

► Lab Air ►►

Safe air management for laboratories





► The art of handling air ►►

TROX understands the art of competently 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.

Application-oriented solutions for laboratories.

Ventilation and air conditioning in laboratories have to meet specific, extremely stringent safety requirements since their purpose is to protect the people working in these labs. TROX provides bespoke solutions that set new standards for research facilities and laboratories all over the world:

- For all types of laboratories, whether chemical, pharmaceutical, biological or medical, for areas with potentially explosive atmospheres (ATEX) and for related areas such as storage rooms for solvents, chemicals or compressed gas cylinders.
- For all safety levels: Biosafety level BSL 1–4.
- With adjustable, flexible solutions, be it a stand-alone system for a small lab or a solution for a large laboratory with many rooms and hence a large number of fume cupboards and workbenches that are connected by a bus system.

*Max Delbrück Centre for Molecular Medicine (MDC), Berlin, Germany (2),
Rhine-Waal University of Applied Sciences, Kamp-Lintfort, Germany*

► Extensive know-how ►►

This application brochure deals primarily with the LABCONTROL air management system. LABCONTROL ensures stable and reliable room air conditions and the perfect interaction of the relevant ventilation and air conditioning components. Since its release 20 years ago, it has been constantly adapted to the demands of the market.

The extensive know-how and expertise gained from many meetings and discussions with specialist consultants have led to the development of innovative and practical solutions which fulfil the desire of our customers for simplified assembly, wiring, commissioning, maintenance, and expandability of the system. It is not surprising, then, that TROX air management systems are successfully used in hundreds of laboratories all over the world.

TROX has both the know-how and the expertise to continually raise standards in the field of air distribution for laboratories. Since 1998 our experts have been members of the standards committees for the EN 1822, EN 14175, DIN 1946 Part 7, and other guidelines and have provided valuable input to these bodies.



The following application brochures are also available:

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





► Complete systems ►►

One-stop shop. Complete solutions from a single source.

TROX provides tailored comprehensive air conditioning solutions that cover each stage of the airflow: from control components to air handling units, to aerodynamically optimised diffusers and efficient filters, and to fire protection and smoke extract components. TROX means that customers can get everything from a single source.

The X-CUBE air handling unit acts as the centre of the automation level and hence makes control even easier. All ventilation components are integrated with the central control system of the air handling unit, which can be used as a self contained control centre for smaller buildings, but which can also be integrated with the central BMS due to modular adapters for all the usual bus communication systems.

Where work safety and the protection of people and the environment are priorities, it is of paramount importance that all components of a lab air system complement each other perfectly.

Fewer interfaces, less coordination effort.

The advantages for specialist consultants and HVAC contractors are obvious: one-stop shop and one face to the customer – for efficient ventilation and air conditioning systems. The result is a drastic reduction of the usual interface or coordination problems in the design stage.

The AHU subsystem: simple, functional, safe.



The X-CUBE air handling unit includes a central automation level 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 with the proven AS-i system.

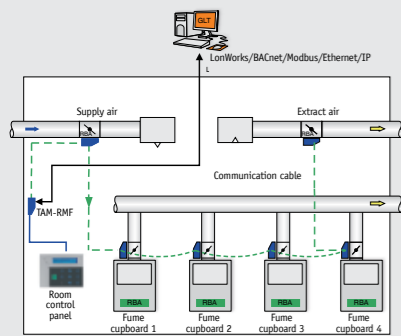
Max Delbrück Centre for Molecular Medicine (MDC), Berlin, Germany

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

- Air entry – weather protection
- Air treatment/heat recovery
- Air movement
- Air removal – smoke extract
- Air shut-off – fire protection
- Air management
- Air distribution

Integrated TROX air management system

- Room management function: All room related data and configurations are stored on one controller
- BMS interfaces: LON, BACnet, Modbus, IP-based webservice
- Plug and play: Automatic data exchange between the controllers; no addressing required
- Interactive commissioning (EasyConnect)
- Easy maintenance, room diagnosis and room configuration
- Rapid and precise control to maintain setpoint values
- Modular hardware



Room control (example)

Principal standards and guidelines:

- DIN 1946, part 7, Ventilation systems in laboratories
- EN 14175, Fume cupboards
- DIN 12925, Safety storage cabinets
- Directive 94/9/EC, Equipment intended for use in potentially explosive atmospheres (ATEX)

► **Protection of people and the environment** ►►

In laboratories, where hazardous substances are handled, the design of the ventilation and air conditioning system has to focus on the protection of lab staff and of the environment. Three prime objectives according to EN 14175 have to be achieved:

- Retention capacity and contamination control: Fume cupboards must prevent dangerous concentrations of gases, fumes or dusts from escaping and being released into the lab.
- Air change: Fume cupboards must prevent the development of an atmosphere that can ignite or even explode.
- Splash and shatter protection: Fume cupboards must prevent spray or flying fragments from injuring people.

While splash and shatter protection can obviously be ensured by the construction of a fume cupboard, the first two points require volume flow control. This is why air management also has the principal task of creating conditions that meet these requirements reliably and efficiently, in Germany to DIN 1946-7 and EN 14175:

- Providing sufficient fresh air while complying with the comfort criteria stated in EN 15251.
- Diluting and removing hazardous substances that might have been released in the fume cupboard or lab in order to prevent health risks that may result from breathing contaminated air.
- Satisfying the extract air and supply air demand for lab equipment.

Volume flow rates.

The extract air flow determines the required supply air flow. The extract air quantity depends on the type and size of a lab and on the fume cupboards and other extraction equipment. At night, a reduced air change rate is sufficient.

Pressure differences.

In laboratories, research institutes and similar facilities, the air conditioning system must ensure different pressure conditions in order to prevent the release of substances from a lab into other parts of the building. These pressure conditions can be achieved in two ways:

1. Constant supply air to extract air difference and hence constant air transfer.
2. Room pressure control based on a pressure setpoint value.

Removal of substances.

Contaminated air must be diluted, cleaned and removed from a building on the shortest possible way.



The EASYLAB control panel shows actual operating values, emits alarm signals, and allows users to set and change functions comfortably.



► Room air quality and comfort in the workplace ►►

Apart from ensuring that the protection goals are achieved, room air conditioning must also create a comfortable environment with a high room air quality and a comfortable climate. The degree to which the room air quality affects motivation, well-being and general acceptance of a workplace cannot be underestimated. Studies have shown that an increase in the supply air flow rate leads to a significantly higher performance and general satisfaction, and that good air is directly related to fewer allergies and infections and hence fewer absences due to sickness.

Focus on people in the workplace.

Whether fume cupboard or desk, a flexible air conditioning system must ensure maximum well-being and ultimate safety in the workplace at all times.

