

A Guide to the FIA Code of Practice

The best practice design, installation, commissioning and maintenance of Aspirating Smoke Detector Systems



VESDA[®]
by  **xtralis**[™]

Contents

For ease of reference, all section numbers in this short guide are matched to as per the FIA Code of Practice (COP) issue 3, published in February 2012. However, some sections are not commented on by us, so will be shown as no comment in the text.

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A. Objective

The objective of this guide to the FIA COP is to summarise and highlight the most important aspects of the Code of Practice. It provides a short form and quick reference guide to anyone dealing with VESDA detectors and may prompt further investigation in the correct section of the Code of Practice.

Particular guidance on the use of VESDA detectors is provided where relevant.

It is not intended that this document be used in place of the Code of Practice or any other standard.

The FIA CoP was updated in February 2012 and the forward usefully summarizes the changes from the 2006 issue as follows:

- recommended ceiling height limits have been revised following publication of research undertaken by BRE and the FIA.
- performance tests presented in the Appendix have been revised to match the editorial changes implemented in BS 6266:2011
- a new paper bin performance test has been introduced into Annex C
- clarification has been added on the options for using ASD to trigger co-incident detection arrangements for extinguishing release.
- recommendations on the protection of warehouses have been extended in line with best practise and prevailing European Standards.

1. Scope

The scope is as defined on page 9 of the Code of Practise (COP). The purpose of the document is to provide recommendations on all aspects of the implementation of VESDA from planning to maintenance.

The COP discusses:

- the categorisation of systems and applications where they can be used.
- the performance tests that have always been applied to VESDA with the inclusion of some new and more flexible tests.

The COP also has a series of forms that can be used or modified to suit, covering each process from planning to handover and on to maintenance.

The COP does not advise on the size of sample pipes, capillaries or hole sizes, but does suggest that ASPIRE2 software should be used as a design tool to verify these are correctly sized.

2. References

It is strongly advised that the documents described in section 2 on page 8 of the COP are referred to when using this guide.

3. Terms and definitions

No Comment. Refer to the COP

4. Introduction to VESDA

VESDA detectors are the market leader in Aspirating Smoke Detection (ASD) technology and since the introduction of ASD and incorporation in to British Standards and NFPA documents, its use has significantly increased providing a solution to a wide range of applications.

A VESDA system is an integral part of the overall fire system, even replacing conventional systems in certain applications (refer to 4.1). As such, the designer must ensure compliance to National Standards.

4.1 Reasons for using a VESDA detector and its applications

The following three points are the principal reasons for applying ASD and reflect the classes within EN54-20. In the COP, section 10 discusses applications and we have included them in to each of the three classes here. Each heading will define the Class and each sub heading defined as a reason for using a VESDA system.

4.1.1 Very early warning (Class A)

A level of detection well before conventional systems would operate.

4.1.1.1 High sensitivity applications (Reason No.1)

- Computer Rooms
- Clean Rooms
- Telecommunications
- Process Control Machinery
- Bio-Medical Facilities

4.1.1.2 As an alternative or as an initiating device to extinguishing systems (Reason No.2)
This includes all the areas shown above, but can also include foam extinguishing systems in areas like:

- A warehouse with high value stock
- Aircraft Hangers

It is also important that Primary & Secondary detection is considered in High Sensitivity areas and this is discussed in Design Considerations, Chapter 6.

4.1.2 Enhanced smoke sensitivity (Class B)

For areas where a higher level of sensitivity than normal is required, e.g. where smoke is diluted due to height. When designed to this Class, a VESDA system can be configured to operate a smoke management system or actuation of suppression systems.

4.1.2.1 Large open spaces (Reason No.4)

- Shopping Atria
- Warehouses
- Cold Stores
- Aircraft Hangars
- Sports Stadia

4.1.2.2 Objects that require better levels of detection (Reason No.5)

- Process Machinery
- Organs in Churches and Cathedrals
- Works of Art
- Business-critical Areas

4.1.3 An alternative to point or beam type smoke detectors (Class C)

There are many reasons why a VESDA system is used as an alternative to conventional detection systems. The following identifies some of these areas.

4.1.3.1 Restricted or difficult access (Reason No.6)

When the area to be protected is restricted or dangerous; locating the VESDA detector outside this area provides a safer workplace for maintenance activities.

- Ceiling Voids
- EMC Areas
- Floor Voids
- High Ceilings
- Above process machinery

4.1.3.2 Aesthetics (Reason No.7)

Concealed detection is important for appearance or for reducing the risk of vandalism.

- Museums
- Art Galleries
- Churches and Cathedrals
- Stately Homes
- Prison Cells
- Police Custody Suites

4.1.3.3 Environmentally challenging area (Reason No.8)

There are many areas that cause an environmental issue to conventional detection where VESDA can offer a suitable solution whilst avoiding false alarms and reducing maintenance demands.

- Areas with a high temperature
- Cold areas
- Areas with high humidity
- Wash down areas in food production
- Dusty areas

5. Definition of ASD system

The COP identifies a method of defining, in a single unambiguous sentence, the system description. This is important when specifying a VESDA system that it has been designed to meet a specific requirement so as to ensure it can achieve the desired outcome.

With the wide sensitivity range of a VESDA detector, it is capable of achieving all categories of application.

The important aspects for the category take into account the Sensitivity Class, the Sampling Method, the Compliance Test and the Motivators for using a VESDA system.

