IEC TS 62966-3

Edition 1.0 2021-01

TECHNICAL SPECIFICATION

Mechanical structures for electrical and electronic equipment – Aisle containment for it cabinets –
Part 3: Aspects of operational and personal safety

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Mechanical structures for electrical and electronic equipment – Aisle containment for it cabinets –
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – AISLE CONTAINMENT FOR IT CABINETS –

Part 3: Aspects of operational and personal safety

FOREWORD

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62966-3, which is a Technical Specification, has been prepared by subcommittee 48D: Mechanical structures for electrical and electronic equipment, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

The text of this Technical Specification is based on the following documents:

DTS	Report on voting
48D/725/DTS	48D/731/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62966 series, published under the general title *Mechanical structures for electrical and electronic equipment – Aisle containment for IT cabinets*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This Part 3 of IEC 62966 serves as a guide for a consideration from a safety viewpoint of the dimensional and air conditioning aspects of cold and hot aisle containments in data centres described in IEC 62966-1 and IEC 62966-2.

Where aspects of this Technical specification conflict with national regulations and laws of the member states concerned, the provisions of these national regulations shall apply.

Consideration is given to safety-related aspects, such as:

a) escape and evacuation plans;
b) escape routes;
c) emergency exits;
d) functional aspects of escape doors;
e) lighting conditions;
f) lighting and signposting of escape routes;
g) fire protection;

taking into account the existing stringent requirements placed on the protection of IT equipment and the availability of the data the equipment contains.

MECHANICAL STRUCTURES FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – AISLE CONTAINMENT FOR IT CABINETS –

Part 3: Aspects of operational and personal safety

1 Scope

This part of IEC 62966 defines the requirements for operational and personal safety of aisle containments for IT cabinets.

The aim is to provide physical security for the IT equipment installed in the containment using the criteria “availability” and “safety”.

The requirements apply to all operational, working and maintenance procedures.

This document does not apply to ordinary persons, when using installations and equipment.

The requirements described herein are also intended to ensure that it is possible for authorized personnel to enter and remain in the containment (as accessible equipment) and to maintain or upgrade the systems installed in the containment without risk. It should also be possible to evacuate the containment quickly and safely at any time, especially in the event of a fire or any other hazardous situation, whilst reducing the health risk to personnel to a minimum.

Aspects relating to computing, data processing, data storage, building protection or the data centre itself do not fall within the scope of this document. Only those additional aspects arising from the integration of an aisle containment are considered.

The design and positioning of an aisle containment, which is integrated in the data centre, has influence on the following different aspects of operational safety:

a) escape and evacuation plans;
b) escape routes;
c) emergency exits;
d) functional aspects of escape doors;
e) lighting conditions
f) lighting and signposting of escape routes;
g) fire protection.

In this document, these operational safety requirements and recommendations are considered.

To achieve the highest effectiveness, all these requirements are considered as much as possible during the design of an aisle containment.

This document applies to normal operations, not to the initial installation of the containment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
escape route
intended route to a place of safety

3.2
emergency exit
exit which is part of an escape route and leads directly to the outside or to a safe area

3.3
escape and evacuation plan
straightforward and comprehensible document that provides information relating to escape routes and fire fighting equipment

3.4
escape door
every door in an escape route is an escape door

3.5
hold time
time during which a concentration of fire extinguishant shall be maintained at an effective level within the space being protected. The predicted hold time shall be determined by the door fan test or a full discharge test.

3.6
extinguishing gas
electrically non-conducting gaseous extinguishing agent, that, upon evaporation, does not leave a residue

3.7
fire detector
part of a fire alarm system containing at least one sensor that continually or at intervals monitors at least one appropriate physical and/or chemical characteristic (fire characteristic) that occurs in the event of a fire, and that also transmits at least one corresponding signal to the control and indicating equipment

3.8
lead time
time between the alarm signal and the release of the extinguishing medium

3.9
aspirating smoke detector
ASD
high-sensitivity detector, which consists of a central detection unit, that draws air through a system of pipes to detect smoke

Note 1 to entry: The sampling chamber is based on a nephelometer, that detects the presence of smoke particles suspended in air by detecting the light scatterd by them in the chamber. In most cases aspirating smoke detectors require a fan unit to draw in a sample of air from the monitored area through its system of pipes.

3.10
delay device
device that is part of a fire-fighting installation designed to ensure that flooding does not take place until the fire alarm devices have been activated and the specified lead time has expired

3.11
extinguishing gas concentration
value for the concentration of extinguishing gas present in the atmosphere of the area being flooded expressed as % vol

3.12
qualified person
defined as a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work, or the project

3.13
hazard area
containment area plus any adjacent areas that will be flooded with the extinguishing gas

4 Safety requirements of an aisle containment

4.1 General safety requirements

The mechanical design of an aisle containment, consisting of cabinets, cover panels, doors and roof panels shall have adequate design considerations to prevent hazards to people.

The mechanical parts of the aisle containment shall be free of sharp edges, burrs, etc., that could present a safety hazard to personnel involved in their assembly, installation, use or maintenance.

The aisle containment roof panels cannot be walked on, therefore their design and appearance shall make this obvious to personnel working in the data centre.

4.2 Escape routes, emergency exits, escape doors, escape and evacuation plan

4.2.1 Recommended dimensions of escape routes and escape doors/emergency exits

A cold or hot aisle containment that in an emergency represents the only escape route should be dimensioned so that any personnel within it when a particular hazard occurs (e.g. a fire) are able to evacuate it as rapidly as possible. It shall not be permitted to obstruct or lock the escape routes.

The recommended minimum width of an escape route is determined by the maximum number of personnel using the escape route in an emergency. This is shown in Table 1.

Table 1 – Minimum width of escape routes and maximum reduction of clearance

Number of persons (in aisle containment)	**Recommended minimum width of escape routes** mm	**Maximum reduction of clearance** (in the area of doors) mm
up to 5	875	75
up to 20	1 000	150

The minimum width of the escape route shall not be constricted by fixed structures or equipment or by the opening of doors in the escape direction. A reduction of the minimum width of corridors by a maximum of 75 mm or 150 mm in the area of doors is not significant in this case (see Figure 1).

