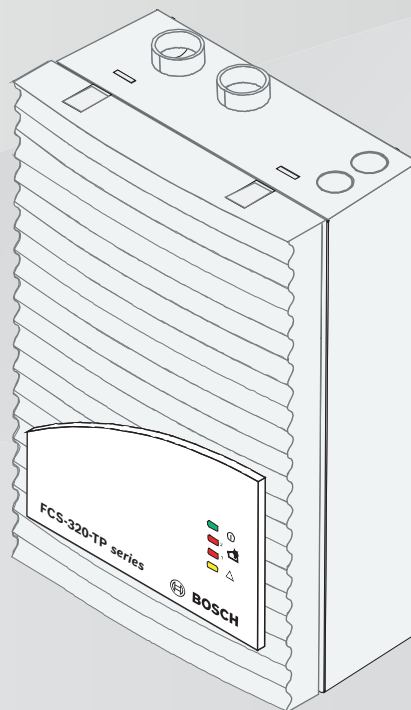




**BOSCH**

# Conventional Aspiration smoke detector

FCS-320-TP series



en

Operation guide



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# 1 Safety

The following symbols identify points in this operation guide that require particular attention in order to guarantee smooth operation and prevent damage.

**Notice!**

Operational malfunction can be prevented and operational improvements can be achieved by observing these instructions.

**Caution!**

This symbol warns against actions and behavior which, if disregarded, could cause property damage.

**Warning!**

This symbol warns against actions and behavior which, if disregarded, could cause personal injury.

## 2 General

### 2.1 Introduction

This operation guide describes the smoke aspiration systems featuring FCS-320 series Aspirating Smoke Detectors and the associated aspiration pipe system.

The FCS-320 designation in this operation guide refers to all FCS-320 series versions. Specific references are made to differences between the individual versions.

### 2.2 Warranty

The operation guide is subject to technical modification without prior notice and makes no claim to completeness. Our "delivery and installation conditions" apply as a matter of principle. Warranty and liability claims in case of personal injury and property damage cannot be asserted if they are based on one or more of the following causes:

- Insufficient attention to the instructions with respect to planning, installation of the aspirating smoke detector, installation of the pipe system, commissioning and maintenance
- Use of the smoke aspiration system contrary to the regulations
- Insufficient monitoring of wearing parts
- Faulty repairs
- Arbitrary constructional changes to the smoke aspiration system
- Acts of God.

Bosch Sicherheitssysteme GmbH, hereinafter referred to as Bosch, assumes no liability for damage or malfunction arising through failure to comply with this operation guide.

**Caution!**

The equipment may only be installed by authorized and qualified personnel!

## 2.3 Copyright

The copyright to this operation guide remains with Bosch.

This operation guide is intended exclusively for installation engineers and their employees. Reprinting this operation guide or extracts thereof is permitted for internal purposes only.

## 2.4 Disposal



Unusable electrical and electronic devices or modules must not be disposed of with normal household refuse. They must be disposed of in compliance with the applicable regulations and directives (e.g. WEEE in Europe).

# 3 Technical specifications

## 3.1 Product description

Aspirating smoke detectors from the FCS-320 series are active fire detection devices that are connected directly to conventional lines for early smoke and fire detection. They are used for room and equipment protection as well as for monitoring air-conditioning units or ducts.

### Variants

The FCS-320-TP1 and FCS-320-TP2 models feature LED displays indicating operating mode, malfunction and alarm (the FCS-320-TP2 has two alarm displays). The FCS-320-TT1 and FCS-320-TT2 models offer differentiated alarm displays (info, Internal and main alarm) as well as a 10-level smoke display (on the FCS-320-TT2, all alarm and smoke level displays are doubled).

The FCS-320-TP1 and FCS-320-TT1 variants are each fitted with a detector module. Both FCS-320-TP2 and FCS-320-TT2 have two integrated detector modules each. Two aspiration pipes can be connected, enabling two areas to be monitored. This effectively doubles the monitoring area.

### Dual-detector dependency

The use of two detector modules in variants FCS-320-TP2 and FCS-320-TT2 also enables a dual-detector dependency to be realized. This means that one area can be monitored by two pipe systems.

### Two alarm stages

Alternatively, the FCS-320-TP2 and FCS-320-TT2 can have two alarm stages configured. A pipe system is connected via a pipe adapter on two detector modules. Selecting different response sensitivities for the detector modules enables the time-staggered triggering of two main alarms.

### Sensitivity

Three detector module versions are available for the FCS-320 aspirating smoke detector series:

- DM-TP-50(80) with a response sensitivity of up to 0.5%/m (0.8%/m) light obscuration
- DM-TP-10(25) with a response sensitivity of up to 0.1%/m (0.25%/m) light obscuration
- DM-TP-01(05) with a response sensitivity of up to 0.015%/m (0.05%/m) light obscuration.

Depending on the detector module used, the FCS-320-TT1 and FCS-320-TT2 models can achieve a resolution ten times higher for displaying up to 0.05%/m (0.08%/m), 0.01%/m (0.025%/m) or 0.0015%/m (0.005%/m) light obscuration.

**Notice!**

The sensitivity value is based on measurements with standard test fires (old value in brackets).

The new High-Power-Light-Source technology permits a broad detection spectrum over all standardized fires.

**LOGIC×SENS**

The intelligent signal processing LOGIC·SENS distinguishes between deception variables and fire events in order to prevent false alarms.

**Reliable airflow monitoring**

Analogous to point-type smoke detectors, which are monitored electronically for wire breaks and short-circuits, highly sensitive and dependable airflow monitoring is required for smoke aspiration systems. The airflow sensors used in the FCS-320 series reliably detect malfunctions such as pipe breakage or obstructions in the air sampling openings. Airflow monitoring is temperature-compensated and can be set depending on the air pressure. The small airflow unit also contains a dynamic airflow sensor that enables a response to small and fast changes in the airflow.

**Patented air sampling openings**

The air sampling openings of the pipe system require clearly defined bore diameters that depend on the planning and design. These precise air sampling openings are created using patented aspiration reducing film sheets, marking tape, and clips, which not only permit easy installation, but also prevent "whistling" noises. Another advantage is the quick and easy detection and checking of the air sampling opening diameters.

**Point-type detector projection**

The system's aspiration points can be equated with point-type smoke detectors. The monitoring areas can therefore be planned in accordance with the applicable national regulations.

**Diagnostics**

There is a system available with the FAS-ASD-DIAGdiagnostic software that enables quick and convenient error containment for maintenance and service. The current and stored unit status is read out via cable data transmission to the PC.

**Selecting the fan voltage**

The fan voltage for special planning can be increased from 6.9 V to 9 V by relocating the fan jumper. This increases the air transport speed and therefore reduces detection time.

## 3.2

### Areas of application

Thanks to their detection principle, FCS-320 aspirating smoke detectors represent an extremely versatile fire protection solution.

**Principle**

Air samples are taken from the monitoring range by a pipe system with defined aspiration borings and then fed to the detection module.

This is especially well-suited for areas in which point-type detectors cannot be used or can only be used under certain circumstances. These include:

- Areas that are difficult to access, in which point detectors are difficult to install and maintain
- Air-conditioned areas
- Areas that require the earliest detection possible
- Areas with a height greater than that allowed for point detectors

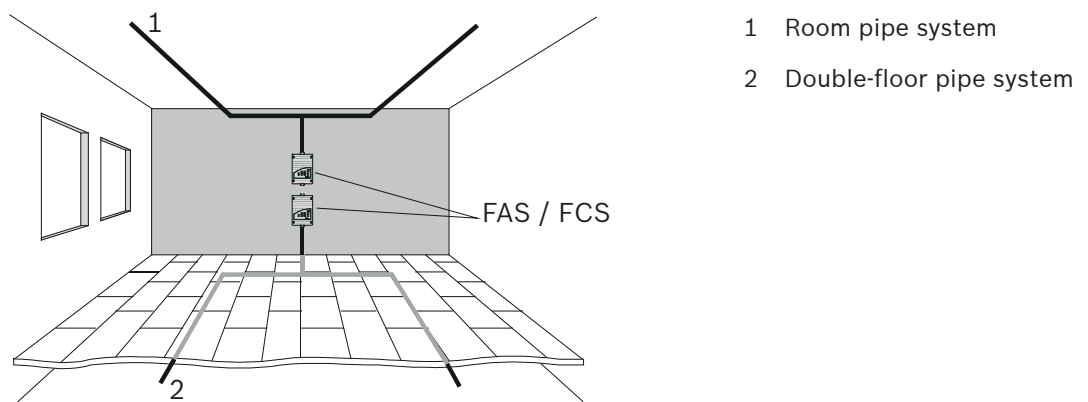


- Areas in which point detectors are not desired for aesthetic reasons
- Areas in which strong electromagnetic fields occur
- Areas that are exposed to high or low temperatures
- Areas with contaminated air that require filter elements
- Areas that must be protected against vandalism.

### Space protection

The FCS-320 series is suitable for monitoring areas such as

- Those with double floors, false ceilings
- Tunnels, ducts, barely accessible hollow spaces
- Storage, high-rise warehouses, elevator shafts
- Museums, cultural institutions
- Hotel rooms, hospital rooms, offices, prison cells, train compartments
- Freezer storage

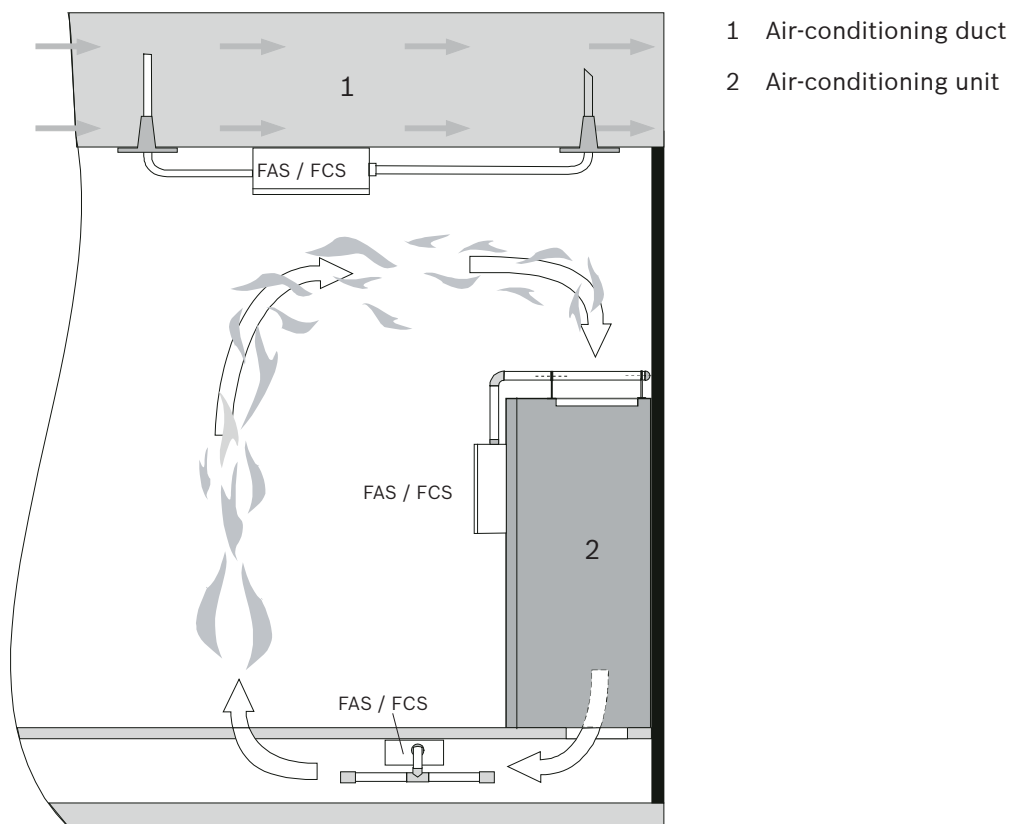


Principle of area monitoring with FCS-320 series Aspirating Smoke Detectors

### Area monitoring with air-conditioning

Area monitoring occurs

- In rooms with air-conditioning for server rooms etc.
- In ventilation ducts
- In double floors, false ceilings
- In IT rooms, e-distributor rooms, transformer cells
- On air-conditioning units (see figure below) or
- In the bypass in air-conditioning ducts.



Monitoring options for an air-conditioning unit or an air-conditioning duct (depiction of principle)

The FCS-320 Aspirating Smoke Detector can be used for early fire detection in areas with special-purpose air conditioning.

Thanks to its high sensitivity, expensive goods and equipment can be monitored reliably. The aspirating smoke detectors from the FCS-320 series are therefore especially suitable for areas of application:

- Where early intervention is essential due to a high value concentration
- Where equipment must always be operational
- Where highly sensitive detection is necessary (e.g. in areas where, due to built-in filter elements, the air contains a low concentration of smoke particles)
- Where high air-exchange rates prevail.

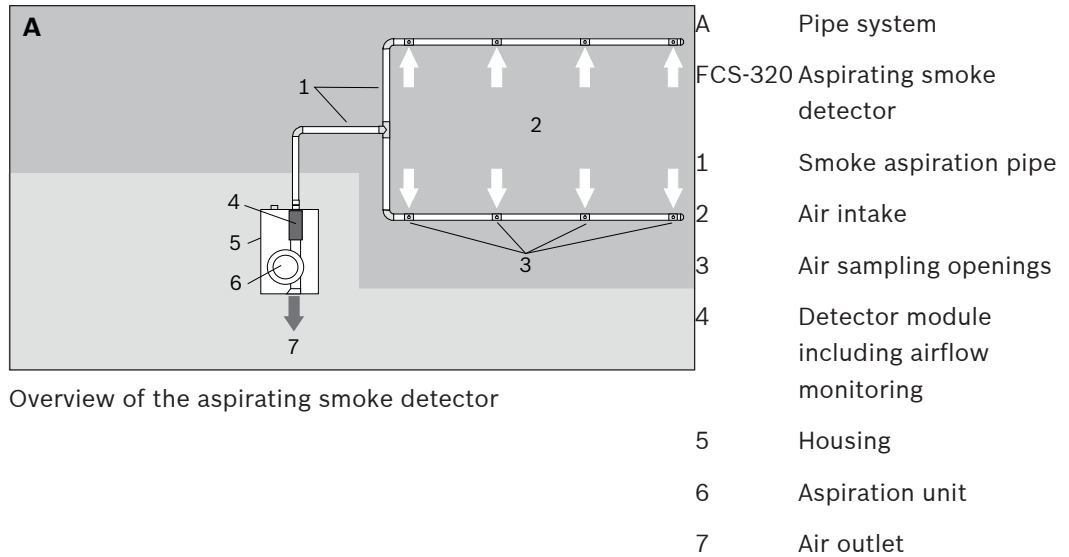
### 3.3 System overview

The smoke aspiration systems comprise an aspirating detector and pipe system.

The aspirating smoke detector comprises the detector module for detecting the smoke aerosols, the aspiration unit for transporting the air samples to the detector module and the airflow sensor for monitoring the pipe system for breakage and obstructions.

The pipe system comprises essentially pipe and fittings. The standard pipe system is made from PVC or ABS. The pipes used for equipment monitoring should be halogen-free.

Each air sampling opening in the pipe system represents a point detector in the planning.



Overview of the aspirating smoke detector

To guarantee reliable operation even under the most difficult conditions (clean rooms, recycling area), there are numerous accessories available, such as air filters, water separators and detonation safety barriers.

### 3.4 Functions

Air samples are taken from the area to be monitored via the aspiration unit. They are fed via a pipe system with defined air sampling openings to the sensitive detection module.

#### Detector module

Depending on the response sensitivity of the detector module in use and programmed alarm threshold, the FCS-320 Aspirating smoke detector series triggers the alarm when the corresponding light obscuration threshold is reached. With the FCS-320-TP1 and the FCS-320-TP2, the alarm is displayed via the alarm LED and/or two alarm LEDs on the unit and transmitted to a connected fire panel. The FCS-320-TT1 and FCS-320-TT2 versions offer differentiated LED displays for info, internal and main alarm. Internal and main alarms are transmitted to the fire panel (with FPA-5000 Rel 2.1; additionally with info alarm from Rel 2.5 or above).

Various delay times can be programmed for the alarm thresholds, as well as for displaying and transferring malfunctions. Alarm messages are saved and are reset after the cause has been eliminated.

#### LOGIC · SENS

The LOGIC · SENS intelligent signal processing compares the measured smoke level with known disturbance variables and decides between alarm and deception.

#### Detector module monitoring

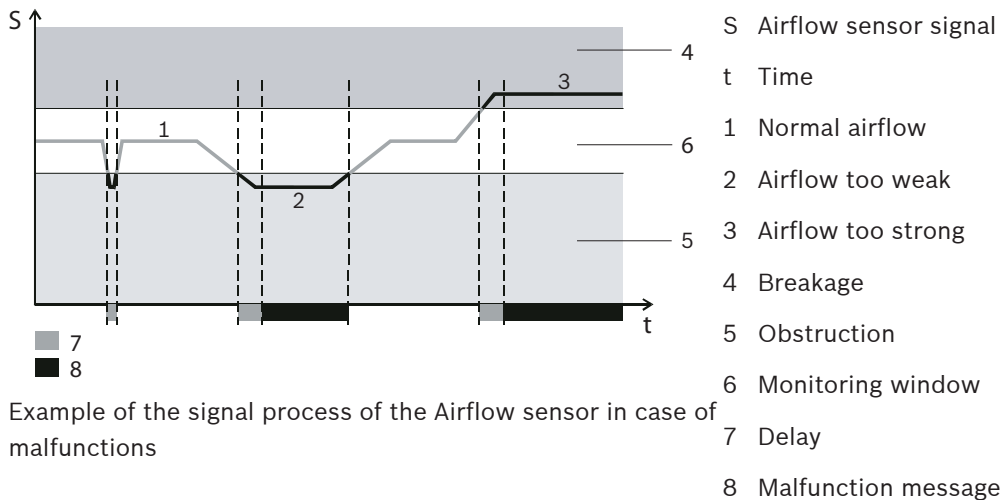
Each detector module is monitored for contamination, signal malfunction and removal. Soiling of the detector module has no effect on its sensitivity. With all variants, any malfunction is displayed via the malfunction LED and transferred to the fire panel. Malfunctions caused by brief environmental fluctuations can be eliminated with a time-delayed setting.

#### Airflow Monitoring

An airflow sensor checks the connected pipe system for breakage and obstruction.

The airflow sensor can – depending on the configuration of the pipe system – detect at least a 50% obstruction to a complete obstruction of the air sampling openings and a breakage in the pipe system that results in a 50% loss from the air sampling openings. Should the fan fail, the airflow in the pipe system is interrupted and this causes a blockage message. Airflow monitoring is temperature-compensated and can be set depending on the air pressure. On expiry of a defined delay, the malfunction is displayed on the aspirating smoke detector and the message is transmitted to the fire panel. The monitoring window thresholds can be modified to suit the environmental conditions (see Airflow Monitoring).

The principal signal curve of the airflow sensor is indicated in Airflow Monitoring.



**Fault Indication**

An imminent detector module or airflow malfunction generates a malfunction message that is displayed on the FCS-320.

**Flash code for malfunction detection**

Malfunctions and certain device statuses are displayed using various LED flash codes on the detector module's electronics PCB. Thus it is possible to differentiate quickly among malfunctions that can be caused by a defective detector module, an obstruction, or a break in the pipe system.

**Resetting via fire panel**

A malfunction message is reset via the connected fire panel. The panel resets alarm and malfunction messages on the unit while simultaneously resetting the detector line via the reset board.

**Calibrating the airflow sensor**

Automatic airflow sensor calibration makes it significantly easier to start the FCS-320. The initialization phase is carried out according to or independently of the air pressure as desired. To set the FCS-320 to the airflow typical for the pipe network, an airflow initialization (flow-init) procedure is carried out. This must be done for each unit once at the start after installation, each time the pipe system is replanned/redesigned and after changing the fan voltage. This enables the unit to determine and save the airflow typical for the pipe network.

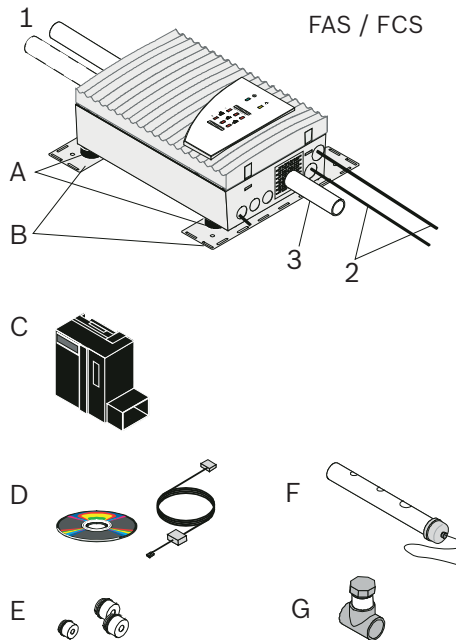
**Pipe System**

A pipe system with an overall length of up to 300 m can be connected to FCS-320 series aspirating smoke detectors over a maximum of 32 aspiration points. Two pipe systems can be connected to both the FCS-320-TP2 and FCS-320-TT2 variants. The entire pipe system then has a total length of 2 x 280 m and a maximum number of 2 x 32 aspiration points.

## 3.5 FCS-320 Aspiration smoke detector series and accessories

### 3.5.1

#### Overview



- 1 Pipe system(s)
- 2 Connections to fire panel/power supply
- 3 Air-return pipe
- A Vibration absorber (sold separately)
- B MT-1 unit mounting
- C Detector module
- D DIAG Diagnostic Software with connection cable
- E Cable bushings (1 x M20, 2 x M25)
- F Test pipe
- G Test adapter

Overview of FCS-320 series aspirating smoke detectors and accessories

FCS-320 Aspiration smoke detector series has the following components:

- Plastic housing
- Plastic connection pieces
- Integrated air-return pipe
- Connection for pipe with 25 mm external diameter
- Aspiration unit with optimized air supply
- Motherboard with interface for diagnostics system, LSN connections, connection for shield wire, as well as DIP switch for address setting
- Supplementary package with cable bushings (1 x M20, 2 x M25)
- FCS-320-TP1 /FCS-320-TP2: optical LEDs for alarm, malfunction and operation
- FCS-320-TT1 /FCS-320-TT2: smoke level LED(s), LEDs for info, internal and main alarm, malfunction and operation
- 1 detector module (for FCS-320-TP1 and FCS-320-TT1) and/or 2 detector modules (for FCS-320-TP2 and FCS-320-TT2).



#### Notice!

Only DM-TP-50(80), DM-TP-10(25) and DM-TP-01(05) detector modules certified to VdS may be used in the FCS-320 series. The detector modules must be ordered separately.

#### Refer to

- *FAS-ASD-DIAG diagnostic software, page 15*
- *Remote indicators, page 16*
- *Device mounting, page 16*
- *Ceiling lead-through adapter, page 20*
- *Water separator for humid areas, page 22*
- *Detonation safety barrier for potentially explosive areas, page 23*

### 3.5.2 FCS-320 series connections

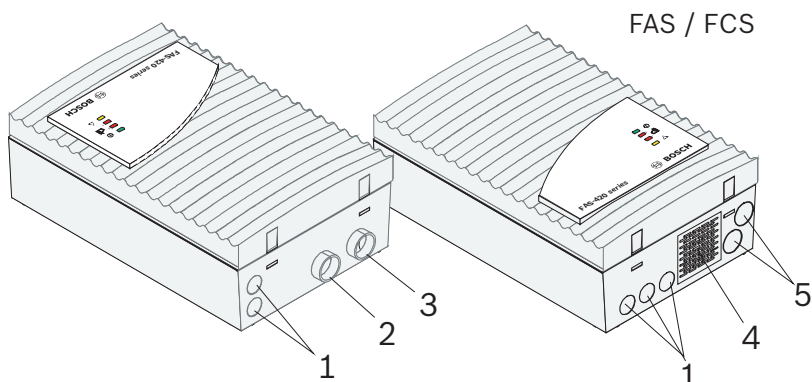


Figure 3.1: FCS-320 connections (see table on next page for explanations)

	Position in figure	Function	Explanation
FCS-320 series	1	Cable bushing for connection of fire panel and additional power supply (input/output)	1 x M 20, for cable diameters of 8 - 12 mm
	2	Pipe system 1 connection	For Ø 25 mm pipe system
	3	Pipe system 2 connection (only for devices with a two pipe system)	For Ø 25 mm pipe system
	4	Connection for air-return pipe	
	5	Cable bushing for connection of fire panel and additional power supply (input/output)	2 x M 25 for cable diameters of 9 - 14 mm (expandable to 14 - 18 mm)

### 3.5.3 FCS-320-TP1/FCS-320-TP2 displays

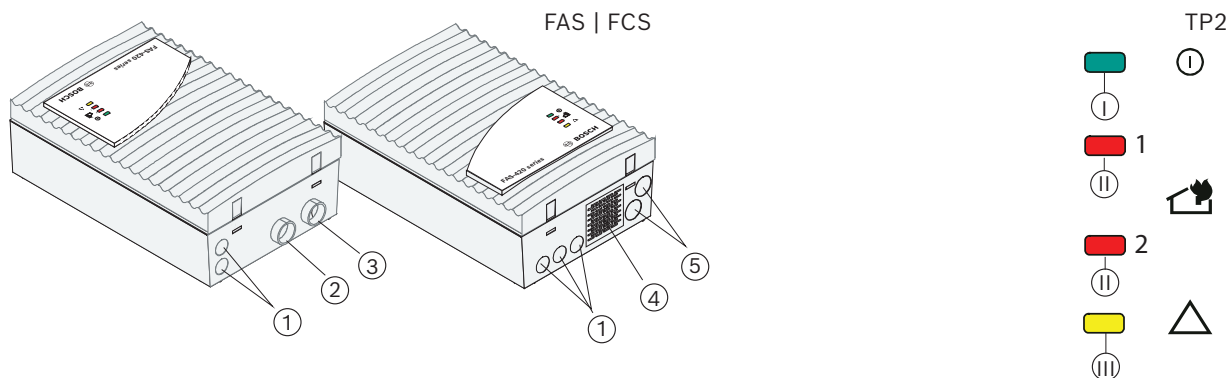


Figure 3.2: FAS-420-TP1/TP2, FCS-320-TP1/TP2 displays

FCS-320-TP	Designation	LED	Color	Explanation
	I	Operation	Green	Operation
	II	Alarm <sup>1</sup>	Red	Alarm
	III	Fault	Yellow	Fault - in the pipe system - of a detector module

				- caused by fan failure
<sup>1</sup> Two alarm LEDs on the FCS-320-TP2				

### 3.5.4 FCS-320-TT1/FCS-320-TT2 displays

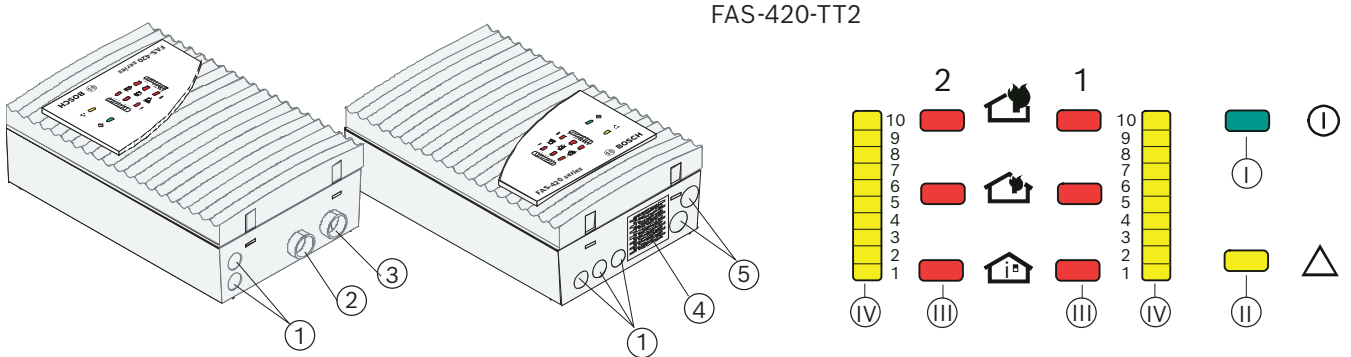


Figure 3.3: FAS-420-TT1/TT2, FCS-320-TT1/TT2 displays

FCS-320-TT	Designation	LED <sup>1</sup>	Color	Explanation
	I	Operation	Green	Operation
	II	Fault	Yellow	Fault - in the pipe system - of a detector module - caused by fan failure
	III	Main alarm	Red	100% smoke level
		Internal alarm <sup>1</sup>	Red	66% smoke level
		Info alarm <sup>1</sup>	Red	33% smoke level
	IV	Smoke level display 1 to 10 <sup>1</sup>	10 yellow LEDs	Current smoke level
<sup>1</sup> All displays doubled on the FCS-320-TT2				

### 3.5.5 FAS-ASD-DIAG diagnostic software

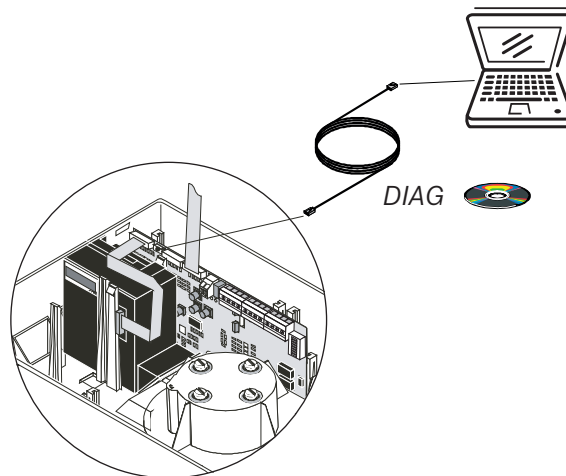


Figure 3.4: Diagnostic software for reading out unit status

The diagnostic software enables the saved and the current unit status, as well as the error messages to be displayed on the PC or laptop.

The supplied diagnostics cable connects the aspirating smoke detector ("DIAG" connection on the motherboard) to the PC. The FAS-ASD-DIAG version is connected to the PC via a USB port, earlier DIAG versions via a COM port.

Diagnostic messages remain saved in the unit for at least 3 days in order to be able to evaluate even short, sporadically occurring errors (e.g. in case of changed operating conditions).

Resetting the device via the diagnostic software deletes all saved diagnostic messages.

The software also allows the deletion of error messages.



#### Notice!

The diagnostic software can be used to save in file format all the stored and current diagnostic data as well as any settings made. To be able to compare the data read out, save each file under a different file name.

### 3.5.6

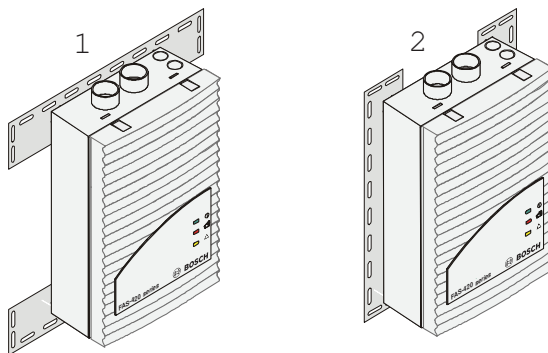
#### Remote indicators

A remote indicator must be connected if the aspirating smoke detector is not directly visible or has been mounted in false ceilings or floors.

The external detector alarm display is installed in an obvious place in halls or entrances of the building section or areas concerned.

### 3.5.7

#### Device mounting



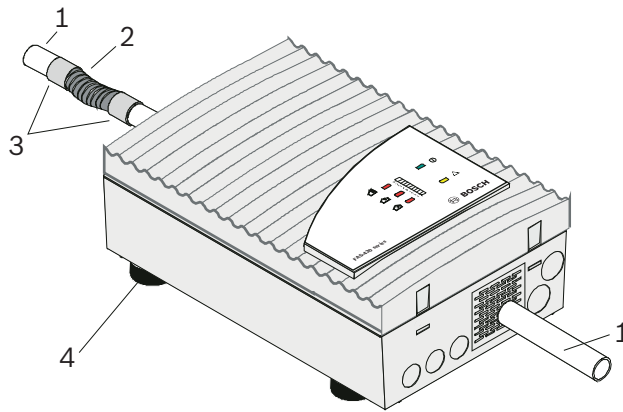
- 1 Horizontal installation
- 2 Vertical installation

Mounting for FCS-320 series Aspirating Smoke Detector

The MT-1 unit mounting is used if a direct wall installation is not possible, e.g. installation on racks.



### 3.5.8 Measures for reducing operating noise



- 1 Smoke aspiration pipe
- 2 Flexible hose
- 3 Fitting
- 4 Vibration absorbers

Absorption of the operating noises caused by airflows

#### Vibration absorbers

The fans of the aspirating smoke detectors cause a noise level of approx. 45 dB(A). Mounting the FCS-320 onto vibration absorbers can effectively reduce noise transmission through the installation elements. This results in a reduction in the noise level from 1 to 2 dB(A). Additional operating noises may be caused by vibrations on the pipe system, which are generated by the air flowing through it. This can be remedied by inserting a corrugated hose (approx. 15 cm long) between pipe system and aspirating smoke detector to create a flexible transition.

In noise-sensitive areas, the sound level can also be reduced by installing a piece of plastic pipe approximately 100 mm long into the air outlet opening of the unit. This is done by breaking out the pre-punched opening in the protective grille (e.g. using a small edge cutter).

## 3.6 Pipe system components

### 3.6.1 Overview

A	Pipe system connection
B	Smoke aspiration pipe
1	Connection for test adapter
2	T-fitting
3	Air filter
4	Water separator
5	Detonation safety barrier (not permitted for EN 54-20 or ISO 7240-20)
6	90° pipe bend
7	Aspiration hose for ceiling lead-through
8	Ceiling Lead-through
9	Fitting

Pipe system components

10	Double threaded joint
11	90° pipe elbow
12	45° pipe elbow
13	Aspiration reduction
14	End cap

During planning/design, a distinction is drawn between area monitoring and equipment monitoring. For both applications, PVC pipes and halogen-free pipes can be used but the restrictions of EN 54.20 must be observed. The pipes used for equipment monitoring should be halogen-free.

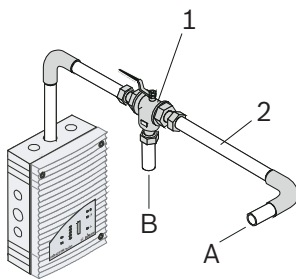
The figure shows essential accessory components that can be selected for the application concerned.

The pipe system must be constructed using pipes with an external diameter of 25 mm and the associated fittings.

If the maximum permissible pipe lengths are used, then for the pipe returns, pipes with an exterior diameter of 40 mm and the appropriate fittings must be used.

**Blowing-out system**

In areas that are susceptible to dust particles or icing, it may be necessary to blow out the aspiration pipe system and its air sampling openings. The figure below shows a manual blowing-out system with a three-way tap.



