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## Fire detection in exhibition rooms

Protection of people and cultural assets

Museums and historical buildings generally have a number of large exhibition rooms with high ceilings. Although deceptive phenomena do not generally present a problem in such applications, the height of the room (and the large volume of air) will cause the concentration of any fire-related aerosol to be strongly diluted. This demands high sensitivity smoke detection, which can be best provided by an ASD (Aspirating Smoke Detection) system. ASD systems are able to detect even the smallest aerosol concentrations and offer the ideal solution for fire detection in exhibition halls in modern museums.

However, in historically sensitive buildings the installation of such a system is often not permitted, due to the impact on the authenticity and fabric of the building. In such cases an alternative solution is to use a combination of sensitive wireless smoke detectors and linear smoke detectors.

In the event of a fire, the highest priority must be given to alerting and evacuating all parties at risk and in good time. A fire protection system is needed that guarantees rapid, reliable fire detection and activates both the alarm devices and the relevant fire control installations.

Early warning of a fire in historical buildings and museums is essential; not only for saving lives, but also for the protection of cultural heritage. However, unnecessary evacuation activities due to false alarms must be avoided.

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# Introduction

Exhibition rooms are generally large rooms in which various objects or works of art are displayed (to the public); they fall into two basic categories:

- Rooms where products and services are presented and marketed (industrial and trade exhibitions)
- Rooms where historical artifacts or works of art are exhibited (museums or art galleries)

In both cases the objective is to enable as many members of the public as possible to view the displayed objects between certain hours of the day.

In some exhibition centers the type and duration of an exhibition can vary widely. This is particularly true for exhibition centers, where industrial or trade exhibitions are held. If such a room is being used for an IT-exhibition, where products and services are being presented, we can assume that this will be a clean environment with only a low fire risk. If live demonstrations (e.g. vapor steam cleaners) are to be held in the room, together with an integrated restaurant service, then we need to reckon with a harsh environment with a locally heightened fire risk. When we consider a room in a museum or art gallery, however, where old paintings are being displayed, we can expect a clean environment but with a high fire risk.

The above examples show that we cannot generalize; there is no such thing as “the exhibition room”. This is particularly true with regard to fire protection. This document focuses on fire protection in those rooms where historical artifacts or works of art are being displayed. Many of these rooms are situated in historical buildings, in which the displayed objects interrelate with the rooms themselves.

In a similar way, this also applies to exhibition rooms in modern buildings. The layout, the lighting and the décor are designed in such a way that the room becomes an integral part of the exhibition.

## Highlights

- The main focus is on minimizing the damage to exhibits and the rooms themselves
- The irreplaceable nature of historical structures and artworks automatically implies a high fire risk
- Typical fire hazards include electrical overloading or short-circuits in electrical installations
- Even the smallest of fires can lead to irreplaceable losses of cultural heritage

# Basic conditions

## Objectives

- Recognition of an abnormal aerosol concentration and transmission of this information to a fire safety officer (or similar responsible person) so that the situation can be evaluated and the appropriate counter measures can be taken (e.g. disconnecting an overheated air conditioning unit or closing the air intake, to prevent contaminated air entering the room).
- When a noticeable increase in the aerosol concentration is detected (indicating an incipient fire) the visitors in the area must be warned and the security staff mobilized. The staff can then invoke the previously defined counter measures, so that damage to the exhibits and to the room itself can be kept to an absolute minimum (e.g. switching off electrical equipment, extinguishing the fire, moving exhibits to safety).
- When a fire is detected in an exhibition room, smoke and fire must not be allowed to spread to neighboring areas. This is particularly important when adjacent rooms are also exhibition rooms.

## Typical fire hazards

- Overload or short-circuit of electrical installations (e.g. cables, switches, etc.).
- Defective electrical equipment (e.g. air conditioning, heating, lighting).
- Danger created by negligent human behavior (e.g. maintenance work, careless handling of candles, vandalism).

## Typical development of a fire

Fires started by an electrical source exhibit a very typical fire development pattern:

- When electrical equipment overheats small quantities of an aerosol will be generated. If during this phase the power to the device is removed, then no fire will occur and any damage will normally be limited to the equipment itself.
- If the electrical power is not interrupted, then a smoldering fire can develop, which produces increasing amounts of visible smoke. If such a fire can be detected in the early stages, it can still be dealt with easily and the damage can be limited to a small area.
- If appropriate counter measures are not taken at this stage, then the smoldering fire can develop into an open fire, which can cause enormous damage.

If the fire has been caused by carelessness (e.g. burning candles during a festive occasion) or even deliberately (arson) then we will be confronted with an open fire from the outset.

