



FAS-420 Aspirating Smoke Detector LSN "improved version"

FAS-420



BOSCH

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1 General

1.1 Introduction

This operation guide describes the smoke aspiration systems featuring FAS-420 series aspirating smoke detectors and the associated aspiration pipe system.

In this operation guide, the designation FAS-420 refers to all FAS-420 series (FAS-420-TP1, FAS-420-TP2, FAS-420-TT1 and FAS-420-TT2) as well as all -SL variants. Specific references are made to differences between the individual versions.

1.2 Safety Instructions

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.

1.3 Warranty

This operation guide is subject to technical modification without prior notice and makes no claim to completeness.

As a rule, our “delivery and installation conditions” apply.

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.

**WARNING!**

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

1.4 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.

1.5 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).

2 Technical Specifications

2.1 Product Description

Aspirating smoke detectors from the FAS-420 series are active fire detection devices that are connected directly to the Local SecurityNetwork (LSN) "improved version" for early fire detection. They are used for room and equipment protection as well as for monitoring air-conditioning units or ducts.

Local SecurityNetwork (LSN) improved

The FAS-420 series aspirating smoke detectors were developed specifically for connection to the FPA-5000 Modular Fire Panel and offers the upgraded features of the LSN "improved version" technology.

- Flexible network structures, including T-tapping with no additional elements
- Up to 254 LSN-improved elements per loop or stub line
- Unshielded cable can be used.

The FAS-420 series also offers all the established benefits of LSN technology. The operating data and fault messages can be read off the FPA-5000 operating and display unit.

Variants

The FAS-420-TP1, FAS-420-TP2, FAS-420-TP1-SL and FAS-420-TP2-SL variants feature LED displays indicating operating mode, faults and alarms (the FAS-420-TP2 and FAS-420-TP2-SL have two alarm displays). The FAS-420-TT1, FAS-420-TT2, FAS-420-TT1-SL and FAS-420-TT2-SL offer differentiated alarm displays (info, pre and main alarm) as well as a 10-segment smoke level display (on the FAS-420-TT2 and FAS-420-TT2-SL, all alarm and smoke level displays are doubled).

The FAS-420-TP1, FAS-420-TP1-SL, FAS-420-TT1 and FAS-420-TT1-SL variants are each fitted with a detector module.

The FAS-420-TP2, FAS-420-TP2-SL, FAS-420-TT2 and FAS-420-TT2-SL variants each have two integrated detector modules. 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 FAS-420-TP2 and FAS-420-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 FAS-420-TP2 and FAS-420-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.

Dual-zone dependency

Connecting to the FPA-5000 Modular Fire Panel and programming using RPS software also permit a dual-zone dependency.

Sensitivity

Three detector module versions are available for the FAS-420 aspirating smoke detector series:

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

Depending on the detector module used, the FAS-420-TT1 and FAS-420-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. Further sensitivity levels to suit the

application range can be selected via the RPS programming software.



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 (for response sensitivity, detection points, see Section 3.4 Defining the Response Sensitivity, page 37).

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 FAS-420 series reliably detect malfunctions such as pipe breakage or obstructions in the air sampling openings.

The small airflow unit also contains a dynamic airflow sensor that enables a response to small and fast changes in the airflow.

Airflow monitoring is temperature-compensated and can be set depending on the air pressure.

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

A system with FAS-ASD-DIAG Diagnostic Software, which enables quick and convenient error containment, is available 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.

For -SL variants, the fan voltage can also be set to 6.5 V.

2.2 Areas of Application

Thanks to their detection principle, FAS-420 aspirating smoke detectors represent an extremely versatile fire alarm system.

Principle

Air samples are taken from the monitoring area by a pipe system with defined aspiration openings and then fed to the detector 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 with a height greater than that allowed for point detectors
- Areas in which point detectors are not desired for aesthetic reasons
- Areas in which electromagnetic fields are influential
- 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 FAS-420 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
- Freezer storage.

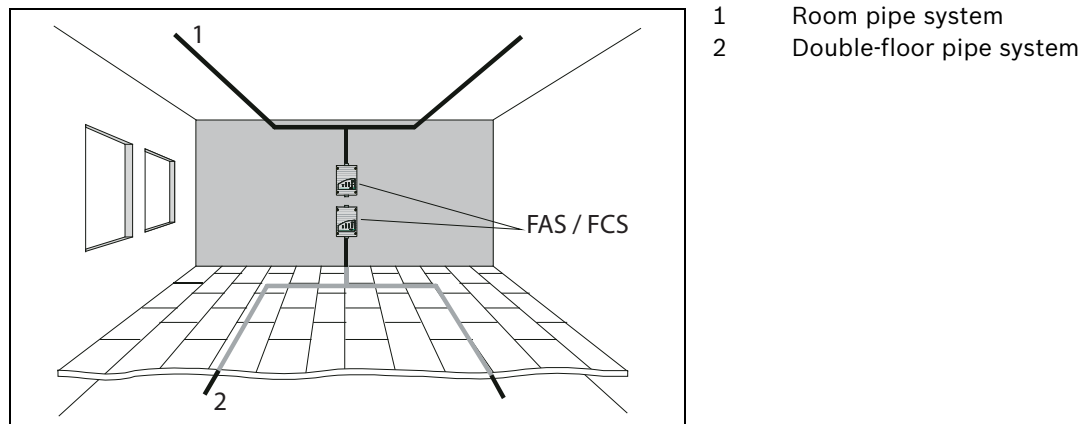


Figure 2.1 Principle of area monitoring with FAS-420 series aspirating smoke detectors

Area monitoring with air-conditioning

Area monitoring occurs

- In rooms with air-conditioning for server rooms etc.
- In ventilation ducts
- Over double floors, false ceilings
- In IT rooms, e-distributor rooms, transformer cells
- On air-conditioning units (see *Figure 2.2*) or
- In the bypass in air-conditioning ducts.

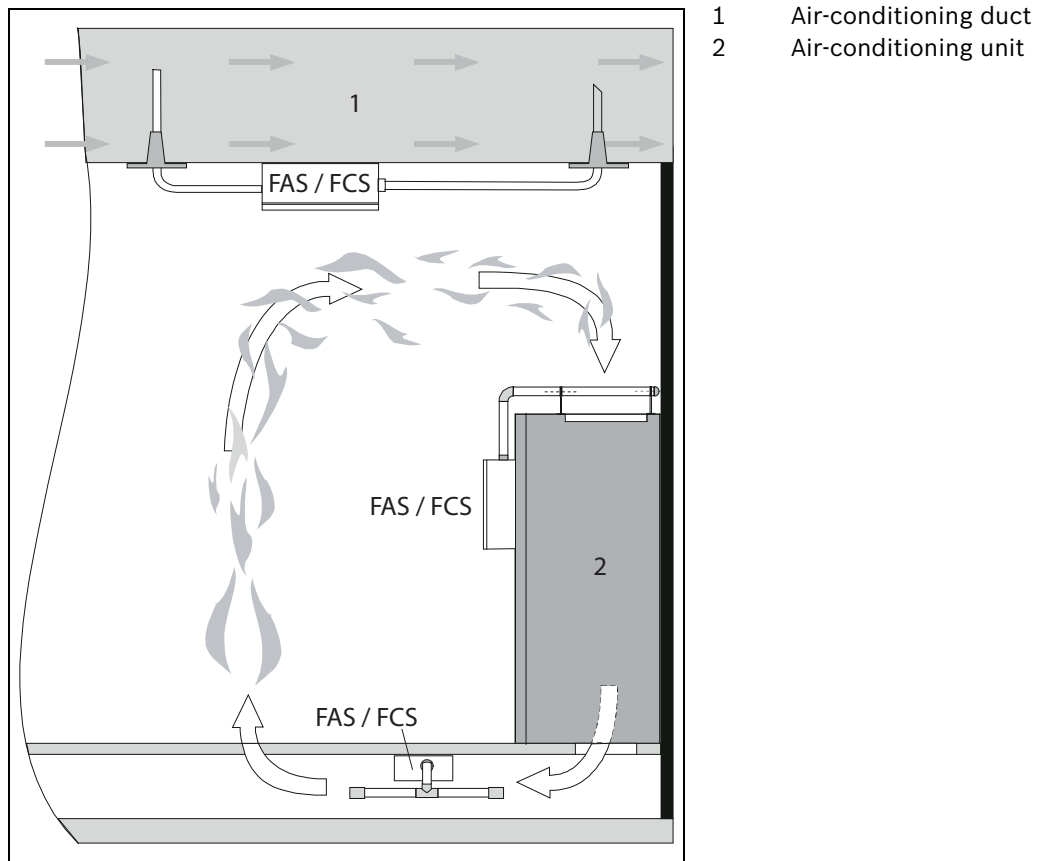


Figure 2.2 Monitoring options for an air-conditioning unit or an air-conditioning duct (depiction of principle)

Equipment protection

Equipment monitoring involves the direct monitoring of an object. These can be unventilated or force-cooled units or cabinets, e.g.

- Distributor cabinets, switching cabinets
- Telephone-switching equipment
- Measuring, control, and regulation equipment.

Area monitoring in noise-sensitive areas

All -SL variants are equipped with an extremely quiet fan and can therefore be used in noise-sensitive areas, such as

- Hotels
- Hospitals
- Libraries
- Prisons etc.

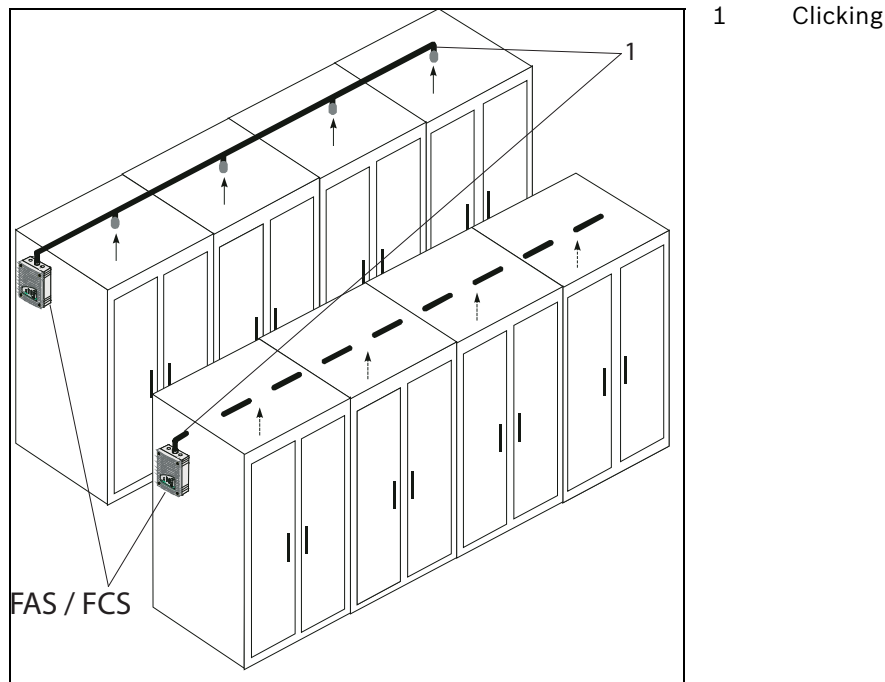


Figure 2.3 Principle of equipment monitoring with FAS-420 series aspirating smoke detectors

FAS-420 series aspirating smoke detectors can also be used for early fire detection in areas with special-purpose air conditioning.

Its high detection sensitivity enables high value goods and equipment to be monitored. The FAS-420 series is therefore especially suitable for application areas with difficult detection conditions

- Where early intervention is essential due to a high concentration value
- Where equipment must always be operational
- Where highly-sensitive detection is required (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.

2.3 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.

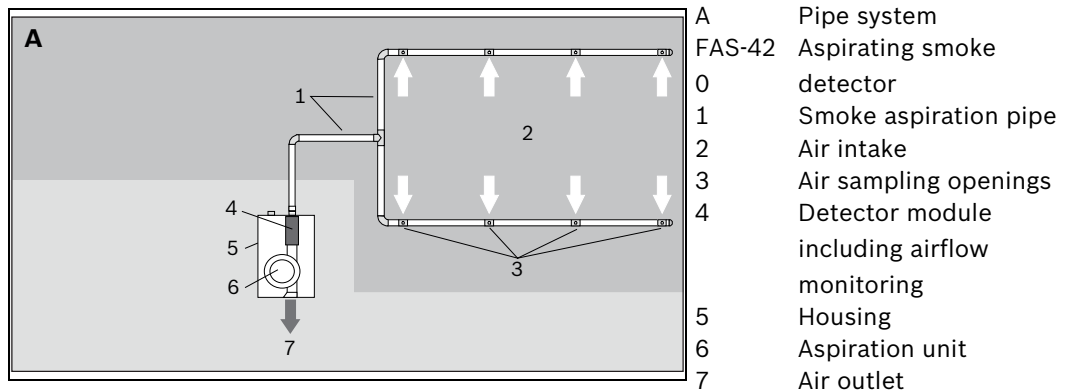


Figure 2.4 Overview of the aspirating smoke detector

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.

2.4 Functions

Air samples are taken from the area to be monitored using the aspiration unit. They are fed via a pipe system with defined air sampling openings to the sensitive detector module (see *Figure 2.4*).

Detector module

Depending on the response sensitivity of the detector module in use and programmed alarm threshold, the FAS-420 series aspirating smoke detector triggers the alarm when the corresponding light obscuration threshold is reached. With the FAS-420-TP1 and the FAS-420-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 FAS-420-TT1 and FAS-420-TT2 versions offer differentiated LED displays for info, pre and main alarm. Pre 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 (see Section 4.3 Settings on the Unit Motherboard, page 67). 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. LOGIC · SENS can be activated and/or deactivated using the RPS programming software.

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 (see Section 3.2 Principles of Pipe Planning, page 33) – 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 Section 3.3 Airflow Monitoring, page 36). The principal signal curve of the airflow sensor is indicated in *Figure 2.5*.

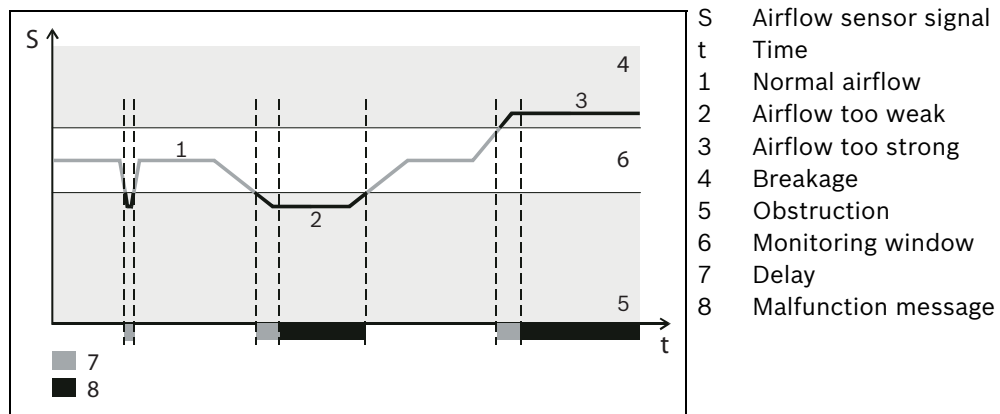


Figure 2.5 Example of the signal process of the airflow sensor in case of malfunctions

Fault Indication

An imminent detector module or airflow malfunction generates a malfunction message that is displayed on the FAS-420.

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. Alarm and malfunction messages are displayed simultaneously on the unit via the Local SecurityNetwork LSN using the reset function on the detector line.

Calibrating the airflow sensor

Automatic airflow sensor calibration makes it significantly easier to start the FAS-420. The initialization phase is carried out according to or independently of the air pressure as desired. To set the FAS-420 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 FAS-420 series aspirating smoke detectors over a maximum of 32 aspiration points. Two pipe systems can be connected to both the FAS-420-TP2 and FAS-420-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.

2.5 FAS-420 Series Aspirating Smoke Detectors and Accessories

2.5.1 Overview

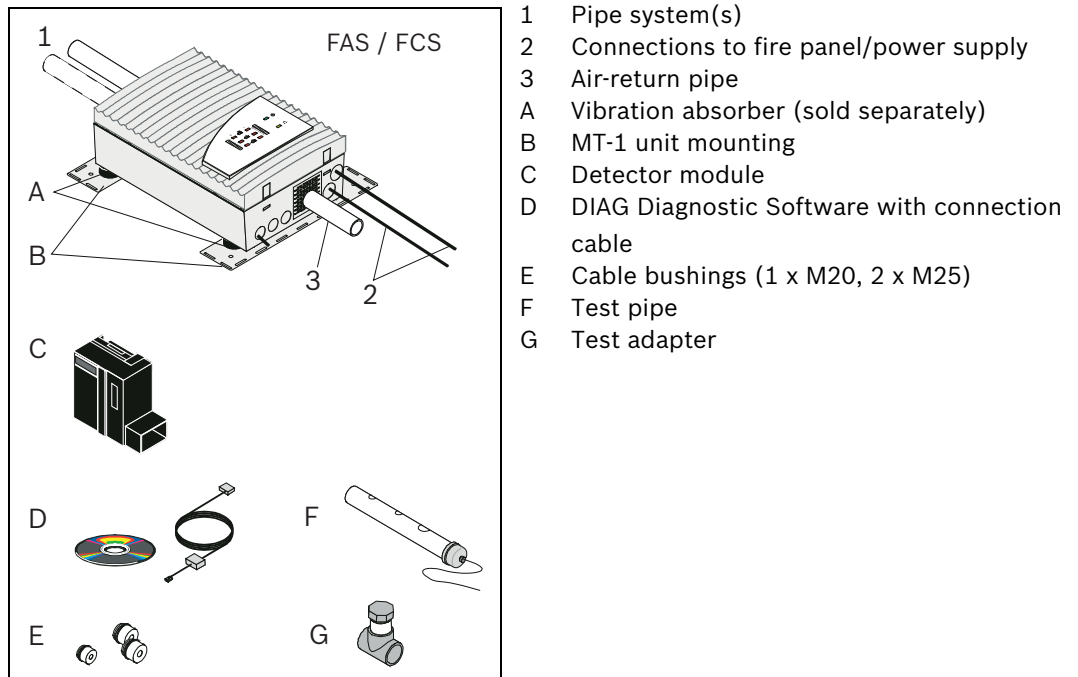


Figure 2.6 Overview of FAS-420 series aspirating smoke detectors and accessories

FAS-420 series aspirating smoke detectors comprise 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)
- FAS-420-TP1/FAS-420-TP2: optical displays for alarm, malfunction and operation
- FAS-420-TT1/FAS-420-TT2: smoke level display(s), optical displays for info, pre and main alarm, malfunction and operation
- 1 detector module (for FAS-420-TP1 and FAS-420-TT1) and/or 2 detector modules (for FAS-420-TP2 and FAS-420-TT2).



NOTICE!

Only type DM-TT-50(80), DM-TT-10(25) and DM-TT-01(05) detector modules with VdS certification can be used in the standard units from the FAS-420 series. The detector modules must be ordered separately.

Information on other accessories for special applications can be found in

- *Section 2.5.5 FAS-ASD-DIAG Diagnostic Software*
- *Section 2.5.6 Remote Indicators*
- *Section 2.5.7 Device Mounting*
- *Section 2.6.3 Ceiling Lead-through*
- *Section 2.6.5 Water Separator for Humid Areas*
- *Section 2.6.6 Detonation Safety Barrier for Potentially Explosive Areas.*

2.5.2 FAS-420 Connections

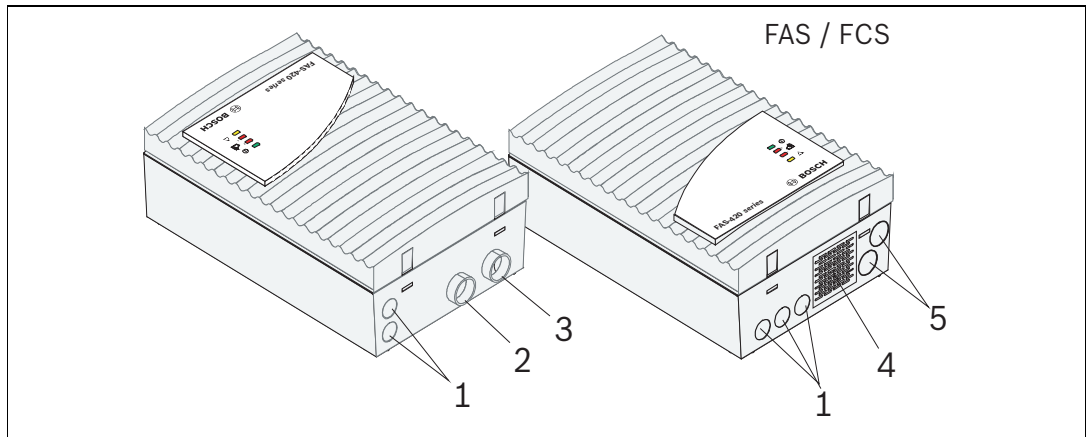


Figure 2.7 FAS-420 connections (see table on next page for explanations)

	Position in Figure 2.7	Function	Explanation
FAS-420 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 (for FAS-420-TP2 and FAS-420-TT2 only)	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)

2.5.3 FAS-420-TP1/FAS-420-TP2 Displays

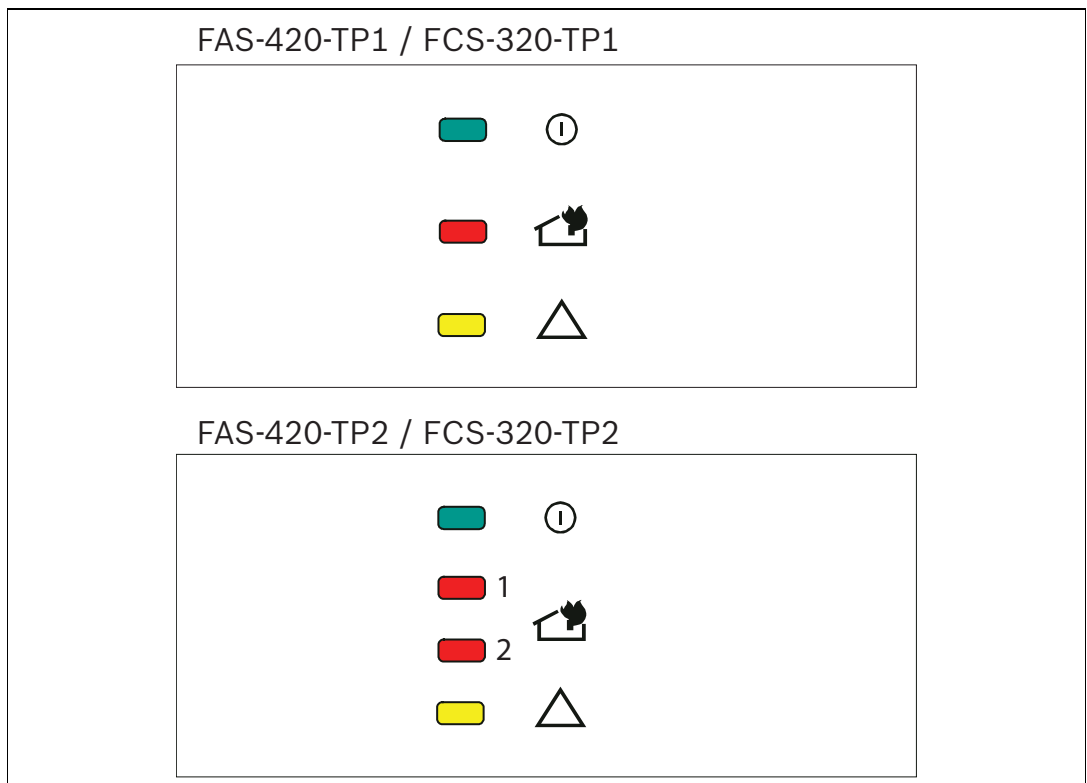


Figure 2.8 FAS-420-TP1 / FAS-420-TP2 displays

FAS-420-TP	Display	LED	Explanation
	Operation	Green	Operation display
	Alarm ¹	Red	Alarm indication
	Fault	Yellow	Fault <ul style="list-style-type: none"> - in the pipe system - of a detector module - caused by fan failure
¹ Two alarm displays on the FAS-420-TP2			

2.5.4 FAS-420-TT1/FAS-420-TT2 Displays

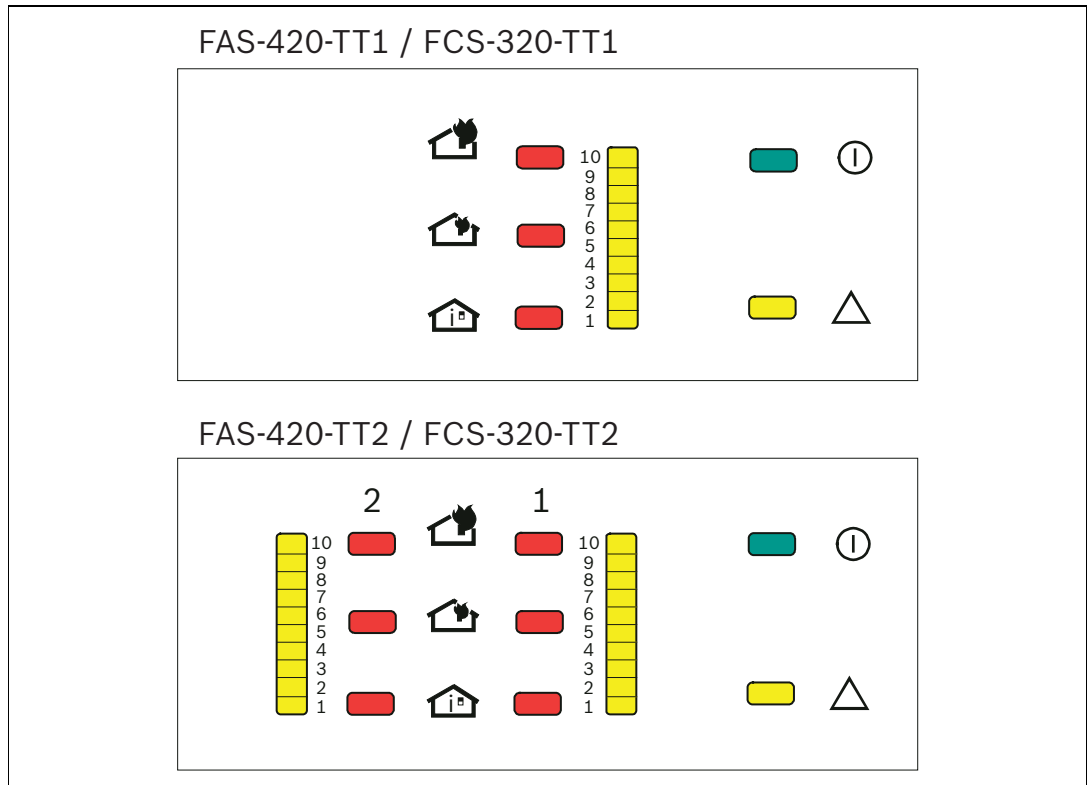


Figure 2.9 FAS-420-TT1 / FAS-420-TT2 displays

FAS-420-TT	Display	LED ¹	Explanation
	Operation	Green	Operation display
	Fault	Yellow	Fault <ul style="list-style-type: none"> - in the pipe system - of a detector module - caused by fan failure
	Main alarm	Red	100% smoke level
	Pre-alarm ¹	Red	66% smoke level
	Info alarm ¹	Red	33% smoke level
	Smoke level display 1 to 10 ¹	10 yellow LEDs	Current smoke level
¹ All displays doubled on the FAS-420-TT2			

2.5.5

FAS-ASD-DIAG Diagnostic Software

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 use a COM port (see *Figure 2.10*).