- A Blast air supply connection
- B Pipe system connection
- 1 Three-way tap
- 2 25 mm aspiration pipe  
Aspiration reducing clips

Components of manual blowing-out systems

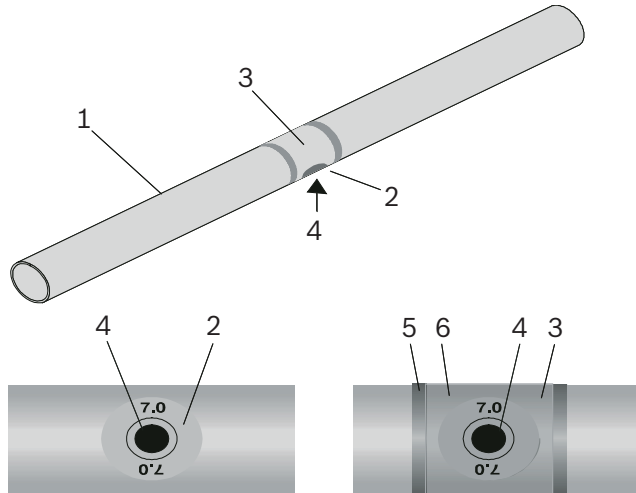
**3.6.2**

**Air sampling openings**

**Aspiration reducing film sheets**

An air sampling opening is a 10 mm bore in the aspiration pipe that is covered with a patented aspiration reducing film sheet with the required opening diameter. The size of the opening depends on the structure of the pipe system (see Planning).

The aspiration reducing film sheet is secured with marking tape to prevent it from becoming displaced. The marking tape is a transparent sticky film with red edges and a 10 mm hole. It is placed over the aspiration reducing film sheet so that the air sampling opening is not concealed and can be seen from long distances.

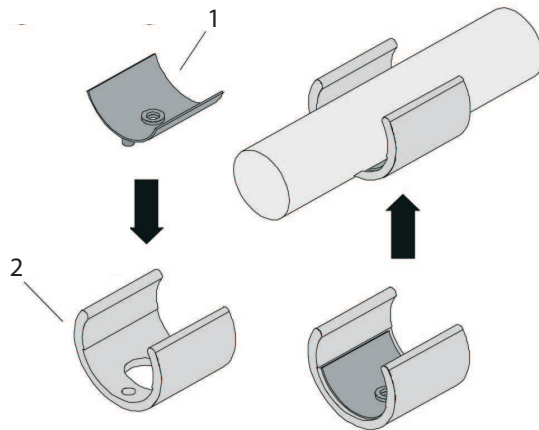


- 1 Smoke aspiration pipe
- 2 Air sampling opening with aspiration reducing film sheet
- 3 Marking tape for aspiration reducing film sheet
- 4 Air sampling opening
- 5 Fire red (RAL 3000)
- 6 Transparent

Air sampling opening with aspiration reducing film sheet and marking tape

**Aspiration reducing clips**

In areas susceptible to obstructions or icing, special, patented ASD aspiration clips with flexible aspiration reductions are used (see figure below).



- 1 Aspiration reduction for deep-freeze facilities
- 2 ASD aspiration clip made of plastic

**Aspiration reduction for soiled areas and deep-freeze areas**

During use in deep-freeze areas, the flexible aspiration reduction expands in the air sampling openings and pushes the ice away during blowing out. The special plastic clip ensures that the aspiration reduction remains at the defined location.

As the clips are more stable under pressure and the elastic rubber insert significantly improves the cleaning effect, they are used for all plans and designs which require a blow-off system due to environmental influences (e.g. increased exposure to dust).



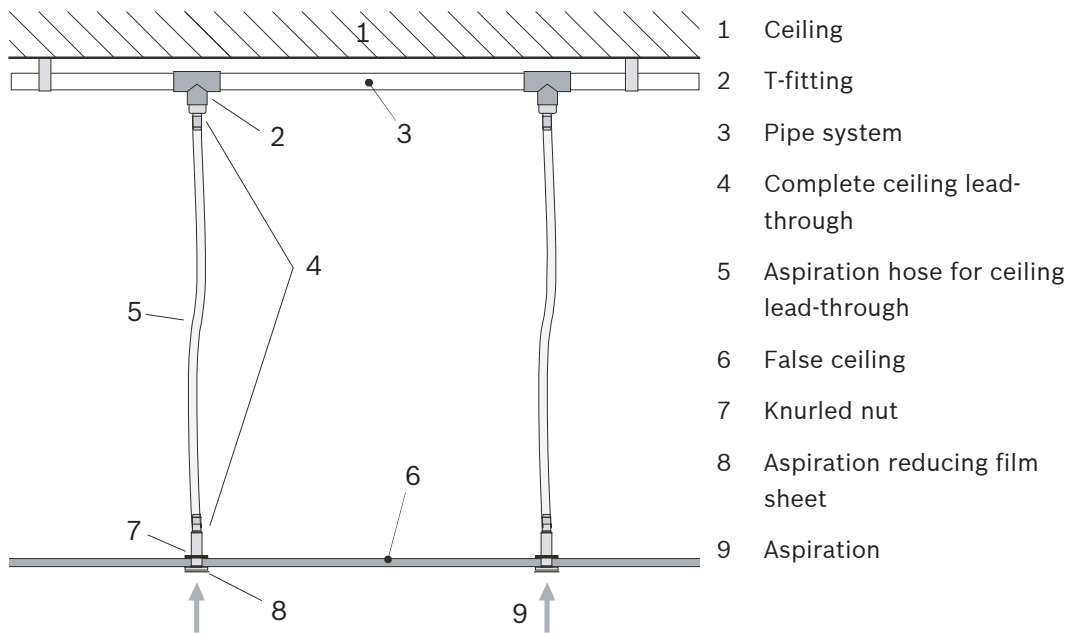
**Notice!**

The standard AF-x aspiration reducing film sheets and the marking tapes are not suitable for use in low-temperature areas.

The aspiration reductions with plastic clips are available separately.

**3.6.3**

**Ceiling lead-through adapter**



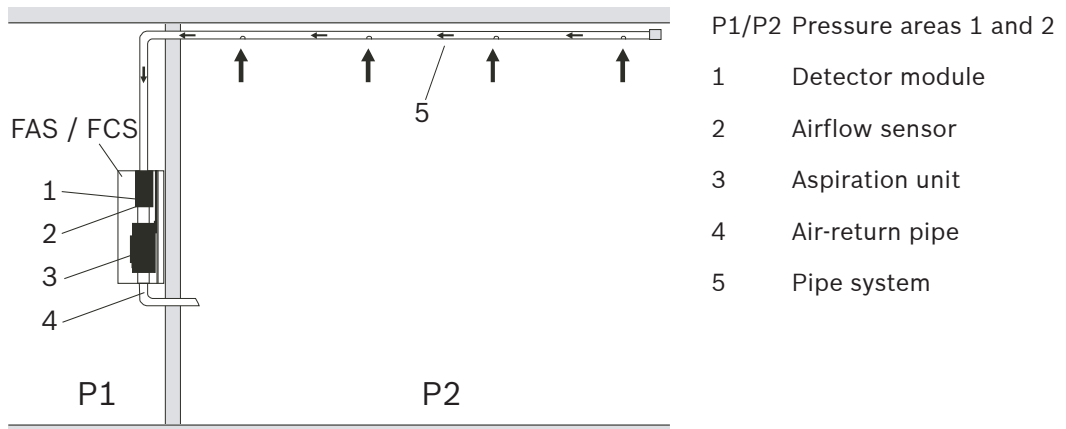
Ceiling lead-throughs

A concealed pipe system for area monitoring can be realized by installing in a false ceiling. This requires the use of ceiling lead-throughs in the false ceiling. The ceiling lead-through can be used with a false ceiling thickness of up to approx. 35 mm. According to the planning and design guidelines, the ceiling lead-throughs are fitted with aspiration reducing film sheets with defined air sampling openings and connected to the pipe system by means of aspiration hoses.

If these hoses exceed a maximum of 1 m in length, the plan according to Section 3 Planning applies. If structural circumstances dictate that lengths in excess of 1 m are used, the pipe system has to be calculated accordingly.

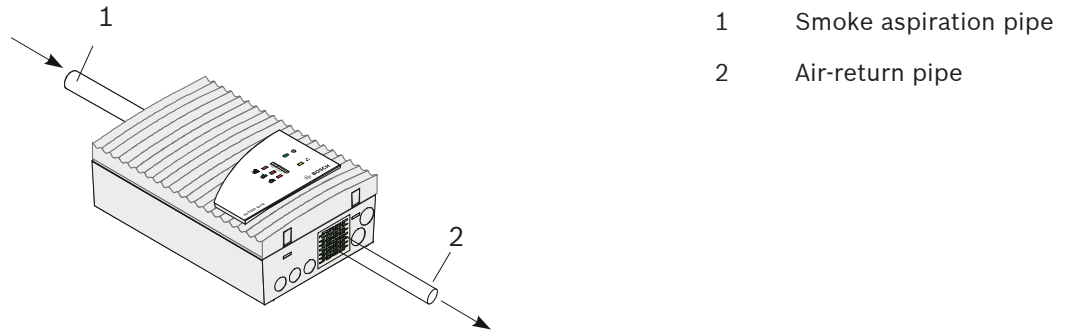
**3.6.4**

**Air-return pipe for pressure areas and atmospheric loads**



Principle of air return

If the aspirating smoke detectors and the pipe system are installed in areas with varying air pressure, the aspirated air must be returned to the pressure area of the pipe system. The air-return pipe can serve to equalize pressure or to prevent atmospheric loads (e.g. odors) in neighboring spaces.



FCS-320 with air-return pipe

The air-return pipe is connected to the air exhaust duct inside the FCS-320 through the ventilation grille. This requires the pre-punched opening in the protective grille to be broken out.



**Caution!**

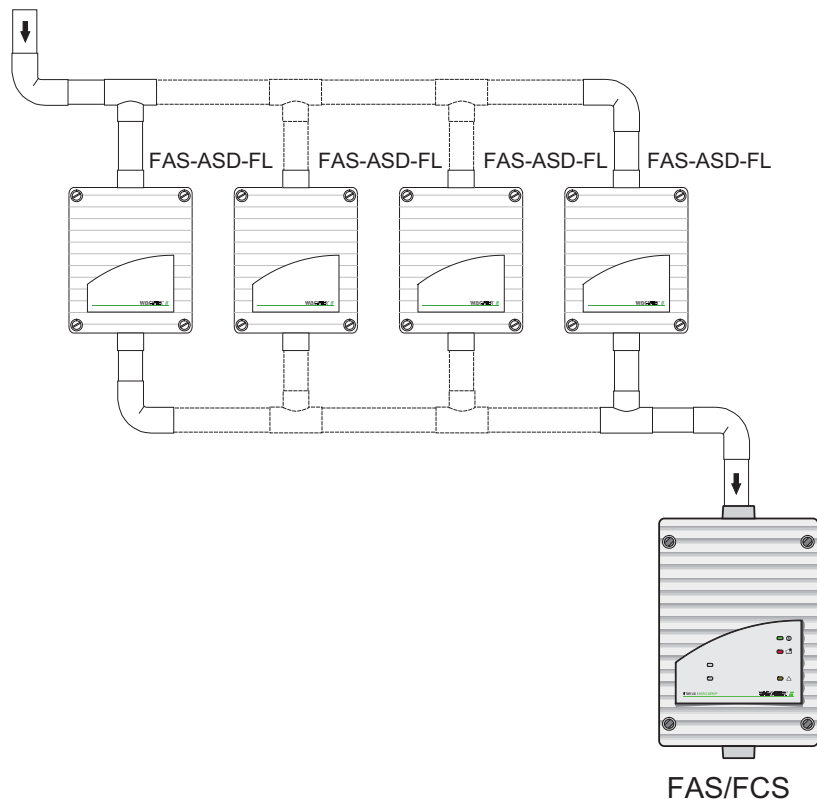
The air-return pipe of the smoke aspiration system should not exceed 2 m. Longer returns must be checked individually.

**3.6.5**

**Air filters for dusty areas**

In areas with interference to the environment such as, e.g. dust, an air filter is to be used to protect the smoke detection system. The standard air filter used is the type FAS-ASD-FL, consisting of a plastic housing with two pipe connections. If the air filters are dirty, then the filter inserts must be changed by opening the filter housing.

In order to extend the maintenance intervals, one air filter can be installed in every output pipe instead of one air filter inside the main sampling pipe. The same design specifications shall apply as stated in the projection tables in the appendix.

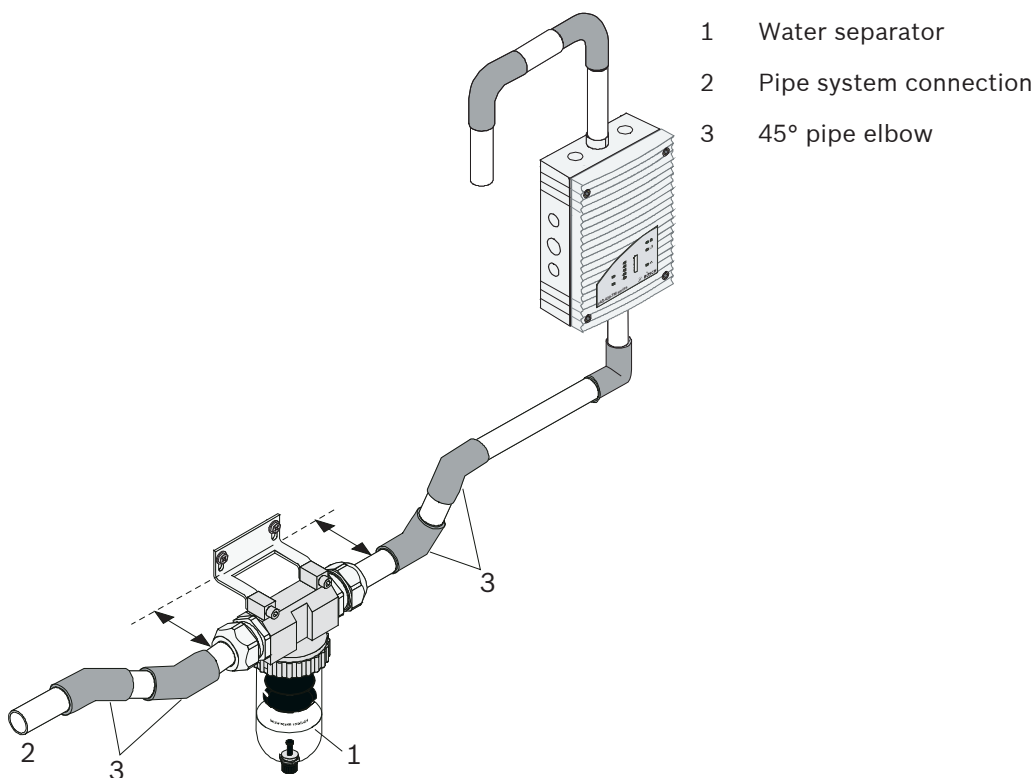


Furthermore, in order to extend the maintenance intervals, several air filters can be installed in parallel in the main sampling pipe. This requires the main sampling pipe to be split into one or several pipes and to be equipped with the same air filter or the combination of air filters. The individual pipes can then alternatively be either combined again to one main sampling pipe or be separately continued into the monitoring area(s). The same design specifications for the individual air filters shall apply as stated in the projection tables in the appendix.

### 3.6.6 Water separator for humid areas

If the smoke aspiration system is operated in environments where condensate can form in the aspiration system, a water separator is used. Condensate can form with sharp temperature fluctuations and in areas where fresh air is monitored. For areas with extremely high humidity, the FAS-ASD-WS Water Separator can be used, for example.

The FAS-ASD-WS Water Separator is integrated at the lowest point in the pipe system downstream of the air filter and the aspirating smoke detector. The 45° pipe elbow permits optimum distance from the wall.

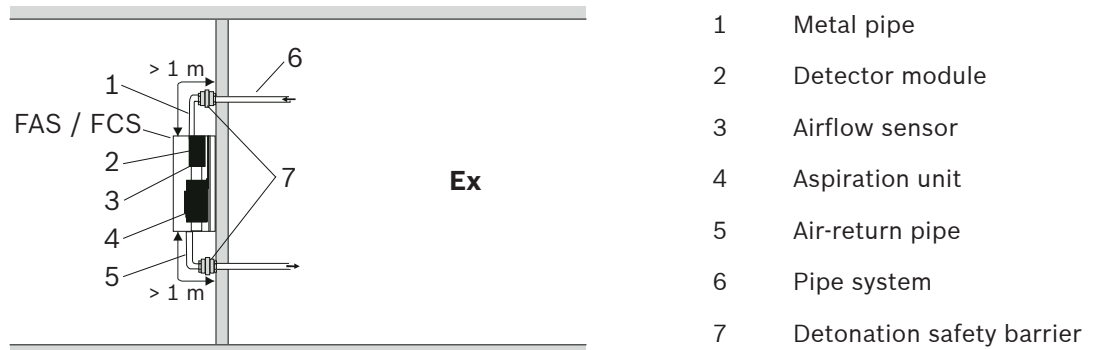


FAS-ASD-WS Water Separator for condensing water vapor and collecting condensate from the pipe system

The FAS-ASD-WS Water Separator can be operated in a temperature range from 0 °C to +50 °C. The sintered metal filter in the water separator has a pore width of 50 µm and causes an additional rough absorption of soil particles. The FAS-ASD-WS is supplied with an angle support and PG cable glands. The 45° pipe elbows (4 units) must be ordered separately.

### 3.6.7

### Detonation safety barrier for potentially explosive areas



Detonation safety barrier in the aspiration pipe system and if necessary in the air-return pipe

Vapor/air and/or gas/air mixture ignition in the aspirating smoke detector may result in pipe explosion or detonation. This depends on the composition, concentration, temperature, and pressure of the flammable mixture.

The detonation safety barrier is a flame trap that is flame-proof in the face of pipe explosions (deflagrations) and detonations.

In normal operation, the steam and gas mixtures flow in any direction through the safety barrier. An ignition of the mixture in the upstream aspirating smoke detector will cause the developing detonation to be arrested. Ignition is prevented by the flame filter. Combustion of the mixture in the flame filters may cause a rebound of the detonation front. To prevent this, a minimum pipe length of 1.0 m between the installation point of the detonation safety barrier and a possible ignition source (aspirating smoke detector) must be maintained. Permanent fire prevention is thus achieved indirectly.



**Caution!**

The connecting pipe between the aspirating smoke detector and the detonation safety barrier must be made of metal. During installation, care must be taken to ensure that the threaded connections are bolted together gas-tight using synthesesol or sealing tape.

### 3.7

### Scope of delivery: Smoke aspiration system

**Basic devices and accessories**

	Designation	product ID
FCS-320-TP1	Standard unit	F.01U.141.197
FCS-320-TP2	Standard unit	F.01U.141.198
DM-TP-50(80)	Detector module	4.998.143.394
DM-TP-10(25)	Detector module	4.998.143.395
DM-TP-01(05)	Detector module	4.998.143.396
TITANUS MT-1	MT-1 device mounting for aspirating smoke detector	4.998.143.410
FAS-ASD-DIAG	DIAG diagnostic software including connection cable, for USB port	F.01U.033.505
FCA-320-Reset	Reset board	F.01U.141.199

	<b>Designation</b>	<b>product ID</b>
FCS-320-IK	Installation kit	F.01U.141.201
RAS Test Pipe	Test pipe	4.998.148.848
RAS Test Adapter	Test Adapter	4.998.148.849

#### Pipe system components

	<b>Designation</b>	<b>product ID</b>
FAS-ASD-PHF16	Polywell aspiration hose, flexible, black, halogen-free	F.01U.029.719
FAS-ASD-TRPG16	Ring nut with PG16 internal thread, 5 per set	F.01U.029.721
FAS-ASD-CSL	Quick-lock coupling, straight, PG16 internal thread	F.01U.029.720
FAS-ASD-3WT	Three-way tap, incl. fittings, for 25 mm pipe system	F.01U.029.718
FAS-ASD-F	Flange for ventilation duct	F.01U.029.722
FAS-ASD-AR	Aspiration reduction, with 10 mm bore for attaching an aspiration reducing film sheet, 10 per set	F.01U.029.724
FAS-ASD-CLT	Ceiling lead-through, white, ABS, 10 per set	F.01U.029.725
FAS-ASD-AHC	Aspiration hose (PE) for ceiling lead-through	F.01U.029.727
FAS-ASD-DSB	Detonation safety barrier for 25 mm pipe system	F.01U.029.716
FAS-ASD-WS	Water separator with sintered metal filter and manual drain valve, including mounting bracket and PG cable glands for 25 mm pipe system	F.01U.029.717
FAS-ASD-FL	Large air filter box, for 25 mm pipe system, inc. 1 filter set and two PG29 screw connections	F.01U.029.714
FAS-ASD-RFL	Replacement filter set for large air filter box	F.01U.029.715



#### Notice!

Four 45° pipe elbows are required to install the FAS-ASD-WS water separator.

#### Air sampling opening components

<b>Designation</b>	<b>product ID</b>
Marking tape for aspiration reducing film sheet AF-BR, 10 units.	4.998.143.413
Aspiration reducing film sheet 2.0 mm AF-2.0, 10 units.	4.998.143.416
Aspiration reducing film sheet 2.5 mm AF-2.5, 10 units.	4.998.143.417
Aspiration reducing film sheet 3.0 mm AF-3.0, 10 units.	4.998.143.418
Aspiration reducing film sheet 3.2 mm AF-3.2, 10 units.	4.998.143.419
Aspiration reducing film sheet 3.4 mm AF-3.4, 10 units.	4.998.143.420
Aspiration reducing film sheet 3.6 mm AF-3.6, 10 units.	4.998.143.422



Designation	product ID
Aspiration reducing film sheet 3.8 mm AF-3.8, 10 units.	4.998.143.423
Aspiration reducing film sheet 4.0 mm AF-4.0, 10 units.	4.998.143.424
Aspiration reducing film sheet 4.2 mm AF-4.2, 10 units.	4.998.143.425
Aspiration reducing film sheet 4.4 mm AF-4.4, 10 units.	4.998.143.426
Aspiration reducing film sheet 4.6 mm AF-4.6, 10 units.	4.998.143.427
Aspiration reducing film sheet 5.0 mm AF-5.0, 10 units.	4.998.143.428
Aspiration reducing film sheet 5.2 mm AF-5.2, 10 units.	4.998.143.429
Aspiration reducing film sheet 5.6 mm AF-5.6, 10 units.	4.998.143.430
Aspiration reducing film sheet 6.0 mm AF-6.0, 10 units.	4.998.143.431
Aspiration reducing film sheet 6.8 mm AF-6.8, 10 units.	4.998.143.432
Aspiration reducing film sheet 7.0 mm AF-7.0, 10 units.	4.998.143.433

**Notice!**

Plastic clips for deep-freeze facilities and blowing-out systems are sold separately.

**3.8****Technical data****3.8.1****FCS-320 Aspiration smoke detector series****Electrical**

Power supply (conventional)	14 V DC to 30 V DC	
Rated supply voltage	24 V DC	
Max. current consumption (at 24 V)	FCS-320-TP1 FCS-320-TT1	FCS-320-TP2 FCS-320-TT2
– Starting current, fan voltage 6.9 V (without reset board)	300/300 mA	320/330 mA
– Starting current, fan voltage 9 V (without reset board)	300/300 mA	320/330 mA
– On standby, fan voltage 6.9 V (without reset board)	200/200 mA	220/230 mA
– On standby, fan voltage 9 V (without reset board)	275/260 mA	295/310 mA
– On alarm, fan voltage 6.9 V (without reset board)	210/230 mA	240/290 mA
– On alarm, fan voltage 9 V (without reset board)	285/290 mA	315/370 mA
Reset board current consumption	Max. 20 mA	

**Mechanics**

Displays on the device FCS-320-TP1/FCS-320-TP2	
– Operation	Green LED

– Fault	Yellow LED
– Alarm	1 red LED/2 red LEDs
Displays on the device FCS-320-TT1/FCS-320-TT2	
– Operation	Green LED
– Fault	Yellow LEDs
– Level display	1 x / 2 x smoke level display, each with 10 segments (1-10)
– Alarm	1 x 3 / 2 x 3 red LEDs for info alarm, internal alarm and main alarm
Conical duct connections for Ø 25 mm	
– Aspiration pipe	1 pipe/2 pipes
– Air-return pipe	1 pipe
Cable bushings	5 x M 20 and 2 x M 25
Dimensions (H x W x D)	292 x 200 x 113 mm
Weight	Approx. 1.5 kg
Housing material	Plastic (ABS)
Housing color	Papyrus white (RAL 9018)

#### Environmental conditions

Protection category as per EN 60529	IP 20
Permissible temperature range	
– Aspiration smoke detector	-20 °C to +60 °C
– PVC pipe system	0 °C to +60 °C
– ABS pipe system	-40 °C to +80 °C
Permissible relative humidity (non-condensing)	10 to 95%

#### Special features

sound power level	45 dB(A)
Max. response sensitivity (max. light obscuration)	
– DM-TP-50(80) Detector Module	0.5%/m (0.8%/m) *
– DM-TP-10(25) Detector Module	0.1%/m (0.25%/m) *
– DM-TP-01(05) Detector Module	0.015%/m (0.05%/m) *
Life cycle of the fan (12 V)	43,000 hrs at 24 °C

\* The sensitivity value is based on measurements with standard test fires (old value in brackets).

### 3.8.2 Pipe system

	FCS-320-TP1 FCS-320-TT1	FCS-320-TP2 FCS-320-TT2
Maximum pipe length	300 m	2 x 280 m
Maximum number of air sampling openings	32	2 x 32
Maximum size of monitoring area	2880 m <sup>2</sup>	5760 m <sup>2</sup>

### 3.8.3 Smoke Aspiration System Components

#### Water separator (FAS-ASD-WS)

Features	For use in areas with very high humidity
	Plastic housing with manual drain valve
	Sintered metal filter
	PG cable glands for 25 mm pipe system
	Incl. assembly bracket
Dimensions (H x W x D)	210 x 170 x 90 mm
Weight	Approx. 1.4 kg

#### Filterbox, large (FAS-ASD-FL)

Features	For use in areas with increased exposure to dust
	Incl. filter set and two PG29 cable glands
Housing material	ABS plastic
Housing color	Light gray RAL 7035
Dimensions (H x W x D)	194 x 122 x 96 mm
Application temperature range	-30 °C to +70 °C

#### Replacement filter set, large (FAS-ASD-RFL)

Features	Set comprising one fine, one medium and one coarse filter insert (60 ppi, 45 ppi and 25 ppi)
Application temperature range	-30 °C to +70 °C

#### Detonation safety barrier (FAS-ASD-DSB)

Type	PROTEGO Type EG IIA
Explosion group	II A
Flame filter	3-way
Gap width	0.7 mm
Pipe connection thread	G 3/4 inch, incl. transition thread on one side for connecting to the aspiration pipe system

Length x diameter	112 mm x 80 mm
Certification	EC type-tested

**Three way tap (FAS-ASD-3WT)**

Features	With 3 transition threads for connection to a 25 mm pipe system
Operating pressure	Max. 10 bar
Housing material	PVC plastic
Seal	Teflon (PTFE)
Length	131 mm
Application temperature range	0 °C to +50 °C

**Ceiling lead-through (FAS-ASD-CLT) with aspiration hose (FAS-ASD-AHC)**

Maximum false ceiling thickness	35 mm
Max. length of aspiration hose per ceiling lead-through	1 m
Ceiling lead-through fitting material	ABS
Aspiration hose material	PE
Color of aspiration hose and ceiling lead-through	White
Application temperature range	-40 °C to +80 °C

**4****Planning**

Basic information on the relevant topics can be found in

- *Regulations, page 29*
- *Principles of pipe planning, page 30*
- *Airflow monitoring, page 33*
- *Defining the Response Sensitivity, page 34*
- *Planning limits, page 35.*

The following sections describe plans with standard requirements for airflow monitoring:

- *Standard Pipe Planning, page 36*
- *Planning for long pipe feed lines, page 54*
- *Simplified pipe planning, page 51*

The pipe plan for more sensitive airflow monitoring is described in

- *Pipe planning for single-hole monitoring, page 45.*

The plan for monitoring air-conditioning ducts is described in

- *Planning for forced airflow, page 65.*

The principles for measuring power supply and pipe length are contained in

- *Power supply, page 72.*

## 4.1 Regulations

The planning regulation below is based on the system limits of the FCS-320 series. Here, the corresponding national regulations of the countries in their respectively applicable version must be adhered to and planning must be adjusted to these.

The planning for the aspirating smoke detector in accordance with EN 54-20 or ISO 7240-20 is described below. The basic conditions are specified in Regulations. Planning must be carried out in accordance with Standard Pipe Planning. In addition to Standard Pipe Planning, special applications are also bound by the restrictions of the planning notes in accordance with Planning with Single-hole Monitoring and the following sections. These must be taken into account from the start in the case of any special planning processes.

### Planning options in accordance with EN 54-20 or ISO 7240-20:

Various technical solutions are available to suit different planning criteria. The following table lists the chapters in which the solutions are described.

Planning criteria	Technical solution	Principles	Restriction
Area monitoring in general	Basic planning	Section Standard Pipe Planning	
Detection of failure of a single opening	Single-hole monitoring planning	Section Standard Pipe Planning	Section Pipe Planning for Single-Hole Monitoring
Equipment protection/ cabinet monitoring	Simplified pipe planning	Section Standard Pipe Planning	Section Simplified Pipe Planning
Long supply lines	Planning with long supply lines	Section Standard Pipe Planning	Section Planning for Long Pipe Feed Lines
Reducing transport time	Planning with acceleration openings	Section Standard Pipe Planning	Section <i>Planning with acceleration openings, page 55</i>
Ventilation ducts	Planning for forced airflow	Section Standard Pipe Planning	Section <i>Planning for forced airflow, page 65</i>

### EN 54-20 or ISO 7240-20

For VdS systems, compliance is also required with the following guidelines:

- "Guideline for automatic fire detection systems, planning and installation", VdS Schadenverhütung GmbH, Cologne (VdS 2095)
- The guideline "Installation protection for electrical and electronic systems" VdS Schadenverhütung GmbH, Cologne (VdS 2304)
- The "Planning Aspirating Fire Detectors" data sheet from VdS Schadenverhütung GmbH, Cologne (VdS 3435)

The applicable national regulations must also be observed, for example in Germany:

- DIN VDE 0833 parts 1 and 2 "Alarm systems for fire, intrusion and hold-up"

- Additional provisions for the installation of fire detection systems, which are published by fire directors of fire departments, by the construction supervision authorities or by the construction law authorities that have only local validity.



### Notice!

For planning, the system limits in accordance with Planning Limits are to be observed.

Select airflow monitoring and the associated planning limits (see Airflow Monitoring) and check these for any restrictions imposed by country-specific regulations.

If the on-site planning deviates from the standard plans described below, this must always be checked with activation attempts for correct detection of a malfunction and a fire. A special plan may be required.

Plans not contained in the operation guide must be requested.

## 4.2

### Principles of pipe planning

The aspiration pipe network must be designed such that all possible fires in the monitoring area can be dealt with at an early stage.

The number of air sampling openings and the structure of the pipe system depend on the size and geometry of the monitoring range. The pipe system must be laid out according to the planning guidelines in this chapter, taking into account the following issues:

#### Symmetrical structure

The pipe system should preferably have a symmetrical structure, i.e.

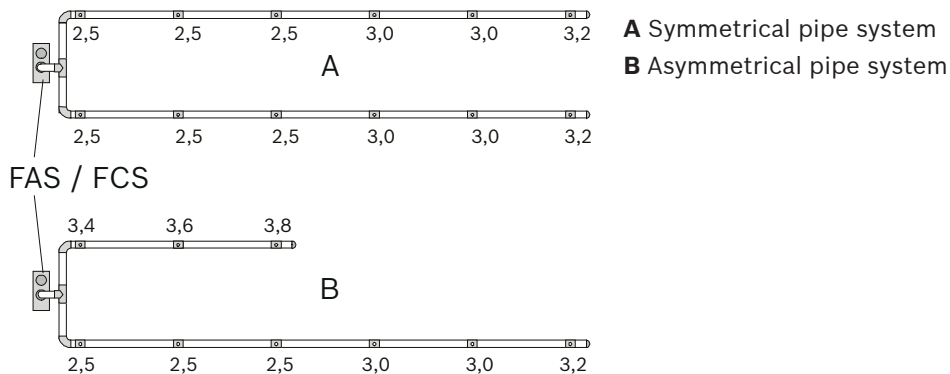
- Same number of air sampling openings per pipe branch
- Same pipe branch lengths (should not exceed  $\pm 20\%$  deviation)
- Same distance between neighboring air sampling openings on the smoke aspiration pipe (should not exceed  $\pm 20\%$  deviation).

#### Asymmetrical structure

If structural circumstances dictate that the pipe system is to be designed asymmetrically, the following conditions apply:

- The number of air sampling openings and the length of the shortest and longest pipe branch within the pipe system must not exceed a quantity ratio of 1:2.
- The distance between neighboring air sampling openings on the smoke aspiration pipe must be equal (should not exceed  $\pm 20\%$  deviation).
- The diameters of the air sampling openings are determined separately for each pipe branch. The diameters depend on the total number of air sampling openings in the pipe branch in question.

The figure shows a typical U-pipe system with three or six air sampling openings and the air sampling opening diameters calculated according to Standard Pipe Planning.



**Tab. 4.1: Example of a symmetrical and an asymmetrical U-pipe system**

In many applications, greater distances between the aspirating smoke detector and the aspiration pipe must be bridged. This is done using pipes with greater diameters (40 mm), which guarantees maximum planning (see also Planning for Long Pipe Feed Lines). However, pipes with greater diameters restrict the length of the pipe system.

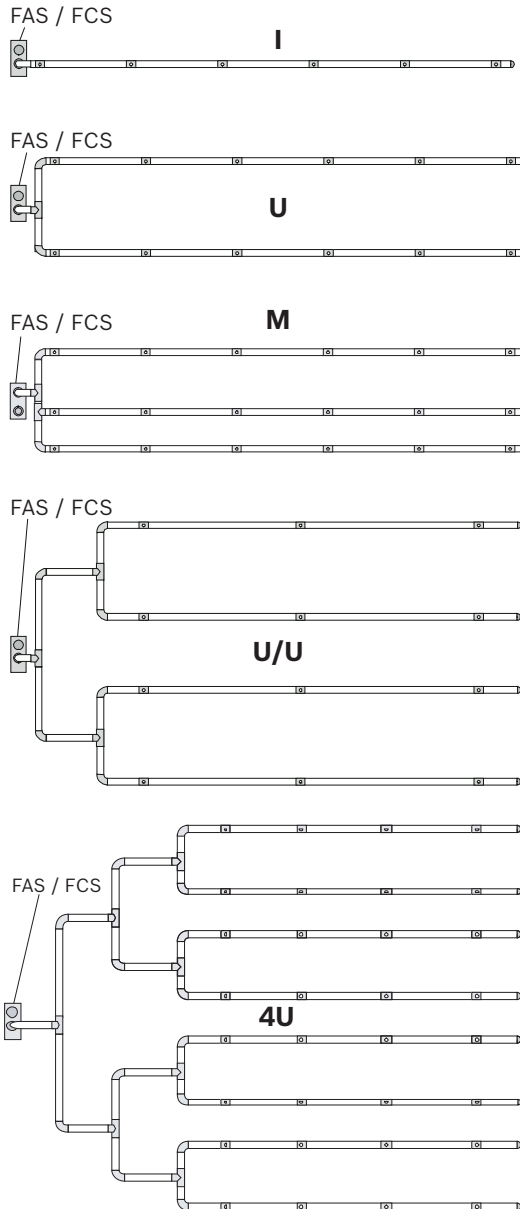
**Branch length**

To achieve short transport times for the smoke aerosols in the aspiration pipe and thus quick detection, it is better to plan several short branches than fewer long ones (preferably U and double U-pipe system).