## Critical points

- Even the smallest of fires can cause considerable damage to very valuable, often irreplaceable artifacts.
- The strong dilution of the aerosol concentration in a large room requires a detection system capable of recognizing extremely small smoke concentrations.
- The appearance of a room is part of the exhibition and may only be impaired to a very small degree by installations such as fire detectors etc.
- Historically valuable ceilings and walls may not be damaged (no subsequent installation of cables).
- The room layout can change from one exhibition to another. We must therefore ensure that fires will be detected early in spite of any additional partitions or showcases.
- Any damage must be limited to a single room by ensuring that fire cannot spread to neighboring areas.
- The extinguishing agent used in suppressing a fire should not cause any additional damage to the objects on show.
- Popular exhibitions attract a large number of visitors: to avoid any panic breaking out a rapid, orderly evacuation is essential.



Details	Comments/Notes
Automatic fire detectors: Wireless smoke detectors          Linear smoke detector	To ensure reliable fire detection and have only a minimal impact on the aesthetics of the ceiling <ul style="list-style-type: none"> <li>• Parameter set with high sensitivity</li> <li>• Supervision area of approx. 40 m<sup>2</sup> (per detector) in accordance with the high fire risk</li> <li>• Wireless detectors can be mounted on the ceiling with minimal impact on the structure of the building as no cables must be installed</li> <li>• If required, colored detectors can be used to blend in with the color of the ceiling</li> </ul> To ensure the detection of a smoldering fire with minimal heat generation <ul style="list-style-type: none"> <li>• Parameter set with high sensitivity</li> <li>• Supervision width of 4 m in accordance with the high fire risk</li> <li>• Mounted on the wall at a height of approx. 4.5 m, in such a way that the effect on the aesthetics is minimal</li> <li>• If necessary the detectors can be recessed into the walls</li> </ul>
Manual call points: MCPs	Manual activation of a fire alarm (via the fire detection panel ) <ul style="list-style-type: none"> <li>• Single or double action (depending on local regulations)</li> </ul>
Alarming devices: Sounder-beacons	Sounders with supplementary optical indication to alert any persons in the room so they have time to react.
Manual suppression: Hand-held fire extinguisher	Hand-held foam fire extinguisher; for the manual suppression of minor fires.
Positioning of the system elements: (see Figure 1)	8 Wireless smoke detectors <ul style="list-style-type: none"> <li>• Evenly spaced on the ceiling</li> </ul> 3 Linear smoke detectors <ul style="list-style-type: none"> <li>• Evenly spaced at a height of approx. 4.5 m</li> <li>• Mounted on the narrower walls of the room (with fire detection in the longitudinal direction)</li> </ul> 2 Manual call points <ul style="list-style-type: none"> <li>• Next to the doors (inside the room)</li> <li>• At a height of 1.4 m ± 0.2 m</li> </ul> 2 Sounder-beacons <ul style="list-style-type: none"> <li>• At clearly visible positions in the room (e.g. above the doors)</li> </ul> 2 Hand-held fire extinguishers <ul style="list-style-type: none"> <li>• Next to the doors (inside the room)</li> <li>• Handle height 1.0 m ± 0.2 m</li> </ul>

# Practical experience

As described in the introduction, exhibition rooms can be divided into two basic categories: rooms in which industrial or trade exhibitions take place and rooms in museums and art galleries where historical artifacts or works of art are exhibited.

## Rooms in which industrial or trade exhibitions take place

In this sort of room the layout and environmental factors may vary greatly, depending on the current exhibition type. These factors must be taken into consideration when defining a fire protection concept.

If structural measures such as effective compartmentalization can be observed and organizational measures such as the ban on the storage of inflammable, explosive and highly combustible materials can be strictly enforced, then there is only a low to medium probability of a fire occurring in such a room.

The requirements for optimal fire protection are largely determined by the type of exhibition concerned.

In reality, the fire detection, alarming and extinguishing infrastructures are designed to prevent any large scale damage occurring, while minor damage will generally be accepted. However, if even minor damage is not acceptable, then the solution must be adapted to fit the fire protection requirements of the exhibition in question. In many cases the costs of such an adaptation for the duration of the exhibition (days or weeks) cannot be justified and additional security personnel will be drafted in to achieve the specified reduction in fire risk.

- Fire detection** For the majority of exhibition rooms the fire detection requirements can be fulfilled by smoke detectors with medium sensitivity. Large rooms with a height of over 6 m should additionally be equipped with linear smoke detectors, so that smoldering fires can also be detected.
- Additionally, a manual call point should be installed at every exit door. False alarms must be avoided as they can lead to unnecessary evacuation and in the worst case to panic. For this reason in areas with significant deceptive phenomena (e.g. intensive steam development in a restaurant) corresponding counter measures must be taken. Modern fire detection systems offer the possibility of adapting the detection behavior of the detectors to such situations.
- It is essential, however, that such measures are discussed and agreed with the responsible persons (e.g. security personnel, municipal fire service).
- Alarming** Exhibitions with a large number of visitors will have a higher noise level. Therefore, in addition to the standard sounders, such rooms should also be equipped with optical alarming devices (e.g. beacons or sounder-beacons).
- Extinguishing** To limit fire damage to the absolute minimum, small fires should be quickly suppressed by hand-held fire extinguishers. In particular foam extinguishers with a content of 6 liters should be used: they are a manageable size and are suitable for a wide range of fires. If there is a danger of special fires, such as oil/fat fires in a restaurant, then appropriate fire extinguishers should be installed in the corresponding areas.