However, the clearance in the area of doors shall at no point be less than 800 mm.

The clearance in the area of doors shall at no point be less than 850 mm if there are normally up to 20 people in the hazard area.

National regulations and safety directives that deviate from these dimensions are to be observed.

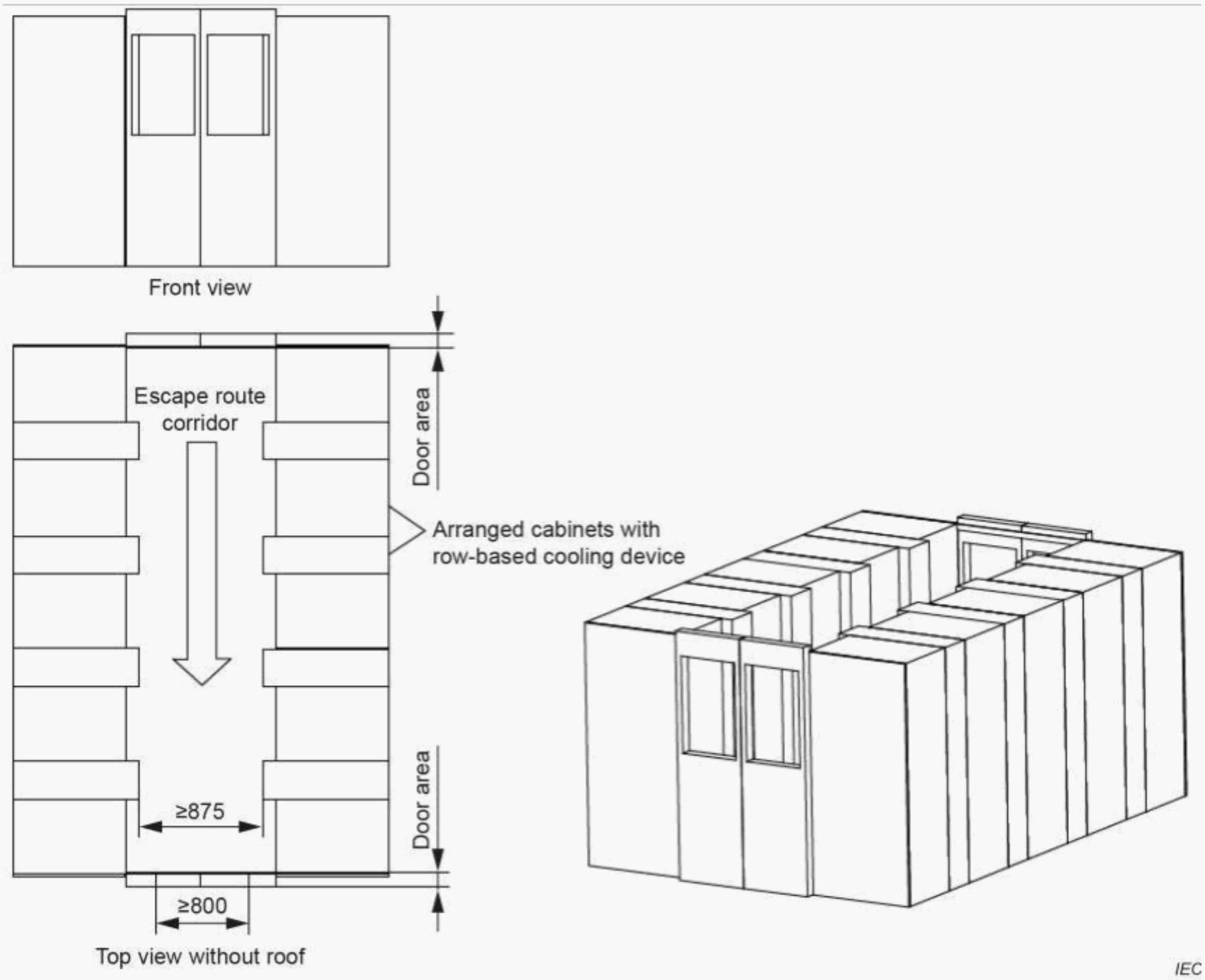


Figure 1 – Minimum width of escape routes in an aisle containment

The vertical clearance of escape routes shall be at least 2 000 mm. Within the area of doors, a reduction of the clearance of maximum 50 mm is allowable (see Figure 2).

National regulations and safety directives that deviate from these dimensions are to be observed.

