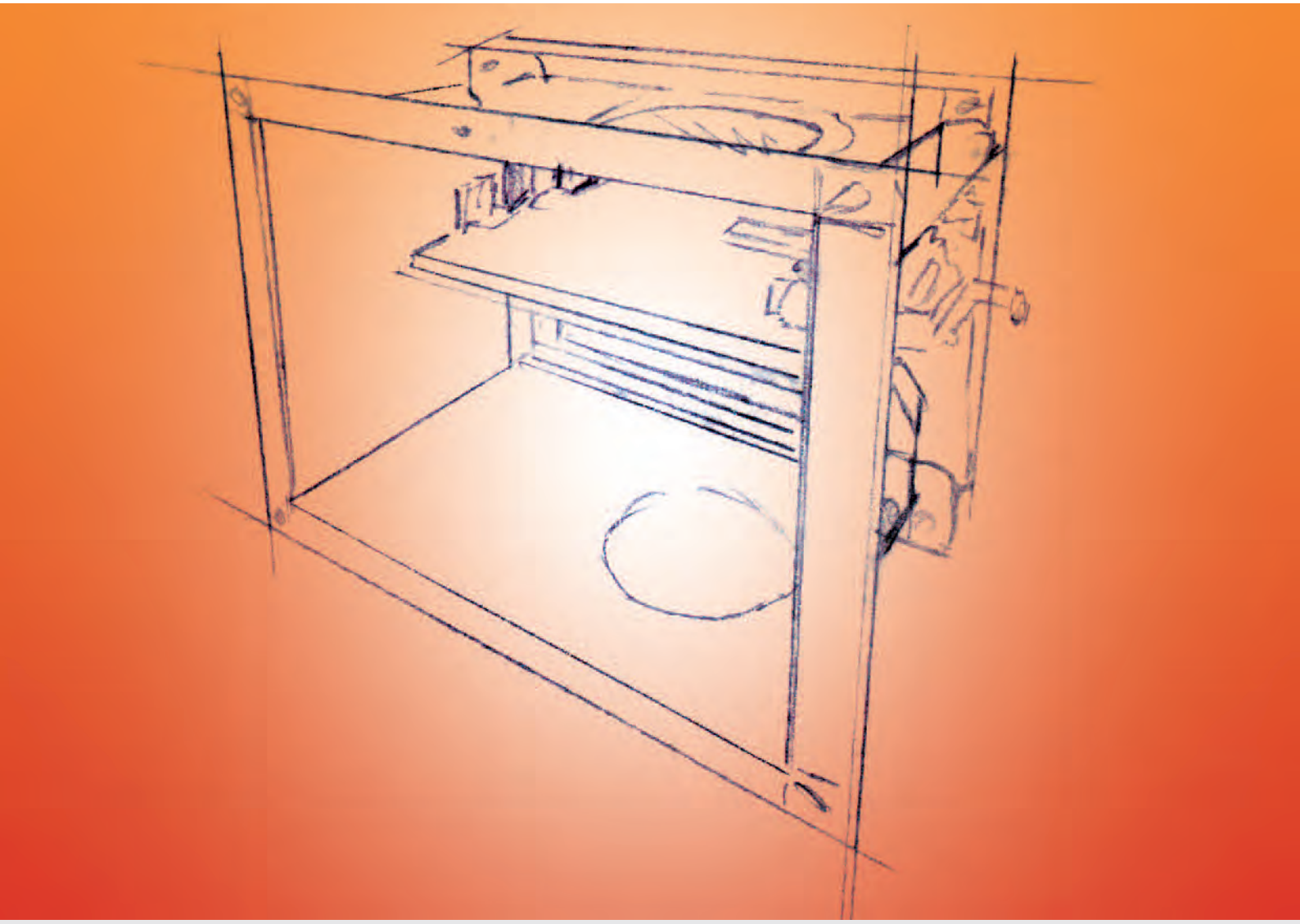
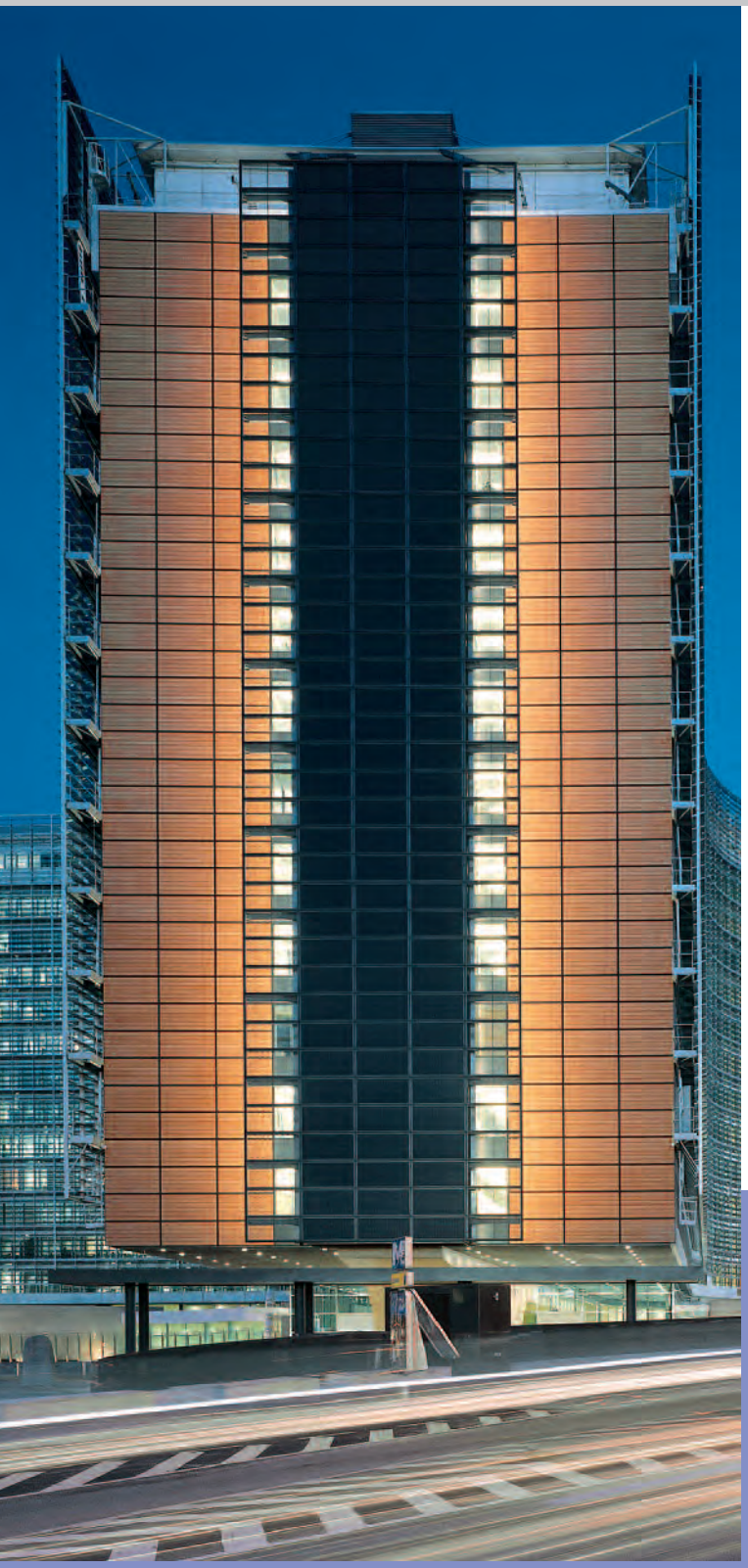
Fire and Smoke Protection
in Air Conditioning Systems

Design Manual



TROX® TECHNIK

The art of handling air



Berlaymont, Brussels, Belgium

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The art of handling air

TROX understands the art of competently handling air like no other company.
The only true measure of good indoor ventilation and air conditioning is – people. People come first. Their well-being, their vitality and ability must be promoted. And their safety is the primary objective in case of danger, such as fire.

As a leader in this field TROX is continually setting new standards in the industry with its research and development work. The systematic research and development are expanding thanks to project-specific development work. Here, TROX is developing practical specialised solutions for both new and existing buildings, and is opening up new markets and sustainable sales opportunities with new and innovative products. The tunnel dampers and solutions for all of Europe are impressive examples.

TROX headquarters, Neukirchen-Vluyn, Germany

TROX CUSTOMER SUPPORT
TROX places great value on customer care and provides support in the design and supply of components and systems, as well as service and maintenance, during the entire project cycle of design, development, and operation of a ventilation and air conditioning system.

TROX in figures
- 3,200 employees worldwide
- > € 350 million turnover in 2010
- 25 subsidiaries in 22 countries
- 13 production plants in 11 countries
- 11 research and development centres worldwide
- More than 25 TROX sales offices and more than 50 representatives and importers across the globe

Products for ventilation and air conditioning

Components
- Diffusers
- Air terminal units
- Fire and smoke protection components
- Sound attenuators
- Dampers and external louvres
- Filter units and filter elements

Systems
- Air-water systems
- Laboratory ventilation systems
- Communication systems for fire and smoke protection
- High performance cooling systems for the IT sector (AITCS)

National Sports Centre, Luxembourg

TROX has created this design manual to enable you to easily select individual types of fire and smoke protection products for specific applications in air conditioning systems. Here you will find a general explanation of fire and smoke protection, notes on the German legal regulations, product overviews and explanations of individual product use.

We wish you much satisfaction and success with our new design manual.

Share the experience: **The art of handling air!**

TROX® TECHNIK
The art of handling air

Research for improved safety

The International Center for Fire Protection is the new innovation driving force in the TROX GROUP when it comes to fire and smoke protection. It is the most advanced centre for testing, research and development in Europe.

Here, fire testing is primarily conducted to determine the fire protection classification of building products for ventilation and air conditioning systems in accordance with national and international standards. Furthermore, scientific experiments can be conducted to investigate specific fire protection problems outside the requirements of standards. The facilities in the International Center for Fire Protection are also suitable for expert testing and reporting. And finally, the Center conducts basic research and materials testing and works closely with universities and research establishments throughout the world.

With the International Center for Fire Protection, TROX can respond in an even more flexible manner to specific customer requirements and technical challenges and help its customers gain a competitive edge.

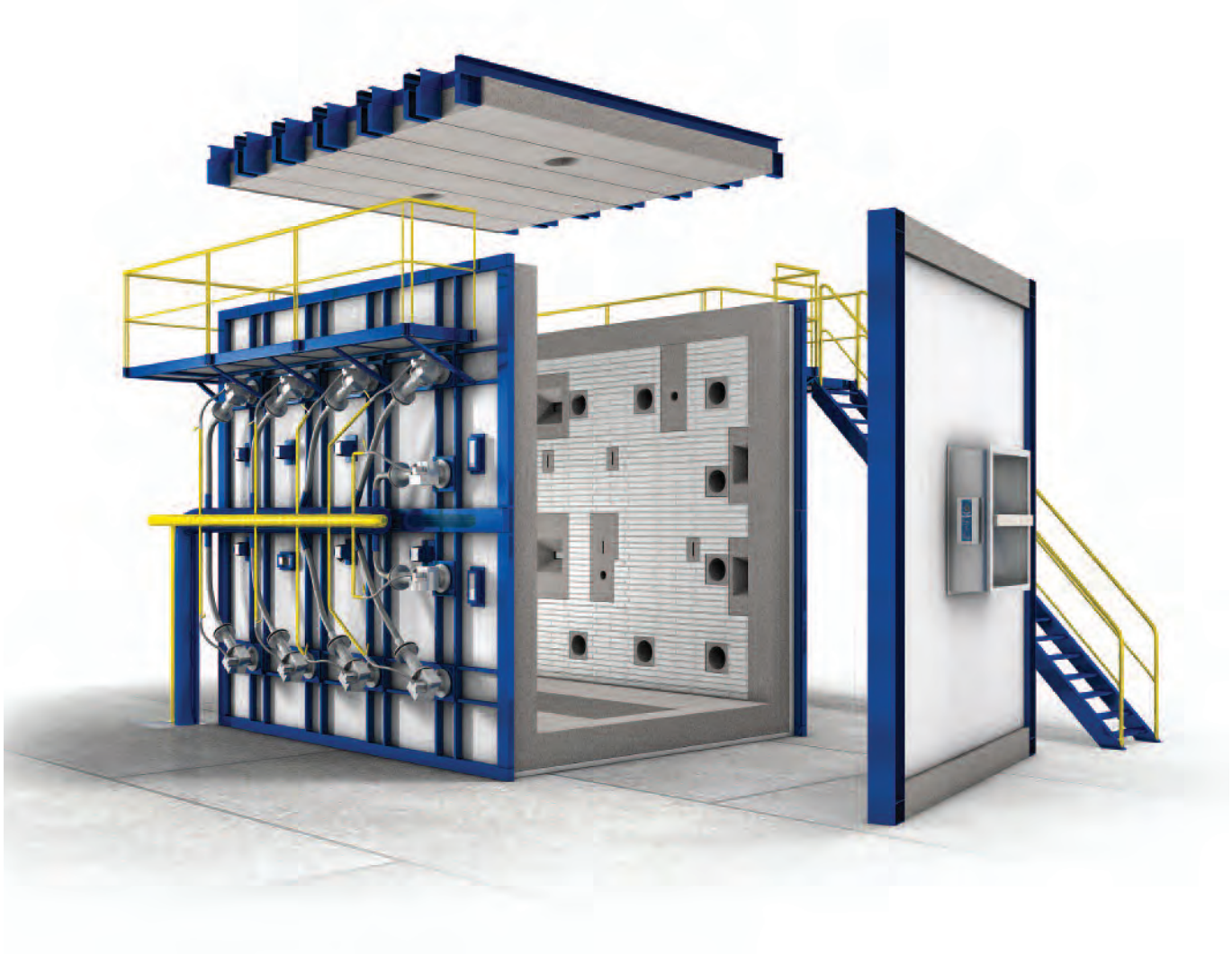
More space for knowledge transfer

The International Center for Fire Protection has a lecture room for 60 people. It is used for training courses and workshops for customers, employees and partners. Furthermore, the University of Applied Sciences in Aachen, Germany, offers seminars at the Center.

The International Center for Fire Protection in figures

Building floor area:	612 m²
Buidling dimensions:	14.3 m x 42.8 m
Building height:	11.62 m
Capacity:	7,112 m³
Fire test laboratory floor area:	400 m²
Total useful area:	820 m²
Flue:	16 m high, 1.60 m in diameter

International Center for Fire Protection, Neukirchen-Vluyn, Germany



Furnace

The furnace

The heart of the International Center for Fire Protection is a furnace measuring 4 x 5 x 5 metres, which is big enough to test even the largest tunnel dampers that are used for extracting smoke from tunnels or from an underground metro or railway station.

The combination furnace for wall and ceiling tests in figures

Exterior dimensions: W = 4 m, L = 5 m, H = 5 m
Combustion chamber
dimensions: W = 3 m, L = 4 m, H = 4 m
Max. output of the 20 gas-operated burners: 9 MW
Max. temperature: 1,200 °C
Inspection ports: 8
No. of temperature sensors in the furnace: 28
Measuring points: 128
Cameras: Two cameras record the complete test procedure in real time.

Versatile usage

The furnace consists of four solid boundaries as well as a removable wall and ceiling section for mounting the samples. This construction provides a great level of flexibility as it enables fire tests of building products in walls, ceilings and false ceilings as well as tests of ventilation ducts traversing the furnace.

Four monitors in the control room show the control of the furnace for test procedures and the results of the fire testing, such as pressure curves, time-temperature curves, sample temperatures and real time camera images.