Windows 2000 or Windows XP can be used as the operating system (earlier diagnostic software versions (with serial interface) run under WINDOWS 95, 98, ME, 2000 and NT). For correct color display, the monitor and graphics card must be able to display more than 256 colors.

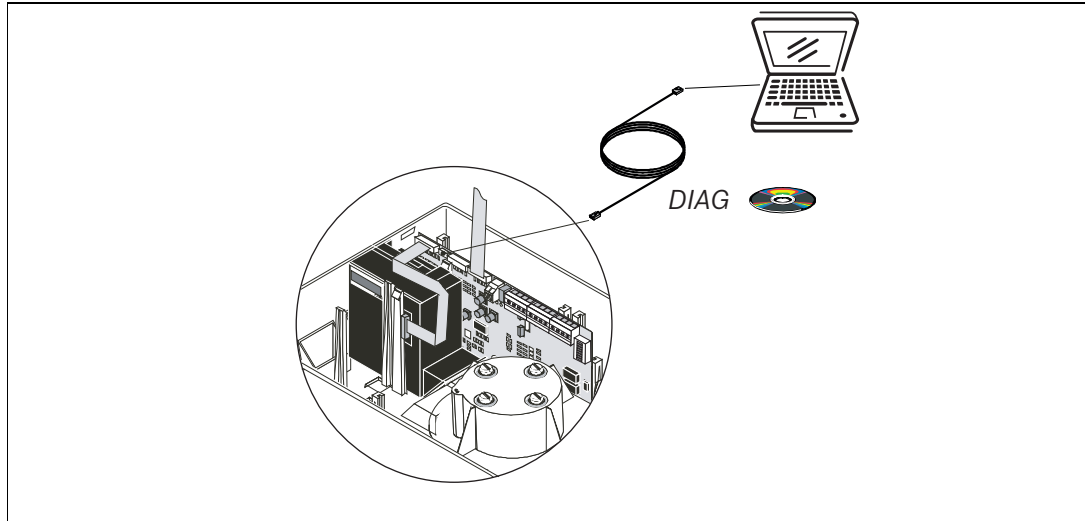


Figure 2.10 Diagnostic software for reading out device states

Diagnostic messages remain saved in the diagnostic software 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 all stored and current diagnostics data, as well as the settings made via the RPS programming software as a file. To be able to compare the data read out, save each file under a different file name.

2.5.6

Remote Indicators

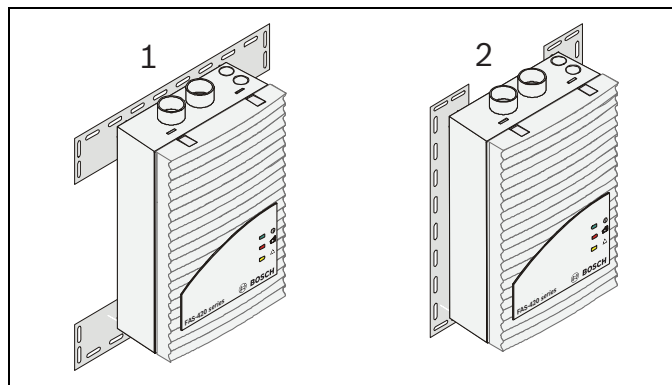
A remote indicator must be connected if the aspirating smoke detector is not directly visible or has been mounted in false ceilings or floors.

The external detector alarm display must be mounted in an obvious place in halls or entrances of the building section or areas concerned.

The display is connected to the unit motherboard via the "X6 ext. Display" (D-/D+/V-/V+). Only digital remote indicators made by Wagner can be used for this connection; these are available by separate order.

Alternatively, FNS-420-R LSN Strobes can be connected via LSN and configured via FSP-5000-RPS.

2.5.7 Device Mounting

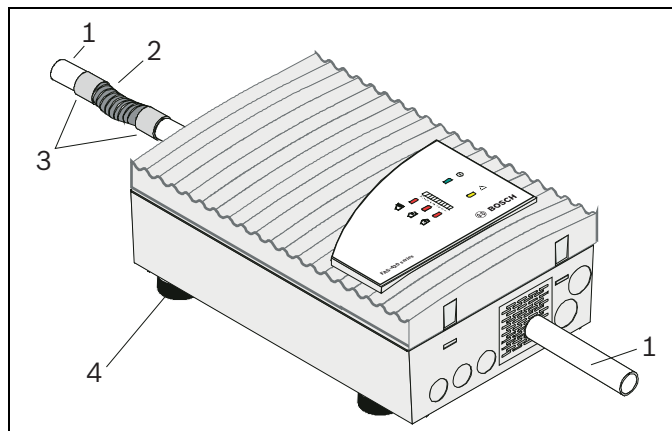


- 1 Horizontal installation
- 2 Vertical installation

Figure 2.11 Mounting for FAS-420 series Aspirating Smoke Detector

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

2.5.8 Measures for Reducing Operating Noise



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

Figure 2.12 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 FAS-420 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 (see *Figure 2.12*).

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). All -SL variants are equipped with an extremely quiet fan that limits the noise level to 38 dB(A). Thanks to the additional sound damper, fan noise can be reduced to 34 dB(A); this ensures that the detector is in accordance with DIN 4109 for living and sleeping areas.

2.6 Pipe System Components

2.6.1 Overview

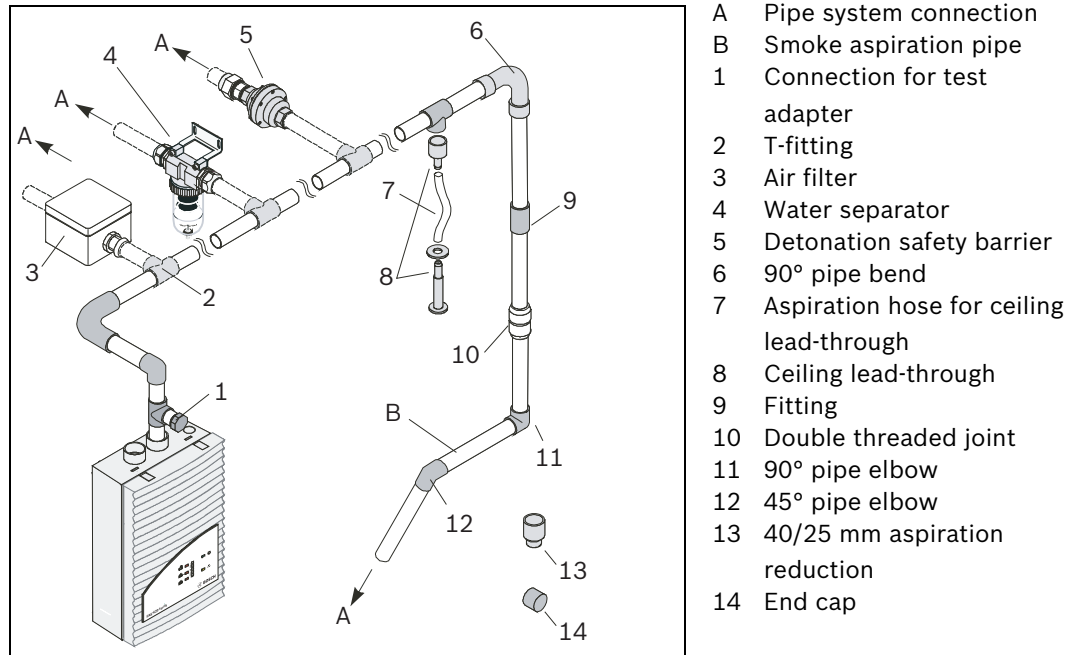


Figure 2.13 Pipe system components

During planning/design, a distinction is drawn between area monitoring and equipment monitoring. For both applications, PVC and halogen-free pipes can be used, but the restrictions of EN 54-20 must be observed. Halogen-free pipes should be used when monitoring equipment.

Figure 2.13 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 (see also Section 3.9 Planning for Long Pipe Feed Lines, page 58).

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. Figure 2.14 shows a manual blowing-out system with a three-way tap.

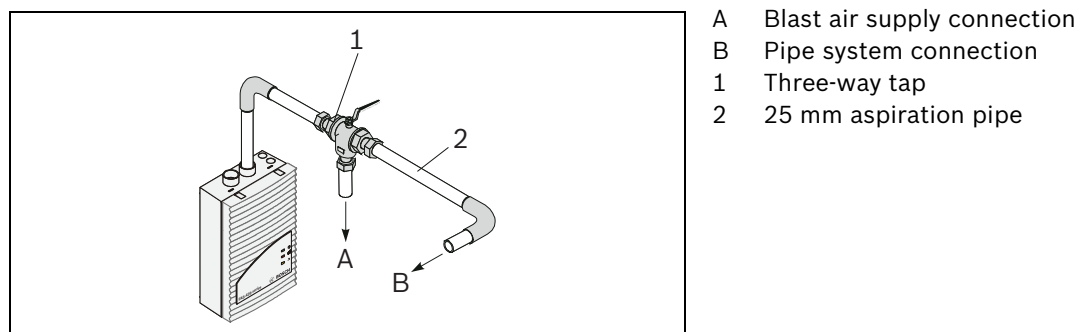


Figure 2.14 Manual blowing-out system components

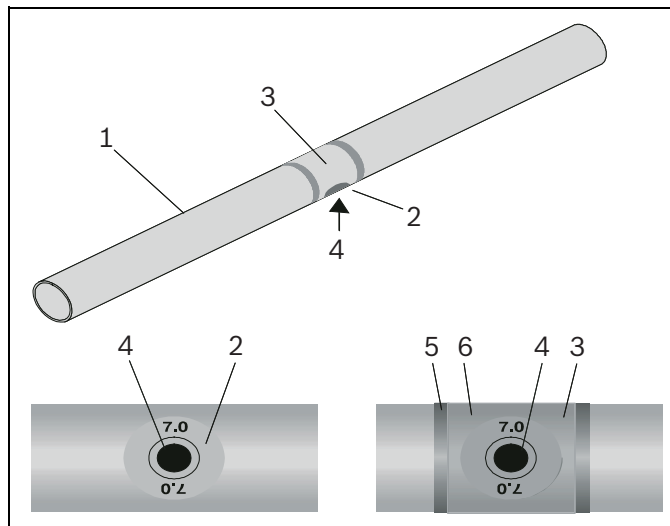
2.6.2

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 construction of the pipe system (see Section 3 Planning, page 32).

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.

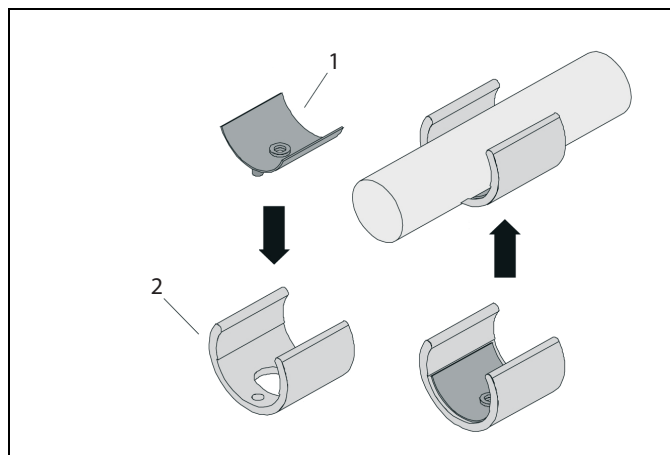


- 1 Smoke aspiration pipe
- 2 Air sampling opening with aspiration reducing film sheet
- 3 Marking tape for aspiration reducing film sheet
- 4 Air sampling opening
- 5 Fire red (RAL 3000)
- 6 Transparent

Figure 2.15 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 2.16*).



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

Figure 2.16 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).

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.

2.6.3

Ceiling Lead-through

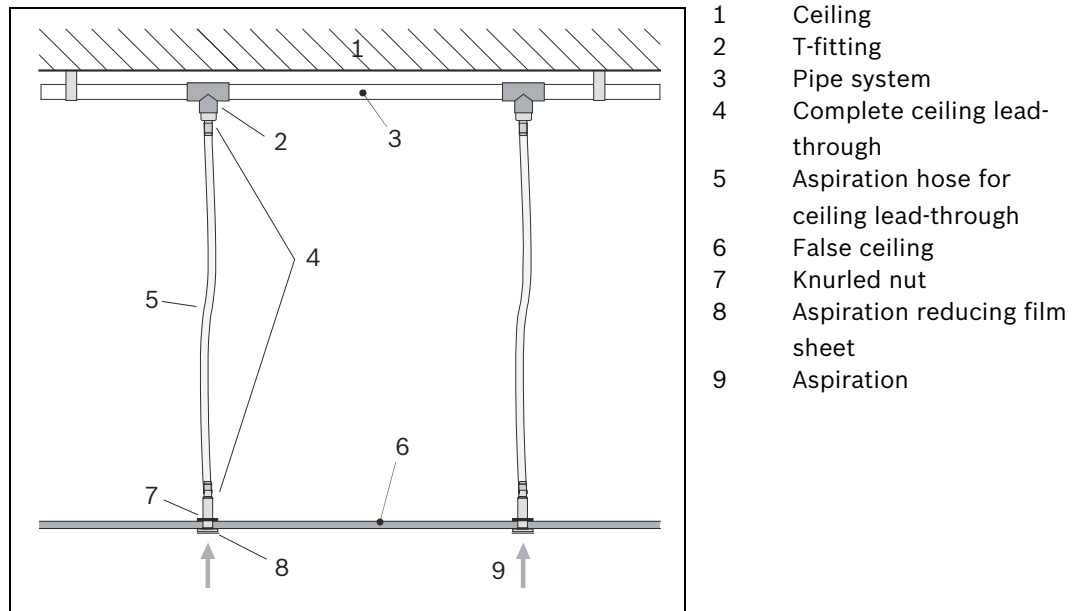


Figure 2.17 Ceiling lead-throughs

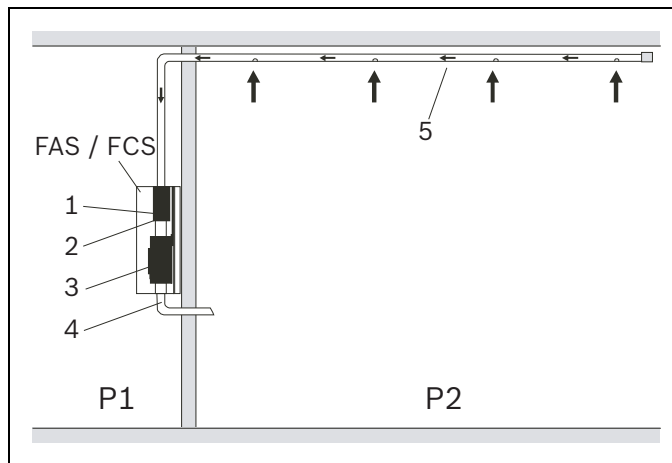
A concealed pipe system for area monitoring can be realized by installing in a false ceiling. This requires the use of ceiling lead-throughs in the false ceiling. The ceiling lead-through can be used with a false ceiling thickness of up to approx. 35 mm.

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 (see *Figure 2.17*).

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.

2.6.4

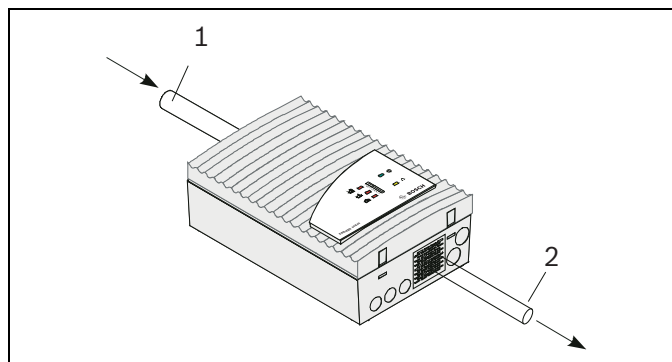
Air-Return Pipe for Pressure Areas and Atmospheric Loads



- P1/P2 Pressure areas 1 and 2
- 1 Detector module
- 2 Airflow sensor
- 3 Aspiration unit
- 4 Air-return pipe
- 5 Pipe system

Figure 2.18 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 (see *Figure 2.18*). The air-return pipe can serve to equalize pressure or to prevent atmospheric loads (e.g. odors) in neighboring spaces.



- 1 Smoke aspiration pipe
- 2 Air-return pipe

Figure 2.19 FAS-420 with air-return pipe

The air-return pipe is connected to the air exhaust duct inside the FAS-420 through the ventilation grille (see *Figure 2.19*). This requires the pre-punched opening in the protective grille to be broken out.

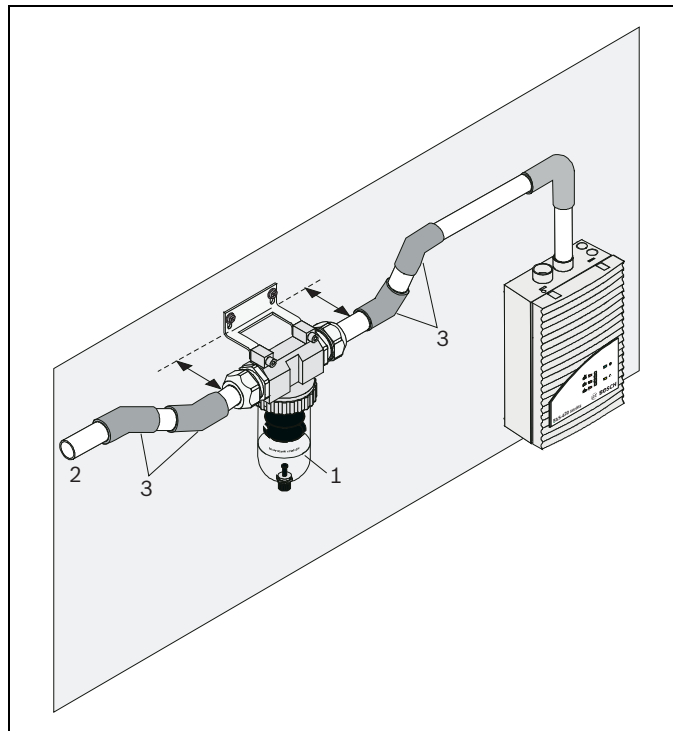


CAUTION!

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

2.6.5 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.



- 1 Water separator
- 2 Pipe system connection
- 3 45° pipe elbow

Figure 2.20 FAS-ASD-WS Water Separator for condensing water vapor and collecting condensate from the pipe system

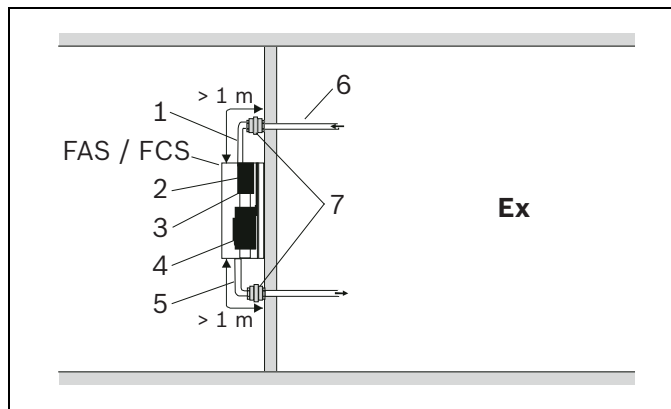
The FAS-ASD-WS Water Separator is integrated at the lowest point in the pipe system upstream of the air filter and the aspirating smoke detector. The 45° pipe elbow permits optimum distance from the wall (see *Figure 2.20*).

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.

2.6.6

Detonation Safety Barrier for Potentially Explosive Areas



- 1 Metal pipe
- 2 Detector module
- 3 Airflow sensor
- 4 Aspiration unit
- 5 Air-return pipe
- 6 Pipe system
- 7 Detonation safety barrier

Figure 2.21 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 (see *Figure 2.21*).

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 synthesol or sealing tape.

2.7 Scope of Delivery: Smoke Aspiration System

Basic devices and accessories

	Designation	Product ID
FAS-420-TP2	Standard unit	F.01U.029.255
FAS-420-TP2	Standard unit	F.01U.029.256
FAS-420-TT1	Standard unit	F.01U.029.252
FAS-420-TT2	Standard unit	F.01U.029.253
FAS-420-TP2-SL	Standard unit Silent	F.01U.083.877
FAS-420-TP2-SL	Standard unit Silent	F.01U.083.876
FAS-420-TT1-SL	Standard unit Silent	F.01U.083.875
FAS-420-TT2-SL	Standard unit Silent	F.01U.083.874
DM-TT-50(80)	Detector module	4.998.143.400
DM-TT-10(25)	Detector module	4.998.143.401
DM-TT-01(05)	Detector module	4.998.143.402
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
RAS Test Pipe	Test pipe	4.998.148.848
RAS Test Adapter	Test adapter	4.998.148.849

Pipe system components

	Designation	Product ID
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
FAS-ASD-SL	Sound damper for FAS aspirating smoke detector	F.01U.090.252



NOTICE!