Apart from the important task of retaining contaminated air, the air conditioning system must create a comfortable work environment, and then without creating too much noise.

The wide spectrum of air conditioning systems, units and components puts TROX into a unique position: being able to find a bespoke solution for different conditions and for each lab building. 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, provide our customers with tailored air conditioning systems and overall safety.

Fig. 1: Relation between ventilation and performance

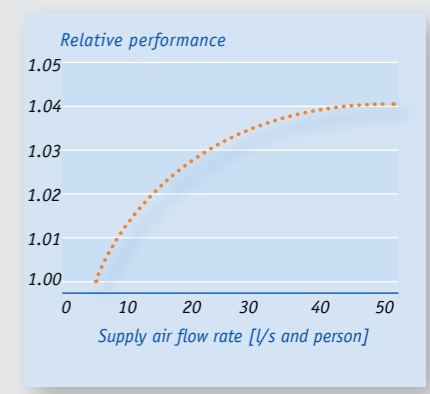
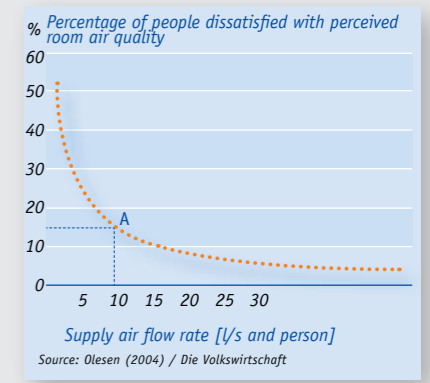
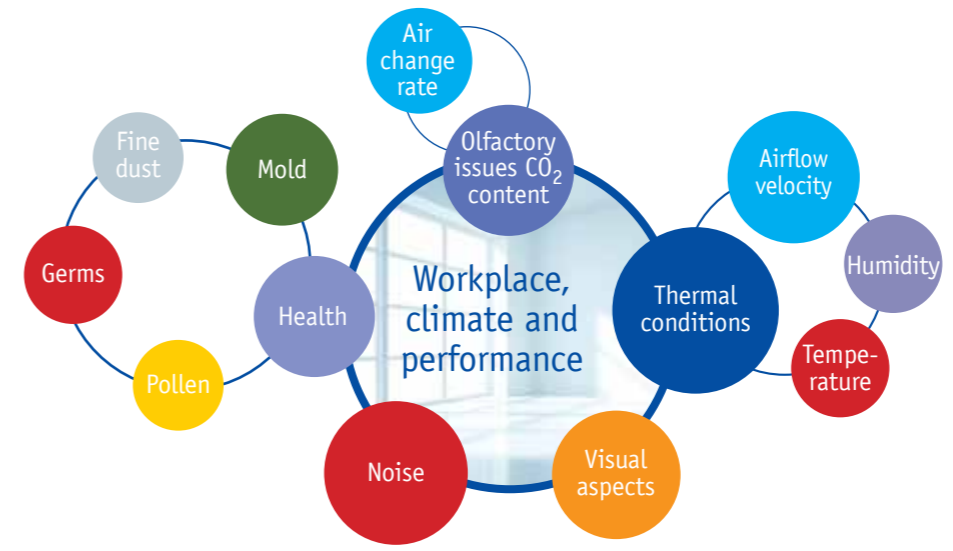
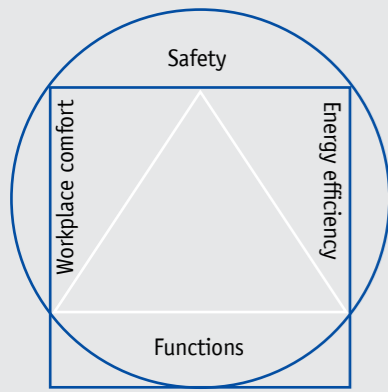


Fig. 2: Percentage of dissatisfied employees depending on ventilation rate



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.



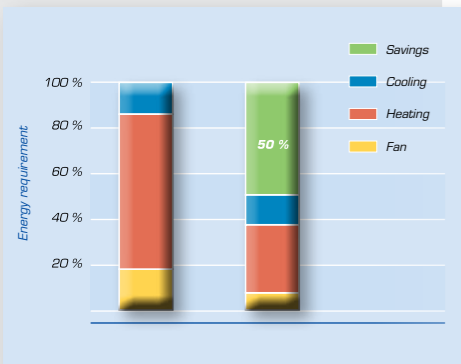


Squaring the circle in ventilation and air conditioning

Control factors for high air quality and energy efficiency:

- Individual control for each zone
- Shut-off and other forced control signals
- Flexible flow rate between V_{min} and V_{max} or switching between operating modes
- No adverse effect between control circuits
- Setpoint change is possible at any time
- Decentralised control
- Control elements can be integrated with the central BMS

Energy savings due to demand-based ventilation



The German Energy Saving Ordinance (EnEV) aims at reducing carbon emissions and other greenhouse gases. For example, it requires that damper blade positions are signalled to the central BMS.

Energy consumption can be cut by 50 % with demand-based ventilation.

► **Energy-efficient and demand-based ventilation** ►►

To operate a laboratory as efficiently as possible and to considerably lower the operating costs, which are substantial in any case, it is necessary to reduce the volume flow rates to the lowest level that is hygienically safe. Air treatment and air distribution should be as efficient as possible. TROX air management systems achieve a very high level of efficiency due to intelligent volume flow rate control. The ventilation and air conditioning system runs with full power only when people are actually working in a lab. At other times a lower room air change rate will be sufficient. The air conditioning system must try to achieve a balance between effective air distribution, energy efficiency of the system, and safety and comfort of the staff. Ventilation and air conditioning are energy-efficient only if they meet the following requirements:

- Automatic hydraulic balancing of volume flow rates
- Supply air and extract air balancing
- Minimising damper blade pressure losses
- Demand-based volume flow rate adjustment to room usage
- Adapting fan speeds to the air requirement
- Communication between the components of the system
- Smooth integration with various central building management systems

