Fire Safety
in Ventilation Systems
DS 428.4
Code for technical measures for fire protection in ventilation systems

Systemair has a complete range of components for fire protection of ventilation systems. This brochure will provide a list of the most commonly used components, including fire- and smoke dampers, smoke dampers, smoke evacuation dampers and a fire control system for monitoring and exercising of the dampers. It also shows various system solutions that provide an overview of the different possible combinations, all of which are in accordance with the fire protection standard DS 428.4.

DS 428.4
Foreword
The standard contains a number of requirements that dictate how to achieve a responsible fire technical safety and operation of ventilation systems.

Introduction
The standard contains a number of requirements to ensure a responsible fire technical construction of ventilation systems, so that the risk for start, developing and spreading of a fire due to the ventilation system is minimized.

Scope
The purpose of this standard is to ensure that mechanical ventilation systems shall be designed, executed and maintained in such a manner that the potential for start, developing and spreading of a fire due to the system is minimized. The standard contains requirements regarding design, construction, testing, and operation of mechanical ventilation systems.

The standard applies to mechanical and hybrid ventilation systems permanently installed in buildings. Installations for natural ventilation must be performed according to this standard to the extent that they can be assimilated with mechanical ventilation.

Installations for industrial or semi-industrial processes and storage should at least follow the requirements in the standard, but there may be additional requirements from authorities.

Definitions
Fire section: Separation with building material class (R) E60 A2-s1, d0 (formerly BS60)
Fire cell: Separation with building material class (R) E60 (formerly BD60)
R: Carrying capacity
E: Integrity
I: Isolation
S: Tightness for smoke

A2: Non-combustible material
S1: Very limited smoke development
D0: No burning droplets
RV: Smoke fan intended for a smoke extraction system
Ho: Horizontal
Ve: Vertical
E: Fire from the inside and outside.

Fire-, flame-, smoke- and smoke evacuation dampers
BRS: Fire- and smoke damper class E60 (ve ho i (s) o), 70 °C fire thermostat, spring-return actuator. Shall prevent fire and smoke being spread between fire sections.
FRS: Flame- and smoke damper class E60 (ve ho i (s) o), 70 °C fire thermostat, spring-return actuator. Shall prevent smoke being spread between fire sections.
RS: Smoke damper class E30 (ve ho i (s) o), 70 °C fire thermostat, spring-return actuator. Shall prevent smoke being spread between fire cells.
RES: Smoke evacuation damper class E30 (ve ho i (s) o), spring-return actuator. Must ensure the discharge of smoke during a fire situation.

Flexible connections: Must comply with class A2-s1,d0, melting point of at least 850 °C, max length of 300 mm for fan connections in unexploitable attic.

Roof curbs: Must be insulated with 50 mm insulation A2-s1,d0, through the roof, minimum 100 mm under and 100 mm above the roof.

System solutions:
The duct system must be such designed, that the risk of smoke and fire spreading to other fire cells, fire sections or similar building units is not increased.

Damper-secured system:
Securing a ventilation system against spreading of smoke must be based on the creation of reasonable security against that smoke and combustion products can enter the duct system.

Smoke-ventilated systems:
Securing a ventilation system against spreading of smoke must be based on the creation of reasonable security against that smoke and combustion products, which have entered the duct system, can not be spread through the duct system to other fire cells, fire sections or similar building units.

A smoke-ventilated system must be such designed, that smoke in the system is discharged to the outside with reasonable safety. A smoke-ventilated system cannot be combined with fire-, flame- and/or smoke damper, which prevents the discharge of smoke that has entered the system. With the exception of the outermost fire cell or similar building units, from where spreading of smoke to other fire cells, or similar building units are impossible. In a smoke-ventilated system, the smoke must run via a duct, by-passing parts of the system with large flow resistance, or components in which the risk of clogging of the smoke particles from a fire is great. This includes filters, heat recovery components, heating- and cooling coils, etc.
Fire Safety in Ventilation Systems

Fire Safety

Regarding fire safety of ventilation systems, the most important is: To save lives and valuable inventory, and to ensure good working conditions for the rescue team. A fire occurrence must be limited before it develops into a disaster. Foremost to save lives, but also significant values may be lost. The requirements for personal safety and the emergency response capacity are very closely linked to the risk of fire spreading and stability of the building. Strategically, this means that in case of a fire, persons must be able to exit the building by themselves or with help from the rescue team.