Four 45° pipe elbows are required to install the FAS-ASD-WS Water Separator.

Air sampling opening components

Designation	Product ID
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
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.

2.8 Technical Specifications

2.8.1 FAS-420 Aspirating Smoke Detector series

Electrical

LSN power supply	15 V DC to 33 V DC	
Auxiliary power supply	14 V DC to 30 V DC	
LSN current consumption	6.25 mA	
Current consumption from auxiliary power supply (at 24 V)	FAS-420-TP1 FAS-420-TT1	FAS-420-TP2 FAS-420-TT2
- Starting current, fan voltage 6.9 V	300 mA	330 mA
- Starting current, fan voltage 9 V	300 mA	330 mA
- On standby, fan voltage 6.9 V	200 mA	230 mA
- On standby, fan voltage 9 V	260 mA	310 mA
- On alarm, fan voltage 6.9 V	230 mA	290 mA
- On alarm, fan voltage 9 V	290 mA	370 mA

Mechanics

Displays on the device FAS-420-TP1/FAS-420-TP2	
- Operation	Green LED
- Fault	Yellow LED
- Alarm	1 red LED/2 red LEDs
Displays on the device FAS-420-TT1/FAS-420-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, pre-alarm and main alarm
Conical duct connections for \varnothing 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 of aspirating smoke detector	-20 °C to +60 °C
Permissible relative humidity (non-condensing)	10 to 95%

Special features

Sound power level FAS-420-TP1/-TP2/-TT1/-TT2	45 dB(A)
Max. response sensitivity (max. light obscuration)	
- DM-TT-50(80) Detector Module	0.5%/m (0.8%/m) *
- DM-TT-10(25) Detector Module	0.1%/m (0.25%/m) *
- DM-TT-01(05) Detector Module	0.015%/m (0.05%/m) *
Service life 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).

2.8.2 FAS-420 Aspirating Smoke Detector series -SL Variants

Electrical

LSN power supply	15 V DC to 33 V DC			
Auxiliary power supply	14 V DC to 30 V DC			
LSN current consumption	6.25 mA			
Current consumption from auxiliary power supply (at 24 V)	FAS-420			
	-TP1-SL	-TP2-SL	-TT1-SL	-TT2-SL
- Starting current, fan voltage 6.5 V	190 mA	250 mA	300 mA	330 mA
- Starting current, fan voltage 6.9 V	190 mA	250 mA	300 mA	330 mA
- Starting current, fan voltage 9 V	190 mA	250 mA	300 mA	330 mA
- On standby, fan voltage 6.5 V	130 mA	170 mA	150 mA	190 mA
- On standby, fan voltage 6.9 V	140 mA	180 mA	160 mA	200 mA
- On standby, fan voltage 9 V	170 mA	210 mA	210 mA	250 mA
- On alarm, fan voltage 6.5 V	150 mA	180 mA	180 mA	220 mA
- On alarm, fan voltage 6.9 V	160 mA	200 mA	190 mA	230 mA
- On alarm, fan voltage 9 V	190 mA	230 mA	240 mA	280 mA

Mechanics

Displays on the device FAS-420-TP1/FAS-420-TP2	
- Power	Green LED
- Fault	yellow LED
- Alarm	1 red LED/2 red LEDs
Displays on the device FAS-420-TT1/FAS-420-TT2	
- Power	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, pre-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 (W x H 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 according to EN 60529	IP 20
Permissible temperature range of aspirating smoke detector	-20 °C to +60 °C
Permissible relative humidity (non-condensing)	10 to 95%

Special features

sound power level	
FAS-420-TP1/-TP2/-TT1/-TT2 -SL variants	From 31 dB(A)
Max. response sensitivity (max. light obscuration)	
- DM-TT-50(80) Detector Module	0.5%/m (0.8%/m) *
- DM-TT-10(25) Detector Module	0.1%/m (0.25%/m) *

- DM-TT-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).

2.8.3

Pipe system

	FAS-420-TP1 FAS-420-TT1	FAS-420-TP2 FAS-420-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 ²	5760 m ²
Permissible temperature range		
- PVC pipe system	0 °C to +60 °C	
- ABS pipe system	-40 °C to +80 °C	

2.8.4

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 gable 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

3 Planning

Basic information on the relevant topics can be found in

- Section 3.1 Regulations, page 32
- Section 3.2 Principles of Pipe Planning, page 33
- Section 3.3 Airflow Monitoring, page 36
- Section 3.4 Defining the Response Sensitivity, page 37
- Section 3.5 Planning Limits, page 38.

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

- Section 3.6 Standard Pipe Planning, page 39
- Section 3.9 Planning for Long Pipe Feed Lines, page 56
- Section 3.8 Simplified Pipe Planning, page 52

The pipe plan for more sensitive airflow monitoring is described in

- Section 3.7 Pipe Planning for Single-Hole Monitoring, page 46.

The plan for monitoring air-conditioning ducts is described in

- Section 3.11 Planning for Forced Airflow, page 58.

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

- Section 3.12 Power Supply, page 62.

3.1 Regulations

The planning regulation below is based on the system limits of FAS-420. The applicable national regulations of the countries concerned must be observed and the plans modified accordingly.

The planning for the aspirating smoke detector in accordance with EN 54-20 is described below. The basic conditions are specified in *Section 3.1 Regulations*. Planning must be carried out in accordance with *Section 3.6 Standard Pipe Planning*. In addition to 3.6, special applications are also bound by the restrictions of the planning notes in accordance with *Section 3.7 Pipe Planning for 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:

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 3.6	
Detection of failure of a single opening	Single-hole monitoring planning	Section 3.6	Section 3.7
Equipment protection/cabinet monitoring	Simplified pipe planning	Section 3.6	Section 3.8
Long supply lines	Planning with long supply lines	Section 3.6	Section 3.9
Reducing transport time	Planning with acceleration openings	Section 3.6	Section 3.10
Ventilation ducts	Planning for forced airflow	Section 3.6	Section 3.11

With regard to the planning regulation below, the applicable national regulations of the countries concerned must be observed and the plans modified accordingly.

EN 54-20

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 *Section 3.5 Planning Limits* are to be observed.
- Select airflow monitoring and the associated planning limits (see *Section 3.3 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.

3.2

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 (see *Figure 3.1*), 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.

Figure 3.1 shows a typical U-pipe system with three or six air sampling openings and the air sampling opening diameters calculated according to *Section 3.6 Standard Pipe Planning*.

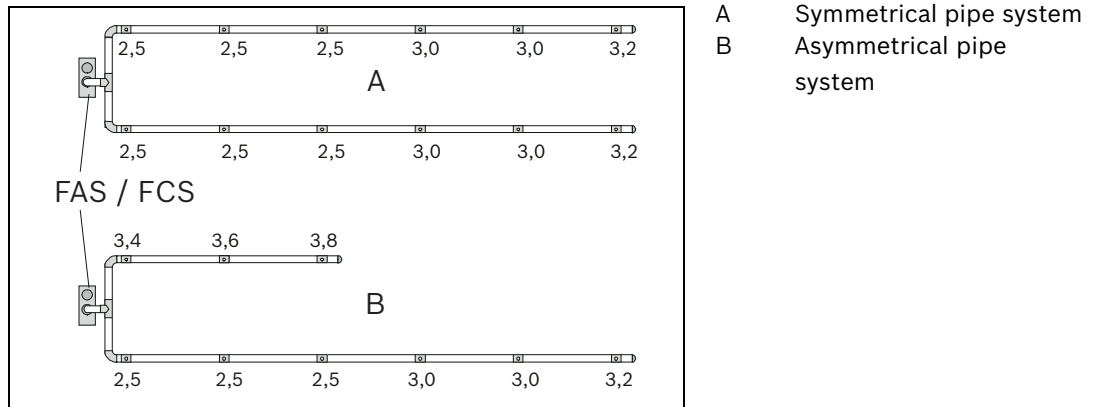


Figure 3.1 Example of a symmetrical and an asymmetrical U-pipe system

Pipe diameter

As a rule, the pipe system is created using pipes with a 25 mm diameter. Both PVC pipes and halogen-free pipes can be used, however, ensure that you comply with the restrictions of EN 54-20. Halogen-free pipes are to be used in preference for equipment monitoring. 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 *Section 3.9 Planning for Long Pipe Feed Lines*, page 56). However, pipes with greater diameters restrict the length of the pipe system.

Longer pipe feed lines

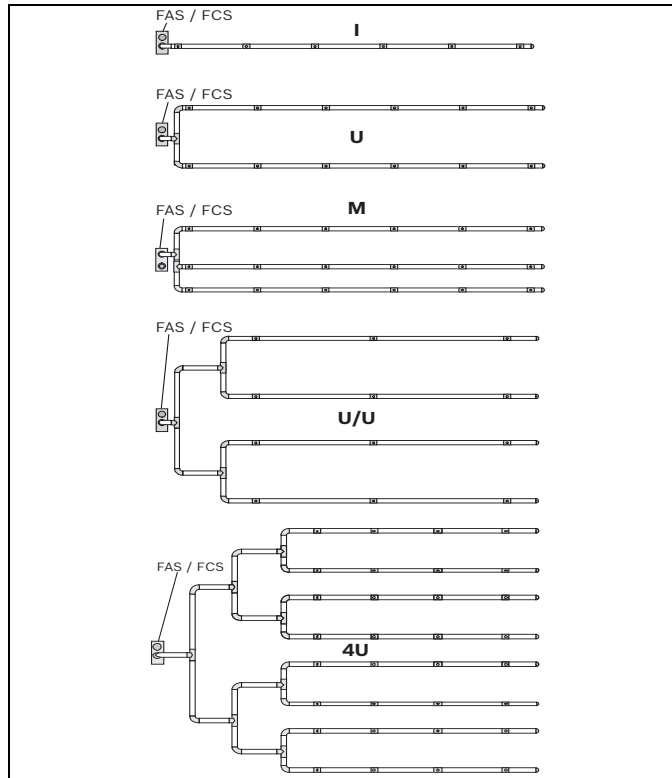
Branch length

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 (see *Figure 3.2*):

- **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

Figure 3.2 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.

	Corresponds to a straight pipe length of
Pipe elbow	1.5 m
Pipe bend	0.3 m

If elbows or bends are used, the maximum total length of the pipe system is reduced.



NOTICE!

It is preferable to use pipe bends rather than pipe elbows. The detection time will be influenced significantly by too high a number of changes of direction.

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.

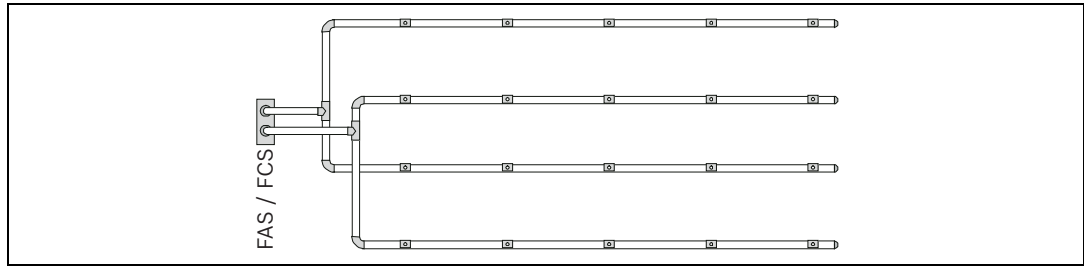


Figure 3.3 Pipe configurations for dual detector dependency

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.

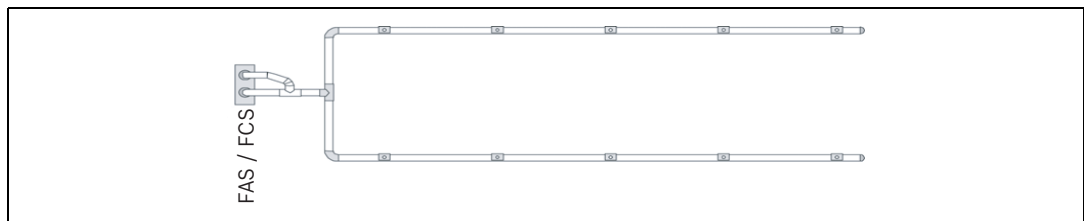


Figure 3.4 Pipe configurations for two alarm stages using the example of a U-pipe system

3.3

Airflow Monitoring

EN 54-20 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, 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
	Complies with EN 54-20			
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" (see Chapter 4.3.1 "Pipe Planning for Single-Hole Monitoring"),
- the airflow sensor was calibrated dependent on the air pressure (see Chapter 7.1.2 "Airflow Calibration according to 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 FAS-420 must be returned to the pressure area of the pipe system (see Section 2.6.4 Air-Return Pipe for Pressure Areas and Atmospheric Loads, page 24).

3.4

Defining the Response Sensitivity

The sensitivity of smoke aspiration systems can be divided into certain fire sensitivity classes in accordance with EN 54-20. These fire sensitivity classes describe specific examples of ways in which the systems can be applied. The permissible system plans given in Section 3.6 can be determined for each classification. Smoke aspiration systems with a higher fire sensitivity class according to EN 54-20 also satisfy the requirements of the lower classes.

Class	Description	Application example
A	Aspirating smoke detector with extremely high sensitivity	Very early detection: significant smoke dilution through air conditioning in IT areas
B	Aspirating smoke detector with increased sensitivity	Early detection: significant time gains thanks to very early fire detection (without air condition)
C	Smoke aspiration system with normal sensitivity	Normal detection: 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 detector modules available.

The table shows the sensitivities you can choose from

Response sensitivity (main alarm)		
DM-TT-50(80) Detector Module	DM-TT-10(25) Detector Module	DM-TT-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

The planning of the monitoring area always occurs according to the national guidelines for point-type smoke detectors.

**NOTICE!**

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

3.5

Planning Limits

The following limit values must always be observed for the FAS-420 series:

Limiting values	Maximum number of air sampling openings per detector module	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 FAS-420-TP2 and FAS-420-TT2, each with two detector modules.

3.6 Standard Pipe Planning

In order to plan in accordance with the EN 54-20 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.

3.6.1 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 sensitive detector module is used or if a certain contingency 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 2.8.4

3.6.2 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 without air filter with 8 openings should satisfy class B if a water separator is also used. The red shaded areas show the potential plans with different pipe shapes and fan voltage.

	General	Example
1.	<p>Selection: Select the planning table with or without air filter, as applicable.</p> <p>Result: Planning table and specified air filter</p>	Select the planning table without air filter, <i>Section Planning without filter, page 41</i>
2.	<p>Selection: Select the number of air sampling openings from the planning table. Note the possible sensitivity classes.</p> <p>Result: Specified detector module with specified setting and alarm threshold</p>	In the <i>Section Planning without filter</i> table, select the column with eight air sampling openings (Number of air sampling openings, 8)
3.	<p>Selection: Select the sensitivity (sensitivity class) of the system according to the gradation described in <i>Section 3.4 Defining the Response Sensitivity</i>.</p> <p>Result: Specified sensitivity class in accordance with EN 54-20</p>	In the <i>Section Planning without filter, page 41</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.	<p>Selection: Select other pipe components, such as a water separator and detonation safety barrier.</p> <p>Result: Specified planning table</p>	Select the <i>Section With water separator, page 41</i> .
5.	<p>Selection: Select the possible pipe length for the relevant pipe shape and fan voltage.</p> <p>Result: Specified planning in accordance with EN 54-20 for the previously specified parameters</p>	In the <i>Section With water separator, page 41</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 *Section 8.3 Planning without filter, page 105* and *Section 8.4 Planning with air filter, page 107*.

Abbreviation	Meaning		CTN
DM	Detector module	DM-01(05)	DM-TT-01(05)
		DM-10(25)	DM-TT-10(25)
		DM-50(80)	DM-TT-50(80)
S	Sensitivity (% LT/m)		
MA	Main alarm		
PA	Pre-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)	MA	A	A	A	A	A	A	A	A	A	A	A	A		A	
		MA	A	A	A	A	A	A	A	A	A	A	A	A		B	
		MA	A	A	A	A	A	A	A	A	A	A	A	A	A		C
		MA	A	A	A	A	A	A	A	B	B	B	B	B	B		
10 (25)	0.1 (0.25)	MA	A	A	A	A	A	A	A	A	A	B	B	B		B	
		MA	A	A	A	A	B	B	B	B	B	B	B	B			
		MA	A	A	B	B	B	B	C	C	C	C	C	C			
		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	
		MA	A	A	A	B	B	B	B	C	C	C	C	C			
		PA	A	A	B	B	B	C	C	C	C	C					
		MA	A	B	B	C	C	C	C								

Without any other pipe accessories

		Number of air sampling openings													
Pipe shape	U _{Fans}	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		
	≥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 _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	...	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	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 _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	...	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	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:

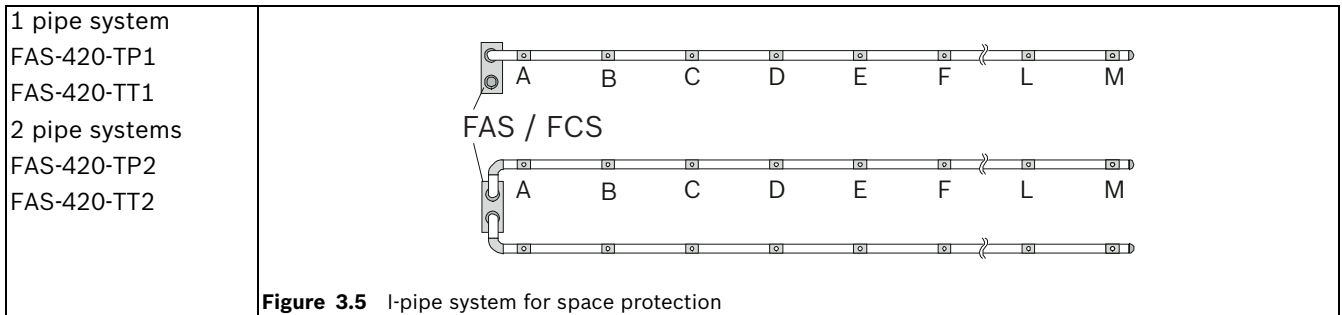


Figure 3.5 I-pipe system for space protection

I-pipe system	Air sampling opening	Number of air sampling openings												
		1	2	3	4	5	6	7	8	9	10	11	12	13
∅ air sampling opening in mm ^a	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
	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

^a Punch diameter of the aspiration reducing film sheet

U-pipe system for space protection

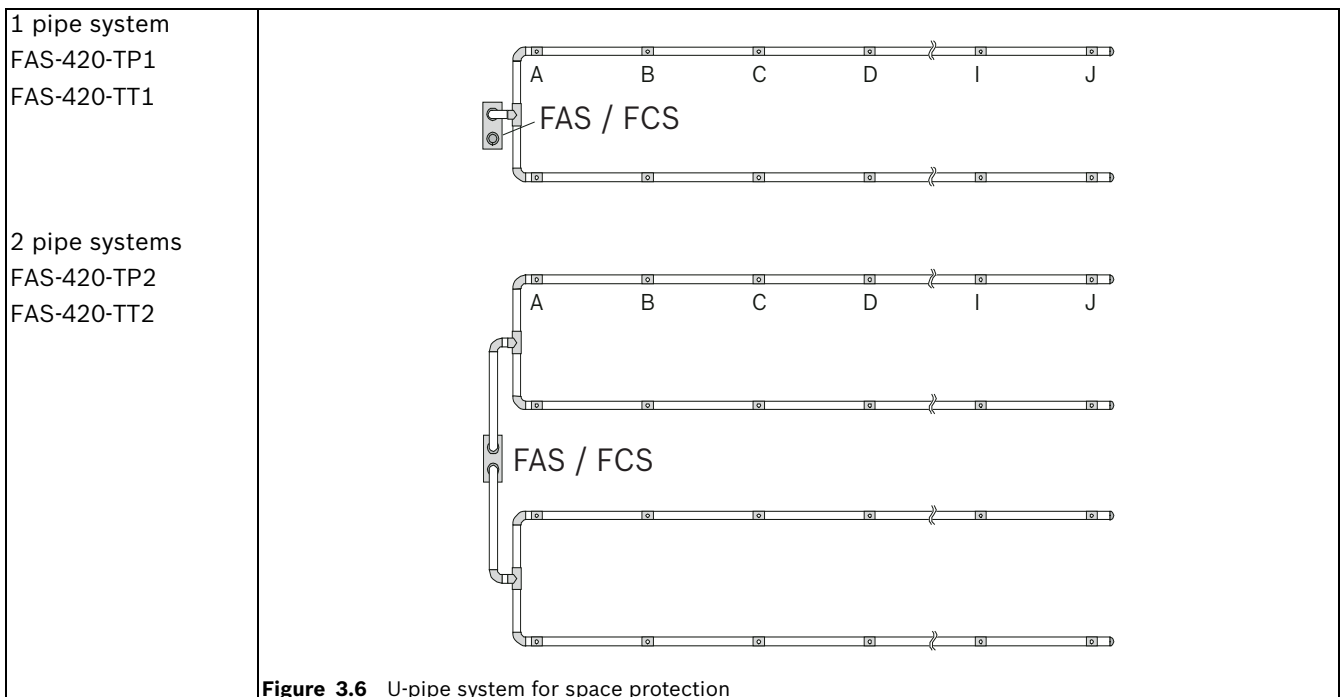


Figure 3.6 U-pipe system for space protection

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 ^a	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

^a Punch diameter of the aspiration reducing film sheet

M-pipe system for space protection

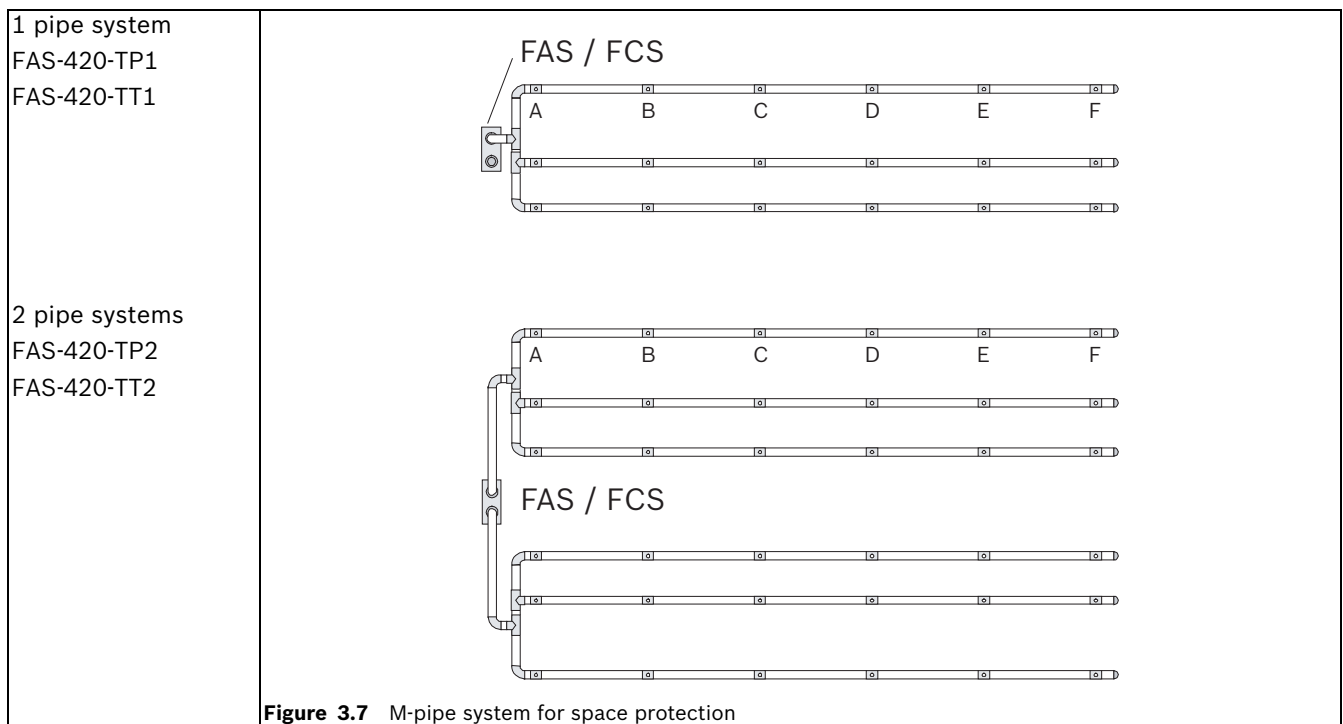


Figure 3.7 M-pipe system for space protection

M-pipe system	Air sampling opening	Number of air sampling openings						
		3	6	9	12	15	18	21
∅ air sampling opening in mm ^a	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