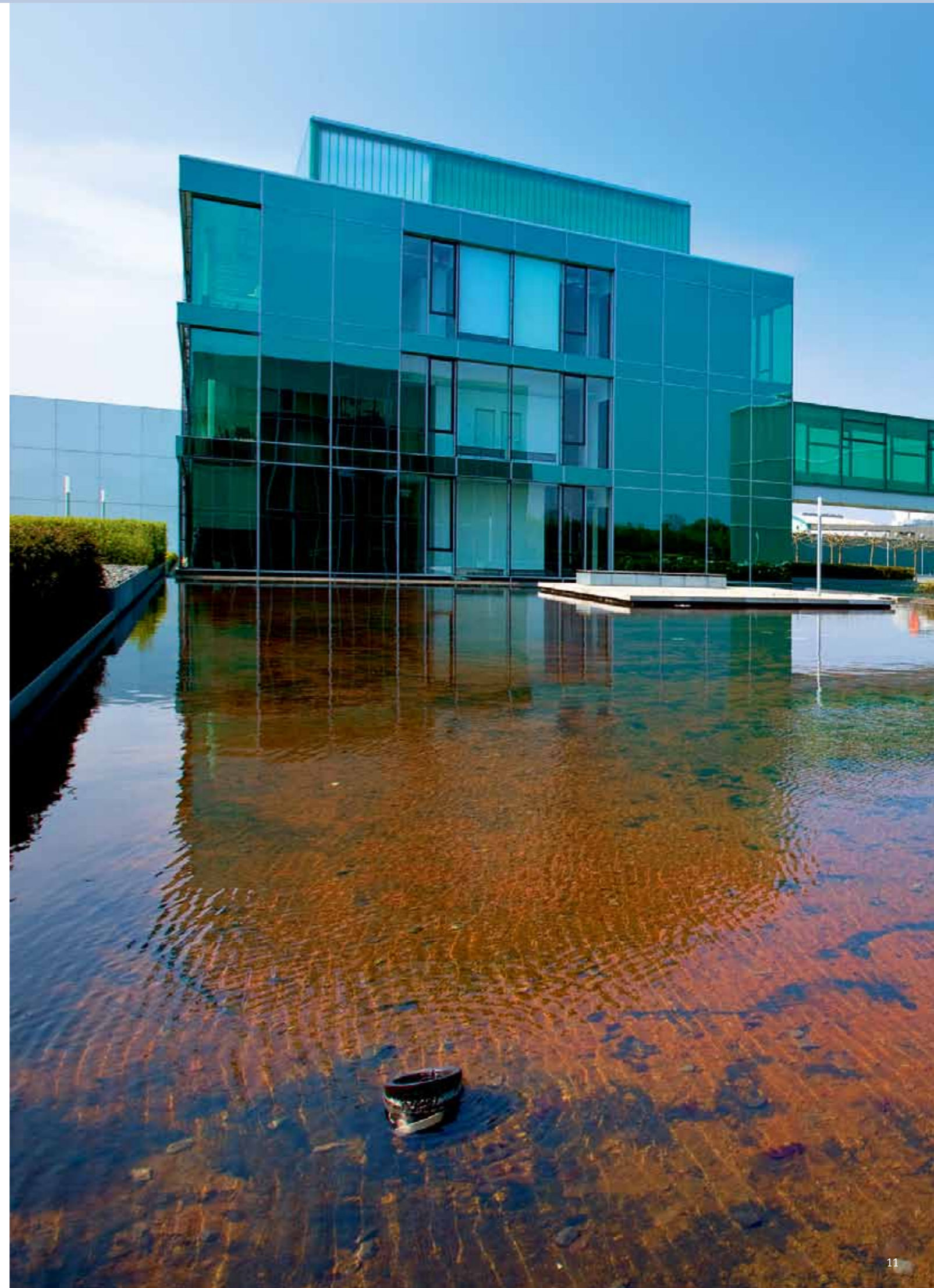
Demand-based optimisation saves energy.

Based on the air hygiene requirements we are referring to very high air change rates: 150 to 200 air changes per hour for fume cupboards, and for example 8 air changes for a room. It is, hence, extremely important that the air management system reacts to changing conditions of use. Volume flow rates and fan speeds should be adjustable, based on demand. When the damper position is signalled to the central BMS or to the X-CUBE control system, the fan speed can be adjusted accordingly in no time.

Air terminal devices need, however, a certain minimal volume flow rate to be effective. The TROX air management system can shut off individual air terminal devices above workplaces that are not in use. This means that the supply air flow rate can be reduced to a feasible level without a negative effect on comfort and performance of the air terminal devices.

Air management systems – flexible and ready to meet any challenge.

TROX air management systems have a flexible, modular structure such that they can be expanded or adapted to changing conditions.



TROX solutions for laboratories

Complete lab air design

Comprehensive and flexible solutions for every requirement.

On the following pages we present innovative lab air systems from TROX. The information is meant to help you design and install various air conditioning systems for laboratories.

The tables on the fold-out page provide information required for the sizing of lab air conditioning systems. You are then invited to follow the way of the air from the central air distribution and the supply air discharge to the air treatment and filtration and finally removal of contaminated air.



Sizing made easy: TROX Easy Product Finder

Innovative, intuitive, easy.

The TROX Easy Product Finder (EPF) design programme simplifies the design and sizing process enormously due to its intuitive navigation functions. Once you have entered the room name, area, height and other basic project parameters, the software suggests the correct components and automatically calculates the respective performance data. The result is just a few mouse clicks away. Two examples shall illustrate the sizing results that can be achieved with the EPF. The tables at the top show the room data which a user has entered and an overview of the room balance values. The lower tables give the results, i.e. selected control components and their volume flow rate ranges.



TROX ^{TECHNIK} The art of handling air		Ground floor
Room data		
Designation	Ground floor lab	
System	EASYLAB	
Control strategy	Extract air led room balancing	
Room height	3.00 m	
Room area	115.00 m ²	
Total extract air to DIN	2875 m ³ /h	
Design total extract air	2875 m ³ /h	
Air transfer	100 m ³ /h	
Minimum room extract air	0 m ³ /h	
Optimised extract air balancing	Yes	
Volume flow rate setpoint change	0 m ³ /h	

Room balance	V _{min}	V _{max}
Minimum extract air requirement	2875 m ³ /h	2875 m ³ /h
Total extract air from equipment	2400 m ³ /h	5640 m ³ /h
Resulting room extract air	475 m ³ /h	0 m ³ /h
Total extract air	2875 m ³ /h	5640 m ³ /h
Total extract air from equipment	0 m ³ /h	0 m ³ /h
Resulting room supply air	2775 m ³ /h	5540 m ³ /h
Total supply air	2775 m ³ /h	5540 m ³ /h
Air transfer	100 m ³ /h	100 m ³ /h
Air change rate (no. of air changes)	8.0	16.0

