with additional functions or building services, e.g. lighting.

8 **Ventilation grilles**
and continuous horizontal runs with adjustable front blades can be installed in walls and floors.

9 **Jet nozzles**
throw the air far into the room. The nozzles are actuated electrically, manually or with an SMA actuator (self-powered) and can be used for heating or cooling mode.

TROXNETCOM 10
makes use of decentralised, open communication systems and hence allows for inexpensive fire protection solutions that can be easily integrated with the central BMS.

Fire dampers 11
are certified for all European countries and prevent fire and smoke from spreading through ventilation ducting. The fire area is consequently shut off from other parts of the building.

Smoke control dampers 12
remove smoke and heat via smoke extract systems and can be used for pressure ventilation, as additional supply air inlets, for air supply and extract, and as part of gas fire extinguishing systems.

Smoke protection dampers 13
are used in ventilation plant rooms or in ducts to prevent smoke from spreading.

External weather louvres 14
protect air conditioning systems against the direct ingress of rain, leaves and birds into fresh air and exhaust air openings.

Multileaf dampers 15
are used in ducts or in wall or ceiling openings to shut off or restrict the airflow. Combinations of external weather louvres and multileaf or non-return dampers have a dual function. They provide not only weather protection but also a means for shut-off, and they prevent air from flowing against the intended airflow direction.

X-FANS smoke exhaust fans 16
remove hot fire smoke in the event of a fire, allow people to move to safety, protect property and make it easier for firefighters to put out the flames. They can also be used for ventilation.

X-FANS jet ventilation systems 17
are an excellent alternative to duct-based ventilation and smoke extract systems for underground car parks.

Tunnel and industrial dampers 18
are used for the ventilation and smoke extract in underground transport systems and car parks.

Purging systems with pressure maintenance 19
prevent smoke logging in stairwells; they include:

Pressure control unit for roof installation A
Axial supply air fan (AXO) B
Push button fire alarm C
Control D

Air conditioning

► High-tech room air conditioning ►►

Thanks to their modular design, TROX X-CUBE air handling units can be perfectly adapted to fit any conditions. They can be individually configured and are hence suitable for a wide spectrum of applications. More than 70 sizes are available, and they are designed for volume flow rates of 600 to 100,000 m³/h at an airflow velocity of 2 m/s. X-CUBE units are available as supply or extract air units or as a combination of both.

The units can be arranged side by side or on top of each other, depending on the installation site. Thanks to lifting eyes at the top the cubes can be easily lifted and moved with a crane. If an X-CUBE unit is to be installed in a shopping centre with small doorways, it is possible to ship individual modules and assemble them on the construction site. A plethora of intelligent product features, such as easy-to-replace filters or an automatic fan diagnosis system, mean that installation, maintenance and operation are much simpler jobs.

An air handling unit – the image to the left shows a rooftop installation – provides centralised fresh air treatment to ensure ideal indoor air quality in terms of air cleanliness, temperature and humidity. High-efficiency fans are used as an energy-efficient means of transporting the air. Sound attenuators minimise operating noise.

Effective, efficient filter systems remove high levels of particulate matter.
One or two filter stages, depending on the quality of the local fresh air, provide effective and efficient separation of particulate matter (present in high concentrations at most shopping centres).

Building owners are obviously also interested in filter systems to be cost effective. The economic efficiency depends on the type of use, the prevailing dust concentration and the operating hours. For this purpose TROX has developed an LCC analysis tool which considerably simplifies selecting the best filter for an application.

Considering practical and location parameters (with data provided by the German environment agency) simplifies and optimises the process for selecting the most efficient filter.

By adapting a filter to local conditions, e.g. air quality, by selecting the correct length or number of pockets, or by balancing between prefilters and final filters, the optimum economic efficiency can be achieved.

In areas where the air is less polluted, filters with lower filtration and energy efficiency can be used. If, however, the air is more polluted, a higher number of filter pockets may yield the desired result. Here, the average differential pressure over the entire period of use must be taken into consideration.