^a Punch diameter of the aspiration reducing film sheet

Double U-pipe system for space protection

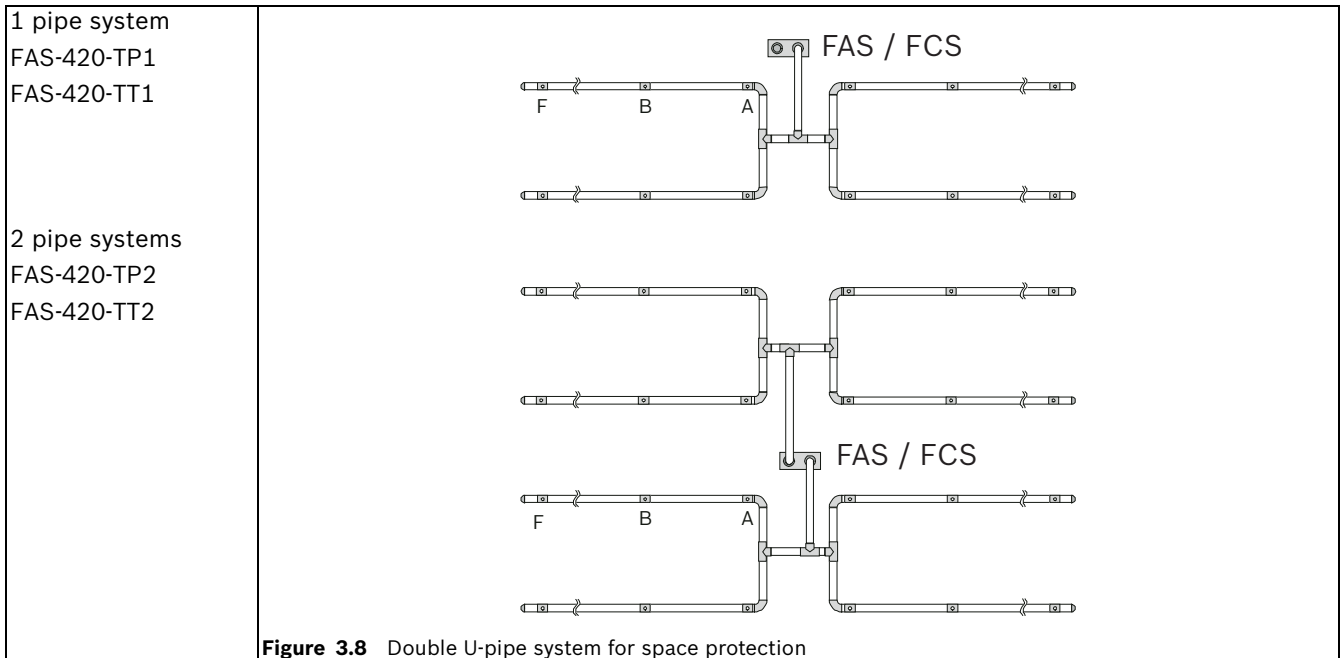


Figure 3.8 Double U-pipe system for space protection

Double U-pipe system	Air sampling opening	Number of air sampling openings					
		4	8	12	16	20	24
∅ air sampling opening in mm ^a	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

^a Punch diameter of the aspiration reducing film sheet

Quadruple U-pipe system for space protection

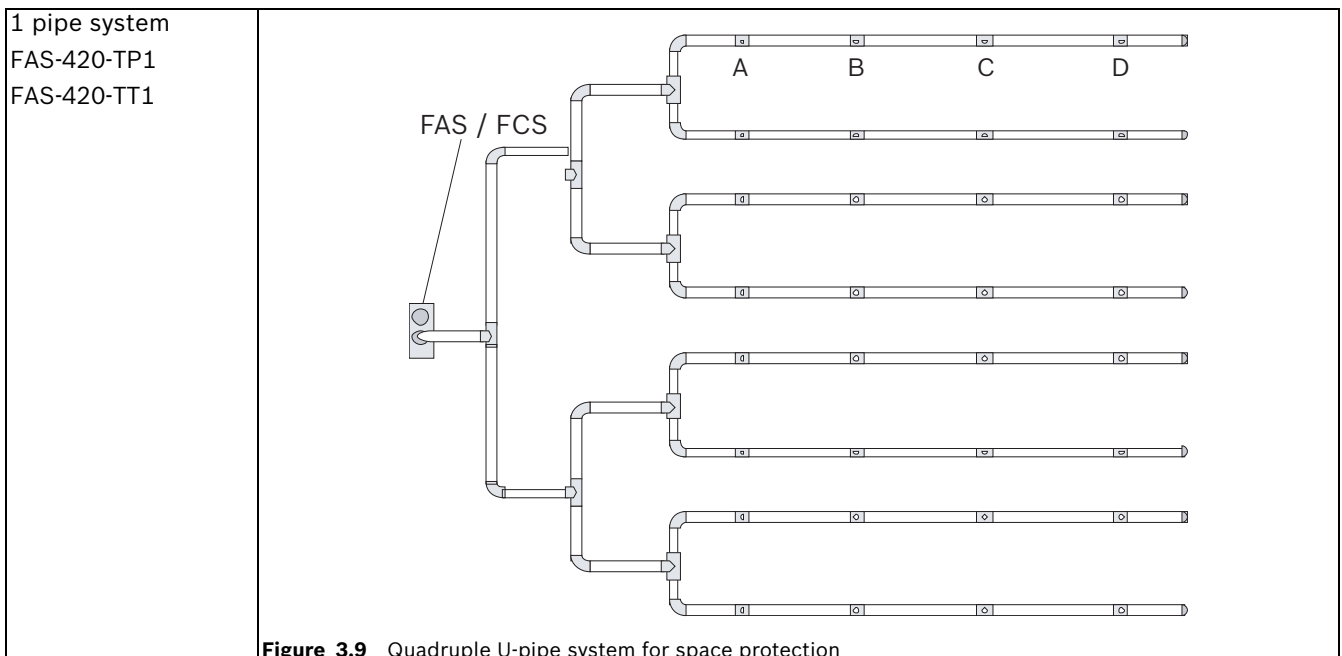


Figure 3.9 Quadruple U-pipe system for space protection

Quadruple U-pipe system	Air sampling opening	Number of air sampling openings			
		8	16	24	32
∅ air sampling opening in mm ^a	A	3.20	2.5	2.0	2.0
	B	-	3.0	2.5	2.0
	C	-	-	3.0	2.0
	D	-	-	-	2.5

^a Punch diameter of the aspiration reducing film sheet

3.7

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 *Section 3.6 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

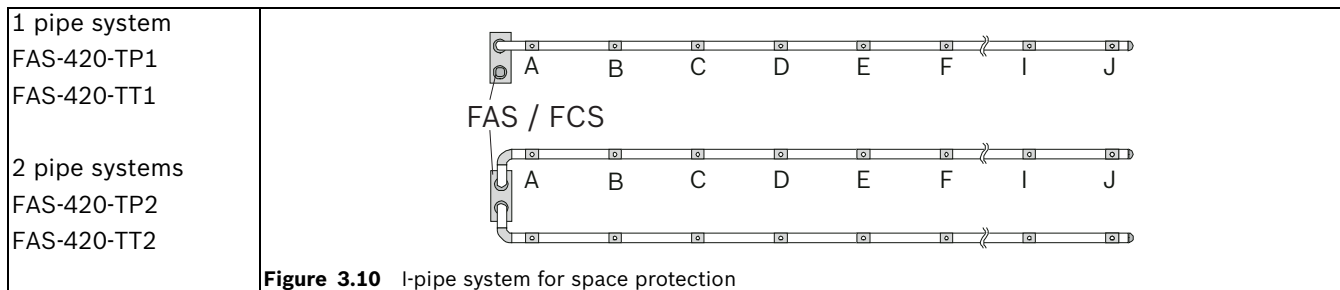


Figure 3.10 I-pipe system for space protection

Limiting values I-pipe system	Min. distance FAS-420 – 1st air sampling opening	4 m
	Max. distance FAS-420 – 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 (∅ 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
∅ air sampling opening in mm ^a	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
	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

^a 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, level I or II must always be set for airflow monitoring.

U-pipe system - single-hole monitoring

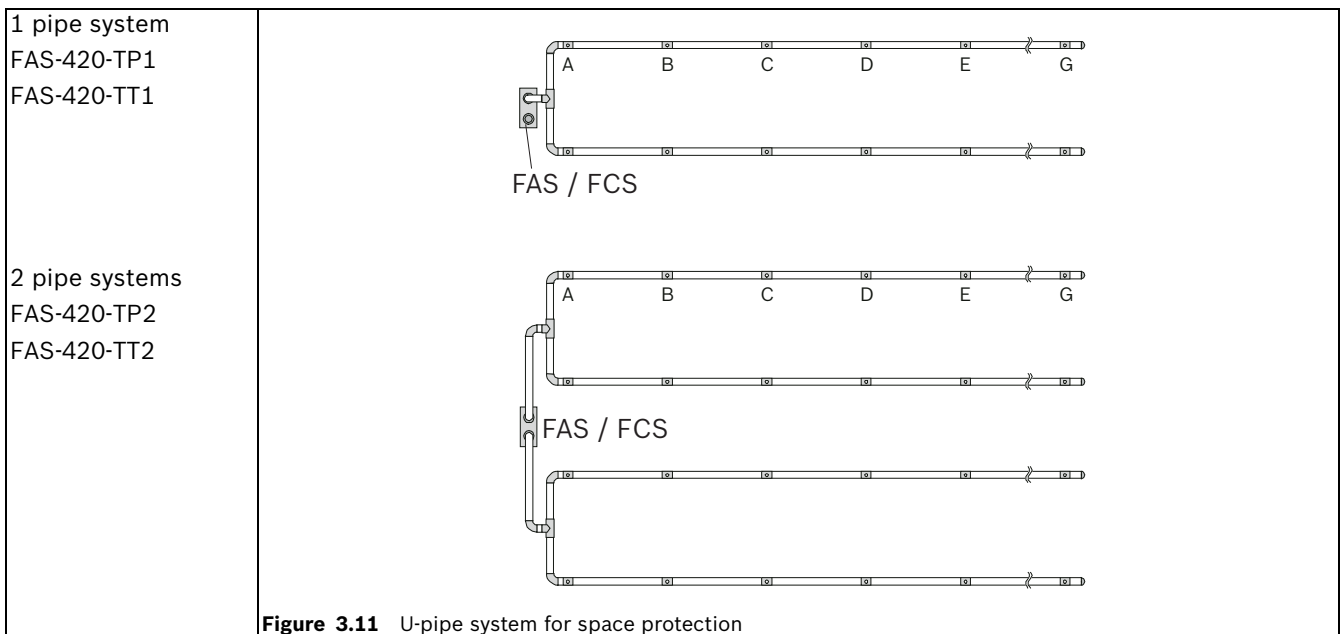


Figure 3.11 U-pipe system for space protection

Limiting values		
U-pipe system	Min. distance FAS-420 – T-fitting	4 m
	Max. distance FAS-420 – T-fitting	20 m
	Max. branch length	
	– With low fan voltage	40 m
	– With high fan voltage	50 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	– With low fan voltage	100 m
	– With high fan voltage	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 ^a	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

^a 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, level I or II must always be set for airflow monitoring.

M-pipe system - single-hole monitoring

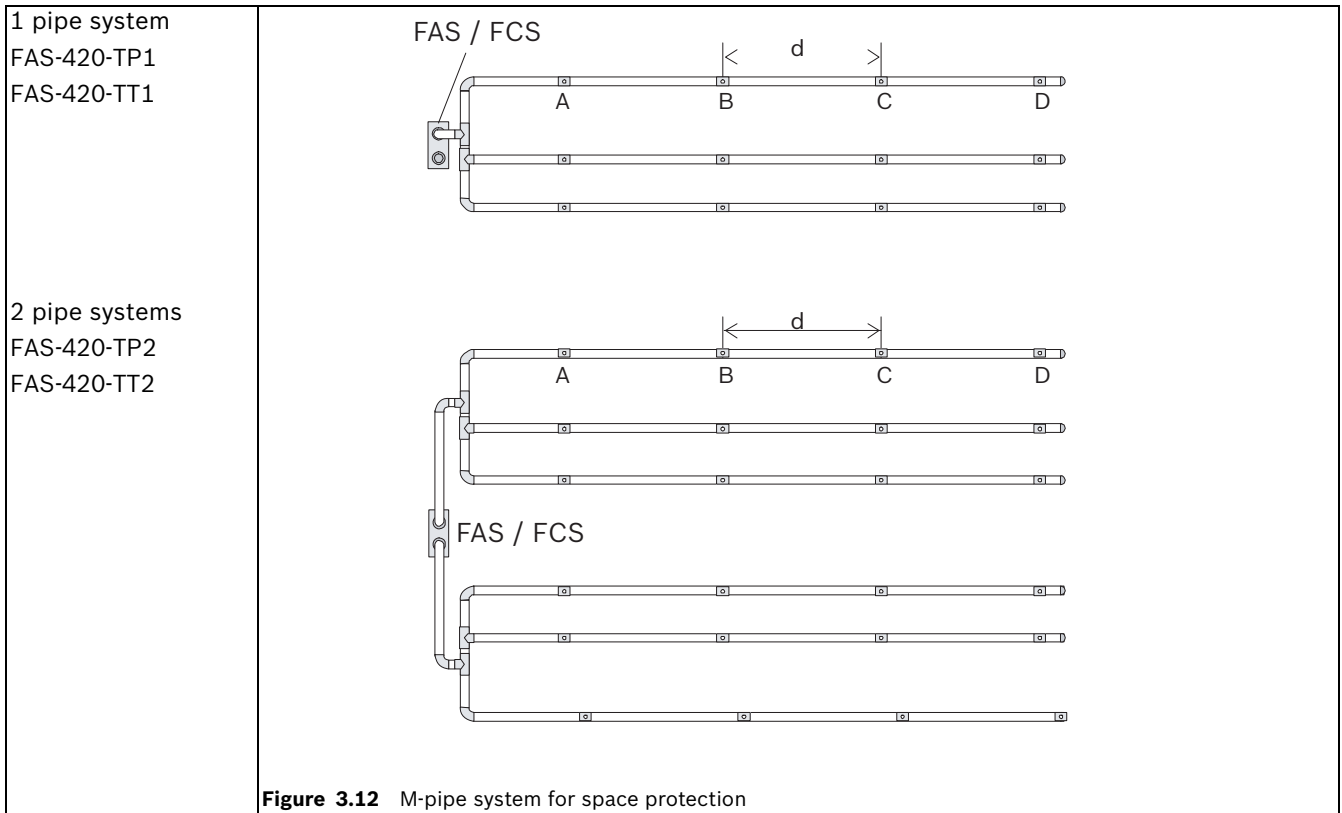


Figure 3.12 M-pipe system for space protection

Limiting values Double U-pipe	Min. distance FAS-420 – last T-fitting	4 m
	Max. distance FAS-420 – last T-fitting	20 m
	Max. branch length	
	– With low fan voltage	30 m
	– With high fan voltage	40 m
	Max. overall pipe length per pipe system (Ø 25 mm)	
	– With low fan voltage	110 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

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

^a 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, level I or II must always be set for airflow monitoring.

Double U-pipe system - single-hole monitoring

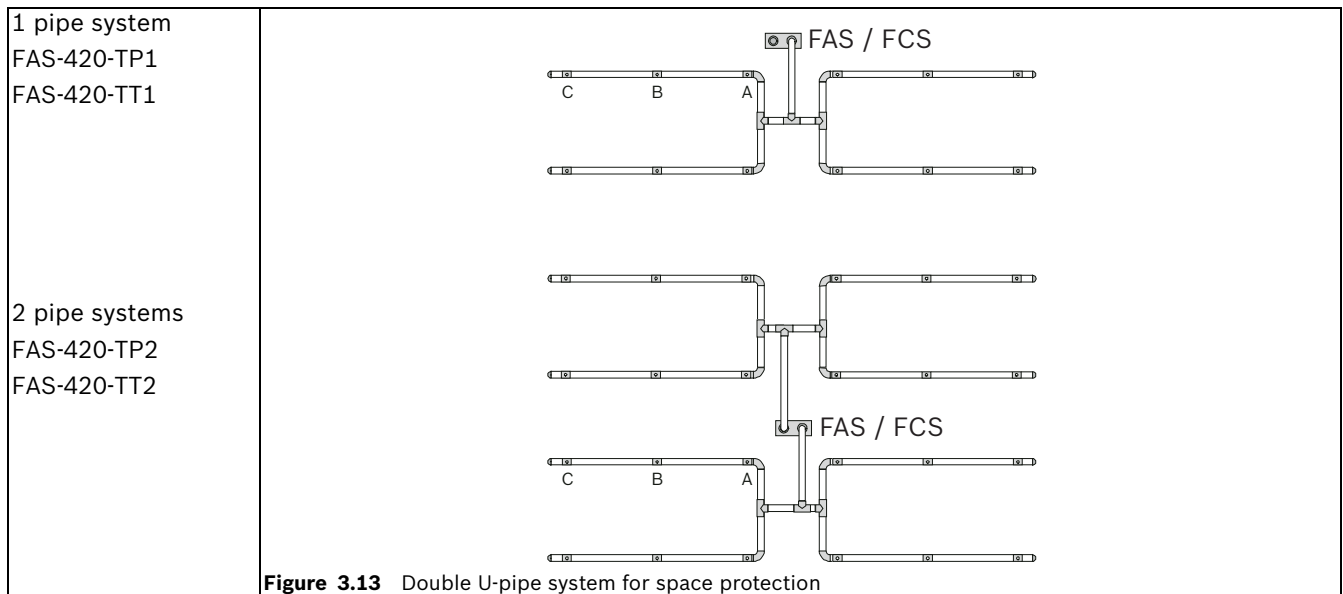


Figure 3.13 Double U-pipe system for space protection

Limiting values		
Double U-pipe	Min. distance FAS-420 – last T-fitting	4 m
	Max. distance FAS-420 – 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
∅ air sampling opening in mm ^a	A	4.0	3.0	2.5
	B	-	3.4	3.0
	C	-	-	3.0

^a 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!

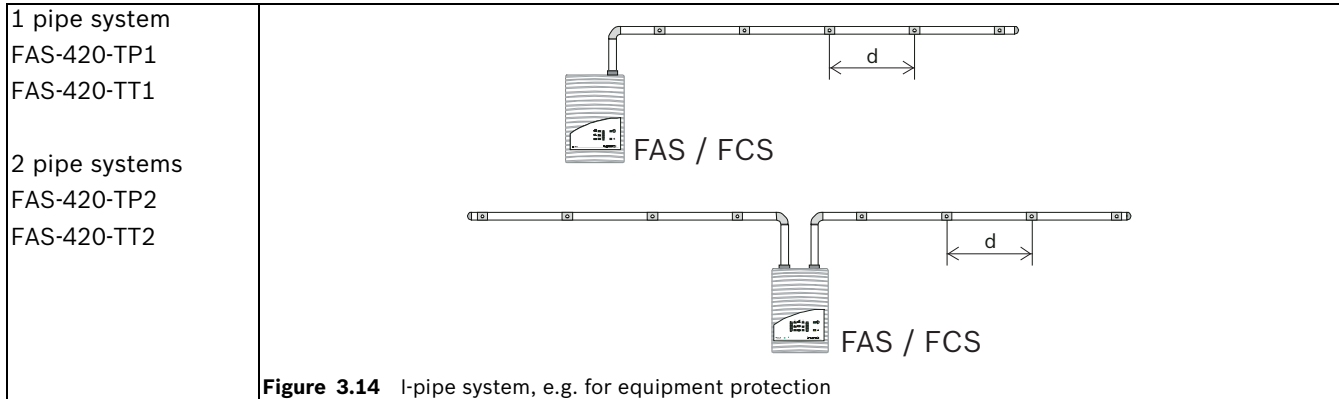
When planning in accordance with EN 54-20, level I or II must always be set for airflow monitoring.