5.1 Sensitivity class

These classes relate directly to those specific to prEN 54-20:2004 and are adopted to ensure that the detector specified can meet the sensitivity class required. This relates to the whole VESDA system and not the just VESDA detector, taking into consideration dilution from multiple sample holes.

- Class A – Very High Sensitivity – e.g. computer rooms.
- Class B – Enhanced Sensitivity – e.g. large open spaces where better detection is required than conventional systems offer.
- Class C – Normal Sensitivity – e.g. where detection equivalent to EN54-7 is required.

5.2 VESDA sampling types/methods

5.2.1 Primary sampling

This is essential in applications of high sensitivity and is an arrangement of sample pipes in the direct line of airpath as the low levels of smoke created at the pre-combustion stage of a fire will travel with the airflow. This could include:

- Air Return Grilles of Air Handling Units
- Pressure Relief Vents
- Extraction Fans

5.2.2 Secondary sampling

This is the spacing of sample holes in place of point-type detectors on the ceiling, or within voids, and needs to be installed as per the requirements of the National Standard.

In this case it is expected that a hole is equivalent to, or better than, a point-type detector.

5.2.3 Localised sampling

This is the use of a VESDA detector to monitor a specific item(s) within an overall space. i.e. a printing press in a print hall.

5.2.4 In cabinet detection

This type of application is very effective, as only a small flexible capillary tube need enter the cabinet, thus making installation simple and avoiding future maintenance restrictions.

5.2.5 Duct detection

VESDA detection applied to ducts provides a simple to install and reliable detection system. Extensive testing of this type of detection method has resulted in a design approach that will overcome pressure changes as a result of airflow changes in the duct.

5.3 Route to compliance

This section talks about compliance to BS and the performance tests that are to be done for systems that do not fully meet BS. Our view is that any VESDA system should be tested using the performance tests described within Appendix A of the COP.

Table 2 of the COP is designed to allow someone to categorise an ASD system. This method ensures that the level of detection and performance of the system meets the protection design objectives of the end-customer. A VESDA system can achieve all aspects of table 2.

5.4 Summary and examples

ASD categories encompass:

- Detector Class A, B or C
- Type/Method of sampling
- Primary Motivation
- Requirements for compliance

This will then result in a useable statement that fully describes the performance characteristics of the system. These examples are as used in the COP:

- Class A detector providing primary sampling within high airflow area to BS 6266 spacing
- Class A detector providing primary sampling for Very Early Warning to meet Test E.2
- Class B detector providing localised sampling of equipment X to BS 6266 spacing
- Class C detector providing secondary sampling for an area with restricted access to BS 5839 spacing.
- Class C system providing duct sampling of a return air duct as part of a smoke containment system to detect a 7-9g pellet according to appendix A

6. Exchange of information and definition of responsibilities

No comment. Refer to the COP

7. Variations of recommendations

No comment. Refer to the COP

8. Design Considerations

There are many important aspects to design and the COP discusses these at length. However, the key points are:

- A VESDA system should be designed to meet the local National Standards, e.g. BS5839, BS6266 or be designed to meet a performance criteria
- A single VESDA detector should only be used to cover areas up to one BS5839 fire zone, 2000 m²
- Failure of any single aspirator or critical component must not affect more than 2000 m² or the fire zone
- Due to the probability that a VESDA detector could generate an alarm before smoke is visible in Very High Sensitivity applications, special training should be considered for personnel dealing with the system.
- If monitoring within a duct, ensure that the area extracted by the duct isn't greater than 2000 m². If it is, additional detection will be required.

Note that the heading numbering in this section deliberately starts at 8.3 to match the relevant sections of the COP.

8.3 Sample point spacing

8.3.1 Horizontal spacing in normal environments

In essence, all guidance relating to the design of conventional point type smoke detectors, including structural beams, partitions, corridors, pitch roofs etc, should be applied to a VESDA system.

In areas where a performance based design is agreed, the standards provide a very good starting point. However, holes may have to be moved, added or removed from certain areas, e.g airpaths or underneath beams. An agreed test should be used to verify system performance.

8.3.2 Ceiling Height Limits

The maximum height for ASD according to the 2006 CoP and BS5839 2008 was very conservative and limited it the same as conventional optical smoke detectors(12-21 m). Despite this, there was a lot of evidence to prove that actually ASD was effective at ceiling heights in excess of 20 m and in some case even up as high as 40 m. This was due to the way an aspirating system benefits from multiple holes receiving diluted smoke and providing an accumulated volume of smoke at the detector.

Independent testing has proven that ASD is effective at ceiling heights of 43 m detecting even relatively small fires. As such, the advice given in the 2011 release of BS5839 allows for ASD at these greater heights and Table 3 gives this guidance, The recommendations given (a-g) should also be adopted.

8.3.3 Sampling in high airflow environments

This is a common use of a VESDA system and relates to Electronic Data Processing.

8.3.3.1 Primary sampling

There is much information in the COP relating to primary detection, but the key aspects are:

- In areas of Very High Sensitivity, Primary Detection is Essential
- Position the pipe on the return air side prior to any filtration
- Aim for one hole covering 0.4 m² maximum of an AHU Grille, (ideal is 0.2 m²)
- Locate the pipe in the best position to suit laminar airflow
- Position holes typically 30-60 degrees off centre of the airflow
- Utilise socket unions or flexible joints to allow maintenance access

8.3.3.2 Secondary detection hole spacing in areas of high airflow

Guidance on hole spacing, or indeed spot detector spacing, in high airflow environments was limited and could easily be misinterpreted.