X-CUBE air handling unit

- Special materials, smooth surfaces on the inside and outside due to high-quality duplex powder coating
- With unlimited configuration options, allowing for project-specific adjustments
- Fast and simple installation due to modular construction
- Complete condensate drainage thanks to stainless steel condensate drip tray, sloped in all directions
- Components are easily accessible for maintenance and cleaning
- Construction variant with controls package is easily connected to the central BMS
- High-quality TROX filters
- High energy efficiency through the use of highly efficient heat recovery systems and fans
- Also available as a weatherproof variant with drip edge and intake hood with tested rain water elimination

X-CUBE air handling units comply with AHU Guideline 01 and are certified by Eurovent. They meet the requirements of all relevant standards and guidelines:

- VDI 6022
- ÖNORM H 6020 and 6021
- SWKI Standard VA 104-01
- DIN 1946-4
- EN 1751
- EN 13053
- EN 1886
- EN 13779

For more solutions and products please visit
www.trox-shopping-air.com

Air distribution

► Comfortable and efficient air distribution ►►

Air must travel long distances in shopping malls. An efficient airflow is the result of duct geometry and route:

- Large cross sections to minimise airflow velocities
- As few bends and junctions as possible

Another critical factor in a system's energy efficiency is intelligent control. Electronically controlled VAV terminal units combined with the X-AIRCONTROL zone control system provide demand-based volume flow rate control to ensure the best possible indoor air quality and temperature while they help to save energy at the same time.

Fire dampers and smoke control dampers play an important role for the safety of ventilation and smoke extract systems.

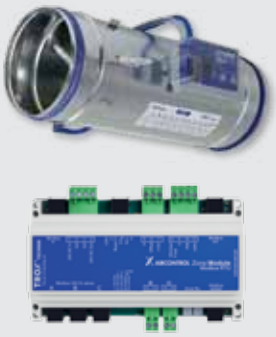
Fire dampers close off ducts and prevent the spread of fire and smoke to adjacent fire compartments. TROX fire dampers meet the high requirements of EN 15650 and are CE certified. They are available for a wide range of different applications such as fire batts or flexible ceiling joints and generally fit state-of-the-art construction methods. Fire dampers are suitable for supply air and extract air systems in potentially explosive atmospheres.

Smoke control dampers provide the full functionality of a fire damper and can be used in mechanical smoke extract systems to remove hot fire gases and to let in additional supply air in one or more fire compartments. The CE marking according to the Construction Products Regulation means that the product can be universally used in all European countries and for different application situations. TROX smoke control dampers such as the EK-EU can be used for ventilation if the mechanical smoke extract system has been approved (general building inspectorate approval) for ventilation.

Duct smoke detectors prevent smoke from spreading through the ducts of ventilation and air conditioning systems because they control and release approved fire dampers and smoke protection dampers that are fitted with an electric or electric-pneumatic release mechanism (power off to close).

Gerber, Stuttgart, Germany

VAV terminal units combined with the X-AIRCONTROL zone control system provide demand-based volume flow rate control to ensure the best possible indoor air quality and comfortable temperatures while they help to save energy at the same time.



TROX fire dampers with CE marking and declaration of performance according to the CPR
TROX RM-O-M
Multifunctional duct smoke detector tested to EN 54-27:2015, with volume flow rate and contamination monitoring

TROX EK-EU smoke control dampers
CE certified according to the CPR, fully open or close even after being exposed to higher temperatures (approx. 800 °C) for 25 minutes.