Buildings – and especially inventory – contain an amount of combustible material. A correct fire safety of ventilation systems can prevent heat and smoke from spreading through the ventilation system. Should for example a too early destabilization of the building occur, a collapse can cause a disaster risk of a significant size. Fire safety in ventilation plants is thus necessary in modern buildings.
Fire- and smoke dampers
PK-I-R EI60/90S

Type PK-I-R EI60S DV9-T
Type PK-I-R EI90S DV9-T
- Approved according to EN 1366-2
- Classified according to EN 13501-3
- Additional class EI60 (ø100-ø630)
- Additional class EI90 (ø710-ø1000)
- Fire class according to DS 428.4, EI60 (ø100-ø1000)
- For mounting in circular ducts (ø100-ø1000)
- For mounting both horizontal and vertical, independent of position of the damper shaft
- Ready to install in all types of walls and ceilings
- Equipped with 24 V spring-return actuator, currentless closed.

Fire- and smoke dampers shall prevent fire and smoke being spread between fire sections or similar fire performance units through the duct system.

The damper blade consists of calcium-silicate board (asbestos-free), fitted in a protecting frame of galvanized steel. The damper blade has a fire passive sealing (a ring of rubber, which prevents penetration of smoke) and a fire active sealing (an expanding fire paste, which prevents penetration of smoke and heat transfer during a fire). The damper has male connection. The damper will be delivered as type DV9-T with spring-return actuator (24 V), currentless closed. 230 V is available.

The actuator will close the damper blade at thermal or electrical signal. The damper has a fire thermostat which, when having reached or exceeded the ambient temperature of 72°C (tolerance of ±1.5°C) in 30 to 60 seconds, activates the actuator and closes the damper blade within 60 seconds.

Accessories: 2 sets of cover plates made from calcium-silicate boards must be used at installation in lightweight walls (gypsum walls) and heavy structures (bricks/concrete), if no casting is made around the damper. The cover plates must be fastened on both sides of the wall/covered and tightened against smoke with fire sealing. Fire- and smoke dampers must always be installed in the section separation. Installation manual and installation certificate PK-I-R EI60/90S, see www.systemair.com/dk/Danmark/Produktkatalog/

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Smoke dampers and smoke evacuation dampers

PK-I-R E60S (RS) and EK-I-R E60S (RES)

Type PK-I-R E60S DV9 (RS)
Type EK-I-R E60S DV9 (RES)
- Approved according to EN 1366-2
- Classified according to EN 13501-3
- Additional class E30/E60 (ve ho i=0)S
- Fire class according to DS 428.4 E30/E60 (ve ho i=0)S
- For mounting in circular ducts (ø100-ø630)
- For mounting both horizontal and vertical, independent of position of the damper shaft
- Equipped with 24 V spring-return actuator, currentless closed/open.

A smoke damper PK-I-R E60S (RS) shall prevent smoke being spread between fire sections or similar fire performance units through the duct system. A smoke evacuation damper EK-I-R E60S (RES) shall ensure the discharge of smoke during a fire. Smoke evacuation dampers are used in ducts with discharge to the outside and in by-pass-ducts that leads the smoke past system parts.

The damper blade consists of galvanized steel and has a rubber sealing, which prevents penetration of smoke.

The damper has male connection. The damper will be delivered as type DV9 with spring-return actuator (24 V), currentless closed at type RS and currentless open at type RES. 230 V is available. An electrical signal to the actuator will activate the damper blade and open/close it within 20 seconds.

Installation manual and installation certificate PK-I-R E60S/EK-I-R E60S, see www.systemair.com/dk/Danmark/Produktkatalog/

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Fire- and smoke dampers
PK-I-S EI90S

Type PK-I-S EI90S DV9-T
• Approved according to EN 1366-2
• Classified according to EN 13501-3
• Additional class EI 90 (ve ho i-o)S
• Fire class according to DS 428:4, EI 90 (ve ho i-o)S
• For mounting in square ducts (100x100 - 1000x1600)
• For mounting both horizontal and vertical
• Ready for installation in all types of walls and ceilings
• Equipped with 24 V spring-return actuator, currentless closed.