With the release of BS6266:2011 there is greater advice on sample hole spacing for ASD.

The process is effectively taking a base 25 m² coverage and increasing or decreasing that area dependant on certain factors. The section of BS6266 that discusses this is copied in to the FIA COP on page 29.

8.3.4 Vertical sampling

A VESDA system can be designed to overcome the risk of heat barriers not allowing smoke to reach to high levels quickly (stratification). Pipes can be run:

- Vertically up the space being protected
- Drop pipes from the main pipe at high level
- Horizontally, suspended below ceiling level

The types of application this may be used in are:

- Atrium
- Warehouses
- Aircraft hangars

In all cases, code compliant coverage at high level must be adopted.

8.4 Reporting, signalling and system integration

8.4.1 Standalone system

When the VESDA detector does not signal to the Control Indication Equipment (CIE), it is considered to be standalone. This is a rare use of a VESDA detector, however the detectors do have multiple volt free contacts, rated at 2A 30vdc, that can be used to trigger external devices of any description.

8.4.2 Integrated Systems

8.4.2.1 Visual alarm signals

The VESDA detector is able to generate multiple alarms. FIRE1 is the alarm threshold that is normally used to trigger the CIE in to a Fire state.

8.4.2.2 Multiple alarm thresholds

Multiple alarm levels are discussed in the COP. These can be used for any number of different scenarios, e.g.:

- Alert – Flashing a Beacon
- Action – Stage one of a gas system and shutting down equipment, e.g. AHU's
- Fire 1 – Activating Fire on the CIE
- Fire 2 – Interface to a Gas Extinguishing System or pre-action suppression system (see section 8.8)

Interface of these levels is via volt free contacts from the VESDA detector as discussed in 8.2.1.

8.4.2.3 Interfacing of the VESDA system can be via volt free contacts or an open protocol connection to the fire system or BMS. Open or short circuit must be monitored in certain cases.

8.4.2.4 Networking

Several VESDA detectors can be connected via a VESDAnet network. This is a two core loop utilising, preferably, a Belden 120 ohm data pair or a suitable fire rated cable, e.g. FireTuf, FP200 or MICC. VESDAnet should always be run as a loop as this prevents loss of signal due to cable failure or fault. However, an open ended daisy chain system may be used but is strongly discouraged. VESDAnet allows central display of information on display modules or a PC running VSM (VESDA System Manager). This benefits an engineer in programming and interrogating a complete system from one location.

If VESDAnet is being used with remote relays connecting centrally to the CIE, a suitable fire rated cable must be used. If VESDAnet is used for information only, fire rated cables are not required.

A single communication fault must not affect an area greater than 2000 m². As long as VESDAnet is run as a loop, this would not happen as the loop is bidirectional.

If there are two faults on the VESDAnet, it must not affect an area greater than 10000 m². This is an issue that must be considered if a central interface to the fire system is being utilised, e.g. using the relays in remote displays to connect at one location to the fire system. If VESDAnet is being used only for information and/or ease of maintenance, and the interface to the CIE is directly at the VESDA detector, then this will pose no problem.

8.5 Fault monitoring

The VESDA detector has three levels of Fault.

- Minor Fault – The system needs some service attention but is still operational
- Urgent Fault – The system may not be capable of detecting smoke and needs urgent attention
- Isolate – The fire outputs have been isolated

Depending on the VESDA detector type, these could be separate relays. However, all Fault levels should be reported to the CIE as Fault. This also includes the external Power Supply Unit (PSU) supplying the VESDA detector with 24vdc. The PSU can be monitored by use of the General Purpose Input on the VESDA detector programmed as “Mains OK”.

8.6 Maintenance

Maintenance of the system should be agreed at the design stage and deviations from the commissioned values for things like airflow and smoke transport time should be agreed.

Commissioning documentation should be used to verify consistency with commissioned values.

The VESDA System Design Manual provides guidance on recommended maintenance activities and schedules.

8.7 Power Supply Unit

A suitable PSU should be used to support the VESDA detector. The PSU supplied by Xtralis are designed specifically for the purpose of supplying the VESDA detector and have sufficient power and battery space for compliance to BS. All PSU supplied by Xtralis are approved to EN54-4.

Although the PSU may be capable, it is important that if one PSU is used to supply more than one VESDA detector, if the PSU fails and the VESDA detectors are rendered inoperable, this does not affect an area greater than 2000 m². The larger PSU supplied by us has individual fused outputs to ensure that a short on one output does not affect the remaining outputs used to power other detectors.

8.8 Extinguishing systems

The use of VESDA systems as part of the extinguishing release process has been employed for many years. BS6266 and BS7273-1 should be noted. A VESDA detector has a wide sensitivity range. It can be used for the second stage of a gas system release. There are number of innovative and very reliable ways of configuring VESDA systems for coincidence detection.

There are a number of points that should be read and observed within the COP.

8.8.1 Coincidence detection with ASD

Coincidence is used to verify a fire and typically is associated with suppression systems where a discharge is expensive and can lead to an unprotected space.

Typically coincidence was from two differing technologies to overcome the limitations and reliability of a single detector type. This is now more commonly done with detection zones through differing loops on an addressable system.

ASD systems can be used as part of a coincidence system and table 4 should be referred to for guidance.

9. Design Tools

The COP advises that a suitable design tool should be available for verification of the system. The ASPIRE2 software, provided free by Xtralis, should be used for this purpose.