Rheinberg fire brigade, Rheinberg, Germany

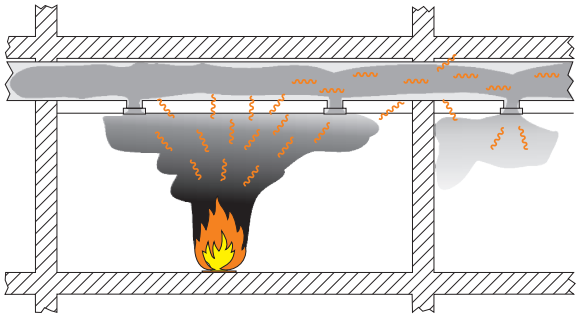
Every person should be able to feel safe in the knowledge that the building they are entering or using will not put them in danger or become a trap. Electrical equipment and combustible materials, which are used to enhance our comfort, are increasingly finding their way into our buildings. For this reason, fire risk can never really be completely ruled out, not least due to human error. The correct preventative measures and components can help to eliminate this risk and restrict the damage caused by fire.
Fire safety components and systems help to minimise the risk of fire and prevent fire and smoke from spreading.

Government building, St. Pölten, Austria

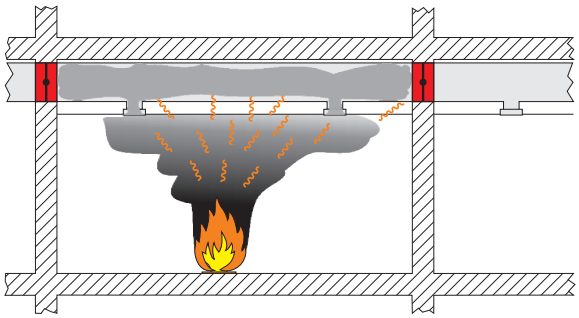
Fire protection in air conditioning systems

A building is divided into fire and smoke compartments in order to restrict the space and time dependent spread of fire and smoke during a fire. To achieve this goal, the spread of fire and smoke from the affected fire compartment to other compartments must be prevented. Walls and ceilings that separate fire compartments from each other must therefore have the necessary fire resistance.
Many modern buildings are equipped with air conditioning systems. The ventilation ducting of these systems goes through walls and ceilings and makes the building vulnerable as far as the required fire resistance rating is concerned. Without further measures, fire protection would no longer be guaranteed. Fire dampers ensure, however, that ventilation ducting is isolated when a fire occurs.

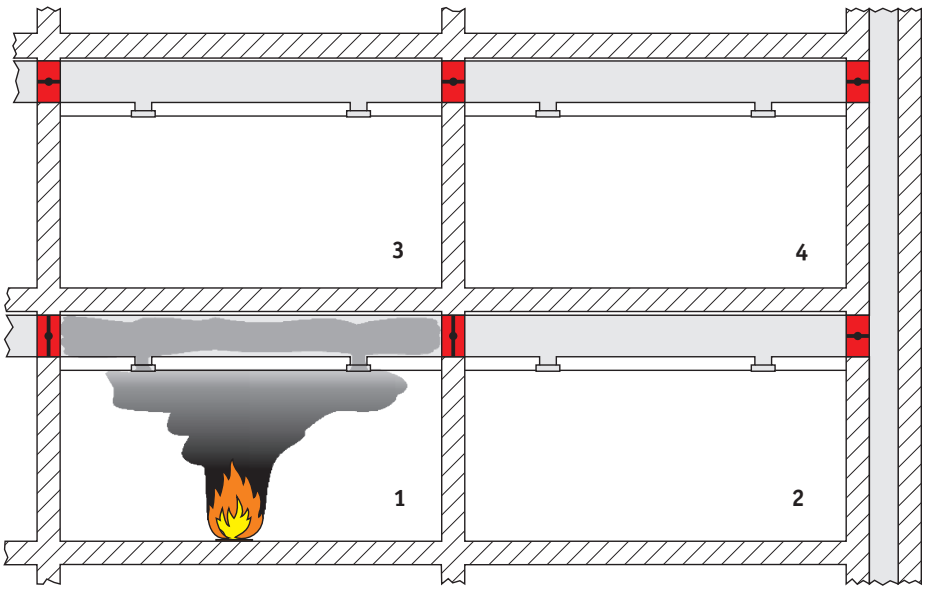
Fire dampers prevent fire and smoke from spreading through ventilation ducting.



Spread of fire and smoke through ventilation ducting



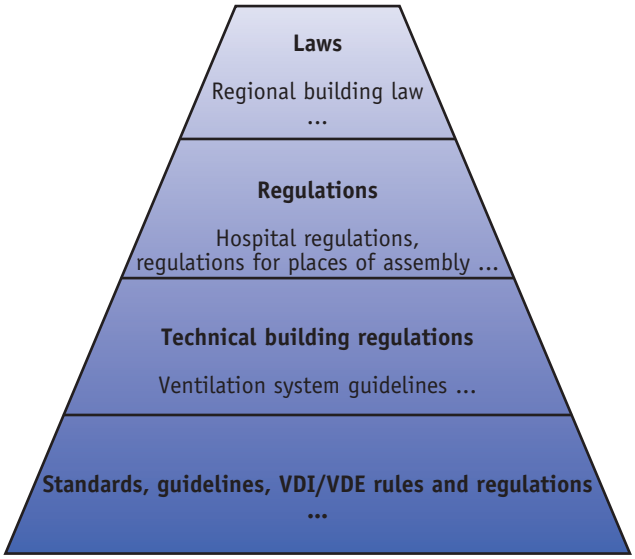
Protected by fire dampers



Subdivision of a building into fire compartments 1 to 4

Legal regulations

Building regulations for fire and smoke control requirements vary from country to country in Europe. In Germany, fire protection is embodied in building law. Compliance with building regulations and guidelines is required. The Building Ministers' Conference (ARGEBAU) publishes the model building regulations (MBO) and the official ventilation system guidelines (MLüAR), and these are valid nationwide. On this basis, or sometimes slightly modified, regional building regulations (LBO) as well as ventilation system guidelines (LüAR) are enacted by federal states as building authority laws.
The planning and design of ventilation and of air conditioning systems must comply with the regulations of the ventilation system guidelines (LüAR).

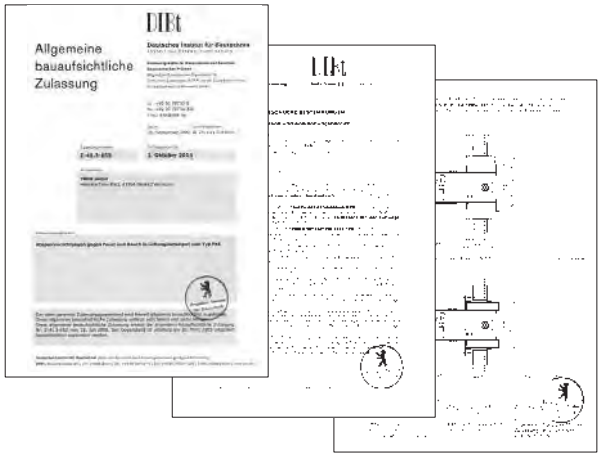


§14 Model Building Regulation
Buildings and structures must be designed, built, modified and maintained in such a way that fire is prevented from occurring. Provisions must be in place to ensure that if a fire was to occur, the fire and smoke do not spread, people and animals can be saved and the fire can be extinguished quickly and effectively.

Usability certification for building products
In accordance with regional building laws, only building products for which technical regulations have been published in the Building Rules List A may be used, and these products must not deviate significantly from these regulations (regulated building products).
Building products that deviate significantly from technical regulations or for which there are no technical provisions or established regulations in terms of the technology (unregulated building products) need:

- a general building inspectorate licence (abZ), issued by the Deutsches Institut für Bautechnik (DIBt - German approval body for construction products and types of construction), or
- a general appraisal certificate (abP), issued by a recognised inspection authority, or
- an approval for the individual case (ZiE), issued by the supreme regional building authority

Usability certification for fire dampers
Fire dampers are included in the Building Rules List B2.
The usability certification is to be provided in the form of a general building inspectorate licence (abZ).
The licence stipulates the correct use.
The licence is preceded by comprehensive fire tests, which are carried out in accordance with European (EN 1366) or German (DIN 4102) standards. These standards regulate the test setup and test procedure.

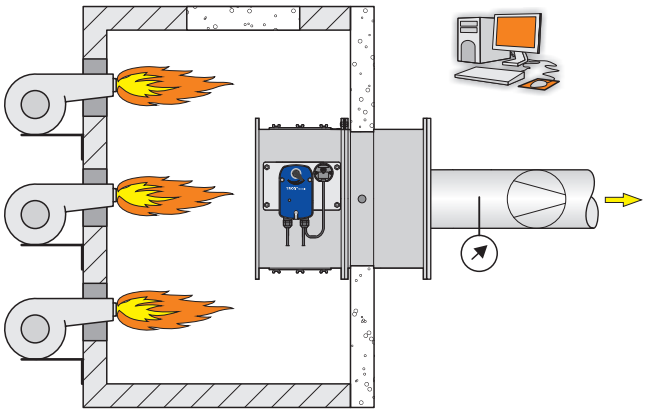


Excerpt from a general building inspectorate licence

Testing of fire dampers

Subjecting a fire damper to fire tests provides verification that it can be used for the application in question.
The test installation must represent the intended site installation and composite assembly reproduced on a 1:1 scale.
In line with European test standards fire dampers with the maximum installation size are fitted in a test frame of a large test furnace. Heating takes place according to the specified time-temperature curve at a negative pressure of 300 Pa. The level of leakage under thermal stress and surface temperatures serve as the major criteria when assessing the fire resistance rating.

TROX furnace

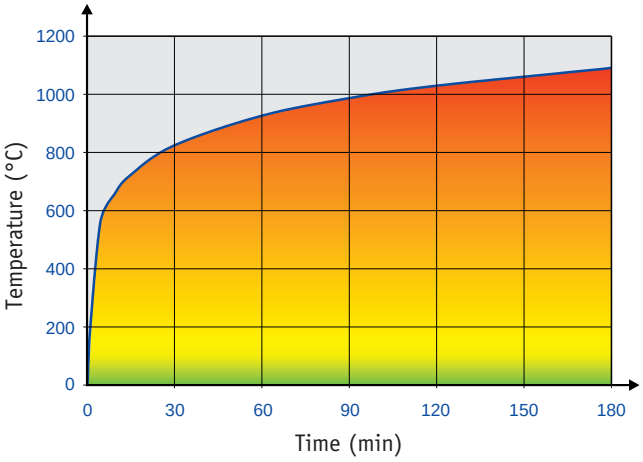


Test setup

Fire phases and temperature profile

The behaviour of a natural fire can be described in phases. The initial fire begins with the ignition phase, which is followed by a smouldering fire. This phase can last from a few minutes to several weeks. Increasing flame propagation and increasing heat lead to an abrupt flash over, and a blazing fire then develops. By consuming all combustible materials, a fully developed fire can reach temperatures of 1000 °C and more.
With the specified time-temperature curve, this fire behaviour can be reproduced consistently and simulated in fire tests.

One of the burners during a fire test



Specified time-temperature curve

Security and reliability in the design phase

Conscious of the need to ensure fire protection, architects and specialist consultants look for solutions to implement fire protection that meet the practical protection objectives of regional building regulations (LBO). Innovative solutions are being sought. Practical solutions have emerged through cooperation in partnership with specialist consultants and contractors. The result is fire dampers that have been tested and given building inspectorate licence which can also offer comprehensive safety in combination with smoke detectors and fire alarm systems.
Fire protection in buildings can thus be implemented as early as in the critical and decisive design phase.

Tried and tested building products provide security in the design phase.

Certified products
Legislation has created transparent methods for ensuring the quality of safety-related products: Only recognised authorities may certify products and ensure compliance with guidelines through regular production inspections by external inspectors.
Users can rest assured that products will function effectively in case of a fire.
In Germany, the reliability of each product is documented through the CE symbol, the licence number and the compliance mark (Ü).

Approved installation location
The licensing procedure for fire dampers stipulates that fire tests covering all applications be conducted in a recognised materials test centre. They are documented in licences and serve as the terms of reference for installation on building sites.

Licence-compliant installation
The required fire resistance rating is achieved when the fire dampers are installed according to the licence and as described in the operating manual.
This requirement is sometimes difficult to adhere to on building sites. The manufacturer of the fire dampers can help in many cases by providing tested, but unpublished, installation details.

Maintenance measures
To permanently ensure the effective operation of fire dampers, a regular function test is required. In general, it is sufficient to release and reopen the fire damper; in case of fire dampers with spring return actuator this can be done by remote control.
Fire dampers must be included in the regular cleaning schedule of the air conditioning system.
There is, however, no need for scheduled lubrication, scheduled replacement of worn parts or similar measures.

Product overview

Type FK-K90

- Nominal sizes:
  B: 200–1500 mm · H: 200–800 mm
  Intermediate sizes in 1-mm increments
- With fusible link or spring return actuator
- Options: – Construction for use in potentially explosive atmospheres
  – Stainless steel/powder-coated casing
  – Clad/coated damper blade

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Type FKS-EU

- Nominal sizes:
  B: 200–800 mm, intermed. sizes in 50-mm increments
  H: 100, 125, 150, 160 and 200 mm
- With fusible link or spring return actuator
- Mortar-based or dry mortarless installation with installation block
- Options: – Stainless steel/powder-coated casing
  – Clad/coated damper blade

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Type FKRS-EU

- Nominal sizes:
  Ø: 100, 125, 150, 160, 200, 224, 250, 280 and 315
- With fusible link or spring return actuator
- Mortar-based or dry mortarless installation with installation block
- Options: – Stainless steel/powder-coated casing
  – Clad/coated damper blade

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Type FKR-01-K90 · FKR-02-K90

- Nominal sizes:
  Ø: 200, 224, 250, 280, 315, 355, 400, 450, 500, 560, 630 and 710 mm
- With fusible link or spring return actuator
- Design with or without flanges
- Options: – Stainless steel/powder-coated casing
  – Clad/coated damper blade

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Type FV-K90 · FVZ-K30

- Nominal sizes: Ø: 100, 125, 160 and 200 mm
- FV-K90: Mortar-based or dry mortarless installation with installation block in:
  solid walls and ceilings, gypsum wallboards, lightweight partition walls with or without metal support structure
- FVZ-K30: Mortar-based installation in screw fixed and primed tiled ceilings, lay-in ceilings and metal panel ceilings Promat 420.87

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Type KU-K30

- Nominal sizes: Q: 300, 400, 500, 600 and 625 mm
- Installation in stand-alone fire-resistant suspended F30 ceilings
  – Tiled ceilings, screw fixed and primed
  – Tiled ceilings with in-lay design
  – Metal panel ceilings: Promat 420.96
  Lindner LMD Type 1,3,4,5,6–11

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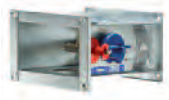
Application

Installation location	Construction and building material	Fire resistance		Available accessories				Flexible connectors required[1]	
		Minimum thickness		Surface subframe	Installation kit	Installation block			
		in mm	F / L			Circular	Rectangular	On one end	On both ends
Page									
Nominal sizes									
Solid walls	Solid walls in concrete, aerated concrete or lightweight concrete	100	F90		FK-K90	FKRS-EU	FKS-EU		
	Solid brick walls	115	F90		FK-K90	FKRS-EU	FKS-EU		
Ceiling slabs	Ceiling slabs in concrete or aerated concrete	100	F90			FKRS-EU	FKS-EU		
Wallboards	Gypsum wallboards	100	F90				FKS-EU		●
Lightweight partition walls (LPW) with metal support structure	Lightweight partition walls with plasterboard cladding	100	F90		FK-K90		FKS-EU, FKRS-EU		●
	Shaft walls with cladding on one side	90	F90		FK-K90		FKRS-EU		●
	Fire walls with cladding on both sides	110	F90		FK-K90				●
	Lightweight partition walls with cladding on both sides and flexible ceiling joint	100	F90		FK-K90				●
LPW without metal support structure	Shaft walls with cladding on one side	40	F90		FK-K90				●
On the face of solid walls and ceiling slabs	Solid walls in concrete, aerated concrete or bricks	100	F90	FK-K90				●	
	Solid ceiling slabs in concrete or aerated concrete	125	F90	FK-K90				●	
Adjacent to solid walls and ceiling slabs	Solid walls in concrete, aerated concrete or bricks	100	F90					●	
	Solid ceiling slabs in concrete or aerated concrete	125	F90					●	
Remote from solid walls	In fire-resistant ventilation ducts		L90					●	
Stand-alone fire-resistant suspended ceilings[2]	Tiled ceilings, screw fixed and primed, grid ceilings with lay-in tiles, or metal panel ceilings		F30						

[1] Flexible connectors are also necessary for walls in compliance with DIN 1053 and for gypsum wallboards with wall thicknesses < 100 mm and partially mortared.