A fire- and smoke damper shall prevent fire and smoke being spread between fire sections or similar fire performance units through the duct system. The damper blade consists of calcium-silicate board (asbestos-free), fitted in a protecting frame of galvanized steel. The damper blade has a fire passive sealing (a rubber sealing, which prevents penetration of smoke) and a fire active sealing (an expanding fire paste, which prevents penetration of smoke and heat transfer during a fire).

The damper will be delivered as type DV9-T with spring-return actuator (24 V), currentless closed. 230 V is available.

The actuator will close the damper blade at thermal or electrical signal. The damper has a fire thermostat which, when having reached or exceeded the ambient temperature of 72°C (tolerance of ±1.5°C) in 30 to 60 seconds, activates the actuator and closes the damper blade within 60 seconds.

Accessories: 2 sets of cover plates made from calcium-silicate boards must be used at installation in lightweight walls (gypsum walls) and heavy structures (bricks/concrete), if no casting is made around the damper. The cover plates must be fastened on both sides of the wall/covered and tightened against smoke with fire sealing. Fire- and smoke dampers must always be installed in the section separation. Installation manual and installation certificate PK-I-S EI90S, see www.systemair.com/dk/Danmark/Produktkatalog/

B: Dimension and weight, kg
A: Fire- and smoke dampers in small sizes. See table A below.


Note: Dampers with dimensions ≤ 150 mm have flange dimensions of 30 mm.

### A: Dimension and weight, kg

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* Damper blade measurements, when it is fully open.
Fire Safety in Ventilation Systems

Fire control system BR-A2
Systemair’s fire control system has been prepared in accordance with DS 428.4 for easy and simple installation (bus system); it is configurable and therefore extremely flexible. The fire control system contains all the necessary functions such as monitoring, testing and verifying the operation of fire- and smoke dampers, smoke evacuation dampers, and communicating with the unit and possibly, the smoke extract fan.

Key features:
• Disables the dampers and disconnects the fan/unit in case of a fire
• Weekly tests of dampers and possibly, the smoke extract fan, to ensure that they are operational
• Manual testing is possible
• Ensures that the dampers are open during normal operation, and ventilation is functioning as planned
• When smoke/fire is detected, you can choose to have all dampers closed and shut down the ventilation in the entire building or only in the current fire section
• Detailed error message on each damper
• 24 V supply and control via the bus system for each damper.

The fire control system consists of the following components:

Control panel BR-A2, BP
• Display for monitoring and setting of the necessary parameters
• Alarm readout for fire- and service alarms and alarm log
• Reset of the alarms above.
• Manual exercise of fire- and smoke dampers, smoke dampers, smoke evacuation dampers, and possibly, smoke extract fan
• Timer-setting for weekly exercise
• A control panel can be connected to max. 16 section controllers
• Event log for the latest 84 exercises and service receipts are saved automatically.

Section controller BR-A2, SK
• Max. 62 damper units can be controlled and monitored
• When using more than 62 dampers an extra section controller must be connected as a “slave”
• Smoke detector (max. 10 pcs.)
• BTB temperature sensor with reset on the control panel, 40 °C (default)
• Detailed error message on each damper
• Stop of the fan/unit
• External fire detection system or signal device
• Start and control of smoke fan
• Service signal
• DPT Differential pressure transmitter for monitoring and control of fan
• IP 54 box enclosed
• Main power supply 230 V AC
• Power supply 24 V DC for 5 dampers
• The section controller can work without any control panel.

Damper module BR-A2, SM
• One damper module used by each fire- and smoke damper, smoke damper or smoke evacuation damper
• Mounting bracket included
• Terminals and cable clamp for connection of damper and bus cable.

Power supply BR-A2, SF
• The section controller can supply the first 5 dampers
• Hereafter use a power supply for every 8 dampers
• Max. 100 m cable to the farthest damper
• Max. total bus length 1200 m.

Smoke detector for duct type RDK-2 (UG-3-O)
• Smoke detector for measuring/detection of smoke in the duct system
• Air velocity between 0.2 and 20 m/s.

Temperature sensor type BTB (TT-522)
• The temperature sensor detects a set temperature due to fire and transmit the signal to the section controller.

