Image: Foppa AG

+ MECHANICAL SMOKE EXTRACTION

In residential buildings, warehouses and underground car parks

Mechanical smoke extraction – now also with D+H

The thermal properties of flue gases and fresh air are not always sufficient to ensure safe, reliable smoke extraction from a building. This issue can be addressed by using fans/ventilators and smoke extraction ducts. When the function of a smoke and heat exhaust system (SHEV) is achieved with motor-driven fans/ventilators, this is defined as mechanical smoke extraction (MSE).

Christoph Kern,
Board Member – Sales

"We have made a very deliberate decision to open up this new business area together with the D+H Group. Until now we have limited ourselves strictly to the use of the thermal properties of gases for our solutions. After more than 5 decades of focussing on SHEV, we want to show why D+H is still the first contact for everything relating to smoke extraction and ventilation, including mechanical smoke extraction."

"In doing this, we are combining our experience in natural smoke extraction (NSE) with the requirements and demands of mechanical smoke extraction (MSE). We want to position our controller among MSE OEM customers and to offer complete solutions regionally through our partners and international subsidiaries."

David Schmengler,
Head of International Sales

René Göhr,
Head of Key Account Management MSE

"Personally, I am very pleased that we now also sell solutions for mechanical smoke extraction. We have the know-how and the well-engineered products to successfully establish ourselves in this business segment."

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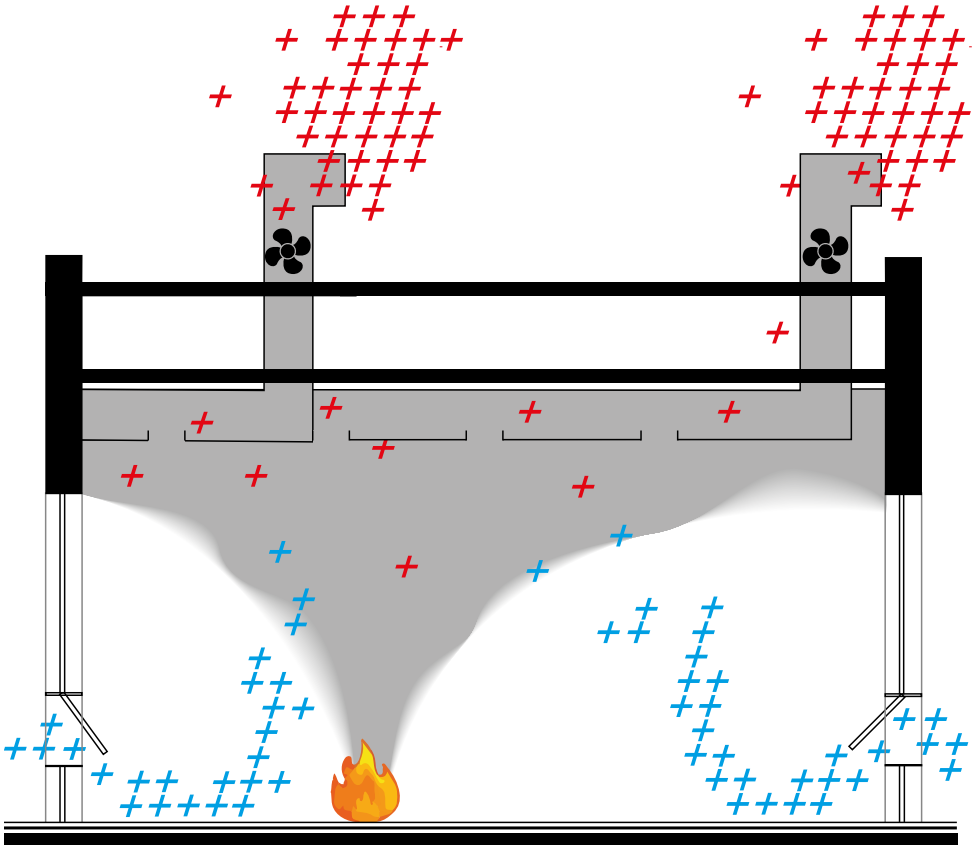
Image: DH Mechatronic UK Ltd

AN ADDED AREA OF EXPERTISE

How does mechanical smoke extraction work?

In case of fire, a mechanical smoke and heat exhaust system (MSE) ensures that interior facilities, basement rooms or underground car parks can have smoke extracted safely and reliably. A mechanical smoke and heat exhaust system uses motor-driven fans/ventilators to suck smoke out of the building either directly or through an installed duct system. At the same time, a comparable amount of fresh air is fed in through backflow openings. This creates a stable low-smoke layer of air in the lower area of the room where the fire can be fought and people can be rescued. At the same time, the thermal load on the building structure is reduced by targeted heat removal. This makes firefighting operations easier and increases the safety of the firefighters. In addition, at lower temperatures there is a higher chance that a burning building can be saved.

A mechanical smoke and heat exhaust system helps make it possible to rescue people who are still in the building. It makes firefighting operations in the building easier for the firefighters and helps protect property as well as prevent operating failures. A mechanical smoke exhaust system can also be used for general ventilation as well as for ventilation after a gas leak, such as CO, NO_2 or LPG.



Mechanically extracted combustion gas (smoke) is replaced with supply air (fresh air). The goal is to achieve a balance between inflowing air and outflowing smoke (fire ventilation system).

What components make up an MSE system?

Mechanical smoke and heat exhaust systems are usually customised for a property. In other words, they are planned and then manufactured based on the application. Therefore, a mechanical smoke and heat exhaust system is not really suitable for mass production. However, such a system does usually consist of smoke extraction fans, automated intake air openings, smoke extraction flaps or fire dampers, smoke detectors and a control panel such as the CPS-M. The individual components of the system are combined into a complete system, installed and calibrated. After that, the CPS-M controller guarantees fully automated and coordinated operation of the system. In case of fire, the system activates automatically as soon as smoke is detected. The system can also be triggered manually at any time.

> "In this type of application area, our CPS-M can prove yet again that it is fully able to perform."

Maik Schmees,
Chief Technical Officer

What does the process look like in case of fire?