3.8 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 *Section 3.6 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

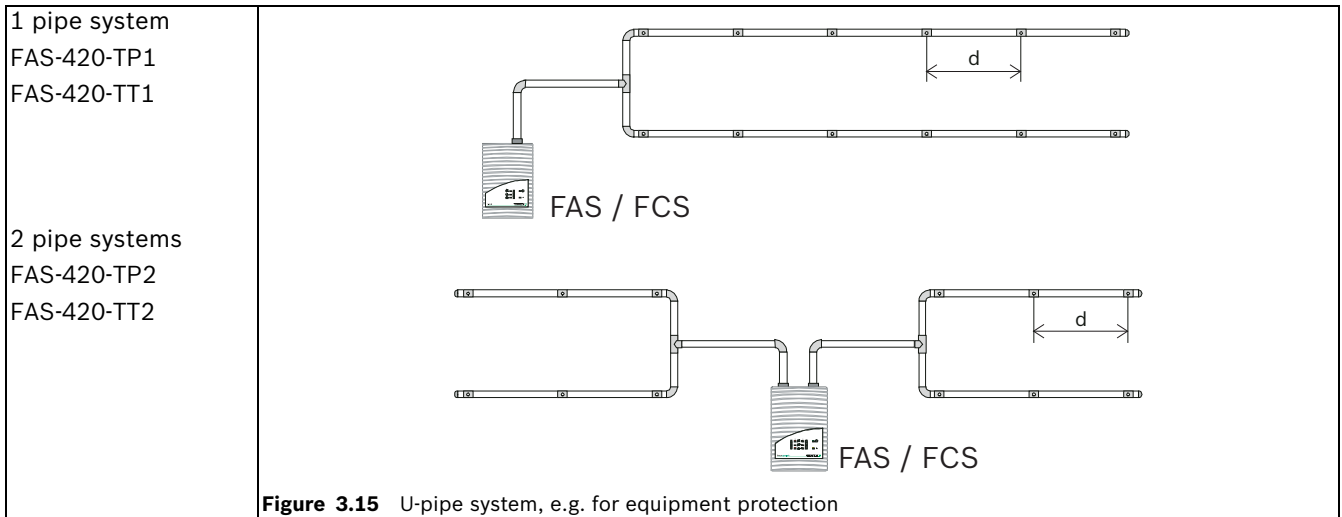


Limiting values I-pipe system	Min. distance FAS-420 – 1st air sampling opening	2 m
	Max. distance FAS-420 – 1st air sampling opening	20 m
	Max. distance: 1st air sampling opening – last air sampling opening	20 m
	Max. overall pipe length (Ø 25 mm)	40 m
	Min. distance between air sampling openings	0.1 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																
Ø of all air sampling openings in mm ^a	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	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

^a Punch diameter of the aspiration reducing film sheet

U-pipe system - simplified planning



Limiting values	Min. distance FAS-420 – T-fitting	2 m
U-pipe system	Max. distance FAS-420 – 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 ^a	6.0	4.4	3.6	3.2	3.0	3.0	2.5	2.5	2.5

^a Punch diameter of the aspiration reducing film sheet

M-pipe system - simplified planning

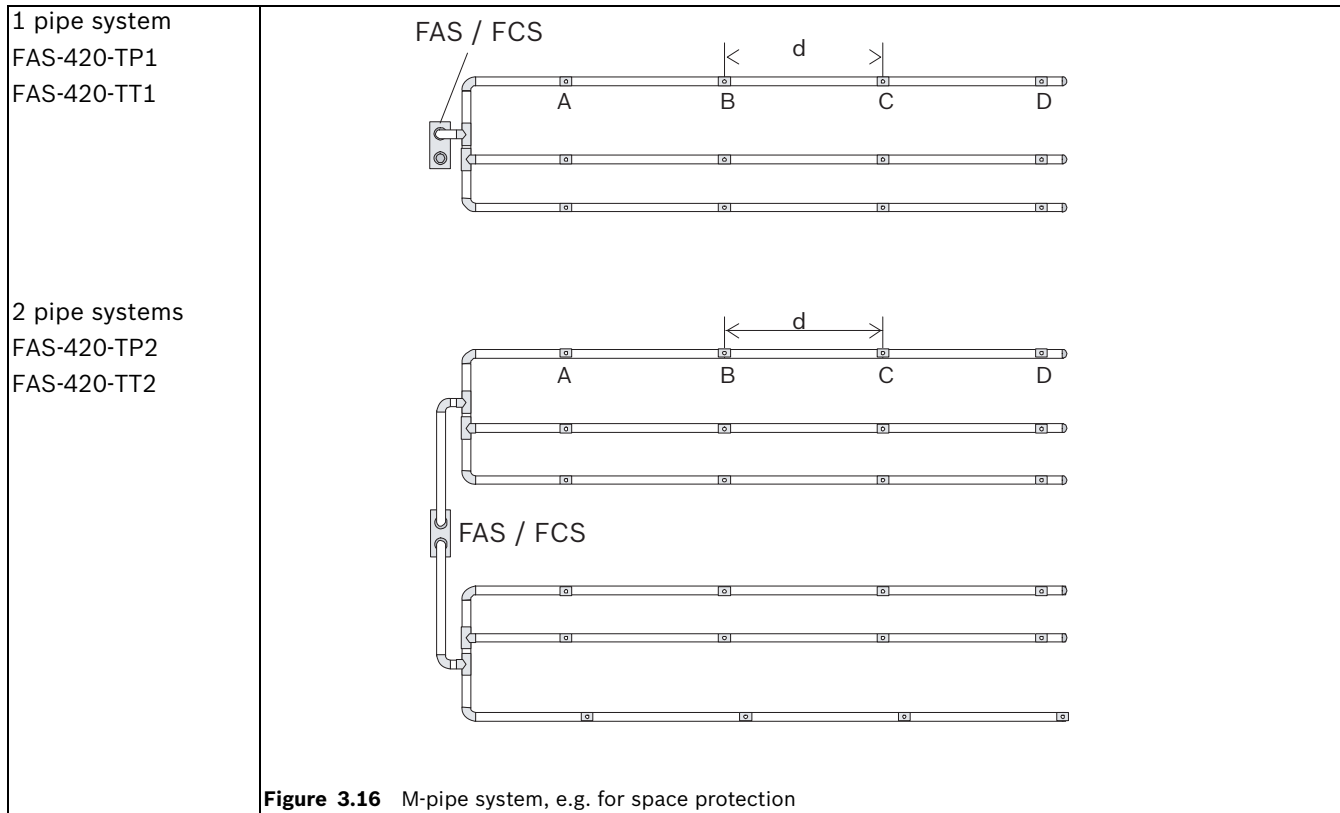


Figure 3.16 M-pipe system, e.g. for space protection

Limiting values Double U-pipe	Min. distance FAS-420 – last T-fitting	2 m
	Max. distance FAS-420 – 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 ^a	5.0	3.6	3.0	3.0	2.5	2.5

^a Punch diameter of the aspiration reducing film sheet

Double U-pipe system - simplified planning

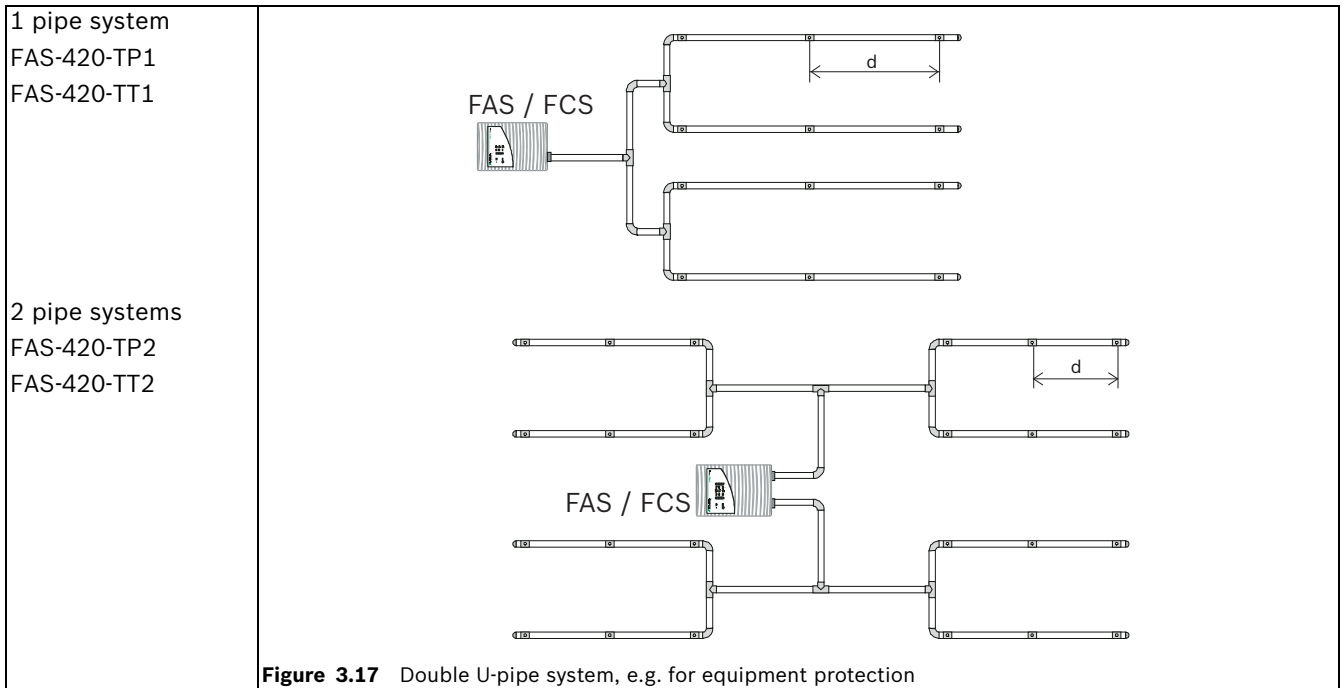


Figure 3.17 Double U-pipe system, e.g. for equipment protection

Limiting values Double U-pipe	Min. distance FAS-420 – last T-fitting	2 m
	Max. distance FAS-420 – 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 ^a	4.0	3.4	3.0	2.5	2.0

^a Punch diameter of the aspiration reducing film sheet

3.9 Planning for Long Pipe Feed Lines



NOTICE!

Only to be used when taking over inventory planning

Pipes with a 40 mm diameter are required for planning pipe feed line A (Figure 3.18). Area B is designed with 25 mm pipes in accordance with Section 3.6 Standard Pipe Planning. The plan applies for the pipe configurations described above.

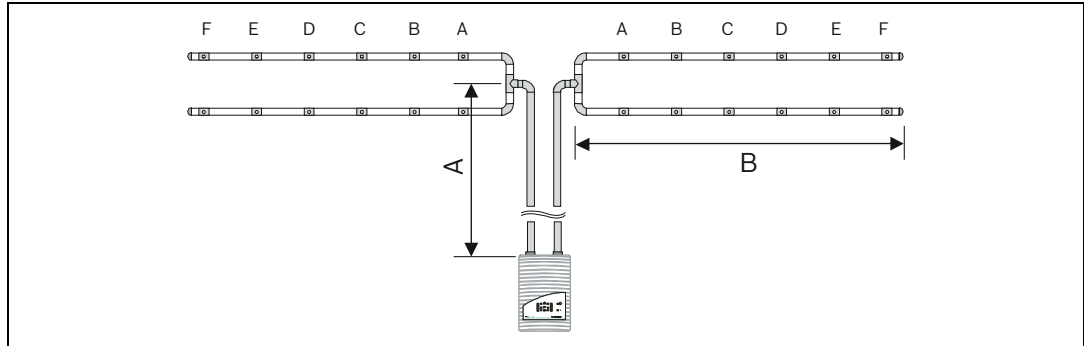


Figure 3.18 Example of a pipe system with long pipe feed lines for area monitoring

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.

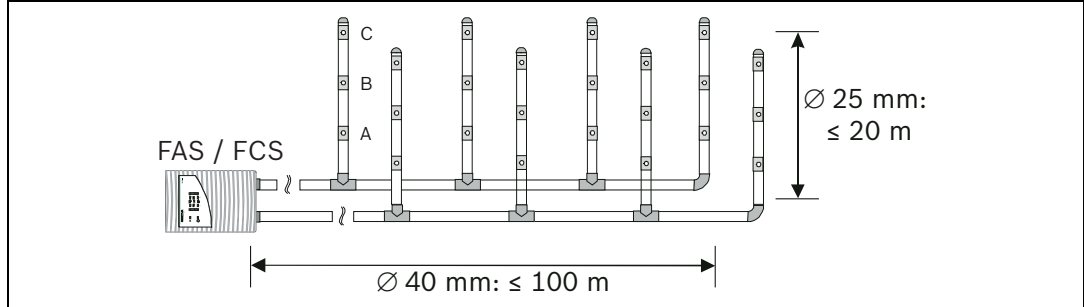


Figure 3.19 Example of special planning for high-rise warehouse

A basic pipe can be installed for high-rise warehouse (Figure 3.19) planning, from which the stub-shaped aspiration pipes are routed.

3.10 Planning with Acceleration Openings

Acceleration openings

In order to meet individual regulations, it may be necessary to increase 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 (Table 3.1)
- the doubled cross-section of the last air sampling opening of a branch (Table 3.2)

Pipe shape	Air sampling openings																				
	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		
Double U				0.50				0.66				0.75				0.80		0.83		0.85	
Quadruple U								0.50								0.66				0.75	0.80

Table 3.1 Factors for increasing the sensitivity (acceleration opening corresponds to one air sampling opening)

Pipe shape	Air sampling openings																				
	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		0.60		0.66		0.71		0.75		0.77		0.80	0.81	0.83			
M			0.33			0.50			0.60			0.66			0.71		0.75		0.77		
Double U				0.33				0.50				0.60				0.66		0.71		0.75	
Quadruple U								0.33								0.50				0.60	0.66

Table 3.2 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, 24 openings are permitted in class B at a sensitivity of 0.25% LT/m. In order to increase the transport time, an acceleration opening the same size as the last air sampling opening is to be used. According to Table 3.1, 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 (Table 3.3)
- the doubled cross-section of the last air sampling opening of a branch (Table 3.4)

Pipe shape	Air sampling openings																				
	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 3.3 Reducing the number of air sampling openings (acceleration opening corresponds to one air sampling opening)

Pipe shape	Air sampling openings																				
	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 3.4 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, 24 openings are permitted in class B at a sensitivity of 0.25% LT/m. In order to increase the transport time, an acceleration opening twice the size as the last air sampling opening is to be used. According to *Table 3.4*, 16 air sampling openings are permitted in this case at a sensitivity of 0.25% LT/m.

3.11 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.

	Low-speed units	High-speed units
Flow speed	Max. 10 m/s	> 10 m/s
Duct cross-section	Large	Small
Differential pressure along the direction of flow.	Low	Large

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

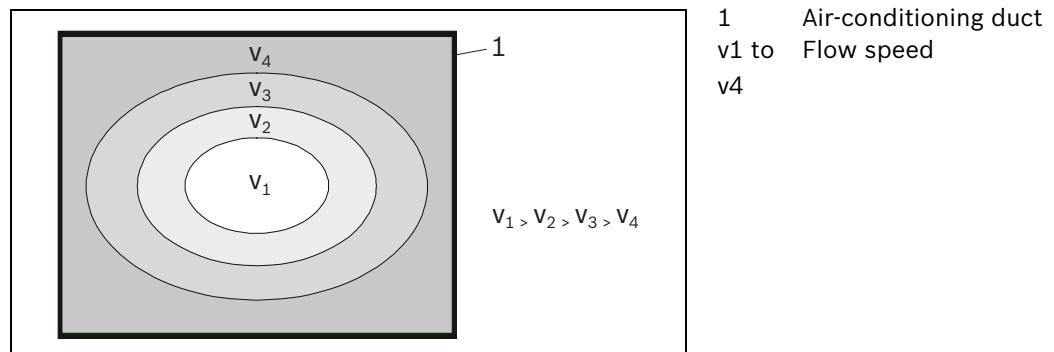


Figure 3.20 Speed distribution in an air-conditioning duct

Aspiration

To achieve optimal detection results, the pipe system should be organized into the areas v1 to v3

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 such "obstacles" 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 *Figure 3.21/*Figure 3.22).

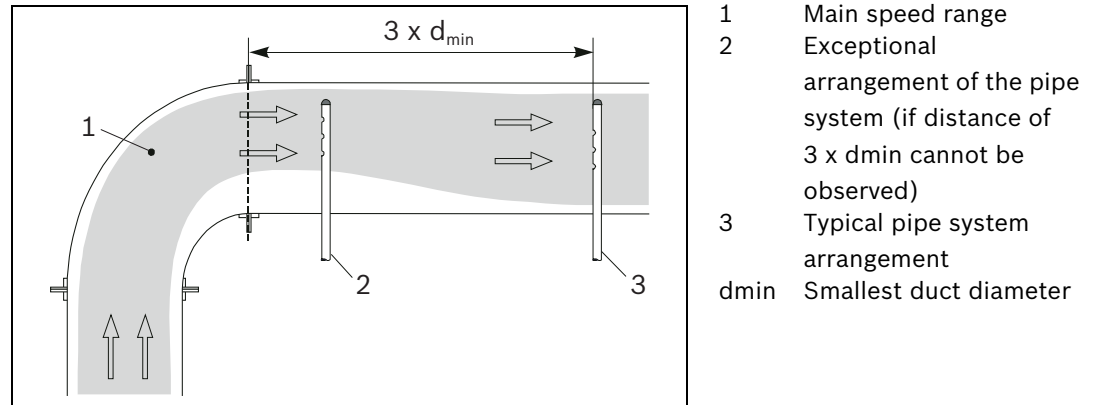


Figure 3.21 Direction change of the duct without air baffles

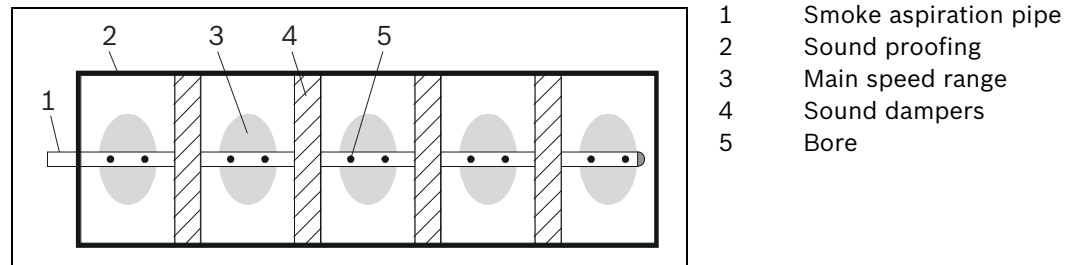


Figure 3.22 Sound dampers in a duct

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

- Since the FAS-420 and the pipe system are located in different pressure ranges, an air-return pipe (see next page) 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.

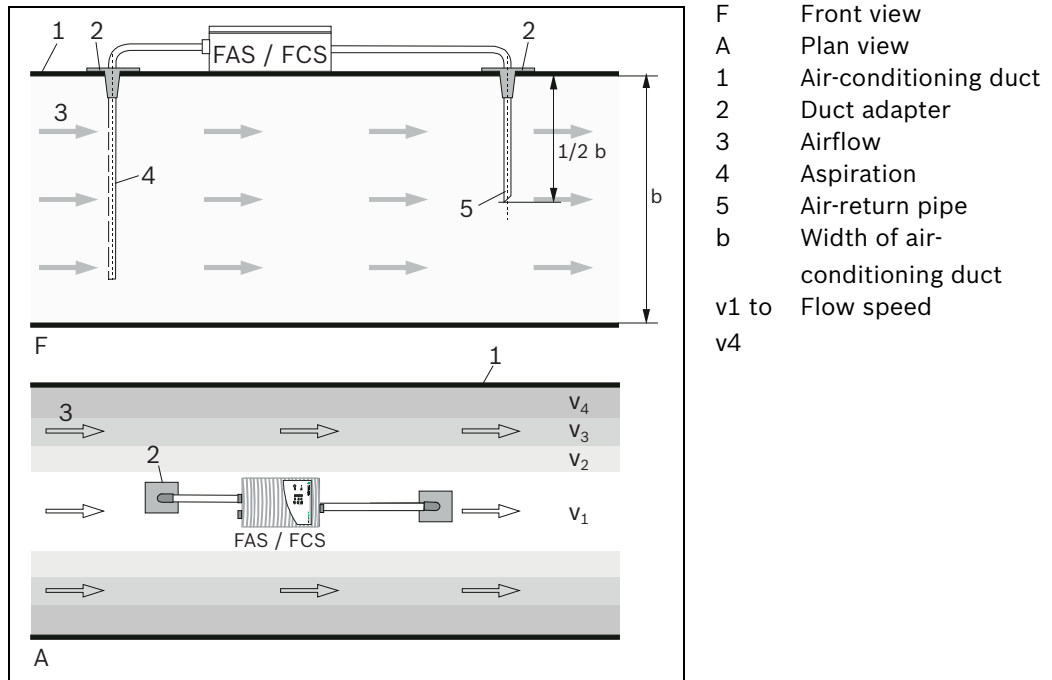


Figure 3.23 Air-return pipe

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 (see Fig. 5.5, page 80).

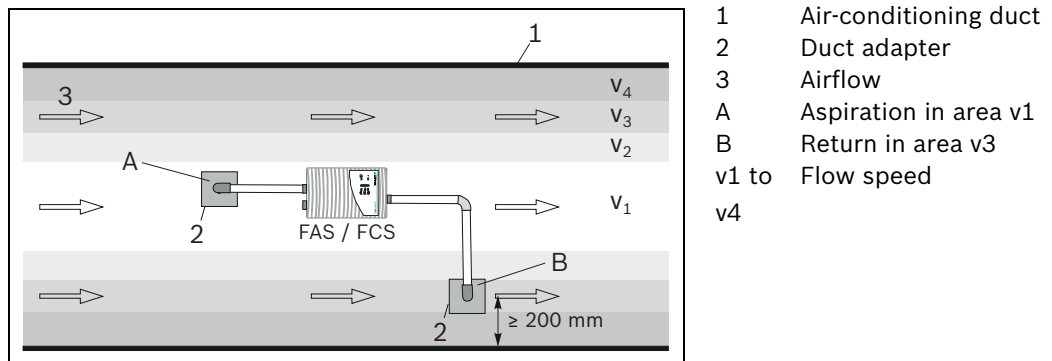


Figure 3.24 Offset arrangement of the air return

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 (see Figure 3.24).

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 ≤ 0.5 m ²	Duct cross-section ≤ 0.5 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 Section 3.8 Simplified Pipe Planning.

The pipe is closed with an end cap without bore hole.

Arrangement

The air sampling openings must face the airflow (see Fig. 5.4).

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

Example

Figure 3.25 shows two planning examples of pipe systems in air-conditioning ducts.

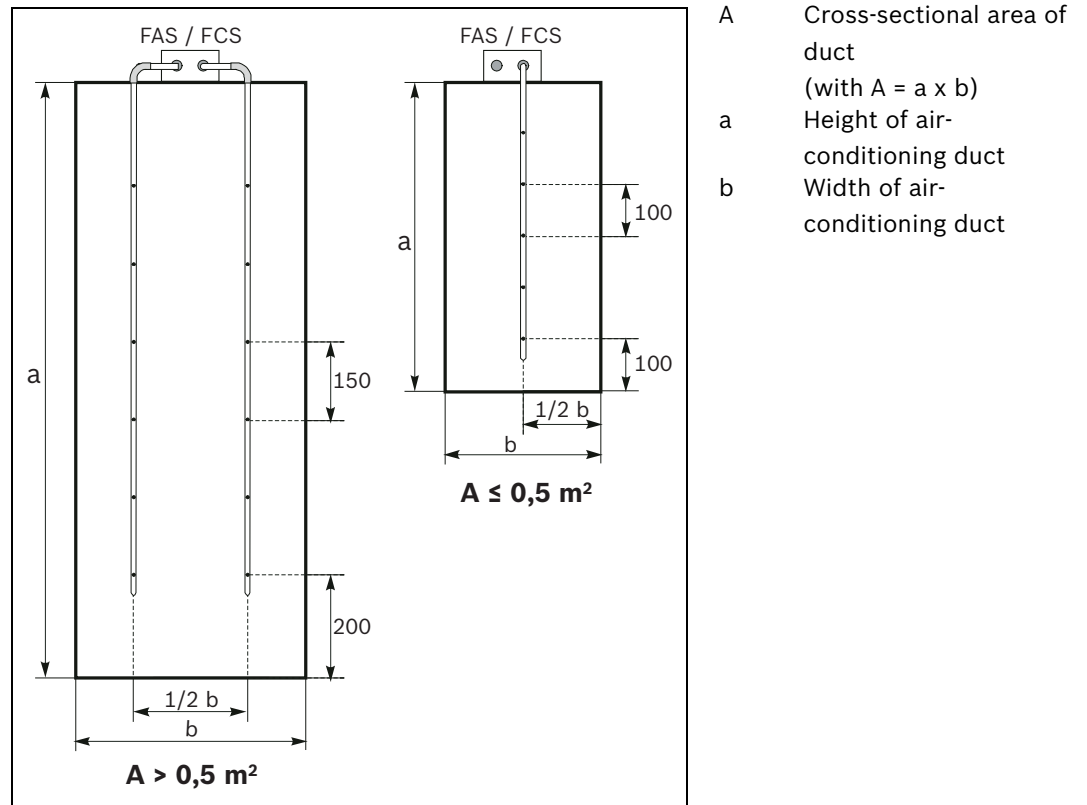


Figure 3.25 Ducts with small and large duct cross-sections

3.12 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).

Current calculation

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

Space protection

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

Equipment protection

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

Charging current

The current required to charge the battery is calculated using the formula below (for space and equipment protection):

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

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

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 battery capacity
- n = Total number of connected aspirating smoke detectors
- n_{\max} = The maximum number of aspirating smoke detectors in a detection area (see example below)

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

- 1 x FAS-420 in detection zone 1
- 2 x FAS-420 in detection zone 2
- 4 x FAS-420 in detection zone 3
- 1 x FAS-420 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 packs are laid out using the calculated total current (I_g) with the highest value.

Please refer to Section 2.8 Technical Specifications, page 29 for the current consumption of the FAS-420.

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.

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

where

- L_{\max} = Maximum line length in [m]
- A = Strand cross-section in [mm²]
- I_g = Total current of all connected aspirating smoke detectors in [A]
- γ = Conductivity: Cu=57 m/Ω mm²
- ΔU = max. voltage drop on the supply line

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 System Designer (FSD) enables case-specific calculations to be carried out for planning the FPA-5000 Modular Fire Panel.

4 Installing the Aspirating Smoke Detector

4.1 General

The regulations, guidelines and provisions described in Section 3.1 apply.

The following must be observed when installing the FAS-420 aspirating smoke detector:

1. 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.
2. 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!

4.2 Installing the Detector Module



NOTICE!

Only DM-TT-50(80), DM-TT-10(25) and DM-TT-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.