TROX ^{TECHNIK} The art of handling air		Ground floor		Volume flow rates [m ³ /h]		ΔP _{st}	Air-regenerated noise	Case-radiated noise
Room balance	Qty	Order code	Info	V _{min}	V _{max}	[Pa]	L _p [dB(A)]	
Fume cupboards								
Fume cupboard 1	8	TVLK/250-D16/ELAB/FH-VS/200/480m ³ /h BE-SEG-02	Equipment function: FH-VS	200	480	200	46	35
Fume cupboard 2	2	TVLK/250-D10/ELAB/FH-VS/200/700m ³ /h BE-SEG-02	Equipment function: FH-VS	200	700	200	45	36
Constant room extract air								
Extract air – cabinet	10	RN-P1/80/40-40m ³ /h		40	40	200	38	23
Room extract air								
Extract air – room	2	TVR-P1/160/ELAB/RE/LAB	Percentage of room extract air: 100 %	238	108	200	46	27
Room supply air								
Supply air – room 1	1	TVR/250/ELAB/RS/LAB	Percentage of room extract air: 33 %	916	1828	200	51	41
Supply air – room 2	2	TVR/250/ELAB/RS/LAB	Percentage of room extract air: 67 %	930	1856	200	51	41
TROX adapter module	1	TAM/LAB-RMF/2875/0/0/0/400/-100 m ³ /h						

The Easy Product Finder has become an invaluable tool for the building services industry, due to:

- reliable technical data
- interactive design wizard
- many report functions, e.g. reports on entry parameters, sizing results, specification texts and bills of material



TROX ^{TECHNIK} The art of handling air		Upper floor
Room data		
Designation	Upper floor lab	
System	EASYLAB	
Control strategy	Extract air led room balancing	
Room height	3.00 m	
Room area	64.00 m ²	
Total extract air to DIN	1600 m ³ /h	
Design total extract air	1600 m ³ /h	
Air transfer	100 m ³ /h	
Minimum room extract air	0 m ³ /h	
Optimised extract air balancing	Yes	
Volume flow rate setpoint change	0 m ³ /h	

Room balance	V _{min}	V _{max}
Minimum extract air requirement	1600 m ³ /h	1600 m ³ /h
Total extract air from equipment	1600 m ³ /h	3280 m ³ /h
Resulting extract air	0 m ³ /h	0 m ³ /h
Total extract air	1600 m ³ /h	3280 m ³ /h
Total supply air from equipment	0 m ³ /h	0 m ³ /h
Resulting room supply air	1500 m ³ /h	1500 m ³ /h
Total supply air	1500 m ³ /h	3180 m ³ /h
Air transfer	100 m ³ /h	100 m ³ /h
Air change rate (no. of air changes)	8.0	17.0

TROX ^{TECHNIK} The art of handling air		Upper floor		Volume flow rates [m ³ /h]		ΔP _{st}	Air-regenerated noise	Case-radiated noise
Room balance	Qty	Order code	Info	V _{min}	V _{max}	[Pa]	L _p [dB(A)]	
Fume cupboards								
Fume cupboard	6	TVLK/250-D16/ELAB/FH-VS/200/480m ³ /h BE-SEG-02	Equipment function: FH-VS	200	480	200	46	35
Constant room extract air								
Extract air – cabinet	6	RN-P1/80/40-40m ³ /h		40	40	200	38	23
Extract air – floor	1	RN-P1/125/126-160m ³ /h		160	160	200	42	19
Room supply air								
Supply air – room 1	1	TVR/250/ELAB/RS/LAB	Percentage of room supply air: 50 %	750	1,590	200	50	39
Supply air – room 2	1	TVR/250/ELAB/RS/LAB	Percentage of room supply air: 50 %	750	1,590	200	50	39
TROX adapter module	1	TAM/LAB-RMF/1600/0/0/0/400/-100 m ³ /h						



**HOCHSCHULE
RHEIN-WAAL**

Rhine-Waal University
of Applied Sciences



► Many parts, one system – intelligent and easy ►►

LABCONTROL EASYLAB controller.

To provide safety and comfort in laboratories at all times, the components of an air conditioning system are interconnected. An intelligent air management system records all relevant data, evaluates them and ensures that setpoint values are maintained. With LABCONTROL and the EASYLAB controller TROX has developed an air management system which is ideal for highly sensitive areas.

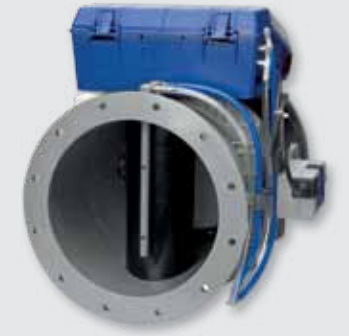
EASYLAB allows all controllers in the network to immediately communicate once they have been installed, i.e. no component addressing is required. Due to their modular hardware structure controllers can be adapted to individual requirements. Plug-in connections combine easy installation with flexible expansion options. Once a fume cupboard has been commissioned, it can be included in the room control, and removed again, at any time and without readjustment. This is real plug and play.

Air handling unit as control centre.

Intelligent functions have been added to the TROX air handling unit in order to further facilitate control of the overall air conditioning system. All ventilation and air conditioning components can be integrated with the air handling unit.

The X-CUBE air handling unit acts as the control centre on the automation level, a setup which drastically reduces the number of communication interfaces and data points on an existing central BMS. This saves costs, cuts the installation and commissioning effort, and ensures safe communication of the ventilation and air conditioning components. This is an important step towards the simplification of the ventilation and air conditioning design as part of building automation. Standard protocols are used for the integration with the central BMS.

TROX EASYLAB is the answer to all questions regarding air management for highly sensitive areas.



TROX X-CUBE CONTROL controls the air handling unit and room volume flow rates; the system also controls and monitors fire protection and smoke extract functions and controls laboratories.



For detailed information and sizing examples, control strategies and areas of application see the LABCONTROL design manual.



▶ Lab air strategies ▶▶

▶ Integrated room air design for laboratories ▶▶

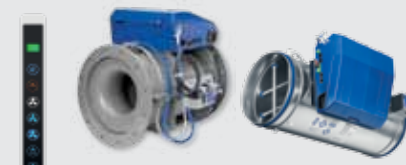
Developing and implementing a comprehensive room air conditioning strategy that meets the most critical safety and comfort requirements is only possible through the close cooperation of specialist consultants, HVAC contractors, users and manufacturers, and then from the beginning, i.e. from the design stage onwards. The TROX know-how and the complete TROX product portfolio can be combined for both new buildings and refurbishment projects.

The illustration on the fold-out page shows you how a lab with innovative TROX products and systems may look like.



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 interfaces required
- Reduced fire load due to bus systems that reduce the 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 X-CUBE Compact (not shown in the building illustration) is a compact air handling unit for volume flow rates of 600 to 6000 m³/h and a heat recovery efficiency in excess of 80 % (dry, to EN 308); it is the ideal solution for small and medium-sized applications.

3 TROX room air management systems 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.

4 FMS Flow Monitoring System is an electronic, self-powered monitoring system for fume cupboards. **VMRK**, a circular volume flow rate measuring unit, recommends itself for ducts with contaminated air.

5 Constant volume flow control Circular, mechanical self-powered CAV controllers for the precise control of constant volume flows of contaminated extract air.