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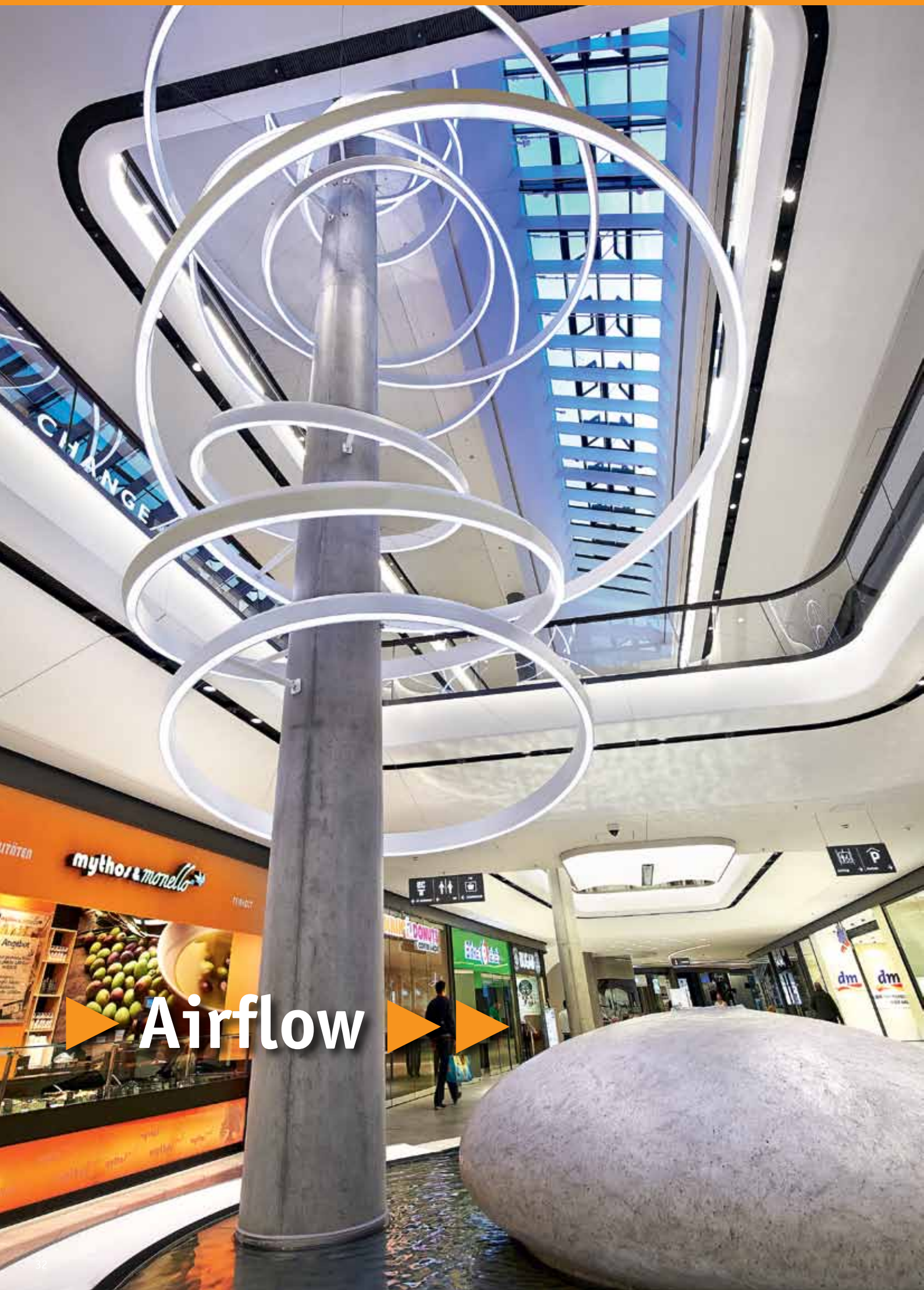

Airflow

► High demand for air requires the optimum airflow ►►

If rooms are occupied with many people, good air quality requires frequent air changes; this is usually achieved with a classical all-air system.

Aerodynamic optimisation.
Aerodynamically optimised air terminal devices are extremely important. Excellent aerodynamic properties ensure maximum safety and thermal comfort in particular with swirl diffusers since the originally high velocity of the turbulent airflow and the temperature differences are rapidly reduced.

Variable demand-based ventilation.
If very diverse architectural and usage parameters need to be considered in the ventilation and air conditioning design process for a retail space, variable volume flow control is the best solution. This control strategy allows airflows to be variably adapted to fit changing room usage scenarios. The automatic adjustment to changing parameters due to intelligent control and communication systems increases the efficiency of a system considerably.