The intake and exhaust air paths are opened
The smoke extraction fans are not turned on until confirmation is received that the backflow openings have been opened. This prevents the building and people from being harmed by an excessively high negative pressure in the building.

The smoke is extracted
Heat-resistant smoke extraction fans guide the smoke out of the affected room. These fans can be installed on the roof, in the wall of the relevant facilities or at a central location. In the case of interior rooms without windows, smoke is routed out of the building through a duct system. Here it is necessary to ensure that the smoke is not released into adjacent rooms. To prevent this unwanted effect, fire dampers can be installed inside of the duct system.

Fresh air flows back into the building
Backflow openings for supply air must have sufficient dimensions and be positioned near the floor with uniform space between them. This ensures that fresh air can flow in within the low-smoke layer without creating turbulence in the smoke. Here, the flow velocity must not exceed the normative requirement. Overall, it must be ensured that there is a balance between the outflowing smoke and the backflowing supply air. If a natural backflow is not possible, then fresh air is supplied mechanically.

Complex smoke extraction scenarios can be realised with a combination of mechanical and natural backflow of supply air (e.g. with fans, automatically opening windows, blinds or automated doors).

Image: Foppa AG

Normative requirements and directives

All components of an MSE system are construction products which are described by harmonised standards. These must be tested and certified for use in Europe by a verified centre. The specifications of the EN standard are also used in many places around the world outside of Europe due to the absence of local standards. Depending on the country, building use and applicable standards, the requirements for mechanical smoke and heat exhaust systems are regulated by:

EN 12101-10 Power supply
EN 12101-7 Smoke extraction ducts
EN 12101-8 Smoke extraction flaps
EN 12101-3 Combustion gas ventilators/fans
EN 12101-1 Smoke curtains

Backflow openings
The backflow openings need to be located near the floor to ensure that smoke-free air is used. The minimum height of the smoke-free layer is 2.50 m.

Flow velocity
The flow velocity of the supply air must correspond to the local normative requirements. In Germany, for example, the flow velocity must not exceed 1 m/s. Likewise, there are regulations governing the fire resistance with which components for smoke exhaust must comply.

Extraction point and extraction speed
The number of extraction points and the distance between them as well as the extraction speed through the fan/ventilator must be observed and taken from the applicable local laws.

Power supply and distribution
The system's power supply is usually set up redundantly – especially for larger projects. This can be done by using on-site emergency power generators or batteries. Here, compliance with the power/capacity requirements for the entire mechanical smoke and heat exhaust system (control panel, fans/ventilators, smoke extraction flaps etc.) from the associated fire protection analysis must be ensured. This includes regulation of how long the system must continue operating properly under full load after a mains outage. Depending on the cable routing, there may also be regulations at the local level for the integrity class of the lines.

Areas of application

If the use of a natural smoke extraction system is not possible for structural or thermal reasons, then a mechanical smoke and heat exhaust system is used. Examples of this include multi-storey buildings, interior facilities and underground car parks (requires important planning steps in addition to MSE). Moreover, shopping centres, large-scale industrial buildings, logistics centres, power plants or heating plants can be equipped with a mechanical smoke exhaust system. The use of a mechanical smoke exhaust system may be the result of specifications in local guidelines and regulations or in the building permit.

One example

In large-area rooms with a clear height of at least 3 m, the specifications of DIN 18232-5, which is valid in Germany, can be used for dimensioning a mechanical smoke and heat exhaust system. This standard stipulates that the maximum smoke compartment area must not exceed 1600 m². Accordingly, larger rooms may need to be subdivided by smoke curtains into multiple smoke compartment areas no larger than 1600 m². If smoke extraction fans are being used to increase the flue gas flow rate, the size of a smoke compartment area can be increased up to 2600 m².

High air exchange in a minimum of time

Smoke extraction and ventilation with an MSE

The principle of a mechanical smoke and heat exhaust system is also generally suitable for the ventilation of buildings or individual rooms. The main reason is the theoretical possibility of high air exchange in the shortest conceivable time. To control ventilation, you need a flexible, high-performance MSE control panel such as the CPS-M (for simultaneous control of the ventilation cycles and of the entire mechanical smoke exhaust system) and, in some cases, additional sensors. This enables stale air, aerosols and gases to be quickly emitted. This additional ventilation function can be easily controlled with a touch panel.

CFD simulations (flow simulations) can be provided by our D+H network on request.

Project example of the D+H Group

No. 1 Old Trafford, Manchester – D+H UK

The property consists out of two residential high rise tower which are connected by a common area. From nearby Manchester Piccadilly and a newly created tram stop there are excellent links to the city centre as well as to the cities of Liverpool, Birmingham and London.

The British subsidiary DH Mechatronic UK Ltd is working in No. 1 Old Trafford in Manchester to install the first mechanical smoke and heat exhaust system from D+H in Great Britain. The scope of the project includes 2 large CPS-M controllers, NSHEV skylights for ventilation of the stairwells, smoke extraction flaps and heat-resistant extractor fans. One CPS-M controller is used in each apartment building. D+H UK is supplying and installing not only the drives and controllers, but also the fans and smoke extraction flaps for the extraction shafts. The high-integrity cabling connects all components of the system to the CPS-M and has to be routed during an early phase of construction.

The corridors on the apartment floors are long dead-end hallways in both directions. They clearly exceed the recommended maximum length of 15 m for the use of a sprinkler system. Therefore, the safety of the residents is ensured by the use of a mechanical smoke and heat exhaust system. To expel the exhaust air from the buildings, extractor fans and an extraction shaft were installed at each corridor end. In Block 1 of the apartment complex, the minimum amount of air to be emitted is 6 m^3/s per fan, while in the somewhat higher Block 2 at least 8 m^3/s of exhaust air must be emitted from the corridors by each fan. If smoke is detected in the corridor, then the windows near the stairwell automatically open to allow a corresponding amount of fresh air to flow back into the corridors.

During everyday operation in ventilation mode, all of the smoke extraction flaps and all of the windows in the corridors open automatically once the temperature in the hallways reaches 23 degrees Celsius or more.

