Protec
Fire and Security Group

Aspirating Detection System

Protec Aspirating Detection System
Generic Design & Installation Guide

ADDRESSING SAFETY SYSTEMS WITH INTELLIGENCE

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GENERIC ASPIRATING SYSTEM DESIGN GUIDE

This Design Guide has been produced by Protec Fire & Security Group to assist when designing Protec Fire & Smoke Aspirating Detection Systems for various applications.

The aim of the Design Guide is to provide a basic design concept to enable the designer to provide a considered, compliant and correctly functioning detection system using Protec Aspirating Systems solutions.

Aspirating detection systems now cover an extensive number and variety of applications. Each different aspirating system application will have many varying dimensions, airflows, background particle levels, sensitivity requirements and performance requirements, etc. Therefore, each application needs to be designed specifically for its own layout and risk.

Aspirating system applications may contain different combustible materials and therefore differing amounts and types of fire and smoke particles may be created in these areas. For this reason, it is important to select the correct detection technology for the risk.

All aspirating systems designers should be fully qualified, competent and conversant with the technical operation and differences of the various aspirating technologies and detectors. Designers should also familiarize themselves with all aspects of local applicable codes and standards.

Please Note:

The information provided within this Design Guide should be used in conjunction with your Local Standards and Fire Codes. Local regional industry practices where relevant should also be observed.

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Definition of a Protec Aspirating Detection System

Aspirating detectors provide an ‘active’ detection system that sample air from a given area or fire zone to detect the presence of combustion particles or smoke.

These combustion and/or smoke particles are transported to the detector via an integral aspirator that continuously draws air from a network of supervised sampling pipes, each containing small holes more commonly known as sampling points.

Having identified an increase in airborne combustion/smoke particle levels this information is presented as a number of staged alarms via both the detector display and outputs and is often integrated into the main building fire alarm system.

Introduction to aspirating ‘Cloud Chamber Detection’ Technology

It is known that particles smaller than the wavelength of visible light occur spontaneously as a material is overheated and in numbers far above those present in a normal ambient environment. Cirrus Pro/ Cirrus CCD and Cirrus HYBRID detectors utilise the ‘Wilson Cloud Chamber’ principle to detect these sub-micron particles that are generated at the incipient and all other stages of fire.

A sample of air from the protected space is delivered to the detector via a centrifugal blower, a portion of which is diverted into a humidifier. At approximately 100% relative humidity, the sample is directed to the Cloud Chamber where, because of cooling due to rapid vacuum expansion, water condenses onto all the airborne particles within the sample.

Consequently, these thermally generated particles cause many droplets to form into a cloud, which is then detected by the measuring system of the Cloud Chamber. The density of the cloud formed is directly proportional to the number of particles present.

The result is a continuous signal that corresponds to the particle concentration. This signal is used to provide a staged alarm sequence with four alarm levels.

Introduction to aspirating ‘Optical’ & ‘Optical/CO’ Technology

One alternative technology to cloud chamber based aspirating detectors is ‘Optical Smoke’ sensing aspirating detectors. Lasers or LED light sources can be used to identify small amounts of visible smoke particles created as material combusts. Generally speaking all optical aspirating detectors should first take the sampled air through a filter to try to remove airborne dust, as this is often the cause of unwanted alarms.

The filtered air then passes into the optical chamber in front of the light source, where reflected light from the visible smoke particles (known as light scatter) is measured by a photo collector.

The optical signal strength (amount of scattered light) is then reported as a measurement of %obs/m on the detector display.

In addition to ‘Optical Smoke’ sensing, some aspirating detectors also include CO (Carbon Monoxide) sensing elements. Through complex algorithms, the monitoring for CO can help avoid unwanted alarms caused by ‘Optical’ only detectors. It should be noted that the CO monitoring in aspirating detection systems is generally only suitable for smaller rooms due to dilution.

Introduction to Protec Aspirating Detectors

Aspirating **FIRE** Detection utilising Cirrus Pro 'Cloud Chamber' Aspirating Fire Detectors

Protec Cirrus Pro Series aspirating fire detectors utilise the 'Wilson Cloud Chamber' as its primary source of detection. This unique 'Cloud Chamber' technology enables the Cirrus Pro detectors to be one of the earliest and most versatile fire detection technologies currently available. In addition, the Cloud Chamber technology ensures that Cirrus Pro detectors provide the least possible potential for 'false alarms' caused by dust, steam, condensation, humidity, high airflow and temperature changes; which can create problems for other aspirating detector technologies. The unique cloud chamber measurement scale is in particles per cm^3 (PCM^3). Protec Cirrus Pro 200 aspirating fire detector is fully compliant with EN54 Part 20.

Aspirating **SMOKE** Detection utilising ProPointPlus 'Optical & CO' Aspirating Smoke Detectors

Protec ProPointPlus aspirating smoke detectors utilise 'optical' LED Scatter Chamber Detectors (SCD's) within each of the four detector sampling ports. Each SCD can be individually pre-set to Class A - high sensitivity (3 holes per pipe), Class B - enhanced sensitivity (5 holes per pipe), Class C - normal sensitivity (8 or 12 holes per pipe) and Prison Cell mode settings. The SCD smoke sensor identifies the visible smoke particles generated as material over-heats. All ProPointPlus aspirating smoke detectors are fully compliant with EN54 Part 20.

Aspirating **FIRE & SMOKE** Detection utilising Cirrus HYBRID Aspirating Fire & Smoke Detectors

Protec Cirrus HYBRID aspirating detector contains two separate detection elements to detect two different phenomenon associated with fire (fire particles and smoke particles). The Cirrus HYBRID detector includes as its primary sensor, a 'Cloud Chamber' fire detector. This is supplemented by high sensitivity 'Optical' detectors provided within each of the four detector sampling ports.

Fire detection – The Cloud Chamber detector identifies invisible sub-micron particles generated during the combustion process when an over-heat condition occurs. The Cloud Chamber measurement scale is in particles per cm^3 (PCM^3) and provides the 'Fire' detection element of the Cirrus HYBRID detector.

Smoke detection – Optical smoke sensors identify visible smoke particles generated as material continues to over-heat. The optical measurement scale is percent obscuration per meter (%Obs/m) and provides the 'Smoke' detection element of the Cirrus HYBRID detector.

Combined Fire and Smoke Scale – Cirrus HYBRID detectors indicate these two separate detection element scales (PCM^3 & %Obs/m) individually, however as its primary display these two scales are combined and integrated on a bespoke scale known as Combined Fire and Smoke (CFS). All Cirrus HYBRID aspirating fire and smoke detectors are fully compliant with EN54 Part 20.

Main Aspirating System Components

Protec Aspirating System Detectors technical summary.

Cirrus Pro 200 Fire Detection

Maximum area of detection allowed:	2000m^2 or a single zone or fire compartment
Maximum total length of sampling pipe:	Approx. 200m (subject to calculation program)
Maximum number of pipes:	4
Maximum number of sampling holes:	EN54 Class A – 36 holes/pipe Gain 9 @ 15% EN54 Class B – 36 holes/pipe Gain 8 @ 15% EN54 Class C – 36 holes/pipe Gain 7 @ 15% All designs subject to calculation program verification.
Sampling pipe I/D:	15mm – 25mm
Supply Voltage:	20 – 29 volts DC
Current consumption:	317mA quiescent – 357mA in alarm
Dimensions:	W – 360mm, H – 215mm, D – 144mm

For the aspirating system detector technical summary on Cirrus Pro models not detailed above please r
to Protec Fire & Protec Fire & Security Group individual product data sheets

ProPointPlus Smoke Detection

Maximum area of detection allowed:	2000m^2 or a single zone or fire compartment
Maximum total length of sampling pipe:	Approx. 200m (subject to calculation program)
Maximum number of pipes:	4
Maximum number of sampling holes:	EN54 Class A – 3 holes per pipe EN54 Class B – 5 holes per pipe EN54 Class C – 8 holes per pipe All designs subject to calculation program verification
Sampling pipe I/D:	15mm – 25mm
Supply Voltage:	20 – 29 volts DC
Current consumption:	Fan speed dependant
Dimensions:	W – 380mm, H – 250mm, D – 137mm

Cirrus HYBRID Fire & Smoke Detection

Maximum area of detection allowed:	2000m^2 or a single zone or fire compartment
Maximum total length of sampling pipe:	Approx. 260m (subject to calculation program)
Maximum number of pipes:	4
Maximum number of sampling holes:	EN54 Class A – 36 holes @ 200 CFS EN54 Class B – 44 holes @ 400 CFS EN54 Class C – 44 holes @ 600 CFS All designs subject to calculation program verification
Sampling pipe I/D:	15mm – 25mm
Supply Voltage:	20 – 29 volts DC
Current consumption:	Fan speed dependant
Dimensions:	W – 380mm, H – 250mm, D – 137mm

Important Note:
The above details reflect the general parameters where EN 54 approved products are required. All aspirating detection systems designs are subject to the local area/country design, installation and performance codes/requirements. Additionally, ALL system designs must be verified using Protec 'ProFlow' sampling pipe calculation program.

'ProFlow' sampling pipe calculations confirm acceptability of operational parameters such as type of detector, lengths of sampling pipes, quantity and diameter of sampling holes or capillary sampling points.

Portable Aspirating Detector

Cirrus Pro Locator

Maximum area of detection allowed	Hand held portable unit for localised testing
Maximum total length of sampling pipe	N/A
Maximum number of pipes	1
Maximum number of sampling holes	N/A
Sampling pipe I/D	N/A
Supply Voltage	100v – 240v 50/60Hz
Battery Life	Standard 2h 30m – Extended 3h 0m
Dimensions	W – 350mm, H – 260mm, D – 120mm

Protec Cirrus Pro Locator is a portable air sampling detector. The detector uses Cloud Chamber Detection (CCD) technology for very early warning fire detection. The unit is typically used to assist in the local identification of a potential fire source within a room, cabinet or general space. Many data centres have a Cirrus Pro Locator as supplementary equipment to the main room detection system to further aid in locating the actual origin of alarm from within electronic racks.

Protec Aspirating Detector Power Supply Units

9300/EN/18

9300/EN/24

9800/EN/38

9800/EN/65

The system designers should ensure a suitable and compatible power supply is used for each aspirating detector. Protec Series 9000 3Amp & 8Amp power supplies are a self-contained supply designed to power Protec aspirating detectors and charge the associated batteries simultaneously.

The charger uses power factor correction to ensure a near unity power factor, and switch-mode technology to provide a lightweight and efficient unit.

The designer should ensure the power supply is sized correctly to suit the alarm load, the quiescent load and alarm standby periods. The following tables provides quiescent and alarm power consumption figures for Protec aspirating detectors.

Cirrus Pro Detector Power Consumption

	STANDING	ALARM LOAD
DESCRIPTION	UNIT	UNIT
Cirrus Pro 100	263	302
Cirrus Pro 200	317	357
Cirrus Pro 200D	414	455
Cirrus Pro 200DSC	487	570
Cirrus Pro 200SC	417	521
Cirrus Pro 200+	410	430
Cirrus Pro 200D+	474	529
Cirrus Pro 200DSC+	564	662
Cirrus Pro 200SC+	417	521
Cirrus Pro X4	779	856
Cirrus Pro X4ND	699	776
Cirrus Pro RDP	80	80

Important Note:
The designer should check the particular model of the above detectors is compliant with the relevant approvals requirements for the particular project, as not all detectors carry all global product approvals.