ASPIRE2 allows the user to input data regarding the pipe layout and detector type. This will then be used to confirm that the balance of the system is acceptable and that the transport time meets the requirements of the customer and meets the COP. There are many other features of ASPIRE2 that aid the installation process including tables showing hole sizes and positions along the pipe and a 3D isometric view of the pipe layout.

9.1 Closed end pipe

It is rare for the end of the pipe to be closed as invariably the end cap hole forms part of the detection layout. However, this may be the case on duct detection and pipes covering return air grilles.

9.2 Vented end cap

This is the normal method that is used for pipe runs with the end cap of either the same hole size as the main holes or in some cases, to improve transport time, a slightly larger hole. Note that it is good practise to design the vented end cap as the last sampling hole of the pipe.

9.3 Pipe design considerations

- Primary Detection
- Secondary Detection
- Maximum Transport Time
- Balance
- Relative Sensitivity

9.3.1 Primary detection sampling systems

This is where the sampling pipe is positioned in the likely path of smoke, for example across a return air grille. It is deemed as supplementary to other detection as it has limited effect when the air flow is off.

9.3.2 Secondary detection sampling systems

This is where the pipe is positioned so that sample holes are in the same location as a conventional detector would be to meet the local code.

9.3.3 Maximum permissible transport time

The maximum allowed transport time is 120 seconds (2 minutes). Xtralis suggests that the transport time should be as short as possible and ideally less than 60 seconds. This is certainly the case in Class A systems where very early warning is required. ASPIRE2 applies a maximum transport time according to the sensitivity Class being specified. For example a VLP must have a predicted transport time <90s in order to operate as a Class B detector.

9.3.4 Balance

Balance is the relationship in flow between extremes of holes. Holes nearer the VESDA detector will be drawing more air than those further away. In an ideal system, the balance should be as close to 100% as possible, but a minimum of 70% is required as this allows for a simplified installation using the same or similar hole sizes along the pipe length.

9.3.5 Relative sensitivity

Relative sensitivity is how much smoke would need to enter one hole in isolation of all the other holes on that detector to make the VESDA unit trigger a Fire1 Alarm. This information is clearly shown in ASPIRE2. ASPIRE2 can also determine aggregate sensitivity, i.e. with smoke split between multiple holes. This is more common in the large open spaces that a VESDA system is frequently used in.

10. Applications

This section discusses the applications of ASD.

10.1 Normal environments

VESDA is increasingly being installed in normal applications due to its discrete detection capability, maintenance ease and the cumulative effect.

- 10.1.1 Where VESDA protects multiple small areas, even if the space only needs one sample hole to meet the standards, it is advisable to allow for two holes to limit the risk of sample hole blockage affecting performance.
- 10.1.2 The limitation of ASD is its addressability. However, having an earlier alarm capability does add extra time in searching for a fire. The following guidance on search times should be considered when an ASD system protects multiple separate areas/rooms:
 - 10.1.2.1 For EN54:20 Class C – Normal Sensitivity – inspection within 1 minute and a travel distance less than 60m
 - 10.1.2.2 For EN54:20 Class B – Enhanced Sensitivity – inspection within 2 minutes and a travel distance less than 60m
 - 10.1.2.3 For EN54:20 Class A – Very High Sensitivity – inspection within 5 minutes and a travel distance less than 60 m

Note : these guidelines reflect BS5839-1 2008 for non-addressable fire detectors

- 10.1.3 If the ASD system can determine the pipe carrying smoke, so a VESDA VLS, this recommendation is applied per pipe/sector.

10.2 Electronic data processing (EDP) Areas

This is the most common application to associate VESDA with. Fire detection is compromised due to high airflows, low thermal energy in smoke, dilution of the smoke and clean air ventilation.

Primary (across return air vents) and secondary (at the top of relevant voids) should always be considered.

The number of VESDA units required will depend on the area of the spaces and the number of AHU's. Our design guides should be consulted.

Secondary spacing of sample holes should be in accordance with 8.3.3.2.

Primary detection is always on the air return grille or pressure relief vent and is normally limited to four grilles although size and location to each other will affect this.

Sample holes should be spaced according to 8.3.3.1 and positioned off the flow by 30-60 degrees and in the predominant flow. Consider using socket unions if pipe restricts access for AHU maintenance. No recommendations are provided in the CoP in relation to the more recent hot aisle/cold aisle arrangements being used in EDP areas. Please refer to the Xtralis Application Guide, *D/N 11782 - Telco and Data Processing* for advise and recommendations for protecting EDP areas with containment aisles.

10.3 Warehousing

Warehouses pose as a unique risk as there are many factors that affect design.

You should refer to section 8.3 for spacing and height limits, but you must also take in to consideration the affect of racking and if this creates compartments in the warehouse. A high risk area within warehouses is the battery charging area for fork lift trucks. It is advised that VESDA be used to monitor these areas and also VESDA Eco could be deployed for gas detection (hydrogen released from a failure in a battery).

10.3.1 Ceiling Detection

Although a Class C system would meet the needs of detection in a warehouse and will add the benefits of maintenance and cumulative detection, a Class B system should be considered if the storage is above head height. In the majority of installations, VESDA would normally be set at a sensitivity that achieves Class B anyway.

Refer to Fig 4 and Fig 5 for suggestions on aisle sampling if the racks reach to within 300 mm of the ceiling.