[2] In accordance with general building inspectorate licence

Type						
FK-K90	FKS-EU	FKRS-EU	FKR-01-K90 · FKR-02-K90	FV-K90	FVZ-K30	KU-K30
						
14	20	21	23	24	25	26
B: 200–1500 H: 200–800	B: 200–800 H: 100–200	Ø: 100 – 315	Ø: 200 – 710	Ø: 100 – 200		Q: 300 – 625
●	●	●	●	●		
●[3]	●	●	●	●		
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					●[5]	●[5]

[3] Minimum thickness 100 mm
[4] Minimum thickness 125 mm
[5] Minimum thickness 150 mm

Proven technology for all applications
Type FK-K90

- Rectangular fire damper
- General building inspectorate licence Z-41.3-321
- Reduced differential pressure and sound power level
- Dry mortarless installation with installation kit
- Remote controlled with spring return actuator (other actuators on request, e.g. for gas extinguishing systems)
- Integration into the centralised BMS with TROXNETCOM

Application

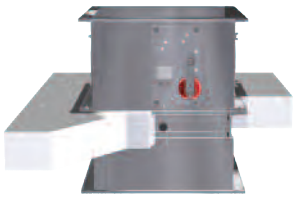
Solid walls
Gypsum wallboards

- Mortar-based or dry mortarless installation
- Mortar bed depth of 100 mm is sufficient
- Multiple dampers side by side possible
- Installation with installation subframe or installation kit

Lightweight partition walls without metal support structure

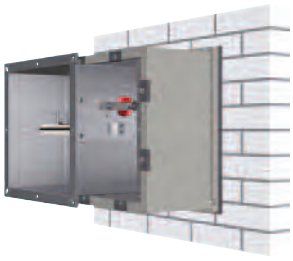
- Dry mortarless installation
- Minimum wall thickness 40 mm
- Cladding on one side
- Installation kit available

Ceiling slabs



- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Suspended or upright installation

On the face of or adjacent to solid walls or ceiling slabs



- On the face of solid walls or ceiling slabs or adjacent to them with a max. distance of 260 mm
- Side by side with an existing mortar-based fire damper in the wall which requires refurbishment
- Surface wall subframe clad with insulation board available

Lightweight partition walls (LPW) and fire walls with metal support structure

- Mortar-based or dry mortarless installation:
  - LPW with cladding on both sides
- Dry mortarless installation
  - LPW with cladding on one side
  - LPW with cladding on both sides
    - Flexible ceiling joint
    - Fire walls
- Installation kit available

Remote from solid walls

- In fire-resistant ventilation ducting made of sheet steel with insulation consisting of:
  - Mineral wool
  - Board materials

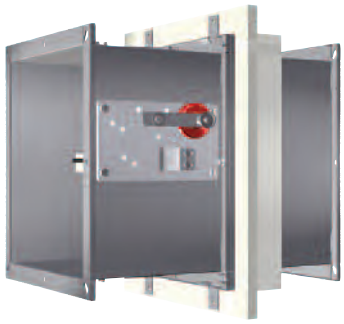
Attachments

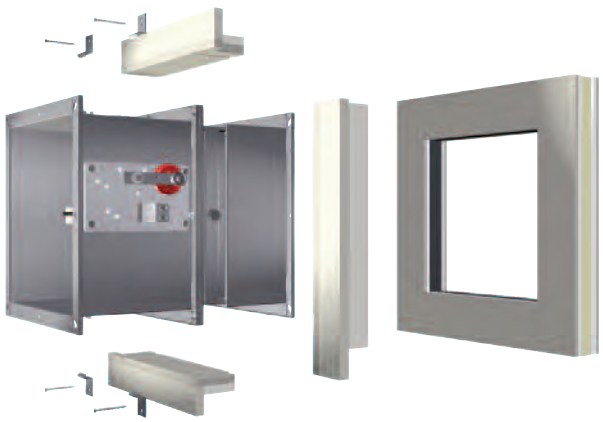
Installation kits

In some cases it is not possible to install the fire damper into the wall or ceiling slab. Using fire-protection insulation, however, installation on the face of the wall or ceiling slab is allowed and can be done simply and cost-effectively with the installation kits provided. Individual parts are match cut for good fit to ensure insulation according to the licence.

Installation kits for dry mortarless installation

For installation without a perimeter mortar infill, installation kits are used. The fire damper is inserted together with the installation kit into the prepared opening (or into an installation subframe if to be installed into a solid wall); the assembly is then screwed in position. Special seals then seal off any remaining gaps in the event of a fire.





Release mechanisms

Thermoelectric with spring return actuator

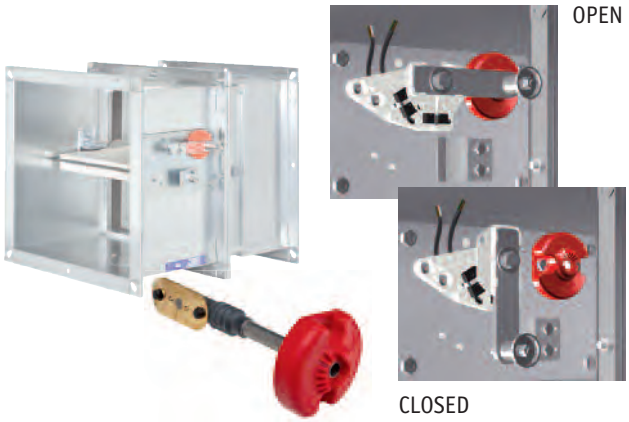
Motorised fire dampers contain thermoelectric release mechanisms and a spring return actuator. When the release temperature is reached (72°C or 95°C), the temperature sensor in the airstream interrupts the supply voltage to the spring return actuator, and the spring return in the actuator causes the fire damper to close. A second temperature sensor monitors the ambient temperature. A test switch allows a simple function test to be performed on site.

Damper blade position indicator
The position of the damper blade can be read from the pointer on the spring return actuator. The actuator includes two limit switches.

Thermo-mechanical with fusible link

Standard fire dampers are equipped with thermo-mechanical release mechanisms. These proven systems are made up of two small brass plates that are connected to each other by means of a special solder (fusible link). If, during a fire, the temperature in the ventilation ducting reaches the nominal fusing temperature of the solder, the two brass plates come apart. This releases the interlock, and the force of the spring causes the fire damper to close.

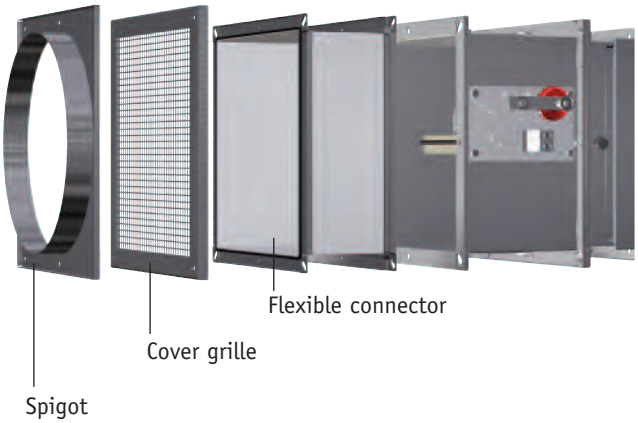
Damper blade position indicator
The position of the damper blade is indicated by the position of the handle. Limit switches are available as an option.



Agbar Tower, Barcelona, Spain

Accessories and attachments

Universal use of the fire dampers is only possible with appropriate accessories. These are available and tailored to the casing construction of FK-K90.



Critical details
Applications for humid or slightly contaminated air require a powder-coated casing or stainless steel construction. The construction of accessories is equally important. This is why the flexible connectors from TROX are constructed such that the medium does not come into contact with any metal parts.

Explosion protection
Explosion is a risk wherever combustible gases, vapours or explosive dusts are stored, processed or handled. These areas also have to be ventilated and they require suitable fire dampers and actuators with an ATEX certificate.
FK-K90 fire dampers with electric spring return actuator with “Ex” certificate (i.e. suitable for use in explosive atmospheres) are tested by Electrosuisse.

Coating
For applications where a high degree of corrosion protection is required, casings and attachments can be supplied with various high resistance coatings. Due to the large number of different possible contaminants, which generally cannot be identified at the design stage, we offer a powder coating that has a high degree of general resistance and also in relation to chemicals. Listings of the resistance levels are available on request.

Fire damper with coating

Motorised fire damper with ATEX certificate

Air transfer application

If, in the context of ventilation design, openings are required in fire-resistant internal walls or ceilings for the purpose of air transfer, “fire resistant barriers specially designed for specific applications” can be used.* This applies to the FK-K90 fire damper combined with the approved RM-O-3-D smoke detector, which prevents fire and smoke from spreading through the transfer opening during a fire.
RM-O-3-D smoke detectors are used in place of top access panels, which is an ideal location in the airstream.

* The building control authority is the body responsible for deciding on the reliability of such openings in conjunction with the approval of the fire protection concept.

Fire-resistant barrier
Type FK

- Rectangular fire damper FK-K90 with spring return actuator, smoke detector RM-O-3-D and cover grilles on both sides
- General building inspectorate licence Z-6.50-2031
- Integration into the centralised BMS with TROXNETCOM

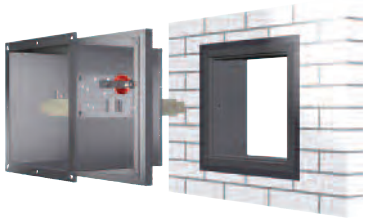
Refurbishing fire dampers

Type E01-K90

- Rectangular fire damper
- General building inspectorate licence Z-41.3-323
- Reduced differential pressure and sound power level
- Remotely controlled with spring return actuator
- Integration into the centralised BMS with TROXNETCOM

Refurbishment options

Refurbishment option 1
Inserting a new E01-K90 fire damper into an old damper

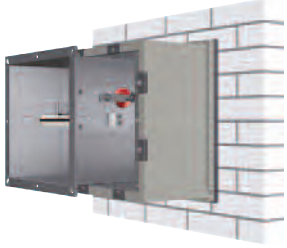


How to proceed:
- Dismantle ventilation ducting
- Remove the connection frame (operating side) of the old fire damper
- Remove internal components containing asbestos
- Insert the spigot of the E01-K90 and secure it in place
- Insert the fire damper E01-K90 and screw it into place
- Modify ducting or replace and install new ducting

Refurbishment option 2
Casting in a new FKK-K90 fire damper with mortar

How to proceed:
- Dismantle ventilation ducting
- Chisel out fire damper containing asbestos
- Cast in the new fire damper with mortar
- Modify ducting or replace and install new ducting

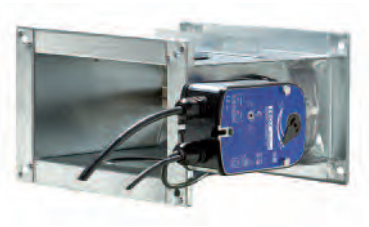
Refurbishment option 3
Installing a new FK-K90 fire damper on the face of or adjacent to the wall or ceiling slab



How to proceed:
- Dismantle ventilation ducting
- Remove components containing asbestos from the old fire damper
- Install the new fire damper with installation kit for the wall or ceiling
- Modify ducting or replace and install new ducting

Compact dimensions – ideal for restricted spaces

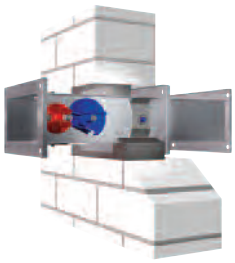
Type FKS-EU



- Rectangular fire damper
- General building inspectorate licence Z-41.3-653
- Reduced differential pressure and sound power level
- Dry mortarless installation with installation block
- Mortar-based installation with a perimeter mortar infill, also in lightweight partition walls
- Remotely controlled with spring return actuator
- Integration into the centralised BMS with TROXNETCOM

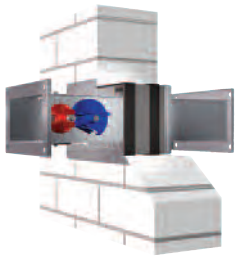
Application

Solid walls
Gypsum wallboards



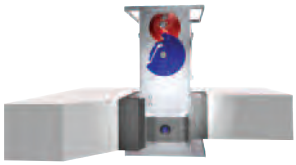
- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Simple fixing in the installation opening with an optional cover plate

Solid walls
Gypsum wallboards



- Dry mortarless installation
- Simple insertion into prepared installation opening
- Fix by screwing cover plate to the wall
- Factory-assembled installation block

Ceiling slabs

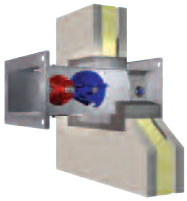


- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Simple fixing in the installation opening with an optional cover plate
- Suspended or upright installation

Ceiling slabs

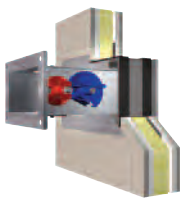
- Dry mortarless installation
- Simple insertion into prepared installation opening
- Fix by screwing cover plate to the wall
- Factory-assembled installation block
- Suspended or upright installation

Lightweight partition walls with metal support structure



- Mortar-based installation
- For wall thicknesses from 100 mm
- Simple fixing in the installation opening with an optional cover plate

Lightweight partition walls with metal support structure



- Dry mortarless installation
- For wall thicknesses from 100 mm
- Fix by screwing cover plate to the wall
- Factory-assembled installation block

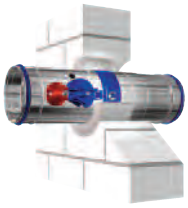
Compact dimensions – ideal for restricted spaces

Type FKRS-EU

- Circular fire damper
- General building inspectorate licence Z-41.3-688
- Reduced differential pressure and sound power level
- Dry mortarless installation with installation block
- Mortar-based installation with a perimeter mortar infill, also in lightweight partition and shaft walls
- Remotely controlled with spring return actuator
- Integration into the centralised BMS with TROXNETCOM

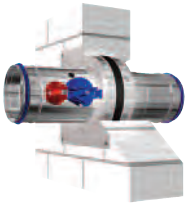
Application

Solid walls



- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient

Solid walls



- Dry mortarless installation with circular installation block
- Simple insertion into prepared installation opening
- Installation opening based on commercial hole sizes
- Fix by screwing cover plate to the wall
- Factory-assembled installation block

Ceiling slabs

- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Suspended or upright installation

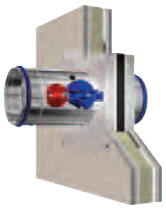
Ceiling slabs

- Dry mortarless installation with circular installation block
- Simple insertion into prepared installation opening
- Installation opening based on commercial hole sizes
- Fix by screwing cover plate to the wall
- Factory-assembled installation block

Lightweight partition walls with metal support structure

- Mortar-based installation
- For wall thicknesses from 100 mm
- Installation also in shaft walls with metal support structures
- The reinforcing section need not be connected to the support structure

Lightweight partition walls with metal support structure



- Dry mortarless installation with square installation block
- Fix by screwing cover plate to the wall
- Factory-assembled installation block
- Installation also in shaft walls with metal support structures

Release mechanisms

Thermoelectric with spring return actuator

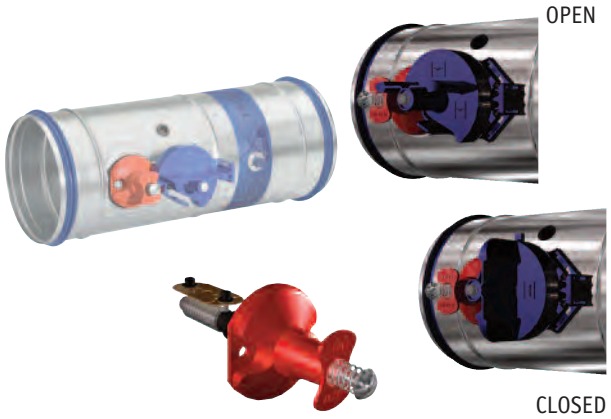
Motorised fire dampers contain thermoelectric release mechanisms and a spring return actuator. When the release temperature is reached (72°C or 95°C), the temperature sensor in the airstream interrupts the supply voltage to the spring return actuator, and the spring return in the actuator causes the fire damper to close. A second temperature sensor monitors the ambient temperature. A test switch allows a simple function test to be performed on site.