ProPointPlus Detector Power Consumption

	ProPoint Plus							
Blower Speed (%)	Quiescent				Alarm			
	SCD 1x	*SCD 2x*	*SCD 3x*	*SCD 4x*	*SCD 1x*	*SCD 2x*	*SCD 3x*	*SCD 4x*
100	360	400	425	455	410	450	475	505
95	347	387	411	440	397	437	461	490
90	334	374	397	425	384	424	447	475
85	321	361	383	410	371	411	433	460
80	308	348	369	395	358	398	419	445
75	295	335	355	380	345	385	405	430
70	282	322	341	365	332	372	391	415
65	269	309	327	350	319	359	377	400
60	256	296	313	335	306	346	363	385
55	243	283	299	320	293	333	349	370
50	230	270	285	305	280	320	335	355
45	220	259	274	293	270	309	324	343
40	210	248	263	281	260	298	313	331
35	200	237	252	269	250	287	302	319
30	190	226	241	257	240	276	291	307
25	180	215	230	245	230	265	280	295
20	170	204	219	233	220	254	269	283
15	160	193	208	221	210	243	258	271
10	150	182	197	209	200	232	247	259
5	140	171	186	197	190	221	236	247

Cirrus HYBRID Detector Power Consumption

	CirrusHYBRID							
Blower Speed (%)	Quiescent				Alarm			
	SCD 1x	*SCD 2x*	*SCD 3x*	*SCD 4x*	*SCD 1x*	*SCD 2x*	*SCD 3x*	*SCD 4x*
100	522	590	626	685	622	690	726	785
95	504	572	608	649	604	672	708	749
90	485	558	595	640	585	658	695	740
85	463	545	572	604	563	645	672	704
80	449	531	554	590	549	631	654	690
75	431	495	535	567	531	595	635	667
70	417	481	522	549	517	581	622	649
65	404	467	504	535	504	567	604	635
60	390	454	485	517	490	554	585	617
55	376	440	472	504	476	540	572	604
50	372	417	454	485	472	517	554	585
45	363	408	445	472	463	508	545	572
40	349	395	431	458	449	495	531	558
35	335	381	417	445	435	481	517	545
30	322	367	422	435	422	467	522	535
25	317	363	395	417	417	463	495	517
20	308	354	372	395	408	454	472	495
15	299	345	358	381	399	445	458	481
10	295	335	345	367	395	435	445	467
5	290	317	331	358	390	417	431	458

Protec Aspirating System Sampling Pipe and Accessories

37-550-68
3 Metre Length 25mm o/d
Red ABS Sampling Pipe

37-550-68-SR
50m Length of 25mm o/d
Flexible Red Sampling Pipe

37-552-70
25mm Red ABS 90°. Long Radius Bend

37-555-73
25mm Red ABS 45 deg. Elbow

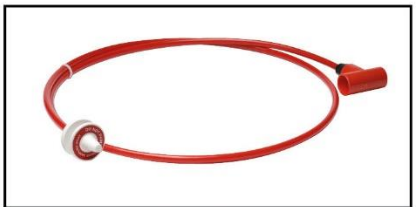
37-554-72
25mm Red ABS 'Tee' Piece

37-553-71
25mm Red ABS End Cap

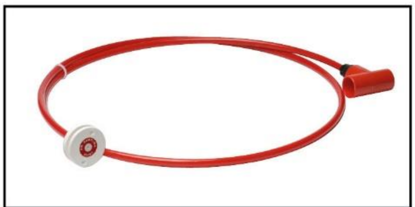
37-559-77
25mm Red ABS Socket Union

37-558-76
Red ABS Pipe Clips

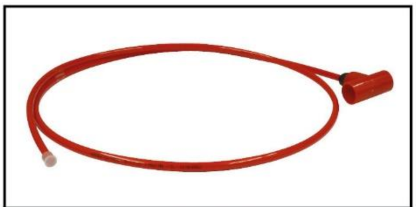
37-551-69
25mm Red ABS Jointing Socket



37-560-70
Conical Head Capillary Sampling point
2mtrs of 10mm sampling tube

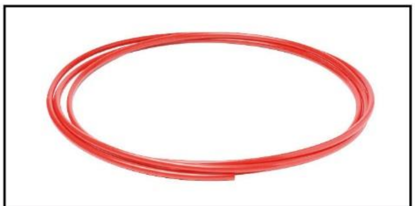


37-561-71
Flush Disc Capillary Sampling point
2mtrs of 10mm sampling tube

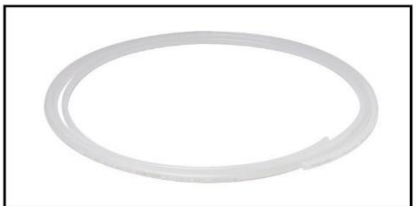


37-562-72
Discrete Capillary Sampling point
2mtrs of 10mm sampling tube

37-563-73
T piece for use with 10mm Capillary
Sampling tube



37-564-74
30mtr coil RED 10mm Capillary
Sampling Tube



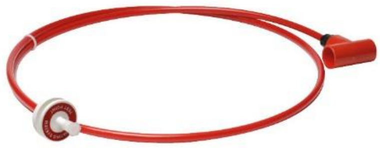
37-564-74W
30mtr coil OPAQUE 10mm Capillary
Sampling Tube

37-566-76
Conical Head Capillary Sampling Point

37-567-77
Flush Disc Capillary Sampling Point

37-568-78
Discrete Capillary Sampling Point

37-585-15
25mm Red ABS End Cap 'Test Point'



37-586-16
Flush Disc Capillary 'Test Point' c/w 2mtrs of 10mm sampling tube.

37-545-71
1m x 25mm o/d Flexible Expansion Loop

37-556-74
S250ml Tin Solvent Cement

23-039-37
Sample Hole Warning Labels. Roll of 100
1no Label required per Sampling Point

37-534-68 - 2.0mm Purple
37-535-69 - 2.5mm Grey
37-536-70 - 3.0mm Yellow
37-537-71 - 3.5mm Blue
37-538-72 - 4.0mm Green
37-539-73 - 4.5mm Black
37-540-74 - 5.0mm W hite
37-541-75 - 6.0mm Brown

Hole Identification Tags
(See Datasheet - MED2123)

61-986-F01 - 25mm In-line Pipe Filter
61-986-28 - 3 Stage Replacement Filter Mesh (See Datasheet - MED2125)

45-023-04
Heavy Duty Dust & Humidity Filter
(See Datasheet - MED2124)

45-023-07 - Heavy Duty Dust & Humidity Filter c/w Self Drain Flexible Loop
(See Datasheet - MED2124)

37-584-14-BIS
Condensation Trap

37-599-29
Flush Disc Capillary Test Point

37-590-20
Pipe Cutter

Typical Aspirating System Applications

High Sensitivity Detection applications include:
- Clean Rooms
- Control Rooms
- Computer Rooms
- Data Storage Facilities
- Archive Storage

General/Enhanced Sensitivity Detection applications include:
- Roof Voids
- Warehouses
- Atria
- Production Facilities
- Power & Utility Plants

Harsh Environment applications include:
- Cold Storage Facilities
- Chilled Storage Facilities
- Food Production Facilities
- Specialist Production Areas
- Dusty Production Plants

Special Risk applications include:
- Electrical Control Cabinets
- Prison Cells
- Power Plants
- Conveyor Systems
- Flight Simulators

Sensitive applications include:
- Heritage Buildings
- Cathedrals
- Museums
- Art Galleries
- Cultural Centres

Pre Design Considerations

Expectations of the completed aspirating detection system

Prior to the detection system design and in the absence of a specification, the designer should consult with the client to confirm the expectations from the completed aspirating detection system. These consultations should include such things as the 'type' of detection system to be installed, the compliance with applicable local area codes and standards, the 'realistic' sensitivity of the detector for the given application and a possible and suitable performance test for the completed installation, if required.

Detector Sensitivity

The sensitivity of the required detection system is dependent upon a number of issues including the application of the detection system, the 'type' of aspirating detection system employed, the ambient background particle levels, local area codes and performance test requirements.

Aspirating detectors have a large sensitivity range. This enables the detectors to be installed in applications as diverse as a 'Cleanroom' requiring the very highest sensitivity available through to a *'polluted'* warehouse/production area, where detector sensitivity is often determined or restricted by the background environmental operating conditions.

By utilising the range of the detector sensitivity, it is possible that from a single aspirating detector up to four alarms can be generated at different points along the fire growth curve as detailed in the example below.

Example 1: Computer Room Installation using a 'cloud chamber' based aspirating detector

Pre-alarm condition	-	May be given when the detector is operating at a very high sensitivity level. This condition would most likely initiate a visual check only of the protected space. It should be noted that there may not be any visible smoke present at this time. (0% obs/ft.)
Fire 1 condition	-	May be given when the fire condition is continuing to develop. This alarm level may 'shut-down' any forced ventilation to enable any point/spot detectors to be more efficient.
Fire 2 condition	-	May be given when the fire condition is continuing to further develop. This alarm could provide a signal to 'evacuate' the building to protect any personnel that may be affected by the alarm condition.
Fire 3 condition	-	May be given when the fire condition is continuing to further develop. This alarm level could provide a signal to a 'fire suppression' system to suppress/extinguish the fire condition.

Example 2: Warehouse Installation using a 'cloud chamber' based aspirating detector

Pre-alarm condition	-	Local area visual investigation, area may contain invisible fire particles and visible smoke particles.
Fire 1 condition	-	Evacuate signal sent to main building fire alarm system – possible similar cause and effect outputs to point type smoke detector installations.
Fire 2 condition	-	Not Used
Fire 3 condition	-	Not Used

Background Particle Levels

The actual sensitivity setting of the detector for each specific application can be affected by the ambient background particle level in the area of detection. This ambient particle level may be influenced by many sources including; the height of the area, the proximity to outside air, any production or manufacturing processes that may be carried out within the environment and the influence of forced air ventilation or air penetrating from adjoining areas.

It is important to remember this ambient background particle level may not be consistent throughout the period of a day, week other time span. With this in mind, the sensitivity of some aspirating detectors can be configured to suit the variable background levels in a number of ways; including different time zone settings typically described as 'day/night' settings and by each day of the week to allow for differences between working days and none working days.

Detector Settings often referred to as 'Detector Class'

Aspirating Detection Systems are generally designed in compliance with standards such as EN54-20:2006 Section 7 and in such cases are classified as a Class A, Class B or Class C Systems. This classification assumes that the final operational environment is suitable for this design and proposed detector sensitivity, both at commissioning stage and more importantly, when the building becomes fully operational. Where the client's environment cannot provide a background level that allows the correct sensitivity, the application may be considered to be of an 'Undefined Detector Sensitivity' and sit outside Class A, B or C.

Class A Detection System
Definition: - Aspirating smoke detector providing very high sensitivity. These systems are often employed in areas so that evasive measures can be initiated before any significant damage is incurred to areas containing mission critical or high value artefacts or operations.

Class B Detection System
Definition: - Aspirating smoke detector providing enhanced sensitivity. These systems are often employed in areas where fire and smoke particles are difficult to detect. This would include areas where there is dilution from high airflow movements or where there are high ceiling spaces.

Class C Detection System
Definition: - Aspirating smoke detector providing normal sensitivity. These systems are often employed as an alternative to point type smoke detectors or beam detectors, for reasons such as; building deflection or where perhaps servicing is made easier using aspirating system pipe installations.

Undefined Detector Sensitivity
Definition:- Aspirating smoke detector providing sensitivity applicable to the operational environment.

Aspirating detection systems are sometimes employed in difficult or harsh environments applications. This is usually after consideration is given to other detection technologies such as point type heat and smoke detectors, beam detectors, flame detectors or linear heat detection etc. When aspirating detection systems are employed in these difficult applications, it is important to consider the effectiveness of the detector sensitivity, as this is usually determined by the varying background ambient environment.

The amount of ambient dust, humidity, temperature, steam, vehicle emissions and other pollutants will all influence the operational sensitivity of the aspirating detector. Therefore, the detector sensitivity is essentially configured to accommodate these ambient background conditions within the End Users operational environment and as importantly, to avoid where possible unwanted alarms from none fire events.
To allow the correct sensitivity setting of these detection systems, it is important to introduce an extended 'soak test period', where the background pollutant variations can be determined. Having logged this information for an appropriate time period, the alarm thresholds can then be configured to avoid unwanted alarms.

Having established the ambient background environment and detector alarm thresholds, a suitable 'performance test' is recommended. Any tests should be agreed by all concerned parties and appropriate health and safety procedures should be adhered to. See Note below on 'Requirement for Aspirating Detection System Function and Performance Testing.'

'Types' of Aspirating Detection Systems

It is generally accepted that there are five concepts of Aspirating Detection System design.

Primary Detection Sampling System
Definition:- A system utilising the airflow created by the air conditioning and ventilation system to carry the sampled air to the sampling points.

Secondary Detection Sampling System
Definition:- A system where the air sampling points are sited and spaced as if they are point type smoke detectors.

Localised Detection Sampling System
Definition:- A system where the air sampling points are arranged and spaced to provide monitoring of specific pieces of equipment.

Duct Detection Sampling System
Definition:- A system where the air sampling is provided within the ducting of a ventilation system.

In-Cabinet Detection Sampling System
Definition:- A system where the air sampling is provided either directly inside or adjacent to a specific piece of electronic hardware or control equipment.

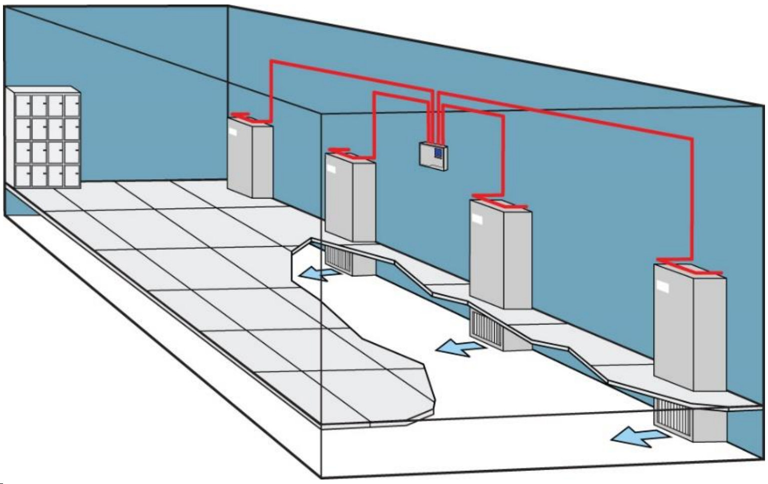
Primary Detection Sampling Systems

Primary Detection Sampling Systems are designed to monitor the airflow movement within a room by strategically positioning the sampling pipe directly in the airflow. This type of detection is usually supplementary to other forms of detection, as it would have limited detection response when the forced airflow is not operational.

