PUBLISHED DOCUMENT

PD CEN/TR
15276-2:2009

Fixed firefighting systems — Condensed aerosol extinguishing systems

Part 2: Design, installation and maintenance

ICS 13.220.20

BSI
British Standards

National foreword

This Published Document is the UK implementation of CEN/TR 15276-2:2009.

The UK participation in its preparation was entrusted to Technical Committee FSH/18/6, Gaseous extinguishing media and systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2009.

ISBN 978 0 580 54125 4

Amendments/corrigenda issued since publication

Date	Comments

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 15276-2

January 2009

ICS 13.220.20

English Version

Fixed firefighting systems - Condensed aerosol extinguishing systems - Part 2: Design, installation and maintenance

Installations fixes de lutte contre l'incendie - Systèmes d'extinction à aérosol - Partie 2 : Calcul, installation et maintenance

Ortsfeste Brandbekämpfungsanlagen - Löschanlagen für kondensierte Aerosole - Teil 2: Planung, Installation und Instandhaltung

This Technical Report was approved by CEN on 9 September 2008. It has been drawn up by the Technical Committee CEN/TC 191.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. CEN/TR 15276-2:2009: E

Contents

Page

Foreword

This document (CEN/TR 15276-2:2009) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI.

This document has the general title *Fixed firefighting systems — Condensed aerosol extinguishing systems* and will consist of the following parts:

— Part 1: *Requirements and test methods for components;*

— Part 2: *Design, installation and maintenance.*

Introduction

It has been assumed in the preparation of this document that the execution of its provisions is entrusted to appropriately qualified and experienced people in the specification, design, installation, testing, approval, inspection, operation and maintenance of systems and equipment, for whose guidance it has been prepared, and who can be expected to exercise a duty of care to avoid unnecessary release of extinguishant.

Product certification: Users of this document are advised to consider the desirability of independent certification of product conformity with this document based on testing and continuing surveillance, which may be coupled with assessment of manufacturer quality systems against EN ISO 9001.

Fire-fighting systems covered in this document are designed to provide a supply of fixed condensed aerosol extinguishing medium to extinguish fire.

The requirements of this document are made in the light of the best technical data known to the working group at the time of writing but, since a wide field is covered, it has been impracticable to consider every possible factor or circumstance that might affect implementation of the requirements.

It is important that the fire protection of a building or plant be considered as a whole. Aerosol extinguishant systems form only a part of the available facilities, but it should not be assumed that their adoption necessarily removes the need to consider supplementary measures, such as the provision of portable fire extinguishers or other mobile appliances for first aid or emergency use, or to deal with special hazards.

Small scale fire tests, comparable with the test methods mentioned in this standard, indicate that aerosol extinguishants can be recognized as effective media for the extinction of certain Class A fires (solid surface burning fires) and Class B and Class C fires according to EN 2, but it should not be forgotten, in the planning of comprehensive schemes, that there may be hazards for which these mediums are not suitable, or that in certain circumstances or situations there may be dangers in their use requiring special precautions.

Advice on these matters can be obtained from the appropriate manufacturer of the aerosol generators or the extinguishing system. Information may also be sought from the appropriate fire authority, the health and safety authorities and insurers. In addition, reference should be made as necessary to other national standards and statutory regulations.

It is essential that fire-fighting equipment, the enclosure and the protected occupancy is carefully maintained and managed to ensure instant readiness when required and effectiveness of the protection. Routine maintenance is liable to be overlooked or given insufficient attention by the owner of the system. It is, however, neglected at peril to the lives of occupants of the premises and at the risk of crippling financial loss. The importance of maintenance cannot be too highly emphasised.

Condensed aerosol may contain traces of toxic substances like those produced by a fire, and will obscure vision like smoke from fire. This standard requires, as a precaution, that the room is evacuated and sealed off whenever a generator is activated - much like recommended response to fires. Precautions include evacuation of the proximity area, criteria for re-entering and other safeguards as stated in paragraph 5.

1 Scope

This document specifies requirements and describes the methods for the design, installation, testing, maintenance and safety of condensed aerosol extinguishing systems and the characteristics of the extinguishant media and types of fire for which it is a suitable extinguishing medium.

This document also covers the use of condensed aerosol extinguishing systems for total flooding applications in normally unoccupied and unoccupiable areas, primarily related to buildings, plant and other specific applications, utilising electrically non-conducting aerosol fire extinguishants and for which there are sufficient data available to enable validation of performance characteristics by an appropriate independent authority.

This document is intended as a standard covering solely condensed aerosol.

This document is not applicable to explosion suppression applications.

This document is not intended to indicate approval of the extinguishants listed herein by the appropriate authorities, as other extinguishants may be equally acceptable.

This document is applicable to the extinguishants which fulfil CEN/TR 15276-1.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 54 (all parts), *Fire detection and fire alarm systems*

EN 12094-1, *Fixed firefighting systems — Components for gas extinguishing systems — Part 1: Requirements and test methods for electrical automatic control and delay devices*

CEN/TR 15276-1:2009, *Fixed firefighting systems — Condensed aerosol extinguishing systems — Part 1: Requirements and test methods for components*

EN 50110, *Operation of electrical installations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN/TR 15276-1:2009 and the following apply.

3.1
actuating mechanism
automatic or manual activation leading to the physical discharge of extinguishant

3.2
approved
acceptable to a relevant authority

3.3
authority
organisation, office or individual responsible for approving equipment, installations or procedures in determining acceptability

NOTE The authority may base acceptance on conformity to the appropriate standards.