10.3.2 In rack Detection

It may be deemed necessary to increase detection with the addition of sampling in the racks. We advise that the FIA COP is reviewed here, but the key points are:

1. A higher density of sample holes in the horizontal plane with holes spaced at 6 m max.
2. When racks extend more than 8 m vertically, position pipes in the top 25% of the rack and no more than 10 m from the ceiling and also a maximum of 8 m between pipes vertically.
3. If multiple vertical pipes are used, offset the sample holes to increase the likelihood that smoke will enter a hole.
4. This gives guidance on the benefits of sampling pipe location either in the rack or on the rack side in the aisle.

Refer to figure 6 for guidance.

10.4 In-cabinet detection

Cabinets fall in to the following categories:

- Sealed – Capillaries in to the cabinet
- Naturally Ventilated – pipe across the extract grille
- Forced Ventilated – pipe across the extract grille

10.4.1 Sealed Cabinets

Capillaries would be required in non-ventilated cabinets, either from above or rising from below.

10.4.2 Sample hole locations and recommendations

- a) locate detection holes in top 10% of cabinet if not ventilated or across ventilation grilles for mechanically or naturally vented cabinets
- b) Consider using more than one hole if the vents are large or numerous
- c) if the cabinet warrants it due to its size, have multiple holes at the top.
- d) Class A & B is recommended and we would certainly suggest high sensitivity in cabinets is beneficial.
- e) Aspirating detection signals should match gas suppression areas.

We would advise that you refer to our design guide for more guidance on sampling inside cabinets.

10.4.3 Number of cabinets

This gives guidance on the number of cabinets protected from Aspirating Units to meet the three sensitivity classes. However, we would advise that all designs are validated with Aspire.

10.5 Heritage buildings

Due to the flexibility of using plastic pipes and capillary tubes, VESDA lends itself well to a discrete installation in heritage buildings. Further guidance can be viewed in our Heritage Design Guide.

10.6 Harsh and Hazardous Environments

The use of VESDA in harsh environments is common. A harsh environment is areas where additional measures would need to be taken with the air sample prior to entering the VESDA detector. This could be extreme temperatures, areas of high humidity or particularly dirty environments.

The most notable comment with any of these areas is that the level of maintenance will increase significantly to that of a VESDA protecting a normal, comms room, type of environment. However, with careful pipe design and the addition of additional pipe components, this becomes a simple solution.

In all of the following applications, we strongly advise that guidance is taken from our design guides.

10.6.1 Cold Areas

The biggest concern in cold areas is temperatures less than zero degrees centigrade.

10.6.1.1 Temperature of air sample

Although VESDA would, in theory, take temperatures down to -20 deg C, we strongly advise that the sample air is above zero to reduce the risk of condensation forming inside the detection chamber. Electronic heating can be used to warm the air, trace heating or heater boxes, but ambient air warming is a simpler and cheaper solution.

10.6.1.2 Moisture

It is generally a low risk of moisture forming inside pipes as cold stress are normally low humidity. However, if this risk is deemed likely, refer to 10.6.2. Moisture can form on the outside of the pipes and can also freeze, but this will not affect the operation of the VESDA.

10.6.1.3 Freezing of sample points

This is the biggest issue with Aspirating in cold environments. It is almost impossible to stop ice forming on pipes and over holes of ice is likely to build up. The only solution is to avoid locating sample holes near risk areas, for example:

- Avoiding doors entering from external ambient areas as warmer moist air enters and freezes
- Avoiding positioning holes directly in front of blast chillers as a defrost cycle can create moisture.
- Avoiding any other potential risk areas.

10.6.1.4 Installation

Comments are made, but refer to our design guide for VESDA specific guidance on installation.

10.6.2 Wet Areas

If VESDA is monitoring areas of high humidity or wash down, there is a high risk of water entering the pipe. This water can be removed with the inclusion of one or multiple (where there are numerous low points) water traps, either manual or automatic. It is also important that the VESDA is installed in the inverted orientation to minimize the risk of water entering the detector.

10.6.3 High temperature areas

As with cold areas, it is common to use ambient air to reduce the temperature of the air in the pipe. Be aware that this could lead to condensation forming in the pipe, so water traps should be considered.

10.6.4 Dirty and dusty areas

VESDA utilizes an internal filter. In areas of high dust load, this filter can become contaminated quickly, so inline filters could also be considered. The inline filter is not monitored so must be regularly checked to avoid an increase in filter effectiveness. In very dirty applications, the VESDA LaserINDUSTRIAL should be considered.

The blockage of sample holes due to dust contamination is also important to consider. This can easily be overcome by using pipe purging, either manual or automatic. VESDA will generate a fault when the flow drops by 20%, so will still be an operational system until the pipe is purged.

10.6.5 Potentially explosive environments.

There are two hazardous environment units from Xtralis. It is important that the hazard classification of the environment is advised so as to ensure it meets the requirements. It is not acceptable to use standard VESDA detection mounted outside of the hazardous area as it will extend the explosion risk to the safe area.

10.6.6 Inaccessible or restricted environments

This is a common application for VESDA as the detector is mounted in one location whilst the sampling is conducted in the restricted area.

Consideration should be made to extending the end of the pipe to the same or an alternative area for pipe integrity testing.

In some restricted/access limited areas, for example, cable tunnels or floor voids, the additional use of VESDA ECO should be considered for monitoring of certain gasses.

The exhaust of the VESDA should be returned to the risk area if a pressure differential is possible.