6 Swirl 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.

7 Ceiling diffusers are ideal for large, modern laboratories with soft cooling methods such as adiabatic cooling; their controlled velocity profile at the point of discharge is an advantage.

Induction units 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.

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

▶ One-stop shop ▶▶



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.

X-FANS process extract air fans are made of plastic and fitted with special seals and are hence ideal for the removal of aggressive media.

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 dampers 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.

One-stop shop. In addition to the products shown here, TROX offers many more and in fact covers the entire range of components and systems for ventilation and air conditioning:

- Filters and filter systems
- Sound attenuators made of PPS
- Other air terminal devices for mixed flow and displacement flow, and for installation in ceilings, walls and floors.
- Air-water systems
- Decentralised ventilation systems
- Splitter attenuators and silencers
- Smoke control dampers
- X-FANS smoke exhaust fans
- X-FANS fans



▶ Air management ▶▶

Intelligent solutions for control and monitoring.

The TROX room air management system is designed for the easy interconnection (plug and play) of all controllers; it only requires a communication cable. Continuous data exchange among the controllers is then ensured. The system can easily be connected to the central BMS using the standard communication interfaces LonWorks, BACnet, or Modbus; IP-based communication with Ethernet is also possible.

▶ Fume cupboard control ▶▶

Fume cupboard control in a laboratory is a principal issue since people working in a lab must be protected. Gases or aerosols, which may be the product of some chemical reaction, should be removed at the source. Contaminated air must be diluted, cleaned, filtered and removed from a building on the shortest possible way such that the environment is not also contaminated.

Rapid response.

Rapid response times ensure that no outbreak of hazardous substances can occur, e.g. in fume cupboards with variable, demand-based extract air. This is why EASYLAB controllers, which have been developed for the ventilation of laboratories, act within only 3 s, while the reaction time is only milliseconds. These values comply with EN 14175 for fume cupboards and have been verified and certified by a test institute. For comparison: The action time of standard controllers is usually 120 s. For slave control loops, these rapid response times, which are necessary to meet the room air conditioning requirements of DIN 1946, part 7, put control components under a lot of strain. This is why EASYLAB uses on the room supply air and extract air sides the same quick controllers as those used for fume cupboards.

Lower energy consumption.

The TROX FSE automatic sash device saves energy costs while increasing safety and comfort in laboratories. It is easily integrated with the EASYLAB fume cupboard control using plug and play. The TROX FSE can automatically close the sash if nobody is working at the fume cupboard. Ideally, a closed sash will result in a lower volume flow rate and hence in less energy being consumed. Perfect safety for the surroundings is an added bonus.

More safety, more comfort.

The TROX FSE is definitely a safety feature as sashes that have been left open unintentionally will be automatically closed after a certain time. Users working at a fume cupboard can comfortably open or close the sash by just pushing it lightly or by pressing a button or actuating a pedal switch.



VAV terminal unit TVLK, made of plastic, for lab extract air systems, for the removal of aggressive media

➤ V: 30 – 515 l/s
V: 108 – 1854 m³/h
Δp: 5 – 1000 Pa

◀▶ Ø 250 mm

Closed blade air leakage to EN 1751, class 4

Casing air leakage to EN 1751, class C



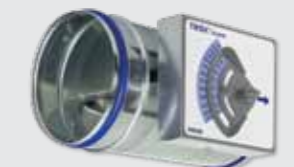
CAV controller RN – for supply air and extract air systems, easy volume flow rate setting without any tools

➤ V: 11 – 1,400 l/s
V: 40 – 5040 m³/h
Δp: 50 – 1000 Pa

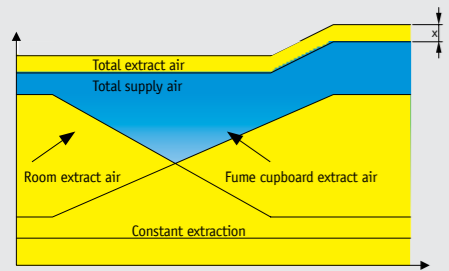
◀▶ Ø 80 – 400 mm

Closed blade air leakage to EN 1751, class 4

Casing air leakage to EN 1751, class C



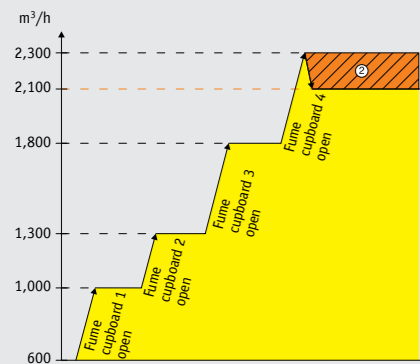
For more solutions and products please visit www.trox-lab-air.com



$x = V$ - difference controlled through supply air to ensure negative pressure

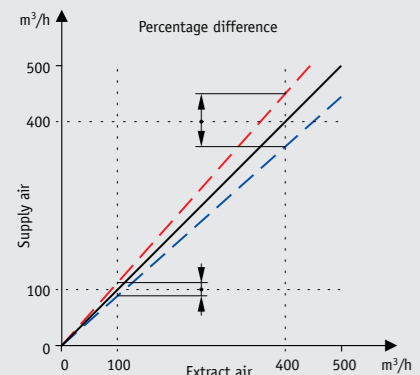
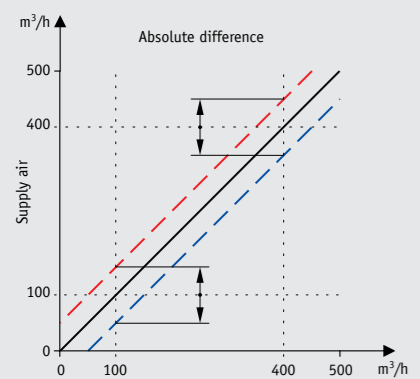
An additional extract air controller increases or decreases the extract air flow depending on the operation situation.

Total extract air for the room



Diversity control reduces the volume flow rate in order to maintain the total extract air.

Room balancing



TROX prefers an absolute difference to a percentage difference as otherwise different negative pressure conditions will occur depending on the total extract air. Only an absolute difference between supply air and extract air ensures a stable negative pressure.

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

► Room balancing ►►

From the point of view of an air conditioning system, the fume cupboards in a lab are rooms within a room; this complicates communication and the maintenance of setpoints. A reliable air management system is important because volume flow rate balances in various room scenarios must be controlled quickly and precisely as volume flow rates in fume cupboards and other extraction units may suddenly change. This requires that the actual volume flow rates are not only precisely measured, but also rapidly signalled such that the setpoint values can be achieved.

Room balancing.

In a lab, the extract air consumers such as fume cupboards, fume hoods or extraction units determine how much supply air is required. EASYLAB adds all extract air values and controls the supply air based on an absolute difference between supply air and extract air, which prevents contaminated air from leaving the lab.