**Pipe configurations**

Depending on the area geometry, five pipe configurations can be selected:

- **I-pipe:** pipe system without branches.
- **U-pipe:** pipe system that branches into two pipe branches.
- **M-pipe:** pipe system that branches into three pipe branches.
- **Double U-pipe:** pipe system that branches symmetrically into four pipe branches.
- **Quadruple U-pipe:** pipe system that branches symmetrically into eight pipe branches.



- I I-pipe system
- U U-pipe system
- M M-pipe system
- U/U Double U-pipe system
- 4U Quadruple U-pipe system

Pipe configurations

**Change of direction**

Elbows and bends in the pipe system increase flow resistance. Therefore, they should only be used where they cannot be avoided for structural engineering reasons. Light change of direction (e.g. with 90 ° pipe bends or air sampling hose) are already approved as part of the project according to EN 54-20 or ISO 7240-20 and need not be considered further.



**Notice!**

Pipe bends must be given preference over pipe elbows. Too many bends and pipe elbows reduce the air speed in the aspiration pipe, thereby increasing the detection time. A 90° pipe elbow corresponds to a straight pipe length of 1.5 m. Because of this, the maximum total length of the pipe system is reduced by 1.5 m.

**Special cases**

If the pipe system does not correspond to the planning guidelines described here owing to structural circumstances, it must be calculated separately for the case in question on request.



**Testing**

For critical applications, test the secure detection with activation attempts. Check also whether there is airflow at the individual air sampling openings.



**Notice!**

In order to increase transport speed in critical application areas, the fan voltage can be increased from 6.9 V to 9 V.

**Dual-detector dependency**

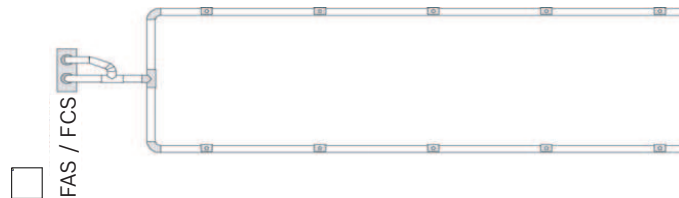
One aspiration line must be assigned per detector module. Both detector modules of a device must be evaluated independently of one another. Only one extinguishing area per smoke aspiration system may be monitored.



Pipe configurations for dual detector dependency

**Two alarm stages**

To implement two alarm stages, a pipe adapter for the aspiration pipe system is required. The two detector modules in the aspirating smoke detector require different response sensitivities.



Pipe configurations for two alarm stages using the example of a U-pipe system

**4.3**

**Airflow monitoring**

EN 54-20 or ISO 7240-20 requires the detection of a 20-percent change in the airflow volume by the detector module's airflow sensor. In order to achieve this, the activation threshold of the airflow sensor must be set to level II. Alternatively, level I can also be used. It is recommended that airflow calibration is carried out dependent on air pressure for both of these settings. In systems that do not need to comply with EN 54-20 or ISO 7240-20, any threshold can be set. The smoke aspiration pipes are planned taking into account the applicable national regulations for the country concerned.

**Adapting the airflow sensitivity**

The sensitivity of the airflow sensor must be adapted to the application. For example, a long pipe system requires a sensitive setting of the airflow sensor. The activation threshold and thus the sensitivity of the airflow sensor can be set on 4 levels. Breakages and obstructions must be accurately detected in the event of a malfunction.

Setting the airflow sensitivity		
Level	Activation threshold	Sensitivity
I	Low (+/- 10% volume flow change)	Very high
II	Average (+/- 20% volume flow change)	High
III	High (+/- 30% volume flow change)	Average
IV	Very high (+/- 50% volume flow change)	Low

Level	I	II	III	IV
	<b>Complies with EN 54-20 or ISO 7240-20</b>			
Activation threshold	Small	Average	Large	Very large
Sensitivity	Very high	High	Average	Low

**Notice!**

Selection of the largest possible, precisely still-approved level is recommended.

**Dynamic airflow sensors**

The airflow monitoring of the unit makes it possible to detect breaks at the end of pipes and identify sudden obstruction of individual air sampling openings (e.g. following tampering with the pipe system). Because these dynamic airflow sensors are only active if level I was selected for the airflow monitoring, the points outlined under "Level I restrictions" must be taken into consideration.

**Restrictions**

Airflow monitoring may only be set to level I if

- planning was carried out in accordance with "single-hole monitoring"
- the airflow sensor was calibrated dependent on the air pressure
- and no larger airflow fluctuations can occur.

**Air pressure differences**

There must be equal air pressure along the length of the aspiration pipe.

**Notice!**

If the aspirating smoke detectors and the pipe system are positioned in areas with different air pressures, the air aspirated by the FCS-320 must be returned to the pressure area of the pipe system (see Air-Return Pipe for Pressure Areas and Atmospheric Loads).

## 4.4

### Defining the Response Sensitivity

The sensitivity of smoke aspiration systems can be divided into certain fire sensitivity classes in accordance with EN 54-20 or ISO 7240-20. These fire sensitivity classes describe specific examples of ways in which the systems can be applied. The permissible system plans given in Standard Pipe Planning can be determined for each classification. Smoke aspiration systems with a higher fire sensitivity class according to EN 54-20 or ISO 7240-20 also satisfy the requirements of the lower classes.

Class	Description	Application example
<b>A</b>	Aspirating smoke detector with extremely high sensitivity	<b>Very early detection:</b> significant smoke dilution through air conditioning in IT areas
<b>B</b>	Aspirating smoke detector with increased sensitivity	<b>Early detection:</b> significant time gains thanks to very early fire detection (without air condition)
<b>C</b>	Smoke aspiration system with normal sensitivity	<b>Normal detection:</b> fire detection with the advantages of smoke aspiration systems



**Notice!**

Depending on the number of air sampling openings, fire sensitivity classes A, B and C can all be achieved with the detection modules available.

The table shows the sensitivities you can choose from

Response sensitivity (main alarm)		
DM-TP-50(80) Detector Module	DM-TP-10(25) Detector Module	DM-TP-01(05) Detector Module
Not permissible	0.8%/m (2%/m) light obscuration	0.12%/m (0.4%/m) light obscuration
Not permissible	0.4%/m (1%/m) light obscuration (standard)	0.06%/m (0.2%/m) light obscuration (standard)
1.0%/m (1.6%/m) light obscuration	0.2%/m (0.5%/m) light obscuration	0.03%/m (0.1%/m) light obscuration
0.5%/m (0.8%/m) light obscuration (standard)	0.1%/m (0.25%/m) light obscuration	0.015%/m (0.05%/m) light obscuration



**Notice!**

The sensitivity value is based on measurements with standard test fires (old value in brackets).

## 4.5 Planning limits

The following limit values must always be observed for the FCS-320 series:

Limiting values	Maximum number of air sampling openings per detector module	32 (2 x 32)
	Maximum total pipe length	300 m (2 x 280 m)
	Minimum pipe length between 2 air sampling openings	4 m
	Minimum pipe length between 2 air sampling openings	12 m

The maximum monitoring area of an air sampling opening corresponds to the monitoring area of point-type detectors in accordance with the applicable planning guidelines.

The maximum total monitoring area, the maximum total pipe length and the maximum number of air sampling openings depend on the selected planning. They are also dependent on the restrictions imposed by national regulations.

Depending on the planning selected, some restricted values may apply.

The values for the maximum number of air sampling openings, the maximum pipe length and the maximum overall monitoring areas apply for each pipe system. Two pipe systems can be connected to aspirating smoke detectors FCS-320-TP2 and FCS-320-TT2, each with two detector modules.

## 4.6 Standard Pipe Planning

In order to plan in accordance with the EN 54-20 or ISO 7240-20 standard, certain factors must be known, such as the system sensitivity requirements, the number of air sampling openings and the accessories needed for the application concerned. These factors can be used to determine the appropriate standard-compliant construction of the pipe system using the following chapter and the planning table in the appendix.

### 4.6.1 Determining the necessary accessories

As accessory components, e.g. filters, have a particular effect on the dimensions of pipe planning, the appropriate accessory must be selected for the application concerned in advance. Retrofitting an accessory, e.g. a fine filter, is largely only possible if a certain reserve is planned in advance.

The following components must be taken into account in this regard:

- Air filter
- Water separator
- Three-way-tap
- Detonation safety barrier

See Section *Smoke Aspiration System Components*, page 27.

#### Refer to

- *Smoke Aspiration System Components*, page 27

### 4.6.2 Pipe planning with pipe accessories

For the purpose of pipe system planning, the following planning table is available for all selected pipe accessories.

- Planning without air filter
- Planning with FAS-ASD-FL air filter



#### Notice!

In order to improve the detection quality of a smoke aspiration system, an area can be monitored with more detection points than required by national guidelines. However, to calculate the necessary sensitivity of an aspirating smoke detector, the number of aspiration points required by the standard must be used.

#### Procedure

In the following **example**, a plan with air filter with 8 openings, not fitted with any other accessories, should satisfy class B. The red shaded areas show the potential plans with different pipe shapes and fan voltage.

	General	Example
1.	<b>Selection:</b>	Select the planning table without air filter, <i>Planning without filter</i> , page 38

	General	Example
	Select the planning table with or without air filter, as applicable. <b>Result:</b> Planning table and specified air filter	
2.	<b>Selection:</b> Select the number of air sampling openings from the planning table. Note the possible sensitivity classes. <b>Result:</b> Specified detector module with specified setting and alarm threshold	In the <i>Planning without filter, page 38</i> table, select the column with eight air sampling openings (Number of air sampling openings, 8)
3.	<b>Selection:</b> Select the sensitivity (sensitivity class) of the system according to the gradation described in Defining the Response Sensitivity. <b>Result:</b> Specified sensitivity class in accordance with EN 54-20	In the <i>Planning without filter, page 38</i> table, select the response sensitivity you require (class A, B or C) from the column highlighted in red. You must select the class that corresponds to the installed detector module and the configured sensitivity.
4.	<b>Selection:</b> Select other pipe components, such as a water separator and detonation safety barrier. <b>Result:</b> Specified planning table	Select <i>With water separator, page 39</i> .
5.	<b>Selection:</b> Select the possible pipe length for the relevant pipe shape and fan voltage. <b>Result:</b> Specified planning in accordance with EN 54-20 for the previously specified parameters	In the <i>With water separator, page 39</i> table, select the pipe shape and fan voltage you require, and note the permissible total pipe length.

You will find the planning tables in question in Planning without filter and Planning with air filter.

Abbreviation	Meaning		CTN
DM	Detector module	DM-01(05)	DM-TP-01(05)
		DM-10(25)	DM-TP-10(25)
		DM-50(80)	DM-TP-50(80)
S	Sensitivity (% LT/m)		
MA	Main alarm		
PA	Internal alarm		
l [m]	Permissible total pipe length in meters		

**Planning without filter**

			Number of air sampling openings													
DM-	S		1	2	3	4	5	6	7	8	9	10	11	12	...	32
01 (05)	0.015 (0.05)	M A	A	A	A	A	A	A	A	A	A	A	A	A		A
	0.03 (0.1)	M A	A	A	A	A	A	A	A	A	A	A	A	A		B
	0.06 (0.2)	M A	A	A	A	A	A	A	A	A	A	A	A	A		C
	0.12 (0.4)	M A	A	A	A	A	A	A	B	B	B	B	B	B		
10 (25)	0.1 (0.25)	M A	A	A	A	A	A	A	A	A	A	B	B	B		B
	0.2 (0.5)	M A	A	A	A	A	B	B	B	B	B	B	B	B		
	0.4 (1)	M A	A	A	B	B	B	B	C	C	C	C	C	C		
	0.8 (2)	M A	A	B	B	C	C	C								
50 (80)	0.313 (0.5)	PA	A	A	A	A	B	B	B	B	B	B	B	B		C
	0.5 (0.8)	M A	A	A	A	B	B	B	B	C	C	C	C	C		
	0.687 (1.1)	PA	A	A	B	B	B	C	C	C	C					
	1.0 (1.6)	M A	A	B	B	C	C	C	C							

**Without any other pipe accessories**

		Number of air sampling openings													
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	...	32
I	6.9	77	77	77	77	77	77	77	77	76					
	≥9	100	100	100	100	100	100	100	100	100	100	100	100		
U	6.9	120	120	120	120	120	120	120	120	120	120	120	120		
	≥9	150	150	150	150	150	150	150	150	150	150	150	150		
M	6.9	170	170	170	170	170	170	170	170	170	170	170	170		
	≥9	180	180	180	180	180	180	180	180	180	180	180	180		
2 x U	6.9	180	180	180	180	180	180	180	180	180	180	180	180		

		Number of air sampling openings															
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	...	32		
	≥9	200	200	200	200	200	200	200	200	200	200	200	200				
4 x U (1 DM)	6.9																
	≥9	300	300	300	300	300	300	300	300	300	300	300	300			300	

**With water separator**

		Number of air sampling openings															
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	...	32		
I	6.9	60	60	60	60	60	60	60									l [m]
	≥9	80	80	80	80	80	80	80	80	80	80						
U	6.9	110	110	110	110	110	110	110	110	110	110	110	110				
	≥9	110	110	110	110	110	110	110	110	110	110	110	110				
M	6.9	110	110	110	110	110	110	110	110	110	110	110	110				
	≥9	160	160	160	160	160	160	160	160	160	160	160	160				
2 x U	6.9	140	140	140	140	140	140	140	140	140	140	140	140				
	≥9	160	160	160	160	160	160	160	160	160	160	160	160				

**With detonation safety barrier**

		Number of air sampling openings															
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	...	32		
I	6.9	46	46	46	46	38											l [m]
	≥9	68	68	68	68	68	68										
U	6.9	60	60	60	60	60	60										
	≥9	60	60	60	60	60	60	60	60								
M	6.9	80	80	80	80	80	80	70	70	70							
	≥9	120	120	120	120	120	120	120	120	120							
2 x U	6.9	80	80	80	80	80	80	80	80								
	≥9	100	100	100	100	100	100	100	100								

**Results**

The following modules can be used with the relevant settings for class B or A:

- 0.015% LT/m (0.05% LT/m) module – with a sensitivity of min. 0.12% LT/m (0.4% LT/m)
- 0.1% LT/m (0.25% LT/m) module – with a sensitivity of min. 0.2% LT/m (0.5% LT/m)
- 0.5% LT/m (0.8% LT/m) module – with setting 0.5% LT/m (0.8% LT/m)

System parameters possible:

- I-pipe system
- 9 V fan voltage, max. 80 m total pipe length for U-pipe system

- U-pipe system  
6.9 V fan voltage, max. 110 m total pipe length  
9 V fan voltage, max. 110 m total pipe length
- M-pipe system  
6.9 V fan voltage, max. 110 m total pipe length  
9 V fan voltage, max. 160 m total pipe length
- Double U-pipe system  
6.9 V fan voltage, max. 140 m total pipe length  
9 V fan voltage, max. 160 m total pipe length

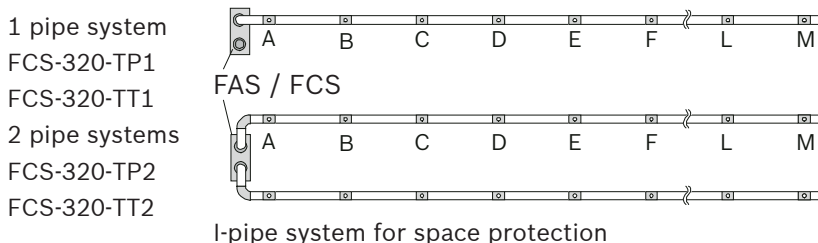


**Notice!**

The sensitivity value is based on measurements with standard test fires (old value in brackets).

**I-pipe system for space protection**

The diameters of the air sampling openings should be taken from the relevant table for each pipe configuration:



Limiting values	Min. distance: FCS-320 – 1st air sampling opening	4 m
I-pipe system	Max. distance: FCS-320 – 1st air sampling opening	20 m
	Max. distance: 1st air sampling opening – last air sampling opening	
	- With low fan voltage	56 m
	- With high fan voltage	80 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	- With low fan voltage	76 m
	- With high fan voltage	100 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	13

I-pipe system	Air sampling opening	Number of air sampling openings												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Ø air sampling opening in mm <sup>a</sup>	A	7.0	6.0	5.2	4.6	4.2	3.8	3.6	3.4	3.0	3.0	2.5	2.5	2.5
	B		6.8	5.2	4.6	4.2	3.8	3.6	3.4	3.0	3.0	2.5	2.5	2.5
	C			5.6	4.6	4.4	4.0	3.8	3.4	3.2	3.0	3.0	3.0	2.5
	D				5.0	4.4	4.0	3.8	3.4	3.4	3.0	3.0	3.0	2.5
	E					4.4	4.2	3.8	3.6	3.6	3.4	3.0	3.0	3.0

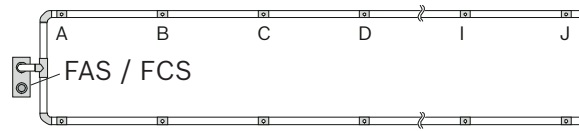


I-pipe system	Air sampling opening	Number of air sampling openings												
		1	2	3	4	5	6	7	8	9	10	11	12	13
	F						4.2	3.8	3.8	3.6	3.4	3.4	3.0	3.0
	G							4.0	3.8	3.6	3.6	3.4	3.2	3.0
	H								4.0	3.8	3.6	3.4	3.2	3.0
	I									3.8	3.6	3.6	3.2	3.2
	J										3.8	3.8	3.2	3.2
	K											3.8	3.8	3.4
	L												4.0	3.8
	M													4.0

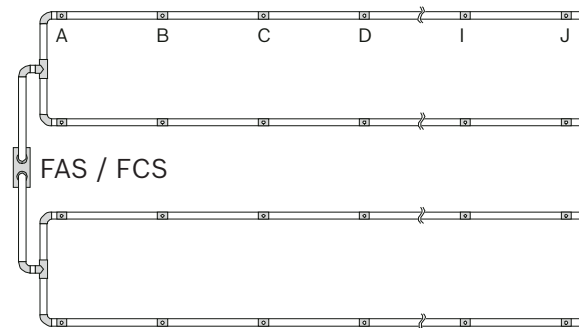
<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**U-pipe system for space protection**

1 pipe system  
FAS-420-TP1  
FAS-420-TT1



2 pipe systems  
FAS-420-TP2  
FAS-420-TT2



U-pipe system for space protection

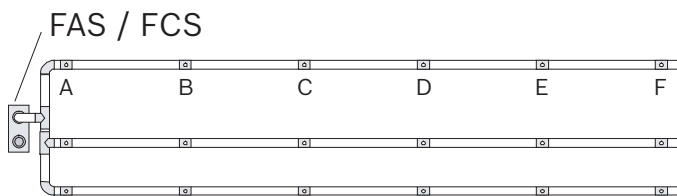
Limiting values	Min. distance: FCS-320 – T-fitting	4 m
U-pipe system	Max. distance: FCS-320 – T-fitting	20 m
	Max. branch length	
	– With low fan voltage	50 m
	– With high fan voltage	65 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	– With low fan voltage	120 m
	– With high fan voltage	150 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	20

U-pipe system	Air sampling opening	Number of air sampling openings									
		2	4	6	8	10	12	14	16	18	20
∅ air sampling opening in mm <sup>a</sup>	A	5.2	3.6	3.4	3.0	2.5	2.5	2.0	2.0	2.0	2.0
	B		4.4	3.4	3.0	3.0	2.5	2.0	2.0	2.0	2.0
	C			3.6	3.2	3.0	2.5	2.5	2.0	2.0	2.0
	D				3.4	3.2	3.0	2.5	2.5	2.0	2.0
	E					3.2	3.0	3.0	2.5	2.5	2.0
	F						3.4	3.2	3.0	2.5	2.5
	G							3.6	3.4	3.0	2.5
	H								3.6	3.4	2.5
	I									3.6	3.6
	J										3.8

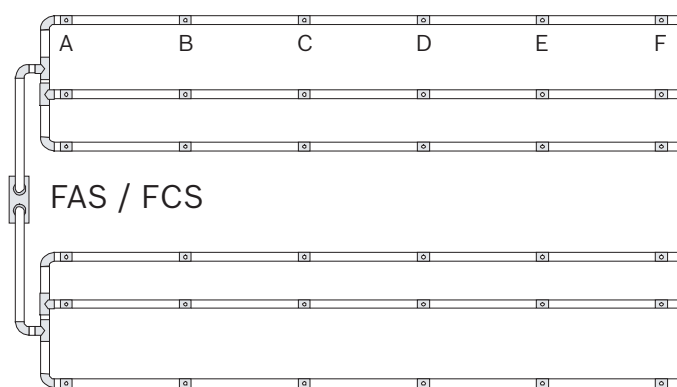
<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**M-pipe system for space protection**

1 pipe system  
FCS-320-TP1  
FCS-320-TT1



2 pipe systems  
FCS-320-TP2  
FCS-320-TT2



M-pipe system for space protection

Limiting values	Min. distance: FCS-320 – last T-fitting	4 m
M-pipe	Max. distance: FCS-320 – last T-fitting	20 m
	Max. branch length	
	– With low fan voltage	46 m
	– With high fan voltage	53 m
	Max. overall pipe length per pipe system (∅ 25 mm)	
	– With low fan voltage	170 m

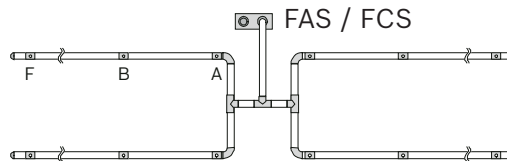
	- With high fan voltage	180 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	21

M-pipe system	Air sampling opening	Number of air sampling openings						
		3	6	9	12	15	18	21
Ø air sampling opening in mm <sup>a</sup>	A	4.4	3.4	3.0	2.5	2.5	2.0	2.0
	B		3.6	3.0	2.5	2.5	2.5	2.0
	C			3.2	3.2	2.5	2.5	2.0
	D				3.2	3.0	2.5	2.5
	E					3.2	3.0	2.5
	F						3.2	3.2
	G							3.4

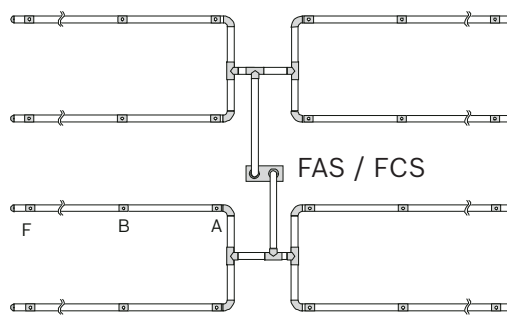
<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**Double U-pipe system for space protection**

1 pipe system  
FCS-320-TP1  
FCS-320-TT1



2 pipe systems  
FCS-320-TP2  
FCS-320-TT2



Double U-pipe system for space protection

Limiting values	Min. distance: FCS-320 – last T-fitting	4 m
Double U-pipe	Max. distance: FCS-320 – last T-fitting	20 m
	Max. branch length	
	- With low fan voltage	40 m
	- With high fan voltage	45 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	- With low fan voltage	180 m
	- With high fan voltage	200 m
	Min. distance between 2 air sampling openings	4 m

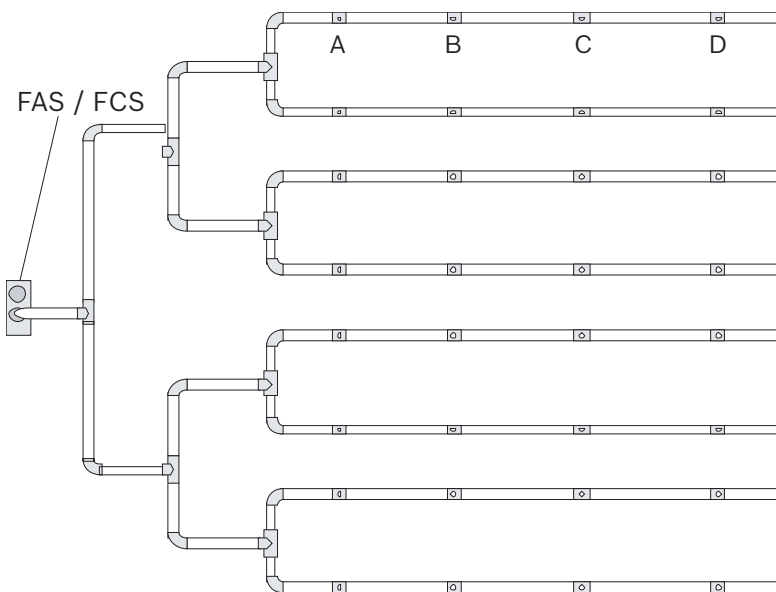
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	24

Double U-pipe system	Air sampling opening	Number of air sampling openings					
		4	8	12	16	20	24
∅ air sampling opening in mm <sup>a</sup>	A	4.0	3.0	2.5	2.0	2.0	2.0
	B	-	3.4	3.0	2.5	2.0	2.0
	C	-	-	3.0	3.0	2.5	2.0
	D	-	-	-	3.2	2.5	2.5
	E	-	-	-	-	3.6	2.5
	F	-	-	-	-	-	3.6

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**Quadruple U-pipe system for space protection**

1 pipe system  
FCS-320-TP1  
FCS-320-TT1



Quadruple U-pipe system for space protection

Limiting values	Min. distance: FCS-320 – last T-fitting	4 m
Double U-pipe	Max. distance: FCS-320 – last T-fitting	20 m
	Max. branch length – With high fan voltage	35 m
	Max. overall pipe length per pipe system (∅ 25 mm) – With high fan voltage	300 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	32

Quadruple U-pipe system	Air sampling opening	Number of air sampling openings			
		8	16	24	32
Ø air sampling opening in mm <sup>a</sup>	A	3.20	2.5	2.0	2.0
	B	-	3.0	2.5	2.0
	C	-	-	3.0	2.0
	D	-	-	-	2.5

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

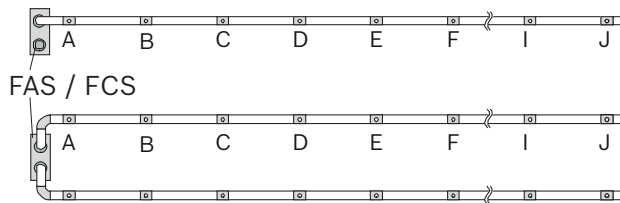
## 4.7 Pipe planning for single-hole monitoring

Depending on the pipe configuration, the following system parameters are used to detect a single air sampling opening or a particular number of obstructed air sampling openings. Planning is to be carried out according to regulations specified in Standard Pipe Planning. Additionally, the following limiting values and opening diameters must be observed. An additional accessory (air filter, condensate separator etc.) can have an effect on the maximum pipe length.

### I-pipe system - single-hole monitoring

1 pipe system FCS-320-TP1 FCS-320-TT1

2 pipe systems FCS-320-TP2 FCS-320-TT2



I-pipe system for space protection

Limiting values	Min. distance FCS-320– 1st air sampling opening	4 m
I-pipe system	Max. distance FCS-320 – 1st air sampling opening	20 m
	Max. distance: 1st air sampling opening – last air sampling opening	
	– With low fan voltage	40 m
	– With high fan voltage	60 m
	Max. overall pipe length (Ø 25 mm)	
	– With low fan voltage	60 m
	– With high fan voltage	80 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	10

I-pipe system	Air sampling opening	Number of air sampling openings								
		2	3	4	5	6	7	8	9	10
Ø air sampling opening in mm <sup>a</sup>	A	6.0	5.0	4.2	3.8	3.2	3.0	2.5	2.5	2.0
	B	6.8	5.2	4.4	3.8	3.2	3.0	2.5	2.5	2.0
	C	-	5.2	4.6	4.0	3.6	3.0	3.0	2.5	2.5
	D	-	-	4.6	4.0	3.6	3.4	3.0	3.0	2.5

I-pipe system	Air sampling opening	Number of air sampling openings								
		2	3	4	5	6	7	8	9	10
	E	-	-	-	4.4	4.0	3.4	3.4	3.0	3.0
	F	-	-	-	-	4.0	3.8	3.4	3.4	3.0
	G	-	-	-	-	-	3.8	3.8	3.4	3.4
	H	-	-	-	-	-	-	3.8	3.8	3.4
	I	-	-	-	-	-	-	-	3.8	3.6
	J	-	-	-	-	-	-	-	-	3.6

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**I-pipe system activation thresholds**

Activation thresholds	Number of openings	2	3	4	5	6	7	8	9	10
	1 obstructed opening	III	III	II	I	I	—	—	—	—
	2 obstructed openings	0	0	III	III	II	I	I	—	—
	3 obstructed openings	0	0	0	0	III	III	II	I	I
	4 obstructed openings	0	0	0	0	0	0	III	II	I
	5 obstructed openings	0	0	0	0	0	0	0	0	II
	... will be recognized by the setting level x									

— not possible, 0 not practical

**Example**

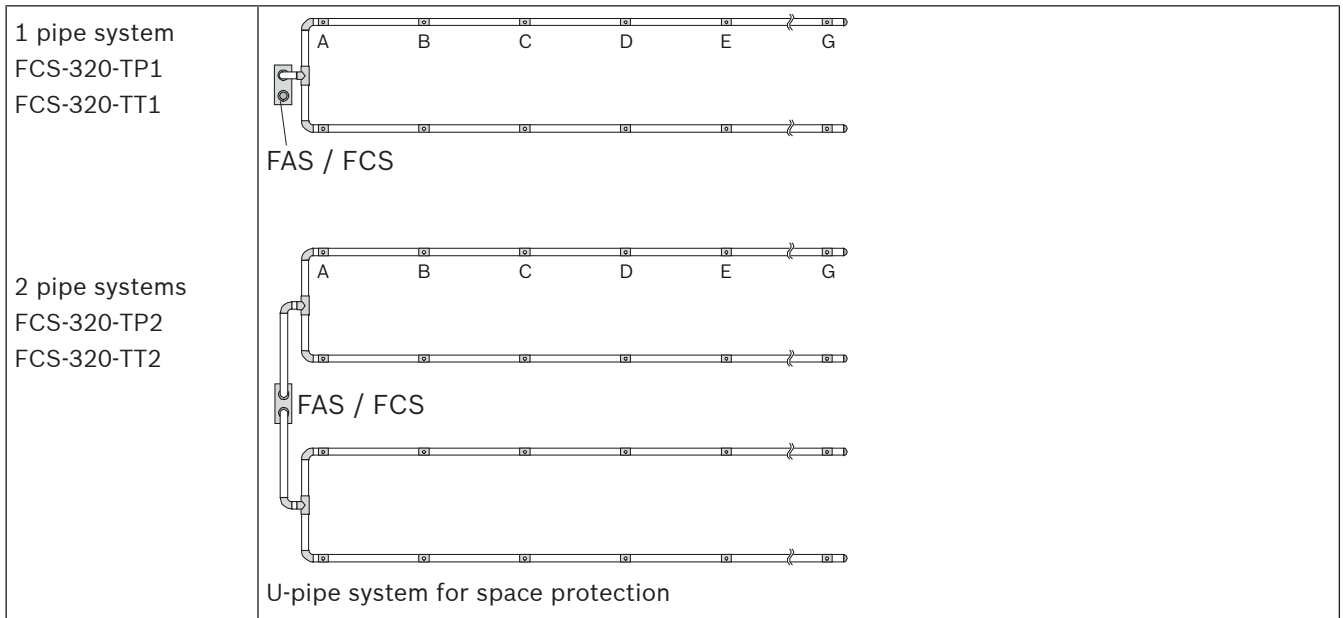
If 3 of a total of 7 air sampling openings are found to be obstructed, the switch for setting the airflow monitoring should be set to level III.



**Notice!**

When planning in accordance with EN 54-20 or ISO 7240-20, level I or II must always be set for airflow monitoring.

**U-pipe system - single-hole monitoring**



Limiting values	Min. distance FCS-320 – T-fitting	4 m
U-pipe system	Max. distance FCS-320 – T-fitting	20 m
	Max. branch length – With low fan voltage – With high fan voltage	40 m 50 m
	Max. overall pipe length per pipe system (Ø 25 mm) – With low fan voltage – With high fan voltage	100 m 120 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	14

U-pipe system	Air sampling opening	Number of air sampling openings						
		2	4	6	8	10	12	14
Ø air sampling opening in mm <sup>a</sup>	A	5.2	3.6	3.4	3.2	2.5	2.5	2.0
	B	-	4.0	3.4	3.2	3.0	2.5	2.0
	C	-	-	3.6	3.4	3.0	2.5	2.5
	D	-	-	-	3.4	3.2	3.0	2.5
	E	-	-	-	-	3.2	3.0	3.0
	F	-	-	-	-	-	3.2	3.0
	G	-	-	-	-	-	-	3.2

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**U-pipe system activation thresholds per pipe system**

Activation thresholds	Number of openings	2	4	6	8	10	12	14
	1 obstructed opening	III	II	I	—	—	—	—
	2 obstructed openings	0	III	II	I	—	—	—
	3 obstructed openings	0	0	III	II	I	—	—
	4 obstructed openings	0	0	0	III	II	I	—
	5 obstructed openings	0	0	0	0	III	II	I
	6 obstructed openings	0	0	0	0	0	III	II
	... will be recognized by the setting level x							

— not possible, 0 not practical

**Example**

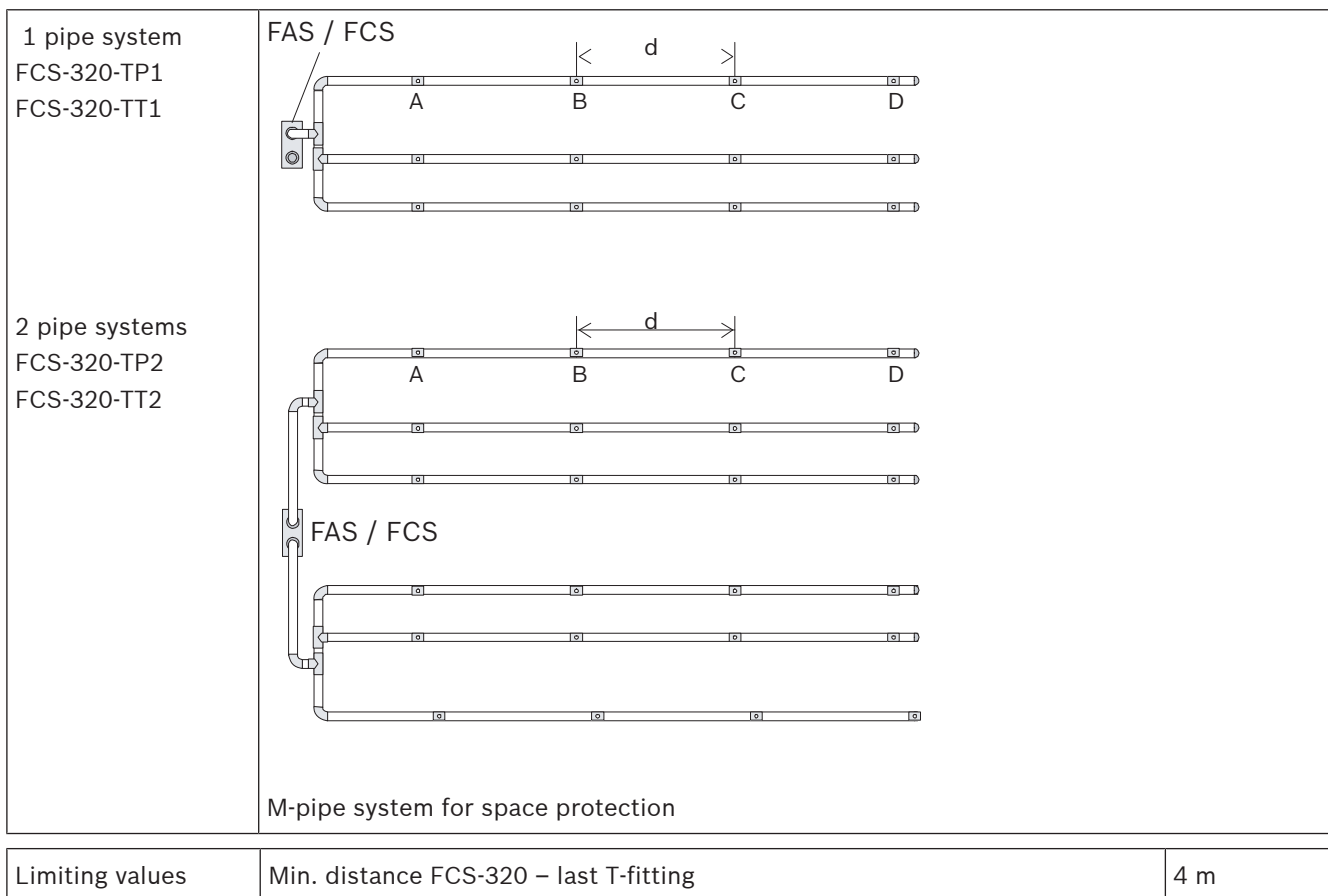
If 3 of a total of 10 air sampling openings are found to be obstructed, the switch for setting the airflow monitoring should be set to level I.