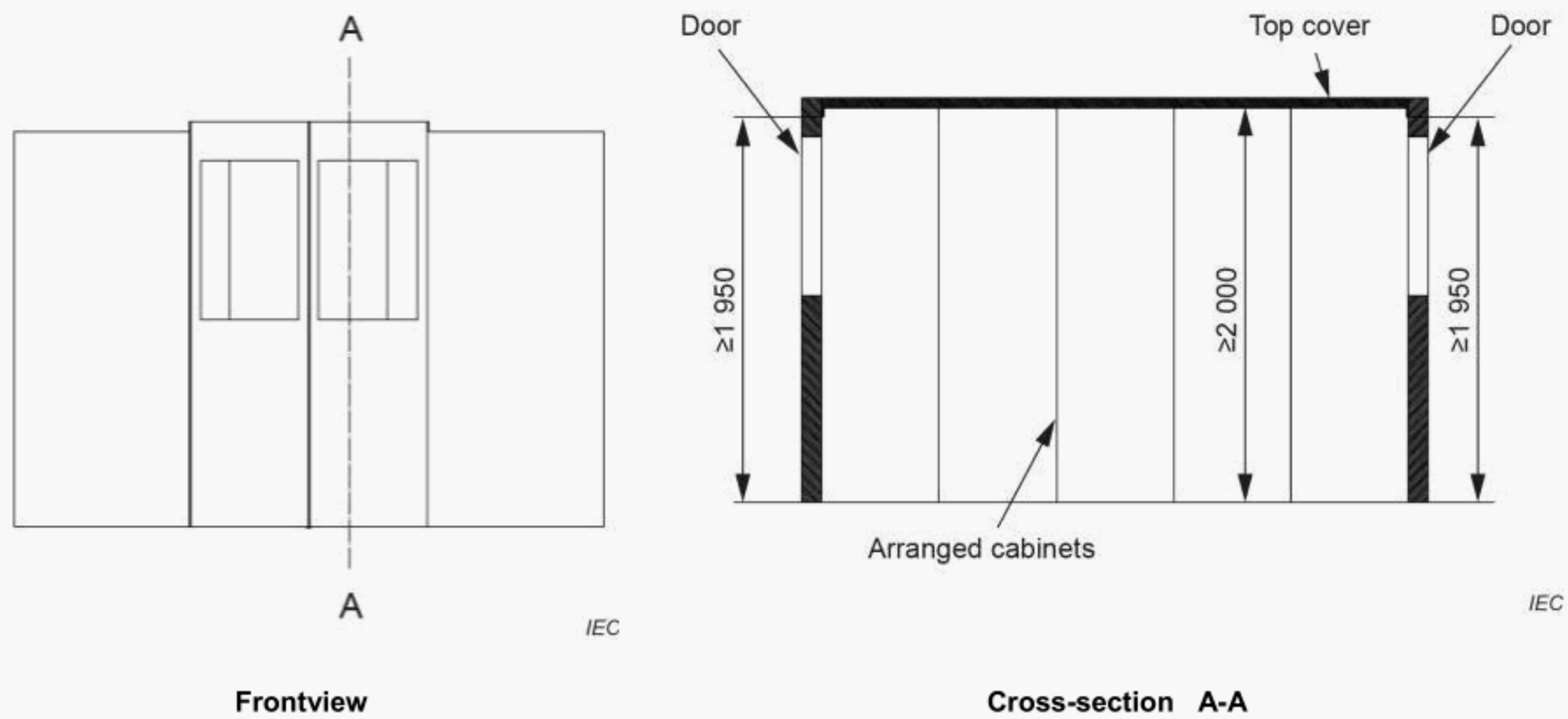


Figure 2 – Minimum height of escape routes in an aisle containment

The location and dimensions of escape routes in the containment are to be determined according to the hazards present (e.g. maximum number of personnel using the escape route).

The lengths of escape routes should be as short as possible and in accordance with national regulations.

In containments with more than one door, the escape direction with the shortest escape route length has to be indicated.

Escape routes shall be signposted in accordance with national regulations.

4.2.2 Functional aspects of escape doors

It is recommended that any manually operated doors that are defined as emergency exits or will be used in emergency situations are to open in the escape direction.

The opening direction of any other doors situated along escape routes depends on the result of a risk assessment to be carried out on a case-by-case basis taking local and operational factors into account, in particular

– the potential hazard situation;
– the number of persons who will be obliged to use an escape route at the same time;
– and the type of personnel that depends on the usability of the doors.

The use of revolving or sliding doors that are operated purely manually is to be considered in light of local directives or to be the subject of a risk assessment.

Doors that close automatically may only be employed in corridors/escape routes that are exposed to the risk of fire if they comply with building standards.

All doors situated along an escape route and/or emergency exit shall, in the event that personnel have to rely on being able to use the escape route, open easily without having to resort to any special equipment.

The opening mechanism shall be instantly recognisable and easily accessible.

Lockable doors located along an escape route shall open easily from inside and outside (for rescue personnel) without having to resort to any special equipment.

Where locking systems are being used, an Emergency Open button shall be provided to enable the door to be opened easily without having to resort to any special equipment. An electrical locking system shall also unlock itself automatically in the event of a power failure.

4.2.3 Lighting and signposting of escape routes

The specifications in respect of the lighting and signposting of the data centre should be implemented uniformly throughout the containment if the (enclosed) cold or hot aisle is defined as an escape route or would have to be used as such in emergency situations.

If safe evacuation of the containment cannot be guaranteed should the general lighting fail, e.g. if the amount of light entering the containment through its translucent cover panel is inadequate, the containments shall be equipped with emergency escape lighting.

Emergency escape lighting for escape routes, emergency exits and door signs shall be implemented in accordance with national and local directives (e.g. safety at work-directive).

4.2.4 Escape and evacuation plan

Escape route plans that take account of the applicable national regulations and include the containments, assuming the (enclosed) cold or hot aisle is defined as an escape route or would have to be used as such in an emergency situation, are to be produced.

A containment as an accessible equipment and no fix part of a building, can change its appearance, design or position within the building in dependence of the current use. Consequently each change of form of the containment results in a new escape or evacuation situation within the containment. These changes shall be considered to adapt to the existing escape and evacuation plan of the surrounding data centre.

4.3 General – Fire protection in an aisle containment

4.3.1 Overview

A fire hazard exists wherever flammable substances, oxygen and an ignition source are present. If an oxygen reduction system is not in use, an ample level of oxygen will be present throughout the containment. The amount of flammable material and the potential ignition sources are therefore significant factors when assessing the fire risk. Potential ignition sources include the following:

– faulty air conditioners;
– loose terminals and clamping connections;
– faulty components;
– overloaded power supplies;
– missing or incorrect overload protection equipment;
– incorrectly performed electrical work;
– negligence of personnel;
– work activities involving fire hazards;
– localised hot spots.

A cold or hot aisle containment is considered an accessible equipment (see Figure 3) in which the presence of strong cooling air flows gives rise to certain requirements with respect to fire protection, fire detection and fire suppression. From a fire protection viewpoint, a distinction shall always be made between a cold aisle containment and a hot aisle containment.

In addition to the protection of IT equipment and the stored data, fire protection also covers the protection of the personnel carrying out their duties within a containment. The aims of fire protection are therefore:

a) IT equipment:

protection of systems and data from the immediate effects of the fire (flames, heat, smoke, pyrolysis gases from smouldering fires).

b) Personnel:

protection from the immediate effects of the fire (flames, heat, smoke, highly toxic gases);

protection from the effects of gas extinguishing systems (lack of oxygen).