With this project, D+H UK has succeeded in implementing a complex MSE solution with various functions.

Image: D+H UK

How mechanical smoke extraction works with the CPS-M controller

We have developed an outstanding controller for all application areas, such as a mechanical smoke exhaust system. The CPS-M is a control panel for controlling systems designed to prevent the spread of smoke, heat and fire – and it can be expanded to meet individual requirements. The CPS-M controls and monitors all components and regulates the power supply for the entire system. During everyday use, the CPS-M is also suitable for controlling ventilation systems in buildings. Above all, however, the CPS-M demonstrates its special capability in complex systems such as a mechanical smoke and heat exhaust system. The programming and structure of the CPS-M are based on fire scenarios or on directives for the design of ventilation systems. This means, for example, the controller can be used in underground car parks. If sensors detect too much carbon monoxide (CO), nitrous dioxide (NO_2) or liquefied petroleum gas (LPG) in the underground car park, then smoke extraction fans will be started by the CPS-M. The fans can be activated by means of frequency converters, soft starters or directly by contactors (switches).

We can win over customers with these equipment features and functionalities

- Design for customised solutions/projects
- Guarantees the safe and gentle start-up of fans (with a frequency converter, soft starter or directly)
- Compatible with all fire dampers, smoke extraction flaps and electric window drives for backflow openings
- Monitored group outputs 24 V DC / 230 V AC for activation of all common smoke extraction flaps and fire dampers
- Runtime monitoring
- Multiple options for displaying the operating status, e.g. touch panel (optional)

The CPS-M supports the Modbus RTU protocol, which means that status signals of the individual components and control signals can be forwarded to the building management system (BMS). A shared touch panel can be used to display the operating status of multiple control units in the building. As a result, you can keep track of everything even in large, extensive systems with multiple AdComNet nodes. The individual nodes are networked using AdComNet, the first bus system to be certified for SHEV by the VdS Technical Inspection Services, an internationally renowned institution for fire protection and general safety in companies. This technology allows control panels to be combined to form a single decentralised and overarching system. This involves linking the controllers in such a way that complex scenarios and individual smoke compartments can be configured depending on space utilisation.

Your advantage with the CPS-M

- Thanks to its modular design, the controller can be individually configured for all of the customer's requirements
- If the building is ever expanded, simply retrofit additional assemblies
- The Modbus RTU-based ACB bus communication for the drives makes it possible to reduce the cost of the entire system. In addition to lower costs and effort for the cabling, the number of modules required is also reduced
- Window drives can be activated individually by the CPS-M, even for a shared line with just one connection, by means of ACB (Modbus)
- No additional lines are needed for the ACB drive end position messages required for the MSE because they are queried over the same bus line
- The integrated emergency power supply guarantees smooth operation of the controller even if there is a power cut in the building
- The controller can be freely and easily configured with the D+H SCS software
- Not bound to the software and programmers of other PLC manufacturers
- Low energy requirements for the controller in emergency power operation
- Flexible and cost-conscious support provided by the global D+H service network

Convenient for installers and service technicians

Configuration with the D+H Service & Configuration Suite (SCS)

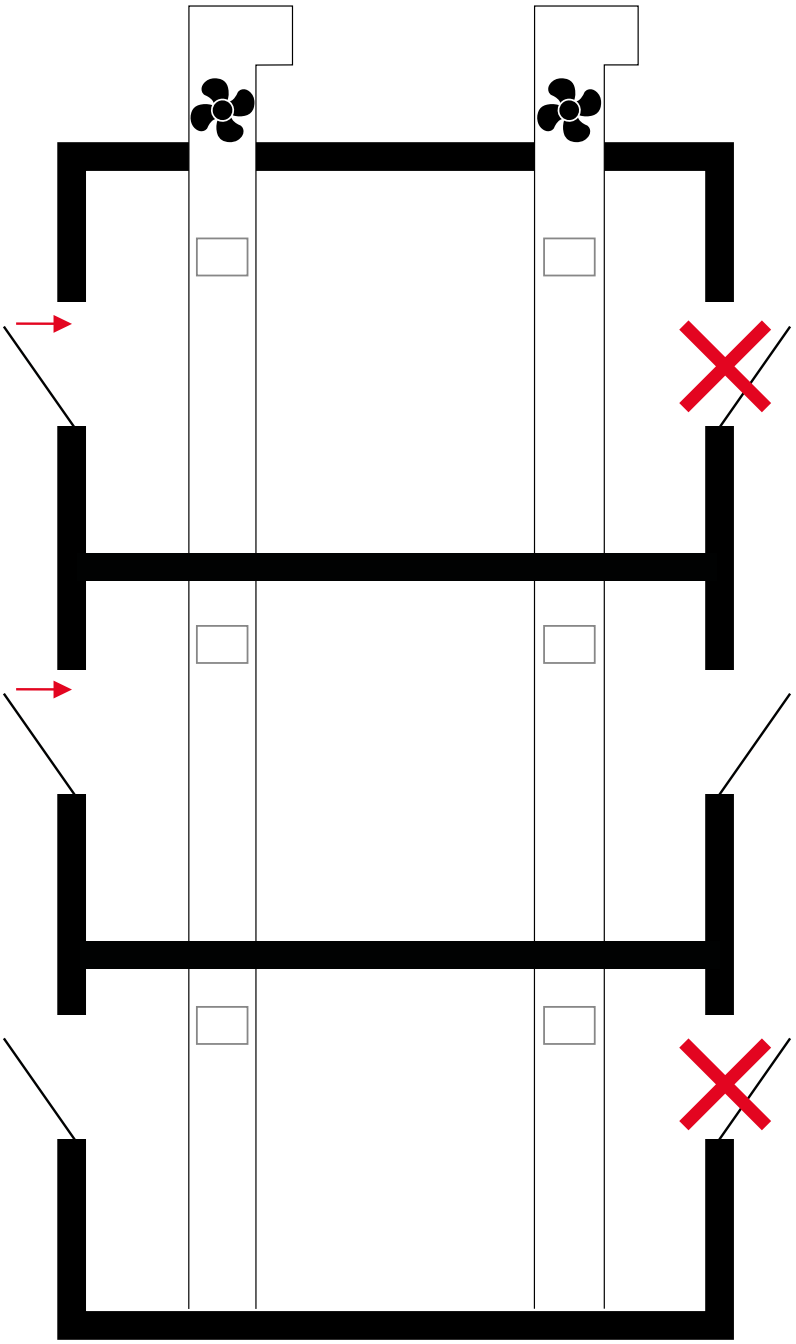
All you need to automate a mechanical smoke and heat exhaust system is the SCS software developed by D+H. Installers have been using this particularly user-friendly software for years to configure and run diagnostics on AdComNet networks. The CPS-M is easy to configure with the SCS software using drag and drop. It is also easy to combine multiple lines and groups with one another in large and complex networks. In this case, it doesn't matter which controller the individual AdComNet components are connected to. The SCS software can be used to configure all the elements from any point.