Differential pressure transmitter type DPT
• Differential pressure transmitter incl. connector and measure hose, detects the pressure in the duct and transmits the signal to the section controller
• Monitors the exhaust fan operation
• Control of smoke fan operation by weekly exercising
• Pressure control of the smoke fan in a fire situation.
**Wiring plan**

- **TIME ec**
- **KBR/F-EC** 230 V AC
- **DVG-V/F-EC** 230 V AC
- **AXC(B)** 400 V AC
- **DVV** 400 V AC
- **RDK-2**
- **BTB**
- **DPT**

- **BR-A2, BP, Control panel**
- **BR-A2, SK, Section controller** 230 V AC
- **BR-A2, SM Damper module, max. 5 pcs.**
- **BR-A2, SF, Power supply** 230 V AC
- **BR-A2, SM Damper module, max. 8 pcs.**
- **BR-A2, SM Damper module**
- **BR-A2, SF, Power supply** 230 V AC

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### PDS network cable Cat 6 AWG 23 (24)
- 1 x 230 V AC
- 1 x 230 V AC (fire resistant cables)
- 3 x 400 V AC (fire resistant cables)
- 3 x 400 V AC (shielded, fire resistant cables)

Length of power supply cables may typically be:
- Damper placed typically 2 and 2 (distance 2 m).
- Example 1: First pair 40 m, next pair 15 m, next pair 15 m etc.
- Example 2: First pair 10 m, next pair 30 m, next pair 30 m etc.

If a fan and frequency converter is placed in the same cell, fire resistant cables can be omitted.
Damper-secured systems can be used in all usage categories, but are most suitable for usage category 1, 2, 3, and 6. These usage categories are all buildings for day time occupancy, where ventilation often will be stopped at night. These categories include for instance:

1: Offices, industrial and warehouse buildings, certain garages, outbuildings and carports.

2: Teaching rooms, school day-care centers, after-school facilities, day centers.

3: Shops, shopping malls, places of public assembly, meeting rooms, canteens, restaurants, cinemas, discotheques, theatres.

6: Elderly housing, treatment rooms and wards on hospitals, nursery-homes, homes and institutions for people with physical or mental difficulties, nurseries and kindergartens.

For usage category 1, 2 and 3, there will be some exceptions for penetration of fire cells, for example, if there is already established automatic fire alarm- and warning systems, sprinkler- and warning systems, smaller secondary rooms for short stay or if there is established a direct escape route to the outside from the room.

Systemair fire control system ensures that smoke dampers and fire- and smoke dampers closes by fire and by night stop.

Detection of fire must be made for each fire section in the exhaust duct. Smoke dampers between cells are

Spreading of smoke and fire through the duct system

The duct system must be such designed, that the risk of smoke and fire spreading to other fire cells, fire sections or similar building units is not increased.

Penetration of fire sections must be ensured with fire- and smoke dampers BRS. Penetration of fire cells must be secured with smoke dampers RS.

Systemair fire control system ensures that smoke dampers and fire- and smoke dampers closes by fire and by night stop.

Detection of fire must be made for each fire section in the exhaust duct. Smoke dampers between cells are

Example 1
1 fire section, 3 fire cells: 4 pcs. smoke dampers RS. Fire control system consisting of: 1 pcs. BR-A2, BP control panel, 1 pcs. BR-A2, SK section controller, 4 pcs. BR-A2, SM Damper modules, 1 pcs. RDK-2 Smoke detector for duct, 1 pcs. DPT pressure transmitter. All ventilation ducts in the ventilation room and unexplorable attic must be insulated with thermal insulation class A2-s1, d0. The drawing is indicative, and it is the design engineer’s responsibility to ensure that the design is in accordance with the law.