10.7 Duct Detecion

VESDA offers a very effective solution to sampling inside ducts. Once again, reference should be made to our duct detection design guide.

A couple of key points to observe:

- Only one duct should be protected from one VESDA
- The sample pipe and exhaust pipe should match to ensure a static pressure between the intake and exhaust probes.
- As with all duct detection, position the sampling in clear and clean airflows, so avoiding bends and restrictions.

11. Product Standards and Marking

All VESDA systems are manufactured to meet all the requirements EN54-20 and is marked accordingly.

12. Limitation of False Alarms

There are a number of different categories of false alarm. However, only Unwanted Alarms and Equipment False Alarms relate to a VESDA system.

12.1 Unwanted alarms

Due to the high sensitivity of a VESDA detector, it is a common misconception that it is prone to false alarms. Unwanted alarms are, in fact, rare. Appropriate training is essential in areas of Very Early Warning as an alarm condition from VESDA can be thought of as being false as no fire is evident, but an incipient fire is actually developing.

There are a number of features of VESDA that help in the limitation of false alarm and these are discussed in the FIA COP.

12.1.1 Alarm thresholds

The Alarm thresholds on a VESDA detector have a great deal of adjustment, so setting the threshold above the normal operating background of the protected space is never a problem. The sensitivity range of the VESDA detector is 0.005% to 20% Obs/m* with almost no limit to where the thresholds can be set. Fire1 has a maximum and minimum sensitivity to ensure compliance to LPCB. The main point to note is that the VESDA detector is a fixed calibration unit and the sensitivity is not being continually altered to compensate for degradation of the sensor optics or noise created by background change.

* LaserFOCUS is 0.025% to 20%

12.1.2 Fault logs

The VESDA detector has a comprehensive log recording up to 18000 events that include smoke changes, alarm conditions, fault conditions and user intervention. This log is invaluable for two reasons:

- Recording the normal background activity to allow a decision to be made as to a suitable alarm threshold
- Investigation in to Fire and Fault activity, seeing trends in alarm conditions that could be attributed to external influences, e.g. a power supply with a fault switching on and off.

12.1.3 Multiple alarm thresholds

As well as the wide sensitivity range of a VESDA detector, it also offers multiple alarm thresholds. Dependant on the detector type, this can be up to four different levels allowing effective application of staged alarms. For example, all four could be used as follows:

- ALERT – As it suggests, alerting someone, so activating a localised strobe or sounder
- ACTION – This could instigate a controlled shut down of plant and machinery and also possibly stage 1 of a gas discharge system
- FIRE 1 – Is generally treated as a normal point-type smoke detector and will activate an Evacuation on the fire alarm panel
- FIRE 2 – Is normally used for the 2nd stage of a gas discharge system.

These staged alarms also allow a response that could prevent activation of the main fire system, for example if unauthorised hot works are being undertaken.

12.1.4 Referencing

As mentioned earlier, a VESDA detector has fixed calibration. As such, once the alarm thresholds are set there is no automatic adjustment of the detector's sensitivity. The only time that a change may happen is when referencing is used. If there is a risk that smoke from an external source can enter the area being protected, the external air can be monitored by use of another VESDA detector acting as a reference.

This reference detector will offset the main detectors to avoid an unwanted alarm caused by this external influence.

12.1.5 Alarm delays

The VESDA detector can have a delay of up to 60 seconds per alarm threshold. These delays can also be made "Cumulative", i.e. if each threshold is 20 seconds and the smoke level rises above Fire 1, there will be a delay of 60 seconds before Fire 1 activates. Alternatively they can be "Simultaneous" where only the delay time for the level breached will take effect. This can vary depending on the detector in use.

12.1.6 Day/night settings

On some VESDA detectors these are referred to as Alarm Set 1 and 2 as it is rare that this feature is used for day and night settings. In essence, all fire thresholds can have a different sensitivity to overcome a normal activity. This change can either happen at specific times as controlled by the VESDA internal clock or via an external input in to the VESDA detector. Some possible uses could be :

- During cleaning stages of plant machinery
- In Churches or Cathedrals where incense is burned during services
- In theatres, where stage smoke is used for effects

NOTE: The LaserCOMPACT does not have different sensitivity sets.

12.1.7 Software algorithms

VESDA detectors incorporate dust rejection algorithms as described in the COP but these do not adjust the detector's sensitivity to smoke. Such dust rejection algorithms should not be confused with "adaptive algorithms" which adjust the alarm thresholds according to the measured background level. While these adaptive algorithms are sometime referred to as "artificial intelligence" they should be treated with some caution as there is some evidence that their behaviour is unpredictable (Annex J EN54-20:2006). As stated in 12.1.1, VESDA detectors have fixed calibration.

12.1.8 Filtering

The filter in a VESDA detector has a unique function. It provides a clean air bleed that protects the optical components of the VESDA chamber. Protecting the optical components from dirt and dust ensures the continued sensitivity of the detector.

The status of the filter is monitored and a service engineer can interrogate the life used of the filter and estimate its replacement time. The life of the filter can be greatly reduced in dirty industrial applications, but in a typical office type environment, life expectancy is up to three years.

12.2 Equipment false alarms

These can be limited by using VESDA detectors as they are extensively tested by third party certification companies to ensure approval and correct operation. All VESDA detectors and remote modules have LPCB compliance. It is also important that servicing is conducted in accordance with section 15 of the COP and as described in the Maintenance Section of the VESDA System Design Manual (available at www.xtralis.com/vesda).