Thus the CPS-M is configured in the familiar environment of the SCS software. It is also just as easy to configure all of the components of the mechanical smoke and heat exhaust system. When doing so, the installer can rely on familiar functions such as SHEV links. Additionally, AND / OR logic modules can be used to implement even complex requirements. The option of assigning custom names to individual components in the network gives you a clearer overview – even in the case of complex networks. The complete configuration is stored in the network so that no database or similar solution is required for a read-out.

The following functions, which are already integrated into the SCS software, are especially useful for a mechanical smoke and heat exhaust system controller:

Timer function
Start / activation delay between somke extraction fans.

Smoke protection link
All the windows close where there is no alarm. As a result, adjacent fire compartments are kept smoke-free.

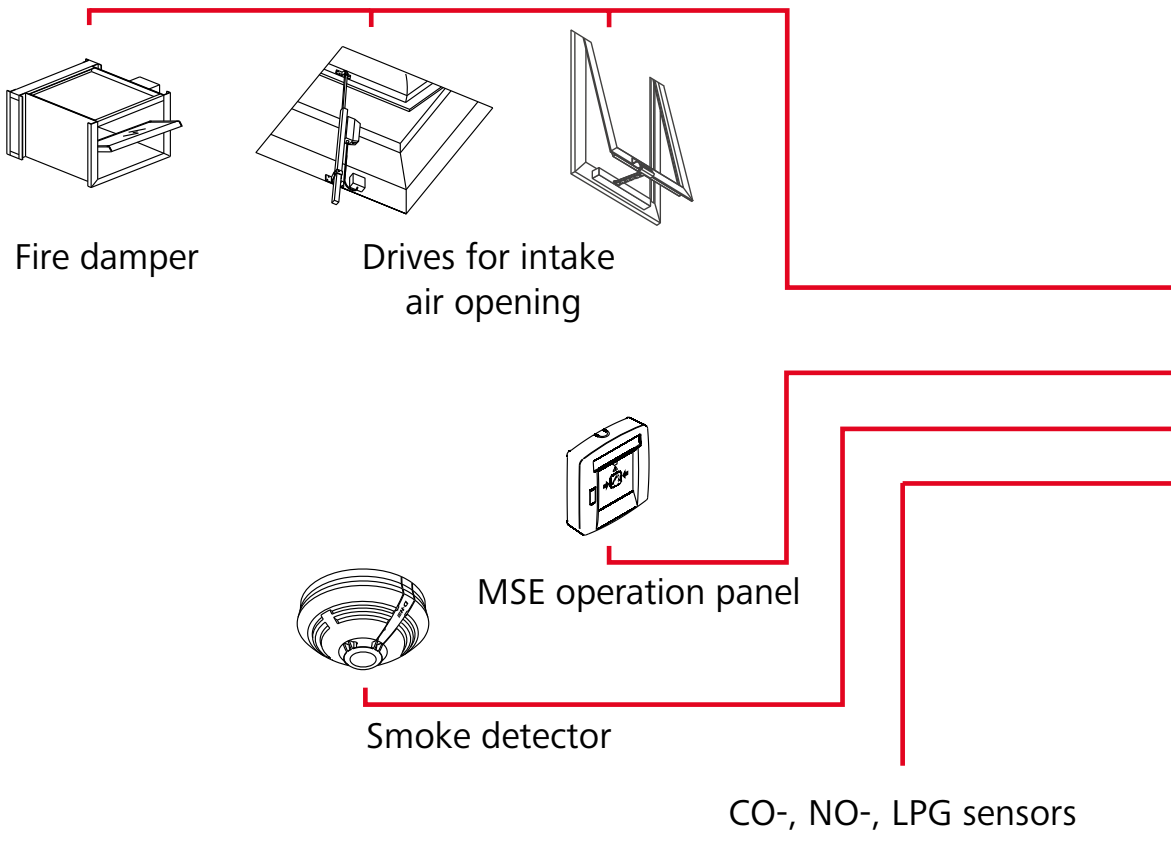


Minimum link
A smoke extraction fan does not start for example until at least one of two backflow openings have been reported as OPEN.