Due to the cumulative effect (air with combustion particles entering more than one sampling point), the sensitivity of such a system when monitoring a single point of extract or supply, may be directly related as equal to the sensitivity of a central detector. Consultation should be sought with Protec Fire & Security Group or its nominated representative where detection is taken from multiple supply and extract points on the same detector.

Aspirating detectors can operate at very sensitive levels when used as a means of Primary Detection and as such, are often used to 'shut-down' mechanical ventilation systems to enable 'point type' detectors to operate more efficiently.

Note: Primary detection is usually regarded as supplementary to other forms of detection due to its limited response capability once the air movement ceases. With this in mind, the aspirating system designer should confirm with local area/country design codes to identify other additional relevant forms of detection within the protected areas.



Primary Detection Example
(All sampling points located directly in the airflow of the room at the return air grille of each handling unit)

Secondary Detection Sampling Systems

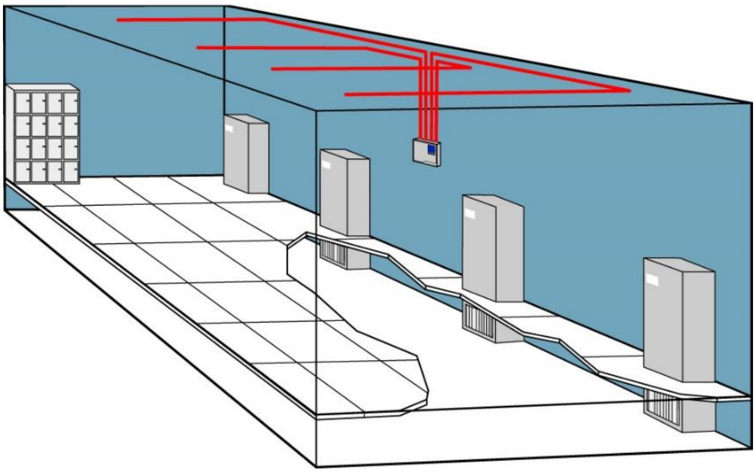
Secondary Sampling Systems are designed so that the air sampling points are sited and spaced as if they are 'point type' smoke detectors in line with local standards and codes.

This design concept may offer an extremely good alternative to 'point type' detectors or 'beam' detectors when installed in high applications. For these high level applications, it may be necessary to install some vertical or multi-level sampling points as some smouldering fires produce little heat energy to carry particles to the high level detection points.

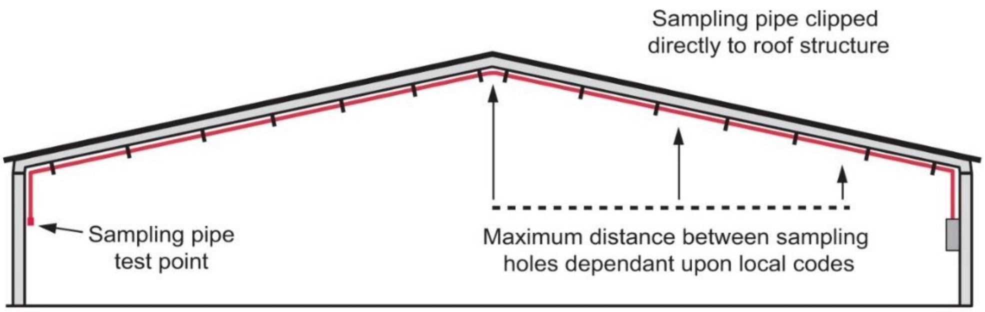
Care should be taken with this design option to ensure that ceiling 'apex' areas, voids and compartments are covered correctly.

Where access for maintenance of 'point type' detectors or 'beam' detectors may be either difficult or expensive, Secondary Sampling Systems can provide a logical and inexpensive design option. It is recommended that dedicated sampling pipe 'test points' are installed in accessible locations. This will enable the integrity of the entire sampling pipe array, to be confirmed during maintenance visits. Note: In addition to test point testing, the airflow values of each sampling pipe also require verification with the previous commissioning/service visit values.

The design of a secondary aspirating detection system could comply with local country codes and standards, however, the performance with regards to airflow dynamics, may be improved with additional sampling holes drilled into the sampling pipe. This would be at virtually no additional cost to the installation. Additionally, on some smaller installations, extra sampling holes can increase the air flow in sampling pipes, which can allow pipes to be less susceptible to room airflow pressure changes.



Secondary Detection Example
(All sampling points located in the position of 'point type' smoke detectors)



Secondary Detection Example
(All sampling points located in the position of 'point type' smoke detectors)

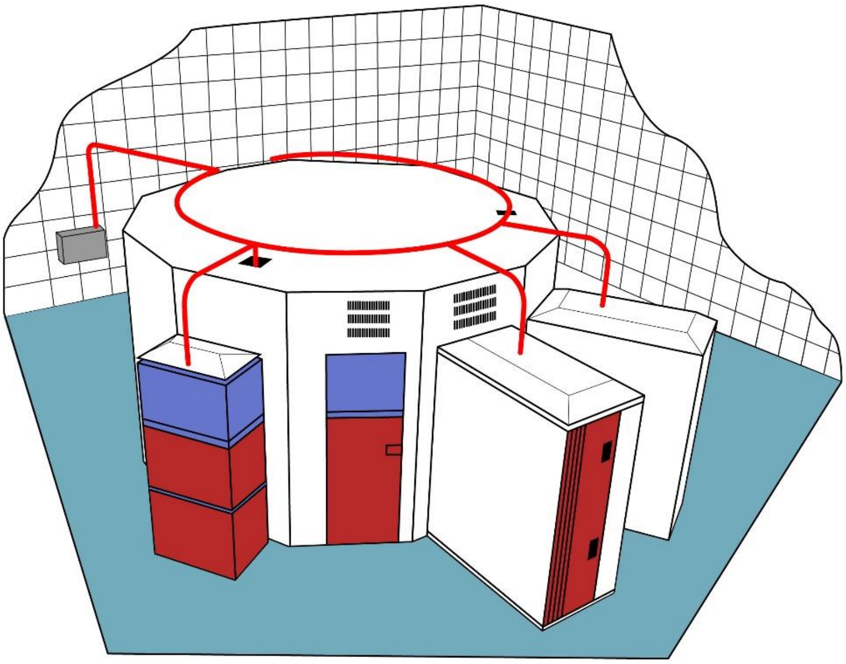
Localised Detection Sampling Systems

For localised sampling, the pipe work and sampling points are arranged to monitor specific pieces of equipment in an open area.

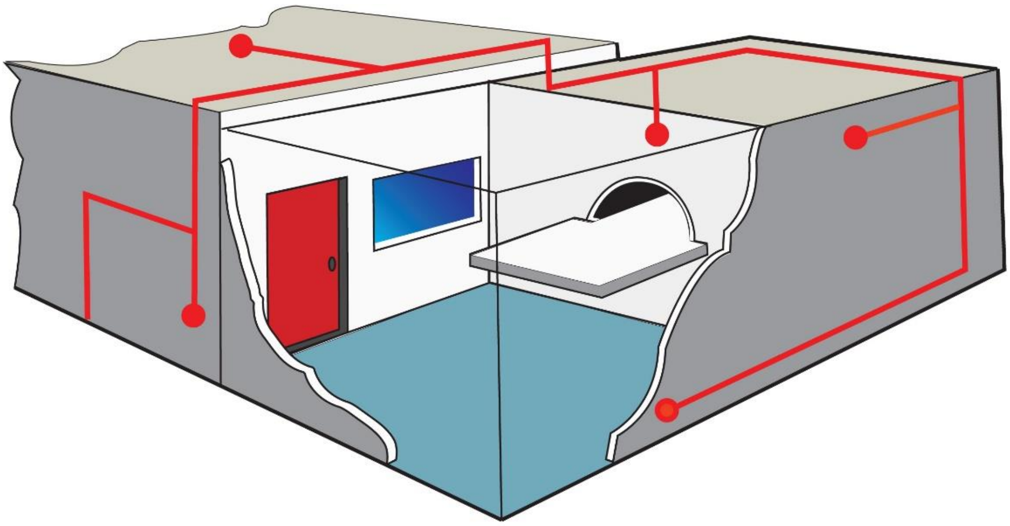
This method of detection is usually established following some type of test simulation to best recreate, where possible, the actual application. The sensitivity of such a system is generally dependent upon the application and environment of the specific piece of equipment.

Consideration must also be given by the end user to ensure that any future changes to the equipment do not have a detrimental effect on the installed detection system.

Localised Detection Example - Data Storage Carousel



Localised Detection Example - MRI Scanner



Duct Detection Sampling Systems

Aspirating Detectors may be used for duct sampling, dependent upon the risk and application.

Duct detection systems usually comprise of the aspirating detector mounted locally to the protected duct. An 'air inlet' sampling pipe probe is installed into the ducting to carry the sampled air to the detector and an 'exhaust' sampling pipe probe is installed into the ducting to return the sampled air to the duct.

It is strongly recommended that Duct Sampling Systems are installed in straight lengths of ducting at a distance of 6 times the diameter of the duct downstream of any bends, nozzles, tee's or branches, etc. For this reason, Duct Sampling is not recommended for flexible ducts due to the turbulence of air usually found within this type of ducting.

For small ducts up to 1m wide, the 'air inlet' sampling pipe probe is mounted in the centre of the duct with sampling holes spaced approximately 200mm apart. The 'exhaust' sampling pipe probe should be mounted a minimum of 500mm downstream of the 'air inlet' probe and at a quarter of the height of the duct from the top or bottom of the duct, with a minimum of 4 holes mainly concentrated towards the middle of the duct.

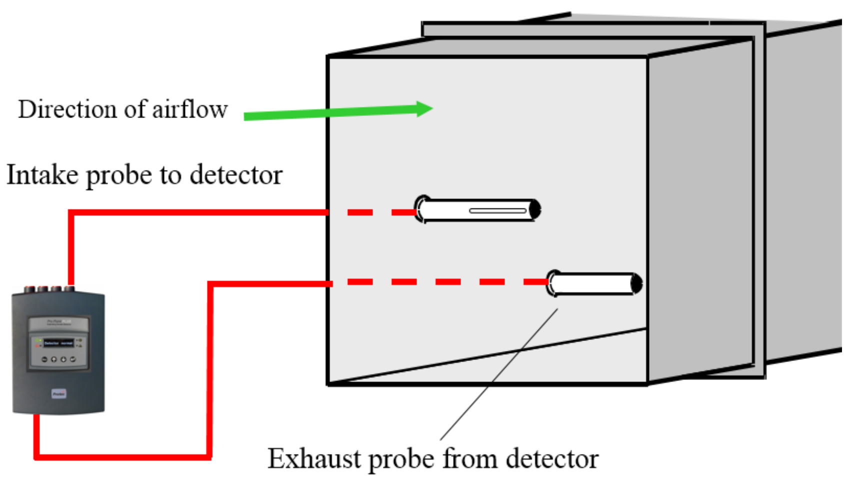
For larger ducts 1m - 2 m wide, it is recommended that the 'air inlet' sampling pipe probe be branched outside the duct to create two individual probes. These should be mounted proportionally within the height of the duct, with the 'exhaust' sampling pipe probe mounted centrally within the duct. Again, a minimum of 4 sampling holes concentrated mainly towards the middle of the duct should be installed.

The quantities and diameter of all sampling holes should be confirmed utilising the Protec 'Pro Flow' sampling pipe calculation program.

Sampling from multiple ducts is not recommended.

Sampling from ducting and ambient environments is not recommended on the same detector.

The FIA Code of Practice Issue 3 February 2012 offers some useful guidance on Duct Sampling or alternatively for further information on this specialist type of aspirating detection system design please contact Protec Fire & Security Group.



In-Cabinet Detection Sampling Systems

In-Cabinet Detection sampling is where the air sampling is provided either directly inside or adjacent to electrical cabinets, racks, consoles, switchgear, cable trays or any other electrical equipment, electronic hardware or control equipment.

This monitoring technique may be used where the protection of specific pieces of equipment is critical to the continued operation of communications, control or production processes.

In-cabinet detection systems should not be expected to provide detection outside of the protected cabinet/equipment. Room detection should be provided by other dedicated aspirating detectors.

The designer should consider the quantity of cabinets protected by a single detector, as in an alarm condition the inspection of many cabinets may be time consuming. Consideration must also be given by the end user to ensure that any future changes to the equipment function or layout do not have a detrimental effect on the detection system.