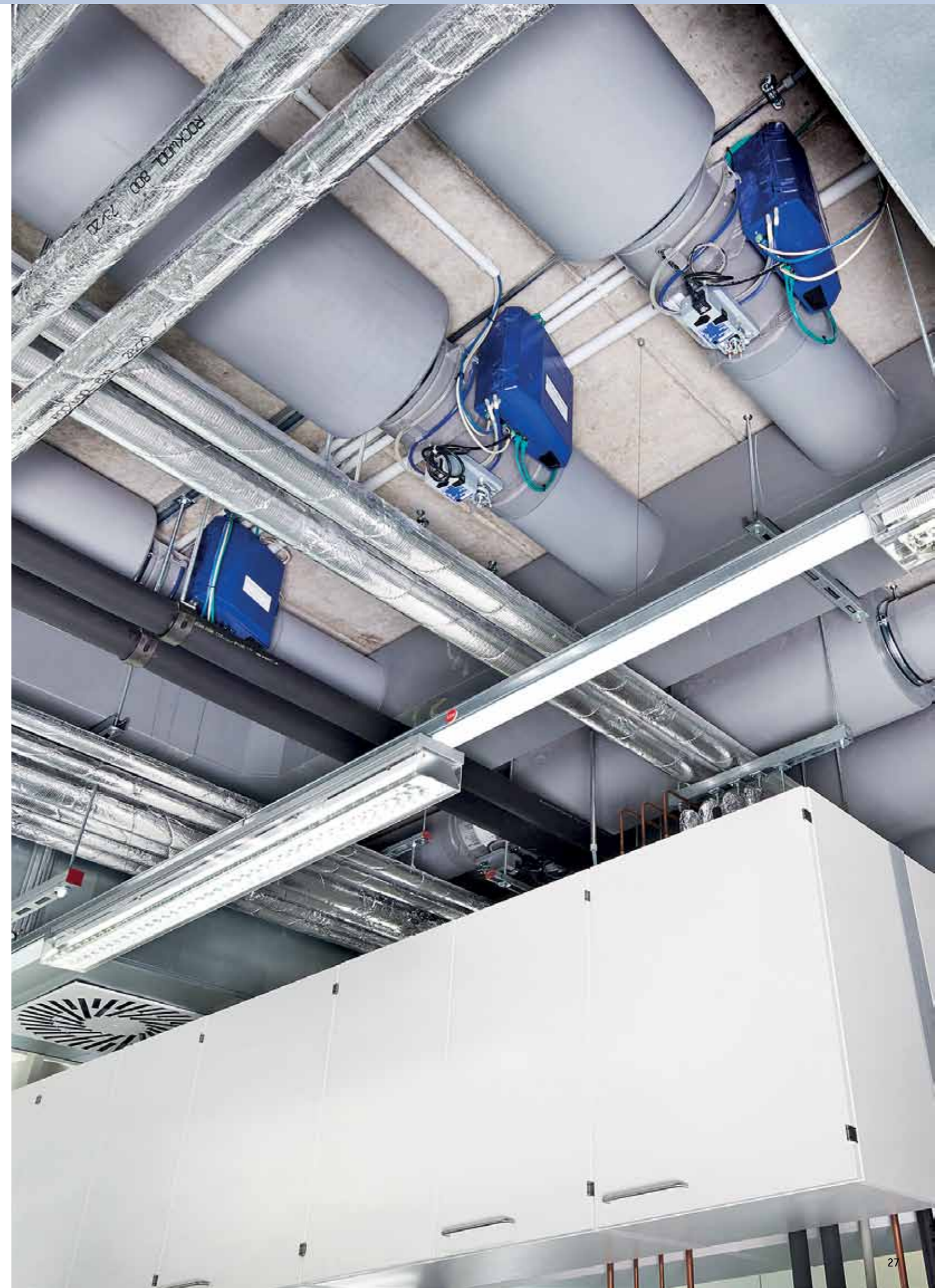
Efficient interplay of fan speed and damper blade position.

Ideally, air conditioning systems should include variable volume flow control and speed-controlled fans such that they can adjust efficiently to changes of usage. EASYLAB and fast actuators ensure that the damper blades of TROX volume flow rate controllers react swiftly to any changes and maintain the required air balance, e.g. by reducing the supply air flow rate. The correct and quick functioning of EASYLAB requires that there is always a sufficient pressure in the duct system. This can be achieved efficiently and safely in two ways:

1. Measurement of the duct pressure where an undersupply occurs first: maintaining the duct pressure setpoint value. The point where an undersupply occurs first is difficult to find, however, since it tends to wander in the duct system with changing operating conditions.
2. Evaluation of the combined damper blade positions of all VAV terminal units: It is possible with sophisticated logic to vary the speed of supply air and extract air fans in such a way that the dampers work with the blades in the position that results in the least pressure loss (almost completely open). The logic is part of the X-CUBE control package. This ensures that the 'accelerator' (high fan speed) and the 'brake' (damper blade almost closed) are not actuated at the same time.

Selective diversity control

To reduce investment costs, centralised systems are often not designed for 100 % capacity. If all extract air consumers ran with full capacity, the fume cupboards in a more unfavourable position in the duct system would suffer from a lack of air. EASYLAB allows for a refined control strategy to maintain work safety at as many workstations as possible when the design total extract air is exceeded. Any reduction of the volume flow rate for a fume cupboard is displayed (alarm), reminding users to close fume cupboards that should not be open. Diversity control makes it possible to design smaller plant rooms and a smaller duct system, thereby reducing investment and operating costs.

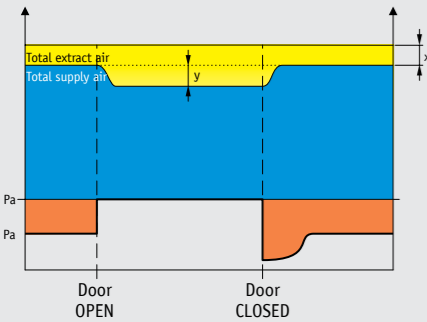


EASYLAB control components for room pressure control in sensitive areas.



Reference pressure.

The reference pressure must never be neglected. A stable reference pressure is the prerequisite for satisfactory room pressure control.



Defined room pressure control.

EASYLAB lets you change from volume flow rate control to pressure control at a later stage, without the need to change any controllers. What is required is the addition of a room pressure transducer, and room pressure control must be enabled in the controller configuration.



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► Room pressure control ►►

TROX EASYLAB ensures the fast and precise control of volume flow rates in a room. Short response times and precise control are basic requisites for the perfect room air management.