Swirl diffusers for a rapid air change.
If a rapid air change is required, TROX swirl diffusers are just what is needed. There is hardly any other manufacturer who offers such a wide range of construction variants and attractive designs. Whether installed freely suspended (and with an extended border) or flush with the ceiling, the diffusers always blend in perfectly with the room architecture and offer ideal solutions for both large and small retail spaces.

Jet nozzles for high volumes.
Large and high-ceilinged entrance areas or galleries require air terminal devices that can throw air far into the room. Intelligent control systems ensure that the airflow is quickly adapted to uses of varying intensity and changing climatic conditions.

The use of advanced polymer technology opens up entirely new design options. TJN jet nozzles allow for the precise adjustment of the supply air jet to the prevailing room conditions; the nozzles are acoustically optimised and more energy-efficient than similar products since the actuator is flat and fitted on the outside. Additional pressure losses are avoided.

An innovative option: Due to so-called shape memory alloys the discharge angle of jet nozzles changes based on the supply air temperature, thereby ensuring the comfort criteria in the occupied zone, both in heating and in cooling mode.

Gerber, Stuttgart, Germany

Mixed flow
VDW ceiling swirl diffusers for high room air change rates. Supply air and extract air variants for comfort zones
- 7 – 470 l/s
  25 – 1,692 m³/h
- □ 300, 400, 500, 600, 625, 825 mm
  Ø 300, 400, 500, 600, 625 mm

AIRNAMIC swirl diffusers
Ceiling swirl diffusers with fixed air control blades, for high volume flow rates at low sound power levels and low differential pressure due to innovative polymer technology
- 13 – 385 l/s
  47 – 1,386 m³/h
- □ 300, 600, 625 mm

RFD ceiling diffusers – higher comfort thanks to lower sound power levels
- 4 – 330 l/s
  14 – 1,188 m³/h
- □ 160, 200, 250, 315, 400 mm

TJN jet nozzles
throw the air far into the room. They are actuated electronically, manually, or with an SMA actuator (self-powered).
- 20 – 1,000 l/s
  72 – 3,600 m³/h
- Ø 160, 200, 250, 315, 400 mm

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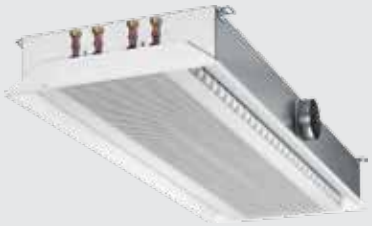
Active chilled beam DID614
Primary air:
- 8 – 83 l/s
  30 – 300 m³/h
- L: 593, 598, 618, 623, 1,193, 1,198, 1,243, 1,248 mm
  B: 593, 598, 618 and 623 mm
  H: 230, 245 mm

Cooling capacity: up to 2,170 W
Heating capacity: up to 3,000 W

Active chilled beam DID642
- 10 – 125 l/s
  36 – 450 m³/h
- L: 893 – 3,000 mm
  B: 593, 598, 618, 623 mm
  H: 170, 205 mm (plus services)

Cooling capacity: up to 3,100 W
Heating capacity: up to 2,330 W



X-BEAM

► Air-water systems for the dissipation of high heat loads ►►

In typical shops, large amounts of waste heat are produced by lighting, freezers and other pieces of equipment. If all heat loads were to be dissipated only by the supply air, an increased volume flow rate would be required. And higher volume flow rates also mean a higher energy consumption, a more difficult supply air discharge, and also higher costs. This is where energy-efficient air-water systems, such as the TROX X-BEAM units with an additional heat exchanger, are the perfect complement to the existing system layout.

Specifically in shopping centres, where high thermal loads prevail, air-water systems offer a critical advantage: They use water to cool or heat the air. This allows the heating and cooling capacity to be designed independent of the fresh air flow rate, while offering the advantage of a much more efficient form of energy transport than air.

X-BEAMS can be mounted in plain sight, but are typically installed in suspended ceilings. They can also be equipped with additional functions (lighting, loudspeakers, sprinklers).

We continuously run mock-ups and experimental tests to improve X-BEAM aerodynamics; the goal is to find ways of using water for cooling at relatively high temperatures when combined with geothermal energy.

Air management

► Air management ►►

Not only does the TROX X-CUBE provide retail spaces reliably with a continuous supply of treated fresh air, the unit has now been enhanced with an added intelligent function.