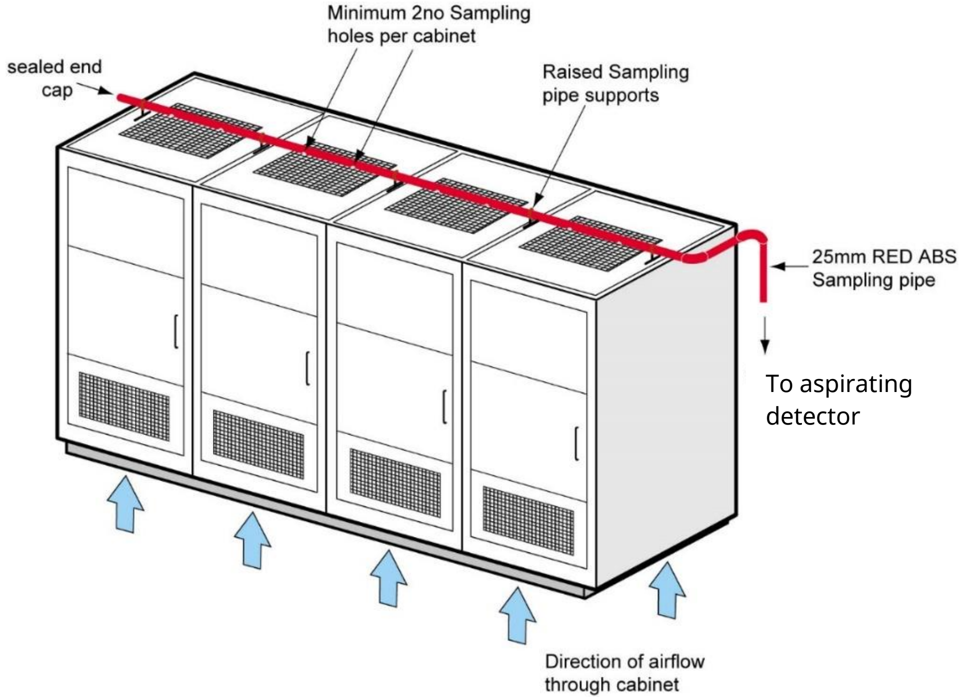
ABS sampling pipe is non-conducting and therefore has no effect on sensitive electronic components. Likewise, unwanted alarms should not be experienced from electromagnetic interference.

Above Cabinet Sampling Pipes

Sampling pipes are placed directly above the equipment, in the path of the airflow generated by the forced or natural ventilation.

Sampling pipes should be located in the centre of the exhaust air stream or directly above the equipment being protected. To enable optimum performance these sampling holes may need to be placed off centre of the airflow. If there are multiple equipment exhausts then sampling points must be located over each opening.

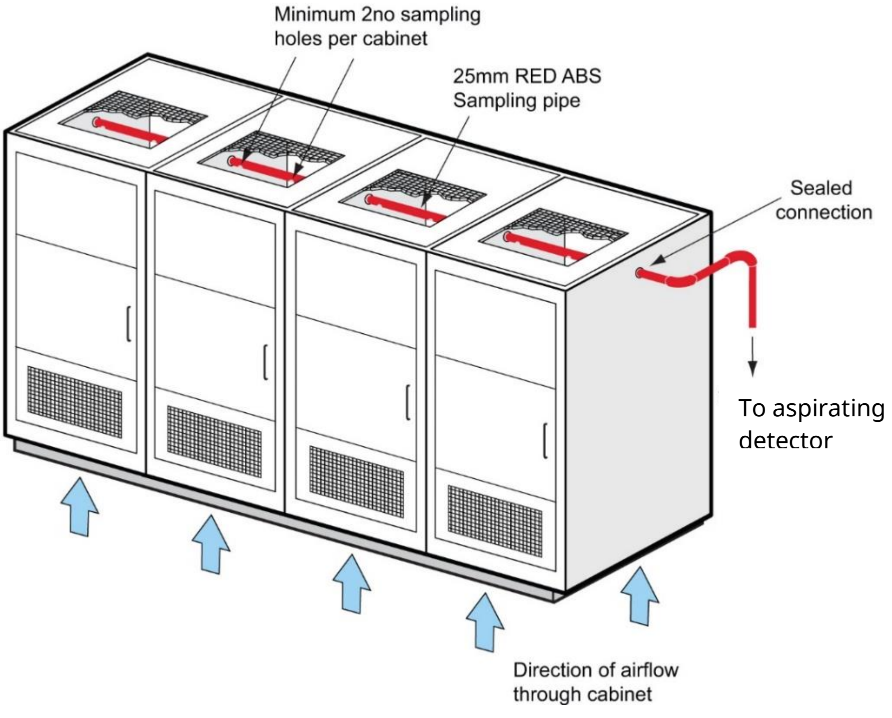
Where cabinet exhaust vents are large, it may be necessary to use two or more sampling pipes to adequately detect all potential incidents. When possible, a series of tests should be performed to verify the efficiency of the installation. If differential pressures create airflow faults, it may be a requirement to modify the aspirating detector exhaust to rectify this.



In-Cabinet Sampling Pipes

This method of detection is often achieved using standard sampling pipe or 'Capillary Sampling Points' installed directly inside 'locked' electrical cabinets. If detection is provided by utilising forced airflow through a cabinet, then consideration should be given to the overall system detection capabilities should the forced airflow fail or be switched off.

For safety reasons, it is recommended that dedicated sampling pipe 'test points' are installed in 'safe' locations. This enables the integrity of the entire sampling pipe array to be confirmed during maintenance visits, without the need to power down electrical cabinets to gain access to the sampling points. To enable optimum performance, sampling holes may need to be placed off centre of the airflow. If differential pressures create airflow faults, it may be a requirement to modify the aspirating detector exhaust to rectify this.

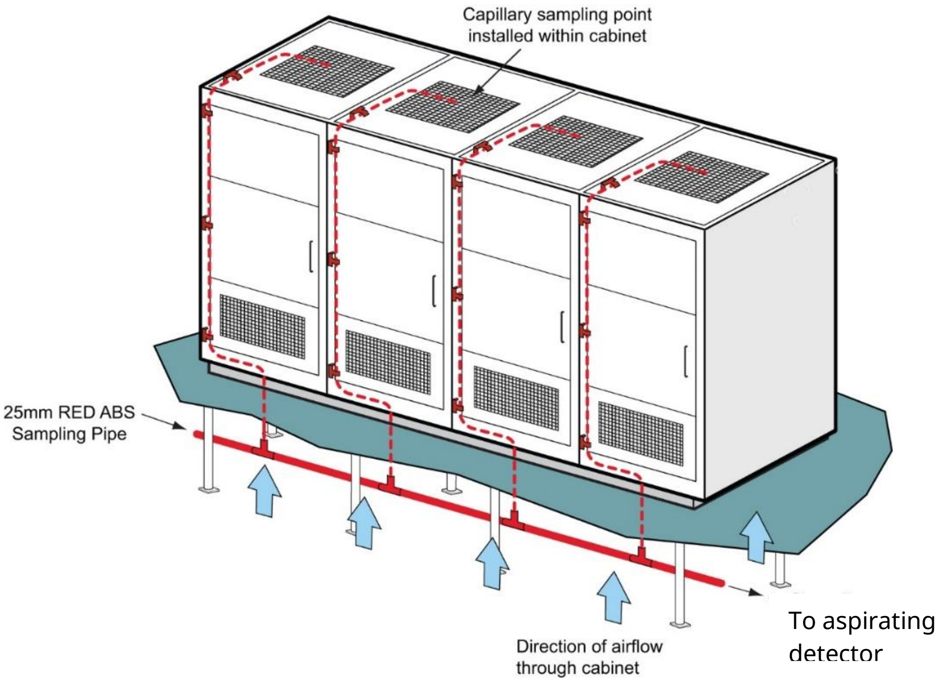


Alternative In-Cabinet Sampling Pipes Utilising Capillary Sampling Points

A more aesthetically pleasing installation may utilise the under floor void area for the main trunk pipe, with small bore capillaries installed to the optimum detection position.

The capillary sampling pipe should be securely fixed inside the cabinets to prevent interference with the normal operation of the cabinet.

To enable optimum performance, sampling holes may need to be placed off centre of the airflow. Additionally, it may be a requirement to take the aspirating detector exhaust into the protected cabinets. If differential pressures create airflow faults, it may be a requirement to modify the aspirating detector exhaust to rectify this.



Other Aspirating Detection System Design Considerations

Stratification Effect on Aspirating System Designs

Stratification can occur when air containing smoke particles or gaseous combustion products is heated by smouldering or burning material. Whilst becoming less dense than the surrounding cooler air, it rises until it reaches a level at which there is no longer a difference in temperature between it and the surrounding air. The smoke plume, as it rises, encounters colder air from above which absorbs heat and slows the upward movement of the smoke.

As this stratified gas layer moves away from the fire, cooling and dilution will eventually produce a well-mixed flow of combustion products.

Stratification can also occur during hot days when the sun has heated the roof structure of a building to a high temperature producing a much hotter air layer just below the roof. A small fire starting at ground level may not have the thermal energy to push the smoke particles through the higher temperature air barrier. This would result in the smoke not reaching the detection points on the roof level until the fire is considerably larger.

Testing has indicated that a ‘cloud chamber’ based detection system such as Protec Cirrus HYBRID or Cirrus CCD are slightly less susceptible to stratification when compared to ‘optical’ only aspirating detectors, however this phenomenon should not be ignored and must still be a design consideration.

One option when stratification is considered to be relevant would be to allow sampling holes to be dropped from the main ceiling detection level to a height where they would not be affected by the stratification (these are known as extended sampling points). An alternative option would be to install one or more (as required) vertical sampling pipes, in addition to the main ceiling detection sampling points.

Dilution Effect on Aspirating System Designs

Dilution can affect aspirating detection systems and therfore this should be considered at design stage. The amount of dilution is affected by the detector sensitivity and the number of sampling holes within the protected area.

When combustion/smoke particles are only drawn through a single sampling hole, these particles are diluted when they reach the detector by the clean air drawn through the remaining holes. Given that this is the case, the more sampling holes used on the design the greater the potential for dillution.

Aspirating systems should be designed (and proven by a sampling pipe calculation program) to ensure a similar amount of airflow is drawn through each sampling hole. Additionally, verification testing of detector response and transport time is required for each sampling hole.

Where Protec EN54 part 20 approved aspirating detectors are used the restrictions on the number of sampling holes has been determined as an integral part of the approval process. The following should be applied by all designers to these designs.

Cirrus Pro aspirating system designs
EN54 Class A – maximum 36 holes/pipe Gain 9 @ 15%
EN54 Class B – maximum 36 holes/pipe Gain 8 @ 15%
EN54 Class C – maximum 36 holes/pipe Gain 7 @ 15%

ProPointPlus aspirating system designs
EN54 Class A – maximum 3 holes per pipe
EN54 Class B – maximum 5 holes per pipe
EN54 Class C – maximum 8 holes per pipe

Cirrus HYBRID aspirating system designs
Non- scanning detectors
EN54 Class A – 36 holes @ 200 CFS
EN54 Class B – 44 holes @ 400 CFS
EN54 Class C – 44 holes @ 600 CFS

Cirrus HYBRID aspirating system designs
Sscanning detectors
EN54 Class A – 36 holes @ 400 CFS
EN54 Class B – 44 holes @ 400 CFS
EN54 Class C – 44 holes @ 600 CFS

For other design standards and product approvals the designer should seek the technical requirements of that standard.

Pressure Differentials between Rooms

The aspirating system designer should consider the location of the aspirating detector for a number of reasons including (but not limited to) accessibility, security, temperature and any other environmental conditions.

However, one consideration often overlooked is the location of the aspirating detector when related to the protected space. This can be very important to the fundamental operation of the detector, especially if there are air pressure differentials between these two areas. These are often (but not always), rooms that contain some sort of forced air movement. Typical examples of these applications can include; computer suites, cold storage facilities, chilled storage, duct sampling systems and many others, where the detector is located in adjoining rooms/areas to the protected space.

The most common way to avoid this potential problem is to ensure the aspirating detector exhaust is returned to the same air space protected by the sampling pipes, thereby equalising any pressure differential.

Venturi Effect around Sampling Holes

The aspirating system designer should consider any natural or forced air movement likely to be prevalent around the areas where the sampling holes are located. One effect of excessive natural or forced air movement could be to create areas where a Venturi Effect would reduce or possibly prevent, air entering the sampling points thus restricting the efficiency of one or more sampling holes.

Some applications including duct detection, in-cabinet detection where forced or natural airflows are expected, cold storage, chill storage and cooler storage facilities are particularly vulnerable to this potential problem.

Transport Time Requirements for Aspirating System Designs

Transport Time Definition:
Definition: The time for aerosols to transfer from a sampling point to the smoke sensing element.

Maximum Transport Time
Definition: The maximum time in the aspirating detection system for aerosols to transfer from the furthest sampling point to the smoke sensing element.

Maximum transport time requirements are given below for Class A, Class B and Class C designs with reference to FIA Code of Practice for Design, Installation, Commissioning and Maintenance of Aspirating Smoke Detector (ASD) Systems Issue 3 February 2012.

Class A designs – maximum transport time = 60 seconds
Class B designs – maximum transport time = 120 seconds
Class C designs – maximum transport time = 120 seconds

Maintenance Test Points

Definition: A test point, provided beyond the last sampling point, to test the integrity of the pipe network. Such a test point is closed in normal operation and is not subject to the maximum transport time.

