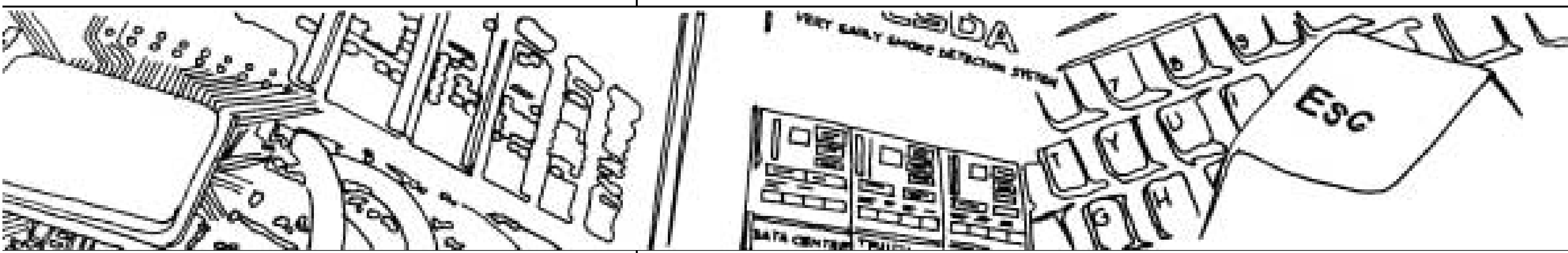
VESDA®

ASPIRATING SMOKE DETECTION



DESIGN GUIDE

IDCs, EDPs,
COMPUTER ROOMS

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1. INTRODUCTION

Electronic data processing sites (EDP's) such as Internet Data Centres (IDCs), Network Operating Centers (NOCs) and similar applications represent a considerable fire risk due to their high power requirement and density of electronic circuitry. Reliable, very early smoke detection systems can drastically eliminate this risk and efficiently protect mission critical data and equipment.

Being an innovative pioneer of aspirating technology, VESDA provides the earliest possible warning of a potential fire by detecting the incipient (pre-combustion) stage of a fire event. This guide has been prepared by VESDA engineers who have gained outstanding design experience, with over 60 000 systems installed worldwide. The guide is intended for consultants and designers who will be involved in the site layout and design. It contains the relevant design considerations and recommends how the aspirating smoke detection system may be installed in this special environment.

2. DESIGN CONSIDERATIONS

During the specification and design of an aspirating system the following aspects should be taken into consideration:

- the level of protection required by the customer
- the airflow characteristics of the room
  - including how the installed equipment in the room affects the air flow
- the potential pollution from outside air (i.e. fresh air makeup in the Air Handling Unit (AHU), and
- the local codes/standards requirements.

3. LEVEL OF PROTECTION

The level of protection in an IDC area can range from very insensitive conventional detection to highly sensitive particle detection. This is dictated by three factors: the coverage or positioning of the fire detection system, its sensitivity and the density of sampling/detection holes. Designers choose aspirating smoke detectors because they address all of the above aspects.

In an IDC environment, fires typically begin in the Electronic Data Processing (EDP) equipment. In addition, all other electronic equipment and cabling can pose a risk. Therefore, the protection of the room, the AHU and voids (i.e. ceiling and floor) may also be necessary. The following guidelines are to assist the designer in achieving the optimum level of protection required by a customer. National standards, codes of practice or requirements should always be taken into consideration.

The spacing or density of the sampling holes are dictated by the local standards. Sensitivity, on the other hand, is determined by the room environment and the level of response required to specific tests, therefore it is not practical to define it in this guide. Reliance is placed on installation recommendations and commissioning. Table 1 shows the possible areas of protection of an IDC or similar environment.

Areas	Optimum	Satisfactory	Basic
AHU/ Return Air (24hr)	✔	✔	✔
Room (at ceiling level)	✔	✔	✔
Void (floor)	✔	✔	✔
Void (ceiling)	✔		
Cabinet	✔	✔	

Table 1 Areas of Protection

The following sections will describe design recommendations related to the different protection areas. All pipework designs should be verified using the VESDA Sampling Pipe Modelling Program – ASPIRE™. This program illustrates the significance of various parameters in an aspirating smoke detection system so that the most appropriate design can be applied.