EASYLAB controllers are the brains of our air management systems; due to their modular structure they can be adapted to each individual project. The controllers include plug and play communication, which allows for the fast, clean and easy integration of all components into the air management system. The software has been designed for lab control; it is very precise and ensures that the required room pressure values are maintained.

Specialist consultants and HVAC contractors benefit from the flexible EASYLAB control system, which is also easy to install:

- Easy integration of room controllers using a standard communication cable; no addressing required
- Flow rate balancing with defined air transfer
- Room pressure control
- Automatic volume flow rate balancing including all supply air and extract air controllers
- Diversity control
- Optimised extract air balancing
- The minimum discharge velocity on air terminal devices is maintained
- Uninterruptible power supply

Room pressure control as a cascade.

If pressure control is required due to legal directives or ordinances, or if the room leakage is too low and it is no longer possible to alter the nominal volume flow rate within required tolerances, it is possible to supplement or combine room balancing with pressure control. The room balancing control strategy is maintained also for pressure control.

Integration of a door contact.

In addition to pressure control, EASYLAB allows for integrating a door contact. This provides the following options:

- Suppressing the acoustic alarm, which is emitted in case of a pressure deviation, for a certain period of time (can be configured)
- Suppressing alarm signalling to the central BMS for a certain period of time (can be configured). If a door contact is used, opening the door does not immediately lead to an alarm. An alarm is signalled only (optional) when the door remains open for too long.
- Temporarily switching off pressure control.

Rhine-Waal University of Applied Sciences, Kamp-Lintfort, Germany





Air discharge patterns

Flow behaviour for high comfort.

The construction of air inlets and outlets and their combination and installation position determine the ventilation flow behaviour and hence the effectiveness and efficiency of a lab air strategy. In the occupied zone the ideal air discharge pattern can be achieved with high induction levels that lead to a rapid reduction of airflow velocities and of the temperature differences between room air and supply air. If the goal is a laminar flow, the airflow velocity and a homogeneous airflow must be maintained.

Airflow control strategies for laboratories

Selecting air terminal devices.

The DIN 1946-7 requirement of eight air changes per hour is a challenge to the ventilation for laboratories. When selecting a supply air diffuser, the exact installation location is as important as the cooling load of a room. If one compares a room air conditioning system to a chain, air terminal devices would be the most critical links for thermal comfort. To obtain a high degree of comfort and safety, the discharge velocity of the supply air must not be too high, yet strong enough to dilute the air in the lab.

Due to the high heat loads in a lab, which are caused by the lab equipment, labs must be cooled both in winter and in summer. Yet cooling and high volume flow rates also mean high energy consumption. Cooling creates high temperature differences, which in turn adversely affect the comfort and may also be a safety problem. When cold air 'falls' from the ceiling, it may induce air from the fume cupboard, i.e. drive it into the room. This can be safely avoided, however, by an intelligent control strategy and the correct placement of suitable air terminal devices.

It is important to take the lab furniture and equipment into consideration already in the design stage in order to find the best possible installation location for air terminal devices. Furniture and equipment have an impact on the airflow in the room and can interfere with effectiveness and comfort.

The minimum air discharge velocity on diffusers in a variable air control system must be achieved to ensure comfort independent of the operating conditions. The air management system takes the type of diffuser into consideration and provides the necessary signals to ensure the minimum air discharge velocity.



Swirl diffusers – whisper quiet due to optimised air discharge.

Mixed flow

VDW ceiling diffusers for high room air change rates. Supply air and extract air variants for comfort zones

- ⌚ 7 – 470 l/s
25 – 1692 m³/h
- ◀▶ □ 300 – 825 mm
Ø 400 and 600 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 due to lower sound power levels

- ⌚ 4 – 330 l/s
14 – 1188 m³/h
- ◀▶ □ 125 – 400 mm





Max Delbrück Centre for Molecular Medicine (MDC), Berlin, Germany

Inducing displacement flow

TROX HESCO duct nozzle diffuser

An ideal air terminal device for rooms with high air change rates.

- ☉ 72 – 2824 m³/h
- 20 – 785 l/s
- ◀▶ 500 – 2000 mm



PROCONDIF Profile Controlled Diffusion

These diffusers are also an excellent solution for providing supply air from above to sensitive areas in labs, creating a displacement flow in the occupied zone.

- ☉ 280 – 600 m³/h
- 78 – 167 l/s
- ◀▶ 600 x 600, 625 x 625 mm



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▶ **Tailored components for air discharge** ▶▶

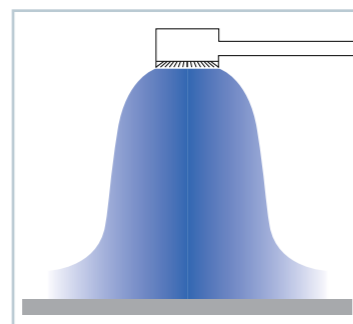
TROX has developed bespoke solutions for the special requirements of laboratories.

- Air terminal devices which ensure a rapid change of large air volumes in the lab
- PROCONDIF: Air discharge with the PROCONDIF is ideal for labs as large volume flows can be supplied with only medium supply air to room air temperature differences to selected spots in a room. This results in a homogeneous, low-turbulence air movement in the occupied zone.

The diffuser is ideal for supplying air while causing only low induction levels. The velocity profile is achieved by a honeycomb structure with very fine channels of different widths.

The 30° discharge angle creates a bell-shaped air pattern, i.e. the supply air does not adhere to the ceiling (Coanda effect).

- Air-water systems and air terminal devices which are easy to clean and meet the hygiene requirements in offices, corridors, toilets and specific lab areas
- Decentralised ventilation systems for offices with an external wall



The PROCONDIF diffuser is also suitable for freely suspended installation. The bell-shaped air pattern supplies fresh air to rooms without causing eddies near fixtures or furniture.

▶ **Air-water systems for the dissipation of high heat loads** ▶▶

Lab equipment generates high volumes of waste air. 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. Air-water systems are a sensible addition here.

In many countries, air-water systems such as TROX DID active chilled beams ensure the energy-efficient dissipation of high heat loads generated by lab equipment.

With an all-air system, large volume flow rates are required, which in turn incur high energy costs for air treatment and air transport. Air-water systems move energy with water, which is more efficient than air, such that less energy is required for the same cooling capacity.

Air-water system

Active chilled beam DID632

- Primary air:
- ☉ 6 – 85 l/s
 - 22 – 306 m³/h
 - ◀▶ L: 900 – 3,000 mm
 - B: 593, 598, 618 und 623 mm
 - H: 210 mm
- Cooling capacity: up to 2,500 W
Heating capacity: up to 3,000 W



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▶ Air treatment ▶▶

Innovative systems are extremely reliable.