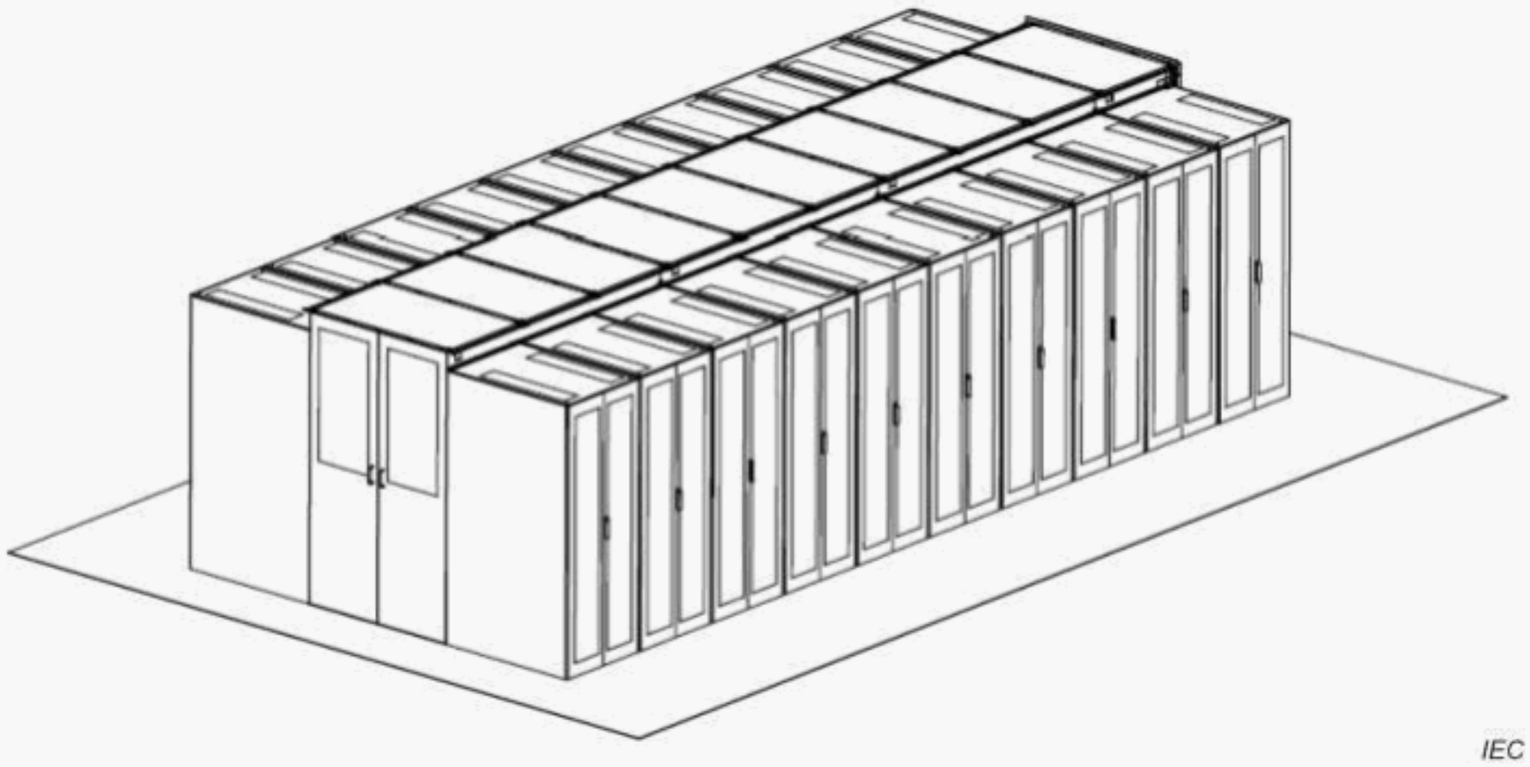


Figure 3 – Typical arrangement of an aisle containment representing a walk-in-equipment solution

Consult the relevant local authorities for more information regarding the applicable local fire protection regulations.

4.3.2 Fire prevention

To minimise the fire load, the structural elements of the containment (e.g. transparent plastic coverings) should be made of non-combustible or fire retarding materials (e.g. real glass). If this is not possible, the materials used are as a minimum requirement to be flame retardant and not drip when exposed to flames. To prevent fires, all materials and components shall as a minimum requirement conform to Flammability Class V2 as defined in IEC 60695-11-10.

Storage of materials in containments, especially flammable materials that represent an additional fire load, is not permitted.

The presence of ignition sources (e.g. fire) in containments is not permitted.

To reduce the risk of a fire, an oxygen reduction system can be employed. If the oxygen level is reduced below 17 %, personnel should be subjected to relevant medical examination before entering protected areas of the data centre.

4.3.3 Fire and smoke detection

Qualified persons shall be employed in the design and installation of fire protection equipment.

The planning of an appropriate fire suppression system shall consider the special conditions predominating in a containment, which are

– rapid changes of pressure and air-speed due to air conditioning;
– defined direction of air flow;
– accessibility by personnel.

Air is analysed to detect smoke as the preferred characteristic indicator of fire.

To avoid delays in detection of combustion products or other evidence of fire, a combination of the following systems should be employed:

a) aspirating smoke detectors, which allow a more sensitive and targeted detection by using a tube system to aspirate air in a wider area, and

b) optical smoke detectors at the top cover and at places of particular risk of fire.

NOTE In locations where individual items of air-conditioned IT equipment, such as containments, are installed, the placing of point-type smoke detectors on the ceiling is not a satisfactory solution. Pockets of warm air or a strong flow of air from the air-conditioning system prevent adequate amounts of hot smoke from rising quickly enough to reach the point-type smoke detectors.

In order to be able to detect a fire as early as its pyrolysis phase, it is recommended that multiple highly sensitive aspirating smoke detectors (ASDs) are used. Aspirating smoke detectors use a system of pipes to extract air samples directly out of the air flow coming from the air conditioning system. The samples are passed to a detector module which examines them for minute particles of smoke known as smoke aerosols.