TROX X-CUBE: Central air handling unit for efficient room air management.
The air handling unit can act as the centre of the automation network within the air conditioning system and can also serve as a management system for smaller buildings. X-CUBE Control determines, collects and evaluates all data for the air conditioning system with regard to its functions and their optimisation.

The number of communication interfaces and data points on an existing central BMS can thus be drastically reduced, just like the installation and commissioning effort. Innovative air management systems with intelligent control components ensure the safe communication of the ventilation and air conditioning components. This makes the design of the ventilation system as part of building automation much easier and enables efficient, demand-based operation. Standard protocols are used for the integration with the central BMS.

X-AIRCONTROL.
X-AIRCONTROL is a system of master modules and zone modules used to control the ventilation and air conditioning in single rooms or in different parts of a building (zones). An X-AIRCONTROL master module can control up to 125 zone modules, and if an X-CUBE unit with integral controls is used, that X-CUBE Control system can assume the function of a master module.

TROX air management system

- Room management function: For the first time, all room-related data and configurations are stored on one controller.
- BMS interfaces: LON, BACnet, Modbus, IP-based webserver
- Stand-alone room control using an AIRCONTROL zone module together with a control panel
- Easy maintenance, room diagnosis and room configuration
- Rapid and precise control to maintain setpoint values
- Modular hardware

For more solutions and products please visit
www.trox-shopping-air.com

Safety systems

Preventive fire and smoke protection saves lives.

Shopping malls are highly complex buildings in which enormous volumes of air are moved. If a fire breaks out, fire protection systems must shut off adjacent compartments and keep escape routes free from smoke.

► High-tech solutions for fire protection and smoke extract ►►

In the event of a fire, personal safety, support of the fire and rescue service, and protection of property are the prime objectives, and they have to be met by an advanced central BMS and an effective safety management concept:

- Detect fires at an early stage and while the temperature is still fairly low.
- Prevent the propagation of fire and smoke to escape routes and surrounding occupied zones by releasing fire and smoke control dampers.
- Automatically activate the smoke extract system.
- Maintain positive pressure in corridors, stairwells, and escape and rescue routes with adequate pressurisation systems.
- Keep escape routes free from smoke to allow people to get to safety.
- Ensure that lifts stop only those floors where no smoke has been detected.

Comprehensive safety system.
Shopping centres are high footfall venues and require sophisticated safety systems with components that are perfectly complementary with one another. With the TROXNETCOM intelligent control system, TROX links fire and smoke protection dampers, smoke control dampers, volume flow controllers, duct smoke detectors, and smoke exhaust and ventilation fans to create a system of superior reliability (SIL2). TROXNETCOM makes sure that the individual system components communicate with one another, while system conditions are monitored and the necessary parameters are adjusted immediately.

TROXNETCOM can also be used with an air handling unit. The AHU display allows system users to track functional tests, for example. Standard communication protocols allow for the seamless integration of TROXNETCOM and higher-level building automation systems. The advantage for specialist consultants: fewer interfaces, less work.

Integral fan diagnosis system.
The integral X-FANS diagnosis system helps to detect any damages at an early stage and hence allows for condition-based maintenance.

Type DAX axial fire gas roof fan BV AX:
When combined with DAX accessories, axial smoke exhaust fans can be used as rooftop smoke exhaust fans. Saving energy is always one of the biggest challenges facing building owners and designers. Roof fans, however, require an opening in the roof of the building through which thermal energy can escape. The Type DAX axial fan features a newly developed casing which is suitable for installation on flat or sloped roofs; it is weatherproof, can resist even strong winds, is thermally insulated and equipped with an actuator-operated shut-off damper. The building envelope remains efficiently sealed such that energy saving ordinances are satisfied.

TROXNETCOM integrates fire protection and smoke extract components into a system and allows for central BMS connection.