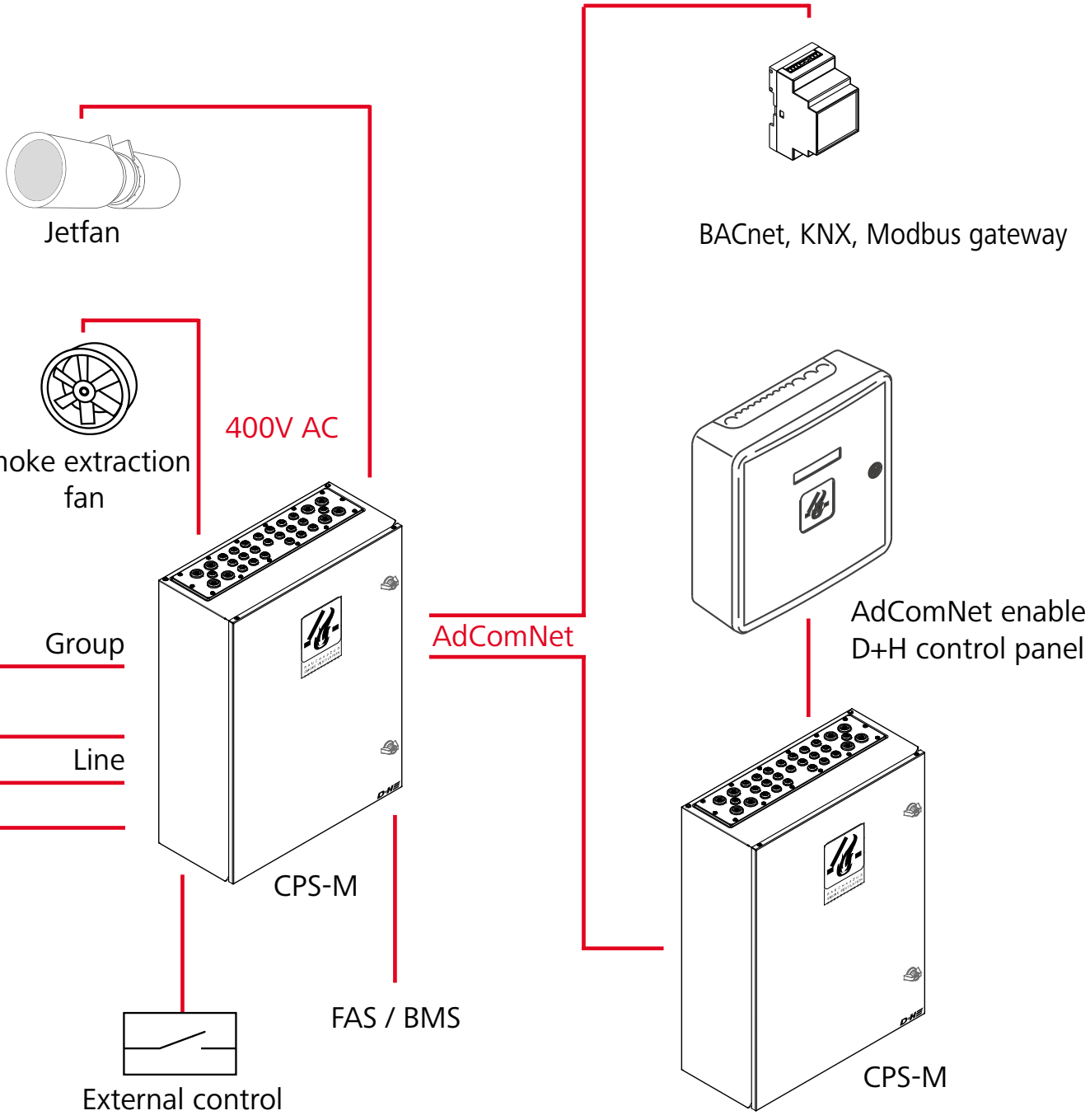
Lockout function
In the event of an alarm, additional fire compartments are locked. Then you can look at one fire scenario at a time.

Typical components of a mechanical smoke and heat exhaust system with the CPS-M

- CPS-M AdComNet-enabled components
- Smoke extraction fan
- Smoke extraction flap and/or fire damper
- Smoke extraction duct system
- Manual MSE operation panels
- Intake air opening (windows, doors, gates)
- Sensors for CO, NO_2 and LPG (in underground car parks)
- Smoke detectors
- CPS-M control panel
- Smoke curtains



> Our mature technology fully comes into effect here. D+H control panels are just as perfectly suited for controlling and monitoring a complex mechanical smoke extraction system as they are for daily ventilation operation.



Application in a residential building

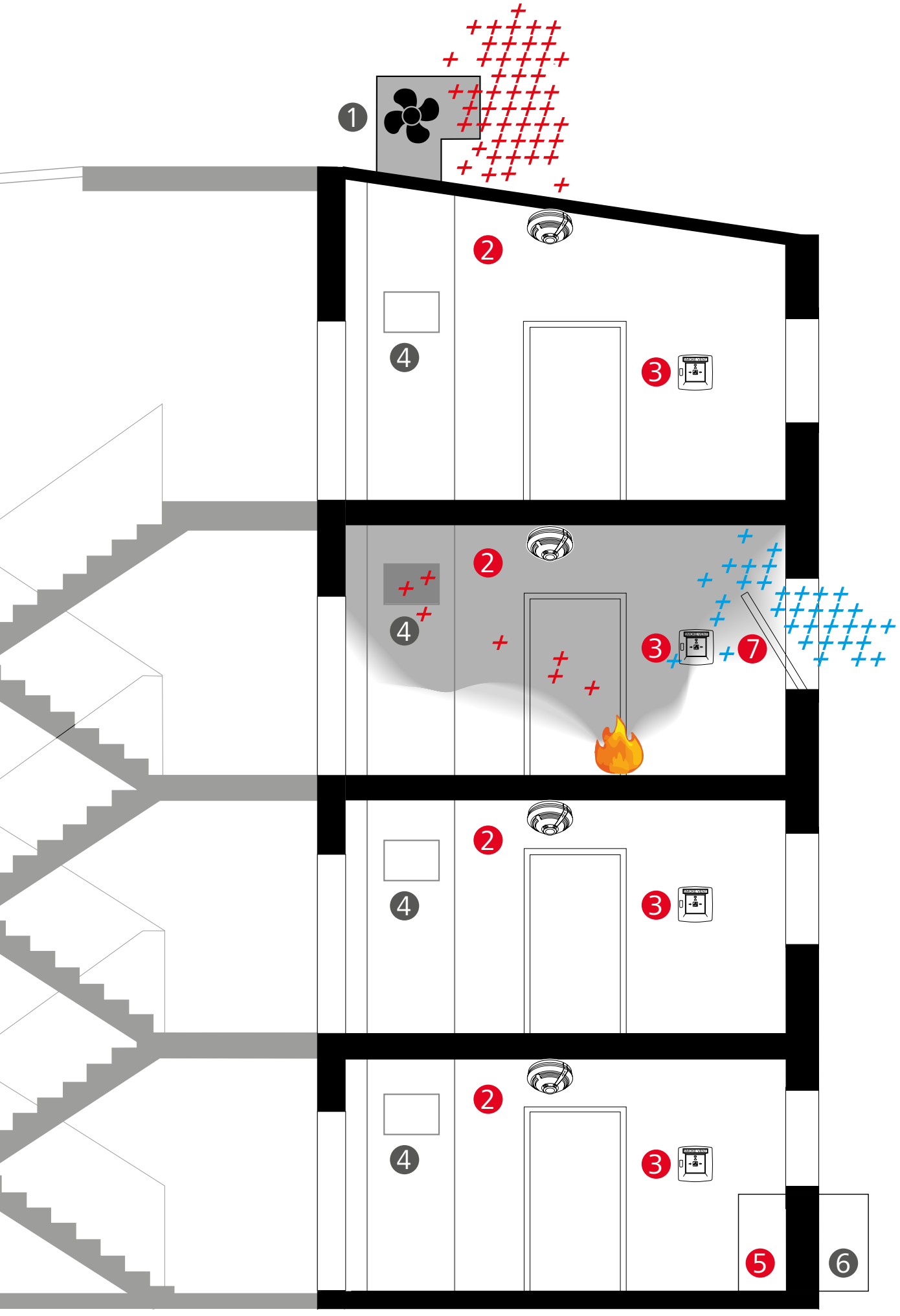
What you need:

1. Roof ventilators
2. Smoke detectors
3. Smoke vent buttons
4. Smoke extraction flaps / blinds
5. CPS-M controller
6. Reliable 400 V power supply
7. Intake air opening e.g. by means of a D+H drive (e.g. CDC Series)

D+H article

Third-party product

Your D+H contact person will be happy to support you with planning, project development and searching for suitable suppliers for third-party products.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Application in a warehouse

What you need:

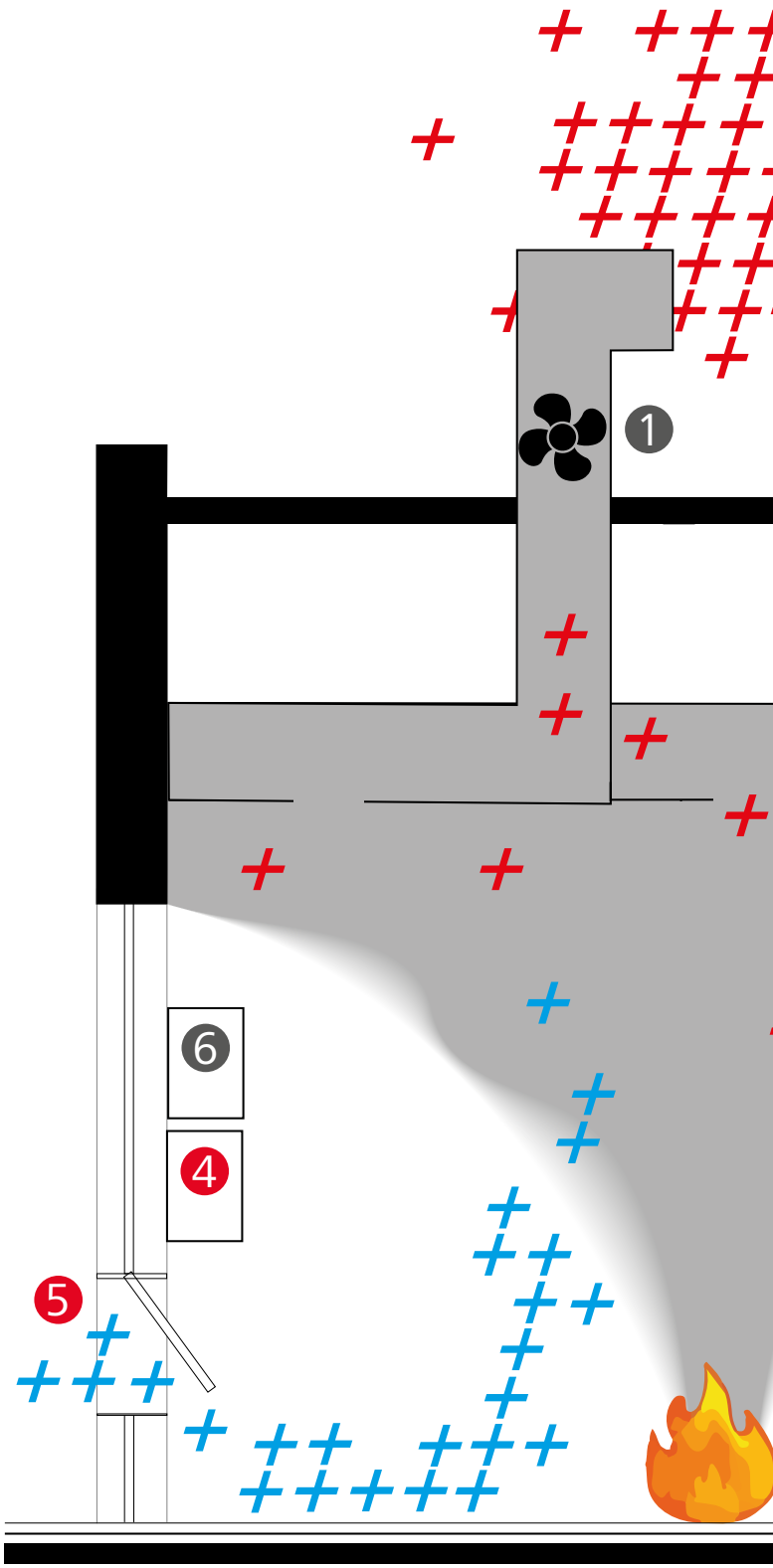
1. Roof ventilators
2. Smoke detectors
3. Smoke vent buttons
4. CPS-M controller
5. Intake air opening e.g. by means of a D+H drive (e.g. CDC Series)
6. 400 V battery unit for the emergency power supply
7. Smoke extraction duct