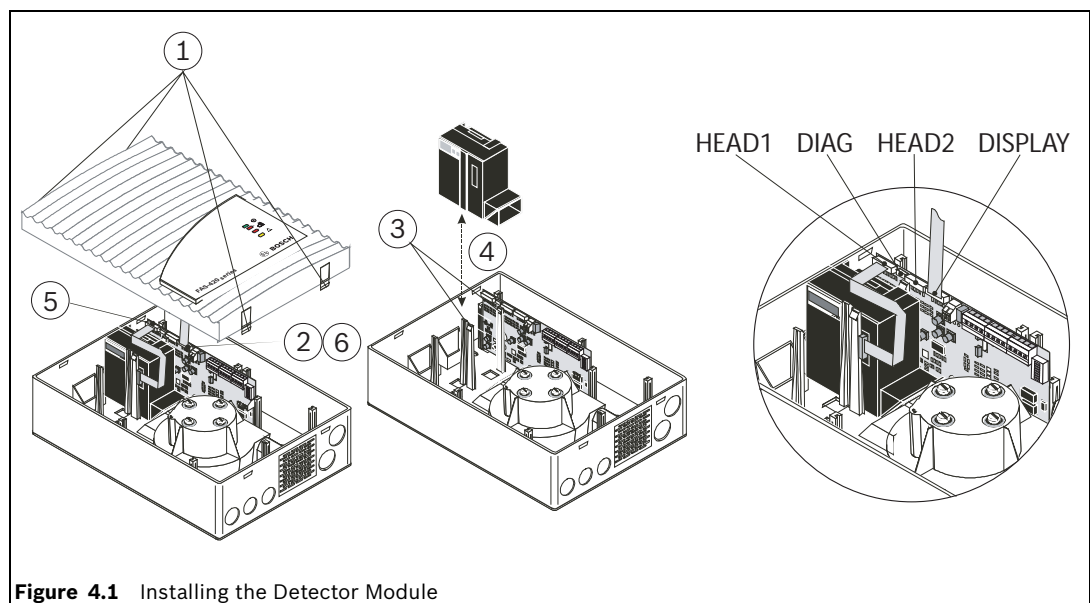


Figure 4.1 Installing the Detector Module

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 (see *Figure 4.1*):

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!

FAS-420-TP2 and FAS-420-TT2 variants

These unit types are 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 BR1 is open (see *Section 4.3.4 Number of Detector Modules*).

1. Spread the brackets provided for fixing the detector module slightly apart.
2. 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.
3. Connect detector module 1 to the "HEAD1" connection on the motherboard using the flatband cable.
FAS-420-TP2 and FAS-420-TT2 variants:
Connect detector module 2 to the "HEAD2" connection on the motherboard using the flatband cable.
4. Reconnect the display board cable to the "DISPLAY" connection on the motherboard.

4.3 Settings on the Unit Motherboard

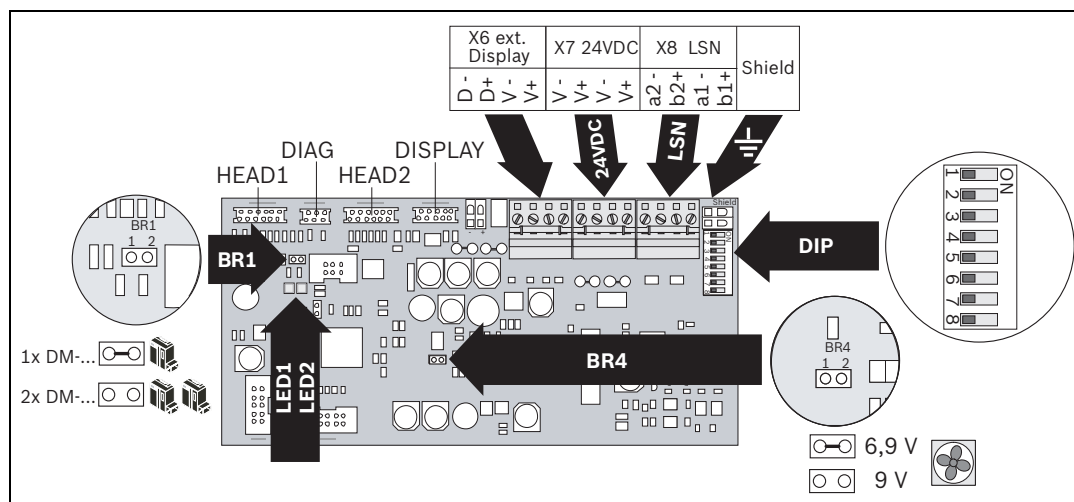


Figure 4.2 Settings on the motherboard

4.3.1 Setting the Detector Address

The aspirating smoke detector is set via the 8 DIP switches on the motherboard ("DIP") using a suitable plastic insulated tool.

The default address is "0" (all DIP switches to "off").

The DIP switch settings for all approved addresses are listed in the table in the Appendix, page 103-104 (0= off, 1= on).

Address (A)	Operating mode	Network structure		
		Loop	Stub	T-branch
0	Automatic address assignment in "improved version" LSN mode	X	X	-
1 to 254	Manual address assignment in "improved version" LSN mode	X	X	X
255 = CL	Automatic address assignment in "classic" LSN mode (address range: max. 127)	X	X	-

X = possible - = not possible

**NOTICE!**

It is not permitted to use different operating modes in one loop/stub/T branch next to each other!

4.3.2**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 BR4 (see *Figure 4.2*).

The default setting is marked in bold.

Fan voltage	Jumper BR4, 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 jumper BR4 only when the unit is switched off.

4.3.3**Setting the Fan Voltage (SL Variant)**

For FAS-420-xx systems, the standard fan voltage setting is 6.9 V.

**CAUTION!**

For SL variants, always remove jumper BR4 from the motherboard.

Close or open jumper the jumpers BR1 and BR2 only when the device is switched off.

Re-initialize the airflow if you have switched the fan voltage.

The fan voltage on the fan activation circuit board on SL devices is set using the jumpers BR1 and BR2. The default setting is marked in bold.

Fan voltage with FC-2	Jumper BR1, pin no. 1+2	Jumper BR2, pin no. 1+2
6.5 V	O	X
6.9 V	X	O
9 V	O	O

X = pin pair bypassed O = pin pair open

4.3.4**Number of Detector Modules**

The number of populated detector modules is factory set depending on the model variant (jumper BR1 on the motherboard, see *Figure 4.2*).

Variant	Number of detector modules	Jumper BR1, pin no. 1+2
FAS-420-TP1 / FAS-420-TT1	1 detector module	X
FAS-420-TP2 / FAS-420-TT2	2 detector modules	O

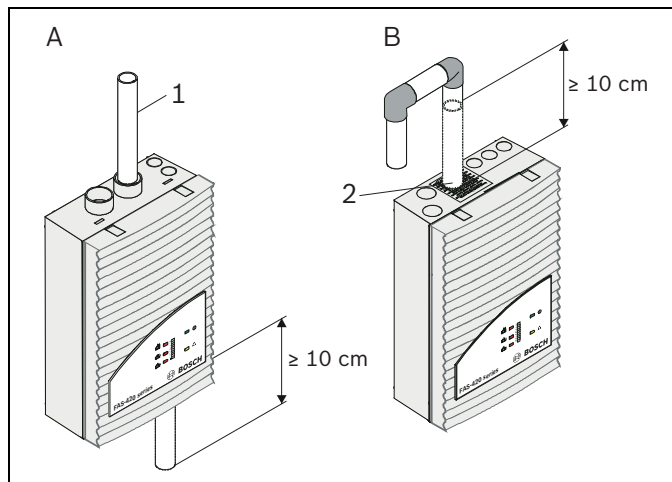
X = pin pair bypassed
 O = pin pair open

4.4 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.



- A Aspiration device upwards
- B Aspiration device downwards with air outlet opening upwards
- 1 Smoke aspiration pipe
- 2 Air-return pipe

Figure 4.3 Installation of the FAS-420

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

Aspiration downwards

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 (see *Figure 4.3*).

Mounting type MT-1

The aspirating 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 (see *Figure 4.4*).

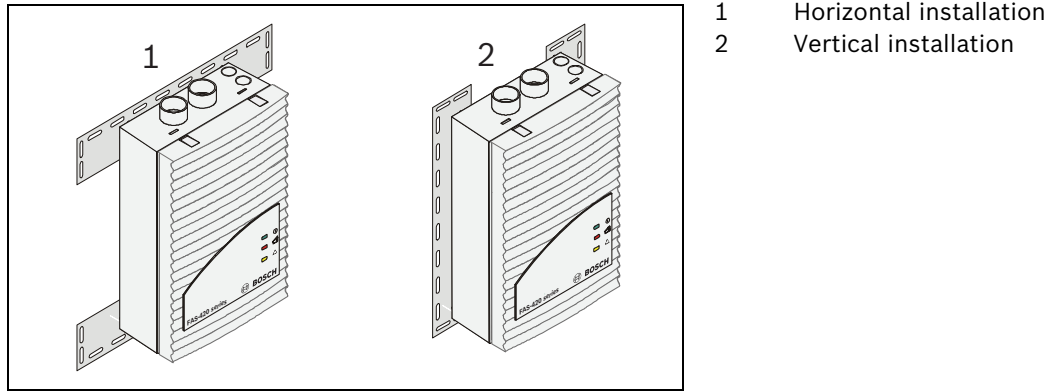


Figure 4.4 Installing on mounting type MT-1

Installation material	FAS-420	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).

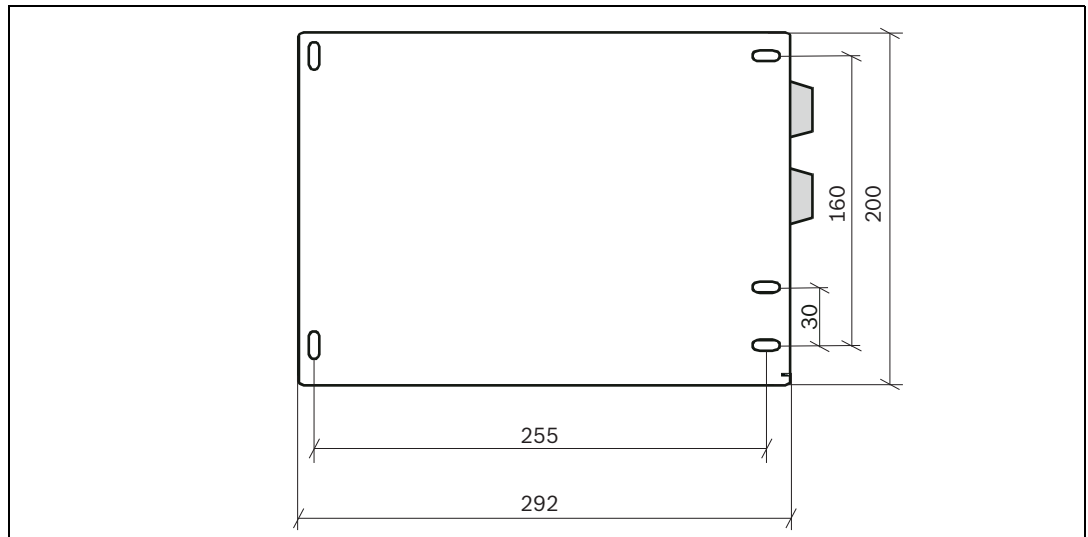


Figure 4.5 Bore distances of FAS-420 without mounting

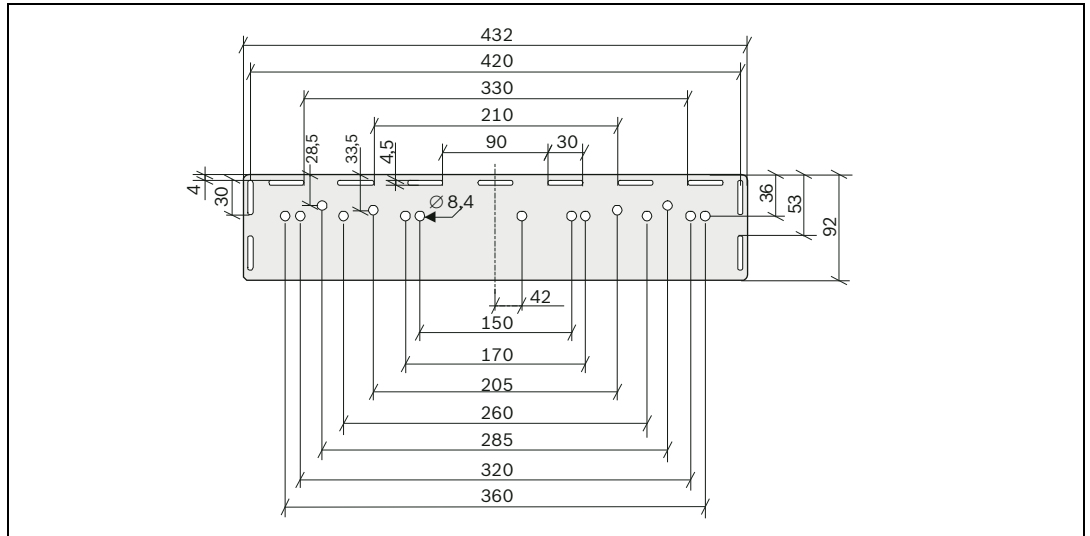


Figure 4.6 Bore distances with mounting type MT-1

Reducing operating noises

If the aspirating smoke detector is installed in noise-sensitive areas, observe the instructions in Section 2.5.8 Measures for Reducing Operating Noise, page 20.

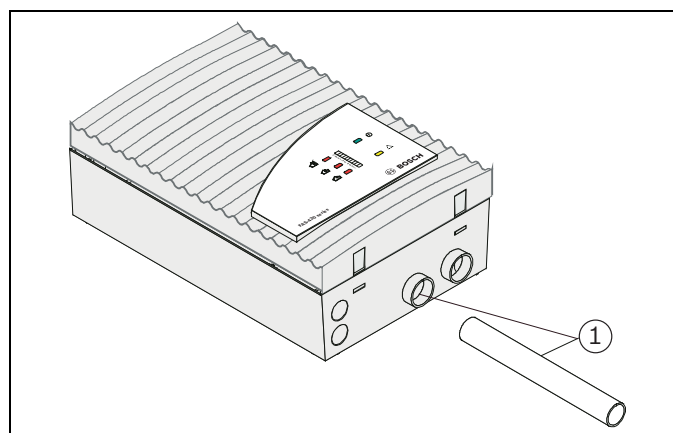
Installation

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

1. To connect the aspiration pipe to the FAS-420, insert it into the pipe connection provided (see Figure 4.7).



1 Smoke aspiration pipe

Figure 4.7 Connecting the aspiration pipe to the FAS-420 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 Section 5.1 Length Change of the Pipe System).

4.5 Connection to the Fire Panel

4.5.1 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 connections using a sharp object.
Caution: Do not cut the cable bushings with a knife!
4. Route the connection cable(s) (max. 2.5 mm²) 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. The connection terminals of the 24 V additional supply voltage and the LSN connection are plug connections and are easy to remove.

**NOTICE!**

The units are usually connected to an additional power supply. When connecting to the FPA-5000 Modular Fire Panel, the voltage is supplied via the AUX outputs of the BCM 0000 Battery Controller Module. Alternatively, an external power supply unit (e.g. FPP-5000 or UEV 1000) can be used.

Designation	Cable	Function	
Shield	-	Shield wire	
X8 LSN	b1+	Yellow	LSN b, incoming
	a1-	White	LSN a, incoming
	b2+	Yellow	LSN b, outgoing
	a2-	White	LSN a, outgoing
X7 24 VDC	V+	Red	Additional power supply, incoming
	V-	Black	
	V+	Red	Additional power supply, outgoing
	V-	Black	
X6 ext. Display	V+	Red	Supply voltage for digital parallel display *
	V-	Black	
	D+	-	Data line connection for digital parallel display *
	D-	-	

* Digital parallel displays for the FAS-420 series are available by separate order.

4.5.2 LSN Configuration

Once the aspirating smoke detector has been connected to the LSN, the detector and detector module, or the two detector modules (FAS-420-TP2 and FAS-420-TT2), are configured using the FSP-5000-RPS programming software via a laptop connected to the FPA-5000 Fire Panel.

Information on the LSN configuration can also be found in the Online Help feature of the RPS programming software. Notes on diagnostics data for the fire panel are contained in the operation guide for the FPA-5000.



NOTICE!

Both a dual-detector dependency and a dual-zone dependency can be established when connecting the FAS-420-TP2 and the FAS-420-TT2 to the FPA-5000 Modular Fire Panel.

4.5.3 Parameter Settings via RPS (Remote Programming Software)

The parameters for each detector module are specified in the relevant "Sensor" dialog window via drop-down fields. The defaults settings in RPS are marked in bold.

1. Enter the used detector module.
2. Select all other parameters (see tables).

Detector module	Sensitivity			Further sensitivity A second sensitivity can be set, e.g. for day/night mode. For adjustable sensitivity levels, see left.
DM-TT-01(05)	DM-TT-01(05)	DM-TT-10(25)	DM-TT-50(80)	
DM-TT-10(25)	0.015%/m (0.05%/m)	0.1%/m (0.25%/m)	0.5%/m (0.8%/m)	
DM-TT-50(80)	0.03%/m (0.1%/m)	0.2%/m (0.5%/m)	1.0%/m (1.6%/m)	
	0.06%/m (0.2%/m)	0.4%/m (1%/m)		
	0.12%/m (0.4%/m)	0.8%/m (2%/m)		

Activation threshold for airflow malfunction	Alarm delay
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

Airflow fault delay	LOGIC·SENS filter
30 seconds	Off
2 minutes	On
15 minutes	
60 minutes	



NOTICE!

When the fire panel is in revision mode, the LOGIC·SENS is temporarily deactivated, allowing the detector modules to be checked quickly and directly.

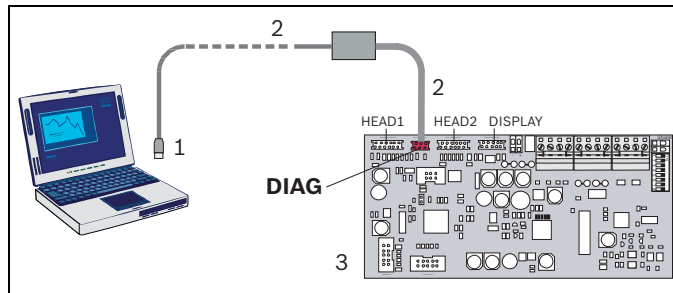
The sensitivity value is based on measurements with standard test fires (old value in brackets). The activation threshold for the airflow malfunction is set to 20% volume flow change by default. Higher values are not permitted within EN 54-20.

4.6 Connecting an External Detector Alarm Display

A digital external detector alarm display can be connected to the 420 series aspirating smoke detectors. This is available by separate order.

Connect the remote indicator to the motherboard of the FAS-420 using the terminal strip X6 (see *Figure 4.2, Page 65*). The unit must be in a voltage-free state for this. Alternatively, FNS-420-R LSN Strobes can be connected via LSN and configured via FSP-5000-RPS.

4.7 Data Logging



- 1 USB port with FAS-ASD-DIAG, COM1/COM2 with earlier versions
- 2 DIAG connection cable
- 3 FAS-420 motherboard

Figure 4.8 Connecting a PC via the diagnostics cable

The 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 RPS 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 port (see *Figure 4.8*).

Windows 2000 or Windows XP can be used as the operating system (earlier diagnostic software versions (with serial interface) run under WINDOWS 95, 98, ME, 2000 and NT). For details, please see the diagnostic software documentation.

4.8 Replacing a Detector Module

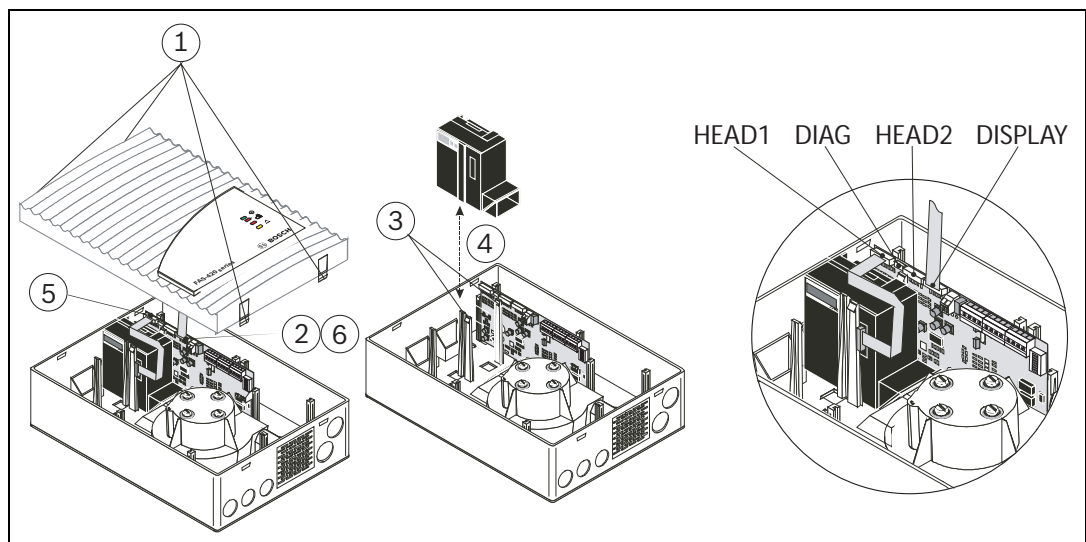


Figure 4.9 Replacing a detector module



CAUTION!

Switch off the unit before carrying out any connection work!

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

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.
 3. Unplug the detector module's connector cable from the motherboard.
 4. 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.
 5. Attach the detector module to the connection on the motherboard: detector module 1 to "HEAD 1", detector module 2 to "HEAD 2".
 6. Reconnect the display board cable to the "DISPLAY" connection on the motherboard.
Before initialization, the operating voltage must be connected again. To initialize the pipe system, press the S2 flow-init button on the detector module.
1. Close the housing cover.

5 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

For pipe systems with long pipe feed lines (see also *Section 3.9 Planning for Long Pipe Feed Lines, page 56*), 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 *Section 2.8.3 Pipe system, page 30* in the Technical Specifications chapter.

The pipe system must be constructed according to planning specifications and taking into account the planning guidelines (see *Section 3 Planning*).

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 be used only 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 changes of direction can cause an airflow malfunction in the FAS-420 and have a negative impact on the detection time. As a benchmark, a pipe bend corresponds to a straight pipe length of 0.3 m. An elbow corresponds to a straight pipe length of 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 may bend or even tear.

- 5. Close open pipe ends with an end cap.



NOTICE!

On completion, test the pipe system:

- For leaks
- For fault-free connections
- For correct planning of the air sampling openings.

5.1

Length Change of the Pipe System

Length changes to 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:

$$\Delta L = L \times \Delta T \times \delta$$

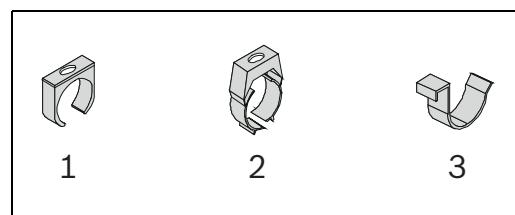
where

- ΔL = Length change in [mm]
- L = Length of the pipe to be calculated in [m]
- ΔT = Maximum temperature difference in [°C]
- δ = Length change coefficient in [mm/m x °C]
- δ_{PVC} = 0.08 mm/m x °C
- δ_{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

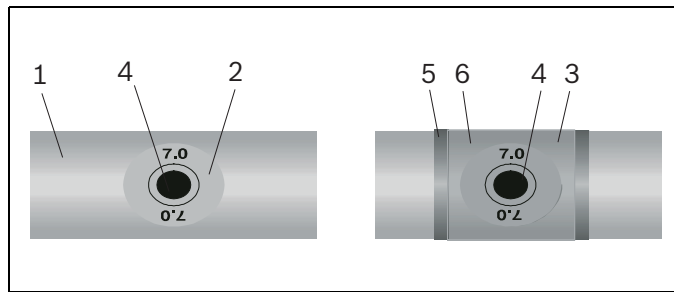
PVC pipe clips are used as standard for installing the pipe system. These clips do not allow any length extensions.