Damper blade position indicator
The position of the damper blade can be read from the pointer on the spring return actuator. The actuator includes two limit switches.

Thermo-mechanical with fusible link

Standard fire dampers are equipped with thermo-mechanical release mechanisms. These proven systems are made up of two small brass plates that are connected to each other by means of a special solder (fusible link). If, during a fire, the temperature in the ventilation ducting reaches the nominal fusing temperature of the solder, the two brass plates come apart. This releases the interlock, and the force of the spring causes the fire damper to close.

Damper blade position indicator
The position of the damper blade is indicated by the position of the handle. Limit switches are available as an option.



Office building Rondo 1, Warsaw, Poland

For large diameters – with or without a flange

Type FKR-01-K90

Type FKR-02-K90

- Circular fire damper
- General building inspectorate licence Z-41.3-322
- Reduced differential pressure and sound power level
- Mortar-based installation with a perimeter mortar infill
- Remotely controlled with spring return actuator
- Integration into the centralised BMS with TROXNETCOM

Application

Solid walls and ceiling slabs

- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Suspended or upright installation
- Also allowed for gypsum wallboards

Fire protection valve for supply or extract air

Type FV-K90

- Circular fire protection valve
- General building inspectorate licence Z-41.3-317
- Reduced differential pressure and sound power level
- Dry mortarless installation with installation kit
- Mortar-based installation with a perimeter mortar infill, also in lightweight partition walls
- Integration into the centralised BMS with TROXNETCOM

Application

Solid walls
Gypsum wallboards

- Mortar-based installation
- Circular or square installation opening
- Circular or rectangular trim ring available
- Rear accessibility not required

Ceiling slabs

- Mortar-based installation
- Circular or square installation opening
- Circular or rectangular trim ring available
- Top accessibility not required after initial installation

Lightweight partition walls with metal support structure

- Mortar-based installation
- No metal support structure required
- Circular or rectangular trim ring available
- Rear accessibility not required

Lightweight partition walls with metal support structure

- Dry mortarless installation
- No metal support structure required
- Circular or rectangular trim ring available
- Rear accessibility not required

Lightweight partition walls without metal support structure

- Mortar-based installation
- Circular or rectangular trim ring available
- Rear accessibility not required

Lightweight partition walls without metal support structure

- Dry mortarless installation
- Circular or rectangular trim ring available
- Rear accessibility not required

Fire protection valve for supply or extract air in suspended F30 ceilings

Type FVZ-K30

- Circular fire protection valve
- General building inspectorate licence Z-41.3-319
- Installation in stand-alone fire-resistant suspended F30 ceilings
  - Tiled ceiling screw fixed and primed
  - Grid ceiling with in-lay panels
  - Metal panel ceiling
    Promat 420.87

Application

Tiled ceiling, screw fixed and primed
Grid ceiling with in-lay panels

- Mortar-based installation
- Simple installation using backplates
- Cover rings available
- Top accessibility not required after initial installation

Metal panel ceiling

ABN AMRO office building, Amsterdam, Netherlands

Fire damper for air terminal devices in suspended F30 ceilings

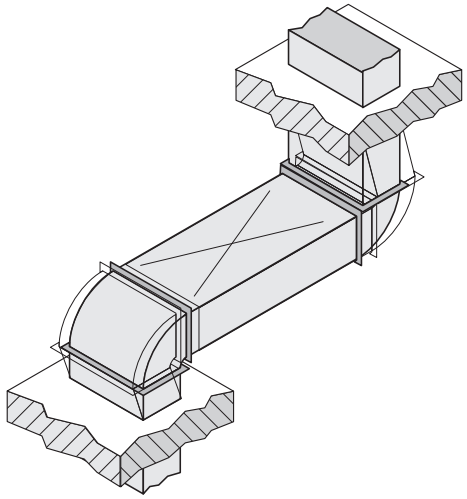
Type KU-K30

- Rectangular fire damper in conjunction with air terminal devices
- General building inspectorate licence Z-41.3.320
- Reduced differential pressure and sound power level
- Installation in stand-alone fire-resistant suspended F30 ceilings
  - Tiled ceiling screw fixed and primed
  - Grid ceiling with in-lay panels
  - Metal panel ceiling
    Promat 420.96
    Lindner LMD F30-A/AB Type 1, 3, 4, 5 and 6 – 11
- Possible air terminal devices
  - FD
  - TDF-SilentAIR
  - TDV-SilentAIR
  - VDW
  - DLQ · ADLQ
- Design with 24 V or 230 V spring return actuator
- Control by means of smoke detectors or central fire alarm systems
- Integration into the centralised BMS with TROXNETCOM

Type KU-K30 fire damper in a suspended Lindner ceiling

Restriction of forces

The ventilation system guidelines stipulate that ventilation ducts must be installed or manufactured such that they do not exert any heavy forces on load-bearing or fire-resistant walls and connecting spigots as a result of the ducts heating up when exposed to fire. Forces > 1 kN are considered as heavy.
If sufficient expansion is allowed, namely for steel ventilation ducts 100 mm per installed metre length of duct, then the force criterion is met. Flexible connectors are one such possibility to provide for the expansion. LüAR offers alternatives by means of an "S" configuration in the ducting (see below).



The LüAR requirements for force and load protection apply also to the installation of fire dampers. These must be connected by means of combustible flexible connectors made of normal flammable building materials (material classification B2 in compliance with DIN 4102) and these must be capable of axial extension of at least 100 mm. Alternatively, flexible circular aluminium connecting ducts can be used.

Installation configuration	Flexible connectors required	
	On one end	On both ends
Walls in compliance with DIN 1053, wall thickness < 100 mm		●
Lightweight partition walls		●
Walls made of gypsum wallboards		●
Installation with partial mortaring of the fire damper		●
Adjacent to and on the face of solid walls and ceiling slabs	●	
Remote from a solid wall	●	

Installation

Fire dampers to be installed remote from solid walls must be fixed to solid ceiling slabs such that they are suspended horizontally. When rating the suspension, the additional weight of the insulation must be allowed for. The insulation must be installed according to the manufacturer's specifications and the applicable usability certification.

The fire dampers are suspended using threaded rods. The rods can be bare if their length does not exceed 1.50 m; longer rods require insulation.
The threaded rods must be selected according to the combined weight of the fire damper and the insulation.
Installation is carried out using approved steel dowels with a fire protection certificate.
Alternatively, the fire dampers can be fixed to the ceiling slab using steel fixing plates with several steel plug anchor fixings.
Threaded rods can pass through the ceiling slab and must be secured on the top of the slab with steel nuts and washers.

Servicing

Fire dampers have to be operationally reliable. This must be ensured by the property owner, who is in charge of any maintenance programmes. Compliance with the terms and conditions of the general building inspectorate licence is required as is compliance with any operating or installation instructions and with DIN EN 13306 in conjunction with DIN 31051.
To test if a fire damper functions correctly, closing and opening it will suffice. For motorised fire dampers this can be done via remote control. There are no fixed maintenance intervals; maintenance and repair can be carried out as needed, i.e. depending on the condition of the fire damper.

Inspection	Actions to prolong useful life
Inspection	Actions to determine and assess the operational condition; identify the causes of wear, if any; determine the necessary remedial measures
Repair	Actions to return dampers to an operational condition
Improvement	Actions to increase operational reliability without changing the specific function

Activity	Remote control not possible	Remote control possible
Inspection and required servicing activities prior to commissioning (on site)	•	
Inspection every six months/year* (on site)	•	
Inspection every six months/year* (by means of the central fire alarm system)		•
Maintenance, e.g. cleaning to ensure effective operation, repair as required dependent on condition)	•	
Inspection according to LBO (on site)	•	

* Annually, if two consecutive inspections within 6 months did not show any deficiencies.

Frauenkirche church, Dresden, Germany

Standards applicability and refurbishment

The legal regulations on building safety standards do not require existing lawfully constructed buildings and structures to be upgraded to new statutory provisions that were not in force at the time of a building's construction.
Upgrading existing buildings to current building law regulations can only be demanded by building permit authorities if it is necessary to avert a specific immediate danger to public safety or order, and particularly to people's life or health.

A fire damper may have to be refurbished or replaced for one or more of the following reasons:

- Excessive leakage
- Inadequate fire-resistance rating
- Components containing asbestos

Fire dampers that were installed before 1974, i.e. prior to the certification requirement, had to meet lower standards with regard to smoke tightness and fire-resistance rating than fire dampers installed from 1974 onwards. The reason are differences in construction and installation. Some fire dampers have components that contain asbestos. Dampers without any asbestos did not come into being until 1988.

Deutsche Telekom Real Estate, Frankfurt/Main, Germany

Fire dampers before 1974 (without certification)
Do not meet current standards in terms of fire rating, smoke tightness and insulation.
Fire dampers from 1974 to 1981 (with certification)
Damper blades, gaskets between casing components, and compression seals contain asbestos.
Fire dampers from 1981 to 1988 (with certification)
Compression seals contain asbestos.
Fire dampers from 1988 onwards (with certification and/or general building inspectorate licence)
Asbestos-free.

1974 – 1981

1981 – 1993

IMPORTANT! Work on dampers containing asbestos must be carried out by specialists that have completed an officially recognised training course on how to handle hazardous substances containing asbestos. These specialists must have passed an exam and be able to provide evidence to this effect. For details refer to the technical regulations for hazardous substances, the TRGS 519, and the building regulations of federal states (Germany).

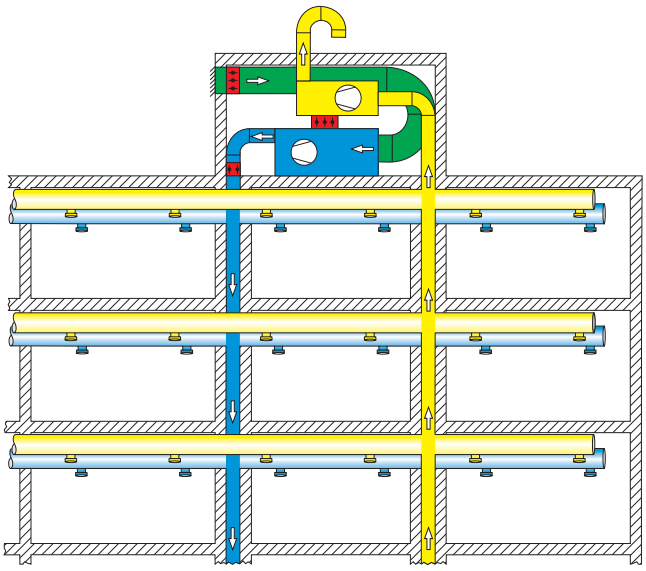
BYK-Chemie, Wesel, Germany

A comprehensive fire protection scheme for a building should include measures that prevent smoke from being spread through ventilation systems. Otherwise smoke and fumes from fires outside or inside the building could reach occupied zones via the supply air ducts. Smoke control dampers prevent this from happening.
Smoke control dampers in the ventilation ducting for supply air, fresh air and, if necessary, recirculated air are controlled by smoke detectors compliant with the LüAR ventilation system guidelines.
Smoke control dampers are included in the Building Rules List B2 which is why their usability has to be certified with a general building inspectorate licence (abZ). The licence stipulates the correct use.

Representation of Bavaria at the EU, Brussels, Belgium

Application

Smoke control dampers are equipped with spring return actuators and close when the smoke detectors detect smoke.
Smoke detectors monitor the fresh air, supply air and, if necessary, the extract air or recirculated air.
Smoke control dampers are installed in ventilation ducts within the ventilation plant room. They must be made of non-combustible building materials (melting point > 1000 °C). Typical installation locations are on the plant room boundary walls and on ceiling slabs or walls of building services shafts.
Smoke control dampers have no classified fire-resistance rating and can therefore not replace components that require a fire-resistance rating such as fire dampers.



Prevents smoke in the plant room from spreading

Type JZ-RS

- Rectangular smoke control damper
- General building inspectorate licence Z-78.4-51
- Reduced differential pressure and sound power level
- Remotely controlled with spring return actuator
- Integration into the centralised BMS with TROXNETCOM

Düsseldorf International Airport, Düsseldorf, Germany

Roughly 200,000 fires occur every year in Germany, claiming the lives of approx. 600 people, mainly through smoke inhalation. Many fires are not caused by carelessness but rather by a technical defect such as deficient electrical cabling. This means that a fire can occur almost anywhere and anytime.
Effective prevention is multifaceted:
– Structural
– Technical (including early detection systems for fire and smoke, etc.)
– Organisational

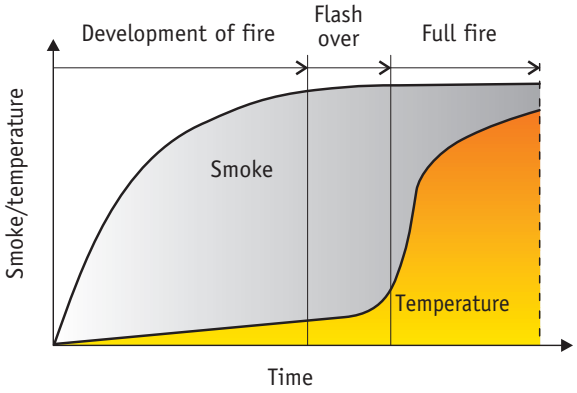
University library, Cottbus, Germany

Early fire detection

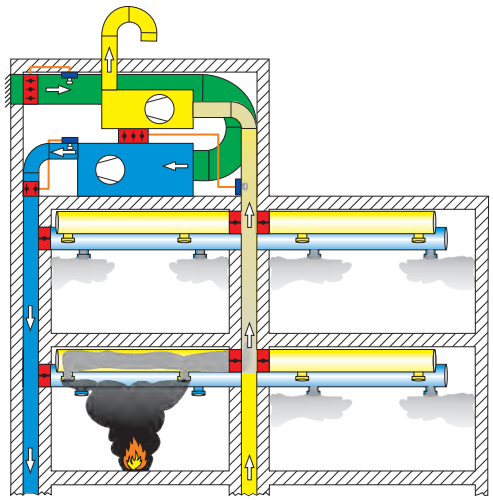
In the initial phase of a fire, the temperature increases only very slightly over a long period of time. The volume of smoke that develops and spreads, however, is very large. As long as the temperature of the smoke near a fire damper remains below 72 °C, the fire damper will stay open.

To prevent smoke from spreading in buildings through the air conditioning system, it is extremely important that the smoke is detected at an early stage. Smoke detectors that operate on the principle of light scattering detect the smoke regardless of its temperature so that the fire dampers can be closed before the release temperature is reached.

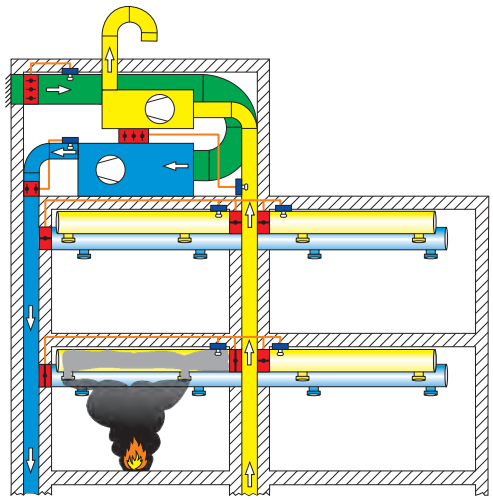
TROX offers smoke detectors approved by the German approval body for construction products and types of construction (Deutsches Institut für Bautechnik). Combined with fire dampers with spring return actuators, these smoke detectors can ensure optimum protection.