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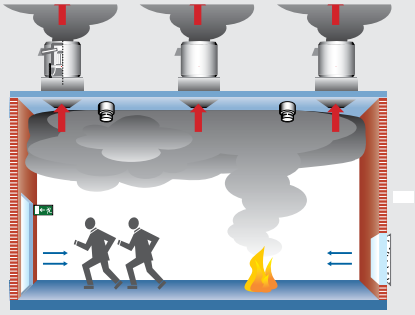
► Mechanical smoke extract in shopping malls ►►

Smoke extract by creating layers
Smoke detectors are installed throughout the space and are automatically activated in the event of a fire. As a consequence, the supply air inlets open and the fans begin to exhaust the preset volume flow.



X-FANS smoke exhaust fans
are available for 200 °C, 300 °C, 400 °C and 600 °C.

X-FANS smoke exhaust fans for roof installation
are available in various designs and for a wide range of temperatures. They are used for the central or decentralised smoke extract in production facilities and in retail and assembly spaces.

Mechanical smoke extract systems are mandatory in special structures such as shopping malls, which are highly complex buildings that experience high footfall. Most fatalities in a fire occur due to smoke inhalation. And this is precisely why smoke control plays a critical role in ensuring personal safety. Because they are essential for self rescue, external rescue, firefighting and protection against loss of property, mechanical smoke extract systems are a sensible solution and, ultimately, the safest option for everyone involved.

Smoke extract by creating layers.
This approach uses aerodynamics to create two separate horizontal layers:

- a layer of smoke near the ceiling
- a layer of fairly clean air near the ground so that people are able to pass and exit the building safely

In the event of a fire, the buoyancy of the smoke drives contaminants and soot particles upwards to the ceiling area of the fire compartment. In the process the updraught induces air, which results in a higher flow rate of the hot fire gas.

The mass flow of hot fire gas extracted near the ceiling is replaced by a low-velocity fresh air supply near the ground. There has to be a balance between the incoming fresh air and the outgoing hot fire gases so that the life saving layer of clean air is maintained.

The intake of additional supply air on one hand and the air extract on the other hand result in a pressure drop. This pressure drop is countered by smoke exhaust fans so that the volume flow rate setpoint is achieved and the hot fire gases can be safely removed from the fire compartment.

In spaces that are larger than 200 m², the clean air layer near the floor should be at least 2.5 m high. The calculation basis for determining volume flow rates and temperatures when sizing mechanical smoke and heat exhaust systems is specified in DIN 18232-5. It applies to internal spaces of 400 to 1,600 m² with a height of at least 3 m.

Smoke extract by dilution.
For spaces where a clean air layer for safe evacuation and firefighting is not a priority, smoke dilution can be applied. Due to the high degree of mixing, however, the space will not be completely free from smoke. Dilution can also be used to prevent the spontaneous combustion of partial combustion products and unburnt pyrolysis products (backdraught with potential subsequent flash over).

► Pressurisation systems in stairwells ►►

For stairwells in taller shopping malls, keeping escape and rescue routes free from smoke is an essential requirement for maintaining viable evacuation and firefighting options, even over longer periods of time.

Stairwell pressurisation and purging systems.
There are various different systems and strategies available to meet the safety objective of keeping escape and rescue routes, and especially stairwells, free from smoke. Depending on the fire protection strategy, different safety objectives may be defined to prevent smoke logging. While some smoke may be acceptable for some areas, others will have to be completely free from smoke, depending on the type and usage of a building.

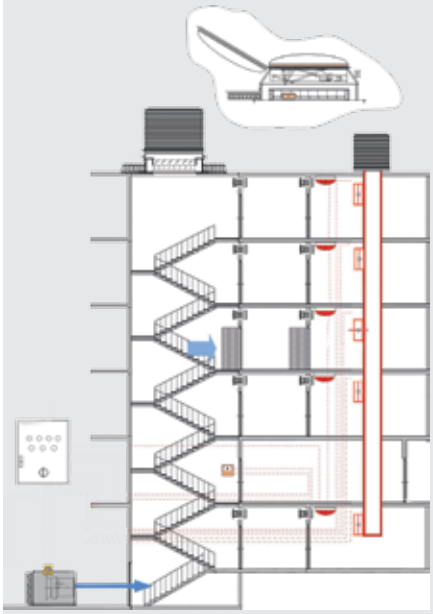
If it is not essential to keep a space completely free from smoke, a purging system with pressure control is suitable. This allows stairwells to remain mostly free from smoke. A pressure control unit is installed in combination with a roof light dome, e.g. at the top of a stairwell. When a smoke detector detects a fire in the building, the dome opens and the fan is activated. The pressure control unit creates a minimum closed-door pressure of 15 Pa. The maximum door-opening force must not exceed 100 N. Smoke entering the stairwell is diluted and purged. Keeping a stairwell in this case almost free from smoke is possible as long as the doors to the stairwell are not opened frequently.