As 'Maintenance Test Points' do not form part of the sampling pipe detection system, the transport time taken from the 'Test Point' to the detector is not restricted. However, the transport time taken from each 'test point' should be recorded and repeated on each visit with any changes in time investigated. Additionally, when maintenance test points are used it is a requirement that the airflow value readings be compared and confirmed with previous airflow value readings to ensure they remain the same.

For other design standards and product approvals the designer should seek the technical requirements of that standard.

Design Verification

It is a requirement that upon completion of every aspirating system design confirmation of all the design parameters is verified by the use of a compatible sampling pipe design calculation programme.

This programme should confirm the following:

- The model number, type and fan speed of the selected detector
- The relevant approvals of the selected detector
- The minimum and maximum pipe lengths and number of sampling holes proposed
- The airflow rates, parameters and pressures at each part of the installation
- The time taken from all the sampling holes to the detector (transport time).

This programme will confirm the sampling hole dimensions and will indicate if there are any errors with the overall design.

Requirement for 'Commissioning/Function Testing'

Any commissioning or functionality testing required by any design code or local country legislation, should be carried out when the installation works are fully electrically and mechanically complete. Testing should include the individual testing/proving of ALL sampling holes of the aspirating detection system, using only the correct test material and in conjunction with the relevant Protec product manuals. The results of these tests should be recorded on the appropriate commissioning documentation.

The designer should therefore confirm at design stage the possible requirements of any functionality testing with regards to any cause and effects of the installed aspirating detection system, should this be required.

Requirement for 'Performance Testing'

Prescriptive or Performance Based Designs
Typically, 'point type' smoke detection systems usually only require compliance to an area of coverage per device. Aspirating detection systems however should be designed to achieve an acceptable level of fire detection for the protected area and to take into consideration other aspects such as ventilation and forced or natural extraction points. Therefore, the designer should, where possible, request information or acquaint themselves with any aspects of the proposed area to be protected, that could be affected by these air movement and any other influences.

Prescriptive or Performance based designs are dependent upon the classification of the proposed aspirating system employed. Generally, there is only one situation where a performance test can be omitted and that is when the approved aspirating detector is deployed (and is fully compliant with the specific requirements of the product approval), with sampling hole spacings that fall within the full requirements of the relative prescriptive code. In all other situations, it is recommended that a suitable performance test is specified and carried out during commissioning to verify the system.

Note: Performance test should only be carried out when the building is in its final environmental and operational state, with any air conditioning, production machinery, environmental conditions etc. active.

The designer should therefore confirm with the client at design stage the most suitable 'performance test' for the installed aspirating detection system should this be required.

Typical Rules Regarding Sampling Pipe Types and Installation

Please refer to the Generic Installation Guide later in this manual.

Sampling Pipe Expansion and Contraction

Please refer to the Generic Installation Guide later in this manual.

Sampling Pipe Clips, Fixings and Labelling

Please refer to the Generic Installation Guide later in this manual.

Environmental Considerations – Condensation, Dust, Temperature etc..

Please refer to the Generic Installation Guide later in this manual.

Sampling Pipe 'Maintenance Test Points' Installation

Please refer to the Generic Installation Guide later in this manual.

Sampling Pipe Dust Management

Please refer to the Generic Installation Guide later in this manual.

Extended or Capillary Sampling Pipe

Please refer to the Generic Installation Guide later in this manual.

Sampling Pipe Calculation Program (ProFlow)

The design of any Aspirating Detection System should be confirmed by producing a sampling pipe calculation.

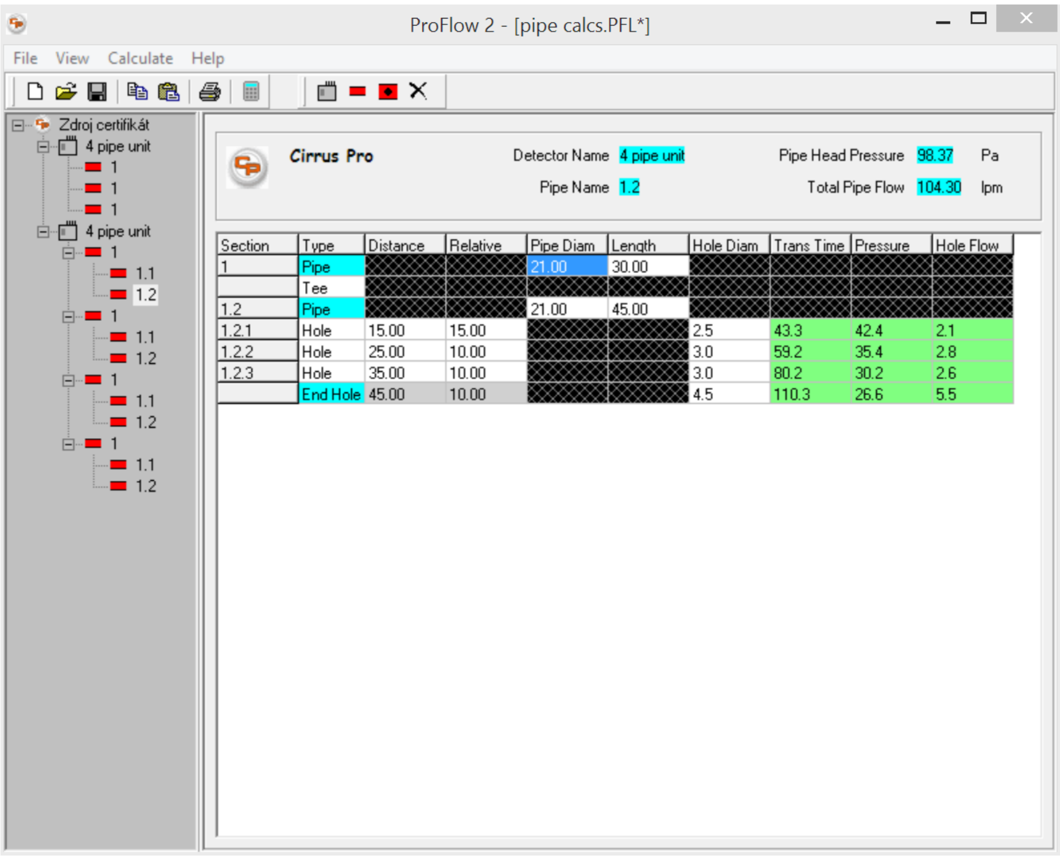
'ProFlow 2 and ProFlow 3D' is a 'Windows' based software program that allows the designer to enter the site specific information and then to automatically check a range of possible aspirating detector, sampling pipe sizes, sampling pipe lengths, quantity and diameter of sample holes or capillary sampling point configurations.

These programs can allow many design configurations to be evaluated and helps the designer to choose the most suitable layout for each individual application.

Some software 'default' parameters may be changed to allow compliance with local codes or project specific problems.

The completed calculations may be saved and should be presented to the system installer to ensure the proposed design is followed accurately. The installer should advise the designer if any part of the works cannot be completed in line with the original proposal, whereupon a revised sampling pipe design and calculation should be completed to ensure correct operation.

In addition, the calculation information should also be presented to the commissioning or test engineer to allow the detector to be configured correctly. The engineer can then confirm, through actual sampling pipe and sampling hole testing, the correct aspirating detection system operation, in line with the design proposals.

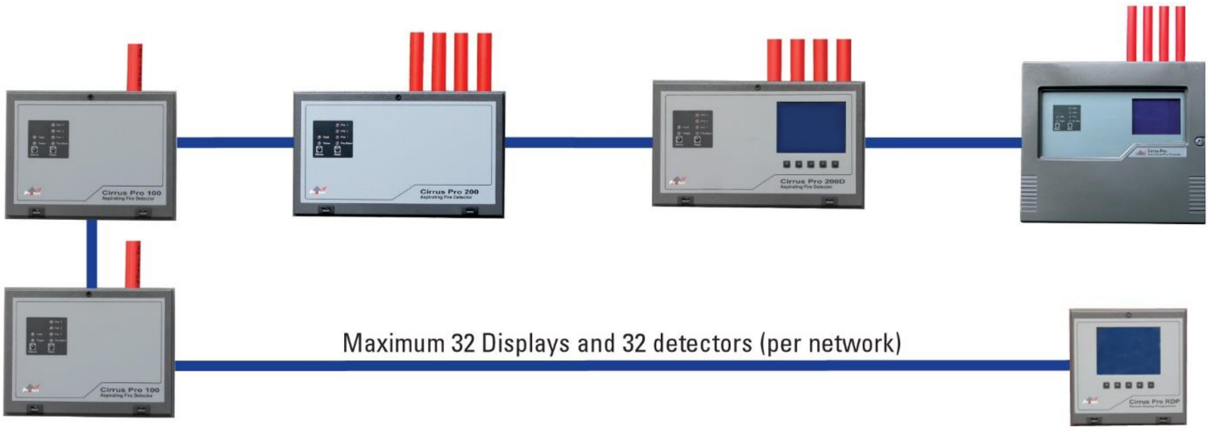


Aspirating Detector Comms Networks

Cirrus Pro RS485 Networks

Cirrus Pro detectors may be networked together to form an information highway between all connected detectors and displays. The RS485 network may consist of up to a maximum of 32 Cirrus Pro detectors and up to 32 Cirrus Pro displays. Each network device (detector or display) is given a network number for individual identification on the network.

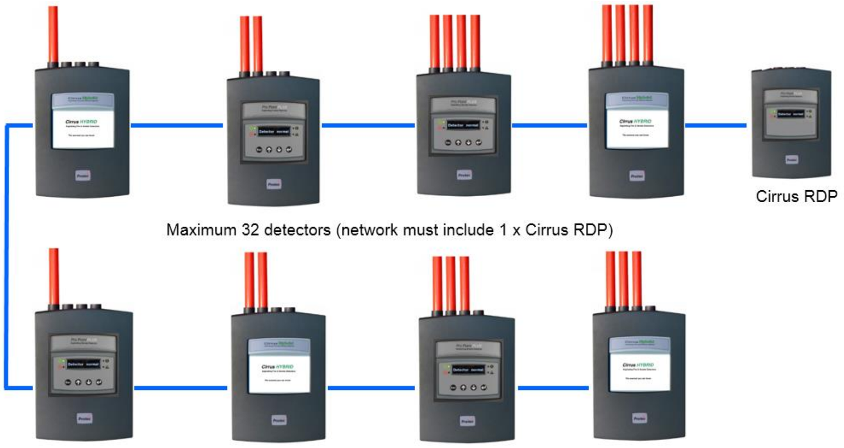
If a Cirrus Pro detector identifies either an 'alarm' or 'fault' condition, this information is given on all the required displays. A 'network fault' is provided at each display if a network connected device has lost communications with the main network.



Cirrus HYBRID and ProPointPlus RS485 Networks

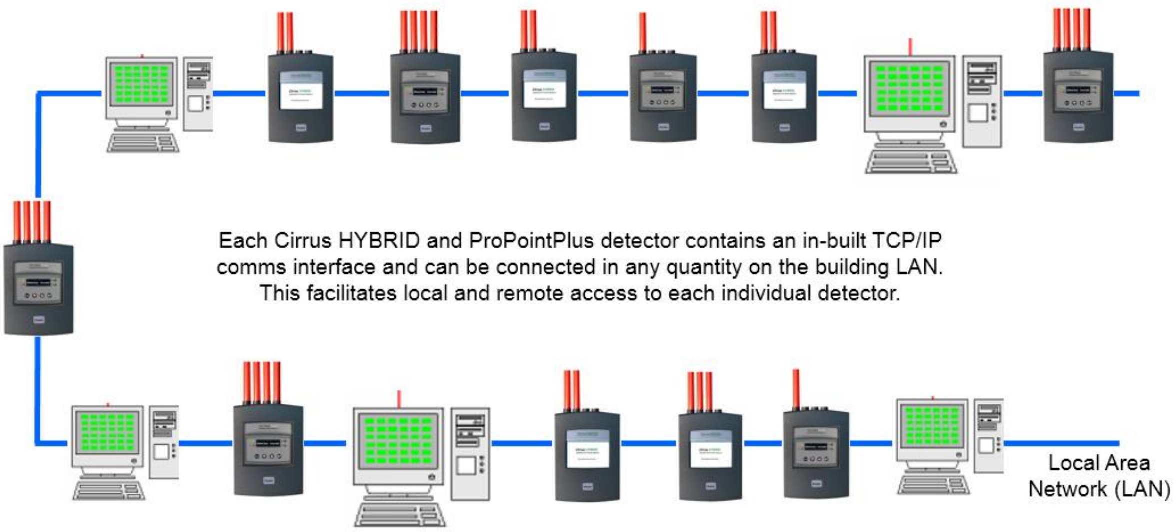
Cirrus HYBRID & ProPointPlus detectors may be networked together to form an information highway between all connected detectors. The RS485 network may consist of up to a maximum of 32 Cirrus HYBRID/PPP detectors. Each network device (detector or display) is given a network number for individual identification on the network.

If a network detector produces either an 'alarm' or 'fault' condition, this information can be viewed from the Protec Asp. RDP. A 'network fault' is produced at each display if a network connected device has lost communications with the main network. Each network must contain a Protec Asp. RDP.