A suitable BMS allows for efficient, safe and smooth interaction of all building services. The seamless integration of TROX air handling units with the central BMS is ensured by control and monitoring systems that provide comprehensive communication and configuration functions and hence a high level of flexibility.

▶ High-tech room air conditioning for labs ▶▶

Air handling units for laboratories must be extremely reliable but also flexible such that they can be adapted to changes of use. The TROX X-CUBE air handling unit has virtually unlimited configuration options and defines high levels of flexibility, reliability and safety. The hygiene version is characterised by some additional features:

- Use of damper blades that comply with closed blade leakage class 4 to EN 1751
- Powder-coated attenuator splitters
- Stainless steel floor panels inside
- Heat recovery: run around coil system, cross flow heat exchanger
- Wide selection of energy-efficient heat recovery systems such as rotary heat exchangers, plate heat exchangers and run around coil systems

Variable use.

TROX X-CUBE units are very versatile. 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.

Air handling unit as 'master' of the automation level.

The TROX X-CUBE can be integrated with all air conditioning components. It determines, collects and evaluates all data for the air conditioning system with regard to its functions and the optimisation of these function and can hence be used as the control centre on the automation level. Standard protocols are used for communication. In smaller buildings, the air handling unit can actually function as a control centre.

Energy-efficient heat recovery systems.

For very demanding requirements of hygiene and safety, a high-efficiency run around coil system is used in which the supply air flow and the extract air flow are completely separate to prevent the transfer of odorous substances or germs.

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 due 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 due to highly efficient heat recovery systems and fans
- Also available (optional) as a weatherproof variant with drip edge and intake hood with tested rain water elimination

X-CUBE



Hydraulic unit for high-efficiency run around coil systems



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► ATEX – Certified TROX safety products ►►

Wherever combustible gases, vapours or dusts are present, there is a risk of explosion. The building or system owner is responsible for the safety in areas with potentially explosive atmospheres. It is hence reassuring when the installed mechanical self-powered, electronic or pneumatic components come with certificates that prove their safety and suitability for use in potentially explosive atmospheres – as is the case with many TROX products.

The TROX product portfolio includes fire dampers, volume flow controllers and in particular special fans for use in potentially explosive atmospheres.

Explosion-proof fans.

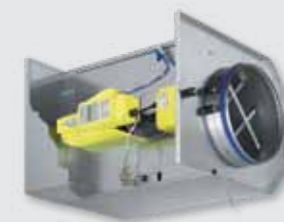
Selecting the correct fan is most important where difficult chemical or thermal factors play a role. TROX TLT offers a large portfolio of fans, including:

- High-performance centrifugal fans for roof installation, suitable for aggressive gases and vapours
- Versatile centrifugal fans in 50 different sizes
- Compact axial fans for installation in ducts and walls, where space is restricted, suitable for large air volumes yet low pressure increase and high efficiency

The material depends on the purpose of the fan or on the degree of chemical or thermal influences to which the fans are exposed: Available materials include PVC, PP, PPs, PPs-el, PE, PVDF, or GRP or variants with GRP. For impellers, there is a choice of PVC, PP, PPs, PPs-el, PVDF, GRP, or steel with plastic or other coating, or rubberised steel, depending on the construction, size or degree of exposure of the fan. An extensive range of accessories is also available.

Fans to be used in areas with potentially explosive atmospheres may be fitted with three-phase motors with protection level IP55 (with 'increased safety' – EEx eII) and temperature class T4 (certified by the German PTB). As a consequence, the fans can be used based on the zones listed in 94/9/EU (ATEX 95) or EN 14986.

TVR-Ex VAV terminal unit for variable volume flow rates



Circular CAV controller RN-Ex for constant volume flow rates



Rectangular CAV controller EN-Ex for constant volume flow rates



Rectangular fire damper FK-EU with explosion-proof spring return actuator



TROX TLT explosion-proof fan



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

► Lab air from TROX ►►

TROX has fitted laboratories all over the world:

Abbott GmbH & Co. KG Ludwigshafen, AC/PC Münster, Aldrich Chemie Steinheim, Asta Medica Mainz, BASF Ludwigshafen, BAT Bayreuth, Bayer AG Dormagen, Leverkusen and Wuppertal, Biopark Regensburg, BMW Dingolfing, Boehringer Ingelheim, BTU Cottbus, BYK-Chemie Wesel, Charité Berlin, CVUA Münster, Dow Corning Wiesbaden, Dräger Medical Lübeck, Magdeburg University of Applied Sciences, Jülich Research Centre, Friedrich Schiller University in Jena, Goldschmidt AG in Essen, Dresden University of Applied Sciences, Hüls AG in Marl, H.C. Starck in Goslar, Hilti in Kaufering, InfraServ in Frankfurt-Höchst, Dresden Institute for Polymer Research, Bremen International University, IZB in Munich, Merck in Darmstadt, Hannover Medical School, Martin Luther University in Halle, Max Planck Institutes in Dresden, Frankfurt, Jena, Mainz, Magdeburg and Rostock, Paul Ehrlich Institute in Frankfurt, RWTH Aachen University, Ruhrhaus Lab in Essen, Ruhr University in Bochum, Sachs in Schweinfurt, Sartorius in Göttingen, Solvay in Hannover, State Office for Food Safety in Braunschweig, Chemnitz Technical University, Dresden Technical University, Elementis at TPK in Cologne, Freiburg University Hospital, Greifswald University, Anatomy Dept. of Hamburg University, Heidelberg University Hospital, Forensic Medicine Dept. of Cologne University, Cologne Center for Molecular Medicine, Leipzig University, Pathology Dept. of Münster University, Universities of Bonn, Essen, Potsdam, Rostock and Würzburg, Tübingen University Department of Otolaryngology, Head and Neck Surgery, VW in Wolfsburg, Aventis in Lyon (F), Schering in Milano (I), Novartis in Basel (CH), Janssen Pharma in Beerse (B), Sanofi in Montpellier (F), Sandoz in Langkampfen (A), L'Oréal in Paris (F), 3M China (CHN), Henkel Shanghai (CHN), ARK Therapeutics (FI), Atrium Helsinki (FI), Techcenter Reinach Basel (CH), Kaari-talo Helsinki (FI), Eli Lilly in Florence (I), SARAS Petrol Chemie in Sardinia (I), Chiron Vaccines in Siena (I), UMG KRC Zagreb (HR), BIO Industry Park in Cavanese (I), Nanotalo Helsinki (FI), Allschwil Innovation Park (CH), University of Oxford (GB), Irchel Campus of Zurich University (CH), Sabancı University in Istanbul (TK), Marseille University (F), Birmingham University (GB), Catania University (I), Graz University (A), Jilin University of Shanghai (CHN)



TROX[®] TECHNIK
The art of handling air

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