If a space should be totally cleared, a pressurisation system is used to extract the smoke. This approach ensures that 2 m^3/s flow through the open door and that the stairwell is kept free from smoke. The door-opening force for this system type must also not exceed 100 N. Smoke-free escape routes allow occupants to move to safety, and firefighters to get in and attack the fire.

Pressurisation and purging systems should comply with the following standards and guidelines:

DIN 12101-6:2005 Specification for pressure differential systems, Kits
MHHR 2008 – Guideline for high-rise buildings
VDMA code of good practice no. 24188 – 2011
User guidelines for pressurisation systems – 2011

Positive pressure smoke control:
Maintaining positive pressure keeps stairwells free from smoke.



Components of a pressurisation system:

- Push button fire alarm
- Supply air fan
- Multileaf smoke protection dampers
- Pressure control dampers
- Pressurisation system control
- Ventilation grilles

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► Mechanical smoke extract in underground car parks ►►

X-FANS smoke exhaust fans remove hot fire gases from the individual fire compartments of underground or enclosed car parks. Customers have a choice of different constructions for various temperature ranges, depending on the car park layout.

Variants of X-FANS smoke exhaust fans

Smoke exhaust fans	Max. volume flow rate [m³/h]	Temperature
Roof fans	55,000	600 °C 400 °C 300 °C 200 °C
Axial fans	265,000	600 °C 400 °C 300 °C 200 °C
Centrifugal fans	160,000	600 °C 400 °C
Wall-mounted fans	55,000	600 °C 400 °C 300 °C 200 °C

X-FANS jet ventilation fans are used for the ventilation and smoke exhaust in underground car parks.

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Due to their low ceiling, underground and enclosed car parks present a particular challenge to smoke extract systems.

Smoke extract through the ductwork.
The first and foremost task of extract air systems is removing the exhaust fumes through extract air ducts. At the same time, fresh air is led into the structure through ventilation ducts or additional supply air inlets, e.g. the access ramps. Smoke exhaust fans which can also be used as ventilation fans ensure air changes based on the air quality. In the event of a fire, hot fire gases are removed through the ductwork so that the conditions for safe evacuation can be maintained for as long as possible.

Keeping spaces smoke-free with a jet ventilation system (JVS).
Jet ventilation systems are proven solutions for ventilating underground and enclosed car parks. In ventilation mode, the jet fans blow, or 'throw', the air far into the internal space such that the air in that space is changed and the CO gases are removed; this keeps the car park supplied with fresh air. Fans drive the extract air out of the car park through central smoke shafts. Typically, two fans are installed side by side or one after another as a standby system to ensure operation even if one of the fans fails.

In the event of a fire, the smoke gas temperature increases, and the gases rise towards the ceiling, where they spread. If smoke is detected, the fans in the jet ventilation system are switched on and drive the hot fire gases towards the central ventilation shafts. At the beginning, a layer is created which is nearly free from smoke. Escape and rescue routes are hence easy to recognise and allow people to leave the building.

The jet ventilation fans are only switched on after about three to five minutes. Then people can leave the car park via the short escape routes. Once activated, the jet fans effectively reduce temperatures and dilute hot fire gases in the fire compartment area. This covers also corners and other poorly ventilated areas. The firefighters can now locate and eventually extinguish the fire without being obstructed.

The jet ventilation system allows for large fire compartments so that underground car parks can be designed accordingly – open, spacious, and pleasant. Users will welcome the additional ease of orientation, feel better, feel safer – and are indeed safer in such a car park.