**Notice!**

When planning in accordance with EN 54-20 or ISO 7240-20, level I or II must always be set for airflow monitoring.

**M-pipe system - single-hole monitoring**





Double U-pipe	Max. distance FCS-320 – last T-fitting	20 m
	Max. branch length	30 m
	– With low fan voltage	40 m
	– With high fan voltage	
	Max. overall pipe length per pipe system (Ø 25 mm)	110 m
	– With low fan voltage	140 m
	– With high fan voltage	
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	12

M-pipe	Air sampling opening	Number of air sampling openings			
		3	6	9	12
Ø air sampling opening in mm <sup>a</sup>	A	4.4	3.4	3.0	2.5
	B	-	3.6	3.0	2.5
	C	-	-	3.2	3.2
	D	-	-	-	3.2

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**M-pipe system activation thresholds per pipe system**

Activation thresholds	Number of openings	3	6	9	12
	1 obstructed opening	III	I	—	—
	2 obstructed openings	0	II	—	—
	3 obstructed openings	0	III	I	—
	4 obstructed openings	0	0	II	I
	5 obstructed openings	0	0	0	II
	6 obstructed openings	0	0	0	III
	7 obstructed openings	0	0	0	0
	... will be recognized by the setting level x				

— not possible, 0 not practical

**Example**

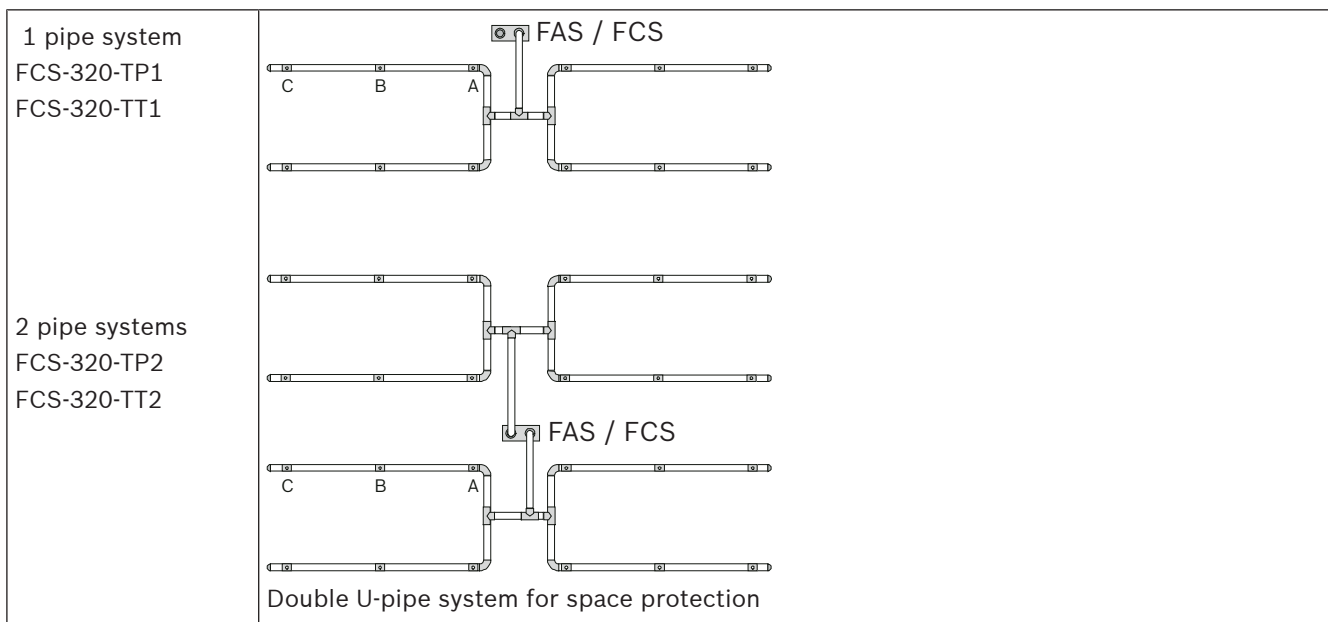
If 3 of a total of 9 air sampling openings are found to be obstructed, the switch for setting the airflow monitoring should be set to level I.



**Notice!**

When planning in accordance with EN 54-20 or ISO 7240-20 , level I or II must always be set for airflow monitoring.

**Double U-pipe system - single-hole monitoring**



Limiting values	Min. distance FCS-320– last T-fitting	4 m
Double U-pipe	Max. distance FCS-320 – last T-fitting	20 m
	Max. branch length	
	– With low fan voltage	20 m
	– With high fan voltage	30 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	– With low fan voltage	100 m
	– With high fan voltage	140 m
	Min. distance between 2 air sampling openings	4 m
	Max. distance between 2 air sampling openings	12 m
	Max. number of air sampling openings (n) per pipe system	12

Double U-pipe	Air sampling opening	Number of air sampling openings		
		4	8	12
Ø air sampling opening in mm <sup>a</sup>	A	4.0	3.0	2.5
	B	-	3.4	3.0
	C	-	-	3.0

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**Double U-pipe system activation thresholds per pipe system**

Activation thresholds	Number of openings	4	8	12
	1 obstructed opening	I	—	—
	2 obstructed openings	II	I	—
	3 obstructed openings	0	II	I

	4 obstructed openings	0	III	II
	5 obstructed openings	0	0	III
	6 obstructed openings	0	0	III
	... will be recognized by the setting level x			

— not possible, 0 not practical

**Example**

If 4 of a total of 12 air sampling openings are found to be blocked, the switch for setting the airflow monitoring should be set to level II.



**Notice!**

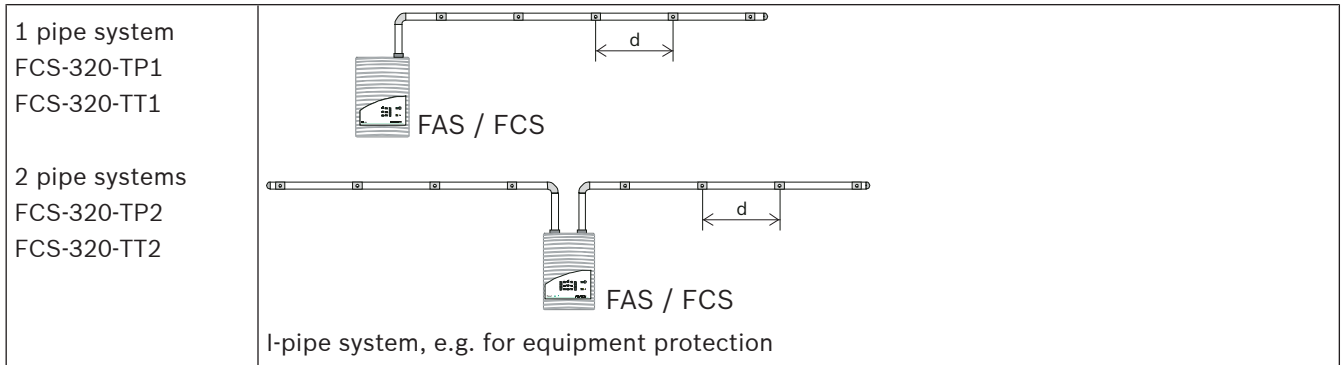
When planning in accordance with EN 54-20 or ISO 7240-20, level I or II must always be set for airflow monitoring.

### 4.8 Simplified pipe planning

Simplified planning is used for equipment protection and in premises with smaller dimensions. The benefit of this type of planning is the standard diameters of the suction openings.

Planning is to be carried out according to regulations specified in Standard Pipe Planning. Additionally, the following limiting values and opening diameters must be observed. An additional accessory (air filter, condensate separator etc.) can have an effect on the maximum pipe length.

**I-pipe system - simplified planning**

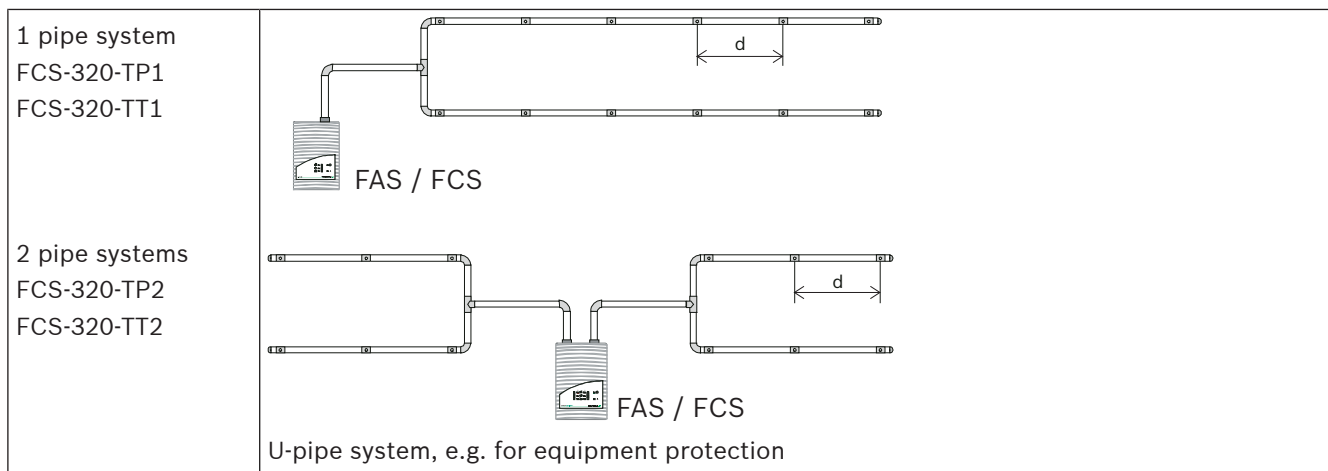


Limiting values	Min. distance FCS-320 – 1st air sampling opening	2 m
I-pipe system	Max. distance FCS-320 – 1st air sampling opening	20 m
	Max. distance: 1st air sampling opening – last air sampling opening	20 m
	Max. overall pipe length (Ø 25 mm)	40 m
	Min. distance between air sampling openings	0.1 m
	Max. distance between air sampling openings	4 m
	Max. number of air sampling openings (n) per pipe system	18

I-pipe system	Number of air sampling openings																	
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Ø of all air sampling openings in mm <sup>a</sup>	6.0	5.0	4.4	4.0	3.6	3.4	3.2	3.0	3.0	3.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**U-pipe system - simplified planning**

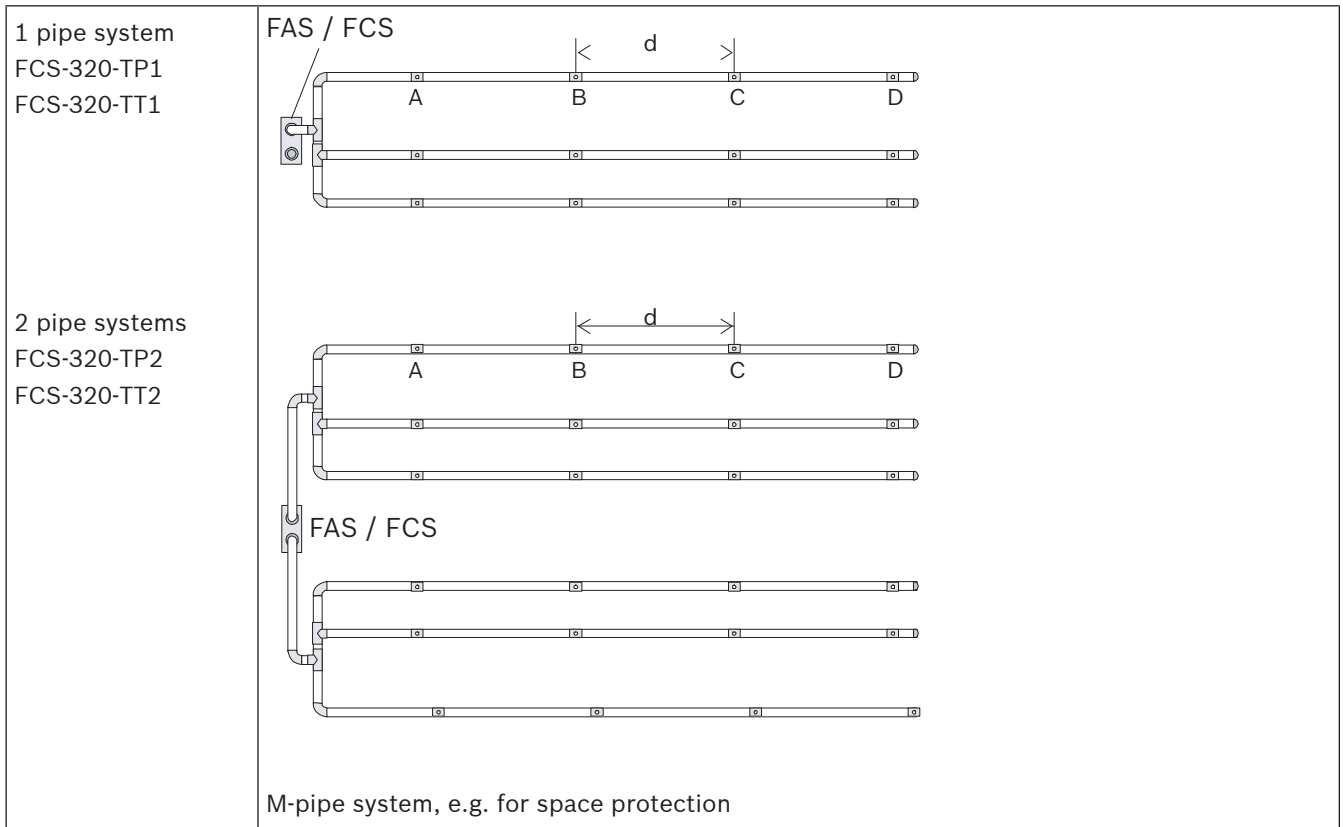


Limiting values	Min. distance FCS-320 – T-fitting	2 m
U-pipe system	Max. distance FCS-320 – T-fitting	20 m
	Max. branch length	20 m
	Max. overall pipe length (Ø 25 mm)	60 m
	Min. distance between air sampling openings (d)	0.1 m
	Max. distance between air sampling openings (d)	4 m
	Max. number of air sampling openings (n) per pipe system	18

U-pipe system	Number of air sampling openings									
	2	4	6	8	10	12	14	16	18	
Ø of all air sampling openings in mm <sup>a</sup>	6.0	4.4	3.6	3.2	3.0	3.0	2.5	2.5	2.5	

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**M-pipe system - simplified planning**

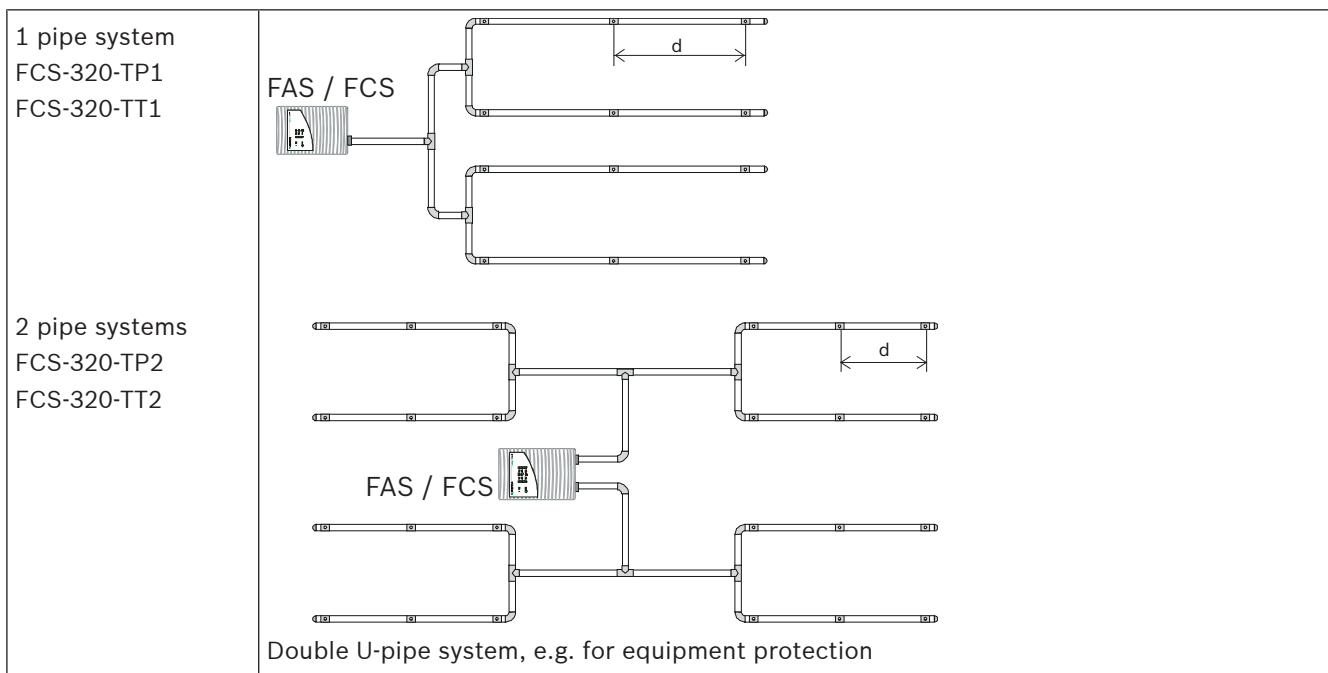


Limiting values	Min. distance FCS-320 – last T-fitting	2 m
Double U-pipe	Max. distance FCS-320 – last T-fitting	20 m
	Max. branch length	20 m
	Max. overall pipe length (Ø 25 mm)	80 m
	Min. distance between air sampling openings (d)	0.1 m
	Max. distance between air sampling openings (d)	4 m
	Max. number of air sampling openings (n) per pipe system	18

M-pipe	Number of air sampling openings					
	3	6	9	12	15	18
Ø of all air sampling openings in mm <sup>a</sup>	5.0	3.6	3.0	3.0	2.5	2.5

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

**Double U-pipe system - simplified planning**



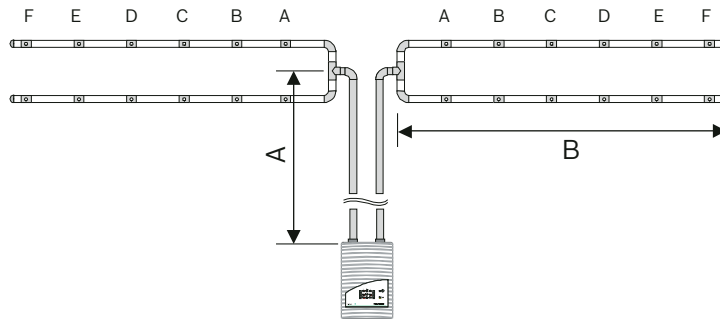
Limiting values	Min. distance FCS-320 – last T-fitting	2 m
Double U-pipe	Max. distance FCS-320 – last T-fitting	20 m
	Max. branch length	20 m
	Max. overall pipe length (Ø 25 mm)	100 m
	Min. distance between air sampling openings (d)	0.1 m
	Max. distance between air sampling openings (d)	4 m
	Max. number of air sampling openings (n) per pipe system	20

Double U-pipe	Number of air sampling openings				
	4	8	12	16	20
Ø of all air sampling openings in mm <sup>a</sup>	4.0	3.4	3.0	2.5	2.0

<sup>a</sup> Punch diameter of the aspiration reducing film sheet

## 4.9 Planning for long pipe feed lines

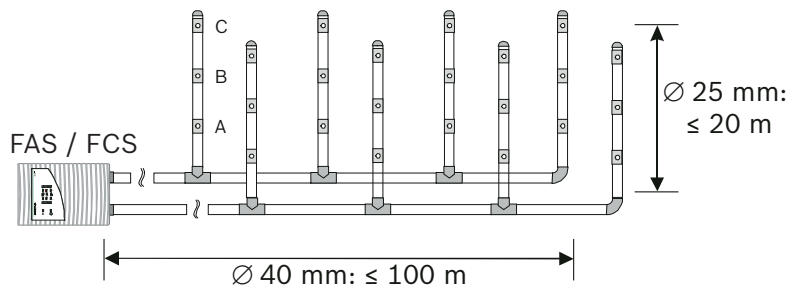
Pipes with a 40 mm diameter are required for planning pipe feed line A. Area B is designed with 25 mm pipes in accordance with Standard Pipe Planning. The plan applies for the pipe configurations described above.



Example of a pipe system with long pipe feed lines for area monitoring

The general pipe planning is restricted by the use of long pipe feed lines as follows:

- Pipes with a 40 mm diameter increase transport time.
- 1 m pipe with a 40 mm diameter replaces 3 m pipe with a 25 mm diameter.



Example of special planning for high-rise warehouse

A basic pipe can be installed for high-rise warehouse planning, from which the stub-shaped aspiration pipes are routed.

## 4.10

### Planning with acceleration openings

#### Acceleration openings

In order to meet individual regulations, it may be necessary to decrease the transport time of the systems. This can be fulfilled by fitting the ends of the pipe branches with acceleration openings, which increase transport speed. Depending on the regulations concerning transport time, it may be necessary to dimension an acceleration opening with the same or double the diameter of the last air sampling opening on a pipe branch. Only authorized aids should be used to calculate the transport time. The additional airflow of the acceleration openings also reduces the sensitivity of the air sampling openings. If required, this reduction can be offset as follows:

	Method of resolution	Primarily used in
1	Increasing the sensitivity of the detector module	Previously installed systems
2	Reducing the number of air sampling openings	Systems currently being planned

#### 1. Option: increasing the sensitivity

Reduced sensitivity at the air sampling openings can be offset by using a more sensitive detection setting. A distinction must be made regarding whether the cross-section of an acceleration opening is smaller or the same as:

- the cross-section of the last air sampling opening of a branch
- the doubled cross-section of the last air sampling opening of a branch

	Air sampling openings																				
Pipe shape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	24	32
I	0.50	0.66	0.75	0.80	0.83	0.85	0.87	0.88	0.90	0.90	0.91	0.92	0.92								
U		0.50		0.66		0.75		0.80		0.83		0.85		0.87		0.88	0.90	0.90			
M			0.50			0.66			0.75			0.80			0.83		0.85		0.87		
2 x U				0.50				0.66				0.75				0.80		0.83		0.85	
4 x U								0.50								0.66				0.75	0.80

Table 4.2: Factors for increasing the sensitivity (acceleration opening corresponds to one air sampling opening)

	Air sampling openings																				
Pipe shape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	24	32
I	0.33	0.50	0.60	0.66	0.71	0.75	0.77	0.80	0.81	0.83	0.84	0.85	0.86								
U		0.33		0.50		0.66		0.66		0.71		0.75		0.77		0.80	0.81	0.83			
M			0.33			0.50			0.66			0.66			0.71		0.75		0.77		
2 x U				0.33				0.50				0.66				0.66		0.71		0.75	
4 x U								0.33								0.50				0.66	0.66

Table 4.3: Factors for increasing the sensitivity (acceleration opening corresponds to two air sampling openings)

Example:

A class B double U-pipe system with 24 air sampling openings is planned. According to EN 54-20 or ISO 7240-20, 24 openings are permitted in class B at a sensitivity of 0.25% LT/m. In order to decrease the transport time, an acceleration opening the same size as the last air sampling opening is to be used. According to 1. Option: *increasing the sensitivity*, page 55, the necessary sensitivity of the detector module in this case is  $0.25 \% \text{ LT/m} * 0.85 = 0.1875 \% \text{ LT/m}$ .

## 2. Option: reducing the number of air sampling openings

Reduced sensitivity at the air sampling openings can be offset by reducing the number of air sampling openings. A distinction must be made regarding whether the cross-section of an acceleration opening is smaller or the same as:

- the cross-section of the last air sampling opening of a branch
- the doubled cross-section of the last air sampling opening of a branch



	Air sampling openings																				
Pipe shape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	24	32
I		1	2	3	4	5	6	7	8	9	10	11	12								
U				2		4		6		8		10		12		14	16	18			
M						3			6			9			12		15		18		
Double U								4				8				12		16		20	
Quadruple U																8				16	24

**Table 4.4: Reducing the number of air sampling openings (acceleration opening corresponds to one air sampling opening)**

	Air sampling openings																				
Pipe shape	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	24	32
I		1	1	2	3	4	5	6	7	8	9	10	11								
U				2		2		4		6		8		10		12	14	16			
M						3			3			6			9		12		15		
Double U								4				4				8		12		16	
Quadruple U																8				8	16

**Table 4.5: Reducing the number of air sampling openings (acceleration opening corresponds to two air sampling openings)**

Example:

A class B double U-pipe system with 24 air sampling openings is planned. According to EN 54-20 and ISO 7240-20, 24 openings are permitted in class B at a sensitivity of 0.25% LT/m. In order to decrease the transport time, an acceleration opening twice the size as the last air sampling opening is to be used. According to 2. Option: reducing the number of air sampling openings, page 56, 16 air sampling openings are permitted in this case at a sensitivity of 0.25% LT/m.

It may be necessary to decrease the system's transport time in order to meet individual requirements. For this purpose, acceleration apertures can be planned at the end of the pipe branch, which will increase the transport rate.

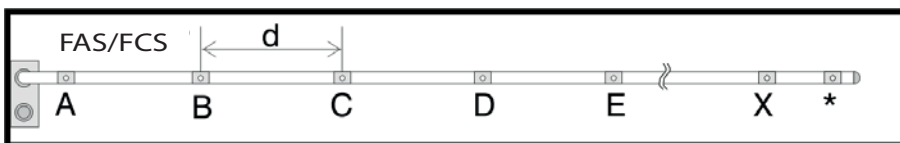
For the design of pipe systems with acceleration apertures, please refer to the following table for aspiration holes and particular pipe configuration. Furthermore compliance is required with special design tables for the design of smoke aspiration systems with acceleration apertures



**Notice!**  
**Type and source of hazard**

Due to physical properties, the detection of pipe rupture is derated when using pipe systems with acceleration apertures.

**I-Pipe**



\* acceleration aperture

	Number of apertures									
	1	2	3	4	5	6	7	8	9	10
	Sampling aperture type Ax-x.x									
A	7.0	7.0	7.0	3.2	3.0	2.5	2.0	2.0	2.0	2.0
B	a	7.0	7.0	7.0	3.8	3.0	2.5	2.0	2.0	2.0
C	-	a	7.0	7.0	6.0	3.6	3.0	2.5	2.0	2.0
D	-	-	a	7.0	7.0	5.6	3.6	3.0	2.5	2.0
E	-	-	-	a	7.0	7.0	5.2	3.6	3.0	2.5
F	-	-	-	-	a	7.0	7.0	5.2	3.6	3.2
G	-	-	-	-	-	a	7.0	7.0	4.4	3.4
H	-	-	-	-	-	-	a	7.0	7.0	4.0
I	-	-	-	-	-	-	-	a	7.0	7.0
J	-	-	-	-	-	-	-	-	a	7.0
K	-	-	-	-	-	-	-	-	-	a
L	-	-	-	-	-	-	-	-	-	-
M	-	-	-	-	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-	-
O	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	-	-	-	-	-	-	-
R	-	-	-	-	-	-	-	-	-	-
S	-	-	-	-	-	-	-	-	-	-
T	-	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-	-

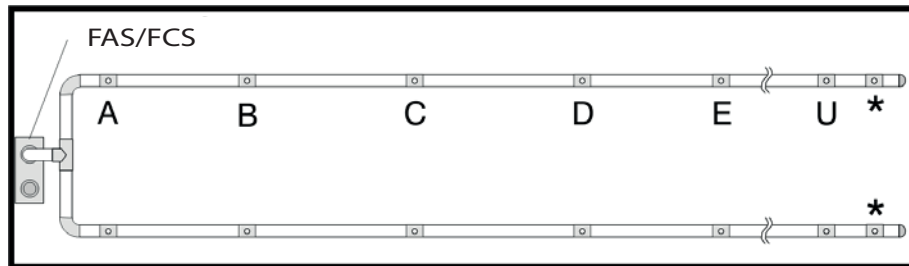
a = Acceleration openings = 7.0 mm

	Number of apertures									
	11	12	13	14	15	16	17	18	19	20

	Sampling aperture type Ax-x.x									
A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
B	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
C	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
D	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
E	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
F	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
G	3.0	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
H	3.4	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
I	3.6	3.2	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
J	7.0-	3.6	3.4	2.5	2.5	2.0	2.0	2.0	2.0	2.0
K	7.0	6.8	3.6	3.2	2.5	2.0	2.0	2.0	2.0	2.0
L	a	7.0	6.8	3.2	3.4	2.5	2.0	2.0	2.0	2.0
M	-	a	7.0	6.8	3.6	3.2	2.5	2.0	2.0	2.0
N	-	-	a	7.0	6.0	3.6	3.0	2.5	2.0	2.0
O	-	-	-	a	7.0	6.0	3.4	3.0	2.5	2.0
P	-	-	-	-	a	7.0	6.0	3.4	3.0	2.5
Q	-	-	-	-	-	a	7.0	5.6	3.4	2.5
R	-	-	-	-	-	-	a	7.0	5.2	3.4
S	-	-	-	-	-	-	-	a	7.0	5.0
T	-	-	-	-	-	-	-	-	a	7.0
U	-	-	-	-	-	-	-	-	-	a

a = Acceleration openings = 7.0 mm

**U-Pipe**



\* acceleration aperture

	Number of apertures									
	2	4	6	8	10	12	14	16	18	20

	Sampling aperture type Ax-x.x									
A	7.0	7.0	6.8	4.6	3.0	2.5	2.5	2.0	2.0	2.0
B	a	7.0	7.0	5.0	3.6	2.5	2.5	2.5	2.5	2.5
C	-	a	7.0	7.0	5.0	3.0	3.0	2.5	2.5	2.5
D	-	-	a	7.0	7.0	5.0	3.0	3.0	2.5	2.5
E	-	-	-	a	7.0	7.0	4.0	3.0	3.4	2.5
F	-	-	-	-	a	7.0	7.0	3.6	3.4	2.5
G	-	-	-	-	-	a	7.0	7.0	4.0	3.0
H	-	-	-	-	-	-	a	7.0	6.0	4.0
I	-	-	-	-	-	-	-	a	7.0	6.0
J	-	-	-	-	-	-	-	-	a	7.0
K	-	-	-	-	-	-	-	-	-	a
L	-	-	-	-	-	-	-	-	-	-
M	-	-	-	-	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-	-
O	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	-	-	-	-	-	-	-
R	-	-	-	-	-	-	-	-	-	-
S	-	-	-	-	-	-	-	-	-	-
T	-	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-	-

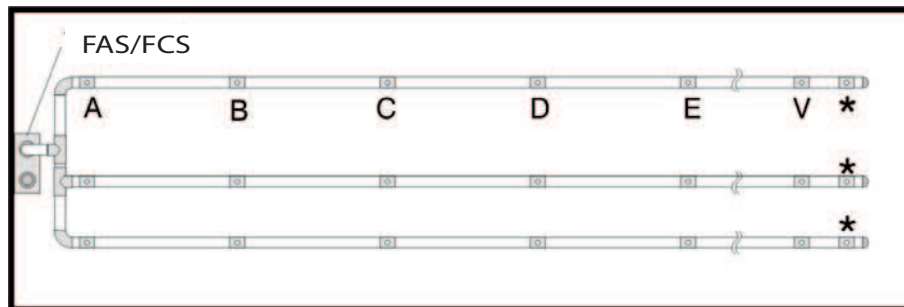
a = Acceleration openings = 7.0 mm

	Number of apertures									
	22	24	26	28	30	32	34	36	38	40
	Sampling aperture type Ax-x.x									
A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
B	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
C	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
D	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
E	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
F	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
G	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

H	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
I	4.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
J	5.6	4.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
K	7.0	5.2	4.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5
L	a	7.0	5.0	4.0	3.0	2.5	2.5	2.5	2.5	2.5
M	-	a	7.0	5.0	4.0	3.0	2.5	2.5	2.5	2.5
N	-	-	a	7.0	5.0	4.0	3.0	2.5	2.5	2.5
O	-	-	-	a	7.0	5.0	4.0	3.0	2.5	2.5
P	-	-	-	-	a	7.0	5.0	4.0	3.2	2.5
Q	-	-	-	-	-	a	7.0	5.0	4.0	3.2
R	-	-	-	-	-	-	a	7.0	5.0	4.0
S	-	-	-	-	-	-	-	a	7.0	5.0
T	-	-	-	-	-	-	-	-	a	7.0
U	-	-	-	-	-	-	-	-	-	a

a = Acceleration openings = 7.0 mm

**M-Pipe**



\* acceleration aperture

	Number of apertures										
	3	6	9	12	15	18	21	24	27	30	33
Sampling aperture type Ax-x.x											
A	7.0	7.0	6.8	4.6	3.0	2.5	2.5	2.0	2.0	2.0	2.0
B	a	7.0	7.0	5.0	3.4	2.5	2.5	2.5	2.5	2.5	2.0
C	-	a	7.0	7.0	5.0	3.6	3.0	2.5	2.5	2.5	2.5
D	-	-	a	7.0	7.0	4.6	3.4	3.0	2.5	2.5	2.5
E	-	-	-	a	7.0	7.0	4.0	3.2	3.4	2.5	2.5
F	-	-	-	-	a	7.0	6.8	3.6	3.4	2.5	2.5