Explanation of symbols

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<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tr>
<td>Fire cell separation</td>
<td>Fire cell separation</td>
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<tr>
<td>Ventilation duct</td>
<td>Ventilation duct</td>
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<td>RS</td>
<td>Smoke damper</td>
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<tr>
<td>RES</td>
<td>Smoke evacuation damper</td>
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<td>BRS</td>
<td>Fire- and smoke damper</td>
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<td>ax-Pa</td>
<td>Smoke resistance indicated in Pa</td>
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<td>B-iso</td>
<td>Fire insulation</td>
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<tr>
<td>iso</td>
<td>Insulation</td>
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<tr>
<td>RV</td>
<td>Smoke fan</td>
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<tr>
<td>BTB</td>
<td>Fire thermostat/temperature sensor BTB</td>
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<td>DPT</td>
<td>Pressure transmitter DPT</td>
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<td>RDK-2</td>
<td>Smoke detector, duct mounting RDK-2</td>
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<td>ABA+AVA</td>
<td>Auto. fire alarm- and warning system</td>
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activated by the shared detector of the current fire section.

At fire detection, you can choose to let supply- and exhaust fans continue to run, and only close the smoke dampers and fire- and smoke dampers that are operating the fire affected section.

Air intake- and exhaust dampers must also be closed. You can also choose to stop the supply- and exhaust fans. Then all smoke dampers and fire- and smoke dampers must close.

Weekly exercise of smoke dampers and ensuring that the dampers are open during normal operation. It is possible to do manual testing of dampers.

Example 2
3 residential fire sections, 6 residential fire cells: 6 pcs. BRS fire- and smoke dampers, 6 pcs. RS smoke dampers. Fire control system consisting of: 1 pcs. BR-A2, BP control panel, 1 pcs. BR-A2, SK section controller, 1 pcs. BR-A2 SF power supply, 12 pcs. BR-A2, SM Damper modules, 3 pcs. RDK-2 Smoke detector for duct, 1 pcs. DPT pressure transmitter. Alternatively, 3 pcs. BR-A2, SK section controls (no BR-A2 SF power supply, but BRS in all branches of the shaft). All ventilation ducts in the ventilation room and unexplorable attic must be insulated with thermal insulation class A2-s1, d0. The drawing is indicative, and it is the design engineer’s responsibility to ensure that the design is in accordance with the law.
Smoke-ventilated systems can be used in all usage-categories, but are especially suitable for usage category 4, 5, 6, and for buildings whose upper floors are higher than 22 meters above the ground. Usage category 4, are for example residential buildings and youth housing, where there is a requirement for 24 hours of operation of the ventilation system. Usage category 5, are for example hotels, hostels, inns, dorms and guesthouses where there is a requirement for full automatic fire alarm- and warning systems, if there are more than 10 beds. Otherwise, a voluntary automatic fire alarm- and warning system must be considered. Alternatively there must be established a damper-ensured system, which must be either for 24 hours of operation or with an automatic fire alarm- and warning system, which is required if there are more than 10 beds. Usage category 6 Elderly housing, treatment rooms and wards on hospitals, nurseryhomes, homes and institutions for people with physical or mental difficulties, nurseries and kindergartens. All buildings where a complete automatic fire alarm- and warning system is demanded. A smoke-ventilated system must be such designed, that smoke in the system is discharged to the outside with reasonable safety. A smoke-ventilated system cannot be combined with fire-, flame- and/or smoke damper, which prevents the discharge of smoke that has entered the system. In a smoke-ventilated system, the smoke must run via a duct, by-passing parts of the system with large flow resistance or components in which the risk of clogging of the smoke particles from a fire is high. This includes filters, heat recovery components, heating- and cooling coils etc. A by-pass duct is equipped with a smoke evacuation system.
A damper that is closed at normal operation with voltage (currentless open). A smoke-ventilated system is generally performed as a duct class EI 30/E60 A2-s1,d0, which also includes ducts in installation shafts and unexploitable attics. An exception to this is ducts in the ventilation room, ducts in the open air (outdoor) and ducts that only serve one fire section and are located within this. Ducts in an unexploitable attic, which only serves one fire section and are located within this, must be insulated with minimum 50 mm insulation class A2-s1,d0. Branches from a fire insulated duct should be fire insulated corresponding to the diameter of the branch, but a minimum of 0.2 m. For an extraction system, reasonable safety for the discharge of smoke to the outside can be achieved by: Smoke-ventilated system with smoke fan in operation, where all residential fire cells is performed with a minimum of 50 Pa smoke resistance.