Temperature rise and smoke development



Spread of cold smoke (< 72 °C)



Increased safety thanks to smoke detectors

Legal regulations

In Germany, fire protection is embodied in building law. Compliance with building regulations and guidelines is required.
The Building Ministers' Conference (ARGEBAU) publishes the model building regulations (MBO) and the official ventilation system guidelines (MLüAR), and these are valid nationwide. On this basis, or sometimes slightly modified, regional building regulations (LBO) and ventilation system guidelines (LüAR) are enacted by federal states as building authority laws.
The planning and design of ventilation and air conditioning systems must comply with the regulations of the ventilation system guidelines (LüAR).

§14 Model Building Regulation
Buildings and structures must be designed, built, modified and maintained in such a way that fire is prevented from occurring. Provisions must be in place to ensure that if a fire was to occur, the fire and smoke do not spread, people and animals can be saved and the fire can be extinguished quickly and effectively.

Lux Energy, Luxembourg City, Luxembourg

Functional description

Measurement principle
TROX smoke detectors detect smoke based on the principle of light scattering. If the air contains suspended particles, as is the case with smoke, beams of light are deflected by these particles and fall onto a sensor (photo diode), which does not receive light in clear air but is illuminated by the scattered light. When the brightness of the scattered light exceeds a certain threshold, the fire damper or smoke control damper is released and closes.

Air flow monitoring
Monitoring the air flow ensures additional safety. The interior of the sensor head and the measurement chamber for air flow monitoring are protected from coarse dust by a filter. Over time, coarse dust can settle on the filter and make it impermeable. This means that smoke can no longer be detected because it does not reach the interior of the sensor head. At the same time the measuring electrode detects zero air flow and a contact is activated.

Reliability
Dust and other suspended particles in the air can lead to slow but continuous contamination of the measuring system slowly but continuously. Since the alarm threshold automatically adjusts to the level of contamination, false alarms become less likely, and the air flow monitoring system continues to work safely and reliably for long periods of time.

Inspection
A test gas is used to check the function of the smoke detectors and the safety-related function of the dampers.

Fire dampers and smoke control dampers with spring return actuator 230 V AC

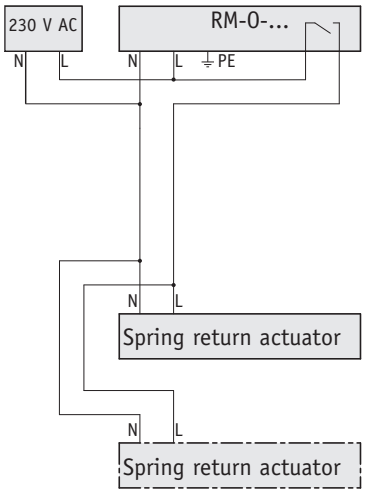
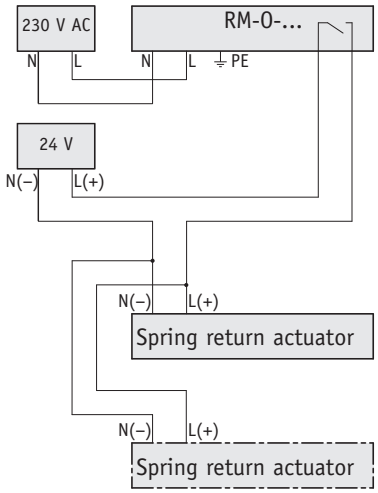


Diagram shows “power off”, i.e. fire damper or smoke control damper closed

Fire dampers and smoke control dampers with spring return actuator 24 V AC/DC



Monitoring of ventilation ducting

Type RM-O-3-D

- Smoke detector for fire and smoke control dampers
- General building inspectorate licence Z-78.6-125
- For air velocities from 1 to 20 m/s
- Independent of the air flow direction
- Supply voltage 230 V AC, 50/60 Hz
- Potential-free signal and alarm relays
- Integral signal lamps
- Contamination level indicator
- Automatic adjustment of alarm threshold
- Long service life

Monitoring of ventilation ducting

Type RM-O-VS-D

- Smoke detector for fire and smoke control dampers
- General building inspectorate licence Z-78.6-67
- For air velocities from 1 to 20 m/s
- Independent of the air flow direction
- Air flow monitoring with lower warning limit of 2 m/s
- Supply voltage 230 V AC, 50/60 Hz
- Potential-free signal and alarm relays
- Integral signal lamps
- Contamination level indicator
- Automatic adjustment of alarm threshold
- Long service life

Porsche Museum, Stuttgart, Germany

Smoke extract dampers

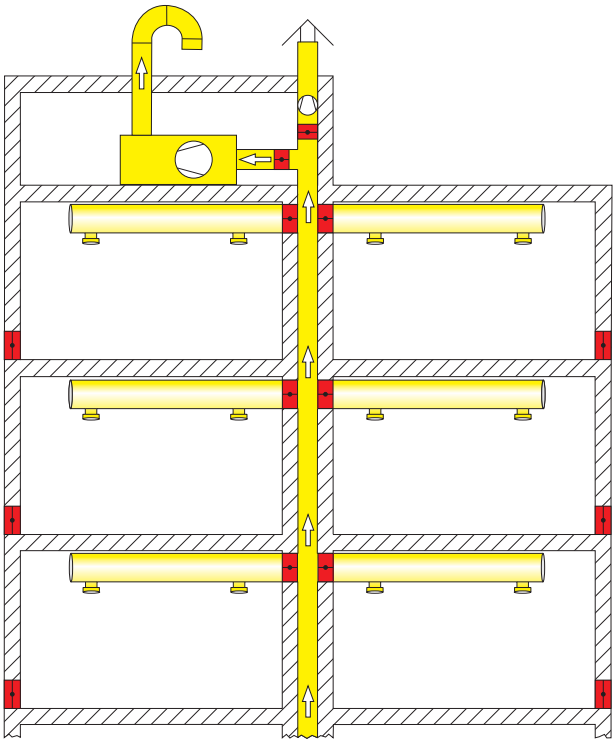
Fire protection of a building is not restricted to the prevention of fires from spreading, it also includes whatever is necessary to enable people to safely leave the building and to support firefighters who extinguish the fire. Smoke from a fire poses a considerable risk during the evacuation of a building because of its aggressive or poisonous fumes and because it hinders visibility immensely. Powered smoke extract systems are efficient systems for extracting smoke from occupied zones and escape routes and keeping them smoke-free at least up to head level. Smoke-free escape routes enable people to leave the building safely or to be rescued.

Porsche Museum, Stuttgart, Germany

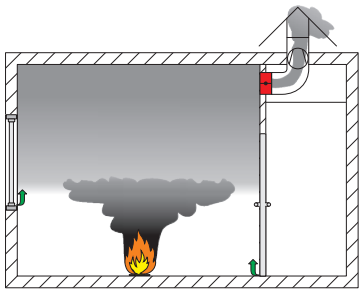
Requirements

The thermal buoyancy during a fire causes the smoke to rise upwards. The room air induced in the upward movement of the combustion gases determines the flow of smoke laden air to be removed. If the flow of extract air through the smoke extract system is too low, the smoke-free zone will progressively move downwards. DIN 18232 outlines measures for ensuring a smoke-free zone and for the construction of smoke extract systems that both allow users of a building to escape safely and facilitate the operation of rescue teams.

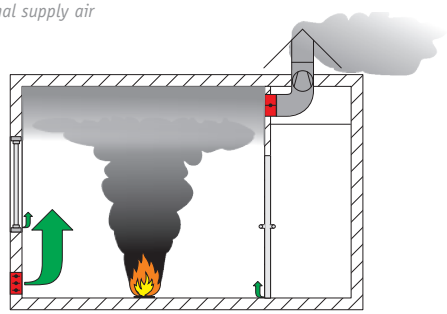
Excessive smoke and heat produced by a fire can be quickly removed from the building by means of powered smoke extract systems. Removing large volumes of smoke is only possible if there is a sufficient inflow of supply air, and this can only be achieved with correctly sized air transfer openings.



Ventilation with a combined ventilation/smoke extract system



Without additional supply air



With additional supply air

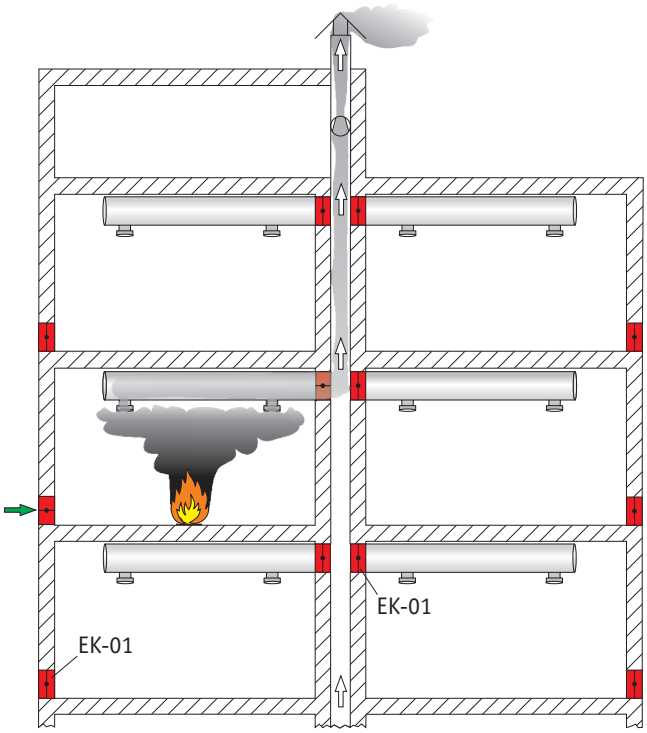
Supply and extract openings

The position of the openings for supply and extract air should ensure a smoke-free zone up to a height of at least 2.50 m.

For uniform air flow into and out of the building, the velocity of the supply air should not exceed 3 m/s.

Smoke extract system

Smoke extract systems generally penetrate several floors or fire compartments. EK-01 smoke extract dampers are installed where the fire-resistant smoke extract ducts branch off the main ducting. They open during a fire to remove hot smoke but will prevent the fire from spreading to other fire compartments.
Such a solution requires separate smoke extract ducting in addition to supply and extract air ducting.

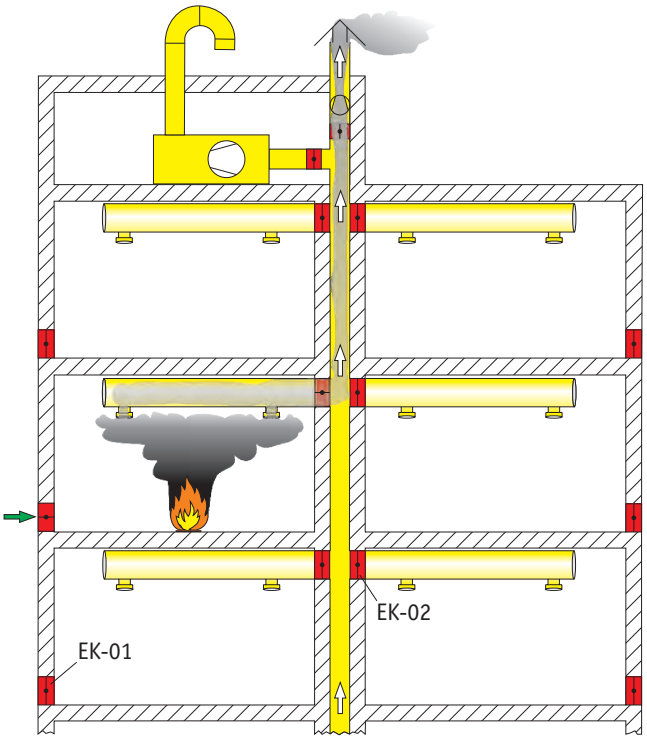


Smoke extract system

Smoke detection with cyclone technology

Smoke extract operation

Combined ventilation/smoke extract systems operate on a different principle. The fire-resistant smoke extract systems may also be used to remove extract air. During ventilation operation, all dampers are open. During a fire, all dampers close with the exception of those needed for smoke extract. Such solutions require controls that incorporate not only the dampers for smoke extract and the inflow of additional supply air but also the fans.



Smoke extract operation of a combined ventilation/smoke extract system

For smoke extract systems and additional supply air

Type EK-01

- Rectangular smoke extract damper
- General building inspectorate licence Z-78.2-13
- Operational range of up to 600 °C for an individual fire compartment
- Casing, damper blade and enclosure made of temperature-resistant calcium silicate
- Remotely controlled with actuator
- Integration into the centralised BMS with TROXNETCOM

For smoke extract systems with ventilation function

Type EK-02

- Rectangular smoke extract damper
- General building inspectorate licence Z-78.3-101
- Casing, damper blade and enclosure made of temperature-resistant calcium silicate
- Remotely controlled with actuator
- Integration into the centralised BMS with TROXNETCOM

Application

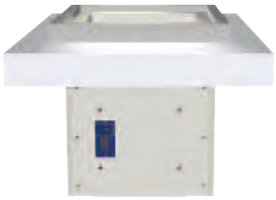
Solid walls
Gypsum wallboards

- Mortar-based or dry mortarless installation
- Mortar bed depth of 100 mm is sufficient
- Installation next to each other or on top of each other with partial mortar infill

On the face of solid walls and ceiling slabs (above or below)

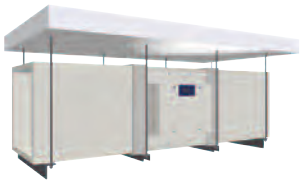
- On the face of solid walls and ceiling slabs
- Minimum thickness of walls or ceilings 100 mm
- Also allowed with vertical rotation axis

Ceiling slabs



- Mortar-based installation
- Mortar bed depth of 100 mm is sufficient
- Suspended or upright installation

On fire-resistant ducting – horizontal or vertical



- Also allowed with vertical rotation axis
- Installation on smoke extract ducting with or without fire-resistance rating
- The connection between smoke extract damper and smoke extract ducting has to be of the same material/ construction as the ducting.