TCP/IP Networks

Cirrus HYBRID and ProPointPlus aspirating detectors can be incorporated onto dedicated aspirating system IP networks or general building IP networks. Network cabling for this type of installation utilises Cat 5 cable.



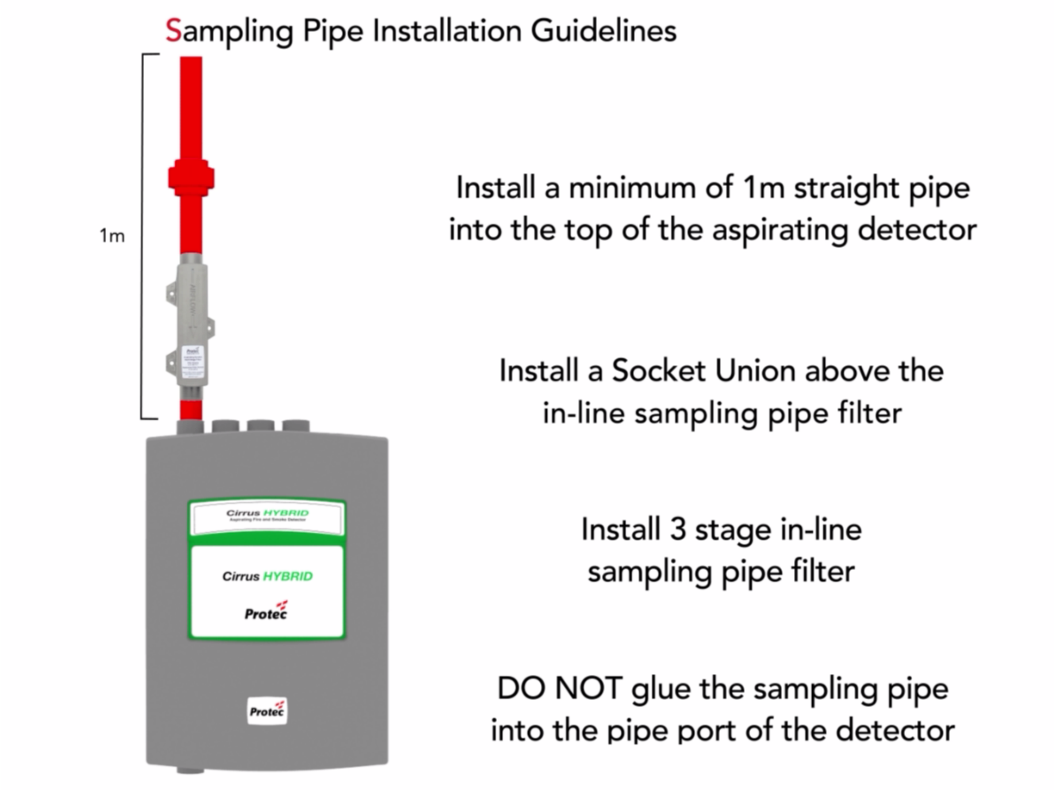
Please note that Cirrus Pro RS485 networks are NOT compatible with Cirrus HYBRID and ProPointPlus RS485 networks.

For further information on networking of any Protec aspirating detectors please refer directly to Protec Fire & Security Group.

GENERIC ASPIRATING SYSTEM INSTALLATION GUIDE

Following on from the generic application design guides, detailed previously in this document, there are a number of generic installation procedures and techniques that should be adhered to, in order to provide a high quality and fit for purpose aspirating detection system.

Many of these are detailed in the following pages and all parties including the specifiers, designers, installers, commissioning and future servicing engineers, should all be fully aware of these.



All Protec aspirating systems should be fitted with in-line sampling pipe filters. Ideally, these should be installed in a position above the aspirating detector. If this is not possible, the filter should be installed at a serviceable position between the aspirating detector and the first sampling hole. The exact type of filter (standard or heavy duty) should suit the actual application.

Protec would recommend the installation of a sampling pipe socket union above the in-line pipe filter to allow any filter removal if necessary without disruption to the main sampling pipe installation.

Ideally a 1m length of vertical sampling pipe should be installed above the aspirating detector to allow linear airflow directly into the aspirating detector.

Sampling Pipes (General)

All sampling pipe should be smooth bore, nominal diameter, airtight and able to withstand the required nominal pressure. Recommended pipe materials include uPVC, ABS, Copper and Galvanised Steel. The use of other sampling pipe material, particularly flexible type pipes should be confirmed with Protec Fire & Security Group or its nominated representative prior to installation.

The selected sampling pipe should be suitable for the environment in which it is to be installed. As an example, uPVC sampling pipe and accessories should not be installed in temperatures below 5ºC. Care should be taken in the selection of sampling pipe with regards to the sampling pipe bore diameters. All sampling pipe installations shall be confirmed as suitable using the 'ProFlow' sampling pipe calculation program.

For most standard applications Protec recommend industry standard ABS sampling pipe.

General Information
ABS (Acrylonitrile Butadiene Styrene) is a homogenous material with good chemical resistance and high impact strength. Other advantageous features are its suitability for use at low temperatures (-40°C) and its ease of jointing.

Standards
Protec supplied Aspirating Pipe and Fittings are produced under a strict quality control system approved to EN ISO 9001. Protec supplied Aspirating Products have been Tested by LPCB to EN 54-20 Clause 5.7, EN 61386-1 Class 1131. LPCB Test Report No- TE250773

Individual products are in accordance with the appropriate British Standards.
Fittings (inch) BS 5391 Part 1, EN 1452 Part 3, EN 54-20 Clause 5.7, EN 61386-1 Class 1131
Fittings (Metric) Din 8063, Kiwa 549, ISO 727
Pipe BS 5391 EN 61386-1 Class 1131
Adhesive BS 4346 Part 3

Colour
Protec supplied ABS products are manufactured in Red, White and Grey Colours.

Temperature
ABS is suitable for use over a wide temperature range from -40°C to +70°C.

Jointing of sampling pipe and their accessories

Protec supplied 'Solvent Cement' for ABS sampling pipe is specially formulated to chemically weld pipes and fittings together. The solvent cement chemically melts the two surfaces to be joined, so that when they are fitted together, they form a homogenous mass, which then cures to form a weld. Note: This is not a glued joint. It is therefore important to choose the correct type of adhesive, as another type may be detrimental to the integrity of the system.

Jointing 'always':-

a) Cut the pipe at right angles to its axis, and to the required length using the correct cutting tool.
b) Dry fit the pipe to the socket of the fittings. When the pipe is fully home in the socket, draw a line around the pipe at the edge of the socket. Where this is not possible, measure the socket depth and draw a line at the corresponding point along the pipe. This will give a visual indication, to ensure that the pipe is fully pushed home in the socket.
c) Apply the solvent cement with a suitably sized brush or the brush provided in the adhesive lid. Ensure that the area of the pipe up to the visual indicator is completely covered with an even layer of cement. This part of the operation must be done quickly and neatly, as the solvent must still be wet when the pipe and fitting is pushed together.
d) Push the pipe and fittings together and hold in place for up to 30 seconds. When the joint is made, a bead of solvent cement will form around the outer joint of the pipe and socket. This excess cement should be wiped away leaving the outer part of the joint clean.

Jointing 'never':-

a) Make joints in rain or wet conditions
b) Use dirty brushes or cleaning rags, which are dirty or oily.
c) Use the same brushes with different solvent cements.
d) Dilute or thin solvent cements with cleaner.
e) Leave solvent cement tins open. The contents will evaporate and the cement performance will be weakened.
f) Use near naked lights, or smoke whilst jointing. Solvents are highly inflammable.
g) Make joints in a confined space as solvents emit hazardous vapours which are dangerous when inhaled.

Sampling Pipe Expansion and Contraction

Expansion or contraction of plastic pipe is caused by temperature change occurring within the pipe wall. When the operating temperature of a pipe is greater than when it was installed, then the pipe will expand. If the operating temperature is lower, then it will contract.

There are two factors to consider when calculating expansions or contractions in pipes.
1) Ambient temperature of the (air temp) environment when installing the pipe.
2) Change of temperature of pipe contents or environment following installation.

Any change of the above factors will affect the mid-wall temperature of the pipe, thus causing either expansion or contraction. The designer should make provision for pipe expansion and contraction based upon the type of pipes used and the temperature variations expected within the protected environment.

Calculation Expansion/Contraction

1) The change in length due to contraction or expansion in a pipe system is determined by the following formula:

$\Delta L = \Delta T$ x L x □

Where ΔL Expansion (ΔL_e) or contraction (ΔL_c) in mm
ΔT Difference in temperature between the installation and the operating temperatures in ^{o}C (= T operate –T install)
L Length of pipe when installed
□ Relevant coefficient of expansion

Example:
Using information on the tables below, find the expansion and contraction on a 25mm diameter ABS pipe system, installed at 10^{o}C. The maximum and minimum operating temperatures are 30^{o}C and 8^{o}C respectively. The overall length of the installation is 30m.

Step 1) Calculate temperature change for expansion and contraction:

ΔT = 30 - 10 = +20^{o}C.
ΔT = 8 - 10 = -2^{o}C.

Step 2) Now calculate expansion and contraction,
Expansion $\Delta L_e = \Delta T$ x L x □□□ 20 x 30 x 0.100 = 60mm
Contraction $\Delta L_c = \Delta T$ x L x □□□ -2 x 30 x 0.100 = -6mm

Step 3) In order to provide for the correct solution, it is necessary to take the greater value, regardless whether it is due to expansion or contraction.
i.e. ΔL = 60mm.

Coefficient of Linear Expansion for Plastics

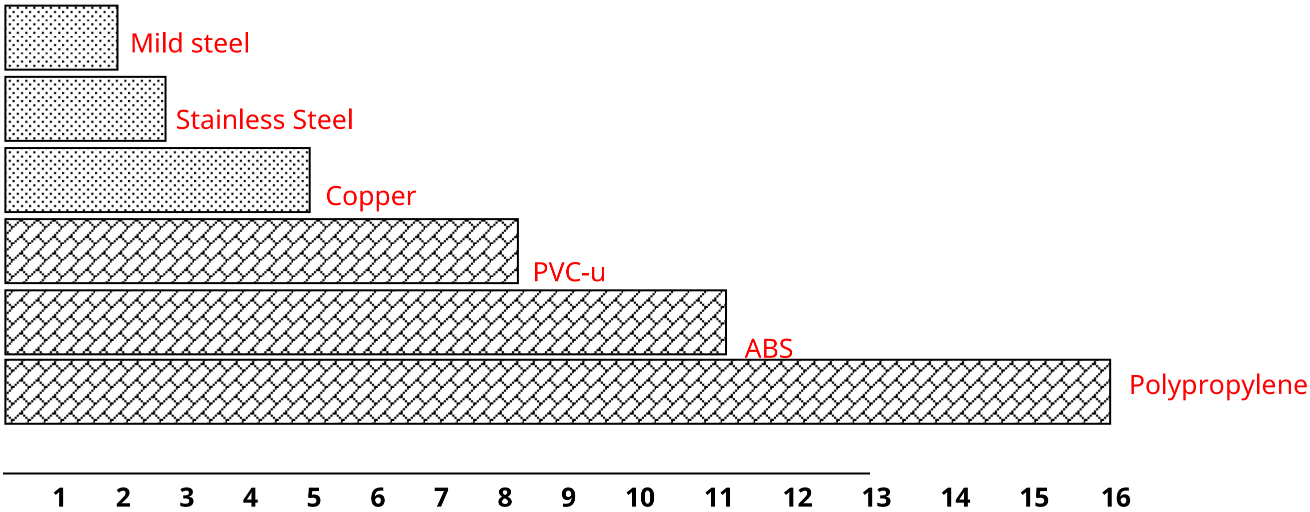
Material	Coefficient x (10^{-5} m/m°C)	Length/Temp °C Equipment mm/m °C
PVC – U	7.8	0.78
ABS	10.1	0.100
P.P	15.0	0.150
P.E	20.0	0.200

The meaning of the above coefficients is for example: ABS will expand 0.100mm per metre, for every 10°C raised in mid-wall temp above the installation temperature.