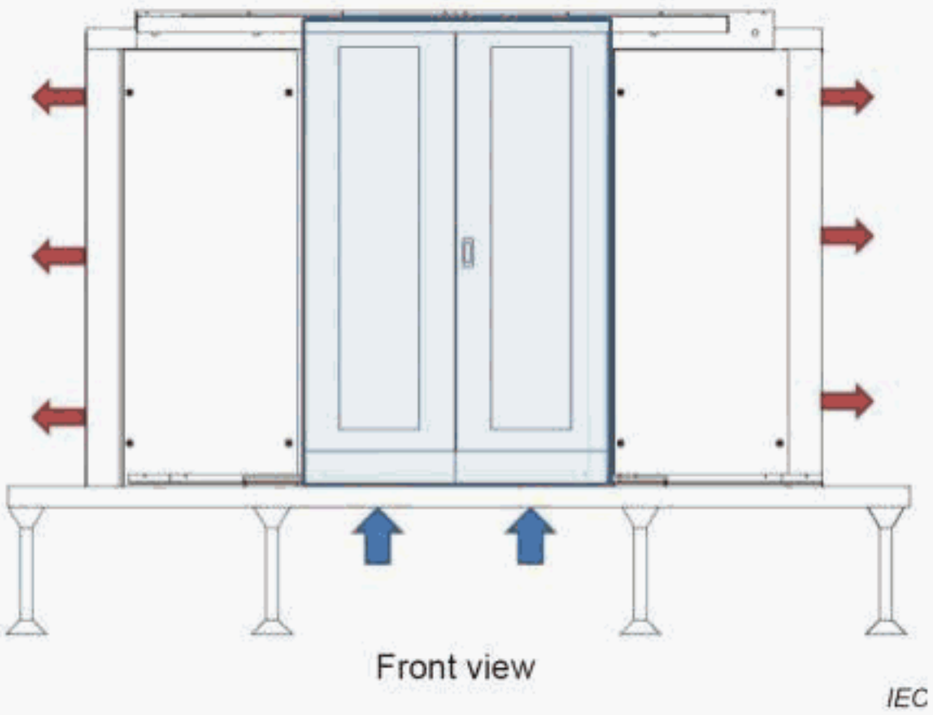
The high degree of sensitivity of these systems reduces false alarms to a minimum.

If systems that provide an early warning of smoke or fire are installed, the alarm signal they generate shall not automatically cause an interruption to the flow of air produced to control the ambient conditions in the containment.

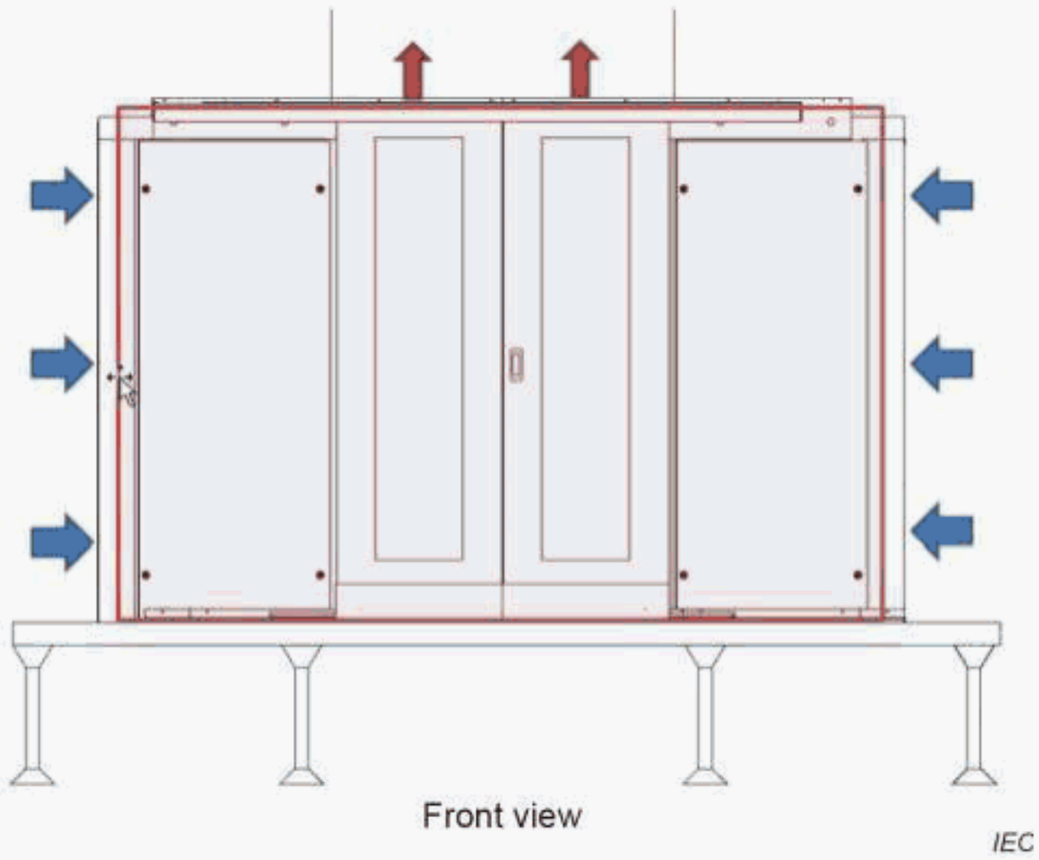
Due to their differing flow conditions, cold aisle and hot aisle containments are to be considered separately and differently (see Figure 4).

– The fire detection device within a cold aisle containment should include aspirating smoke detectors.

– The hot aisle containment shall include aspirating smoke detectors in combination with point-type optical smoke detectors, if total area monitoring is stipulated by local regulations.