Lightweight partition walls with metal support structure

- Dry mortarless installation
- Walls in compliance with DIN 4102-4, table 48, or with valid general appraisal certificate
- Minimum wall thickness 100 mm

Control of smoke extract dampers

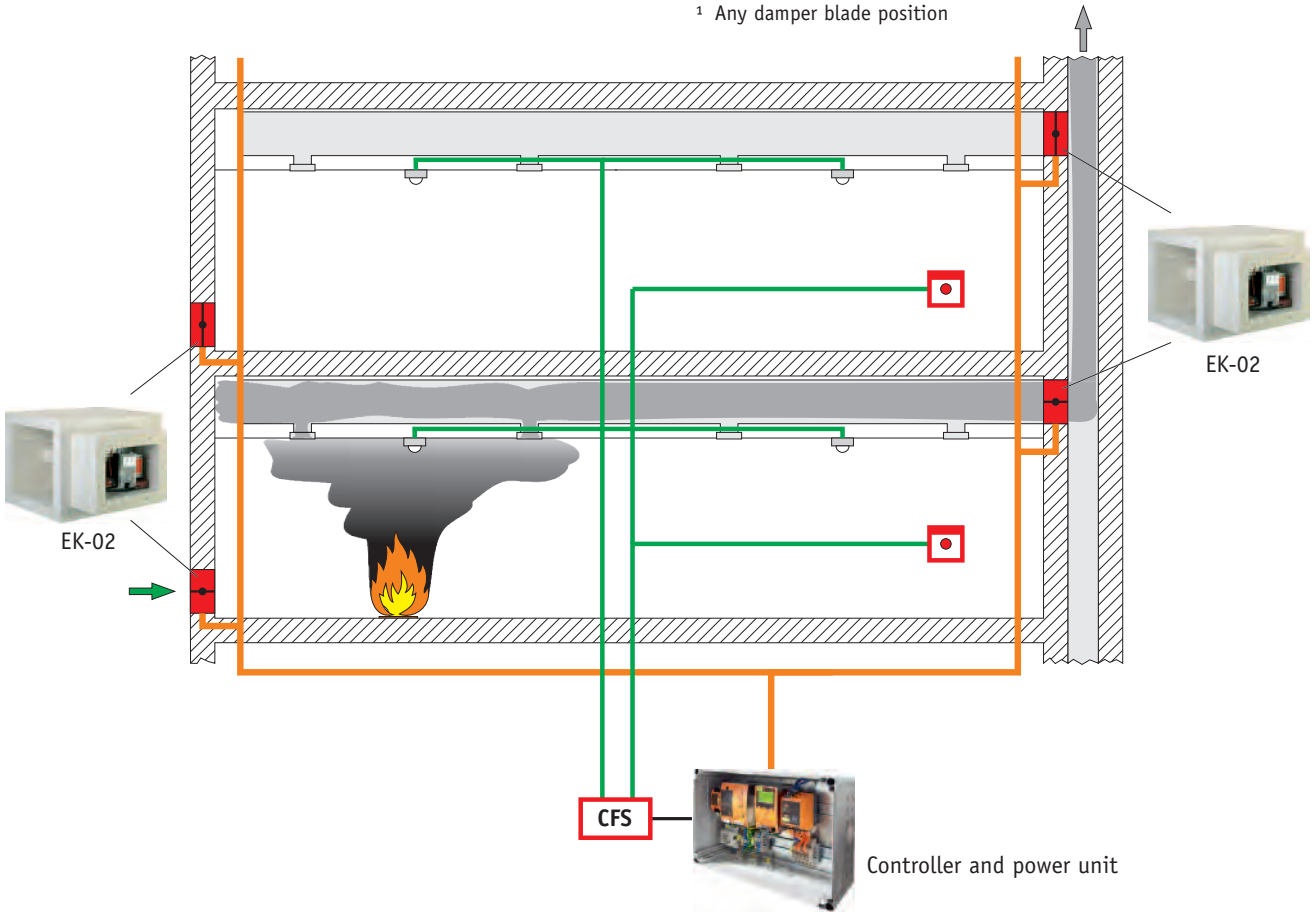
The smoke extract system with smoke extract dampers is usually operated by the central fire alarm system (CFS). Smoke detectors and other components for fire detection are routed back here. In case of a fire, a previously stored action plan is implemented: the smoke extract fan starts up, the smoke extract dampers move into the required position, and the fire brigade is alerted. The fire brigade can, if necessary, alter the action plan via manual control.

Smoke extract dampers in combined ventilation/smoke extract systems must be equipped with a battery unit. It ensures that the damper moves into the required and safe position even if the supply voltage fails shortly after the smoke extract damper has been activated.

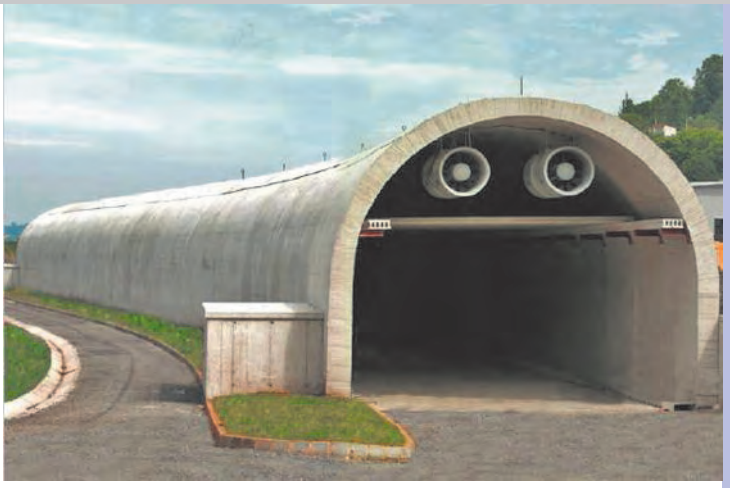
Function overview

	Smoke extract system		Combined ventilation/smoke extract system	
Type	**EK-01**		**EK-02**	
Function	**Smoke extract**	**Add-itional supply air**	**Smoke extract/ venti-lation**	**Air flow**
Normal operation				
All compartments	CLOSED	CLOSED	OPEN	CLOSED
Power failure				
All compartments	Remains CLOSED	Remains CLOSED	CLOSES	Remains CLOSED
Smoke extract				
Affected compartment	OPEN	OPEN	OPEN	OPEN
Other compartments	CLOSED	CLOSED	CLOSED	CLOSED
Smoke extract and power failure after signal input				
Affected compartment	Stops[1]	Stops[1]	OPENS	OPENS
Other compartments	CLOSED	CLOSED	CLOSED	CLOSED

[1] Any damper blade position



The tragic, devastating fires in Europe and other countries in recent years have led to a revision of the safety guidelines for road and railway tunnels.
Large volumes of smoke and fumes are released in the very early stages of a fire, and the temperature can quickly rise to over 1000°C, for example in case of a burning lorry.
As a consequence, European committees have been working on the development of recommendations for suitable fire protection schemes, including systems to automatically detect, locate, and, if necessary, fight fires.



Fundación Barredo, San Pedro de Anes, Spain

Fire protection technology for underground transport systems

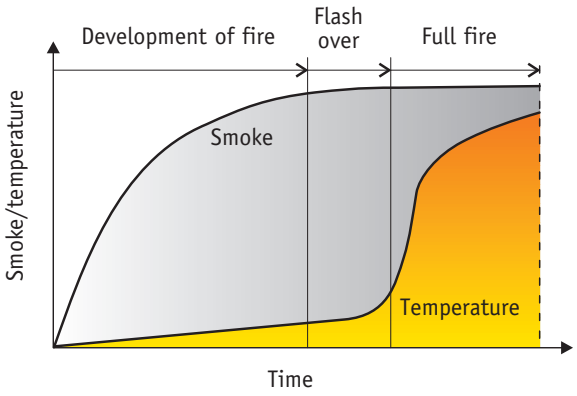
Designers of components and systems for new as well as for existing operational tunnels should draw on the knowledge and experience available not just in their own country but worldwide. The following guidelines, amongst others, are available:

- Directive 2004/54/EC on minimum safety requirements for tunnels in the Trans European Road Network
- RABT (Richtlinie für die Ausstattung und den Betrieb von Straßentunneln / Guideline for equipment and operation of road tunnels)
- EuroTAP (European Tunnel Assessment Programme)
- PIARC (World Road Association)

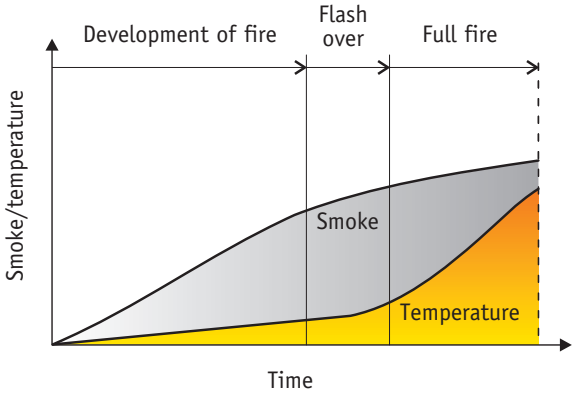
TROX has been involved for decades in tunnel building all over the world and is an active member of various commissions working on the safety of tunnels. In the field of fire protection and smoke extract, TROX has been known for their certified safety systems.
When developing and building underground transport systems, many and diverse factors have to be taken into account. Hence it is not surprising that standard solutions are the exception rather than the rule. This is true also for tunnel dampers which are used in ventilation and smoke extract systems.
TROX tunnel dampers are usually project-specific solutions involving many functions. For this reason, a joint design process is absolutely fundamental with regard to functional performance, units required and interfaces, from conception, construction and on to commissioning. A cooperative development process is essential to ensure that a project is completed on time and the required performance achieved.

Smoke extract from tunnels

The great dangers arising from fires in tunnels can be considerably reduced with smoke extract systems. With a sufficient number of smoke detectors, fires can already be detected in their development stages. The tunnel control room then activates the smoke extract system to slow down the temperature increase and to reduce the concentration of fire smoke.



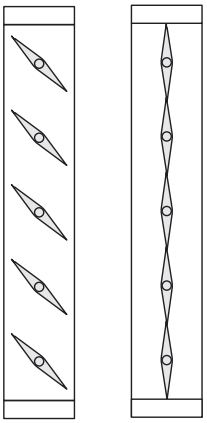
Tunnel without smoke extract



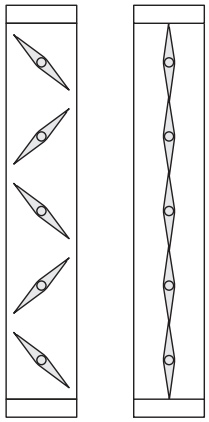
Tunnel with smoke extract

Functional description

Tunnel dampers can have their blades connected to provide parallel or opposed blade action. Parallel operation is always employed when the damper blade position is used to control the air flow rate. In contrast opposed blade operation provides better control characteristics and beyond that, can achieve very much better closed blade low leakage performance due to the way that the blades and linkage operate.la



JFP-EU
Parallel



JFO-EU
Opposed

Environmental conditions

The environmental conditions for tunnel dampers in underground transport systems are difficult in normal operation and become extreme in case of a fire.

Normal operation

- Seasonal temperature and humidity fluctuations
- Pressure waves and vibrations caused by vehicles
- Large amounts of dirt and dust

In case of a fire

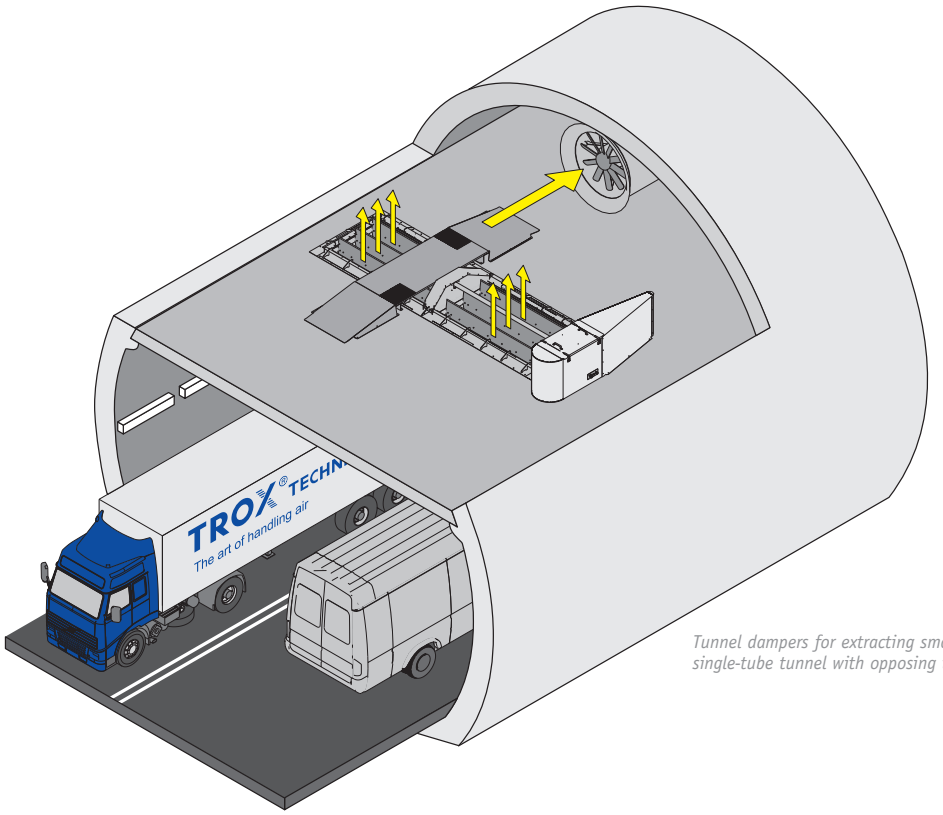
- Hot fire smoke and fumes
- Water and steam from the firefighting process
- High temperatures

Tunnel under the Elbe river, Hamburg, Germany

Application in road tunnels

In road tunnels, tunnel dampers are part of the ventilation and smoke extract systems. They are generally installed in the false ceilings above the lanes or in the ventilation plant rooms. In normal operation, the dampers are used to control the flow rate of the air extracted from the tunnel. In case of a fire, two or three dampers near the source of the fire open automatically as soon as the fire is detected while the other dampers usually are closed. At the same time, the extract fans are run at maximum performance.
In this manner the smoke is efficiently extracted from the danger zone, thus letting people escape from the area and making it easier for the fire brigade to fight the fire.
Tunnel dampers can fulfill numerous functions from fresh air control to the isolation of tunnel sections as a fire damper.

Controlling tunnel dampers
Tunnel dampers are generally controlled using electric actuators. To protect the actuators from the high temperatures of a fire, they can be equipped with a heat-insulating protective enclosure and aerodynamic cover plates.
The tunnel dampers have position limit switches for the blade positions OPEN and CLOSED. The function of the tunnel dampers can be tested from the tunnel control room and monitored at any time.



Tunnel dampers for extracting smoke from a single-tube tunnel with opposing traffic flow

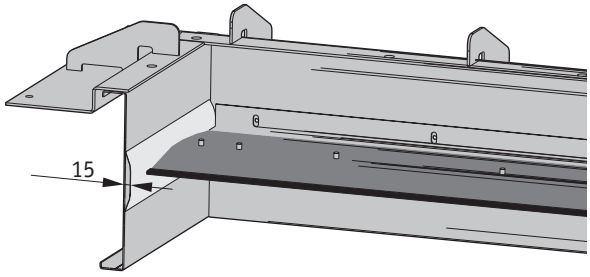
Application in railway and metro tunnels, and underground stations

Tunnel dampers in railway and metro tunnels are, like tunnel dampers in road tunnels, part of the ventilation and smoke extract systems.

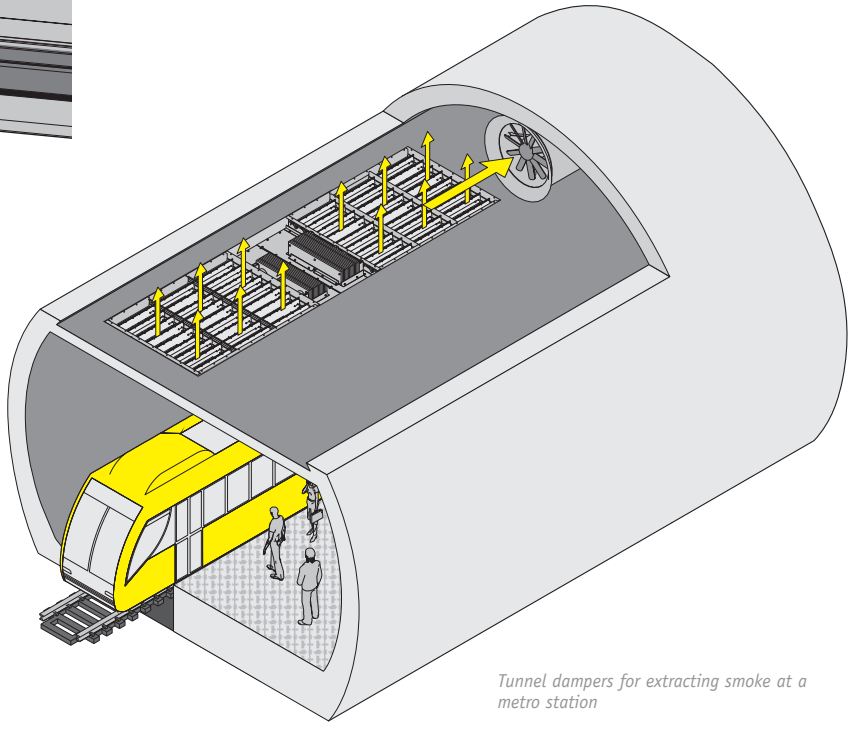
Further applications are possible in underground stations for railways and metros. Here, tunnel dampers can be installed into the supply air ducting of ventilation systems, act as smoke extract dampers, or perform the function of a fire damper and isolate tunnel sections and entire stations. All sorts of installation locations in walls and ceilings result in special requirements with respect to construction.