Example 4
Residential ventilation with heat recovery unit and smoke fan: 1 pcs. smoke fan RV, 2 pcs. FLXB flexible connections, 2 pcs. smoke damper, 3 pcs. smoke evacuation damper. Fire control system consisting of: 1 pcs. BR-A2, BP control panel, 1 pcs. BR-A2, SK section controller, 5 pcs. BR-A2, SM damper modules, 1 pcs. DPT pressure transmitter, 1 pcs. BTB temperature sensor, 3 pcs. cooker hoods H-106-E. All ventilation ducts in the ventilation room must be insulated with thermal insulation class A2-s1, d0. All ducts in shaft and unexploitable attic must be insulated with fire insulation class EI30/E60 A2-s1, d0. The drawing is indicative, and it is the design engineer’s responsibility to ensure that the design is in accordance with the law.
Smoke-ventilated system
Excerpts from DS 428.4

For supply air systems, where the extract system in the operated fire sections or similar fire units are designed as smoke-ventilated system, can reasonable safety for the discharge of smoke to the outside be achieved by: Converted system, where the supply air system is designed as a smoke-ventilated duct system, supplemented with a smoke fan or coupled with the smoke fan in the extract system. All residential fire units are performed with a minimum of 30 Pa smoke resistance. A smoke resistance including connected ducts and possible flexible connections must everywhere be performed as material class A2-s1, d0 with a melting point of at least 850 °C. The smoke fan can be the extract fan for the normal operation or a separate fan exclusively for smoke extraction. The connection point for the smoke fan must be at or above the upper channel system branching to the

Example 5
Residential ventilation with the smoke fan as daily, normal fan (50 Pa): 1 pcs. RV smoke fan KBR/F-EC (400 °C), 2 pcs. FLXB flexible connections, 1 pcs. Ceboco 10 pressure control, 3 pcs. cooker hoods H-106-E (50 Pa), 1 pcs. AKHI roof cowl. Alternatively, roof fan type DVG-V/F-EC can be used. All ducts in shaft and unused attic must be insulated with fire insulation class EI30/E60 A2-s1, d0. The drawing is indicative, and it is the design engineer’s responsibility to ensure that the design is in accordance with the law.
operating area, so that smoke will not be sucked down into a duct system with branches. A smoke fan must be able to withstand the occurring temperature for 60 min. after the fire has started, valid from a normal-temperature operating fan with a minimum of 1 hours operation and at an ambient temperature of 20 °C without cooling from wind or rain. Functional requirement is documented by manufacturer.

The temperature at the smoke fan is set as a mixing temperature, consisting of 945 °C from the fire room, and 20 °C from the remaining rooms (the mixing temperature must be at least 100 °C). The fire room is usually determined as the fire cell with the largest air volume - for systems with variable air volume, uses the maximum air volume rate. For calculation of the maximum flue gas temperature, the maximum air volume in the fire room is used. For remaining rooms, use diversity factor 0.2 for the difference in air volume between minimum and maximum air volume without calculation of other diversity factors. The air volume depends on the building's density and is typically smaller than the air volume. The volume must be sufficient to ensure the system's required smoke resistance, however pressure limited to a maximum of 100 Pa negative pressures at the upper branch to the operating area. This negative pressure must be maintained at maximum and minimum opening of diffusers and dampers in systems with variable air volume.

**Explanation of symbols**

- **Fire section separation**
- **Fire cell separation**
- **Ventilation duct**
- **Smoke damper**
- **Smoke evacuation damper**
- **Fire- and smoke damper**
- **Smoke resistance indicated in Pa**
- **Fire insulation**
- **Insulation**
- **Smoke fan**
- **Fire thermostat or temperature sensor BTB**
- **Pressure transmitter DTP, Cebocon5**
- **Smoke detector duct mounting RDK-2**
- **ABA+AVA**
- **Auto. fire alarm- and warning system**

**Example 6**

Residential ventilation with the extract fan as daily, normal fan (100 Pa). Separate fire insulated ducts in shaft: 1 pcs. KVKE-EC box fan, 2 pcs. FLXB flexible connections, 1 pcs. CEBOCON 5 pressure control (100 Pa), 2 pcs. cooker hoods H-106-E (100 Pa), 1 pcs. AKHI roof cowl. All ducts in shaft and unused attic must be insulated with fire insulation class EI30/E60 A2-s1, d0. The drawing is indicative, and it is the design engineer’s responsibility to ensure that the design is in accordance with the law.