13. Installation

There are a number of points to consider when installing a VESDA detector.

13.1 Siting of equipment

The VESDA detector should be located in an accessible location. This is one of the benefits of a VESDA system when detecting in areas of restricted access.

The filter is located at the front of the VESDA detector, so ensure that nothing restricts access to it.

If the VESDA detector is located in an area different to the risk, consider back venting the exhaust in to the space to avoid an issues with pressure differentials.

Ensure that no environmental issue can damage the VESDA detector. If there is a risk of moisture or dirt affecting the unit, consider mounting it inside our purpose designed IP66 enclosure.

13.2 Electrical installation

The VESDA detector requires a 24 vdc supply. The PSU supplying this must be installed in accordance with specific regulations. Suitable cable should be used according to the risk to link the PSU and the VESDA detector and the VESDA detector and the CIE.

13.3 Mechanical installation

13.3.1 Pipework

The requirements of the pipe used on a VESDA system are that it has a smooth internal bore with a nominal 21 mm ID and any changes of direction are slow radius bends and not tight 90 degree elbows. As such, almost any type of pipe can be used and is invariably chosen based upon the requirements of the installation.

However, we do also supply a pipe specifically for the purpose. This meets the code requirements of being labelled as a smoke detection pipe. It should be clipped at no more than 1.5 m centres. A full range of bespoke pipe fittings is available.

13.3.2 Sampling points

Sample points are either drilled directly in to the main pipe or are in the form of capillary sampling points.

13.3.2.1 Extended sampling pipe or capillary tube

Capillary sampling is simply a method of having the sample hole remote from the main trunk pipe. This could be either for installations where the pipe is located in a void above the protected area, or where a sample hole lower than the pipe is required (drop pipes within racking in warehouses), or where a riser pipe is required (in difficult to access ceiling voids).

We have three purpose designed capillary points to suit most applications. Pipe can also be used to fabricate other suitable capillary forms.

- Conical sample point – this is normally used on suspended ceilings and comes in a kit.
- Flush sample point – this is used where access above for fixing is restricted and is also a kit.
- Discrete sample point – this is used in areas where the hole is required to be invisible, e.g. heritage buildings.
- Normal size pipe – this is achieved by utilising an equal Tee, a length of normal pipe and an endcap with a sample hole.

The size of the hole in the end of a capillary should be determined by modelling on ASPIRE2.

13.3.2.2 Sampling points

Normal sample holes are drilled directly in to the main trunk pipe with a hole size determined through ASPIRE2.

Ensure that the pipe is clear of swarf before connecting to the VESDA detector and also ensure sample holes are clearly identified with the labels available.

Sampling points should be clearly labelled.

13.4 Labelling Requirements

All aspects of the ASD system should be labeled. Xtralis red or white pipe is labeled along its length and capillary sample points are also labeled. Sample holes should also be labeled with a wrap around label.

Discrete installations may not be labeled as this will affect the discrete nature so should be backed up with an accurate plan of the sample points.

13.5 Inspection

A good visual inspection of the installation should be completed prior to commissioning. It may also be necessary to clean the internal pipe to remove swarf and this could be conducted with a vacuum or purging to the pipe.

14. Commissioning and Handover

14.1 Commissioning testing

Commissioning tests should only be conducted when the building is in its final state and the VESDA system can be configured correctly.

14.2 Commissioning

14.2.1 Inspection of installation

It is important that the final installation is inspected to ensure that it matches the design and the ASPIRE2 calculation. Particular note should be made of :

- Ensuring the installation meets the design specification
- Adequate coverage has been made across Air Handling Units
- Compliance to the relevant BS or National Standard is being achieved. Sample holes should meet the minimum performance requirements for individual points.

A thorough inspection of the physical installation should also be conducted, checking the pipe is secured correctly and all holes are identified and correctly sized and spaced. Wiring is installed correctly, PSU's are correctly sized and batteries adequate to meet stand by requirements.

14.2.2 Power up/configuration

The correct power up sequence should be followed as detailed in the documentation supplied with the VESDA detector.

Using a suitable programming tool, either an LCD programmer on the system, a Hand Held Programmer or a PC connected via a High Level Interface running VESDA System Configurator Software (VSC), the VESDA detector should be programmed following the guidelines in the documentation.

14.2.3 Commissioning tests

Xtralis fully endorse that commissioning tests as discussed in the COP are followed.

Before tests are conducted, the area of protection should be in its final operating state, e.g. full room integrity, air conditioning equipment operating and floors and ceilings in tact.

For a prescriptively designed system, as a minimum the following should be tested:

14.2.3.1 Smoke transport time/pipe integrity test

Introduce smoke in to the furthest sample hole in the pipe and time how long before the VESDA detector reacts to this smoke. A reaction is deemed to be an increase of 2 bars above the normal bargraph reading. It could also include an alarm condition, however, if this is the case, any alarm delays should be set to zero before the test.

On systems with multiple branches or pipes, each must be checked. Results should be recorded to be referred to during maintenance of the system.

Transport time should not exceed the time specified for the system or the maximum time specified by the COP – 120 seconds. Ideally it should be less than 60 seconds.

The transport time from a maintenance test point that is closed during normal operation should be recorded but may exceed the maximum transport time as long as the transport time from the furthest detection hole is less than the maximum specified.

14.2.3.2 Fault detection

It is advisable that a High Airflow fault is checked (simulating a broken pipe) and a Low Airflow fault is checked (simulating a blocked pipe or blocked sample holes).