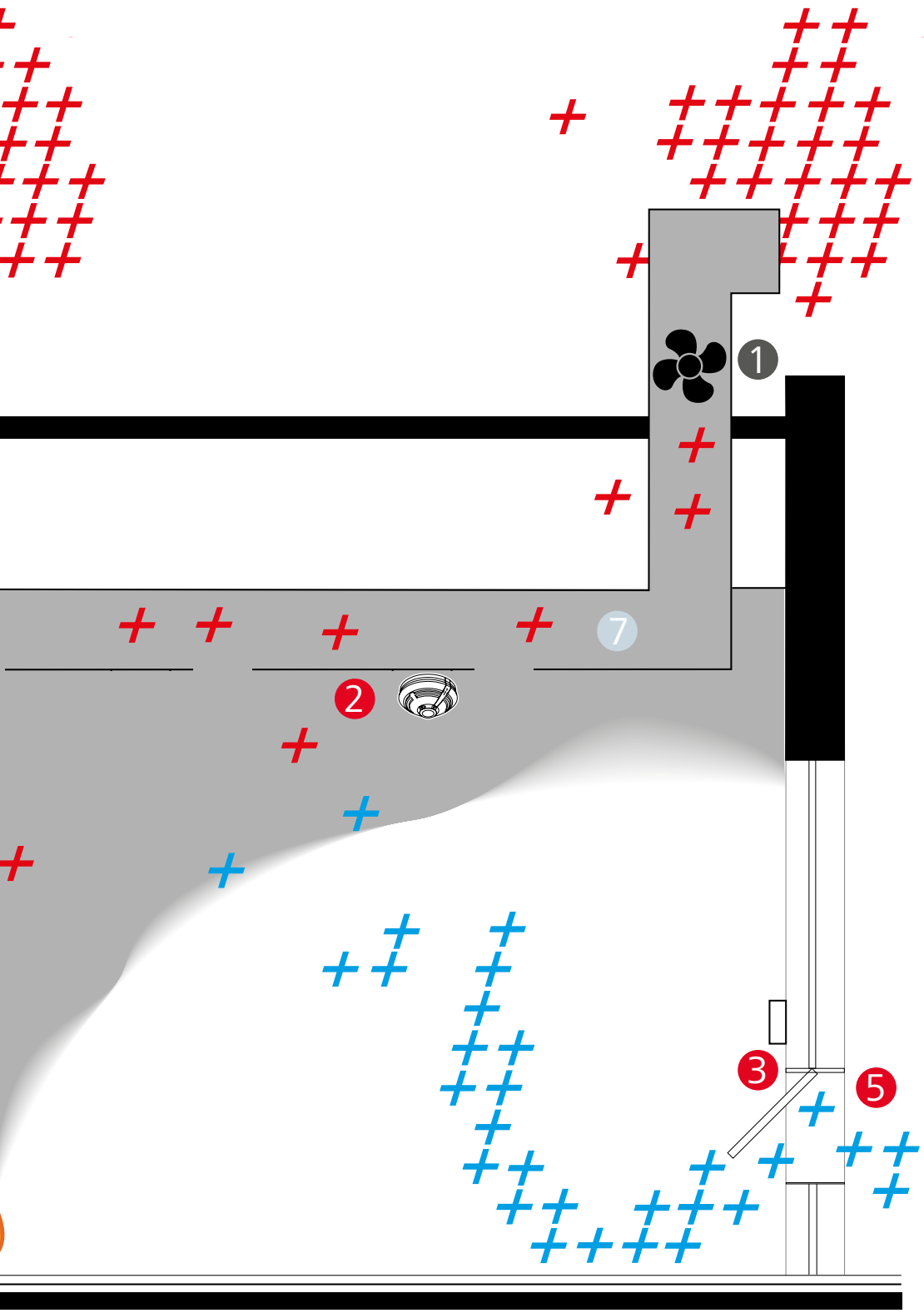
D+H article

Third-party product

Optional third-party product

Your D+H contact person will be happy to support you with planning, project development and searching for suitable suppliers for third-party products.

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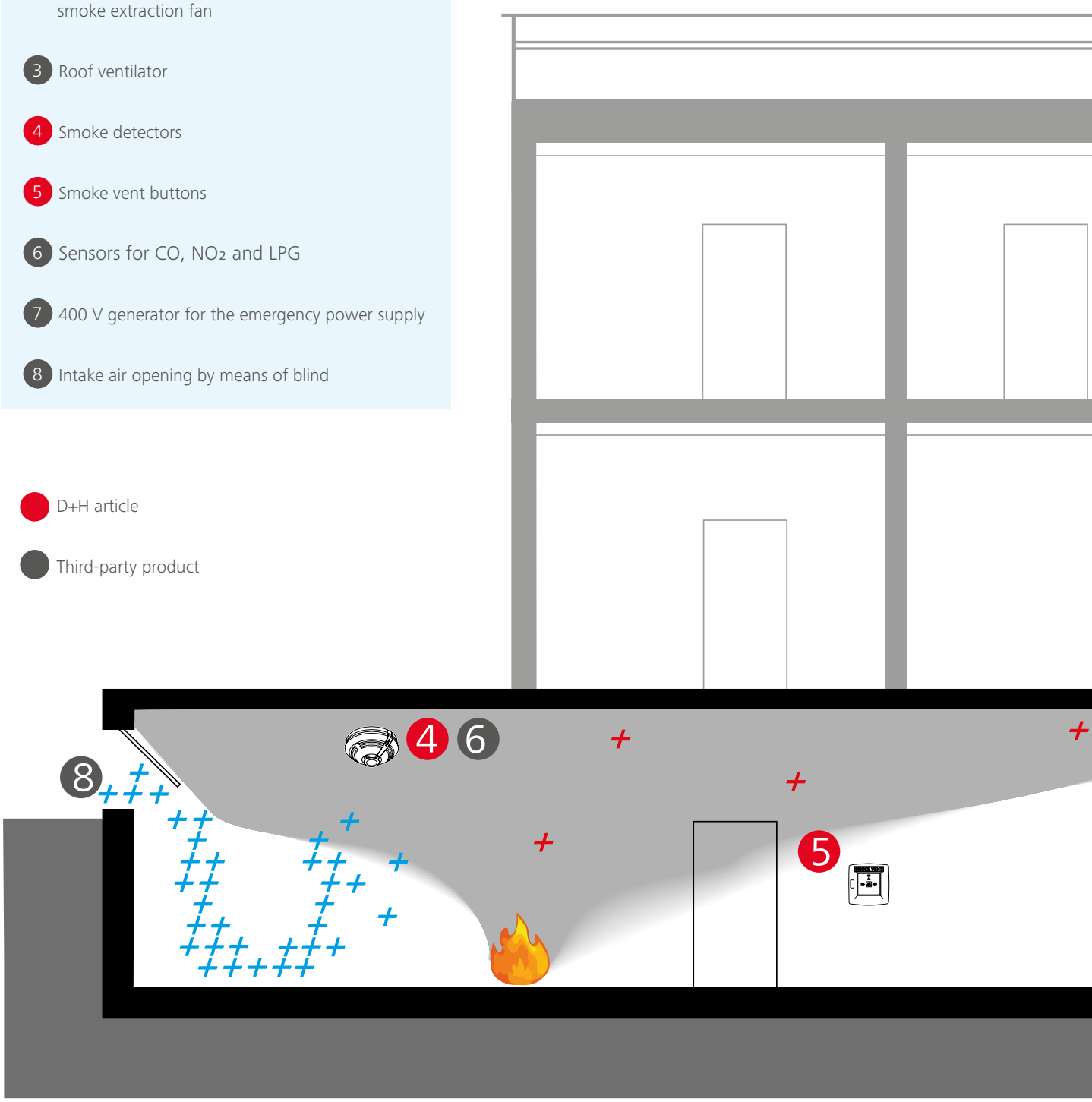
Application in an underground car park*