## Rooms in which historical objects or works of art are exhibited

The environment in such rooms is clean and no deceptive phenomena are expected. Temperature and air quality are often monitored and controlled. Even when the necessary structural measures (such as effective compartmentalization) and organizational measures (such as the strict enforcement of a no smoking ban) have been taken, the fire risk will still remain high - in spite of the fact that the probability of a fire occurring may be very low. The dominant factor here is the enormous damage that could be caused to extremely valuable exhibits and to the room itself.

The aim of fire protection is to limit fire damage to an absolute minimum. This means that the smallest of fires should be detected and extinguished at the earliest possible stage.

**Fire detection** Aspirating smoke detection systems (ASD) ensure the earliest possible detection of an incipient fire. However, installing this type of system in historically sensitive buildings and in rooms with ornate ceilings is often not permitted and the next best solution must be found. Frequently a combination of sensitive wireless smoke detectors and linear smoke detectors is used. When linear smoke detectors are being used, it is important to ensure that any changes to the room layout (e.g. the introduction of partitions and tall showcases) do not have any detrimental effect on the reliability of the detection system.

To protect very valuable or delicate exhibits from damage or theft, they are often displayed in showcases. Large glass display cabinets should be protected by an ASD system. In this way the slightest emissions can be detected, which may indicate the overheating of some material inside the showcases.

**Alarming** As exhibition visitors may also include hearing impaired persons, optical alarming devices such as beacons (or sounder-beacons) should also be installed, in addition to the standard sounders.

**Extinguishing** In many cases the installation of an automatic extinguishing system will not be permitted, due to the impact on the ornate ceilings or due to general aesthetic considerations. An adequate number of manual fire extinguishers, however, must be provided to ensure that small fires can be dealt with rapidly and effectively and any consequential damage can be kept to a minimum. In particular foam extinguishers with a content of 6 liters are recommended as they are a manageable size and are suitable for the majority of fires that can occur in such environments (fire class A – solids; fire class B – liquids).

Foam extinguishers can be aimed directly at the seat of a fire, thus preventing any consequential damage to objects not immediately affected by the fire itself.

# SWING - Wireless technology for maximum protection and flexibility

Wireless fire detection is the ideal solution for rooms or buildings of historical value, with aesthetic or architectural restrictions or for temporary installations. Thanks to wireless technology, devices can be quickly and freely positioned and repositioned. This facilitates planning, allows for cost-efficient installation and offers a high level of freedom and flexibility should room usage or the building structure change in the future.

Learn more about [SWING](#) from Siemens.

# Aspirating Smoke Detection - Early fire detection with excellent reliability and genuine alarm guarantee

Aspirating Smoke Detection (ASD) systems from Siemens ensure reliable fire detection in demanding application areas, where very early fire detection is required and business continuity is paramount. Aspirating smoke detectors continually draw samples of air from the areas requiring protection and evaluate these samples for the presence of smoke. The high detection reliability and immunity to deceptive phenomena provided by these systems are backed up by our genuine alarm guarantee.

Learn more about [ASD](#) from Siemens.

# Everything you need for comprehensive fire protection

Incorporated in a concept tailored to your customers' requirements, Siemens and its Solution Partner network provide:

- Early and reliable fire detection solutions, offering an unrivalled financially backed "Genuine Alarm Guarantee".
- Fully forwards and backwards compatible systems, to ensure any system provided is equipped to integrate the latest technology Siemens has to offer.
- Clear and fast alerting and evacuation processes.

All these aspects are at the core of comprehensive fire protection. Only when these are fulfilled can you be assured that people in your buildings are safe and assets and business operations are protected.

In order to offer your customers peace of mind, Siemens and its Solution Partner network have a variety of service and solution offerings that can be tailored to an individual client's needs. To find out more about this, please visit our Web site at [www.siemens.com/firesafety-markets](http://www.siemens.com/firesafety-markets) or contact your local Siemens organization through [the online contact form](#).

## Advantage Engineering - share the experience

With our dedicated program for consulting engineers, you can benefit from our extensive application know-how and complete portfolio.

With Siemens, you can offer your customers comprehensive fire safety for any application and environmental condition. Your customers will appreciate this as it enables them to reliably protect people, assets and business processes from fire.

Backed by more than 160 years of experience in the field, our offerings for early detection, reliable alarming, orderly evacuation and safe extinguishing are based on innovative and unique technologies. They provide you with convincing arguments like maximized life safety or environmental friendliness, and open the door to strong, long-term customer relationships. And with Siemens, you gain a reliable partner at your side and benefit from our smart tools, in-depth trainings and personal support – wherever you are, wherever you go. For more information please visit [www.siemens.com/advantage-engineering](http://www.siemens.com/advantage-engineering).



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