- 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

Figure 5.1 Overview of mounting clamps

5.2 Air Sampling Openings

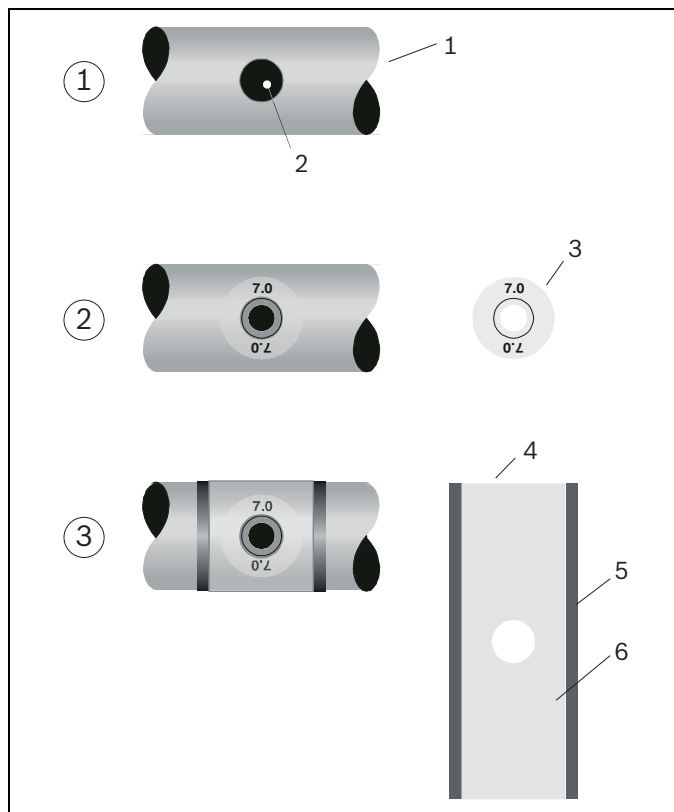


- 1 Smoke aspiration pipe
- 2 Aspiration reducing film sheet with air sampling opening
- 3 Marking tape for aspiration reducing film sheet
- 4 Air sampling opening
- 5 Fire red (RAL 3000)
- 6 Transparent

Figure 5.2 Example of an aspiration boring with aspiration reducing film sheet

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.



- 1 Smoke aspiration pipe
- 2 10 mm aspiration boring
- 3 Aspiration reducing film sheet
- 4 Marking tape for aspiration reducing film sheet
- 5 Fire red stripes (RAL 3000)
- 6 Transparent

Figure 5.3 Applying the aspiration reducing film sheet

Aspiration borings

1. 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.
2. Select the size of the aspiration reducing film sheet according to the specifications. Glue the aspiration reducing film sheet to the opening (see *Figure 5.3*).
3. Glue the marking tape over the aspiration reducing film sheet, in order to prevent the film sheet from becoming detached.



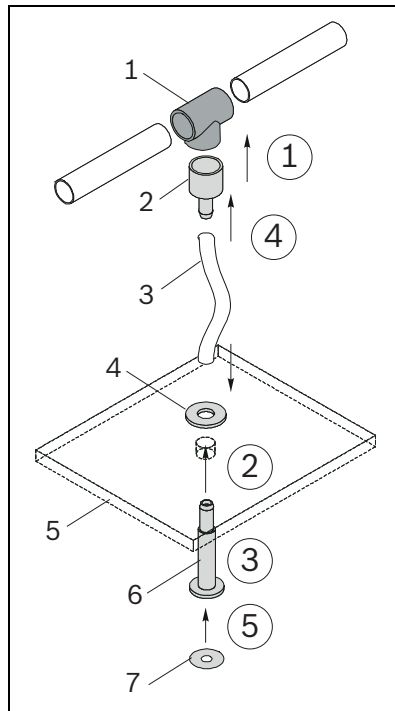
NOTICE!

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.

5.3

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:

1. 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.
2. Drill a \varnothing 13 mm hole in the false ceiling for each ceiling lead-through.
3. 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.
4. 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.
5. 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.

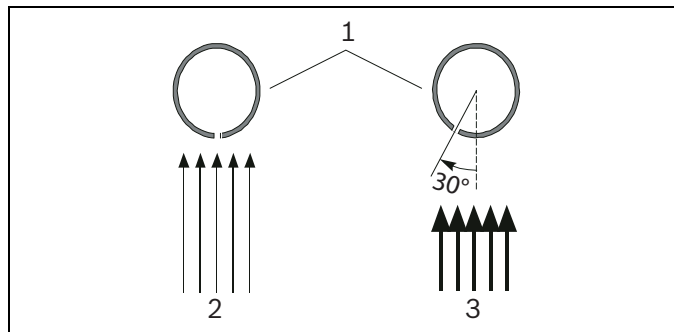
5.4 Monitoring with Forced Airflow

5.4.1 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 (see *Figure 5.4*).



- 1 Aspiration pipe with air sampling openings
- 2 Exhaust speed $< 0.5 \text{ m/s}$
- 3 Exhaust speed $> 0.5 \text{ m/s}$

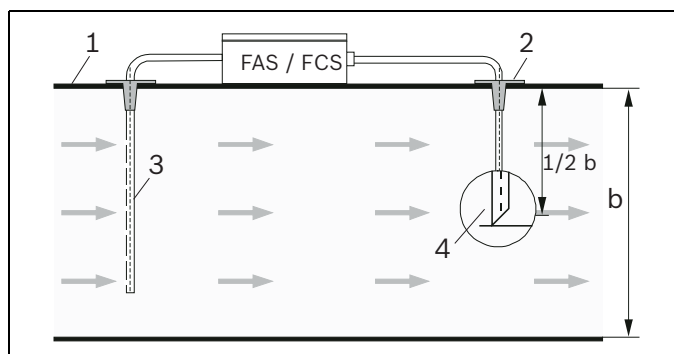
Figure 5.4 Positioning the air sampling opening depending on air speed

5.4.2 Detection in the Bypass



NOTICE!

For detection in airflows $\geq 2 \text{ m/s}$, additionally feed the exhaust from the FAS-420 back into the airflow area. Cut the end of the air-return pipe at an angle of 45° (see *Figure 5.5*).



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

Figure 5.5 Positioning the air-return pipe – example with an air-conditioning duct (bypass)

For details on connecting the air return, please see *Section 5.6 Air-return Pipe*.

For FAS-420 planning in these applications, see *Section 3.11 Planning for Forced Airflow*, page 58.

5.5 Air Filter

5.5.1 Installing the Air Filter Box

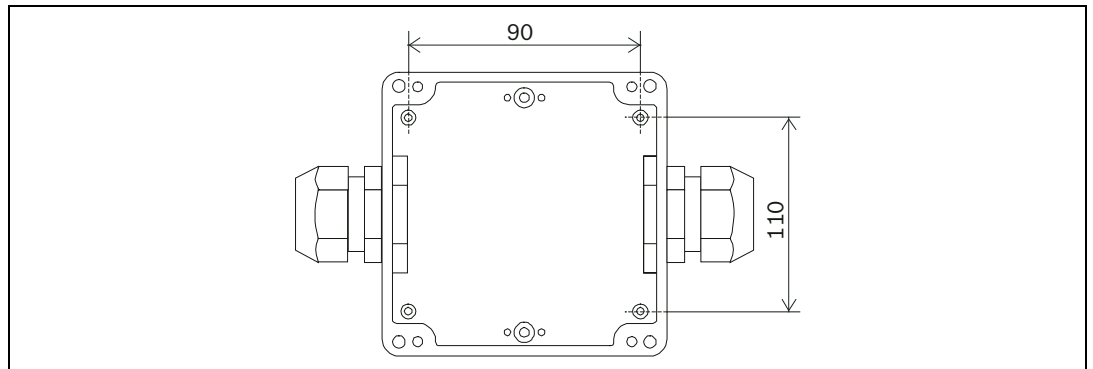


Figure 5.6 Boring distances of holes in base of FAS-ASD-WS air filter box
 Air filter box

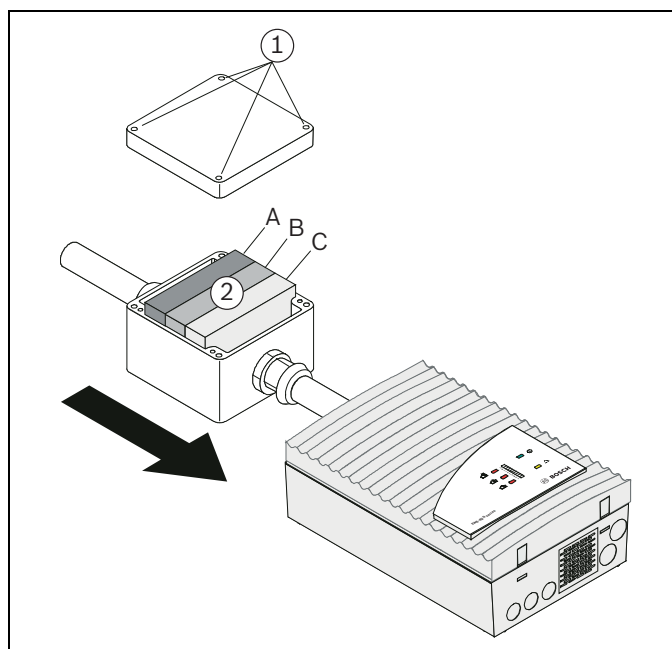
1. To use the filter box in the pipe system, use the two PG29 filter screw connections supplied.
2. Install these screw connections precisely as for the pipe adapter.
3. When installing the filter, note the throughflow direction, which is specified on the type plate on the side of the lower part of the housing.
4. 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.

5.5.2 Filter Change on the Air Filter Box



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

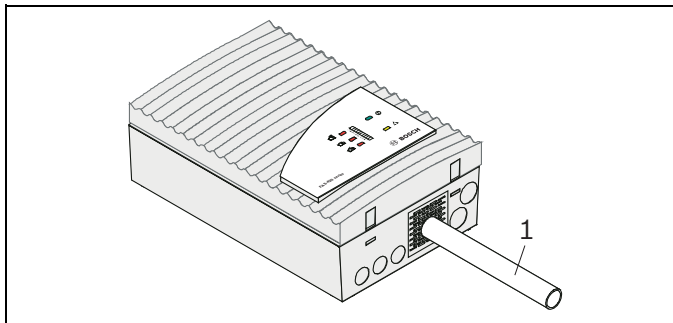
Figure 5.7 Changing the filter inserts (in fig.: FAS-ASD-FL Filterbox Large)

To replace the filter inserts, proceed as follows (see Figure 5.7):

1. Loosen the four screws and remove the housing cover from the filter box.
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 air filter box, 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).

5.6**Air-return Pipe**

- 1 Air-return pipe (aspiration pipe)

Figure 5.8 Installing the air-return pipe

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

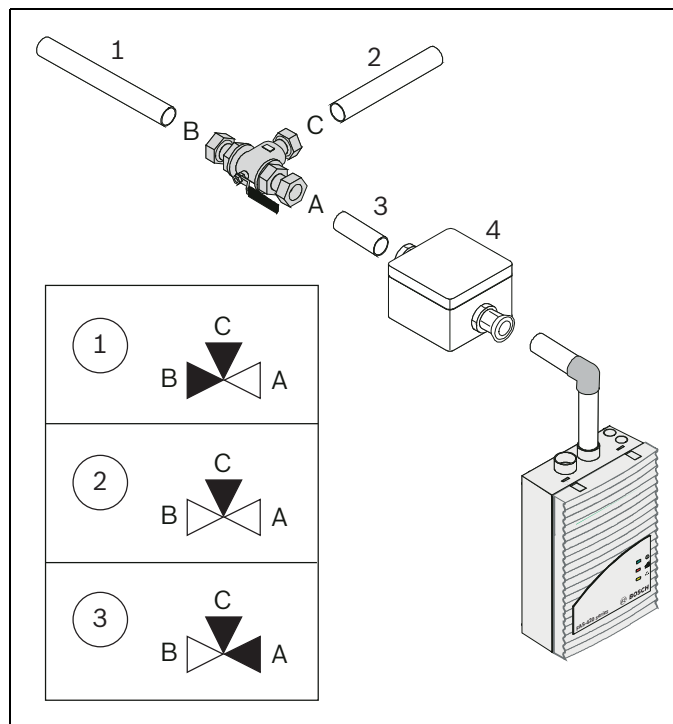
**CAUTION!**

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 *Section 5.1 Length Change of the Pipe System*).

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 FAS-420 with the rubber ring already integrated into the air-exhaust opening.

5.7 Three-way Tap



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

Figure 5.9 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, in contrast, is purified and dehumidified air. If the FAS-420 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.

During installation, note the assignment of the connections:

- Install the aspiration pipe system on connection C.
- Install the FAS-420 on connection A.
- Attach the compressed air supply (compressor or mobile blowing-out system) to connection B of the three-way ball valve.



NOTICE!

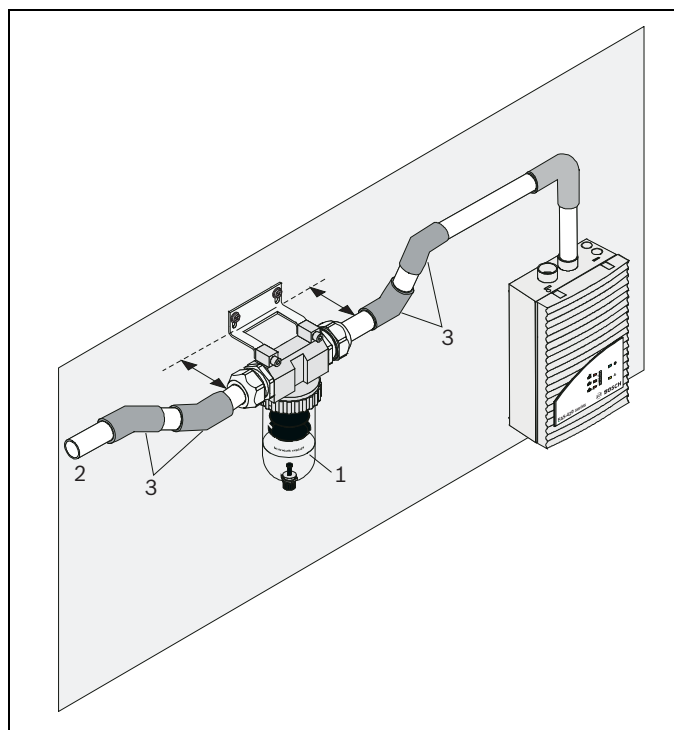
A single blowing-out process can be completed within 50 seconds. If within this time the unit is still connected to the pipe system, the malfunction message "airflow sensor module malfunctioning" will not be evaluated. If the blowing-out process has to be repeated (steps 1 to 3), wait at least 120 s.

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

1. Position the tap lever so as that the blast air and pipe system (B-C connection) are connected.
The connection to the FAS-420 must be blocked for blowing-out!
Manually blow out the pipe system for approximately 10 seconds.
2. 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.
3. Reconnect the blown-out pipe system to the FAS-420 within a further 10 seconds by switching the tap accordingly (A-C connection).

5.8 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 5.10*).



- 1 FAS-ASD-WS Water Separator
- 2 Pipe system connection
- 3 45° pipe elbow

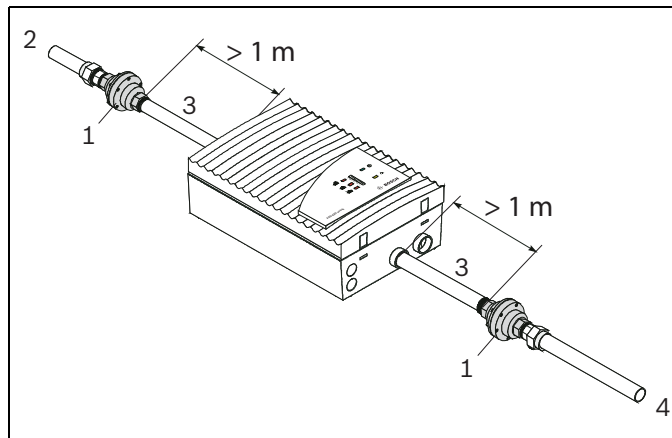
Figure 5.10 Installing the FAS-ASD-WS Water Separator in the pipe system

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 (see *Section 7.8 Maintenance Intervals, page 97*).

5.9 Detonation Safety Barrier



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

Figure 5.11 Installation of the detonation safety barrier on the pipe system and the air return

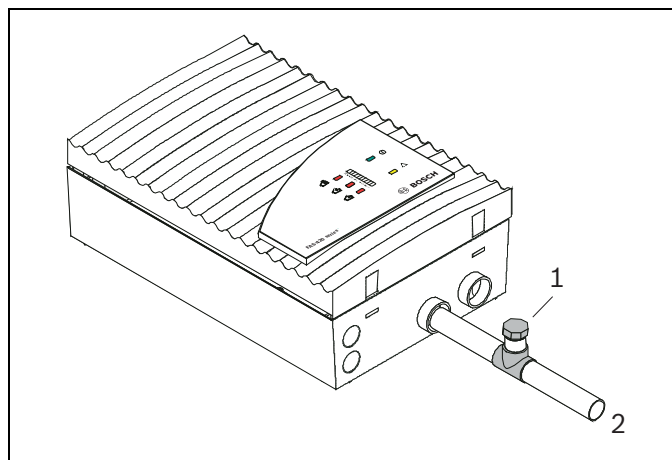
The detonation safety barriers are integrated into the pipe system and the air return at a minimum distance of 1 m from the aspirating smoke detector. The detonation safety barrier is glued to the FAS-420 on the side of the pipe system or the air-return pipe via a transition screw connection and connected to the side of the unit via a steel pipe (see *Figure 5.11*). 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.

5.10 Test Adapter



- 1 Test adapter
- 2 Pipe system connection

Figure 5.12 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 detector module and alarm forwarding have been tested (see *** 'Checking Airflow Monitoring' on page 88 ***), the test adapter must be reclosed to eliminate the risk of an airflow malfunction!

6 Commissioning

6.1 Preparation

Checking the settings

Check the settings of the FAS-420 (Section 4.3 Settings on the Unit Motherboard, page 67) prior to commissioning.

Then connect the unit to the power supply. The detector module of the FAS-420 is ready for operation after approximately 1 minute.

To commission the FAS-420, completely install the pipe system and connect it.

Connection test

Check whether...

1. The correct aspiration reducing film sheets are glued to the air sampling openings.
2. The pipe system is securely connected to the FAS-420 pipe connection.
3. 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). Now measure the negative pressure using a digital pressure gauge (see Section 6.6.2 Conducting the Functional Test, page 90)
 - Either at the opening for the return airflow
 - Or using a test adapter installed directly upstream of the unit in the aspiration pipe (see Section 5.10 Test Adapter, page 85).

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 DIAG diagnostic software.

Follow the procedure below:

1. Install the diagnostic software on a laptop or PC (for details on system requirements and connection, see Section 4.7 Data Logging, page 74).
2. The FAS-420 is connected to the PC via the "DIAG" port on the motherboard using the supplied diagnostics cable.
3. The diagnostic software is started.

The current FAS-420 data is displayed on the PC's 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 Section 6.2 Calibrating the Airflow Sensor, page 86), start-up temperature, air pressure and height above sea level in the test log (see Section 8.5 Test Log for Aspirating Smoke Detectors in the FAS-420 Series, page 110).

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 Section 6.2 Calibrating the Airflow Sensor).



6.2 Calibrating the Airflow Sensor



NOTICE!

The aspirating 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. Restrictions for the simplified procedure are contained in Section 3.3 Airflow Monitoring, page 36.

For an air-pressure-dependent calibration, use the air pressure correction tables in the appendix (Section 8.2 Air Pressure Correction Tables for Airflow Sensor Calibration, page 105).

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.

6.2.1 Air-Pressure-Independent Calibration

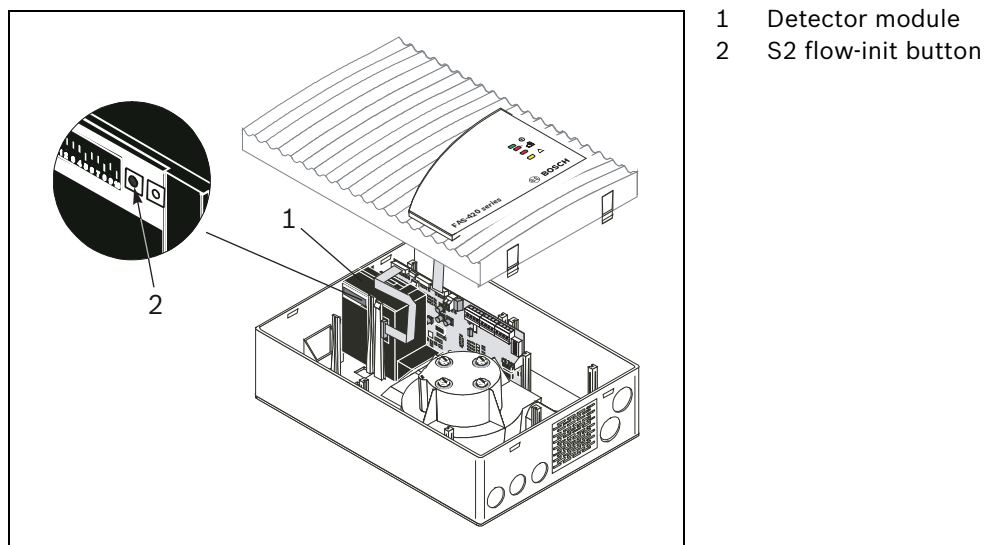


Figure 6.1 Air-pressure-independent calibration of the airflow sensor

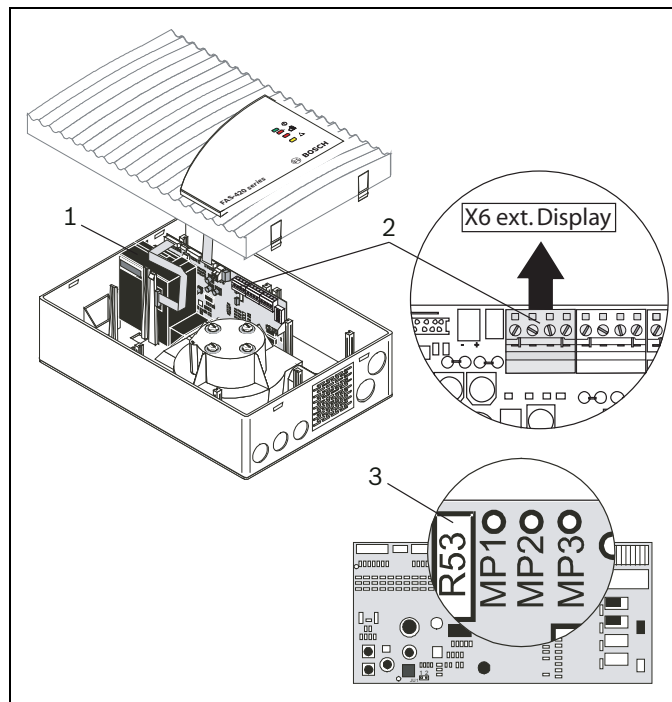
1. Make sure that the aspirating smoke detector has been operating for at least 30 minutes.
 2. To initialize the connected pipe system, press the S2 flow-init button on the detector module concerned (see *Figure 6.1*), until the green operating LED on the unit starts to flash. Initialization is complete 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.

6.2.2 Air-Pressure-Dependent Calibration



- 1 Detector module
- 2 Connection terminal
"X6 ext. Display"
- 3 Trimming
potentiometer R53
- MP2/MP3 Measuring points
MP2 (+) and MP3 (-)

Figure 6.2 Air-pressure-dependent calibration of the airflow sensor

A barometer (recommended: GPB 1300 digital precision pocket barometer from Greisinger electronic GmbH) 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 (see Appendix Section 8.2 Air Pressure Correction Tables for Airflow Sensor Calibration, page 105) 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 (-) (see Figure 6.2). 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 FAS-420 housing and check that it is correctly positioned.

6.3 Testing the Detector Module and Alarm Transmission



NOTICE!

In order to accelerate the alarm evaluation during gas testing, LOGIC · SENS must be set to "off" (see Section 4.5.3 Parameter Settings via RPS (Remote Programming Software)). On completion of the test, reset LOGIC·SENS to "on".

1. 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, ...
– Whether the alarm is displayed on the aspirating smoke detector	– Check whether the display board is connected – There is a fault with the aspirating smoke detector Replace the detector module
– Whether the alarm is transmitted to the fire panel and reported on the appropriate line	– Check the transmission lines

6.4 Checking Malfunction Transmission



NOTICE!

The steps below may only be carried out following an airflow calibration in accordance with *Section 6.2 Calibrating the Airflow Sensor*.

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.

6.5 Checking Airflow Monitoring

Pipe breakage

Check the breakage detection:

- Detach the pipe from the connection to the FAS-420 or open the test adapter.
- Check whether the malfunction display on the aspirating smoke detector lights up.
- Check the data of the airflow sensor using DIAG Diagnostic Software and a PC or laptop.
- Check whether the malfunction is displayed on the fire panel.
- Enter the results into the test log.