► Shopping climate created by TROX ►►

TROX is found in numerous shopping centres around the world:

Belgium: Grand Prés, Mons · **China:** Shenzhen Huarun Center · **Czech Republic:** Prague: Arkády Pankrác · Galerie Vaňkovka · OC: Europark Štěrboholy · Olympia Brno, Brno · OC Futurum, Hradec Králové · OC Plaza Plzeň · OC Forum Nová Karolina, Ostrava · Olomouc CITY · Carrefour Smichov · Galerie Nové Butovica · IKEA Černý Most · Tesco Letnany · Obchodní Centrum · Olympia OC Plaza Plzeň · **Slovakia:** OC Forum, Liberec, Košice · **Germany:** Gerber, Stuttgart · City Center, Hanau · Milaneo, Stuttgart · City Galerie, Augsburg · C&A, Duisburg · Kaufhaus Sinn, Duisburg · My Zeil, Frankfurt/Main · Media Markt, Krefeld · Breuninger Land, Ludwigsburg · Real, Moers · **Hungary:** KIKA Store, Budaörs · Hauer Sweet Shop, Budapest · AsiaCenter, Budapest · Polus Center, Budapest · **Poland:** Centrum Handlowe Batory, Gdynia · Centrum Handlowe Stary Browar, Poznań · Centrum Handlowe IKEA, Warsaw · Złote Tarasy, Warsaw · Centrum Handlowe Arkadia, Warsaw · **Russia:** Moscow: Europelski · Mega IKEA · Gudzon · Reutov Park · Supermarkt Ashah · Metro · **Spain:** 2 Mares, Murcia · Gran Casa, Zaragoza · **Switzerland:** Westside Center Bern · Shops Flughafen Zürich, Kloten · Möbel Pfister, Winterthur · Möbel Pfister, Zürich Walche- platz · Coop City, Winter- thur · **Vietnam:**

Times Square, Ho Chi Min City · **Argentina:** Shopping Abasto, Buenos Aires · Shopping de Mar del Plata · Shopping DOT, Buenos Aires · **South Africa:** Mall of Africa, Johannesburg · Newtown Junction & Retail, Johannesburg · **Mozambique:** Horizon Retail · **Turkey:** Özdilek AVM, Istanbul · **Netherlands:** Designer Outlet Roermond · Heuvelgalerie, Eindhoven · New Babylon, The Hague · Hoog Catharijne, Utrecht · Schiphol Plaza · Marks & Spencer, The Hague · C&A Damrak, Amsterdam · Hilvertshof, Hilversum · **Italy:** Centro Commerciale HAPPIO a Roma, Rome · GIGANTE ad Albino (BG), Bergamo · ROMAGNA CENTER a Savignano sul Rubicone, Forlì · Cesena Centro Commerciale FRECCIA ROSSA, Brescia · CALZEDONIA ad Ala Avio, Trento · H&M Milano Piazza Duomo, Milan · IKEA Udine · IKEA a Navicelli, Pisa · Supermercato Martinelli, Verona · **France:** Angoumars, Angoulème · Nespresso - Champs-Elysées, Paris · Swatch - Champs-Elysées, Paris · Quartier Libre, Pau · QELA (luxury brand) Champs-Elysées, Paris · EURALILLE, Lille · **Malaysia:** Sunway Putra Mall, Kuala Lumpur · **Brazil:** Salvador Norte Shopping, Salvador · RioMar · Fortaleza · Shopping Guararapes, Jaboatão dos Guararapes · Shopping RioMar Fortaleza, Recife · **Austria** Shopping Center Nord, Vienna · G3 Gerasdorf · Citygate, Vienna · **Serbia:** Delta City · Plaza, Kragujevac · **Croatia:** KIKA Zagreb · **Bulgaria:** Sofia: City Center · Mall Sofia · Mall Plovdiv · Galeria Burgas · ECE SERDICA CENTER · The Mall · Park Mall Stara Zagora · Paradise Center · Panorama Mall · IKEA · **Romania:** Palas Iași · Promenada Mall · Promenada Mall, Bucharest

TROX® TECHNIK

The art of handling air

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