3.1. RETURN AIR PROTECTION

Incipient smoke is most likely to travel with the airflow; therefore, positioning VESDA pipework at the return air grille of the AHU[1] ensures that any smoke generated in the environment is identified at the earliest stage, refer to Figure 1.

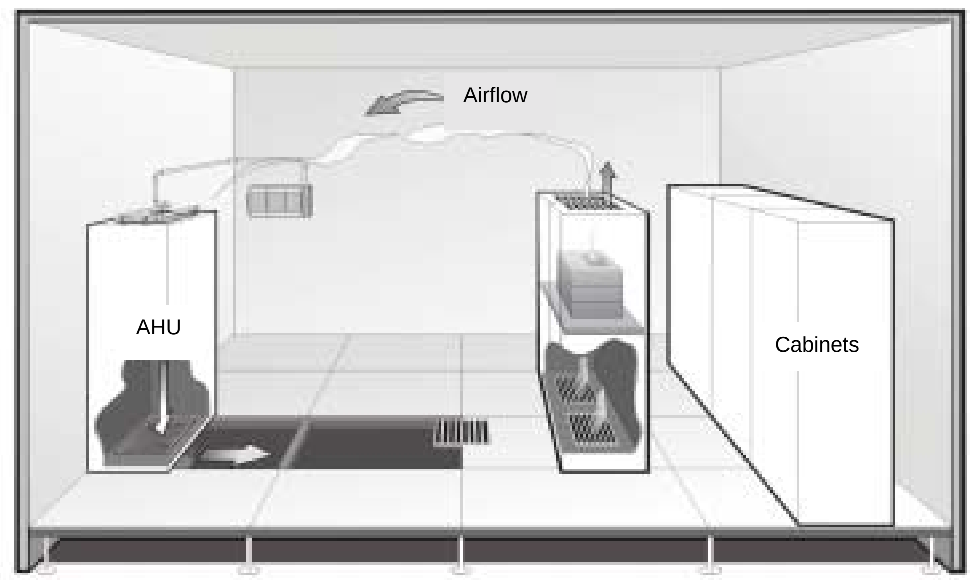

Figure 1 Return Air Protection

NOTE: In rooms where the airflow direction is opposite to the one shown in Figure 1, the sampling pipe may be placed at the return air grille, under the floor void. A combination of detection options, as shown in Table 1, may also be included in addition to the option shown.

3.1.1. Number of Holes

The amount of holes in the sampling pipework is dictated by the capacity of the aspirator. Generally, VESDA would recommend a sampling coverage of 0.2 m^2 (2 ft^2). In practice, a grille measuring 1.5 m x 0.8 m (5 ft x 2.6 ft) is best covered by six sampling holes (refer to Figure 2). As a guide, NFPA 76[2] recommends a maximum hole coverage of 0.4 m^2 (4 ft^2).

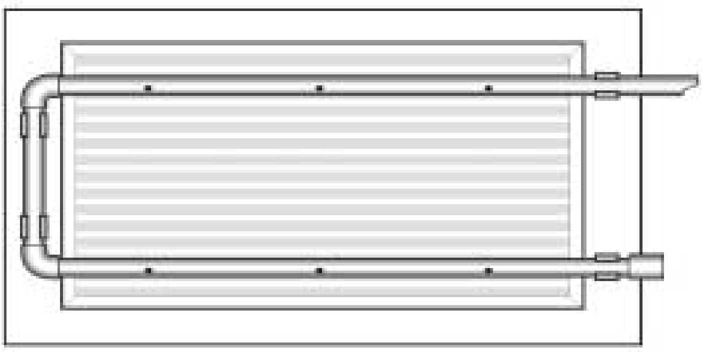

Figure 2 Number of Sampling Holes as per NFPA 76

1 In this guide, the term AHU also includes Air Conditioning/Handling Systems, Return Air Systems, Packages, Heating, Ventilation and Air Conditioning Systems (HVAC), stand alone units or Forced/Pressurised systems through the voids (ceiling and floor).

2 NFPA 76 is a Proposed Draft Recommended Practice referring to the "Standard for the Protection of Telecommunication Facilities".