Obstruction

Check the obstruction detection:

- 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.
- Check the data of the airflow sensor using DIAG Diagnostic Software and a PC or laptop.
- Check whether the malfunction is displayed on the fire panel.
- Enter the results into the test log.



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.

Troubleshooting

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

Check whether...

- All inlet holes are free
- The pipe system has breaks or fractures

3. All pipe connections are tight
4. The fan can blow out freely
5. The correct aspiration reducing film sheets were used

If no faults are detected, the functionality of the FAS-420 and/or the airflow sensor is checked using the test pipe and diagnostic software (see Section 6.6 FAS-420 Functional Test).

6.6 FAS-420 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.

6.6.1 Preparations for the Functional Test

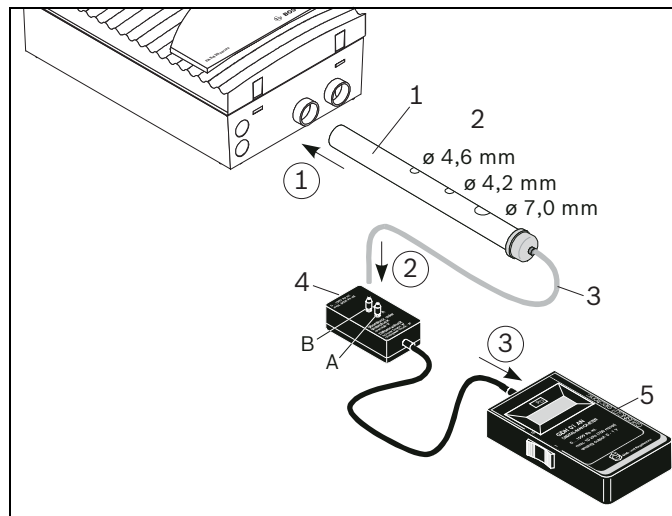
Select the following parameter settings using the FSP-5000-RPS programming software (the settings in the bold font indicate deviations from the default setting):

Activation threshold for airflow malfunction	Alarm delay
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

Airflow fault delay	LOGIC-SENS filter
30 seconds	Off
2 minutes	On
15 minutes	
60 minutes	

Connecting the digital pressure gauge:

1. Connect the test pipe (see Figure 6.3)
2. Connect the pressure measuring hose to the adapter connection B.
3. 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

Figure 6.3 Testing the functionality of the FAS-420



NOTICE!

For the FAS-420-TP2 and FAS-420-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.

6.6.2 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 FAS-420 reveals deviations from the described procedure, the unit or its airflow sensor is defective.

1. Make sure that the aspirating smoke detector has been operating for at least 30 minutes.
2. 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 (see NOTE). 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.
3. Open all of the test pipe's aspiration borings. After a few seconds, the flash code of the LED must go out.
4. Remove the test pipe. The LED flash code on detector module I and detector module II must signal a breakage.
5. 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 *Section 6.1 Preparation, page 85*.

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 *Section 6.2 Calibrating the Airflow Sensor*.
 - 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.
-

7 Maintenance

7.1 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 *Section 7.2 Flash Code Table*).

7.2 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, see Fig. 4.2, page 67).

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)

7.2.1 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.

1. 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.
2. 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.

3. 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.

7.2.2

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.

1. 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.
2. 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.

3. 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.

7.2.3

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.

1. 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.
2. 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).

3. 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.
4. 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.

7.2.4

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.

1. 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.

2. 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.

3. 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.

7.2.5 **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.

7.2.6 **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.

1. 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.
2. 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.
3. 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.
4. 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.

7.2.7 **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.

7.3 **Detector Module and Alarm Transmission**

Proceed in accordance with Section 6.3 Checking the Detector Module and Alarm Transmission, page 89. Also check the detector module visually for exterior contamination or damage and replace if necessary.

**NOTICE!**

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

7.4**Pipe system**

Check the pipe system and the air sampling openings for obstruction in areas susceptible to dust particles or icing. Where necessary, blow out the pipe system and air sampling openings using blast air (class 3 for recycling areas or class 2 for deep-freeze areas). 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 FAS-420 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.

7.5**Check 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 target value then serves as a reference value for the additional evaluation of any airflow malfunctions.

Depending on the airflow threshold selected (see "Adapting the airflow sensitivity" in Section 3.3 Airflow Monitoring, page 36), 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").



NOTICE!

When the fire panel is in revision mode, the LOGIC-SENS is temporarily deactivated, allowing the detector modules to be checked quickly and directly.

Dependent on air pressure

To ensure long-term malfunction-free operation of the device, the airflow sensor must be calibrated according to 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.

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 (see also Section 3.3 Airflow Monitoring, page 36).

Troubleshooting airflow malfunction

If the airflow calibration has been executed 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 type of disturbance value other than air pressure or temperature fluctuation exists.



CAUTION!

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

1. In this case, check the pipe system for leaks and obstructions (see Section 6.5 Checking Airflow Monitoring, page 90, "Troubleshooting").
2. If this check reveals no malfunctions, check the airflow monitoring by connecting the test pipe and conducting the functional test in accordance with Section 6.6.2 Conducting the Functional Test.
3. 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.



NOTICE!

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 on MP1/MP4 in the test log.

1. Observe the current airflow value during ongoing maintenance or check it at the latest during the next inspection.
2. 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, the next less-sensitive threshold should be set.



NOTICE!

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

7.6 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.

7.7 Malfunction Transmission

A malfunction is indicated on the FAS-420 and on the fire panel, where applicable. Proceed in accordance with Section 6.4 Checking Malfunction Transmission, page 90.

7.8 Maintenance Intervals

Maintenance comprises regular inspections and maintenance routines. The smoke aspiration systems should be checked when commissioned and then quarterly. At each fourth check, more comprehensive checks should be made, as described below:

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

Inspection

Measure	Further information can be found in...
Visual check	Section 7.1 Visual check, page 91
Detector module and alarm transmission	Section 7.3 Detector Module and Alarm Transmission, page 94
Check the pipe system	Section 7.4 Pipe system, page 95
Check the airflow sensor calibration	Section 7.5 Check the airflow sensor calibration, page 95
Checking Malfunction Transmission	Section 7.7 Malfunction Transmission, page 97
Empty water separator (if necessary)	Section 5.8 FAS-ASD-WS Water Separator, page 84

Maintenance and 4th annual inspection

Measure	Further information can be found in...
Visual check	Section 7.1 Visual check, page 91
Detector module and alarm transmission	Section 7.3 Detector Module and Alarm Transmission, page 94
Check the pipe system	Section 7.4 Pipe system, page 95
Check the airflow sensor calibration	Section 7.5 Check the airflow sensor calibration, page 95

Checking malfunction transmission	<i>Section 7.7 Malfunction Transmission, page 97</i>
Checking airflow monitoring	<i>Section 7.6 Airflow monitoring, page 97</i>
Empty water separator (if necessary)	<i>Section 5.8 FAS-ASD-WS Water Separator, page 84</i>

8 Appendix

All the permitted detector addresses are indicated in *Section 8.1 DIP Switch Settings for Detector Addresses*. See Section 4.3.1 Setting the Detector Address, page 68.

Notes on the tables in *Section 8.2 Air Pressure Correction Tables for Airflow Sensor Calibration* can be found in Section 6.2.2 Air-Pressure-Dependent Calibration, page 89.

The form in *Section 8.5 Commissioning/Service Test Record for Aspirating Smoke Detectors in the FAS-420 series* is required for commissioning (see Section 6 Commissioning, page 87 ff).

8.1 DIP Switch Settings for Detector Addresses

A	DIP							
	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0
255/ CL	1	1	1	1	1	1	1	1
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	1
3	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	1	0
5	0	0	0	0	0	0	1	0
6	0	0	0	0	0	0	1	1
7	0	0	0	0	0	0	1	1
8	0	0	0	0	1	0	0	0
9	0	0	0	0	1	0	0	1
10	0	0	0	0	1	0	1	0
11	0	0	0	0	1	0	1	1
12	0	0	0	0	1	1	0	0
13	0	0	0	0	1	1	0	1
14	0	0	0	0	1	1	1	0
15	0	0	0	0	1	1	1	1
16	0	0	0	1	0	0	0	0
17	0	0	0	1	0	0	0	1
18	0	0	0	1	0	0	1	0
19	0	0	0	1	0	0	1	1
20	0	0	0	1	0	1	0	0
21	0	0	0	1	0	1	0	1
22	0	0	0	1	0	1	1	0
23	0	0	0	1	0	1	1	1
24	0	0	0	1	1	0	0	0
25	0	0	0	1	1	0	0	1
26	0	0	0	1	1	0	1	0
27	0	0	0	1	1	0	1	1
28	0	0	0	1	1	1	0	0
29	0	0	0	1	1	1	0	1
30	0	0	0	1	1	1	1	0
31	0	0	0	1	1	1	1	1
32	0	0	1	0	0	0	0	0
33	0	0	1	0	0	0	0	1
34	0	0	1	0	0	0	1	0
35	0	0	1	0	0	0	1	1
36	0	0	1	0	0	1	0	0
37	0	0	1	0	0	1	0	1
38	0	0	1	0	0	1	1	0
39	0	0	1	0	0	1	1	1
40	0	0	1	0	1	0	0	0
41	0	0	1	0	1	0	0	1

A	DIP							
	8	7	6	5	4	3	2	1
42	0	0	1	0	1	0	1	0
43	0	0	1	0	1	0	1	1
44	0	0	1	0	1	1	0	0
45	0	0	1	0	1	1	0	1
46	0	0	1	0	1	1	1	0
47	0	0	1	0	1	1	1	1
48	0	0	1	1	0	0	0	0
49	0	0	1	1	0	0	0	1
50	0	0	1	1	0	0	1	0
51	0	0	1	1	0	0	1	1
52	0	0	1	1	0	1	0	0
53	0	0	1	1	0	1	0	1
54	0	0	1	1	0	1	1	0
55	0	0	1	1	0	1	1	1
56	0	0	1	1	1	0	0	0
57	0	0	1	1	1	0	0	1
58	0	0	1	1	1	0	1	0
59	0	0	1	1	1	0	1	1
60	0	0	1	1	1	1	0	0
61	0	0	1	1	1	1	0	1
62	0	0	1	1	1	1	1	0
63	0	0	1	1	1	1	1	1
64	0	1	0	0	0	0	0	0
65	0	1	0	0	0	0	0	1
66	0	1	0	0	0	0	1	0
67	0	1	0	0	0	0	1	1
68	0	1	0	0	0	1	0	0
69	0	1	0	0	0	1	0	1
70	0	1	0	0	0	1	1	0
71	0	1	0	0	0	1	1	1
72	0	1	0	0	1	0	0	0
73	0	1	0	0	1	0	0	1
74	0	1	0	0	1	0	1	0
75	0	1	0	0	1	0	1	1
76	0	1	0	0	1	1	0	0
77	0	1	0	0	1	1	0	1
78	0	1	0	0	1	1	1	0
79	0	1	0	0	1	1	1	1
80	0	1	0	1	0	0	0	0
81	0	1	0	1	0	0	0	1
82	0	1	0	1	0	0	1	0
83	0	1	0	1	0	0	1	1
84	0	1	0	1	0	1	0	0

A	DIP							
	8	7	6	5	4	3	2	1
85	0	1	0	1	0	1	0	1
86	0	1	0	1	0	1	1	0
87	0	1	0	1	0	1	1	1
88	0	1	0	1	1	0	0	0
89	0	1	0	1	1	0	0	1
90	0	1	0	1	1	0	1	0
91	0	1	0	1	1	0	1	1
92	0	1	0	1	1	1	0	0
93	0	1	0	1	1	1	0	1
94	0	1	0	1	1	1	1	0
95	0	1	0	1	1	1	1	1
96	0	1	1	0	0	0	0	0
97	0	1	1	0	0	0	0	1
98	0	1	1	0	0	0	1	0
99	0	1	1	0	0	0	1	1
100	0	1	1	0	0	1	0	0
101	0	1	1	0	0	1	0	1
102	0	1	1	0	0	1	1	0
103	0	1	1	0	0	1	1	1
104	0	1	1	0	1	0	0	0
105	0	1	1	0	1	0	0	1
106	0	1	1	0	1	0	1	0
107	0	1	1	0	1	0	1	1
108	0	1	1	0	1	1	0	0
109	0	1	1	0	1	1	0	1
110	0	1	1	0	1	1	1	0
111	0	1	1	0	1	1	1	1
112	0	1	1	1	0	0	0	0
113	0	1	1	1	0	0	0	1
114	0	1	1	1	0	0	1	0
115	0	1	1	1	0	0	1	1
116	0	1	1	1	0	1	0	0
117	0	1	1	1	0	1	0	1
118	0	1	1	1	0	1	1	0
119	0	1	1	1	0	1	1	1
120	0	1	1	1	1	0	0	0
121	0	1	1	1	1	0	0	1
122	0	1	1	1	1	0	1	0
123	0	1	1	1	1	0	1	1
124	0	1	1	1	1	1	0	0
125	0	1	1	1	1	1	0	1
126	0	1	1	1	1	1	1	0
127	0	1	1	1	1	1	1	1

A	DIP							
	8	7	6	5	4	3	2	1
128	1	0	0	0	0	0	0	0
129	1	0	0	0	0	0	0	1
130	1	0	0	0	0	0	1	0
131	1	0	0	0	0	0	1	1
132	1	0	0	0	0	1	0	0
133	1	0	0	0	0	1	0	1
134	1	0	0	0	0	1	1	0
135	1	0	0	0	0	1	1	1
136	1	0	0	0	1	0	0	0
137	1	0	0	0	1	0	0	1
138	1	0	0	0	1	0	1	0
139	1	0	0	0	1	0	1	1
140	1	0	0	0	1	1	0	0
141	1	0	0	0	1	1	0	1
142	1	0	0	0	1	1	1	0
143	1	0	0	0	1	1	1	1
144	1	0	0	1	0	0	0	0
145	1	0	0	1	0	0	0	1
146	1	0	0	1	0	0	1	0
147	1	0	0	1	0	0	1	1
148	1	0	0	1	0	1	0	0
149	1	0	0	1	0	1	0	1
150	1	0	0	1	0	1	1	0
151	1	0	0	1	0	1	1	1
152	1	0	0	1	1	0	0	0
153	1	0	0	1	1	0	0	1
154	1	0	0	1	1	0	1	0
155	1	0	0	1	1	0	1	1
156	1	0	0	1	1	1	0	0
157	1	0	0	1	1	1	0	1
158	1	0	0	1	1	1	1	0
159	1	0	0	1	1	1	1	1
160	1	0	1	0	0	0	0	0
161	1	0	1	0	0	0	0	1
162	1	0	1	0	0	0	1	0
163	1	0	1	0	0	0	1	1
164	1	0	1	0	0	1	0	0
165	1	0	1	0	0	1	0	1
166	1	0	1	0	0	1	1	0
167	1	0	1	0	0	1	1	1
168	1	0	1	0	1	0	0	0
169	1	0	1	0	1	0	0	1
170	1	0	1	0	1	0	1	0

A	DIP							
	8	7	6	5	4	3	2	1
171	1	0	1	0	1	0	1	1
172	1	0	1	0	1	1	0	0
173	1	0	1	0	1	1	0	1
174	1	0	1	0	1	1	1	0
175	1	0	1	0	1	1	1	1
176	1	0	1	1	0	0	0	0
177	1	0	1	1	0	0	0	1
178	1	0	1	1	0	0	1	0
179	1	0	1	1	0	0	1	1
180	1	0	1	1	0	1	0	0
181	1	0	1	1	0	1	0	1
182	1	0	1	1	0	1	1	0
183	1	0	1	1	0	1	1	1
184	1	0	1	1	1	0	0	0
185	1	0	1	1	1	0	0	1
186	1	0	1	1	1	0	1	0
187	1	0	1	1	1	0	1	1
188	1	0	1	1	1	1	0	0
189	1	0	1	1	1	1	0	1
190	1	0	1	1	1	1	1	0
191	1	0	1	1	1	1	1	1
192	1	1	0	0	0	0	0	0
193	1	1	0	0	0	0	0	1
194	1	1	0	0	0	0	1	0
195	1	1	0	0	0	0	1	1
196	1	1	0	0	0	1	0	0
197	1	1	0	0	0	1	0	1
198	1	1	0	0	0	1	1	0
199	1	1	0	0	0	1	1	1
200	1	1	0	0	1	0	0	0
201	1	1	0	0	1	0	0	1
202	1	1	0	0	1	0	1	0
203	1	1	0	0	1	0	1	1
204	1	1	0	0	1	1	0	0
205	1	1	0	0	1	1	0	1
206	1	1	0	0	1	1	1	0
207	1	1	0	0	1	1	1	1
208	1	1	0	1	0	0	0	0
209	1	1	0	1	0	0	0	1
210	1	1	0	1	0	0	1	0
211	1	1	0	1	0	0	1	1
212	1	1	0	1	0	1	0	0
213	1	1	0	1	0	1	0	1

A	DIP							
	8	7	6	5	4	3	2	1
214	1	1	0	1	0	1	1	0
215	1	1	0	1	0	1	1	1
216	1	1	0	1	1	0	0	0
217	1	1	0	1	1	0	0	1
218	1	1	0	1	1	0	1	0
219	1	1	0	1	1	0	1	1
220	1	1	0	1	1	1	0	0
221	1	1	0	1	1	1	0	1
222	1	1	0	1	1	1	1	0
223	1	1	0	1	1	1	1	1
224	1	1	1	0	0	0	0	0
225	1	1	1	0	0	0	0	1
226	1	1	1	0	0	0	1	0
227	1	1	1	0	0	0	1	1
228	1	1	1	0	0	1	0	0
229	1	1	1	0	0	1	0	1
230	1	1	1	0	0	1	1	0
231	1	1	1	0	0	1	1	1
232	1	1	1	0	1	0	0	0
233	1	1	1	0	1	0	0	1
234	1	1	1	0	1	0	1	0
235	1	1	1	0	1	0	1	1
236	1	1	1	0	1	1	0	0
237	1	1	1	0	1	1	0	1
238	1	1	1	0	1	1	1	0
239	1	1	1	0	1	1	1	1
240	1	1	1	1	0	0	0	0
241	1	1	1	1	0	0	0	1
242	1	1	1	1	0	0	1	0
243	1	1	1	1	0	0	1	1
244	1	1	1	1	0	1	0	0
245	1	1	1	1	0	1	0	1
246	1	1	1	1	0	1	1	0
247	1	1	1	1	0	1	1	1
248	1	1	1	1	1	0	0	0
249	1	1	1	1	1	0	0	1
250	1	1	1	1	1	0	1	0
251	1	1	1	1	1	0	1	1
252	1	1	1	1	1	1	0	0
253	1	1	1	1	1	1	0	1
254	1	1	1	1	1	1	1	0

8.2 Air Pressure Correction Tables for Airflow Sensor Calibration

8.2.1 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

8.2.2 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

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

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	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

8.3 Planning without filter

M = module S = sensitivity (% LT/m) MA = main alarm PA = pre-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	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	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	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		
	0.5 (0.8)	MA	A	A	A	B	B	B	B	C	C	C	C	C	C	C										
	0.687 (1.1)	PA	A	A	B	B	B	C	C	C	C															
	1.0 (1.6)	MA	A	B	B	C	C	C	C																	

8.3.1 Without any other pipe accessories

		Number of openings																							
Pipe shape	U _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
I	6.5	77	77	77	77	77	77	77	77																
	6.9	77	77	77	77	77	77	77	77	76															
	≥9	100	100	100	100	100	100	100	100	100	100	100	100	100											
U	6.5	120	120	120	120	120	120	120	120	120	120	120	120												
	6.9	120	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	150	150	150	150	150	150	150					
M	6.5	170	170	170	170	170	170	170	170	170	170	170	170												
	6.9	170	170	170	170	170	170	170	170	170	170	170	170	160	160	160									
	≥9	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180				
Double U	6.5	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180								
	6.9	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180						
	≥9	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
Quad. U (1 DM)	6.5																								
	6.9																								
	≥9	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	

8.3.2 With water separator

		Number of openings																							
Pipe shape	U _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
I	6.5	60	60	60	60	60	60	60																	
	6.9	60	60	60	60	60	60	60																	
	≥9	80	80	80	80	80	80	80	80	80	80														
U	6.5	100	100	100	100	100	100	100	100	100	100														
	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	110	110	110	110								
M	6.5	100	100	100	100	100	100	100	100	100	100	100	100												
	6.9	110	110	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	160	160	160	160	160	160						
Double U	6.5	140	140	140	140	140	140	140	140	140	140	140	140												
	6.9	140	140	140	140	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	160	160	160	160	160							

8.3.3 With detonation safety barrier

Pipe shape	U _{Fans}	Number of openings																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32
I	6.5	46	46	46	46																		
	6.9	46	46	46	46	38																	
	≥9	68	68	68	68	68	68																
U	6.5	60	60	60	60	60	60																
	6.9	60	60	60	60	60	60																
	≥9	60	60	60	60	60	60	60	60	60													
M	6.5	80	80	80	80	80	80																
	6.9	80	80	80	80	80	80	70	70	70													
	≥9	120	120	120	120	120	120	120	120	120													
Double U	6.5	80	80	80	80																		
	6.9	80	80	80	80	80	80	80	80														
	≥9	100	100	100	100	100	100	100	100	100													

8.4 Planning with air filter

M = module

S = sensitivity (% LT/m)

MA = main alarm

PA = pre-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	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	B	
	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	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	B	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																	

8.4.1 Without any other pipe accessories

		Number of openings																						
Pipe shape	U _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32	
I	6.5	70	70	70	70	70	70	70																
	6.9	70	70	70	70	70	70	70	70															
	≥9	100	100	100	100	100	100	100	100	100	100	90	90											
U	6.5	120	120	120	120	120	120	120	120	120	120	120	120											
	6.9	120	120	120	120	120	120	120	120	120	120	120	120	120	120									
	≥9	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140				
M	6.5	160	160	160	160	160	160	160	160	160	160	160	160											
	6.9	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160								
	≥9	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180			
Double U	6.5	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160								
	6.9	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170				
	≥9	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	

8.4.2 With water separator

		Number of openings																						
Pipe shape	U _{Fans}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32	
I	6.5	60	60	60	60	60	60																	
	6.9	60	60	60	60	60	60	60																
	≥9	80	80	80	80	80	80	80	80	80	80													
U	6.5	100	100	100	100	100	100	100	100	100	100													
	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	110	110	110	110							
M	6.5	100	100	100	100	100	100	100	100	100	100	100												
	6.9	110	110	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	160	160	160	160	160	160					
Double U	6.5	140	140	140	140	140	140	140	140	140	140	140												
	6.9	140	140	140	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	160	160	160	160	160						

8.4.3 With detonation safety barrier

Pipe shape	U _{Fans}	Number of openings																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	21	22	24	32		
I	6.5	46	46	46	46																				
	6.9	46	46	46	46	38																			
	≥9	68	68	68	68	68	68																		
U	6.5	60	60	60	60	60	60																		
	6.9	60	60	60	60	60	60																		
	≥9	60	60	60	60	60	60	60	60	60															
M	6.5	80	80	80	80	80	80																		
	6.9	80	80	80	80	80	80	70	70	70															
	≥9	120	120	120	120	120	120	120	120	120															
Double U	6.5	80	80	80	80																				
	6.9	80	80	80	80	80	80	80	80																
	≥9	100	100	100	100	100	100	100	100	100															

8.5 Commissioning/Service Test Record for Aspirating Smoke Detectors in the FAS-420 series

Device number						
Serial Number						
	Measurement value/set value					
Commissioning						
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]						
Obstruction malfunction						
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+/-						
Breakage malfunction						
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+/-						
Info alarm						
LED flashing+/-						
Relay activates after delay+/-						
Signal transmission to fire panel+/-						
LED saved+/-						
Relay saved+/-						
Pre-alarm						
LED flashing+/-						
Relay activates after delay+/-						
Signal transmission to fire panel+/-						
LED saved+/-						
Relay saved+/-						
Main alarm						
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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"Improved version" LSN mode 66

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