G	-	-	-	-	-	a	7.0	6.8	3.6	3.2	2.5
H	-	-	-	-	-	-	a	7.0	6.0	3.6	3.4
I	-	-	-	-	-	-	-	a	7.0	6.0	3.6
J	-	-	-	-	-	-	-	-	a	7.0	5.6
K	-	-	-	-	-	-	-	-	-	a	7.0
L	-	-	-	-	-	-	-	-	-	-	a
M	-	-	-	-	-	-	-	-	-	-	
N	-	-	-	-	-	-	-	-	-	-	
O	-	-	-	-	-	-	-	-	-	-	
P	-	-	-	-	-	-	-	-	-	-	
Q	-	-	-	-	-	-	-	-	-	-	
R	-	-	-	-	-	-	-	-	-	-	
S	-	-	-	-	-	-	-	-	-	-	
T	-	-	-	-	-	-	-	-	-	-	
U	-	-	-	-	-	-	-	-	-	-	
V											

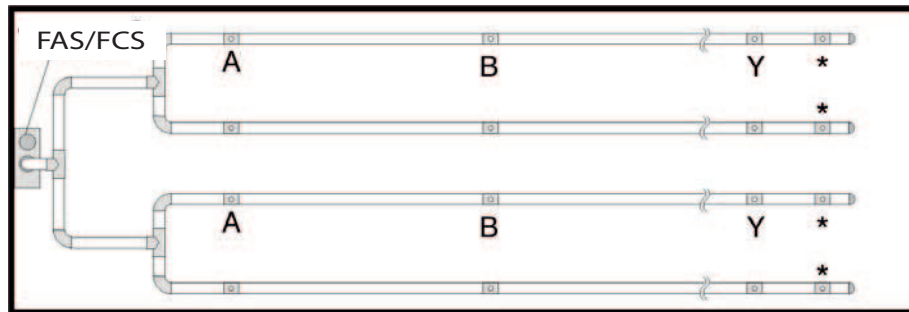
a = Acceleration openings = 7.0 mm

	Number of apertures									
	36	39	42	45	48	51	54	57	60	63
	Sampling aperture type Ax-x.x									
A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
B	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
C	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
D	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0
E	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0
F	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
G	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
H	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
I	3.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
J	3.6	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
K	5.0	3.5	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
L	7.0	4.6	3.6	3.0	2.5	2.5	2.5	2.5	2.5	2.5
M	a	7.0	4.0	3.6	2.5	2.5	2.5	2.5	2.5	2.5
N	-	a	7.0	4.0	3.0	3.0	3.0	2.5	2.5	2.5

O	-	-	a	7.0	3.6	3.6	4.0	2.5	2.5	2.5
P	-	-	-	-	7.0	3.6	5.0	2.5	2.5	2.5
Q	-	-	-	-	a	6.0	7.0	2.5	2.5	2.5
R	-	-	-	-	-	a	a	3.0	2.5	2.5
S	-	-	-	-	-	-	-	6.0	3.0	2.5
T	-	-	-	-	-	-	-	a	6.0	3.0
U	-	-	-	-	-	-	-	-	a	6.0
V										a

a = Acceleration openings = 7.0 mm

**Double-U-Pipe**



\* acceleration aperture

	Number of apertures												
	4	8	12	16	20	24	28	32	36	40	44	48	52
	Sampling aperture type Ax-x.x												
A	7.0	7.0	6.8	4.6	3.0	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
B	a	7.0	7.0	5.0	3.4	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0
C	-	a	7.0	7.0	5.0	3.6	3.0	2.5	2.5	2.5	2.5	2.5	2.5
D	-	-	a	7.0	7.0	4.6	3.4	3.0	2.5	2.5	2.5	2.5	2.5
E	-	-	-	a	7.0	7.0	4.0	3.2	3.4	2.5	2.5	2.5	2.5
F	-	-	-	-	a	7.0	6.8	3.6	3.4	2.5	2.5	2.5	2.5
G	-	-	-	-	-	a	7.0	6.8	3.6	3.2	2.5	2.5	2.5
H	-	-	-	-	-	-	a	7.0	6.0	3.6	3.4	2.5	2.5
I	-	-	-	-	-	-	-	a	7.0	6.0	3.6	3.4	2.5
J	-	-	-	-	-	-	-	-	a	7.0	5.6	3.6	3.0
K	-	-	-	-	-	-	-	-	-	a	7.0	5.0	3.6
L	-	-	-	-	-	-	-	-	-	-	a	7.0	4.6

M	-	-	-	-	-	-	-	-	-	-	-	a	7.0
N	-	-	-	-	-	-	-	-	-	-	-	-	a
O	-	-	-	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	-	-	-	-	-	-	-	-	-	-
R	-	-	-	-	-	-	-	-	-	-	-	-	-
S	-	-	-	-	-	-	-	-	-	-	-	-	-
T	-	-	-	-	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-	-
W	-	-	-	-	-	-	-	-	-	-	-	-	-
X	-	-	-	-	-	-	-	-	-	-	-	-	-
Y	-	-	-	-	-	-	-	-	-	-	-	-	-
Z	-	-	-	-	-	-	-	-	-	-	-	-	-

a = Acceleration openings = 7.0 mm

	Number of apertures												
	56	60	64	68	72	76	80	84	88	92	96	100	
	Sampling aperture type Ax-x.x												
A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
B	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
C	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
D	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
E	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
F	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
G	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0	2.0
H	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0
I	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0	2.0
J	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
K	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
L	3.6	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0
M	4.0	3.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0	2.0	2.0
N	7.0	3.6	3.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
O	a	7.0	3.6	3.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.0
P	-	a	7.0	3.6	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5



Q	-	-	a	6.0	3.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5
R	-	-	-	a	6.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5
S	-	-	-	-	a	6.0	3.0	2.5	2.5	2.5	2.5	2.5
T	-	-	-	-	-	a	6.0	3.0	2.5	2.5	2.5	2.5
U	-	-	-	-	-	-	a	6.0	3.0	2.5	2.5	2.5
V	-	-	-	-	-	-	-	a	6.0	3.0	2.5	2.5
W	-	-	-	-	-	-	-	-	a	6.0	3.0	2.5
X	-	-	-	-	-	-	-	-	-	a	6.0	3.0
Y	-	-	-	-	-	-	-	-	-	-	a	6.0
Z	-	-	-	-	-	-	-	-	-	-	-	a

a = Acceleration openings = 7.0 mm

**Refer to**

- 2. Option: reducing the number of air sampling openings, page 56

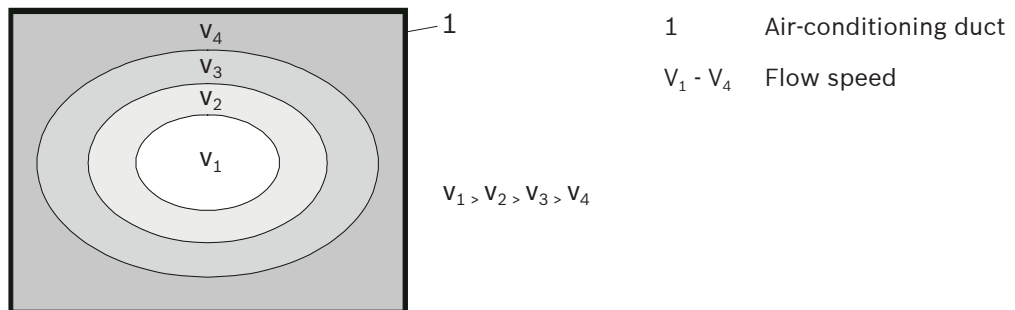
## 4.11 Planning for forced airflow

### Monitoring the air-conditioning ducts

Air-conditioning units are broken down into low and high-speed units (see table below). The details provided in this chapter apply only to low-speed units. There are no adequate empirical values available for high-speed units. Hence, smoke trials must be executed for air-conditioning ducts with flow speeds above 10 m/s, in order to determine optimal response behavior.

Air-conditioning ducts		Low-speed units	High-speed units
	Flow speed	Maximum 6 to 10 m/s	> 10 m/s
	Duct cross-section	Large	Small
	Difference pressures along the flow direction	Low	High

The speed distribution in an air-conditioning duct appears as follows:



Speed distribution in an air-conditioning duct

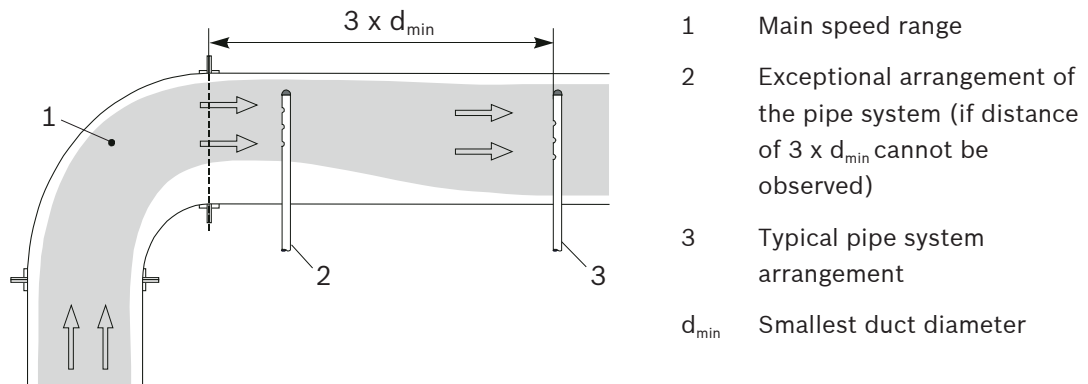
### Aspiration

To achieve optimal detection results, the pipe system should be organized into the areas  $v_1$  to  $v_3$

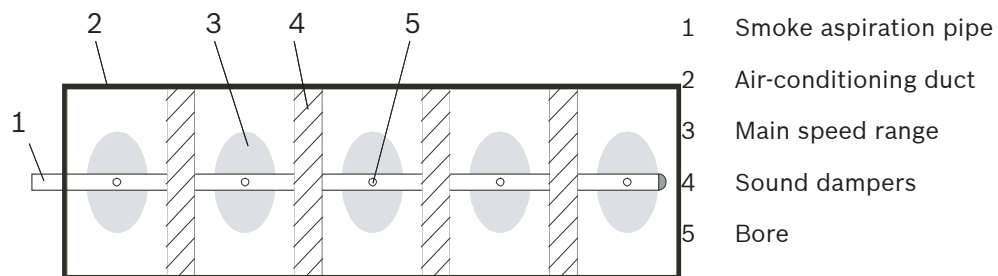
### Installation location of the pipe system

The exhaust duct should be selected as the installation location of the pipe system, as far as possible away from the sound dampers, air baffles and bends. The distance from obstacles of this kind should be at least three times the smallest duct diameter.

If it is absolutely essential to install the pipe system directly behind air baffles, sound dampers or bends; the main speed ranges must be monitored (see *Installation location of the pipe system*, page 66/*Installation location of the pipe system*, page 66).



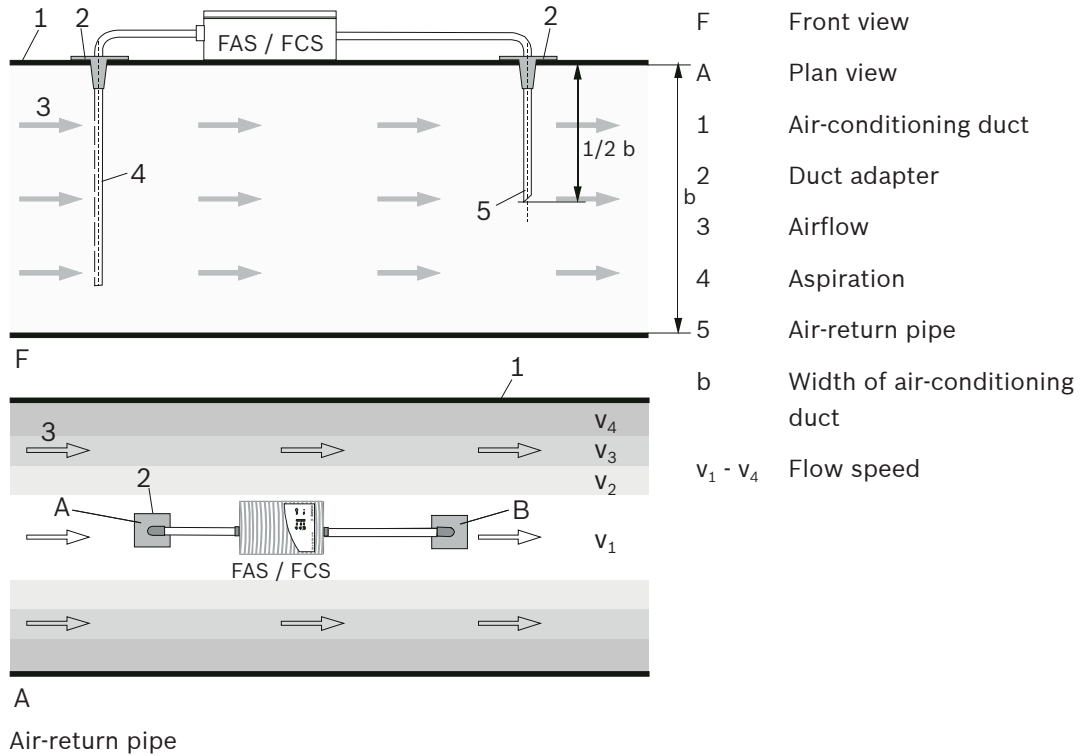
Direction change of the duct without air baffles



Sound dampers in a duct

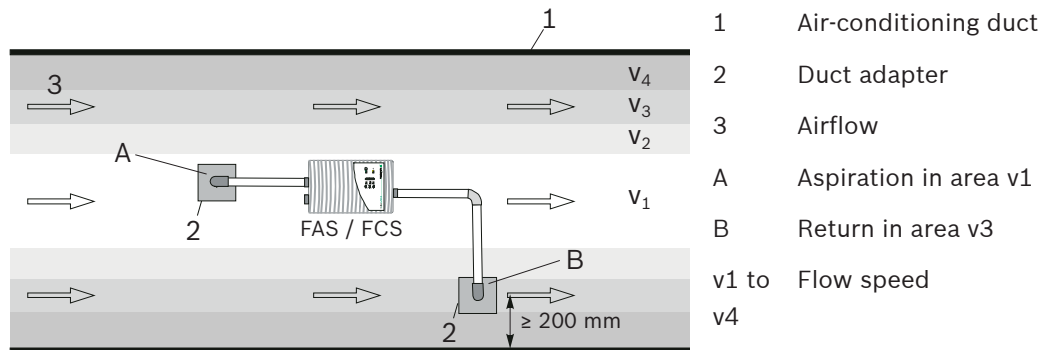
When installing a pipe system in air-conditioning ducts, the following must be observed:

- Since the FCS-320 and the pipe system are located in different pressure ranges, an air return pipe (see *Installation location of the pipe system*, page 66) must be provided.
- The pipe entries into the duct must be airtight.
- The portion of the pipe system that is outside the duct must be sealed airtight.



**Air-return pipe**

The air-return pipe must be positioned at a distance of at least 2 m from the aspiration. The open end of the return is sloped at a 45° angle.



**Offset arrangement of the air return**

If the distance of 2 m cannot be adhered to, the pipes must be arranged offset. This way, a pressure fall between intake and exhaust can be achieved since the pipes are located in different speed ranges.

The distance of the air sampling openings to one another and to the duct wall is represented in the following table.

Bore distances	Duct cross-section	
	$\leq 0.5 \text{ m}^2$	$> 0.5 \text{ m}^2$
Distance of the air sampling openings to the wall	100 to 200 mm	200 to 300 mm
Distance of the air sampling openings to one another	100 mm	150 mm

### Diameter of the air sampling openings

The diameter of the air sampling openings is derived from the number of air sampling openings. The precise value can be obtained from Simplified pipe planning. The pipe is closed with an end cap without bore hole.

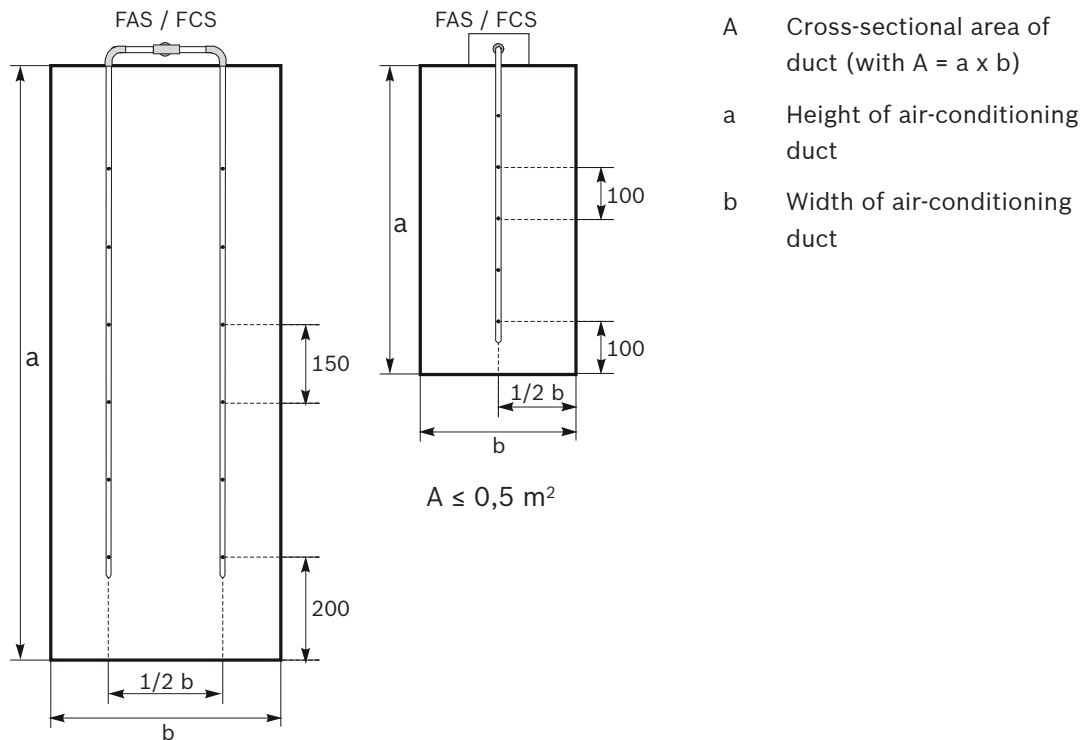
### Arrangement

The air sampling openings must face the airflow.

Note when planning that the air-conditioning ducts are often only accessible from two sides for installation of the pipe system.

### Example

The figure below shows two planning examples of pipe systems in air-conditioning ducts.



$$A > 0,5 \text{ m}^2$$

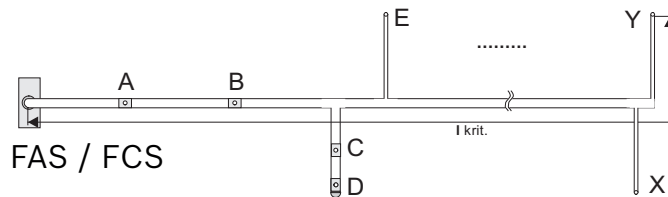
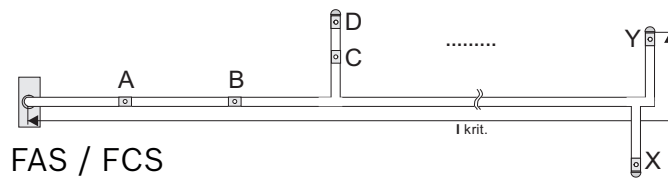
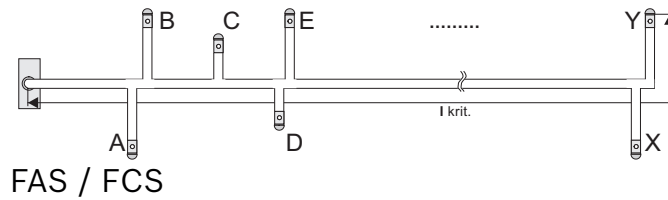
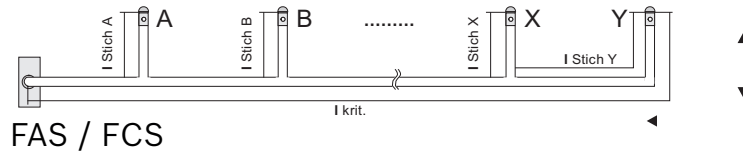
Ducts with small and large duct cross-sections

- A Cross-sectional area of duct (with  $A = a \times b$ )
- a Height of air-conditioning duct
- b Width of air-conditioning duct

## 4.12

### Project planning with branch pipes

Project planning with branch pipe are suitable for sampling points which are located distantly from the main run of the pipe system.



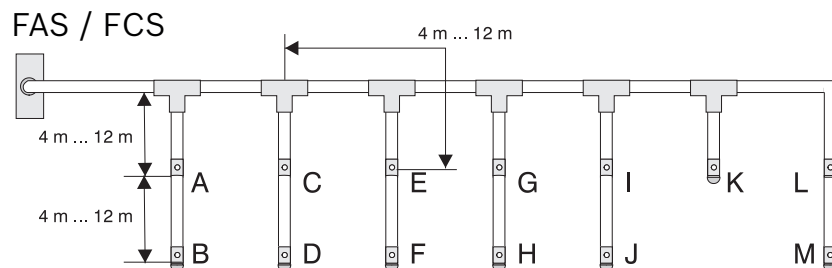
The branch pipes must be projected in accordance to the figure (project planning with branch pipes). The project planning of I-pipe described in the figure must be copied to every single sampling branch of other pipe forms (U, M, double-U pipe system).

Referring to the project planning with burs please notice that the “critical length” (Ikrit.) of a project planning does not exceed the maximum total length of pipe respectively of branch (referring to U, M, double-U pipe system). The critical length described the sampling point which is located most distantly from FCS-320.

Two aspiration apertures in total can be projected on each branch pipes at which the minimal and maximum distance between the aspiration apertures must be respected.

**Opening diameter**

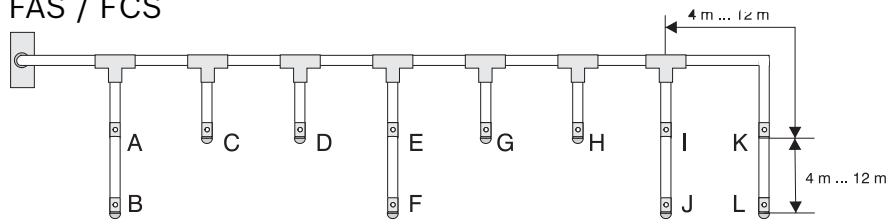
The opening diameters are valid for the projected aspiration apertures in accordance with the chapter „Opening diameter for standard project planning“.



### Distances of apertures

The distance between the T-piece and the following branch pipe as well as the pipe length between aspiration apertures on the branch pipes must not exceed 12 m in total.

### FAS / FCS



### Maximum length of branch pipe

The length of pipe between the last T-piece and the last aspiration apertures is the length of branch pipe. All other branch pipes need to be shorter. Two aspiration apertures in total can be projected on each branch pipe.

If the maximum distance is exceeded a correction by an additional aspiration aperture on a branch pipe can be done. In this connection please notice that two aspiration apertures in total can be projected on each branch pipe.

## 4.13

### Planning with air sampling hose

The application of air sampling hose FAS-ASD-PHF16, PG16 can be useful if several direction changes on a short distance of a pipe system is required, e. g. for avoiding any obstacles. As the transport time can be manipulated negatively by application of an air sampling hose, the influence of the used air sampling hose is to be determined on the allowed total length of pipe as follows.

#### Consideration during application of air sampling hose:

For calculation the maximum length of air sampling pipe with air sampling hose, the length of the air sampling hose must be multiplied by the certain factor b and deducted from the allowed total length of pipe.

$$\text{Air sampling pipe length} = \text{Total pipe length} - (\text{Length of the air sampling hose} * \text{factor b})$$

Factor for calculation of the air sampling hoses length:

Fan voltage	Factor b
6,5 V	0,9
6,9 V	0,6
≥ 9 V	0,7

**Example 1:** Altogether, the air sampling hose of type FAS-ASD-PHF16 with a length of 22 m shall be connected to a FAS/FCS aspirating smoke detector with a fan voltage of 6.9 V. The allowed total length of pipe is 120 m. The result for the maximum air sampling pipe inclusive air sampling hose is:

$$\text{Air sampling pipe length} = 120 \text{ m} - (22 \text{ m} * 0.6) = 106.8 \text{ m}.$$

**Example 2:** In case of a pipe project planning, 100 m of air sampling pipe and air sampling hose shall be connected to a FAS/FCS aspirating smoke detector with a fan voltage of 6.5 V. In accordance to the project planning scale, the allowed total length of pipe can be 120 m for the

complete pipe project planning. The result for the maximum length of the complete air sampling hose of type FAS-ASD-PHF16, which can be integrated within the pipe project planning, after formula adjustment is:

$$\begin{aligned} \text{Length of the air sampling hose} &= (\text{Total pipe length} - \text{Air sampling pipe length}) / 1.1 \\ \text{Length of the air sampling hose} &= (50 - 45 \text{ m}) / 0.9 = 5,55 \text{ m} \end{aligned}$$



**Notice!**

The complete air sampling pipe must not consist of a single air sampling hose. Aspiration reduction must not put about the air sampling hose.

## 4.14 Planning with air return

In some cases, in which differences of air pressure between the area of air sampling device and the area of air sampling point exist, a channel of air pressure of the aspirated test air in the pressure area of air sampling points can be necessary. Therefore, an air sampling hose with a right length should be connected on the air outlet of the air sampling device. As the transport time of an air sampling smoke detection device can be manipulated negatively by an air return, the influence of the air return to the allowed total length of pipe is to be respected.

An air return with a pipe with Ø 40 mm has no influence and can be projected and/or retrofitted without reducing the total pipe length and / or retrofitted.

**Consideration of air returns:**

For calculation the maximum length of air sampling pipe, the length of the air return must be multiplied by the certain factor a) and deducted from the allowed total length of pipe.

$$\text{Air sampling pipe length} = \text{Total pipe length} - (\text{Length of the air return} * \text{Factor a})$$

Factors to calculate the lengths of air return (Ø 25 mm):

Length of the air return	Factor a
0 – 5 m	0.0
> 5 – 10 m	1.6
> 10 – 25 m	3.2

Factors to calculate the lengths of air return (Ø 32 mm):

Length of the air return	Factor a
0 – 5 m	0.0
> 5 – 10 m	0.0
> 10 – 25 m	1.0

**Example:** An air return (Ø 25 mm) from 10 m to be connected to a FAS/FCS. The allowed total length of pipe is 50 m. The result for the maximum air sampling pipe is:

$$\text{Air sampling pipe length} = 50 \text{ m} - (10 \text{ m} * 1.6) = 48.4 \text{ m}$$

## 4.15 Power supply

To measure the power supply, the detector-ready state of the security system and the alarm case are regarded. When the system is ready to detect, the power supply must provide the standby current for the aspirating smoke detectors and ensure the emergency power rechargeable battery is charged in accordance with DIN VDE 0833, part 1 (80% charged in 24 hrs).

The current in the event of an alarm is calculated according to the following formula:

### Calculation of current for space protection

$$I_g = I_A \cdot n_{\max} + I_Q \cdot (n - n_{\max}) \leq I_{PS\max}$$

### Equipment protection

$$I_g = I_A \cdot \sqrt{n} + I_Q \cdot (n - \sqrt{n}) \leq I_{PS\max}$$

### Charging current

The power for charging the rechargeable battery is calculated with the following formula:

$$I_L = \frac{0,8 \cdot K_n}{24}$$

$$I_g = I_Q \cdot n + I_L \leq I_{PS\max}$$

where

$I_g$	=	Total current of all connected aspirating smoke detectors in [A]
$I_A$	=	Alarm current of an aspirating smoke detector in [A]
$I_Q$	=	Standby current of an aspirating smoke detector in [A]
$I_{PS\max}$	=	Max. power supply of the network power supply in [A]
$I_L$	=	Charging current of the rechargeable batteries (80% of the nominal capacity within 24 hours) in [A]
$K_n$	=	Rated capacity of the rechargeable battery in [Ah]
$n$	=	Total number of connected aspirating smoke detectors
$n_{\max}$	=	The highest number of aspirating smoke detectors in one detection zone

The power supply can service detectors from several detection ranges, e.g.:

- 1 x FCS-320 in detection zone 1
- 2 x FCS-320 in detection zone 2
- 4 x FCS-320 in detection zone 3
- 1 x FCS-320 in detection zone 4 etc.

In the example, the zone with the highest energy requirement is zone 3 and hence  $n_{\max} = 4$ . For equipment protection, it is assumed that max.  $\sqrt{n}$  detectors can trigger an alarm at the same time.



### Notice!

The power supply units are laid out using the calculated total current  $I_g$  with the highest value.

Please refer to Technical Specifications for the current consumption of the FCS-320.



**Line calculation**

The maximum line length is derived from the permissible voltage drop on the supply line. The permissible voltage drop is the difference between the end-point voltage of the backup battery (21.5 V) and the lower operating voltage limits of the aspirating smoke detectors.

$$L_{\max} = \frac{\gamma \cdot \Delta U \cdot A}{I_g \cdot 2}$$

where

$L_{\max}$	=	Maximum line length in [m]
$A$	=	Strand cross-section in [mm <sup>2</sup> ]
$I_g$	=	Total current of all connected aspirating smoke detectors in [A]
$\gamma$	=	Conductivity: Cu=57 m/Ω mm <sup>2</sup>
$\Delta U$	=	Charging current of the rechargeable batteries (80% of the nominal capacity within 24 hours) in [A]

To guarantee the impermeability of the housing, the corresponding cable bushing must be selected for the existing cable:

- M 25 cable bushing: Ø 9-14 mm
- M 20 cable bushing: Ø 8-12 mm

The "Fire Alarm System Planning Software" enables case-specific calculations to be carried out for planning the FPA-5000 Modular Fire Panel.

**5****Installing the Aspiration smoke detector****5.1****General**

The regulations, guidelines and provisions described in Regulations apply.

The following must be observed when installing the FCS-320 Aspirating Smoke Detector:

- Do not interfere with, modify or convert the equipment. If adjustments cannot be avoided, consult with the operator, the unit manufacturer and/or the supply company.
- All changes to the house mains (230 V/400 V supply) and to third-party systems must be executed by the builder. This includes e.g.
- Primary connection of the mains charger
- Carrying out any potentially essential lightning and surge protection measures in compliance with relevant standards

**Warning!**

Installation must only be performed by authorized and specialized personnel!

Switch off the unit before carrying out any connection work!

Do not connect or disconnect the detector module while switched on!

## 5.2 Installing the detector module

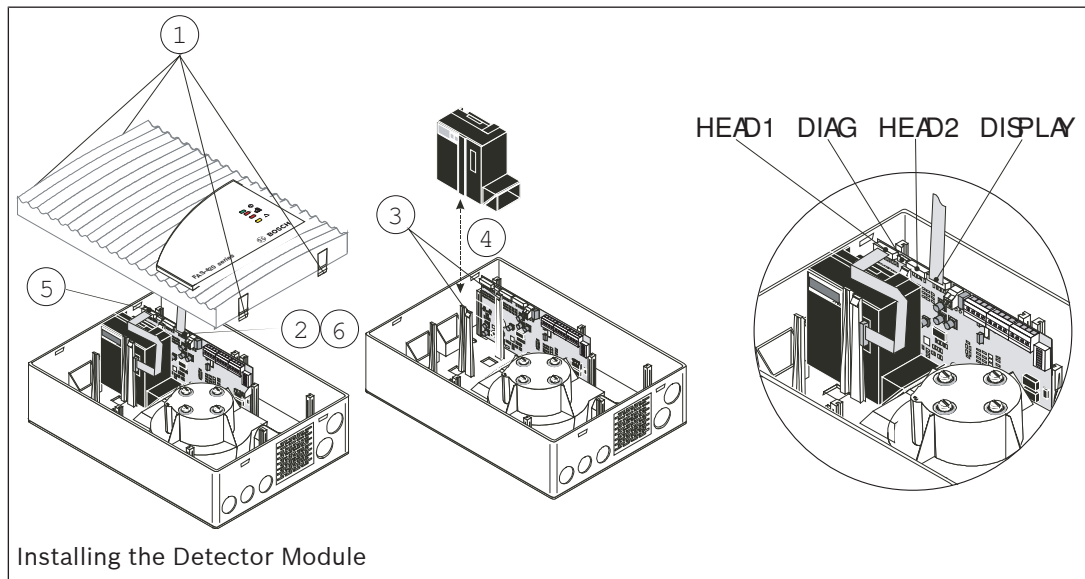


### Notice!

Only DM-TP-50(80), DM-TP-10(25) and DM-TP-01(05) detector modules certified to VdS may be used.

The detector module settings are configured via the RPS software. All DIP switches on the detector module must be set to "OFF".

The sensitivity value is based on measurements with standard test fires (old value in brackets). The activation threshold for the airflow malfunction is set to 20% volume flow change by default. Higher values are not permitted within EN 54-20 or ISO 7240-20.



### Caution!

Electrostatic discharge (ESD)! This can damage electronic components. Ground yourself using a wrist strap or take other suitable measures.

Proceed as follows to install the detector module:

1. Open the unit by carefully unlocking the housing cover's quick locks.
2. Carefully pull the display board connection cable from the motherboard (DISPLAY connection) and remove the housing cover. Once the unit is installed, fix the cover with a service clip.



### Notice!

FCS-320-TP2 variant:

This unit type is factory prepared for the installation of two detector modules:

The fan covers for both aspiration pipes are removed.

The two pipe system connections are cut out.

The pin pair on jumper JU4 is open.

3. Spread the brackets provided for fixing the detector module slightly apart.
4. Carefully insert the detector module until you hear it click into place. Make sure that the used detector module is fixed tightly and securely by the bracket by additionally pushing together the brackets by hand.
5. Connect detector module 1 to the HEAD1 connection on the motherboard using the flatband cable. For devices with a two pipe system: Connect also the detector module 2 to the HEAD2 connection on the motherboard using the flatband cable.