Functional reliability
Functional reliability must be maintained even in case of high-temperature stresses. This is achieved by having spring-loaded seals to take up and compensate for the longitudinal expansion of the individual parts.

TROX tunnel dampers are characterised by very high leak tightness values at high pressures and can withstand temperatures of up to 400°C for 120 minutes.



Spring seals

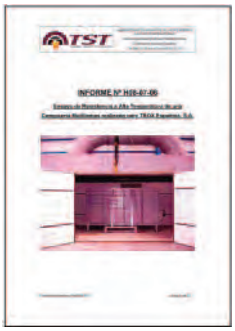


Tunnel dampers for extracting smoke at a metro station

For underground transport systems

Types JFO-EU · JFP-EU

- Rectangular tunnel damper
- Project bespoke design
- Range of application up to 400°C for 120 minutes
- Frame elements, blades, and external linkage made of
  - stainless steel 1.4571
  - galvanised steel
  - galvanised steel, powder-coated
- Bearing elements made only of stainless steel or special bearing materials
- Stainless steel seals
- Remote-controlled by actuator, optionally with heat-protective enclosure
- Integration into the direct digital control system with TROXNETCOM



Test reports from recognised European testing institutes

Central railway station, Essen, Germany

German meteorological service, Offenbach, Germany

Information and communication take on an ever increasing significance in today's world. People not only want more information, they also want more detailed information.
This development is also visible in building automation, and there is no end in sight. A building becomes "transparent" through distributed intelligence and new decentralised communication systems.
Today, these new technologies allow us to develop project bespoke system solutions which can, without problems, be individually integrated into the building management automated systems. In this way, the best solutions for all individual building services can be combined to form the best possible overall solution.
Decentralised communication systems offer you the most advanced technology for your application requirements.

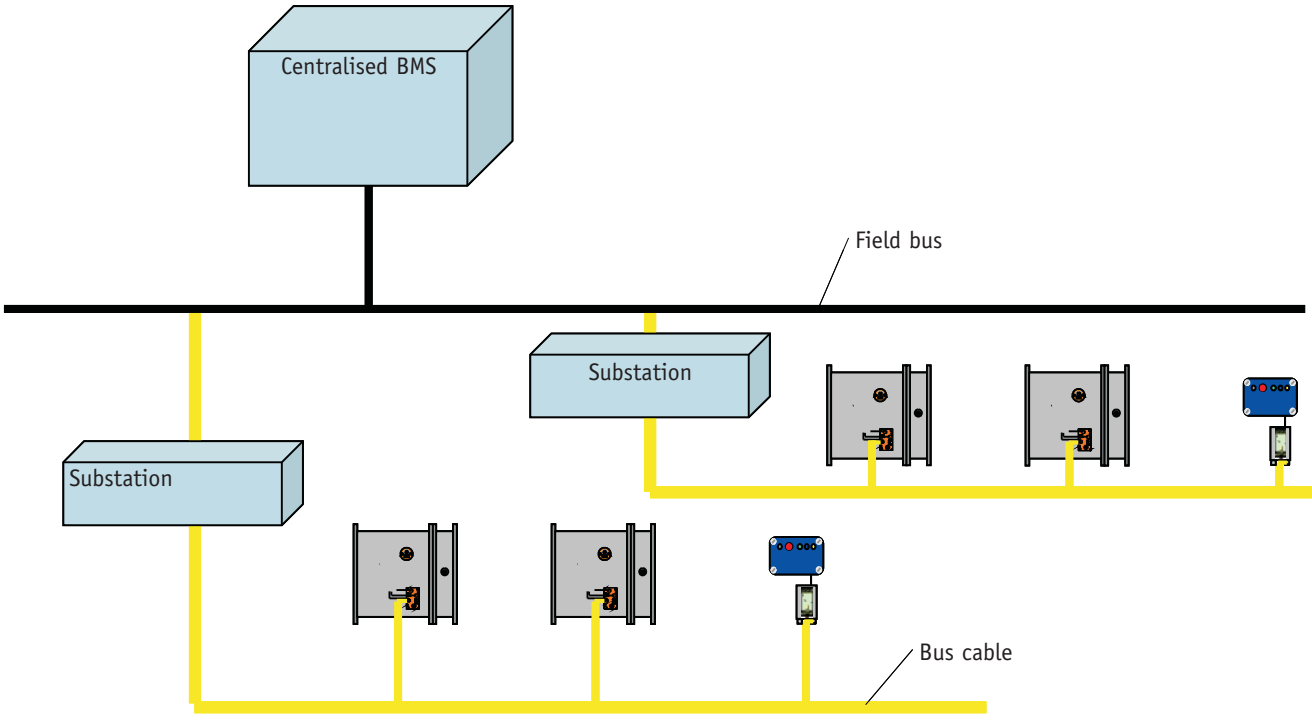
Museum Island, Berlin, Germany

Communication systems for fire protection technology

The functional safety of programmable electronic systems is becoming more and more important in fire protection and is implemented with task-oriented and risk-based concepts. According to EN 61508, the requirements for these systems are based on a risk analysis. Components are given a SIL rating (safety integrity level) and must meet the corresponding requirements to ensured safety even in case of a malfunction.

General advantages of decentralised bus systems

The need to individually wire every single actuator and every single controller are a thing of the past. Modern bus systems only need a bus cable and in some cases a supply cable to connect all components. This saves not only installation time but also cables, connectors, terminal blocks, and control cabinet space. Needless to say it also drastically reduces the fire risks and, also importantly, the installation costs.
All signals from all components on a bus can be addressed and recorded in the central unit.
Inspection is simplified, and measuring, control and regulation processes can all be optimised.



AS interface

The AS interface is a global standard bus system according to EN 50295 and IEC 62026-2.
It enables the integration of different components (modules) into a network regardless of the manufacturer. The modules control actuators and/or receive signals from sensors.
TROX offers an ASi-compliant system to control fire dampers, smoke control dampers, and smoke extract dampers. The TROX modules are characterised by a wide spectrum of functions yet simple cabling.

Special characteristics

- Data exchange and power supply with just one cable
- Central control of actuators and central monitoring of damper blade positions and smoke detectors
- Simple commissioning using standardised software
- Automatic function test including data logging

The system

Communication master

Controller and power units (master)

Modules (slaves)

The communication master is the central display and control panel for the entire system.

- Connection of up to 28 controller and power units
- Shows system operating status
- Operation of actuators
- Menu-driven user guidance in case of errors or malfunctions
- System configuration at the time of commissioning
- Logging of function tests and malfunction reports

The controller and power unit combines the control functions, the power supply, and the data exchange of bus sharing units.

- The controller and power unit is installed near the modules, e.g. as a floor distributor
- Integrated TROX Basic User Software for fire and smoke control
- Communication interface to higher level systems (BACnet/Modbus)
- Display for monitoring and operation
- Units with 1 master - for 31 modules
  2 masters - for 62 modules

The modules establish the link between the measurement and control signals (sensors and actuators) and the network on the so-called field level. A module provides the supply voltage for the operation of actuators.

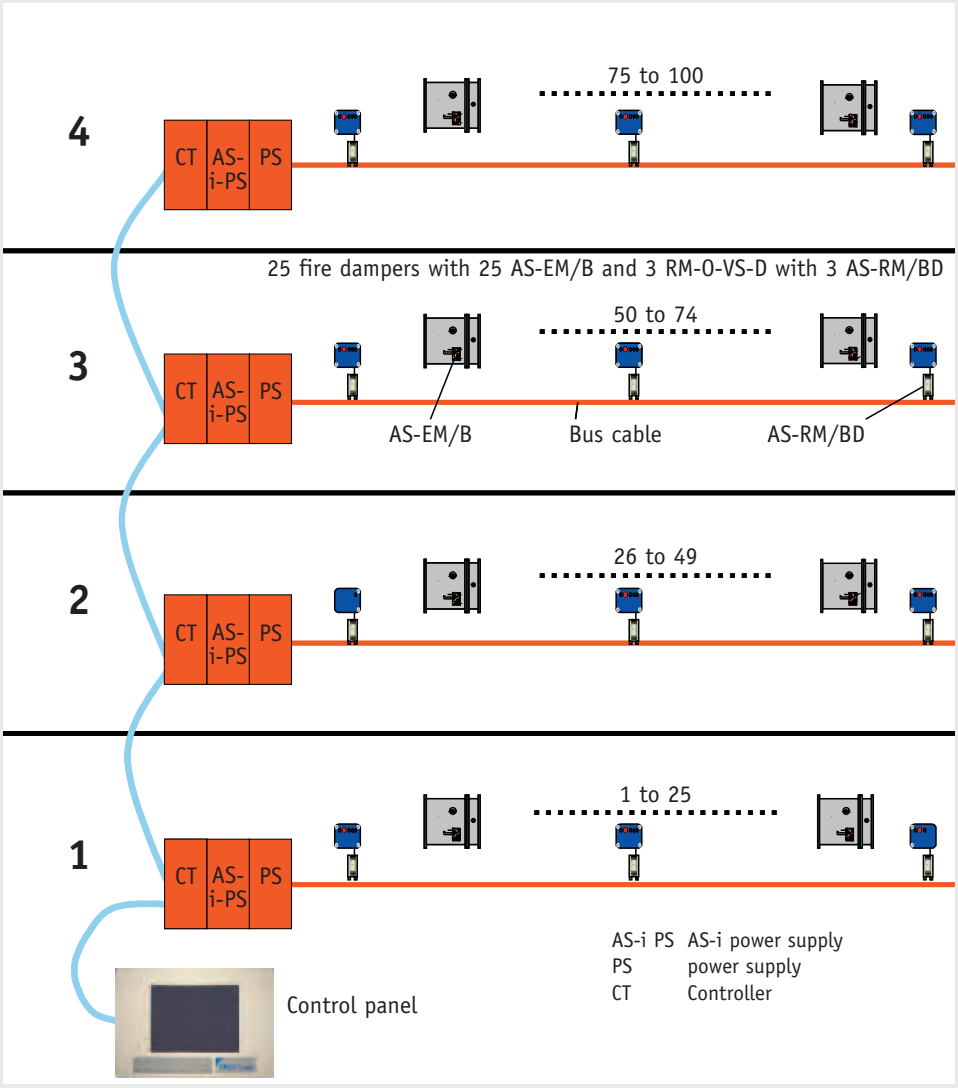
- Modules can be part of a fire damper or used separately to connect one or more fire dampers
- Integrated monitoring function, e.g. for run time monitoring
- Connection to the bus cable is via a flat cable insulation displacement connector

Sizing example

Let us assume that a building is equipped with 100 fire dampers with spring return actuators, and 12 smoke detectors. The dampers and the smoke detectors have to be linked with a bus system and operated from a central operator panel. The building has 4 floors and covers an area of 100 x 100 m. There are 25 fire dampers and 3 smoke detectors on each floor. Connection to a higher level primary control unit is not envisaged.

The following items are required:

- 100 AS-EM/B modules
- 12 AS-RM/BD modules
- 4 AS-i controllers, type TNC-A1305 Profibus DP Slave
- 4 AS-i power supplies, type TNC-A1218
- 5 power supplies, type TNC-D1020 (controller and display)
- 400 m yellow flat cable, type TNC-A4000
- 1 display TP057M (Profibus, DP Master)
  ext. interfaces: Modbus RTU, Modbus IP
  or
  1 display TP104
  ext. interface: BACnet



Product overview

Controller and power units in a control box or for switch cabinets

Type TNC-SVC

- Controller and power unit consisting of
  - Controller
  - Power supply unit
  - AS-i power supply
  - relay module
- For one or two masters
- Communication master can be in the door of the control box
- Integrated TROX Basic User Software for fire and smoke control
- Communication interface to higher level systems (BACnet/Modbus)
- Display for monitoring and operation

Recording of end positions

Type AS-EP

- Module for recording the end positions
- Connection of up to 4 limit switches
  - Damper blade position CLOSED or OPEN for 4 fire dampers
  - Damper blade position CLOSED or OPEN for 2 fire dampers
- Integrated AS interface slave
- Monitoring of signal receipt
- Supply voltage to the module through the AS interface
- Wiring of the limit switches on terminals
- Up to 30 m line length between the module and limit switch
- High strength glands for cable connections

Control of fire dampers, smoke control dampers or smoke extract dampers

Type AS-EM/B · AS-EM/S

- Module to control the actuator of a fire damper, smoke control damper, or smoke extract damper and to record the damper blade positions CLOSED and OPEN as well as any intermediate position
- Integrated AS interface slave
- Monitoring of signal receipt
- Run time monitoring of the actuator is possible (master)
- Connection to the flat cable using insulation displacement connectors (fire dampers and smoke control dampers) or to the fire rated cable (smoke extract dampers)
- Supply voltage to the module and to the actuator through the AS interface via flat cable
- Plug-in for Belimo actuators

Integration of smoke detectors

Type AS-RM/BD

- Module for smoke detectors of type RM-O-VS-D or RM-O-3-D
- Integrated AS interface slave
- Monitoring of signal receipt
- System monitoring
- Contamination level indicator
- Air flow monitoring (only RM-O-VS-D)
- Remotely controlled function test and reset possible
- Connection to the flat cable with insulation displacement connectors
- Supply voltage to the module and to the smoke detector through the AS interface via flat cable
- Connection to the flat cable with insulation displacement connectors

SIL2-certified control of fire dampers, smoke control dampers or smoke extract dampers

Type AS-EM/SIL2

- Module to control the actuator of a fire damper, smoke control damper, or smoke extract damper, and to record the damper blade positions CLOSED and OPEN as well as any intermediate positions with SIL2 licence in accordance with IEC 61508
- Integrated AS interface slave
- Monitoring of signal receipt
- Run time monitoring of the actuator is possible (master)
- Connection to the flat cable using insulation displacement connectors (fire dampers and smoke control dampers) or to the fire rated cable (smoke extract dampers)
- Supply voltage to the module and to the actuator through the AS interface via flat cable
- Plug-in for Belimo actuators

Control of smoke extract dampers with ventilation function

Type AS-EM/S-EK02

- Module to control the actuator of a smoke extract damper with ventilation function, type EK-02
- Pulse signal for damper control with battery unit
- CLOSED or OPEN initiated with single pulse control
- Further (non pulse) input to control (when activated) the smoke extract process, independent of the current damper blade position
- Damper blade moves to the correct position even in case of a power failure (battery unit)
- Integrated AS interface slave
- Monitoring of signal receipt
- Run time monitoring of the actuator is possible (master)
- Connection with fire rated cable
- Supply voltage to the module and to the actuator through the AS interface via flat cable
- Plug-in for Belimo actuators

LON

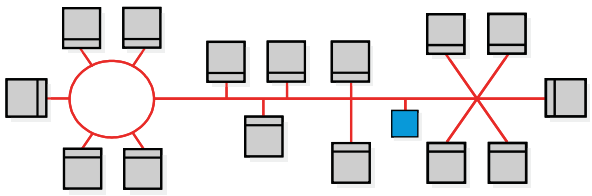
LON and LONMARK indicate a standard Local Operating Network system with manufacturer-independent communications.
Data is transferred by a microprocessor supplied by Echelon Corporation using a unified protocol. LONMARK defines standards to ensure product compatibility.
TROX offers components that meet LON standards.
TROX modules are characterised by a wide spectrum of functions yet simple cabling.

Special characteristics

- Data exchange and power supply can be achieved with just one cable (power cable)
- Decentralised structure with high operational reliability
- Standardised data transfer
- Manufacturer-independent compatibility

The system

Network topology



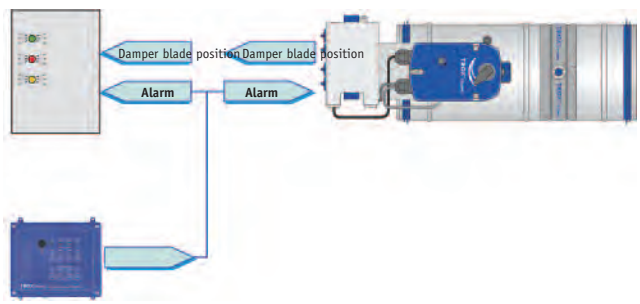
Free topology

Network

The local operating level (subnet) consists of the modules (nodes) and free topology data cables. A subnet can consist of up to 64 nodes or, alternatively, can be extended to 128 nodes using a repeater or router.
Physical data transfer is via systems with or without a transfer of supply voltage. All nodes of a subnet must comply with the system.
In larger networks the routers link the subnets with each other. The routers communicate with each other via the backbone, on a separate network level.
Central monitoring of a LON network is possible and is connected to the backbone or above it.