Cold aisle area, boundary and air flow



Hot aisle area, boundary and air flow

Figure 4 – Cold and hot aisle containment (showing air flow and temperature areas)

c) Arrangement of smoke detectors in cold aisle containments

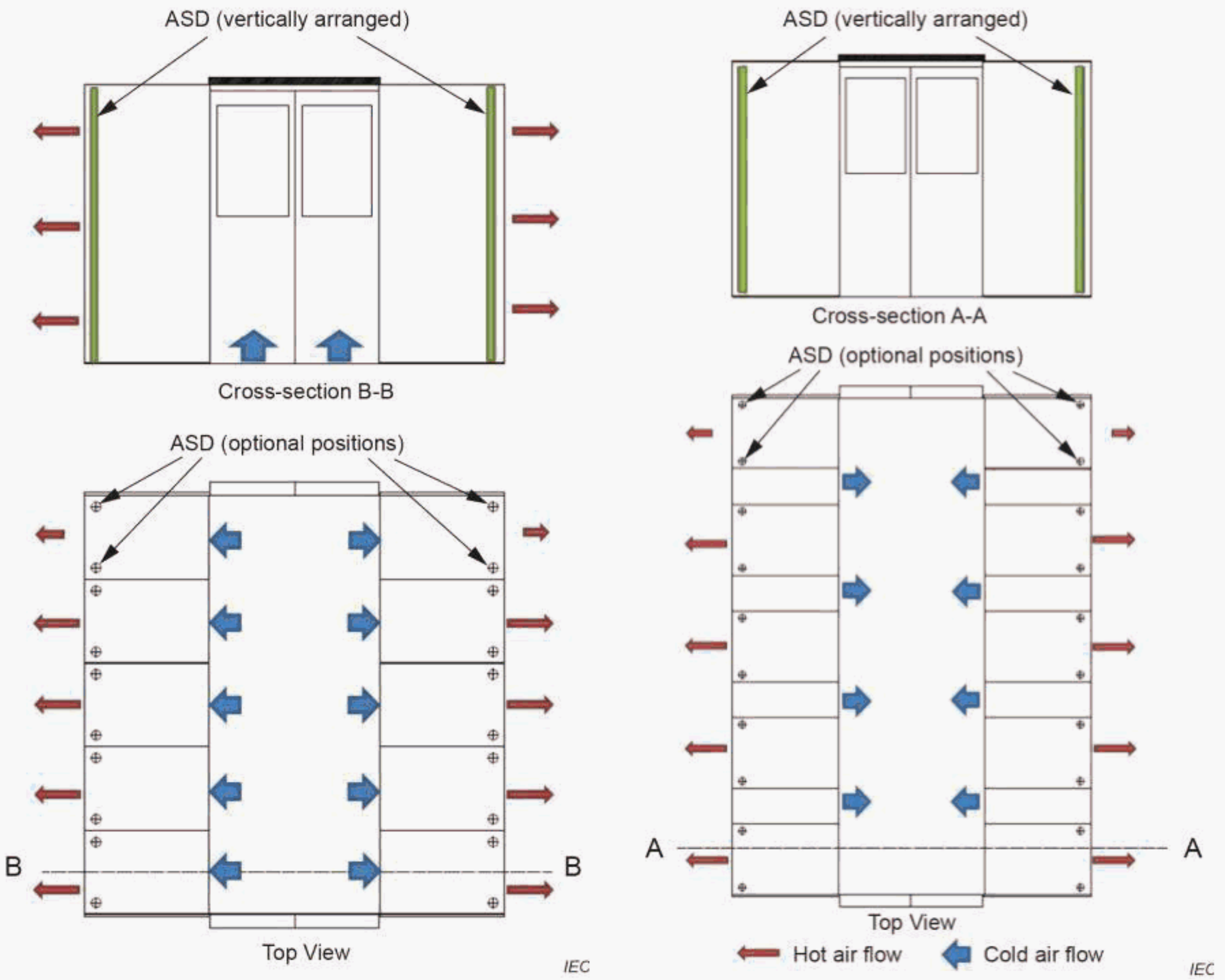
To provide immediate and reliable detection of a fire and its location within a cold aisle containment (with or without a raised floor), or the devices inside it, vertically positioned aspirating smoke detectors are to be installed in the output air flow inside or directly outside each cabinet (see Figure 5).

For basic monitoring purposes, it will be sufficient to connect the aspirating smoke detector to a central suction point of the air-cooling units outside the cold aisle.

Smoke detectors are not required in the cold aisle itself, unless the local authority stipulates total area monitoring.

The same approach can be adopted for cold aisle containments with row-based cooling devices.

In the case of enclosed cabinets with sealed cooling systems, the use of equipment monitoring in the form of integrated fire detection and extinguishing systems is to be preferred. These can be installed as plug-in modules directly into the respective cabinets in the containment.



Configuration with raised floor **Configuration with row-based cooling without raised floor**

Figure 5 – Arrangement of aspirating smoke detectors (ASDs) in a cold aisle containment with or without raised floor

d) Arrangement of smoke detectors in hot aisle containments

To provide immediate and reliable detection of a fire and its location within a hot aisle containment, or the IT devices inside it, vertically positioned aspirating smoke detectors should ideally be installed in the rear, internal output air flow of each cabinet (see Figure 6).

For basic monitoring purposes, it will be sufficient to connect the aspirating smoke detector to a central suction point of the air-cooling units inside the hot aisle containment.

In addition, point-type smoke detectors can be placed inside the inner ceiling area of the hot aisle containment, especially if the local authority stipulates total area monitoring.

In the case of enclosed cabinets with sealed cooling systems, the use of equipment monitoring in the form of integrated fire detection and extinguishing systems is to be preferred. These can be installed as plug-in modules directly into the respective cabinets in the containment.