6. Reconnect the display board cable to the DISPLAY connection on the motherboard.

### 5.3 Settings on the unit motherboard

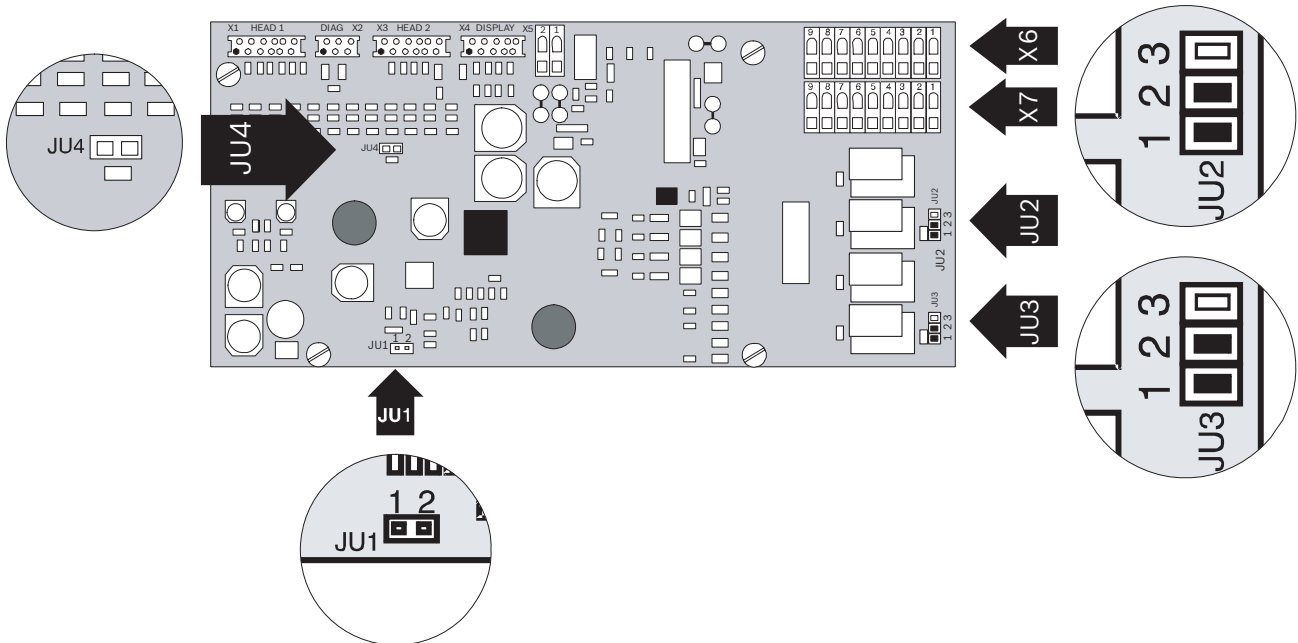


Figure 5.1: Settings on the motherboard

#### 5.3.1 Setting the fan voltage

The standard fan voltage setting is 6.9 V. In critical applications, the fan voltage may be switched to 9 V. This increases the transport speed in the pipe system, thus achieving faster detection with longer pipe lengths.

To switch to 9 V, pull out jumper JU1.

Fan voltage	Jumper JU1, pin no. 1+2
6.9 V	X
9 V	O
X = pin pair bypassed, O = pin pair open	



**Caution!**

Re-initialize the airflow if you switch the fan voltage. Close or open the jumper JU1 only when the device is switched off.

**Refer to**

- , page 75

#### 5.3.2 Number of detector modules

The number of detector modules is factory set in line with the variant (jumper JU4 on motherboard).

Variant	Number of detector modules	Jumper JU4, pin no. 1+2
FCS-320-TP1	1 detector module	X

FCS-320-TP2	2 detector modules	O
X = pin pair bypassed, O = pin pair open		

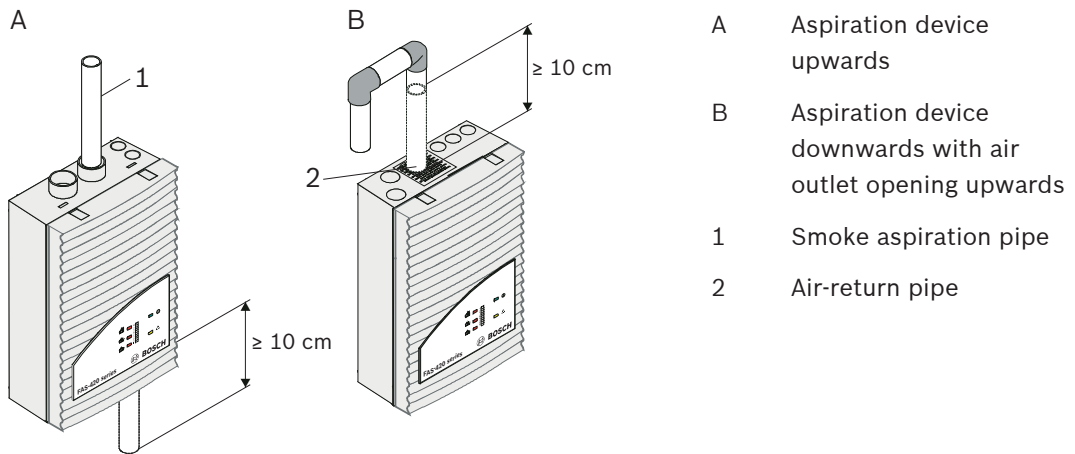
## 5.4 Installing the unit



**Notice!**

When selecting the installation location, it must be ensured that the unit displays are easily visible.

Remember when planning that the unit fans generate a noise level of approx. 45 dB(A). The installation location may not be in any door opening area.

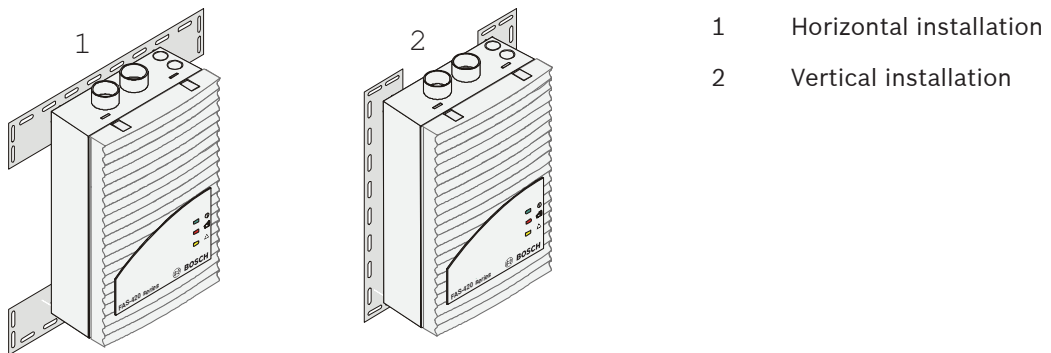


### Installation of the FCS-320

The air outlet on the unit must not be obstructed. There must be a free area of 10 cm in front of the air outlet.

The aspiration smoke detector can be installed with the aspiration device pointing upwards or downwards. Rotate the cover through 180° in the required direction.

- Aspiration from below
  - If the air-return pipe is directed upwards, it must be guaranteed that no foreign bodies or dripping water can penetrate the air return. You should therefore use a short, downward angled pipe.
- Mounting type MT-1
  - The Aspiration smoke detector is either bolted directly to the wall provided for installation using the rear panel or installed by means of unit mounting type MT-1, e.g. onto frames.

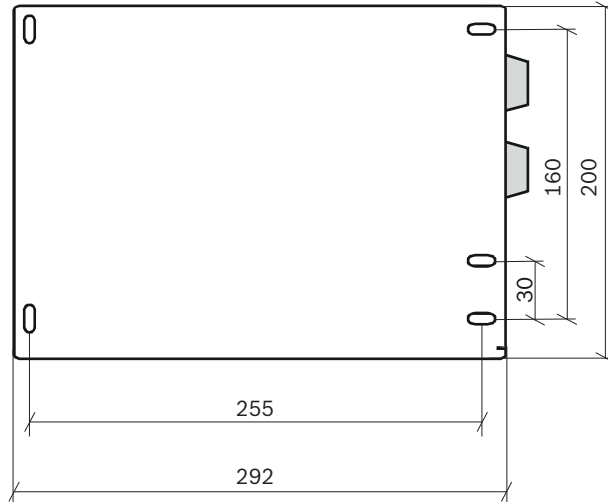


### Installing on mounting type MT-1

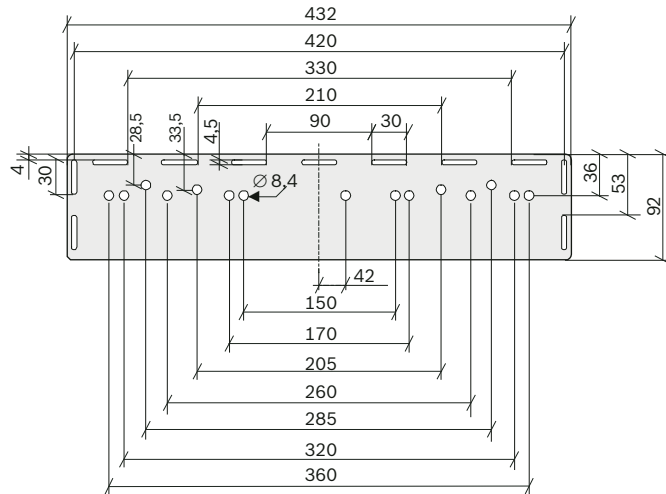
Installation material	FCS-320	Cylinder or flat head screws - Thread diameter: max. 6 mm - Head diameter: 10 mm
	Mounting (type MT-1)	Cylinder or flat head screws - Thread diameter: max. 4 mm - Head diameter: 5 to 7 mm

**Bore distances**

The distances between the bores are shown in the figures below (all measurements in mm).



**Figure 5.2:** Bore distances of FCS-320 without mounting



**Figure 5.3:** Bore distances with mounting type MT-1

**Reducing operating noises**

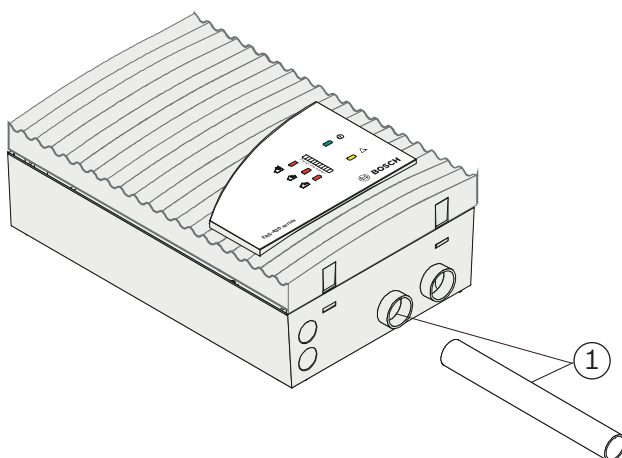
If the aspirating smoke detector is installed in noise-sensitive areas, observe the instructions in Measures for Reducing Operating Noise.

1. First, clearly mark the fixing points on the installation position provided on the equipment. Use the supplied drilling jig as an aid. To guarantee a safe and low-vibration hold, the unit must be secured with four screws.

2. Using four screws appropriate for the installation method, attach the unit securely to the surface or to the unit mounting. Ensure that the unit is not fixed under mechanical stress and that the screws are not tightened too tightly, otherwise damage or undesirable resonance noises could occur. To equalize unevenness and/or prevent vibrations, vibration absorbers (subject to separate order) must be used.

#### Connecting the aspiration pipe

- To connect the aspiration pipe to the FCS-320, insert it into the pipe connection provided.



1 Smoke aspiration pipe

Connecting the aspiration pipe to the FCS-320 Aspirating Smoke Detector



#### Notice!

Do not use glue to connect the aspiration pipe and pipe connection. In the event of sharp temperature fluctuations, the pipe must be fixed immediately in front of the unit so that the pipe does not pull out of the pipe connection when the length changes (see Length Change of the Pipe System).

## 5.5 Installing the Reset Board

### 5.5.1 Installing the reset board

The reset board is optionally available for use with the FCS-320 series. If several FCS-320 units are connected to one detector line, the reset board is installed in the detector line after the last FCS-320 unit. The reset board electrically connected in accordance with the wiring diagram.



#### Notice!

The reset board can be used only if the standby current of the detector line is between 5 mA and 50 mA and the detector line terminates with a resistor.

#### Standby current of the line

Calculate the standby current  $I_R$  of the line as follows:

$$I_R = \frac{U_L}{R_E}$$

where

$R_E$  = original terminal resistance of the line [Ohm]  
 $U_L$  = Line voltage [V]  
 $I_R$  = Standby current of the line [A]  
 The equations used to calculate the terminal resistance and the standby current of the detector line are based on an ideal condition for signal evaluation. If acknowledgement does not take place with the calculated terminal resistance for the relay board, reduce the value of the terminal resistance by approx. 20%.

### Terminal resistance

The reset board simulates the detector line terminal resistance. It is calculated anew and installed on the reset board (Terminal X1). Calculate the value of the terminal resistance  $R_{ER}$  as follows:

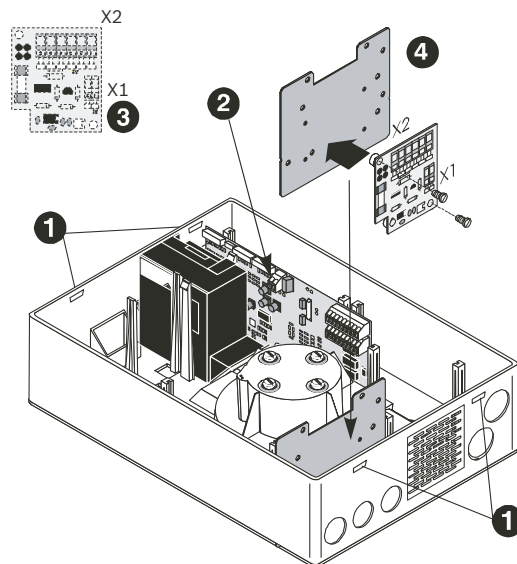
$$R_{ER} = \frac{(U_L - 2,7 \text{ V})}{I_R}$$

where

$R_{ER}$  = Terminal resistance on the reset board [Ohms]  
 $U_L$  = Line voltage [V]  
 $I_R$  = Standby current of the line [A]

## 5.5.2

### Installing the reset board

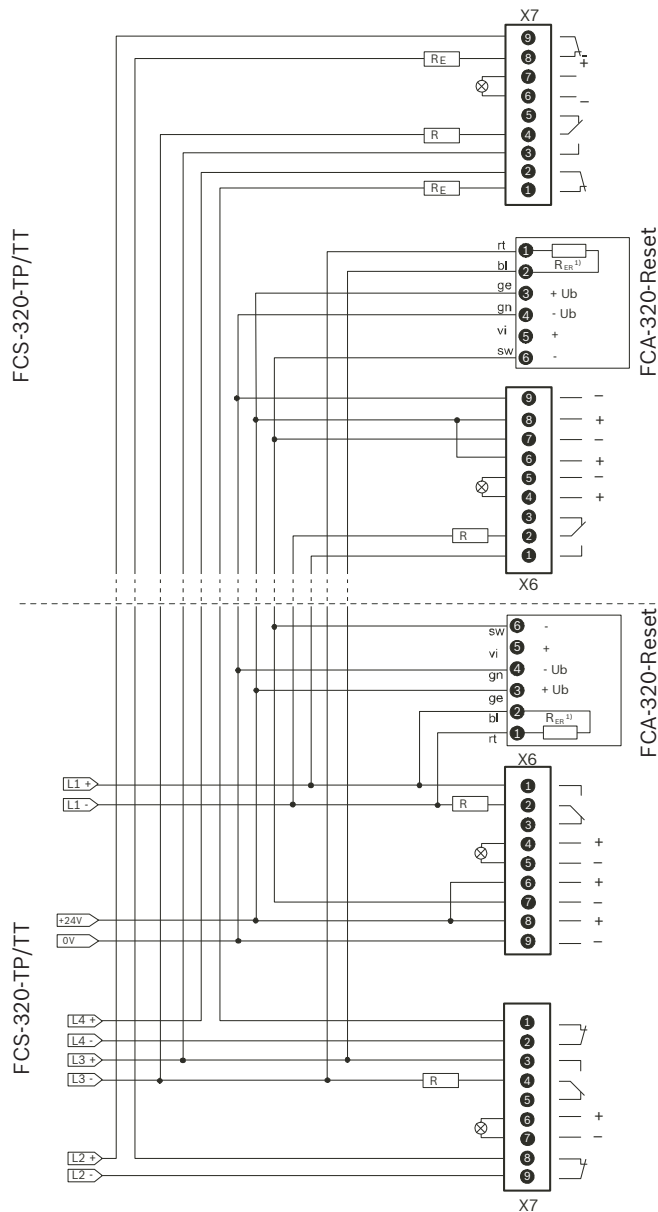


- Carefully unlock the quick-release fasteners on the housing using a slotted-head screwdriver, by simultaneously pressing on the closure latches on one side. Then lift the housing cover off carefully.
- Unplug the display board cable from the motherboard and remove the housing cover. Place the calculated terminal resistor  $1 R_{ER}$  into connection terminal X1. Fasten the reset board with the plastic spacers to the FCS-320-IK installation kit. Mount the installation kit with the attached reset board at the position marked in the FCS-320 housing. Electrical connection (X2) is described in *Electrical connection of the reset board, page 80*. Reattach the display board cable to the motherboard and refit the housing cover. Resecure the cover by engaging the quick-release latches.

### Refer to

- *Electrical connection of the reset board, page 80*

### 5.5.3 Electrical connection of the reset board



## 5.6 Connection to the Fire Panel

### 5.6.1 Electrical Connection



#### Caution!

Switch off the unit before carrying out any connection work!

Proceed as follows to prepare the electrical connections:

1. Using a screwdriver, carefully punch out the required cable entry points of the housing (max. 5 x M20 and 2 x M25).
2. Fit the cable entry point(s) as required with M20 or M25 connections by pushing them into the cable entries. 2 x M25 and 1 x M20 are supplied in the pack.



3. Punch out the cable entries using a sharp object.  
Caution: Do not cut the cable entries with a knife!
4. Route the connection cable(s) (max. 2.5 mm<sup>2</sup>) through the prepared M20 or M25 connections and into the unit. Now cut these to the required length inside the unit.
5. Wire the unit according to the connection information described below.

Terminal	Terminal block X6	Function
1	Al 1	NO contact for 1st alarm relay
2		C contact for 1st alarm relay
3		NC contact for 1st alarm relay
4	+ Ext. Displ.1	Remote indicator for 1st detector module
5	- Ext. Displ.1	
6	+ Reset	+24 V reset input
7	- Reset	0 V reset input
8	+ 24 V	+24 V power supply
9	- 24 V	0 V power supply

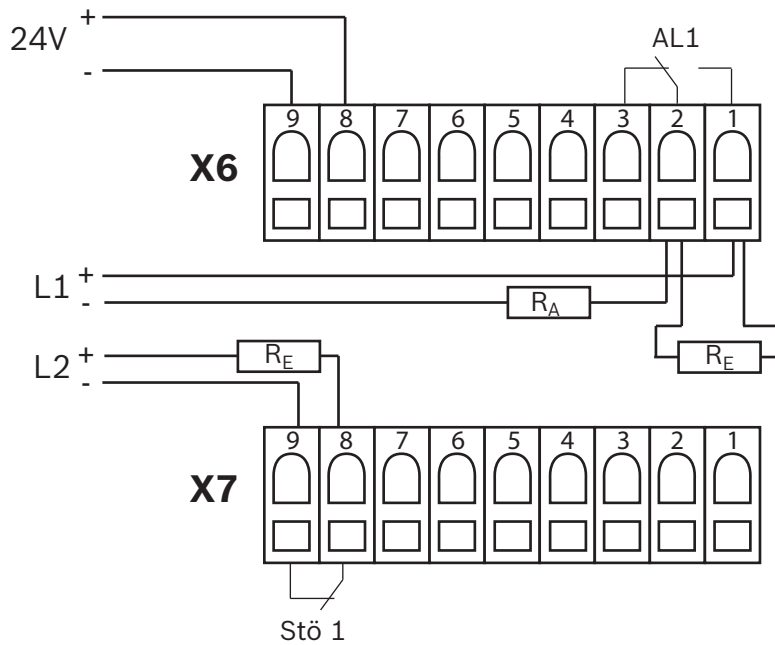
Terminal	Terminal block X7	
1	Fault 2	Fault contact for 2nd detector module
2		
3	Al 2	NO contact for 2nd alarm relay
4		C contact for 2nd alarm relay
5		NC contact for 2nd alarm relay
6	+ Ext. Displ.2	Remote indicator for 2nd detector module
7	- Ext. Displ.2	
8	Fault 1	Fault contact for 1st detector module
9		



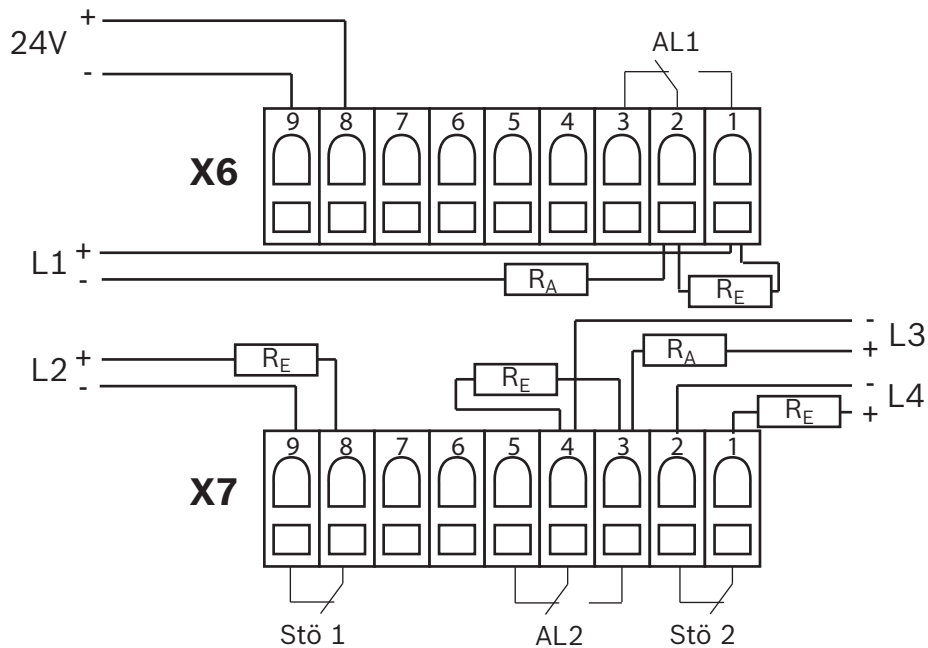
**Notice!**

On Bosch fire panels, use R<sub>A</sub> 820 Ohm for the alarm resistor and RE 2k2 (3k9) for the terminal resistor.

### 5.6.2 FCS-320-TP1 / FCS-320-TT1 Connection to the Fire Panel



### 5.6.3 FCS-320-TP2 / FCS-320-TT2 Connection to the Fire Panel



## 5.7 DIP switch settings

The aspirating smoke detector parameters are set using the DIP switch on the detector modules. The default settings are marked in bold in each case. Select all other parameters (see tables).

Sensitivity			DIP settings	
<b>DM-TP-01(05)</b>	<b>DM-TP10(25)</b>	<b>DM-TP50(80)</b>	<b>Switch 1</b>	<b>Switch 2</b>
<b>DM-TT-01(05)</b>	<b>DM-TT-10(25)</b>	<b>DM-TT-50(80)</b>		
0.12%/m	0.8%/m	-	on	on

Sensitivity			DIP settings	
DM-TP-01(05) DM-TT-01(05)	DM-TP10(25) DM-TT-10(25)	DM-TP50(80) DM-TT-50(80)	Switch 1	Switch 2
(0.4%/m)	(2%/m)			
<b>0.06%/m (0.2%/m)</b>	<b>0.4%/m (1%/m)</b>	-	off	on
0.03%/m (0.1%/m)	0.2%/m (0.5%/m)	1.0%/m (1.6%/m)	on	off
0.015%/m (0.05%/m)	0.1%/m (0.25%/m)	<b>0.5%/m (0.8%/m)</b>	off	off

Alarm delay	DIP settings	
	Switch 3	Switch 4
0 seconds	off	off
<b>10 seconds</b>	<b>on</b>	<b>off</b>
30 seconds	off	on
60 seconds	on	on

Activation threshold for airflow malfunction	DIP settings	
	Switch 5	Switch 6
Low (+/- 10% volume flow change)	on	off
<b>Average (+/- 20% volume flow change)</b>	<b>off</b>	<b>on</b>
High (+/- 30% volume flow change)	off	off
Very high (+/- 50% volume flow change)	on	on

Airflow fault delay	DIP settings	
	Switch 7	Switch 8
30 seconds	off	on
<b>2 minutes</b>	<b>on</b>	<b>off</b>
15 minutes	on	on
60 minutes	off	off

Trouble logging	DIP settings	LOGIC-SENS filter	DIP settings
	Switch 9		Switch 10
not saving	off	off	off
<b>saving</b>	<b>on</b>	<b>on</b>	<b>on</b>



**Notice!**

The sensitivity value is based on measurements with standard test fires (old value in brackets).

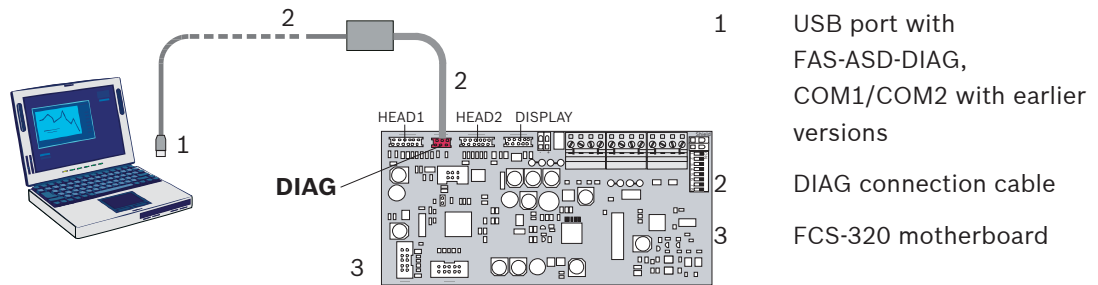
The activation threshold for the airflow malfunction is set to 20% volume flow change by default. Higher values are not permitted within EN 54-20 or ISO 7240-20 .

## 5.8 Connecting an External Detector Alarm Display

A digital external detector alarm display can be connected to the FCS-320 series aspirating smoke detectors. This is available by separate order.

Connect the remote indicator to the motherboard of the FCS-320 using the terminal strip X6. The unit must be in a voltage-free state for this.

## 5.9 Data Logging



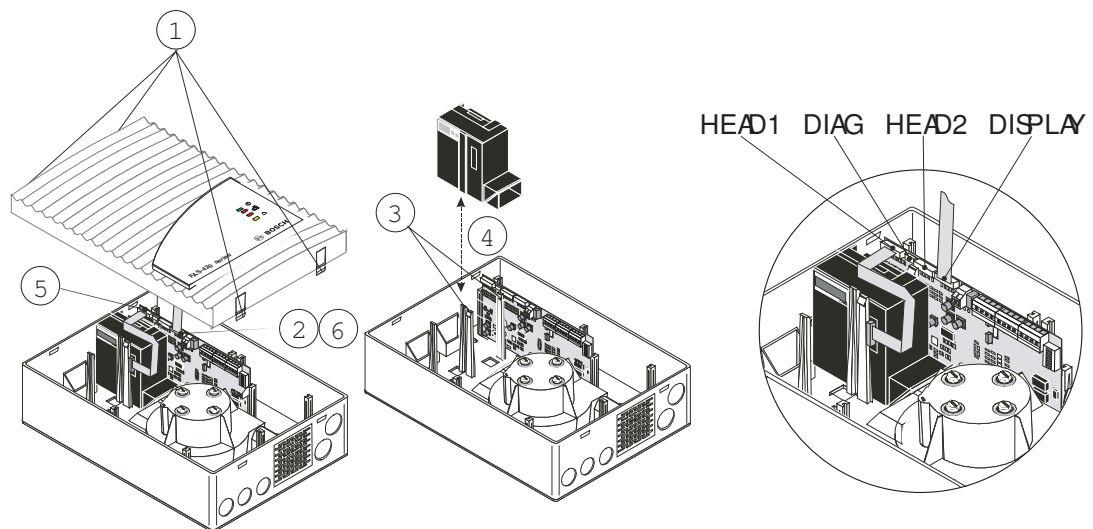
Connecting a PC via the diagnostics cable

The FAS-ASD-DIAG Diagnostic Software is used to conduct the device tests.

The current airflow sensor data, smoke level values, various status values and the parameters configured via the programming software can be read out locally using a laptop. This makes it much easier to detect altered operation conditions in the event of service being carried out. The supplied diagnostics cable connects the aspirating smoke detector ("DIAG" connection on the motherboard) to the PC. The FAS-ASD-DIAG version is connected to the PC via a USB port, earlier DIAG versions use a COM.

For details, please see the diagnostic software documentation.

## 5.10 Replacing a detector module



Replacing a detector module



### Caution!

Switch off the unit before carrying out any connection work!

Do not connect or disconnect the detector module while switched on!

- Open the unit by carefully unlocking the housing cover's quick locks.

- Carefully pull the display board connection cable from the motherboard ("DISPLAY" connection) and remove the housing cover. Once the unit is installed, fix the cover with a service clip.
  - Unplug the detector module's connector cable from the motherboard.
  - Spread the brackets provided for fixing the detector module slightly apart and remove the detector module. Now spread the two brackets again. Carefully insert the new detector module until you hear it click into place. Make sure that the used detector module is fixed tightly and securely by the bracket by additionally pushing together the brackets by hand.
  - Attach the detector module to the connection on the motherboard: detector module 1 to "HEAD 1", detector module 2 to "HEAD 2".
  - Reconnect the display board cable to the "DISPLAY" connection on the motherboard.
- Before initialization the connected pipe system, the operating voltage must be connected again. To initialize, press the S2 flow-init button on the detector module.
- Close the housing cover.

## 6 Installation of the pipe system

At the very least, the pipes and fittings used for the pipe system must comply with class 1131 according to EN 61386-1, 2004. Class 1131 requires the following of the pipe system in use:

Features	Severity
Compression resistance	125 N
Shock resistance	0.5 kg, drop height of 100 mm
Temperature range	-15 °C to +60 °C

The pipe system must be constructed using the following pipes and the associated fittings:

	Exterior diameter	Internal diameter	
		ABS	PVC*
Smoke aspiration pipe	25 mm	21.4 mm	21.2 mm

\* PVC pipes do not correspond to the temperature range given above.

For pipe systems with long pipe feed lines (see also *Planning for long pipe feed lines, page 54*), you must also use the following pipes and the associated fittings:

	Exterior diameter	Internal diameter	
		ABS	PVC
Smoke aspiration pipe	40 mm	35 mm	36.2 mm



**Notice!**

When constructing the pipe system, observe the temperature range specified under *Pipe system, page 27* in the Technical Specifications chapter.

The pipe system must be constructed according to planning specifications and must take into account the planning guidelines.

1. Shorten the pipes with a pipe-cutter (38 mm) or a metal saw. Deburr the joints and clean up the chips.

2. Before gluing, clean the adhesion points with the prescribed cleaning agent (Tangit) to remove dirt and grease. Use the Tangit adhesive to glue the pipe transitions with the appropriate fittings so that they are airtight.

**Notice!**

If halogen-free plastics must be used, the installation procedures may vary depending on the selected material:

ABS is glued

Polypropylene (PP) is welded

Polyamide (PA) is pushed together and bolted.

3. Minimize pipe lengths and changes of direction. Pipe elbows have an extremely high flow resistance. Therefore, they should only be used where they cannot be avoided for structural engineering reasons. If necessary, reduce pipe lengths in proportion to the pipe elbows used.

**Notice!**

Pipe bends must be given preference over pipe elbows. Too many bends and pipe elbows reduce the air speed in the aspiration pipe, thereby increasing the detection time.

A 90° pipe elbow corresponds to a straight pipe length of 1.5 m. Because of this, the maximum total length of the pipe system is reduced by 1.5 m.

4. Fix the pipe system. It must not sag or be possible to move it. Fasten the pipes with pipe clips without rubber inserts. The distance between the pipe clips should not exceed 80 cm. At high temperatures, reduce the distance between the pipe clips to a maximum of 30 cm.

**Notice!**

Do not use pipe clips with rubber inserts since these do not allow length extensions and the pipe system could thus bend or even tear.

5. Close open pipe ends with an end cap.

**Notice!**

On completion, test the pipe system:

For tightness

For fault-free connections

For correct planning of the air sampling openings.

## 6.1

### Length Change of the Pipe System

Length changes (extensions and reductions) of the pipes are caused by temperature changes. Temperature increases cause lengthening of the pipes, temperature drops cause shortening of the pipes. The length change must be given particular consideration if the temperature of the pipe system at the time of installation deviates from the normal operating temperature.

The length change can be calculated using the following formula:

$$\Delta L = L \cdot \Delta T \cdot \delta$$

where

$\Delta L$  = Length change in [mm]

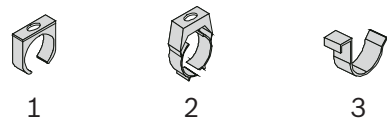
L = Length of the pipe to be calculated in [m]

- $\Delta T$  = Maximum temperature difference in [°C]
- $\delta$  = Length change coefficient in [mm/m x °C]
- $\delta_{PVC}$  = 0.08 mm/m x °C
- $\delta_{ABS}$  = 0.101 mm/m x °C

For example, a temperature change of 10 °C on a 10 m-long PVC pipe causes a length change of 8 mm.

**Mounting clamps**

PVC pipe clips are used as standard for installing the pipe system. These clips do not allow any length extensions.