Expansion in mm from 1°C to 20°C for 1 metre Length Pipe

°C	ABS	
1	0.100	
2	0.200	
3	0.300	
4	0.400	For the temperature range not on the chart, add the factors.
5	0.500	
6	0.600	
7	0.700	
8	0.800	i.e. for ABS @ 37°C
9	0.900	Add 20°C = 2.000
10	1.000	
11	1.100	17°C = 1.700
12	1.200	
13	1.300	37°C = 3.700
14	1.400	
15	1.500	
16	1.600	
17	1.700	
18	1.800	
19	1.900	
20	2.000	

Coefficient of Linear Expansion for other Materials

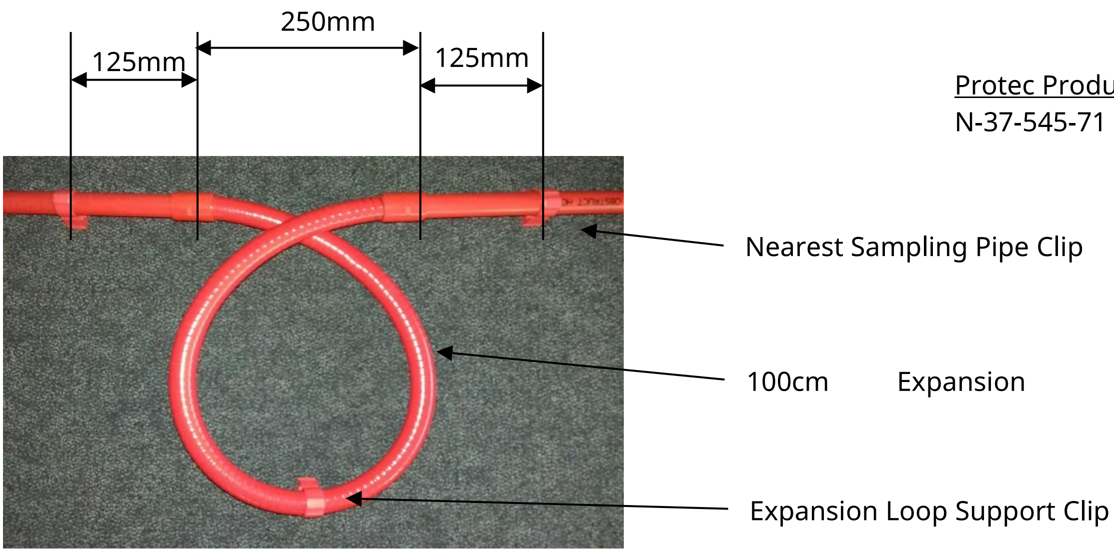


Comparison of thermal expansion of plastics and metals

How to Allow for Expansion or Contraction

Any change of length in a pipe system, whether it is expansion or contraction, will require compensation, so that any stresses generated by the change will not cause damage to the system, this can be achieved by installing Flexible Expansion Loops.

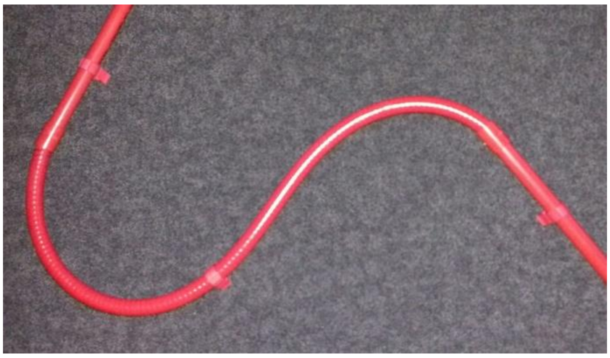
Recommendations for installation of 1m sampling pipe expansion loops:



Protec Product Code:
N-37-545-71

Expansion Loops are designed to compensate for linear expansion or contraction within a pipe system. It is recommended that sampling pipe clips be installed generally as per the detail above. The weight of the expansion loop should be supported to prevent excess stress on any coupling connections. Sampling pipe expansion loops should not be installed in an orientation that allows any moisture/condensation to be held within the loop.

Flexible Loops when used to navigate structural obstructions



Protec Product Code:
N-37-545-71

Flexible loops may be used to navigate pipe through difficult pipe routes and provide a simple and relatively inexpensive installation option. The flexibility of these bends also permits expansion or contraction to be compensated when multiple directional changes are required within a pipe system. (example pipe directional changes around structural steelwork).

The weight of the flexible section should be supported to prevent excess stress on any coupling connections. Flexible sections should not be installed in an orientation that allows any moisture/condensation to be held within the section.

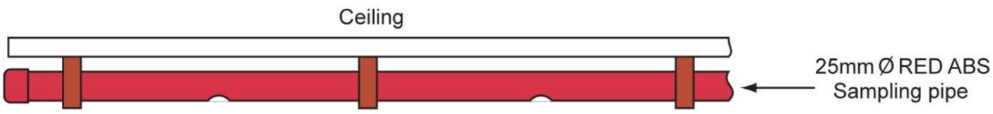
Sampling Pipe Clips, fixings and Labelling

All pipe clips/brackets need to be made with the inside diameter of the bracket marginally larger than that of the pipe outer diameter. This allows for free lineal movement of the pipe, and avoids inhibiting expansion or contraction. They should also be smooth, to avoid damage to the outer surface of the pipe. It should be noted that many of the 'caddie' type knock-on girder clips do not allow for lineal pipe movement as they 'grip' the sampling pipe and therefore, should not be used.

The Protec supplied sampling pipe clip for 25mm ABS sampling pipe is a two position 'locking' clip. The first locking position is really for 27mm sampling pipe but may be used for 25mm sampling pipe if the clip is installed facing upwards. The second locking position 'holds' the sampling pipe within the clip more firmly but still allows for lineal movement of the sampling pipe through the clip caused by expansion and contraction of the sampling pipe due to temperature changes. The clip may be installed in any orientation in this locking position.

Bracket Spacing Intervals

ABS sampling pipes require regular support and the spacing of clips or brackets depends on the pipe used, temperature, and density of the material carried within the pipe carried. The exact type and spacing of sampling pipe fixings should be determined utilizing sampling pipe manufacturers recommendations. For 'general' ABS pipe installations, Protec would recommend a maximum of 1000mm spacing between sampling pipe clips. When temperature change is expected and therefore, expansion and contraction, Sampling pipe clips (as above) which allow lateral movement should always be used. 'Girder' or other similar rigid type clips that retain sampling pipe without allowing for lateral movement should not be used.



The system designer/installer should check that the sampling pipe installation is secured adequately to the building structure. Many types of sampling pipe and capillary pipe fixings are available and it should be ensured that the type & method selected is suitable for both the application and the environment.

Sampling Hole Identification

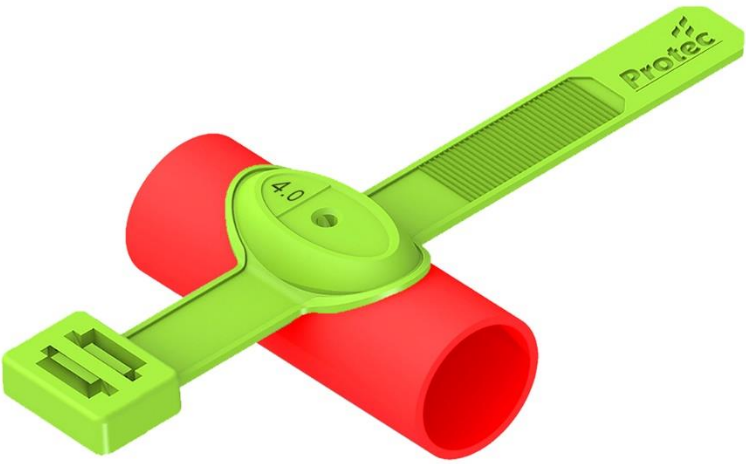
Aspirating detection systems are now installed in an ever increasing variety of different applications, many of which replace standard point type smoke detectors or optical beam detectors. Often these applications include high ceiling spaces, where it is almost impossible to identify where the sampling holes are located and more importantly, if the sampling hole is the correct size.

For this reason Protec would recommend **'HIT's' Hole Identification Tags.**

Each HIT is colour coded to identify its specific sampling hole diameter. This colour coding allows accurate identification of the various sampling hole locations and true hole size for the benefit of commissioning & servicing engineers, clients and even project auditors.

A build-up of dust around a standard drilled sampling hole is common place due to the friction created by the airflow through the sampling hole. Each HIT incorporates a chamfered hole entry which is proven to significantly reduce this dust loading effect.

To assist the installers a common, 8mm diameter drill is all that is required for every sampling hole location.



HIT Product Codes:

Product Code	Description
37-534-68	2.0mm - Purple HIT
37-535-69	2.5mm - Grey HIT
37-536-70	3.0mm - Yellow HIT
37-537-71	3.5mm - Blue HIT
37-538-72	4.0mm - Green HIT
37-539-73	4.5mm - Black HIT
37-540-74	5.0mm - White HIT
37-541-75	6.0mm - Brown HIT

As an alternative Sampling Hole Warning Labels could be used.

Warning Label
Sampling hole warning labels are used to clearly identify the location of each sampling hole. Protec part code N23-039-37.

Environmental & Condensation Considerations

It is very important to consider the effects of condensation on some aspirating detection systems with regards to the aspirating detector, the sampling pipe installation and the future servicing of such a system.

Condensation with regards to the aspirating detector

Many aspirating detectors may cause false (unwanted) alarms when installed in environments where condensation may be permanent or be created due to changing environmental conditions of the protected area. This is particularly a problem for most ‘optical’ based aspirating detectors.

Condensation with regards to the sampling pipe installation

Where condensation is permanently present or can be expected, the complete sampling pipe installation should be installed to allow a gradient where by any condensation formed inside the sampling pipe will, through gravity, drain to its lowest point where it can then be managed using a dedicated condensation drain point.

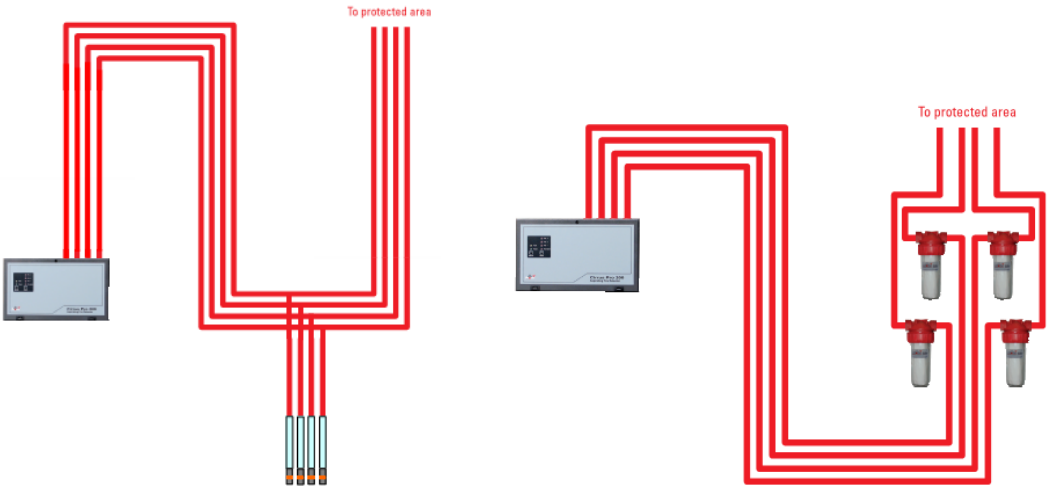
Sampling Pipe Condensation Traps

Where high levels or permanent condensation is anticipated a ‘Sampling Pipe Condensation Trap’ may be placed within the sampling pipe installation. This trap should be located close to the aspirating detector, in a position that is ‘off centre’ from the detector sampling pipe inlet port. It must also be installed in the vertical plane to allow any condensation formed within the sampling pipe to be held in the sampling pipe condensation trap. A sampling pipe condensation trap will be required on each sampling pipe where condensation may be expected.

Typical Condensation Traps

Protec part code: 37-584-14-BIS

Protec part code 45-023-04 Standard 45-023-04-C self-draining.

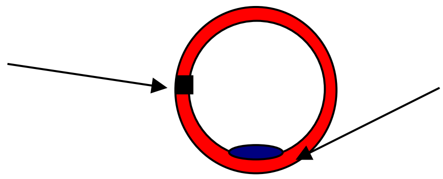


Typical Condensation Trap Installations.

Sampling Pipe Holes.

Normally sampling holes are drilled into the sampling pipe on the bottom (or lower) face of the sampling pipe. However, where condensation may be present it is an advantage to drill the sampling holes on the side wall of the sampling pipe ensuring as much free space as possible remains around the area of the sampling hole. This should prevent any sampling holes becoming blocked when condensation is formed by water droplets and even 'streams' of condensation droplets within the sampling pipe.

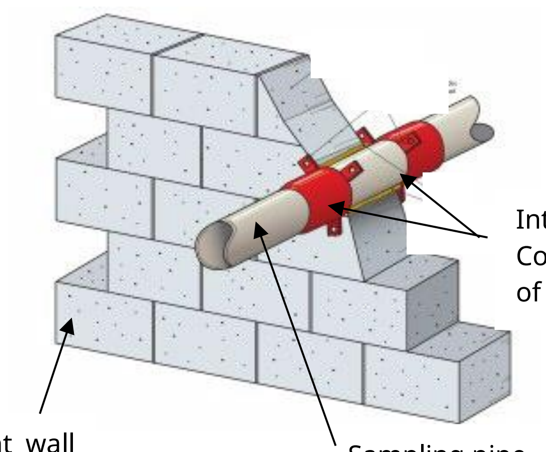
'Revised' location of drilled sampling hole within sampling pipe when condensation may be expected. Thereby, not allowing any condensation to restrict or block any sampling holes.



Please note: The above techniques of condensation management are for guidance only, other alternatives may be more suitable for each specific application and therefore, the designer should consider the best solution for the application.