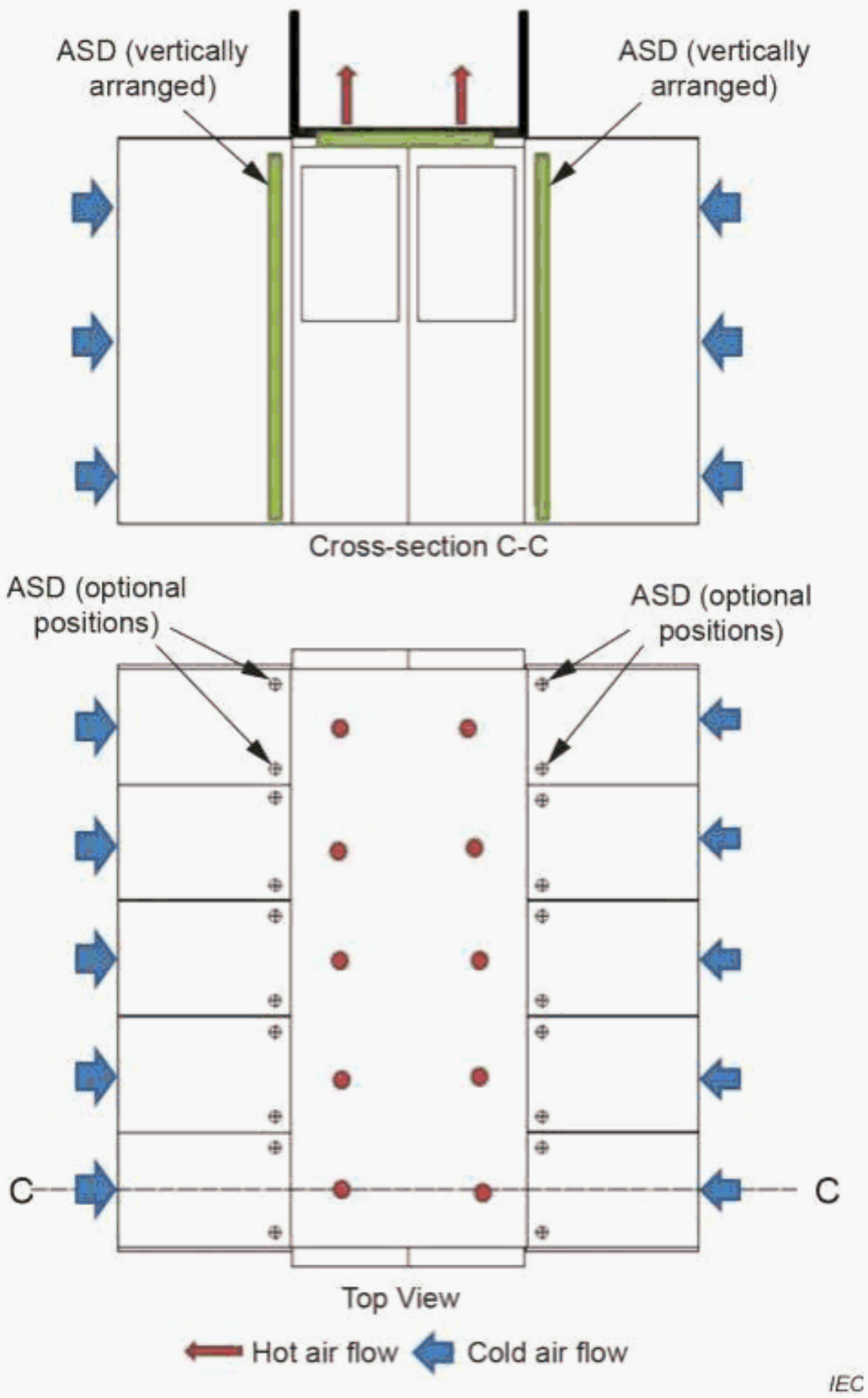


Figure 6 – Arrangement of aspirating smoke detectors (ASDs) in a hot aisle containment

4.3.4 Fire fighting device

4.3.4.1 General

Gas extinguishing systems are the preferred type of fire-fighting system for data centres, as they leave no residues and are non-corrosive. As a result, they cause no lasting damage to the IT equipment, something that would occur if water, for example, was used.

Extinguishing systems like these work by injecting an adequate quantity of extinguishing medium into the protected area to create a concentration of gas that prevents any further combustion. The resulting lowering of the oxygen content necessitates the use of personal protective measures, the extent of which is determined by the type of extinguishing gas used, the oxygen concentration and national or local safety regulations.

The time between the smoke or fire detection and activation of the extinguishing system shall allow the safe egress of personnel.

Suitable protection measures shall be implemented where extinguishing systems are used to enable hazard areas to be evacuated immediately, to prevent personnel from entering following flooding with extinguishing gas, and to ensure that measures are in place to rescue trapped personnel.

Safety aspects, such as

– the training of personnel;
– the use of warning notices;
– the use of alarms and delay devices;

shall be taken into account. Personnel working in the flooded or adjacent areas are to be thoroughly instructed and trained in the measures to be adopted before, during and after flooding by the gas extinguishing system.

Enclosed facilities (flooded areas) that are protected by gas-based extinguishing systems are to be laid out in such a way that the concentration of extinguishing gas required to extinguish the fire is achieved and the necessary holding time is met.

4.3.4.2 Activation and alarming

In addition to any requirements of national or local regulations, fire alarm systems shall be installed in all data centres (e.g. aisle containment):

– where personnel stay, or
– which directly affect the availability of data centre facilities and infrastructures.

To prevent false alarms, the extinguishing system shall be activated by a dual detector dependency.

When the extinguishing system is activated, an audible alarm is to sound that can easily be distinguished from all other operational noises. If the audible alarm in the room is sufficiently loud, no additional alarm will be required in the containment, unless the room alarm in the cold or hot aisle does not differ from the ambient noise level by more than 10 dB.

Audible alarms are to be supported by optical fire alarm devices in the form of flashing lights, which can also be employed as warnings. These flashing lights are to be located such that they are visible from inside the aisle containment. Refer to local authority regulations with regard to the necessity for optical fire alarm devices.

In hazard areas in which personnel are present, fire alarm and delay devices with adequate delay times shall be provided to allow the protected area to be evacuated without undue haste. The delay time prior to flooding with extinguishing gas shall be at least 10 s.

4.3.5 Arrangement of extinguishing nozzles

The arrangement of the extinguishing nozzles shall guarantee a homogeneous distribution of the extinguishing gas concentration within the containment.

Should the containment affect or restrict the homogeneous distribution of the extinguishing gas throughout the entire extinguishing area, the arrangement of the extinguishing gas nozzles is to be adjusted accordingly.