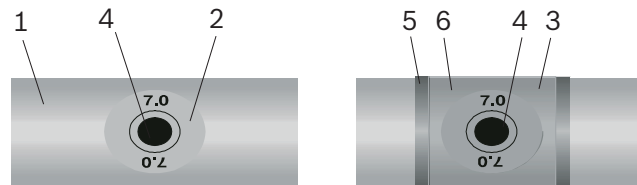


Overview of mounting clamps

- 1 Standard mounting clamps for 25 mm pipe
- 2 Plastic mounting clamps for 25 mm pipe, for length changes and temperatures of up to -40 °C
- 3 Spring steel clamp for 25 mm pipe, for high-rise warehouses and temperatures of up to -40 °C

**6.2**

**Air sampling openings**

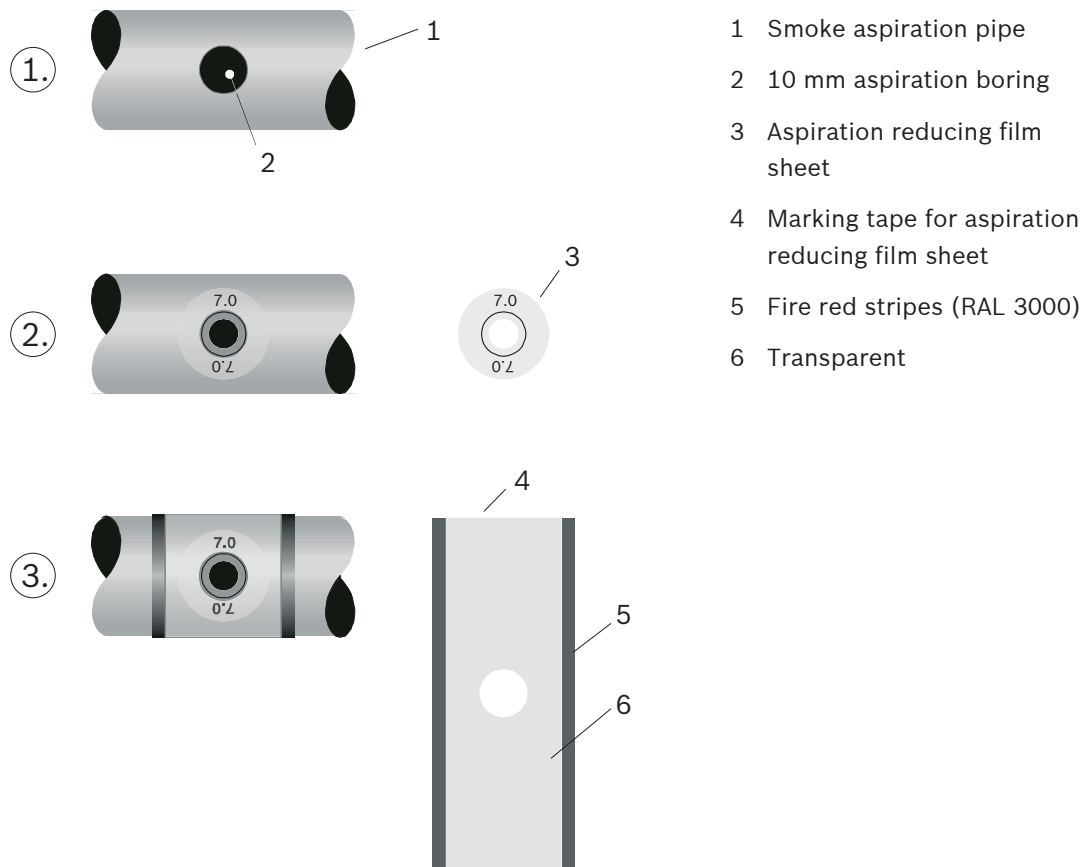


Example of an aspiration boring with aspiration reducing film sheet

- 1 Smoke aspiration pipe
- 2 Aspiration reducing film sheet with air sampling opening
- 3 Marking tape for aspiration reducing film sheet
- 4 Air sampling opening
- 5 Fire red (RAL 3000)
- 6 Transparent

**Air sampling openings**

Select the structure of the air sampling opening (aspiration boring) and the position in the pipe system according to the project specification and taking into account the planning guidelines.



Applying the aspiration reducing film sheet

#### Aspiration borings

- Bore an aspiration boring with a 10 mm drill at a right angle to the pipe. Deburr the boring carefully and remove chips. Clean the boring area (across the entire span of the pipe) of grease and dust, e.g. with Tangit cleaning agent.
- Select the size of the aspiration reducing film sheet according to the specifications. Glue the aspiration reducing film sheet to the opening.
- Glue the marking tape over the aspiration reducing film sheet, in order to prevent the film sheet from becoming detached.



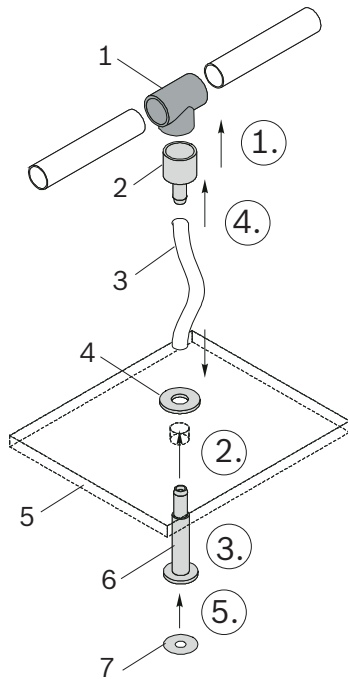
#### Notice!

The holes of the aspiration reducing film sheet and the marking tape must be exactly over the aspiration boring so that the opening diameter of the aspiration reducing film sheet is not changed.

To keep the adhesive surfaces of the film sheets free of dust and grease, avoid touching them.



### 6.3 Ceiling Lead-through



- 1 T-fitting
- 2 Hose connection for ceiling lead-through
- 3 Aspiration hose for ceiling lead-through
- 4 Ceiling lead-through nut
- 5 False ceiling
- 6 Ceiling lead-through (part)
- 7 Aspiration reducing film sheet

The following steps are essential for installing a ceiling lead-through:

- Before gluing, clean the adhesion points with the prescribed cleaning agent to remove dirt and grease. Glue the hose connection to the relevant T-fitting on the aspiration pipe using Tangit adhesive.
- Drill a Ø 13 mm hole in the false ceiling for each ceiling lead-through.
- Install the ceiling lead-through by removing the nut, pushing the part with the hose nozzle through the bore from below, then refitting and tightening the nut above the false ceiling.
- Determine the required aspiration hose and cut to length. Place the cut end of the hose onto the hose nozzle in the ceiling lead-through and onto the hose connection on the aspiration pipe T-fitting. If necessary, heat up the hose using a hot air blower.
- Glue the required aspiration reducing film sheet (as per the planning guidelines) onto the ceiling lead-through.



**Notice!**

The hole in the aspiration reducing film sheet must be positioned exactly over the opening in the ceiling lead-through. The opening diameter in the aspiration reducing film sheet must not be altered.

To keep the adhesive surfaces of the film sheets free of dust and grease, avoid touching them.

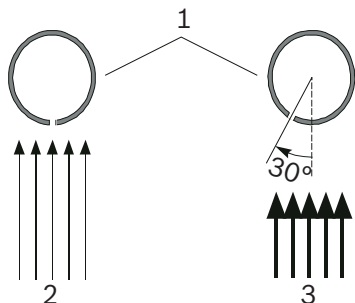
### 6.4 Monitoring with Forced Airflow

#### 6.4.1 Detection at intake and exhaust openings



**Caution!**

If the smoke aspiration occurs in a forced airflow (fan, air-conditioning units), direct the air sampling openings depending on the exhaust speed in the airflow.



- 1 Aspiration pipe with air sampling openings
- 2 Exhaust speed < 0.5 m/s
- 3 Exhaust speed > 0.5 m/s

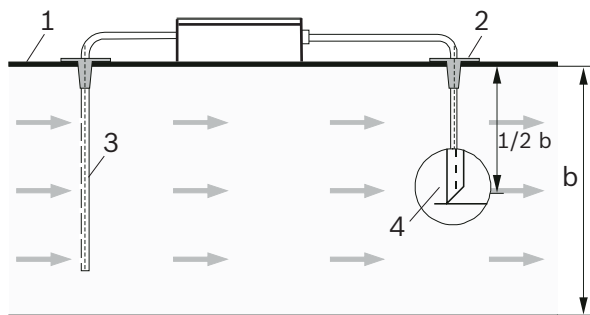
Positioning the air sampling opening depending on air speed

### 6.4.2 Detection in the Bypass



**Notice!**

For detection in airflows  $\geq 2$  m/s, additionally feed the exhaust from the FCS-320 back into the airflow area. Cut the end of the air-return pipe at an angle of 45°.



- 1 Air-conditioning duct
- 2 Duct adapter
- 3 Aspiration
- 4 Air-return Pipe
- b Width of air-conditioning duct

Positioning the air-return pipe – example with an air-conditioning duct (bypass)

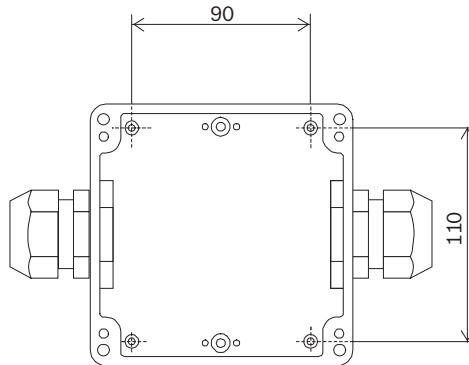
For details on connecting the air-return pipe, please see *Air-return Pipe*, page 92.  
 For FCS-320 planning in these applications, see *Planning for forced airflow*, page 65.

**Refer to**

- *Planning for forced airflow*, page 65
- *Air-return Pipe*, page 92
- *Planning for forced airflow*, page 65

## 6.5 Air Filter

### 6.5.1 Installing the Air Filter Box



**Figure 6.1:** Boring distances of holes in base of FAS-ASD-WS air filter box

#### Filter box

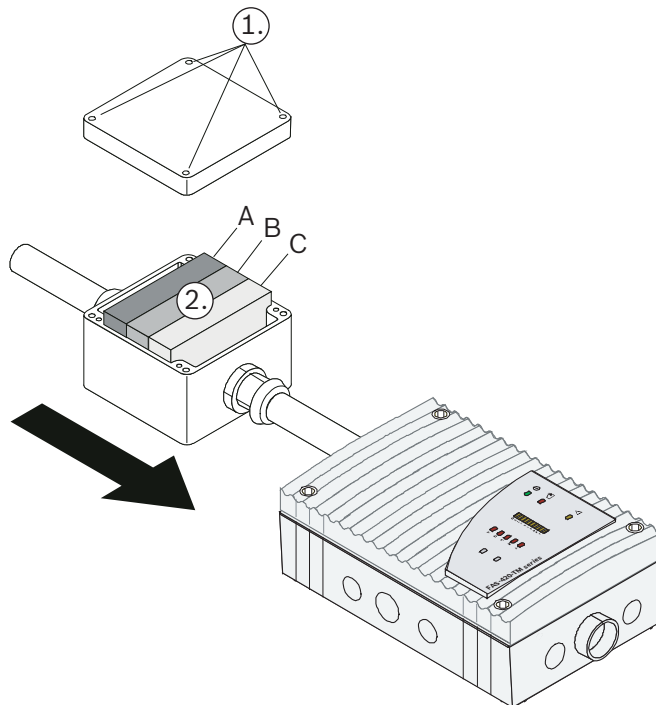
- To use the filter box in the pipe system, use the two PG29 filter screw connections supplied.
- Install these cable glands in precisely the same way as for the pipe adapter, for example.
- When installing the filter, note the throughflow direction, which is specified on the type plate on the side of the lower part of the housing.
- Screw the air filter housing directly onto the wall with the lower part of the housing.

#### Installation material

Cylinder or flathead screws are suitable for wall mounting:

- Maximum thread diameter: 4 mm
- Head diameter: 5 to 7 mm.

### 6.5.2 Filter Change on the Air Filter Box



- A Primary filter
- B Coarse dust filter
- C Fine dust filter

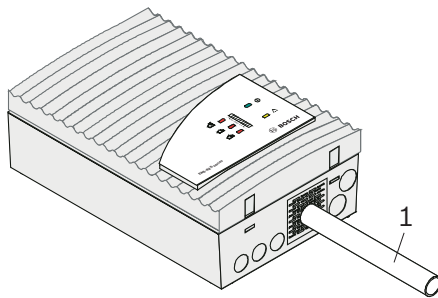
Changing the filter inserts (in fig.: FAS-ASD-FL Filterbox Large)

To replace the filter inserts, proceed as follows:

1. Remove the four screws and remove the housing cover.
2. Remove the old filter inserts and clean the inside of the housing carefully to remove dust. Now fit the cleaned or new filter inserts. When using the spare filter set for the large filterbox, ensure you follow the correct sequence (see label on base of housing). Replace the housing cover and screw it back on.

**Notice!**

In applications with largely fine dust build-up, three fine dust filters can also be used (subject to separate order).

**6.6****Air-return Pipe**

- 1 Air-return pipe (aspiration pipe)

Fix the air-return pipe within the air exhaust opening. No additional components are required.

**Caution!**

In the event of sharp temperature fluctuations, the pipe must be fixed immediately in front of the unit so that the pipe does not pull out of the pipe connection due to length change (see *Length Change of the Pipe System, page 86*).

**Steps:**

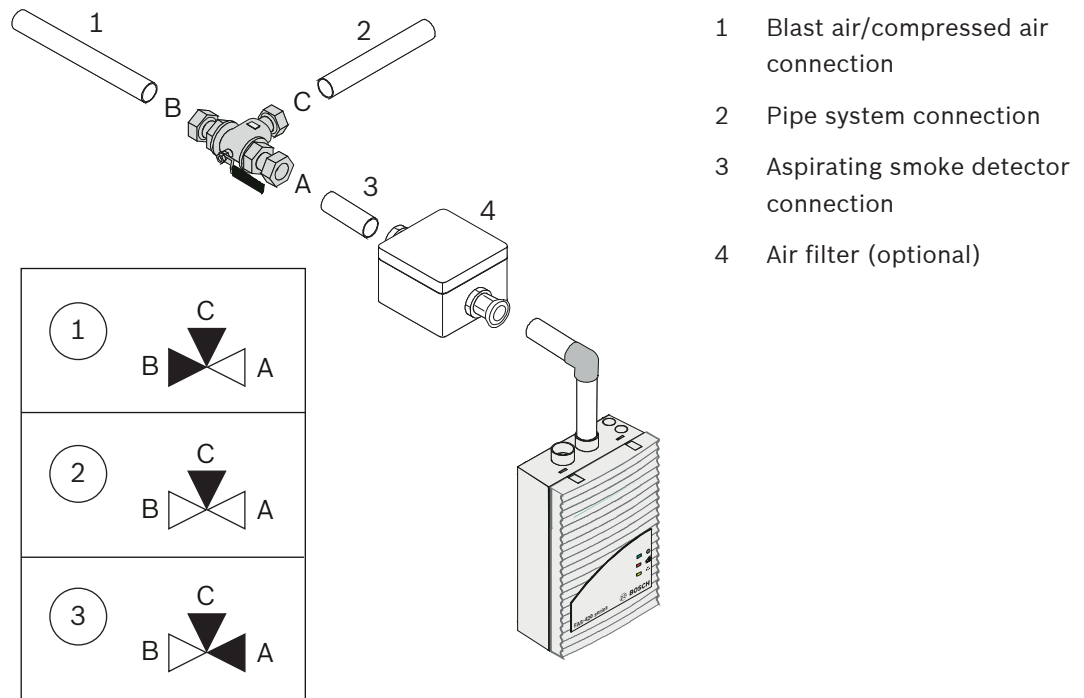
1. Remove the pre-punched pipe opening in the protective grille of the air exhaust opening (e.g. using a small edge cutter).
2. Insert the air-return pipe through the opened pipe opening in the protective grille and fix it to the FCS-320 with the rubber ring already integrated into the air-exhaust opening.

**Refer to**

- *Length Change of the Pipe System, page 86*

## 6.7

### Three-way Tap



- 1 Blast air/compressed air connection
- 2 Pipe system connection
- 3 Aspirating smoke detector connection
- 4 Air filter (optional)

#### Installing the three-way tap

The three-way tap is required to blow out the pipe system with blast air (as a preference) or compressed air. (Compressed air is compressed, non-purified and humid ambient air. Blast air, on the other hand, is purified and dehumidified air. If the FCS-320 and pipe system are located in areas with temperatures below freezing, blast air is to be used for blowing out.) The aspirating smoke detector and the downstream pipe system accessory components (e.g. air filter) must not and cannot be blown-out.

A check valve for relieving pressure from the pipe system must be fitted to the end of each pipe branch. The check valve prevents damage to the air sampling openings and prevents dirt deposits from being blown through the pipe system.

To prevent aspiration reducing film sheets in deep-freeze areas from tearing, it is advisable to use special deep-freeze aspiration reductions. Check valve and deep-freeze aspiration reductions are available on separate order.

#### Connections

Fasten the three-way tap using the transition screw connections in the pipe system.

When installing, note the assignment of the connections:

- Install the aspiration pipe system on connection C.
- Install the FCS-320 on connection A.
- Attach the blast air supply (blast or mobile blowing-out system) to connection B of the three-way tap.



#### Notice!

A single blowing-out process can be completed within 50 seconds. If within this time the unit is still connected to the pipe system, the malfunction message “airflow sensor module malfunctioning” will not be evaluated. If the blowing-out process has to be repeated (steps 1 to 3), wait at least 120 s.

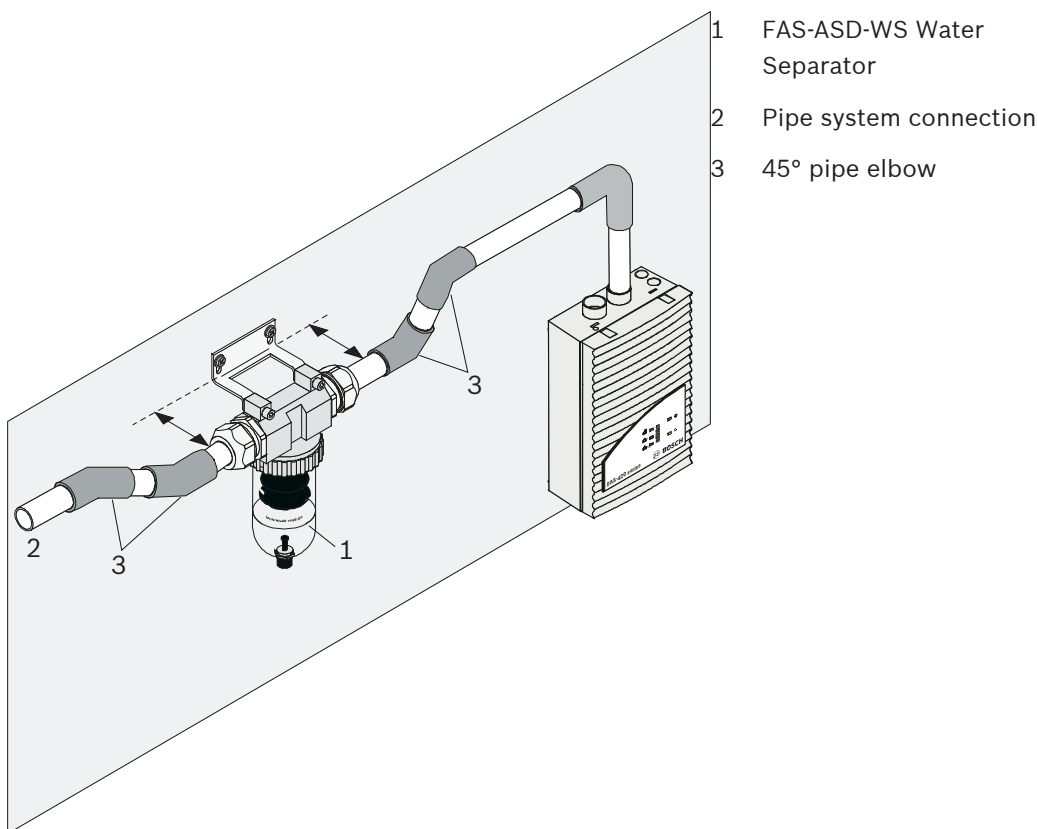
The manual blowing-out process on the pipe system is carried out as follows:

- Position the tap lever so that the blast air and pipe system are connected (B-C connection).  
**The connection to the FCS-320 must be blocked for blowing-out!**  
Manually blow out the pipe system for approximately 10 seconds.
- Set the lever of the tap such that the device is not connected with the pipe system or with the connection for the blast or compressed air supply. Wait approximately 20 seconds so that dust and dirt raised in the pipe system can settle and thus will not be sucked through the aspirating smoke detector.
- Reconnect the blown-out pipe system to the FCS-320 within a further 10 seconds by switching over the tap accordingly (A-C connection).

## 6.8 FAS-ASD-WS Water Separator

### FAS-ASD-WS Water Separator

The FAS-ASD-WS Water Separator must be fitted at the lowest point in the pipe system downstream of the air filter and the aspirating smoke detector (see figure below).



Installing the FAS-ASD-WS Water Separator in the pipe system

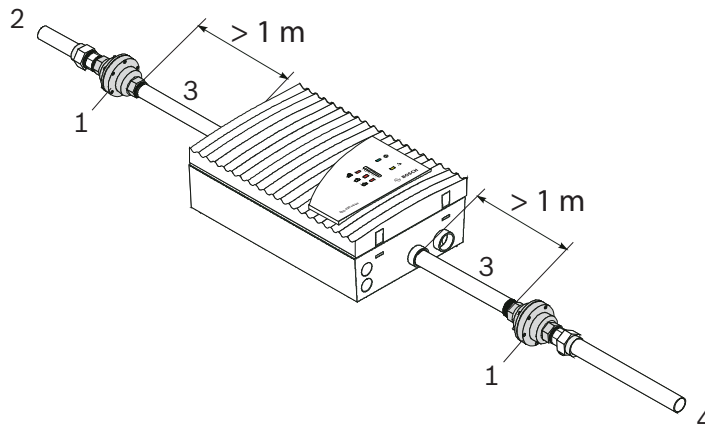
#### Connection

Attach two 45° pipe elbows on both sides (**not** supplied as standard) in order to achieve the optimum distance from the wall for mounting the brackets. When installing, note the correct direction of flow (see arrow on plastic container).

Also fasten the water separator with two screws and the clamp.

To empty, open the drain valve.

### 6.9 Detonation Safety Barrier



- 1 Detonation Safety Barrier
- 2 Air-return pipe connection
- 3 Steel pipe connection
- 4 Pipe system connection

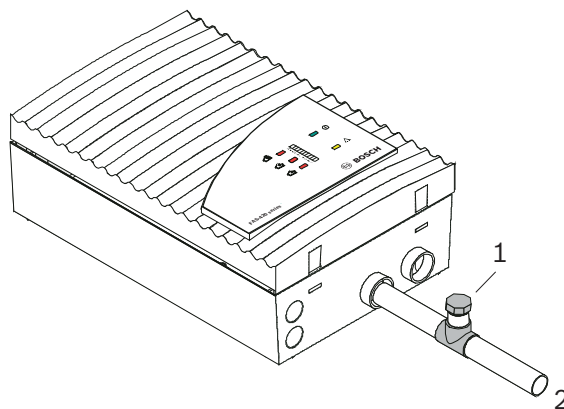
The detonation safety barriers are integrated into the pipe system and the air return at a minimum distance of 1 m from the aspirating smoke detector. The detonation safety barrier is glued to the FCS-320 on the side of the pipe system or the air-return pipe via a transition screw connection and connected to the side of the unit via a steel pipe. The connection between detonation safety barrier and steel pipe/transition screw connection is made using a 3/4" screw connection.



**Notice!**

To create a gas-tight connection between the detonation safety barrier and steel pipe/ transition screw connection, a sealing tape or thread seal must be used. The flow direction for installing the detonation safety barrier is secondary.

### 6.10 Test Adapter



- 1 Test adapter
- 2 Pipe system connection

Installing the test adapter in the pipe system

For test purposes, the pipe system connection is simply pulled out and the test pipe connected directly to the aspirating smoke detector. However, this is not possible if the aspiration pipe system has to be permanently mounted. A test adapter should be used for this application.

The test adapter is glued into the pipe system in the direct vicinity of the aspirating smoke detector. During normal operation, the test adapter must always be closed. It is only opened for maintenance and service purposes in order to admit test gas or smoke.

**Caution!**

Once the detection system of the aspirating smoke detector and the alarm transfer have been tested, the test adapter must be closed again; otherwise there will be an airflow malfunction!

**Refer to**

- *Checking airflow monitoring, page 99*

**7****7.1****Commissioning****Preparation****Checking the settings**

Check the settings of the FCS-320 prior to commissioning.

Then connect the unit to the power supply. The detector module of the FCS-320 is ready for operation after approximately 1 minute.

To commission the FCS-320, completely install the pipe system and connect it.

**Connection test**

Check whether...

- The correct aspiration reducing film sheets are glued to the air sampling openings.
- The pipe system is securely connected to the FCS-320 pipe connection.
- All pipe fittings are glued together and the pipe system is sealed.  
To do this, first close all air sampling openings (e.g. with duct tape). Then measure the negative pressure at the opening for the return airflow using a digital precision pressure gauge (see Conduction the Functional Test).
- Either at the opening for the return airflow
- Or using a test adapter installed directly upstream of the unit in the aspiration pipe.

After a short run-up time, the negative pressure must lie within the following range:

- Fan voltage 6.9 V: 250 Pa to 310 Pa
- Fan voltage 9 V: 460 Pa to 530 Pa.

**FAS-ASD-DIAG Diagnostic Software**

Then check the system using the FAS-ASD-DIAG Diagnostic Software.

Follow the procedure below:

- Install the diagnostic software on a laptop or PC.
- The FCS-320 is connected to the PC via the "DIAG" port on the motherboard using the supplied diagnostics cable.
- The diagnostic software is started.

The current FCS-320 data is displayed on the PC screen.

**FPA-5000 diagnostics data**

Notes on diagnostics data for the fire panel are contained in the user guide for the FPA-5000.

**Notice!**

For a later evaluation of the airflow value, record the calibration type (see *Calibrating the airflow sensor, page 97*), start-up temperature, air pressure and height above sea level in the test log.

Once the airflow sensor has been calibrated, no further changes may be made to the pipe system.

If changes are necessary at a later time, the airflow sensor must be re-calibrated (see *Calibrating the airflow sensor, page 97*).



## 7.2 Calibrating the airflow sensor



### Notice!

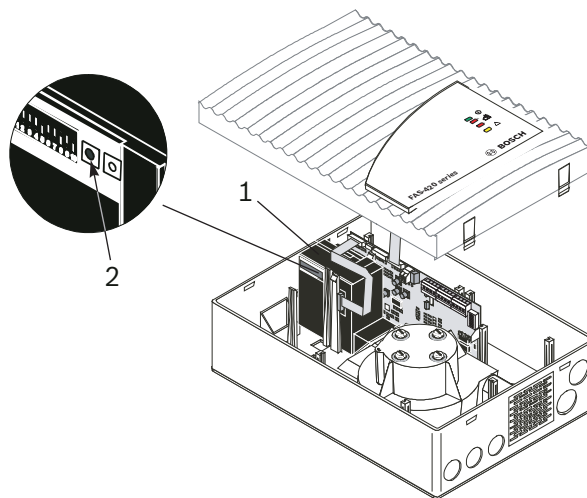
The Aspiration smoke detector must be operated for **at least 30 min prior** to the airflow being initialized to bring it up to operating temperature.

Described below is the procedure for calibrating the airflow sensor, both irrespective of air pressure, i.e. in simplified form, and depending on air pressure..

For an air-pressure-dependent calibration, use the air pressure correction tables in the appendix.

To be able to judge the airflow sensor value correctly during start-up work, always adhere to the type of calibration in the test log.

### 7.2.1 Air-Pressure-Independent Calibration



- 1 Detector module
- 2 S2 flow-init button

Air-pressure-independent calibration of the airflow sensor

1. Make sure that the aspirating smoke detector has been operating for at least 30 minutes.
2. To initialize the connected pipe system, press the S2 flow-init button on the detector module concerned, until the green operating LED on the unit starts to flash. Initialization is complete after approx. 5 s. Following successful initialization, the operating LED lights up permanently.
3. Connect the housing to the FAS-420 and check that it is correctly positioned.

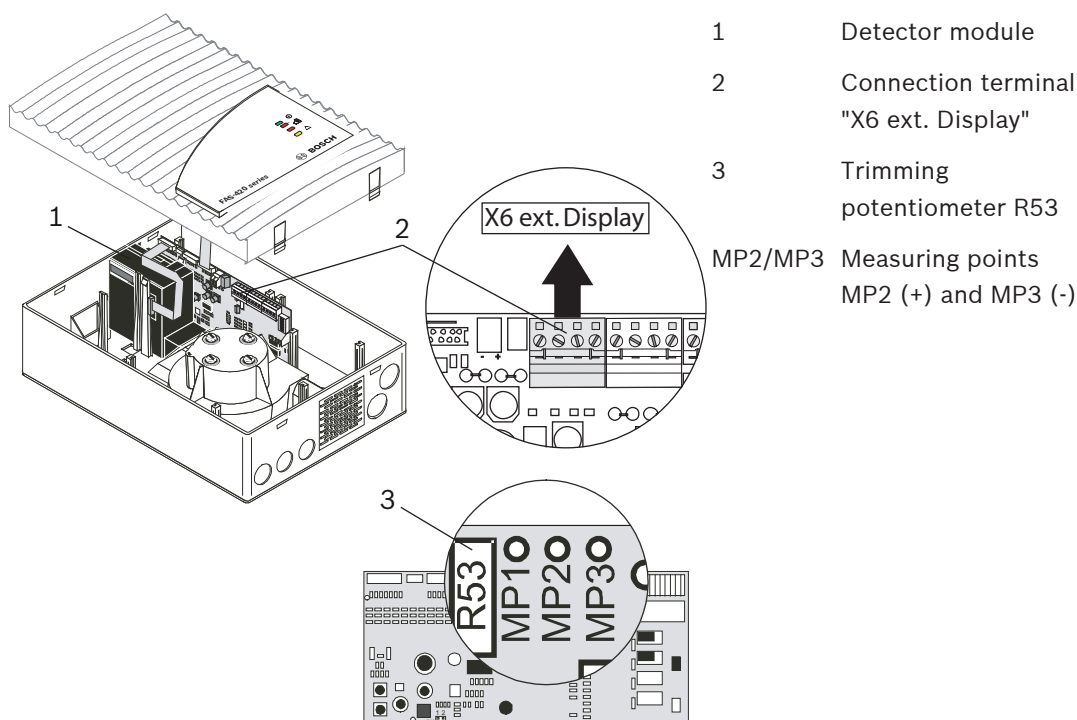
No further modifications may be made to the pipe system during or after initialization. The fan voltage must also remain unchanged following initialization. Otherwise, the initialization procedure must be repeated.



### Notice!

If initialization is not successful, the unit reports a collective fault (fault relay drop off). The precise cause of the abort can be read out using the DIAG Diagnostic Software.

## 7.2.2 Air-Pressure-Dependent Calibration



Air-pressure-dependent calibration of the airflow sensor

A barometer (measuring range from 0 up to 1300 mBar, resolution 1 mBar, accuracy 1mBar +/- 1 digit) and a multimeter are required to calibrate the airflow sensor dependent on air-pressure. The following steps are required:

1. Make sure that the aspirating smoke detector has been operating for at least 30 minutes.
2. Determine the height above sea level, air pressure, and ambient temperature of the installation location and enter these values in the test log.
3. Use the air pressure correction tables to bring the calibration value in line with that of the airflow sensor. Also enter these values into the test report. When selecting the air-pressure-correction table, take the pipe planning into account
4. Remove the "X6 ext. Display" connection terminal from the motherboard. Connect the multimeter to the measuring points MP2 (+) and MP3 (-). Note the polarity. On the measuring device, select the "V-DC" range. The default voltage at the measuring points is 1.2 V.
5. Using the trimming potentiometer, set R53 to the calibration value from the air-pressure-correction table with the help of a small screwdriver. Reinsert the "X6 ext. Display" connection terminal into the motherboard.
6. Connect the FCS-320 housing and check that it is correctly positioned.

## 7.3 Testing the Detector Module and Alarm Transfer



### Notice!

In order to accelerate alarm evaluation while testing with the test gas, LOGIC · SENS must be set to "off". On completion of the test, reset LOGIC·SENS to "on".

- Detach the detector module using test aerosol. Spray the test aerosol either into the first air sampling opening or into the test adapter on the pipe system.
- Use the table below to check the transmission line to the fire panel.

Check...	If this is not the case, ...
<ul style="list-style-type: none"> <li>- Whether the alarm is displayed on the aspirating smoke detector</li> </ul>	<ul style="list-style-type: none"> <li>- Check whether the display board is connected</li> <li>- There is a fault with the aspirating smoke detector Replace the detector module</li> </ul>
<ul style="list-style-type: none"> <li>- Whether the alarm is transmitted to the fire panel and reported on the appropriate line</li> </ul>	<ul style="list-style-type: none"> <li>- Check the transmission lines</li> </ul>

## 7.4 Checking Malfunction Transmission



### Notice!

The steps below may only be carried out following an airflow calibration in accordance with *Calibrating the airflow sensor, page 97*.

Malfunction transmission occurs as part of checking the airflow monitoring system (as per section below).

Check whether, when a pipe breakage and an obstruction are detected, the malfunction is displayed at the aspirating smoke detector and at the fire panel.

## 7.5 Checking airflow monitoring

### Pipe breakage

Check the breakage detection:

1. Detach the pipe from the connection to the FCS-320 or open the test adapter.
  - Check whether the malfunction display on the aspirating smoke detector lights up.
2. Alternatively, check the data of the airflow sensor using the diagnostic appliance and a PC or laptop.
3. Check whether the malfunction is displayed on the fire panel.
4. Enter the result in the test log.

### Obstruction

Check the obstruction detection:

1. Close – depending on the planned airflow monitoring – the corresponding number of air sampling openings with some duct tape.
  - Check whether the malfunction display on the aspirating smoke detector lights up.
2. Alternatively, check the data of the airflow sensor using the diagnostic appliance and a PC or laptop.
3. Check whether the malfunction is displayed on the fire panel.
4. Enter the result in the test log.



### Notice!

A pipe breakage or pipe obstruction is indicated by a flash code via an LED on the detector module:

Breakage: 3 x flashes

Obstruction: 2 x flashes

The corresponding flash code is repeated every two seconds.

### Troubleshooting

If the airflow malfunctions are not correctly detected by the unit, proceed as follows:

Check whether...

- ▶ All inlet holes are free
- 1. The pipe system has breaks or fractures
- 2. All pipe connections are tight
- 3. The fan can blow out freely
- 4. The correct aspiration reducing film sheets were used

If no faults are detected, the functionality of the FCS-320 and/or the airflow sensor is checked using the test pipe or diagnostic software.

## 7.6 FCS-320 functional test

Check functionality using the test pipe, a digital pressure gauge and the diagnostic software. The aspirating smoke detector must be operating for at least 30 min.

### 7.6.1 Preparations for the functional test

Select the following parameter settings using the FSP-5000-RPS programming software (the settings in the bold font indicate deviations from the default setting):

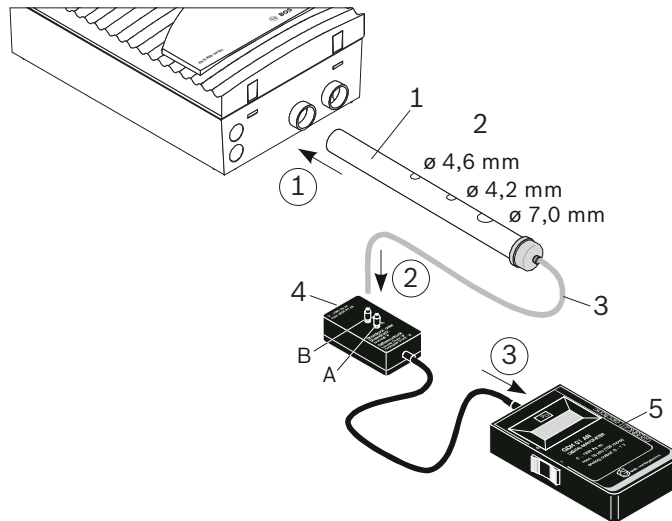
<b>Activation threshold for airflow malfunction</b>	<b>Alarm delay</b>
Low (+/- 10% volume flow change)	0 seconds
Average (+/- 20% volume flow change)	10 seconds
High (+/- 30% volume flow change)	30 seconds
Very high (+/- 50% volume flow change)	60 seconds

<b>Airflow fault delay</b>	<b>LOGIC·SENS filter</b>
30 seconds	Off
2 minutes	On
15 minutes	
60 minutes	

#### Connecting the digital pressure gauge:

- Connect the test pipe
- Connect the pressure measuring hose to the adapter connection B.
- Connect the 4-pin plug of the adapter to the digital pressure gauge and switch it on.



