SHOPPING 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.

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.

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.
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.

**A 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.

PARTICULATE MATTER POLLUTION IN CITY CENTRES

Gerber, Stuttgart, Deutschland

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.
## Particulate Matter Values for Stuttgart: Filter Efficiency

<table>
<thead>
<tr>
<th>Location</th>
<th>PM1.0</th>
<th>PM2.5</th>
<th>PM10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stuttgart, Am Neckartor City area, traffic, 2016</td>
<td>9.5*</td>
<td>18</td>
<td>38</td>
</tr>
</tbody>
</table>

- Value measured by UBA (German environment agency)
- Filtration with M5 approx. 40%
- Filtration with F7 approx. 99.95%
- Filtration with H13 approx. 99.95%

*Linear derivation

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**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
ENERGY-EFFICIENCY IS THE ORDER OF THE DAY

MyZeil, Frankfurt, Germany

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.

**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.

Das Gerber, Stuttgart, Deutschland

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.

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
The 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.

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.
Air conditioning
- High-tech room air conditioning

Air distribution
- Comfortable and efficient air distribution

Airflow
- High demand for air requires optimum air distribution
- Air-water systems for dissipating high heat loads

Air management
- Air management

Safety systems
- High-tech fire protection and smoke extract
- Mechanical smoke extract in shopping malls
- Pressurisation systems in stairwells
- Mechanical smoke extract in underground car parks
• Expert consultancy and support throughout all project stages: from the design stage to the system handover, and also after installation

• Comprehensive service support: commissioning, system integration, maintenance and modernisation

• Easy connection to higher-level systems thanks to standardized interfaces

• Maximum data transparency through the use of open systems such as LonWorks®, Modbus and BACnet

• Air management system solutions from a single source decrease the number of necessary interfaces

• Reduced fire load thanks to bus systems that require significantly less wiring

• Support of flexible building use concepts: systems can be easily adapted to meet new requirements

• Rapid amortisation of investment costs due to reduced operating costs

• Energy savings from optimised systems operation

• Outstanding operational reliability with system self-monitoring
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.

Filter systems

are used in ventilation and air conditioning systems to separate contaminants from the air. High efficiency filters trap even the tiniest particles and microorganisms.

Splitter sound attenuators

use absorption technology to attenuate sound and save energy thanks to their aerodynamically formed frames.

Air terminal units combined with zone control

provide demand-based volume flow rate control to ensure the best possible room air quality and...
temperature while they help to save energy at the same time. An optional air consumption meter measures consumption to enable consumption-based billing.

**Ceiling swirl diffusers and 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 and hence visible.

**Slot diffusers (non-visible)**

provide efficient air discharge and can be subtly integrated into suspended ceilings.

**X-BEAM induction units**

are air-water systems and represent energy-efficient solutions for the ventilation and air conditioning of rooms. When installed on the ceiling, they can be equipped with additional functions, such as lighting elements.

**Ventilation grilles**

and continuous horizontal runs can be installed in walls and floors and equipped with adjustable front grilles.

**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 operated in heating or cooling mode.

**TROXNETCOM**

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**

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**

remove smoke and heat via smoke extract systems and can be used for pressurisation, backfeeding and ventilation, as well as in gas extinguishing systems.

**Smoke protection dampers**

are used as shut-off devices in ventilation plant rooms or in ducts to prevent smoke from spreading.

**External weather louvres**

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

**Multileaf dampers**

Multileaf dampers 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. Not only do they serve as weather protection, they also shut off or block unwanted flows of air moving against the desired airflow direction.

**X-FANS smoke exhaust fans**

remove hazardous smoke gases 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 purposes.

**X-FANS jet ventilation systems**

are an excellent alternative to duct-based ventilation and smoke extract systems for underground car parks.
Tunnel and industrial dampers are used to ventilate and extract smoke from underground transport systems and car parks.

Flushing systems with pressure maintenance minimise smoke levels in stairwells and comprise:

- Pressure control unit for roof installation
- Axial supply air fan (AXO)
- Pushbutton alarms

Control
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