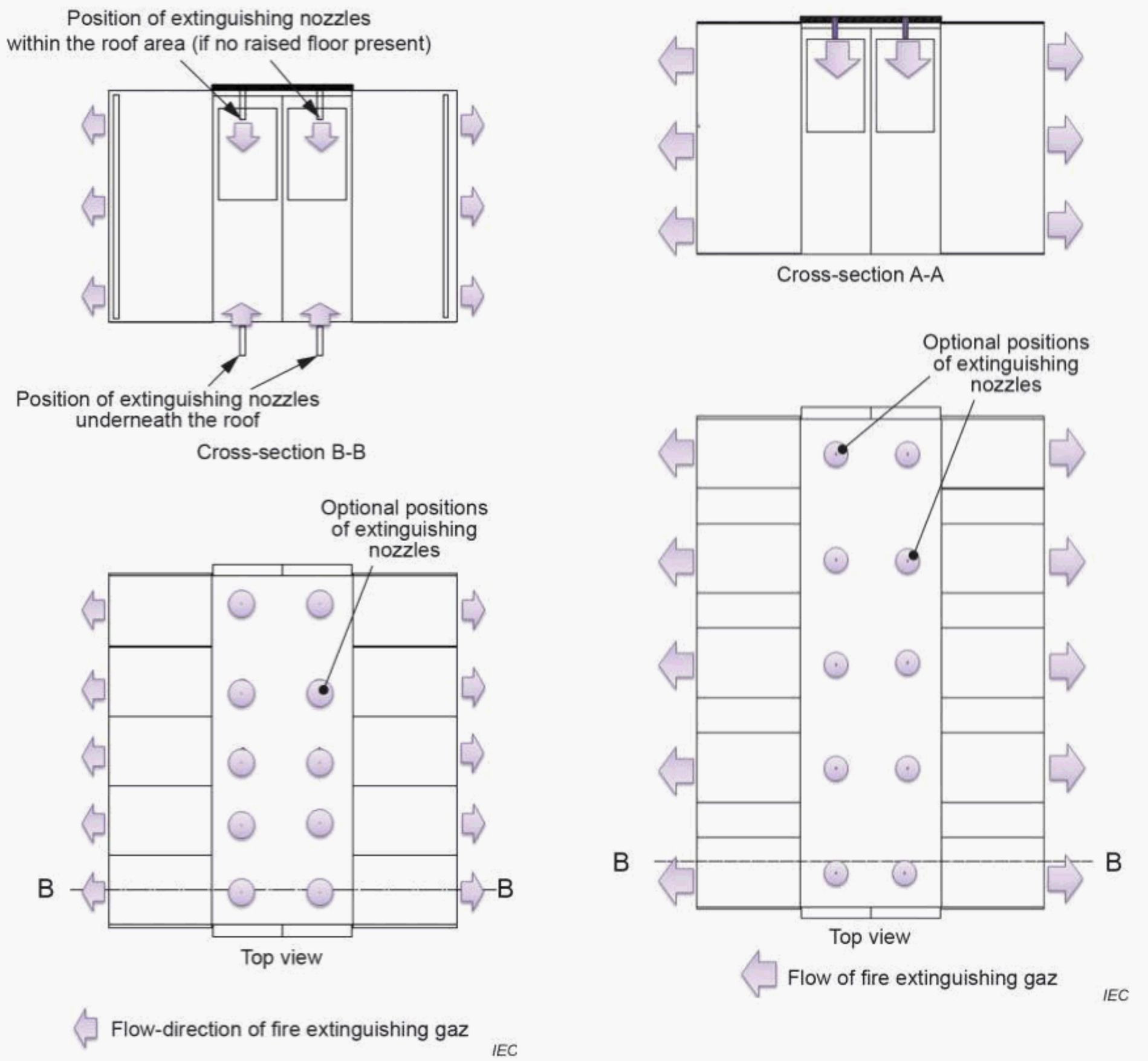
Due to the proximity of extinguishing nozzles (inside the containments) to sensitive disk drives in some items of IT equipment and the resulting risk of interference or damage, preference

shall be given to extinguishing nozzles fitted with silencers or to special noise-reducing nozzles.

No parts of the aisle containment shall be damaged by the escaping extinguishing gas.

a) Arrangement of gas extinguishing nozzles in cold aisle containments

In the case of cold aisle containments with raised floors, the extinguishing gas nozzles should be located within the raised floor underneath the base plate of the containment. In situations where a raised floor is not present, the nozzles should be located within the roof area of the containment (see Figure 7).



Configuration with/without raised floor

Configuration with row-based cooling without raised floor

Figure 7 – Arrangement of extinguishing nozzles in a cold aisle containment with or without raised floor (showing flow-direction of extinguishing gas)

b) Arrangement of gas extinguishing nozzles in hot aisle containments

In the case of hot aisle containments with raised floors, the extinguishing gas nozzles should be located equally as in cold aisle containments, namely in the raised floor underneath the base plate of the containment. In situations where a raised floor is not present, the nozzles are to be located within the roof area of the containment.

The effective concentration of extinguishant in the aisle containment should be maintained for the specified hold time to allow effective emergency action – since it is possible for a persistent ignition source to re-ignite once the extinguishant has dissipated.

In the absence of national or local regulations, the minimum hold time should be at least 10 min.

Consideration should be given during the planning of the containment to the necessity of a pressure relief device in the room to compensate the short-term rise or fall in pressure when the extinguishing gas is released. However, as the server racks normally have adequate opening areas and there are gaps in the casing elements, a pressure relief device or valve will not be necessary in most cases. Moreover, when the extinguishing system is activated, both the cold and hot aisles will be flooded so there will be only be a marginal difference in pressure, which can if required be prevented by use of hydraulic balancing.

After extinguishing the fire, it shall be ensured that the containment is vented and completely free of extinguishing gas. It is not permitted to enter the containment until measurements have demonstrated that it is safe to do so.

4.4 Lighting conditions

The containments are to receive adequate levels of light, either through translucent cover panels or transparent panes in the doors. Alternatively, they shall be equipped with adequate internal lighting that ensures the safety and well being of personnel.

The lighting systems are to be selected and arranged so that they pose no accident risk or hazard to health.

Should a failure of the general lighting pose an accident risk to personnel, the containment shall be equipped with adequate emergency escape lighting.

The minimum duration of this escape lighting shall be in accordance with national or local regulations.

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