What you need:

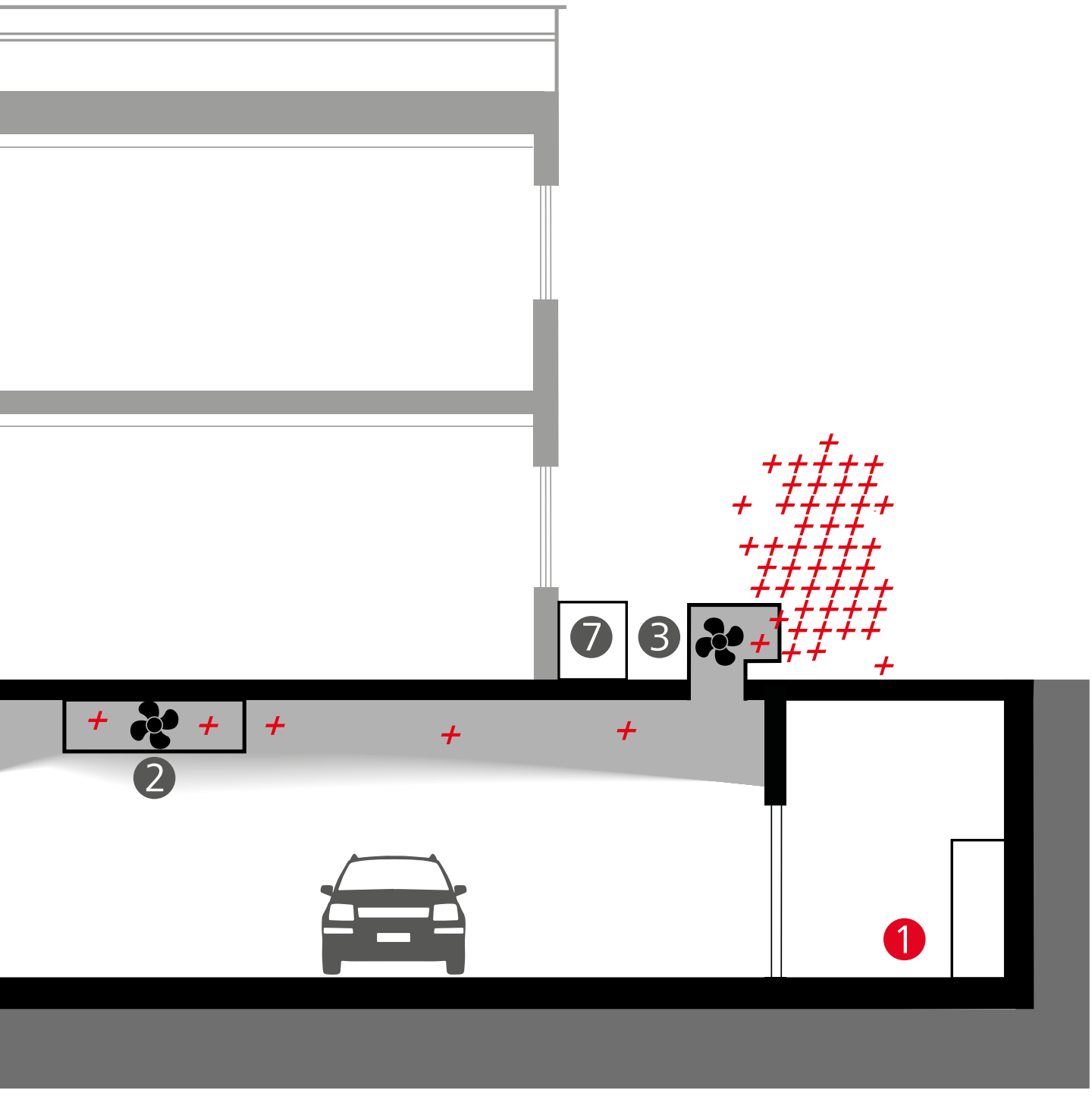
1. CPS-M controller
2. Jetfan (pulse ventilation system) / smoke extraction fan
3. Roof ventilator
4. Smoke detectors
5. Smoke vent buttons
6. Sensors for CO, NO_2 and LPG
7. 400 V generator for the emergency power supply
8. Intake air opening by means of blind

Your D+H contact person will be happy to support you with planning, project development and searching for suitable suppliers for third-party products.



D+H article

Third-party product



*Requires important planning steps in addition to MSE

D+H subsidiaries in Europe

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www.oesterreich.dh-partner.com

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