- 1 Test pipe
- 2 Aspiration borings
- 3 Pressure measuring hose
- 4 Adapter
- 5 Digital pressure gauge
- A/B Adapter connection

Testing the functionality of the FCS-320

**Notice!**

For the FCS-320-TP2 and FCS-320-TT2, the preparation for the function test (see above) and the following functional test (steps 1–7) are to be carried out for **both** detector modules and/or **both** pipe systems.

**7.6.2****Conducting the functional test**

The functional test can be conducted with or without a digital pressure gauge. The complete test is described below. If the test on the FCS-320 reveals deviations from the described procedure, the unit or its airflow sensor is defective.

- Make sure that the aspirating smoke detector has been operating for at least 30 minutes.
- Close all the test pipe's aspiration borings with some duct tape. After a few seconds, the LED flash code on detector module I and detector module II must signal an obstruction. After a short run-up time, the negative pressure must lie within the following range:
  - Fan voltage 6.9 V: 250 Pa to 310 Pa
  - Fan voltage 9 V: 460 Pa to 530 Pa.
- Open all of the test pipe's aspiration borings. After a few seconds, the flash code of the LED must go out.
- Remove the test pipe. The LED flash code on detector module I and detector module II must signal a breakage.
- Reconnect the test pipe to the device. After a few seconds, the flash code of the LED must go out.

**Notice!**

A pipe breakage or pipe obstruction is indicated by a flash code via an LED on the detector module (see Section 7.2 Flash Code Table, page 94):

Breakage: 3 x flashes

Obstruction: 2 x flashes

The corresponding flash code is repeated every two seconds.

**DIAG diagnostic software**

The DIAG Diagnostic Software can be used to track airflow values during the function test. Save all diagnostics data as a file. To be able to compare the data read out, save each file under a different file name.

Information for installing the diagnostic software can be found in *Preparation, page 96*.

**Notice!**

Once any faults have been rectified, the parameter settings must be restored to their original status via the RPS software.

The commissioning procedure must be repeated from *Calibrating the airflow sensor, page 97*. Once commissioning has been concluded, the set values must be collected and saved using the DIAG Diagnostic Software. A printout of the set values should be placed in the project folder.

## 8 Maintenance

### 8.1 Visual check

Check whether...

- The pipe system is securely installed and undamaged (where freely accessible)
- The air sampling openings of the pipe system are free
- The aspiration pipe and connection cable are securely connected
- The unit mounting – if present – is properly secured
- The aspirating smoke detector is damaged (see also *Flash code table, page 102*).

### 8.2 Flash code table

Malfunctions and unit statuses are displayed using flashcodes:

- By means of an LED on the detector module
- By means of one or two LED(s) on the unit motherboard (one LED per detector module).

LED flash code on detector module	
1 flash	Airflow initialization active (flow-init)
2 flashes	Airflow too small (obstruction)
3 flashes	Airflow too large (pipe breakage)
4 flashes	Unit upload (approx. 2 min)
Permanently lit	Detector faulty

LED flash code on the motherboard (LED1/LED2)	
1 flash	Error: internal voltage monitoring 1
2 flashes	Error: internal voltage monitoring 2
3 flashes	Error: fan voltage monitoring
4 flashes	Error: air pressure correction voltage monitoring
5 flashes	Software error
6 flashes	Internal error 1
7 flashes	Internal error 2
8 flashes	Unit upload (approx. 2 min)

#### 8.2.1 1 Flash - Error: Internal Voltage Monitoring 1

In operation with two detector modules, both LEDs flash. When troubleshooting, the following steps should be carried out in the specified order.

- Operating voltage too low

- Using a multimeter, measure the operating voltage (DC) of the aspirating smoke detector.
- The measurement value must be between 14 V and 30 V.  
Restore the correct power supply.
- Display board faulty
  - Disconnect the power from the unit.
  - Remove the display board's connection cable from the motherboard.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the display board is faulty, the malfunction will no longer occur.  
Replace the faulty display board.
- Motherboard faulty
  - You will need a second motherboard to make this diagnosis.
  - Disconnect the power from the unit.
  - Replace the motherboard with a new motherboard of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the motherboard is faulty, the malfunction will no longer occur.  
Replace the faulty motherboard.

### 8.2.2

#### **2 Flashes - Error: Internal Voltage Monitoring 2**

In operation with two detector modules, both LEDs flash. When troubleshooting, the following steps should be carried out in the specified order.

- Operating voltage too low
  - Using a multimeter, measure the operating voltage (DC) of the aspirating smoke detector.
  - The measurement value must be between 14 V and 30 V.  
Restore the correct power supply.
- Detector module faulty
  - Disconnect the power from the unit.
  - Replace the detector module incl. connection cable with a new module of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the detector module is faulty, the malfunction will no longer occur.
  - If you are using two detector modules, repeat the process with the second detector module.  
Replace the faulty detector module.
- Motherboard faulty
  - You will need a second motherboard to make this diagnosis.
  - Disconnect the power from the unit.
  - Replace the motherboard with a new motherboard of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the motherboard is faulty, the malfunction will no longer occur.  
Replace the faulty motherboard.

### 8.2.3

#### **3 Flashes - Error: Fan Voltage Monitoring**

In operation with two detector modules, both LEDs flash. When troubleshooting, the following steps should be carried out in the specified order.

- Operating voltage too low
  - Using a multimeter, measure the operating voltage (DC) of the aspirating smoke detector.
  - The measurement value must be between 14 V and 30 V.

- Restore the correct power supply.
- Fan connection poles reversed
  - The fan does not move.
  - Disconnect the power from the unit.
  - Disconnect the fan connection cable from the motherboard.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the fan connection is faulty, the malfunction will no longer occur.  
Check the fan connection on the motherboard: terminal 1 = red, terminal 2 = black).
- The fans are faulty or obstructed
  - If the fan connection is correct (troubleshooting step 2), the malfunction will reoccur.
  - Measure the fan voltage (DC) using a multimeter.
  - If the fan voltage is outside the limits specified below, the fan may be faulty:  
If the fan voltage is set at 6.9 V, the maximum permissible setting is 7.6 V and the minimum is 6.0 V.  
If the fan voltage is set at 9.0 V, the maximum permissible setting is 10.0 V and the minimum is 7.8 V.  
Replace the entire housing, as the fans cannot be removed.
- Motherboard faulty
  - You will need a second motherboard to make this diagnosis.
  - Disconnect the power from the unit.
  - Replace the motherboard with a new motherboard of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the motherboard is faulty, the malfunction will no longer occur.  
Replace the faulty motherboard.

## 8.2.4

### 4 Flashes - Error: Air Pressure Correction Voltage Monitoring

In operation with two detector modules, both LEDs flash. When troubleshooting, the following steps should be carried out in the specified order.

- The R3 potentiometer is moved to the setting for the pressure-dependent airflow calibration.
  - Using a multimeter, measure the voltage (DC) at measuring points MP2 (x) and MP3 (-).
  - The default measurement value is 1.2 V. However, deviations may occur due to the calibration of the airflow dependent on air pressure.
  - The measurement value must be between 0.5 V and 1.9 V. If the measured voltage value is outside of this range, the R3 potentiometer setting is faulty.  
**Note:** The malfunction only occurs at voltages below 0.2 V or above 2.3 V.  
Using the R3 potentiometer, reset the voltage to a point between the measuring points MP2 (x) and MP3 (-). 1.2 V for calibration independently of air pressure. In accordance with the air pressure correction table for air-pressure-dependent calibration.
- Motherboard faulty
  - The voltage cannot be set in step 1.
  - Disconnect the power from the unit.
  - Remove the detector module's connection cables from the motherboard.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the voltage at measuring points MP2 and MP3 cannot be set with the R3 potentiometer, the motherboard is faulty.  
**Note:** If operating without a detector module, the diagnostics LED flashes 7 times.



- Replace the faulty motherboard.
- Detector module faulty
  - Disconnect the power from the unit.
  - Reconnect the connection cable for the first detector module to the motherboard.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the error reoccurs, the first detector module is faulty.
  - If you are using two detector modules, repeat the process with the second detector module.
- Replace the faulty detector module.

### 8.2.5 **5 Flashes - Error: Programming Error**

In operation with two detector modules, both LEDs flash. The motherboard is faulty and must be replaced with a new board.

### 8.2.6 **6 Flashes or 7 Flashes - Error: Internal Error 1 or Internal Error 2**

If only one LED flashes in operation with two detector modules, the associated detector module is probably faulty. When troubleshooting, the following steps should be carried out in the specified order.

- Incorrect detector module in use.
  - Ensure that you are using a suitable detector module.
  - If a detector module is unsuitable, replace it with a suitable one.
- Faulty connection cable between motherboard and detector module.
  - Disconnect the power from the unit.
  - Replace the connection cable with a new one.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the malfunction no longer occurs, the faulty connection cable was responsible for the error.
  - Replace the faulty connection cable.
- Detector module faulty
  - Disconnect the power from the unit.
  - Replace the detector module with a new one of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the error does not reoccur, the detector module was faulty.
  - Replace the faulty detector module.
- The motherboard is faulty.
  - If you are using two detector modules, both diagnostics LEDs flash.
  - Disconnect the power from the unit.
  - Replace the motherboard with a new motherboard of the same type.
  - Restore the operating voltage and run the unit for a few minutes.
  - If the error does not reoccur, the motherboard was faulty.

### 8.2.7 **8 Flashes: Unit Initialization**

This display does not indicate an error. The LEDs flash during the initialization phase, after the power supply has been connected, to indicate that the system is starting. During the initialization phase, the detector is unable to detect smoke.

## 8.3 **Detector Module and Alarm Transmission**

Proceed in accordance with *Testing the Detector Module and Alarm Transfer, page 98*. Also check the detector module visually for exterior contamination or damage and replace as necessary.

**Notice!**

A hardware defect in the detector module is indicated by a permanently-lit detector module LED.

## 8.4

### Pipe system

Check the pipe system and the air sampling openings for obstruction in areas susceptible to dust particles or icing. If necessary, blow out the pipe system and air sampling openings with blast air. Use a mobile cylinder of compressed air (blowing-out system) or activate the manual blowing-out system located on site. The components (compressors, compressed air containers, dryers) required to supply the compressed air can be obtained directly from the relevant compressed air system suppliers.

**Caution!**

Before blowing out the pipe system, disconnect the FCS-320 from the pipe system; otherwise, the airflow sensor will be damaged.

**Blowing out**

The compressed air supply to the pipe system must be connected so that only the pipe system itself is blown out. The aspirating smoke detector and the downstream accessory components of the pipe system (e.g. air filter) must not and cannot be blown out.

A check valve must be installed at the end of each pipe branch. The check valve prevents damage to the air sampling openings and prevents dirt deposits from being blown through the pipe system. To prevent aspiration reducing film sheets in deep-freeze areas from tearing, it is advisable to use special deep-freeze aspiration reductions.

The compressed air supply and compressed air connection must be installed so that at least 0.7 bar of pressure remains available per pipe branch within the pipe system. This means a minimum of 0.7 bar for the I-pipe, a minimum of 1.4 bar for the U-pipe and a minimum of 2.8 bar for the double U-pipe. The minimum flow cross-section within the compressed air connection must be taken into consideration. If the connection is made, e.g. via a quick release coupler with a flow cross-section of 7.2 mm, an approx. pressure ratio of 1:9 occurs due to the comparatively large flow cross-section within the pipe system (21.4 mm). If, for example, 8 bar of pressure is available at the quick release coupler, this would drop to approx. 0.9 bar due to the larger flow cross-section in the pipe system. In this case, the pressure would still be sufficient for an I-pipe system, but inadequate for U and double U-pipe systems. In plants where contamination of the pipe system/air sampling openings can be expected, the compressed air supply can be connected via a three-way tap. In plants exposed to heavy contamination (e.g. recycling plants) an automatic blowing-out system is recommended. For areas exposed to moderate contamination, in which blowing out is required only at prolonged intervals, the use of a mobile blowing-out system including refillable compressed air cylinder is recommended.

## 8.5

### Checking the Airflow Sensor Calibration

Check the airflow sensor value with the diagnostic software.

**Functional principle**

During initialization of the connected pipe system, the device saves the measured actual value of the airflow as a target value via the integrated airflow monitoring. This nominal value then serves as a reference value for the additional evaluation of a possible airflow malfunction.

Depending on the airflow threshold selected, the current airflow value during operation can

fluctuate around this target value without triggering an airflow malfunction. Only if the selected airflow threshold is exceeded will the airflow malfunction be reported by the device and thus transmitted.

#### **Checking the current value**

The tolerance range of the selected airflow threshold and the actual and target values are represented in the diagnostic software. The boundaries (maximum/minimum) always correspond to a deviation of  $\pm 100\%$  from the saved target value.

Check the deviation of the actual value from the target value. If there is a deviation of  $> \pm 70\%$ , you should make a prophylactic check of the pipe system (see section below on "Troubleshooting airflow malfunction").

#### **Dependent on air pressure**

To ensure long-term fault-free operation of the device, the airflow sensor must be calibrated depending on the air pressure. Only with this type of calibration do low air pressure fluctuations remain within the monitoring window and thus in the permissible tolerance range.



#### **Caution!**

If the airflow change is set at less than 30%, an air-pressure-dependent calibration must be carried out.

#### **Independent of air pressure**

If the sensor calibration is carried out independently of air pressure, fluctuations in the air pressure can cause undesired airflow malfunctions. The calibration of the airflow sensor may only be carried out this way if you ensure that no fluctuations in air pressure will occur in the immediate environment.



#### **Caution!**

If air pressure fluctuations are anticipated in the immediate environment, the airflow sensor must be calibrated dependent on air pressure.

#### **Troubleshooting airflow malfunction**

If the airflow calibration has been carried out depending on air pressure and the actual value still does not lie within the tolerance range of the selected airflow threshold (airflow malfunction displayed on the device), then a further disturbance value in addition to air pressure or temperature fluctuation exists.



#### **Caution!**

In case of a defect in the airflow monitoring, only authorized personnel may replace the detector module!

- In this case, check the pipe system for leaks and obstructions (see Checking Airflow Monitoring, "Troubleshooting").
- If this check reveals no malfunctions, check the airflow monitoring by connecting the test pipe and conducting the functional test in accordance with Conducting the Functional Test.
- If, during troubleshooting, the pipe network has been changed, the original configuration of the pipe network must be restored after the troubleshooting has been completed and the airflow must be recalibrated.

**Caution!**

It is essential that you adhere to the calibration type (air-pressure-dependent or air-pressure-independent) and, if necessary, the values for air pressure, height above sea level, and set voltage in the test log.

- Observe the current airflow value during ongoing maintenance or check it at the latest during the next inspection.
- If the target value is similar to the previous one, disruptive environmental influences are the cause of the deviation. If these negative influences on the airflow monitoring cannot be suppressed, increase the airflow range.

**Notice!**

The diagnostic software can be used to save in file format all the stored and current data for the device, as well as any settings made. To be able to compare the data read out, save each file under a different file name.

## 8.6 Airflow Monitoring

A pipe break or pipe obstruction is indicated for each detector module via the flash code of an LED on the motherboard. Check the airflow monitoring in accordance with Section 6.5 Checking Airflow Monitoring, page 90.

## 8.7 Malfunction Transmission

A malfunction is indicated on the FCS-320 and on the fire panel, where applicable. Proceed in accordance with Section 6.4 Checking Malfunction Transmission, page 90.

## 8.8 Maintenance Intervals

Maintenance includes regular completion of inspections and maintenance. The smoke aspiration systems should be checked when commissioned and then quarterly. At each fourth check, more comprehensive checks should be carried out; the following distinction is therefore made:

- Quarterly test/inspection
- Annual test/maintenance + 4th annual inspection

**Inspection**

Measure	Further information can be found in...
Visual Check	<i>Visual check, page 102</i>
Detector Module and Alarm Transmission	<i>Detector Module and Alarm Transmission, page 105</i>
Checking the Pipe Systems	<i>Pipe system, page 106</i>
Checking the Airflow Sensor Calibration	<i>Checking the Airflow Sensor Calibration, page 106</i>
Checking Malfunction Transmission	<i>Malfunction Transmission, page 108</i>
Empty water separator (if necessary)	<i>FAS-ASD-WS Water Separator, page 94</i>

**Maintenance and 4th annual inspection**

Measure	Further information can be found in...
Visual Check	<i>Visual check, page 102</i>

Detector Module and Alarm Transmission	<i>Detector Module and Alarm Transmission, page 105</i>
Checking the Pipe Systems	<i>Pipe system, page 106</i>
Checking the Airflow Sensor Calibration	<i>Checking the Airflow Sensor Calibration, page 106</i>
Checking Malfunction Transmission	<i>Malfunction Transmission, page 108</i>
Checking Airflow Monitoring	<i>Airflow Monitoring, page 108</i>
Empty water separator (if necessary)	<i>FAS-ASD-WS Water Separator, page 94</i>

## 9 Appendix

The form in *Test Log FCS-320 Series Aspirating Smoke Detectors, page 118* is required for commissioning.

### Refer to

- *Air Pressure Correction Tables for Airflow Sensor Calibration, page 109*

## 9.1 Air Pressure Correction Tables for Airflow Sensor Calibration

### 9.1.1 Equipment protection

Height [m above sea level]	Air pressure [hPa] at a height of														
	973	978	983	988	993	998	1003	1008	1013	1018	1023	1028	1033	1038	1043
0	973	978	983	988	993	998	1003	1008	1013	1018	1023	1028	1033	1038	1043
50	967	972	977	982	987	992	997	1002	1007	1012	1017	1022	1027	1032	1037
100	961	966	971	976	981	986	991	996	1001	1006	1011	1016	1021	1026	1031
150	954	959	964	969	974	979	984	989	994	999	1004	1009	1014	1019	1024
200	948	953	958	963	968	973	978	983	988	993	998	1003	1008	1013	1018
250	942	947	952	957	962	967	972	977	982	987	992	997	1002	1007	1012
300	936	941	946	951	956	961	966	971	976	981	986	991	996	1001	1006
350	930	935	940	945	950	955	960	965	970	975	980	985	990	995	1000
400	924	929	934	939	944	949	954	959	964	969	974	979	984	989	994
450	918	923	928	933	938	943	948	953	958	963	968	973	978	983	988
500	912	917	922	927	932	937	942	947	952	957	962	967	972	977	982
550	906	911	916	921	926	931	936	941	946	951	956	961	966	971	976
600	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970
650	894	899	904	909	914	919	924	929	934	939	944	949	954	959	964
700	888	893	898	903	908	913	918	923	928	933	938	943	948	953	958
750	882	887	892	897	902	907	912	917	922	927	932	937	942	947	952
800	877	882	887	892	897	902	907	912	917	922	927	932	937	942	947
850	871	876	881	886	891	896	901	906	911	916	921	926	931	936	941

900	865	870	875	880	885	890	895	900	905	910	915	920	925	930	935
950	860	865	870	875	880	885	890	895	900	905	910	915	920	925	930
1000	854	859	864	869	874	879	884	889	894	899	904	909	914	919	924
1050	848	853	858	863	868	873	878	883	888	893	898	903	908	913	918
1100	843	848	853	858	863	868	873	878	883	888	893	898	903	908	913
1150	837	842	847	852	857	862	867	872	877	882	887	892	897	902	907
1200	832	837	842	847	852	857	862	867	872	877	882	887	892	897	902
1250	827	832	837	842	847	852	857	862	867	872	877	882	887	892	897
1300	821	826	831	836	841	846	851	856	861	866	871	876	881	886	891
1350	816	821	826	831	836	841	846	851	856	861	866	871	876	881	886
1400	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880
1450	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875
1500	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870
1550	795	800	805	810	815	820	825	830	835	840	845	850	855	860	865
1600	789	794	799	804	809	814	819	824	829	834	839	844	849	854	859
1650	784	789	794	799	804	809	814	819	824	829	834	839	844	849	854
1700	779	784	789	794	799	804	809	814	819	824	829	834	839	844	849
1750	774	779	784	789	794	799	804	809	814	819	824	829	834	839	844
1800	769	774	779	784	789	794	799	804	809	814	819	824	829	834	839
1850	764	769	774	779	784	789	794	799	804	809	814	819	824	829	834
1900	759	764	769	774	779	784	789	794	799	804	809	814	819	824	829
1950	754	759	764	769	774	779	784	789	794	799	804	809	814	819	824
2000	749	754	759	764	769	774	779	784	789	794	799	804	809	814	819
2050	744	749	754	759	764	769	774	779	784	789	794	799	804	809	814
2100	739	744	749	754	759	764	769	774	779	784	789	794	799	804	809
2150	734	739	744	749	754	759	764	769	774	779	784	789	794	799	804
2200	729	734	739	744	749	754	759	764	769	774	779	784	789	794	799
2250	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795
2300	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790
2350	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785
2400	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780
Calibration to [V]	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90

### 9.1.2 Space Protection (I-pipe System)

Height [m above sea level]	Air pressure [hPa] at a height of														
0	973	978	983	988	993	998	1003	1008	1013	1018	1023	1028	1033	1038	1043
50	967	972	977	982	987	992	997	1002	1007	1012	1017	1022	1027	1032	1037
100	961	966	971	976	981	986	991	996	1001	1006	1011	1016	1021	1026	1031
150	954	959	964	969	974	979	984	989	994	999	1004	1009	1014	1019	1024
200	948	953	958	963	968	973	978	983	988	993	998	1003	1008	1013	1018
250	942	947	952	957	962	967	972	977	982	987	992	997	1002	1007	1012
300	936	941	946	951	956	961	966	971	976	981	986	991	996	1001	1006
350	930	935	940	945	950	955	960	965	970	975	980	985	990	995	1000
400	924	929	934	939	944	949	954	959	964	969	974	979	984	989	994
450	918	923	928	933	938	943	948	953	958	963	968	973	978	983	988
500	912	917	922	927	932	937	942	947	952	957	962	967	972	977	982
550	906	911	916	921	926	931	936	941	946	951	956	961	966	971	976
600	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970
650	994	899	904	909	914	919	924	929	934	939	944	949	954	959	964
700	888	893	898	903	908	913	918	923	928	933	938	943	948	953	958
750	882	887	892	897	902	907	912	917	922	927	932	937	942	947	952
800	877	882	887	892	897	902	907	912	917	922	927	932	937	942	947
850	871	876	881	886	891	896	901	906	911	916	921	926	931	936	941
900	865	870	875	880	885	890	895	900	905	910	915	920	925	930	935
950	860	865	870	875	880	885	890	895	900	905	910	915	920	925	930
1000	854	859	864	869	874	879	884	889	894	899	904	909	914	919	924
1050	848	853	858	863	868	873	878	883	888	893	898	903	908	913	918
1100	843	848	853	858	863	868	873	878	883	888	893	898	903	908	913
1150	837	842	847	852	857	862	867	872	877	882	887	892	897	902	907
1200	832	837	842	847	852	857	862	867	872	877	882	887	892	897	902
1250	827	832	837	842	847	852	857	862	867	872	877	882	887	892	897
1300	821	826	831	836	841	846	851	856	861	866	871	876	881	886	891
1350	816	821	826	831	836	841	846	851	856	861	866	871	876	881	886
1400	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880
1450	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875
1500	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870

1550	795	800	805	810	815	820	825	830	835	840	845	850	855	860	865
1600	789	794	799	804	809	814	819	824	829	834	839	844	849	854	859
1650	784	789	794	799	804	809	814	819	824	829	834	839	844	849	854
1700	779	784	789	794	799	804	809	814	819	824	829	834	839	844	849
1750	774	779	784	789	794	799	804	809	814	819	824	829	834	839	844
1800	769	774	779	784	789	794	799	804	809	814	819	824	829	834	839
1850	764	769	774	779	784	789	794	799	804	809	814	819	824	829	834
1900	759	764	769	774	779	784	789	794	799	804	809	814	819	824	829
1950	754	759	764	769	774	779	784	789	794	799	804	809	814	819	824
2000	749	754	759	764	769	774	779	784	789	794	799	804	809	814	819
2050	744	749	754	759	764	769	774	779	784	789	794	799	804	809	814
2100	739	744	749	754	759	764	769	774	779	784	789	794	799	804	809
2150	734	739	744	749	754	759	764	769	774	779	784	789	794	799	804
2200	729	734	739	744	749	754	759	764	769	774	779	784	789	794	799
2250	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795
2300	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790
2350	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785
2400	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780
Calibration to [V]	0.58	0.67	0.76	0.85	0.94	1.03	1.12	1.21	1.30	1.39	1.48	1.57	1.66	1.75	1.84

### 9.1.3 Space Protection (U, Double U, and H-pipe System)

Height [m above sea level]	Air pressure [hPa] at a height of														
0	973	978	983	988	993	998	1003	1008	1013	1018	1023	1028	1033	1038	1043
50	967	972	977	982	987	992	997	1002	1007	1012	1017	1022	1027	1032	1037
100	961	966	971	976	981	986	991	996	1001	1006	1011	1016	1021	1026	1031
150	954	959	964	969	974	979	984	989	994	999	1004	1009	1014	1019	1024
200	948	953	958	963	968	973	978	983	988	993	998	1003	1008	1013	1018
250	942	947	952	957	962	967	972	977	982	987	992	997	1002	1007	1012
300	936	941	946	951	956	961	966	971	976	981	986	991	996	1001	1006
350	930	935	940	945	950	955	960	965	970	975	980	985	990	995	1000
400	924	929	934	939	944	949	954	959	964	969	974	979	984	989	994
450	918	923	928	933	938	943	948	953	958	963	968	973	978	983	988



500	912	917	922	927	932	937	942	947	952	957	962	967	972	977	982
550	906	911	916	921	926	931	936	941	946	951	956	961	966	971	976
600	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970
650	994	899	904	909	914	919	924	929	934	939	944	949	954	959	964
700	888	893	898	903	908	913	918	923	928	933	938	943	948	953	958
750	882	887	892	897	902	907	912	917	922	927	932	937	942	947	952
800	877	882	887	892	897	902	907	912	917	922	927	932	937	942	947
850	871	876	881	886	891	896	901	906	911	916	921	926	931	936	941
900	865	870	875	880	885	890	895	900	905	910	915	920	925	930	935
950	860	865	870	875	880	885	890	895	900	905	910	915	920	925	930
1000	854	859	864	869	874	879	884	889	894	899	904	909	914	919	924
1050	848	853	858	863	868	873	878	883	888	893	898	903	908	913	918
1100	843	848	853	858	863	868	873	878	883	888	893	898	903	908	913
1150	837	842	847	852	857	862	867	872	877	882	887	892	897	902	907
1200	832	837	842	847	852	857	862	867	872	877	882	887	892	897	902
1250	827	832	837	842	847	852	857	862	867	872	877	882	887	892	897
1300	821	826	831	836	841	846	851	856	861	866	871	876	881	886	891
1350	816	821	826	831	836	841	846	851	856	861	866	871	876	881	886
1400	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880
1450	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875
1500	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870
1550	795	800	805	810	815	820	825	830	835	840	845	850	855	860	865
1600	789	794	799	804	809	814	819	824	829	834	839	844	849	854	859
1650	784	789	794	799	804	809	814	819	824	829	834	839	844	849	854
1700	779	784	789	794	799	804	809	814	819	824	829	834	839	844	849
1750	774	779	784	789	794	799	804	809	814	819	824	829	834	839	844
1800	769	774	779	784	789	794	799	804	809	814	819	824	829	834	839
1850	764	769	774	779	784	789	794	799	804	809	814	819	824	829	834
1900	759	764	769	774	779	784	789	794	799	804	809	814	819	824	829
1950	754	759	764	769	774	779	784	789	794	799	804	809	814	819	824
2000	749	754	759	764	769	774	779	784	789	794	799	804	809	814	819
2050	744	749	754	759	764	769	774	779	784	789	794	799	804	809	814
2100	739	744	749	754	759	764	769	774	779	784	789	794	799	804	809
2150	734	739	744	749	754	759	764	769	774	779	784	789	794	799	804

2200	729	734	739	744	749	754	759	764	769	774	779	784	789	794	799
2250	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795
2300	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790
2350	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785
2400	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780
Calibration to [V]	0.54	0.63	0.73	0.82	0.92	1.01	1.11	1.20	1.30	1.40	1.49	1.59	1.68	1.78	1.87

## 9.2 Planning without filter

M = module      S = sensitivity (% LT/m)      MA = main alarm      PA = internal alarm

			Number of openings																						
DM-	S		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32	
01 (05)	0.015 (0.05)	MA	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
	0.03 (0.1)	MA	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	
	0.06 (0.2)	MA	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	C
	0.12 (0.4)	MA	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	
10 (25)	0.1 (0.25)	MA	A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B
	0.2 (0.5)	MA	A	A	A	A	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	C	C	
	0.4 (1)	MA	A	A	B	B	B	B	C	C	C	C	C	C											
	0.8 (2)	MA	A	B	B	C	C	C																	
50 (80)	0.313 (0.5)	PA	A	A	A	A	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	C	C	C
	0.5 (0.8)	MA	A	A	A	B	B	B	B	C	C	C	C	C	C	C	C								
	0.687 (1.1)	PA	A	A	B	B	B	C	C	C	C	C													
	1.0 (1.6)	MA	A	B	B	C	C	C	C																

### 9.2.1 Without any other pipe accessories

		Number of openings																						
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32	
I	6.9	77	77	77	77	77	77	77	77	76														
	≥9	100																						
U	6.9	120																						
	≥9	150																						
M	6.9	170										160												
	≥9	180																						
Double U	6.9	180																						
	≥9	200																						
Quad. U (1 DM)	6.9																							
	≥9	300																						

### 9.2.2 With water separator

		Number of openings																					
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32
I	6.9	60	60	60	60	60	60	60															
	≥9	80	80	80	80	80	80	80	80	80	80												
U	6.9	110																					
	≥9	110																					
M	6.9	110																					
	≥9	160																					
Double U	6.9	140																					
	≥9	160																					

### 9.2.3 With detonation safety barrier

		Number of openings																					
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32
I	6.9	46	46	46	46	38																	
	≥9	68	68	68	68	68	68																
U	6.9	60	60	60	60	60	60																
	≥9	60	60	60	60	60	60	60	60														
M	6.9	80	80	80	80	80	80	70	70	70													
	≥9	120																					

		Number of openings																							
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
Double U	6.9	80	80	80	80	80	80	80	80																
	≥9	100																							

### 9.3 Planning with air filter

M = module      S = sensitivity (% LT/m)      MA = main alarm      PA = internal alarm

			Number of openings																							
DM-	S		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
01 (05)	0.015 (0.05)	MA	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		
	0.03 (0.1)	MA	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	B	B	B		
	0.06 (0.2)	MA	A	A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C		
	0.12 (0.4)	MA	A	A	A	A	A	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C			
10 (25)	0.1 (0.25)	MA	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	C	C	C	C		
	0.2 (0.5)	MA	A	A	A	A	B	B	B	B	B	B	C	C	C	C	C	C	C	C						
	0.4 (1)	MA	A	A	B	B	B	C	C	C	C	C														
	0.8 (2)	MA	A	B	C	C	C																			
50 (80)	0.313 (0.5)	PA	A	A	A	A	B	B	B	B	B	B	C	C	C	C	C	C	C	C						
	0.5 (0.8)	MA	A	A	B	B	B	B	C	C	C	C	C	C	C											
	0.687 (1.1)	PA	A	B	B	B	C	C	C	C	C															
	1.0 (1.6)	MA	A	B	B	C	C	C																		

#### 9.3.1 Without any other pipe accessories

		Number of openings																							
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
I	6.9	70	70	70	70	70	70	70	70																
	≥9	100										90	90												

		Number of openings																										
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32					
U	6.9	120																										
	≥9	140																										
M	6.9	160																										
	≥9	180																										
Double U	6.9	170																										
	≥9	190																										

**9.3.2 With water separator**

		Number of openings																										
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32					
I	6.9	60	60	60	60	60	60	60																				
	≥9	80	80	80	80	80	80	80	80	80	80																	
U	6.9	110																										
	≥9	110																										
M	6.9	110																										
	≥9	160																										
Double U	6.9	140																										
	≥9	160																										

**9.3.3 With detonation safety barrier**

		Number of openings																									
Pipe shape	U <sub>Fans</sub>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32				
I	6.9	46	46	46	46	38																					
	≥9	68	68	68	68	68	68																				
U	6.9	60	60	60	60	60	60																				
	≥9	60	60	60	60	60	60	60	60																		
M	6.9	80	80	80	80	80	80	70	70	70																	
	≥9	120																									
Double U	6.9	80	80	80	80	80	80	80	80																		
	≥9	100																									

## 9.4 Test Log FCS-320 Series Aspirating Smoke Detectors

<b>Device number</b>						
Serial Number						
	Measurement value/set value					
<b>Commissioning</b>						
Visual check +/-						
Negative pressure [Pa]						
Sensitivity [%/m]						
Alarm delay [s]						
Malfunction delay [min]						
Activation threshold [I/II/III/iV]						
Save malfunction [yes/no]						
LOGIC SENS [yes/no]						
Air-pressure-dependent calibration [yes/no]						
Air-pressure-independent calibration [yes/no]						
Height [m above sea level]						
Air pressure [hPa]						
Temperature [°C]						
<b>Obstruction malfunction</b>						
LED flashing +/-						
Relay fails after delay +/-						
Signal transmission to fire panel +/-						
Cause eliminated, LED off +/-						
Relay activates after drop below threshold +/-						
Cause eliminated, LED saved +/-						
Relay remains off +/-						
<b>Breakage malfunction</b>						
LED flashing +/-						
Relay fails after delay +/-						
Signal transmission to fire panel +/-						
Cause eliminated, LED off +/-						
Relay activates after drop below threshold +/-						

<b>Device number</b>						
Cause eliminated, LED saved +/-						
Relay remains off +/-						
<b>Info alarm</b>						
LED flashing +/-						
Relay activates after delay +/-						
Signal transmission to fire panel +/-						
LED saved +/-						
Relay saved +/-						
<b>Internal alarm</b>						
LED flashing +/-						
Relay activates after delay +/-						
Signal transmission to fire panel +/-						
LED saved +/-						
Relay saved +/-						
<b>Main alarm</b>						
LED flashing +/-						
Relay activates after delay +/-						
Signal transmission to fire panel +/-						
LED saved +/-						
Relay saved +/-						

Legend: + in order / - not in order

Date: ..... Place: ..... Issuer: .....

Signature:.....

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