NOTE: In order to obtain the preferred pressure balance, a pipe run of less than 10 m has the end cap blocked. For all designs undertaken, the ASPIRE Sampling Pipe Modelling Program should be used to verify the performance of the system. If the ASPIRE calculations result in a response time exceeding the required limits, then measures need to be taken to reduce the response time. This may be done by enlarging the last sampling hole before the endcap.

Designs should always be re-calculated using ASPIRE to ensure the pressure differentials across the sampling holes is adequate and the response time is within the required limits.

3.1.2. Pipe Location Above Grille

The sampling pipe should stand off approximately 100-200 mm (3.9 - 7.8") from the return air grille in order to avoid the low pressure point directly at the grille's entrance. For smaller grille sizes, it is common for only one sampling pipe to be used across the grille. It is also recommended that the sampling holes face into the direction of the greatest airflow path (refer to Figure 3). The 'x' in Figure 3 denotes where not to place the pipe due to lack of airflow.

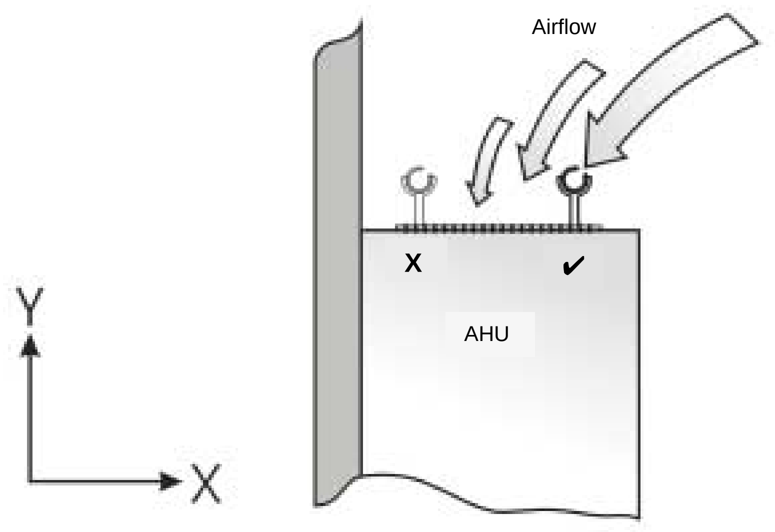

Figure 3 Pipe Position on Return Air Grille

3.1.3. Fine Tuning

Industry experience shows that the pipework can be fine tuned to marginally increase the response time of an aspirating detection system. This is done by locating the sampling holes at an angle of 25-50° to the horizontal direction and in the direct airflow path (refer to Figure 4). As opposed to the holes facing vertically up. Improved sampling can be achieved by avoiding the high velocity (low static pressure) zone and by positioning the holes in line with the airflow streamlines.

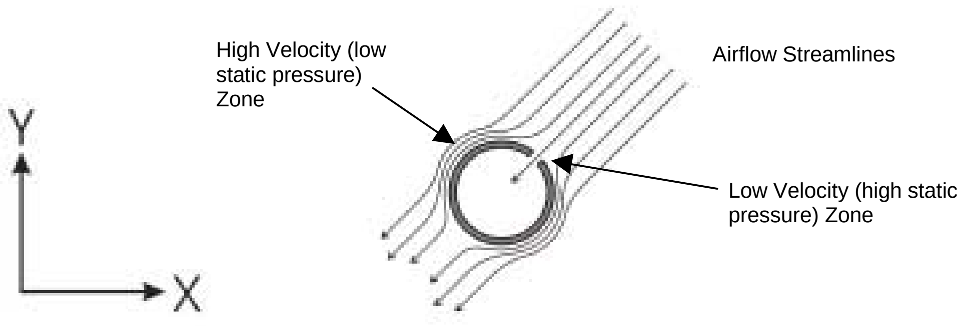

Figure 4 Sampling Hole Orientation

3.1.4. Number of AHUs to Protect

It is generally accepted that a VESDA LaserPLUS (VLP) detector can be used for monitoring more than one AHU, however, due to the increased dilution of smoke, the number of AHU's protected by one VLP should never exceed four. In extreme environments where air changes are greater than ten air changes per hour, the number of AHUs protected by one VLP should be reduced.