Binding network variables

Switch cabinet



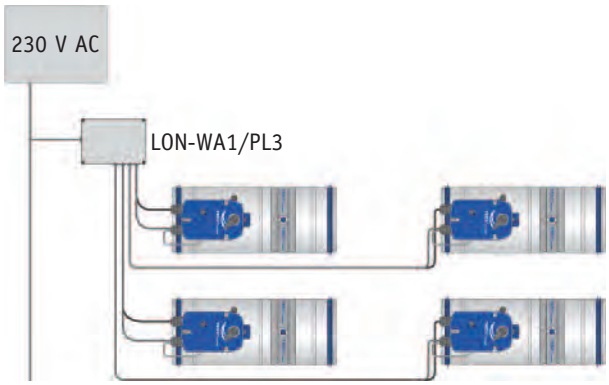
Smoke detector

Data exchange

Data is exchanged between nodes by binding network variables. Network variables ensure an unambiguous data transfer. For commissioning, the network variables between the nodes must be linked, i.e. the outputs of one node must be connected to the inputs of other nodes using a special software. The binding is transferred to the subnet.
The binding is carried out by a system integrator.

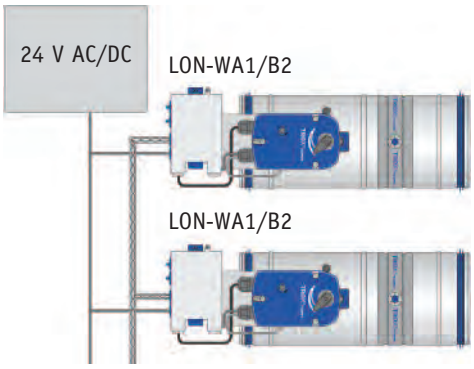
Sizing examples

Type LON-WA1/PL3



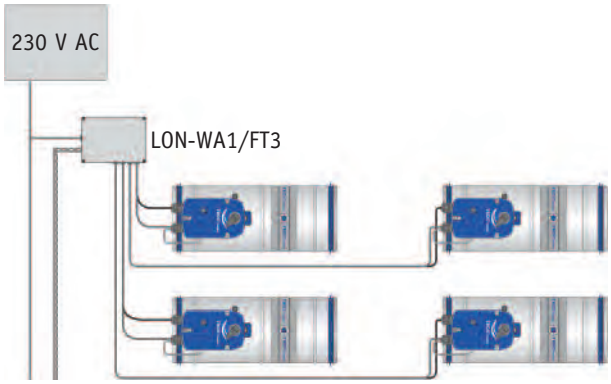
LON Power Line

Type LON-WA1/B2



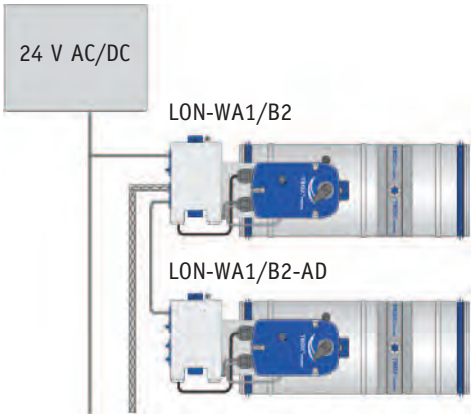
LON FTT10A twisted pair

Type LON-WA1/FT3



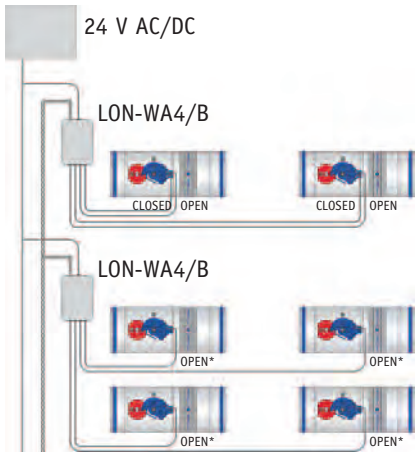
LON FTT10A twisted pair

Type LON-WA1/B2-AD



LON FTT10A twisted pair

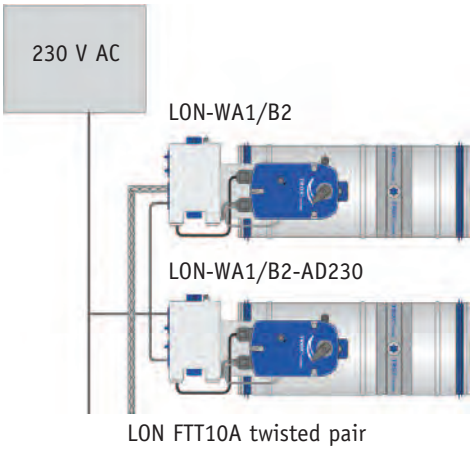
Type LON-WA4/B



LON FTT10A twisted pair

* or CLOSED

Type LON-WA1/B2-AD230



LON FTT10A twisted pair

Product overview

Control of fire dampers or smoke extract dampers

Type LON-WA1/FT3

- Module to control the actuator of a fire damper or smoke extract damper and to record the damper blade positions CLOSED and OPEN
- Connection of up to 4 dampers with actuators with 230 V AC or 24 V AC
- Integrated Echelon FT5000 transceiver
- 8 binary inputs
- 5 binary inputs as a relay with change-over contact, max. 250 V, 5 A
- Supply voltage 230 V AC
- Available as an accessory

Control of fire dampers or smoke extract dampers

Type LON-WA1/PL3

- Module to control the actuator of a fire damper or smoke extract damper and to record the damper blade positions CLOSED and OPEN
- Connection of up to 4 dampers with actuators with 230 V AC or 24 V AC
- Integrated Echelon Powerline transceiver
- No separate bus cable required
- 8 binary inputs
- 5 binary inputs as a relay with change-over contact, max. 250 V, 5 A
- Supply voltage 230 V AC
- Available as an accessory

Recording of end positions

Type LON-WA4/B

- Module for recording the end positions
- Connection of up to 4 limit switches
  - Damper blade position CLOSED or OPEN for 4 fire dampers
  - Damper blade position CLOSED or OPEN for 2 fire dampers
- Integrated Echelon FT10A transceiver
- 4 binary inputs, max. 10 V, 5 mA or potential-free
- Network output variables: SNVT_switch and SNVT_hvac_emerg
- Supply voltage 20–28 V AC/DC
- Protection level IP65
- Available as an accessory

Control of fire dampers

Type LON-WA1/B2

- Module to control the actuator of fire dampers and to record the damper blade positions CLOSED and OPEN
- Connection of a fire damper with spring return actuator 24 V AC/DC
- Connection of a second fire damper is possible with a junction box LON-WA1/B2-AD(230)
- Integrated Echelon FT10A transceiver
- 4 binary inputs, 2 of them with AMP Mate-N-LOK sleeve
- 3 binary outputs as a relay with change-over contact, max. 250 V, 5 A, 1 of them with AMP Mate-N-LOK sleeve
- Supply voltage 24 V AC/DC
- 8-pin terminal connectors to connect to LON-WA1/B2-AD or LON-WA1/B2-AD230
- Protection level IP54
- Supplied with the fire damper or available as an accessory

Control of fire dampers

Type LON-WA1/B2-AD · LON-WA1/B2-AD230

- Junction box for connecting the second fire damper to the LON-WA1/B2
- Connection of a fire damper with spring return actuator 24 V AC/DC
- No separate connection for the supply voltage to the spring return actuator required
- LON-WA1/B2-AD230 with integrated power supply
- 8-pin terminal connectors to connect to LON-WA1/B2
- Customer-site connection with LON-WA1/B2
  - LON-WA1/B2-AD 6-pin
  - LON-WA1/B2-AD230 8-pin
- Protection level IP54
- Supplied with the fire damper or available as an accessory

Smoke detector

Type RM-O-VS-D/LON

- Smoke detector for fire and smoke control dampers with LON interface
- Integrated Echelon FT10A transceiver
- For air velocities from 1 to 20 m/s
- Independent of the air flow direction
- Air flow monitoring with lower warning limit of 2 m/s
- Supply voltage 230 V AC, 50/60 Hz
- Potential-free signal and alarm relays
- Integral signal lamps
- Contamination level indicator
- Automatic adjustment of alarm threshold
- Long service life

Working together with other organisations

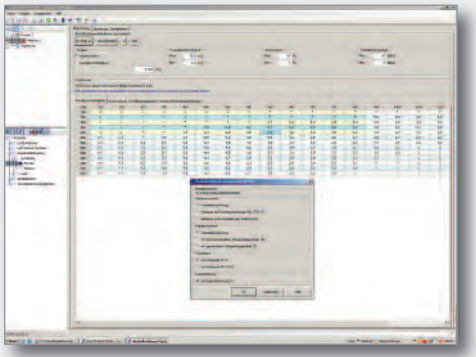
As an expert in fire protection, TROX is a sought-after partner for complex projects in Germany and abroad because TROX is familiar with the requirements of regulators and technical standards throughout the world. This is often a decisive factor in procuring the appropriate approvals for specific solutions from the relevant building authorities. TROX is a company with international experience and is in demand to provide advice to domestic and international bodies in the development of new fire protection standards.

TROX is a member of the following national and international organisations:

- DIBt (German Institute for Building Technology) as expert member
- VDMA (German machine and mechanical engineering association), smoke extract workgroup (FV AL)
- DIN standards committee (German Institute for Standardisation)
- CEN (European Committee for Standards) Technical Committee 127
- BS (British Standard) Committee FSH 22/4
- IG BSK (fire damper workgroup, Switzerland)
- ON (Austrian standards institute) committee ON-K 141 (ventilation technology) and the workgroup ON-AG 141.22 (ventilation systems – fire protection)
- Malaysian Standard MS 555 for “Fire Dampers; Part 1”
- AENOR (Spanish association for standardisation and certification) Fire Protection Committee 23

Technical leaflets

Licences



Design programme

Internet

Leaflets

Technical leaflets

Technical leaflets include product descriptions, information on materials, aerodynamic and acoustic data, dimensions, and details on the correct use of a product. The leaflets contain also a concise specification text, which lists the characteristics of a product and the materials used. Specification texts ensure that only products of high quality are awarded the respective contract.

Licences

For all products that require a licence the original German general building inspectorate licence is available. The licence contains the object to which it applies, the area of application, and general and specific requirements. It completes the project documentation and is part of the revision documentation.

Easy Product Finder

Design programme

The Easy Product Finder design programme on our website allows a detailed selection and design of our products.

- Order code that can be edited
- Diagrams, photos
- Technical data
- CAD drawings (3D models, export in DXF and other standard formats possible)
- Product and variant-specific specification text, order code, and technical data

TROX on the Internet

www.troxtechnik.de

The entire documentation is available on the internet. In addition you will find numerous application examples and references for our products and systems.

References

Hotel Marqués de Riscal, Elciego, Spain

National Theatre, Brussels, Belgium

Millennium Tower, Rotterdam, Netherlands

ABN AMRO office building
Amsterdam, Netherlands

International Airport Galeão
Rio de Janeiro, Brazil

Agios Kosmas
Olympic Sailing Centre
Athens, Greece

Burj al Arab
Dubai, UAE

Rondo 1 office building
Warsaw, Poland

Citibank
Warsaw, Poland

CSOB Group
Prague, Czech Republic

Deutsche Telekom Real Estate
Frankfurt/Main, Germany

Deutscher Wetterdienst
meteorological service
Offenbach, Germany

Elbe tunnel
Hamburg, Germany

European Parliament,
Building D4-D5
Brussels, Belgium

Europe Tower
Budapest, Hungary

Natural Sciences Faculty
Nimwegen, Netherlands

Hotel Mercure, Posen, Poland

Congress Centre, Mérida, Spain

Düsseldorf International
Airport
Düsseldorf, Germany

GlaxoSmithKline
Wavre, Belgium

Grand Hotel
Vienna, Austria

Indoor stadium
Zurich, Switzerland

Central railway station
Essen, Germany

Heysham Power Station
Morecambe, UK

Hospital
Neuchâtel, Switzerland

Hospital
St. Pölten, Austria

Hilton Hotel
Durban, South Africa

Hilton Hotel
São Paulo, Brazil

Hotel Krisztina
Budapest, Hungary

HUK-Coburg insurances,
logistics centre
Coburg, Germany

Hypo Alpe-Adria Center
Zagreb, Croatia

Institut Européen de Chimie
de l´École Polytechnique
Bordeaux, France

International Congress Centre
Durban, South Africa

Jumeirah Beach Hotel
Dubai, UAE

Klimahaus climate exhibition
centre
Bremerhaven, Germany

LTU Arena
Düsseldorf, Germany

Lux Energy
Luxembourg City, Luxembourg

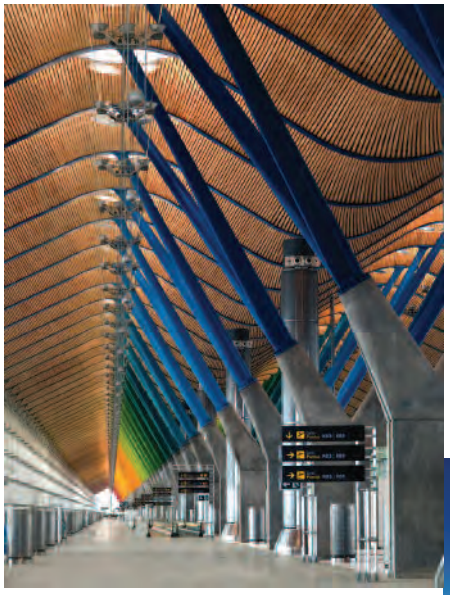
Hotel Marqués de Riscal
Elciego, Spain

MEGA IKEA store
St. Petersburg, Russia

Millennium Tower
Vienna, Austria

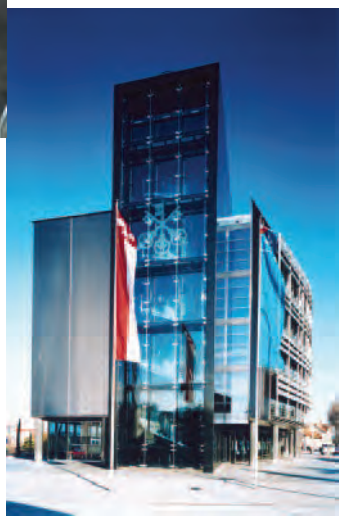
Ministry of Health
Gaborone, Botswana

References



Barajas Airport, Madrid, Spain

Scheepvaart en Transport College, Rotterdam, Netherlands



Société de Banque Suisse, Fribourg, Switzerland

Hydro Power Station Itaipu, Foz do Iguaçu, Brazil

Queen Sophia Museum
Madrid, Spain

Museum Island
Berlin, Germany

Paul Klee Centre
Berne, Switzerland

Petronas Twin Towers
Kuala Lumpur, Malaysia

Porsche Museum
Stuttgart, Germany

Rembrandt Tower
Amsterdam, Netherlands

Royal Theatre
Thessaloniki, Greece

Sabanci Center
Istanbul, Turkey

Soterramiento M30
Madrid, Spain

Spielberk Office Centre
Brno, Czech Republic

Statens Museum for Kunst (National Gallery of Denmark)
Copenhagen, Denmark

Municipal Theatre
Luxembourg City, Luxembourg

Torness Power Station
Dunbar, UK

Agbar Tower
Barcelona, Spain

University library
Cottbus, Germany

Representation of Bavaria at the EU
Brussels, Belgium

Vienna Airport Tower
Vienna, Austria

Hamar Olympic Hall "Vikingskipet"
Hamar, Norway

Warsaw Airport
Warsaw, Poland

Headquarters Germany

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