In some cases, single sample hole blockage is required where there is a risk of malicious damage to the hole, i.e. in a prison cell or police cell. If this is the case, the system should be suitably designed with a small number of holes.

All flow readings should be recorded during commissioning for future maintenance.

The PSU should also be checked to ensure that correct signalling is made in the event of power or battery loss. If this is via the VESDA General Purpose Input, check that the correct signal is generated by the VESDA detector.

It is also possible to use the diagnostics function of the VESDA detector to check for a general fault or a flow fault to ease commissioning and maintenance.

14.2.3.3 Functional tests

Functional tests should be agreed and conducted as detailed in the maintenance section. These tests are to verify that smoke is entering sample holes and the system responds as expected.

If a system is designed to performance requirements, then additional performance tests may be required.

14.2.3.4 Performance tests

When a performance test is required, it should be as described in the COP. However, it is also possible that an agreed test of a different nature may be conducted. It is advised that a video of a smoke test is shown to the client prior to conducting the test so that they are aware of the quantity of smoke and heat generated during the test.

Results from the tests should be recorded so that the test can be repeated during maintenance when necessary.

14.2.4 Signalling

All signalling between the VESDA detector and the CIE must be checked. This can be done during performance tests, or the Diagnostics function of the VESDA detector can be used to force certain conditions or control relays independently.

It should also be verified that Isolating the VESDA detector triggers a fault condition at the CIE.

14.2.5 System handover

It is strongly advised that suitable handover documents are provided to the customer. This can either be in the form of those described in the COP or they could follow those recommended in the VESDA System Design Manual.

15. Maintenance

It is important that the VESDA system gets the same level of maintenance as the Fire System. As a minimum this should be annually.

15.1 Frequency of maintenance

VESDA should be inspected at least annually but can vary and be more frequent.

15.2 Recommendations for routine inspection and testing

Maintenance guidelines for the VESDA system are clearly detailed in the Maintenance section of the VESDA System Design Manual and should be adhered to.

15.2.1 Routine inspection

For a suitable level of maintenance, a programmer or PC connection will be required.

All Fault and alarm outputs should be checked ensuring that the CIE is isolated or disabled so as to ensure an evacuation signal is not generated.

The PSU and batteries should be checked ensuring that any fault on the PSU is reported correctly either directly or via the General Purpose Input.

The filter life should be checked in the filter menu.

All parameters set and recorded during commissioning should be verified with the current readings.

A visual inspection of the pipe work should be made.

15.2.2 Functional tests

The purpose of the functional test is to ensure the system remains as it was during commissioning. Smoke being injected in to each hole is ideal, however, due to the applications of a VESDA system, this may not always be possible, so other techniques can be adopted such as:

- A transport time/pipe integrity test should be conducted to ensure consistency with the commissioned system.
- Flow readings as taken during commissioning are the same, particularly the Raw flow or l/min flow and the percentage flow
- Blockage of one hole (or a group of holes) in certain applications creates a fault.

There are also a number of other suggestions made in the COP that should be considered with regard to testing.

16. User Responsibilities

It is important that the VESDA is checked as per clause 47 of BS5839-1:2008 as with the rest of the fire alarm system.

B. Appendix

The appendix section details the relevant performance tests and the procedure for conducting them. The original tests are still used although there have been some improvements and also there is the inclusion of some new tests. As such, this section should be considered when determining what test should be conducted.

It is important that prior to system design, it is agreed what performance test will be conducted so as to avoid any confusion at hand over of the system.

Appendix A – Table detailing the type of tests

Appendix B – Smoke Pellet Test – used for typical areas complying to BS5839. We are able to supply pellets and the test equipment for this test.

Appendix C – Paper Burn Test – This test is rarely used for VESDA, although in an office type of environment it is possibly a better test than Appendix B. However, it also now includes the paper burn in an incinerator that could be used in large open spaces.

Appendix D – Overheated Enamel Wire – This test is not used for VESDA detectors.

Appendix E – Overheated PVC/LSF wire – There are three tests here,

- E.1 is the 1 m wire and is for Class A and Class B systems, so computer rooms/telecom rooms etc.
- E.2 is a 2 m wire and is for Class A only as it only gives off very small amounts of smoke.
- E.3 is the 2 x 1 m test and is for Class A and B systems where more smoke is required than in test E.1.

Xtralis manufacture a suitable test unit for this procedure and wire for the test.

Appendix F – Overheated Resistor test. Three different tests within this process but this is normally aimed at small cabinets. However, due to the complexity of the equipment, the 2 m wire test is normally used here.

Appendix G – Polyurethane Mat Test. This is rarely done in the UK but is commonly conducted in mainland Europe in place of Appendix B.

Appendix H – Potassium Chlorate/Lactose Test. This is an inherently dangerous test and its use is discouraged. It would be done in place of Appendix B or G.

Appendix I – .1 to 1.5 are the hand over documents.



Recognised as the global market leader in early warning smoke detection, VESDA aspirating smoke detection systems are ideal for:

- mission critical applications
- high airflow applications
- inaccessible areas
- large open spaces.

The system offers a unobtrusive detection for a wide range of vertical markets, including telecommunications, transportation, manufacturing, utilities and storage services.

The VESDA product range includes Detectors, Programmers, Displays, Remote Devices, Systems Management Software, Design Software, Power Supplies, Pipe and Fittings, and a complete assembly of support material.

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Doc. no. 12951_02