Points to Consider:

- If there is any doubt about the air pressure differentials, the sampled air should be returned back into the protected room.
- Filters in the AHU can remove the smoke, therefore monitoring the exhaust of an AHU is not recommended. For specific requirements, however, the exhaust may be monitored to protect the AHU's themselves.
- When monitoring AHUs that require regular filter maintenance, removable sampling pipes should be applied by utilising socket unions. This will ensure that the sampling holes face the correct way when the filter grille and the pipes are re-attached.
- Standard pipe design consideration should always be followed, including minimising pipe length, number of bends and size of the endcap hole in order to achieve a well balanced system.

NOTE: System performance tests are essential to verify the correct positioning and operation of detectors in such environments. The computer cabinets installed may actually deter the smoke from reaching the AHU. Therefore, a performance test of the aspirating system should be conducted with the air conditioning turned on and off.

3.2. ROOM PROTECTION

In IDC type applications, standards typically require ceiling detection. For Very Early Warning it is recommended that aspirating smoke detectors are used in preference to conventional detectors in order to monitor the rooms, especially if the AHU does not operate continuously.

Global standards normally recommend the area of coverage per detector. It is common practice for these figures used in the standards, to be interpreted using a grid layout. Most standards define different grid spacings dependent on certain criteria, such as air change rates or types of detection employed. Careful reference should be made to your relevant standard.

Once the grid layout is determined, the intersections of the grid define the location of conventional detectors. In the case of aspirating systems, the sampling holes may be positioned where conventional detectors would normally be placed (refer to Figure 5).

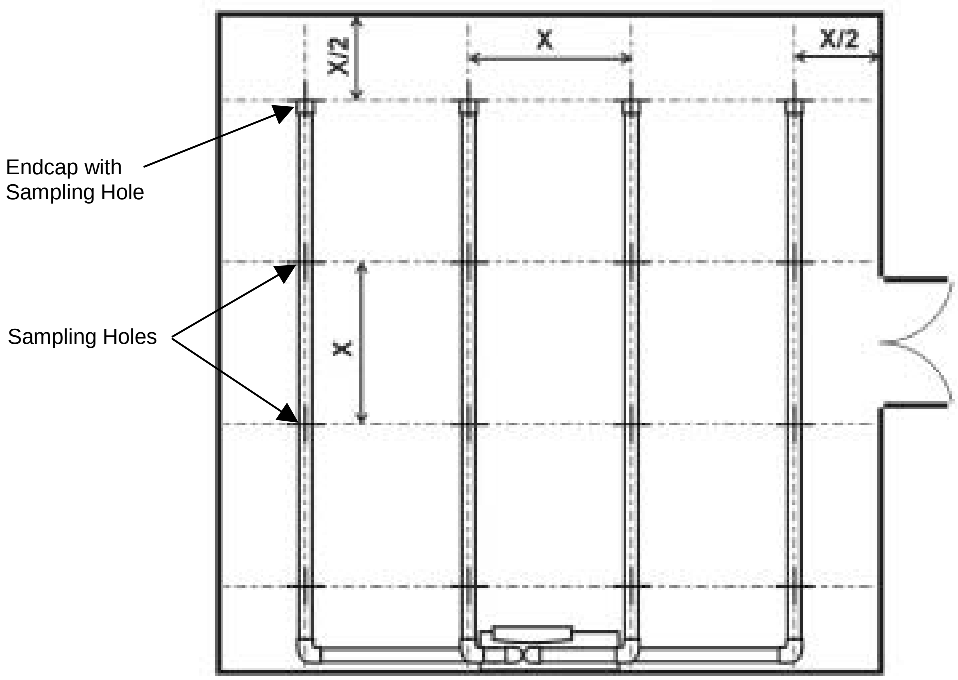

Figure 5   Grid Layout for Detector Spacing

NOTE: For conventional detectors, most standards state that as the air change rate increases, the detector spacing should decrease[3]. However, for aspirating smoke detectors, sample hole spacing (or density) can easily be increased by reducing the distance between sample holes on the sample pipe. Furthermore, as aspirating systems are inherently good at detecting diluted smoke in high airflow areas, the performance-based designs of these systems are increasingly becoming the benchmark by which detection systems in IDC areas are measured (versus the prescriptive standards). Therefore, it is often not necessary to increase the quantity of sampling holes in high air change environments.