Intumescent Fire Stop Collar

Sometimes, during the installation of a network of sampling pipes it is necessary to pass through a fire resistant wall or structure (such as a plant-room, ceiling slab or lift shaft). If this is necessary, then it is good practice to install two 'Intumescent Fire Stop Collars' one either side of the breach of the fire resistant wall/structure on each sampling pipe that penetrates the fire wall as per the detail below.



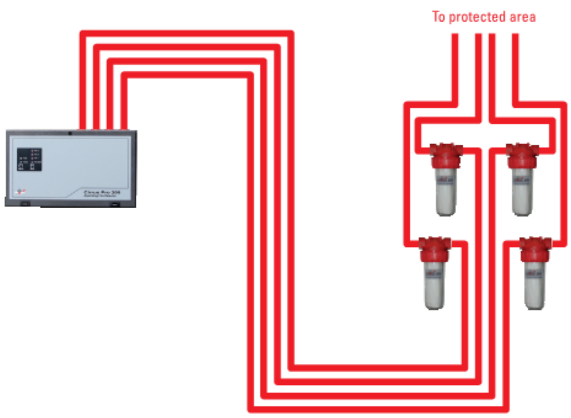
Sampling Pipe Dust Management

In-line Filters

All optical based aspirating detectors can provide unwanted (false) alarms from dust. Due to the sub-micron combustion particle size detected within Cloud chamber based aspirating detectors, they cannot false alarm from dust. However, when airborne dust is excessive, this dust needs to be 'managed' to prevent any internal blockages of the actual detector.

The type of dust filter required is dependent upon the expected amount of dust for the specific application. One option for dust management is the Protec 3 stage in-line dust filter which contains a fine particle filter (greater than 5 micron), a medium particle filter (greater than 10 micron) and a course particle filter (greater than 16 micron). Protec part code 61-986-F01. Other variants on filter grading are available on request.

An alternative to the above where excessive dust can be expected is the Protec Heavy Duty in-line sampling pipe dust filter. Protec part number (45-023-04 Standard, 45-023-04-C self-draining).



Typical installation of Heavy Duty In-line sampling pipe filter.

Protec recommend the installation of suitable in-line pipe 'dust filters' in all sampling pipes installed.

Pipe Purging Systems

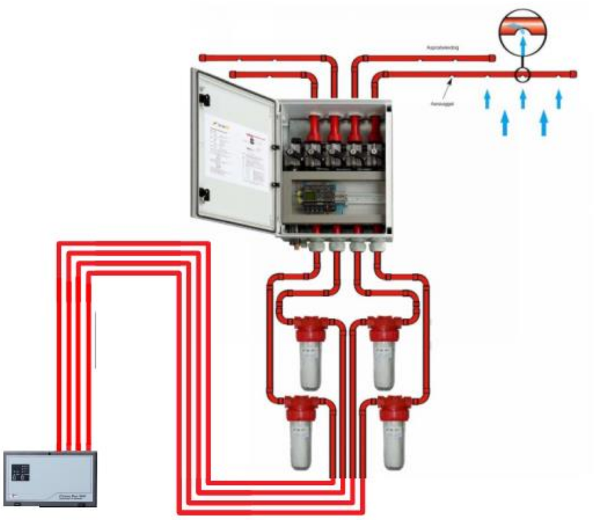
In some applications, it may be necessary to install manual or automated sampling pipe cleaning systems.

If a manual system is used, the designer should consider a purpose made connection point close to the detector to allow the connection of a pipe cleaning device (compressor/vacuum).

If an automated system is used, the designer should consider the location, connection to the sampling pipe and operation of the purging system.

In either option detailed above, the designer should consider the time interval between pipe purging actions and the pipe pressures that are used for the purging process, with regards to the suitability of the sampling pipe and accessories. Additionally, the designer should consider the pipe installation fixing are correctly specified for any additional stresses that may be created by the frequent operation of the purging system.

Extreme example of pipes being impeded by excessive



Protec Cirrus Pro detector with typical pipe purging unit connection

Pipe purging units contain programmers which allow pre-determined time periods between purging operations. These can typically be hourly, daily, weekly monthly etc.

Important Design Note: The designer should also consider that pipe purging, where air is forced up the pipe local to the detector and into the application; should not be used in food preparation or other sensitive area application where dust from inside the pipe may contaminate the product, process or area. In this case, the pipe should be cleaned by a vacuum type process where the vacuum is used to draw air from the protected space to a location before the actual aspirating detector.

For further information on pipe purging systems please contact Protec Fire & Security Group.

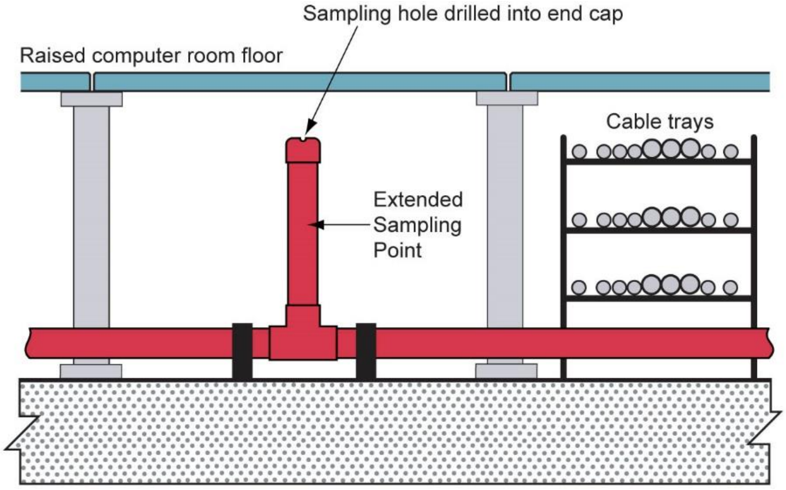
Extended or Capillary Sampling Pipes

All extended or capillary sampling pipe and fittings should be low-pressure loss and be of a smooth bore to prevent turbulence of flow. The selected extended or capillary sampling pipe should be suitable for the environment in which it is to be installed.

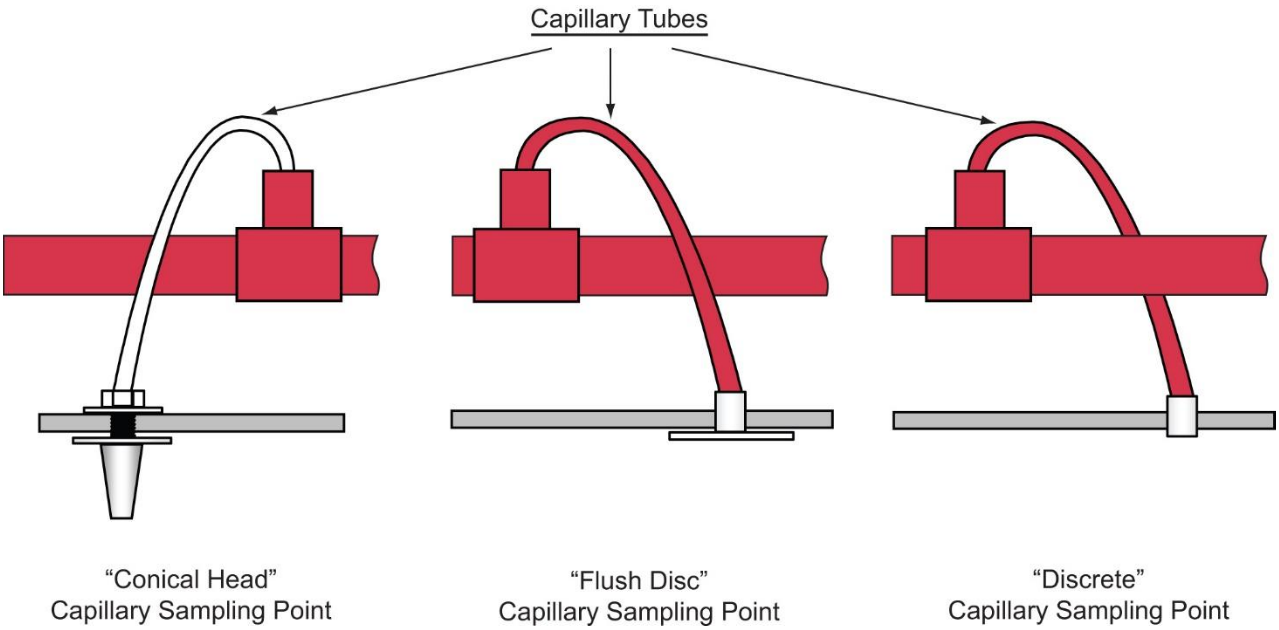
Particular attention should be made to the length of either extended or capillary sampling points as these can create flow restrictions and therefore all designs should be verified by sampling pipe calculations. It is imperative all sampling holes in extended or capillary sampling points should be drilled out to the correct hole size, based on the sampling pipe calculations.

A list of approved capillary sampling pipe accessories is available on the 'Protec Sampling Pipe' data sheet.

Extended Sampling Point



Capillary Sampling Points



Sampling Pipe 'Maintenance Test Points' Installation

Definition: A test point provided beyond the last sampling point, to test the integrity of the pipe work. Such a test point is closed in normal operation and is not subject to the maximum transport time.

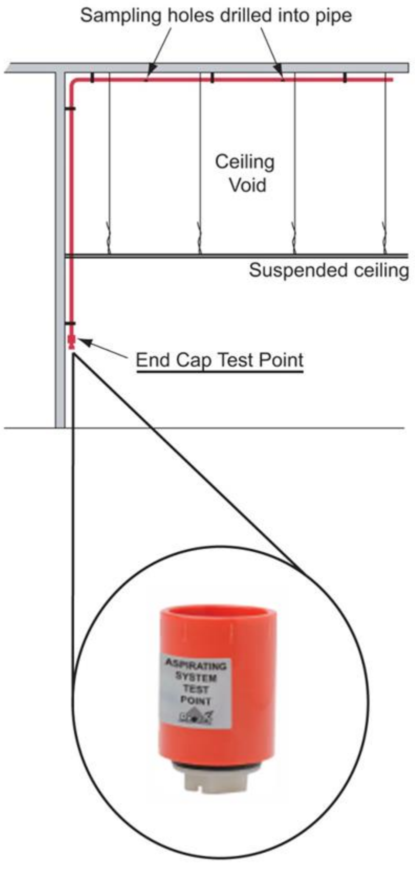
Where sampling pipes are installed at high levels or within enclosed voids or compartments it may be necessary to install sampling pipe 'Test Points.'

These 'Test points' should be installed at the end of each sampling pipe array. Test Points are used to provide a dedicated orifice into the sampling pipe in order that the entire length of pipe can be tested during system servicing. Once testing is complete the 'Test Point' should be re-sealed as it does not form part of the sampling pipe detection system. If sampling holes cannot be accessed for testing purposes during service visits and the dedicated sampling pipe Test Point is used to test the pipe continuity, then additionally the detector airflow values shall be checked to confirm there is no change in flow values from the commissioned status.

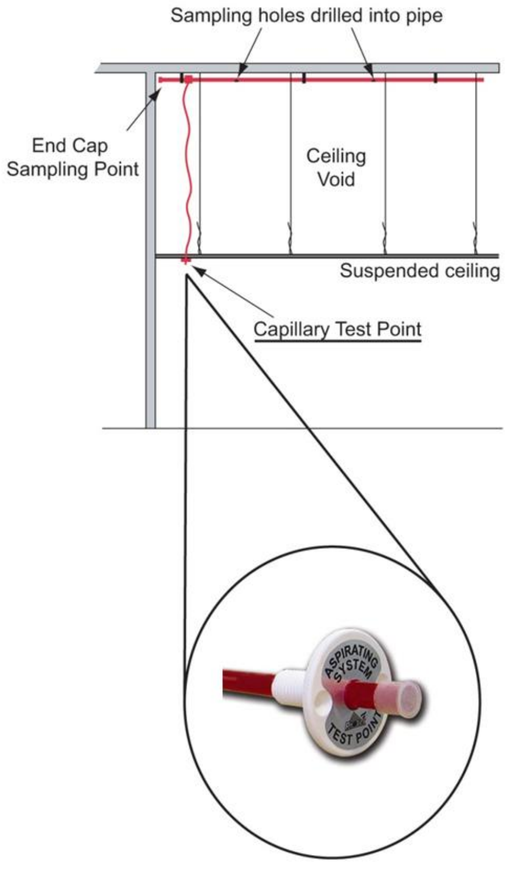
As 'Test Points' do not form part of the sampling pipe detection system the transport time taken from the 'Test Point' to the detector is not restricted. However, the transport time taken from each 'test point' should be recorded and repeated on each visit with any changes in time investigated.

All sampling pipe 'Test Points' should be installed in safe and secure locations and should be made from a material suitable for the environment in which it is to be installed.

End Cap Test Point



Capillary Test Point



References

1. British Standards BS5839-1:2017
2. FIA Code of Practice Issue 3 February 2012
3. Protec Generic Design & Installation Guide
4. Protec Design Guides & Disclosures (located on www.protec.co.uk)

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Aspirating Detection System

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