3.2.1. Room Protection Using Capillary Sampling

Typical IDC environments have false ceilings. A common way to install the sampling pipes for aspirating systems is to position the pipe in the ceiling space and connect a capillary sampling tube from the pipe to the ceiling tile, allowing sampling from the room below (refer to Figure 6). The capillary sampling hole position should coincide with the grid layout as described in the previous section.

[3] AS 1670 is an Australian Standard for "Automatic Detection and Alarm Systems – System Design, Installation and Commissioning", which does state that for air changes of greater than 15 per hour the detector spacing should be reduced.

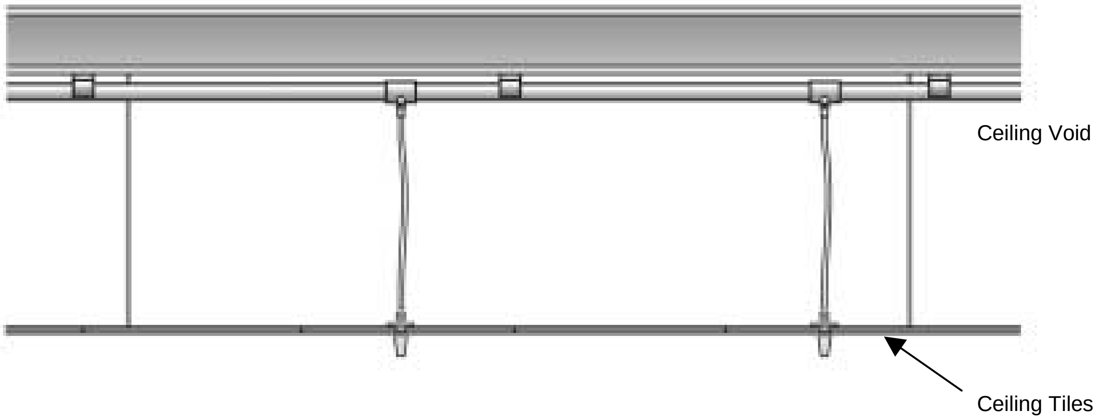

Figure 6 Capillary Room Sampling

3.3. VOID PROTECTION

Aspirating smoke detection systems are particularly well suited for concealed void spaces, as the detector can be located in an accessible location for service or maintenance.

Any void in an IDC type environment should have a smoke detection system installed unless it is an empty void with zero fire risk. This is especially relevant if the void contains cabling and equipment which can contribute to a fire. To determine the spacing of the aspirating sampling holes, the previously described grid layout method should be employed, in accordance with the relevant standards.

Where smoke detectors are installed in shallow voids having poor ventilation, special care should be taken in the detector's positioning. In a fire, the initial smoke layer will usually only take up the first 10% of the void height. For this reason, the sampling holes of the aspirating detection system should be positioned as close to the top of the void as possible.

When positioning the sampling holes, precautions should be taken against the build up of dust or dirt. Therefore, the sampling holes should be drilled on the underside and/or side of the pipe and not the top. Figure 7 illustrates a floor void sampling system. The same setup can be applied if the void were a ceiling or roof space.

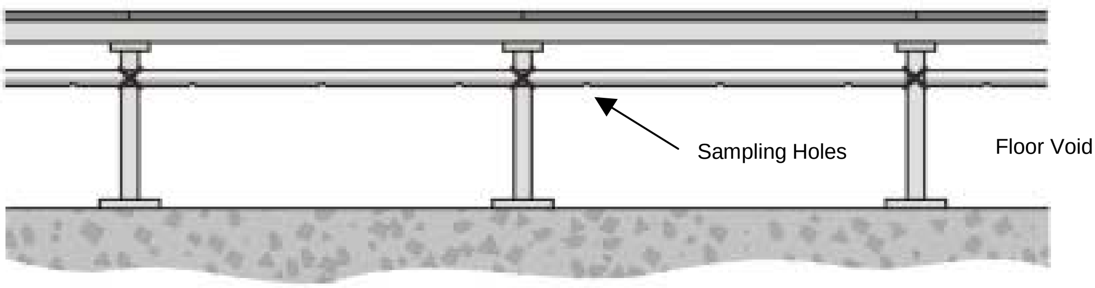

Figure 7 Floor Void Sampling

Points to consider:

- It is recommended that the sampled air is returned into the protected void in order to reduce the potential effect of pressure differentials.
- Consider using stand off sampling pipes in voids for easier cable access; sampling holes would then be drilled into the side of the pipe just below the end cap (i.e. not in the end of the end cap).
- For ease of maintenance it is recommended to position the detector outside of the void.

3.4. CABINET PROTECTION

In an IDC environment there is a high number of cabinet-enclosed mainframe and EDP equipment. Cabinet sampling can provide the most optimum detection of a fire originating in these units and can be achieved by placing one or more sampling holes at the cabinet (refer to Figure 8).

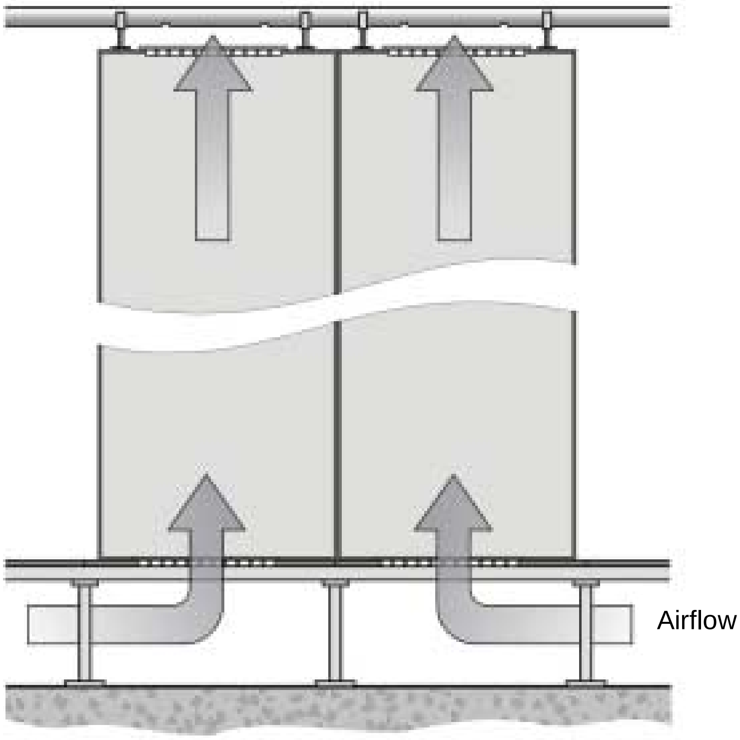

Figure 8 Above Cabinet Sampling

As shown, each cabinet has a dedicated sampling hole in order to sample the air at the earliest moment.

NOTE 1: Another variation of cabinet sampling is to locate capillary sampling tubes up through the bottom of the cabinet from the floor void.

NOTE 2: A dedicated detector can also be mounted in each cabinet to provide the most optimum protection of a potential event.

4. REFERENCING

It is possible that smoke and other external pollutants may enter the protected area from the outside. In this situation, reference sampling can be used to compensate for unexpected increases in ambient air pollution and to prevent unwanted alarms.

A separate detector draws air from the external air “make-up” supply of a mechanical ventilation system and produces a reference reading that is based on external pollution levels. The reference reading can then be subtracted from any or all of the other detectors in the system. For the detectors using a reference, only a net increase in smoke produced from internal sources will produce an alarm condition.

Two parameters are used to set up a referencing system:

1) A delay setting and

2) A percentage offset setting.

These two thresholds are programmable dependent on the room environment conditions (i.e. the air change rates) and the level of fresh air make-up. As a starting point, it is recommended that a two minute delay and an 80% offset setting be used. Depending on the environment, these settings can be changed. Contact your local Vision Fire & Security office for advice concerning these changes.

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