3.4
automatic
performing a function without the necessity of intentional intervention

3.5
automatic/manual switch
means of converting the system from automatic to manual actuation

NOTE This may be in the form of a manual switch on the control panel or other units, or a personnel door interlock. In all cases, this changes the actuation mode of the system from automatic and manual to manual only or vice versa.

3.6
clearance

3.6.1
electrical clearance
unobstructed air distance between extinguishing system equipment and unenclosed or uninsulated live electrical components not at ground potential

3.6.2
thermal clearance
air distance between a condensed aerosol generator and any structure or components sensitive to the temperature developed by the generator

3.7
competent person
designated person, suitably trained, qualified by knowledge and practical experience and with the necessary instructions to enable the required tests and examinations to be carried out

3.8
condensed aerosol
extinguishing medium consisting of finely divided solid particles and gaseous matter, these being generated by a combustion process of a solid aerosol-forming compound

3.9
condensed aerosol generator
non-pressurised device which, when activated, generates an aerosol

NOTE It includes the mounting brackets.

3.10
control device
device which is able to control the sequence of events leading to the activation

3.11
coolant
heat absorbing medium or process

3.12
design application density (g/m^3)
extinguishing factor multiplied by the safety factor, required for system design purposes

NOTE 1 The design factor is expressed in grams per cubic metre.

NOTE 2 Extinguishing factor and design factor have been introduced as an alternative to extinguishing concentration and design concentration respectively as concentration of the actual aerosol cannot be measured or even assessed in some cases (the discharged medium, apart from the condensed aerosol, may contain products of the thermal decomposition of a chemical coolant).

3.13
design quantity
mass of solid aerosol-forming composition necessary to achieve the design factor (density) in the maximum protected volume of a specific risk

NOTE The design quantity is expressed in grams.

3.14
discharge time
time from the generator activation to the end of its discharge

3.15
extinguishing application density
the minimum mass of a specific aerosol-forming compound per cubic meter of enclosure volume required to extinguish fire involving a specific fuel under defined experimental conditions, using a specific aerosol generator type and size, excluding any safety factor.

NOTE The extinguishing factor is expressed in grams per cubic metre.

3.16
family
group of generators with same solid compound, same kind of cooling device, same kind of discharge outlet, same ignition device, same layout and same internal/external architecture

3.17
holding time
period of time during which the extinguishant is required to maintain at least the extinguishing application density throughout the protected area/volume.

3.18
hot work
grinding, welding, thermal or oxygen cutting or heating and other related heat-producing or spark-producing operations

3.19
ignition device
device which is able to ignite the solid aerosol-forming compound

3.20
inspection
visual check to give a reasonable assurance that the extinguishing system is ready to operations

3.21
listing authority
recognized fire protection testing and approval body (notified laboratory)

3.22
location drawing
plan of the risk clearly indicating the as-installed location of all aerosol generators, controls and maintenance isolate switch (lock off devices)

3.23
lock-off device
manual shut-off device that prevents the electrical actuation of aerosol generators

NOTE The device operation provides an indication of system isolation.

3.24
lowest observed adverse effect level
LOAEL
lowest agent factor at which an adverse toxicological or physiological effect has been observed

3.25
maintenance
thorough check to give maximum assurance that the extinguishing system will operate as intended

NOTE It includes a thorough examination and any necessary repair or replacement of system components.

3.26
manual
requiring intentional intervention to accomplish a function

3.27
manufacturer
legal person that is responsible for the design, manufacturing, packaging and quality insurance of a device before it is placed on the market

3.28
monitoring
supervision of the operating integrity of an electrical, mechanical, pneumatic or hydraulic control feature of a system

3.29
no observed adverse effect level
NOAEL
highest agent factor at which no adverse toxicological or physiological effect has been observed

3.30
normally unoccupied area
area that is not occupied by persons under normal circumstances but may be entered occasionally for brief periods

3.31
protected volume
volume enclosed by the building elements around the protected enclosure, minus the volume of any permanent impermeable building element within the enclosure

3.32
release
physical discharge or emission of an aerosol as a consequence of the generator actuation

3.33
safety factor
multiplier of the extinguishing factor to determine the aerosol design factor

3.34
solid aerosol-forming compound
mixture of oxidant, combustible component and technical admixtures producing fire extinguishing aerosol upon ignition

3.35
supplier
legal person that is responsible for the product and is able to ensure that its quality is ensured

3.36
system isolate switch
see lock-off device (3.23)

3.37
thermal ignition device
device, which automatically operates at a rated temperature and is arranged for the ignition of the solid aerosol-forming compound

3.38
total flooding system
fire-fighting system arranged to discharge extinguishant into an enclosed space to achieve the appropriate design factor

3.39
unoccupiable area
area which cannot be occupied due to dimensional or other physical constraints e.g. shallow voids, cabinets

3.40
user
legal person, whom the system is designed for, and who is responsible for operation and to ensure the consistency of performance as described by the supplier and to follow the legal regulations

4 Use and limitations

4.1 General

The design, installation, service and maintenance of aerosol generators should be performed by those competent persons in fire extinguishing system technology.

The hazards against which these aerosol generators offer protection, and any limitations on their use, should be contained in the system supplier's design manual.

The total flooding use of aerosol generators is primarily for protection against hazards that are within an enclosure that will permit to establish and maintain the appropriate design factor of condensed aerosol for the required period of time to assure an effective extinguishment. Local applications are not covered by this standard.

Effects of agent particulate residue on sensitive equipment and other objects should be considered when using condensed aerosol extinguishing agents in spaces containing that type of equipment.

4.2 Extinguishants

4.2.1 General

The extinguishants referred to in this document are electrically non-conductive media.

The extinguishants and specialised system parameters are each covered individually in CEN/TR 15276-1 for specific extinguishants which should be used in conjunction with this document.

The extinguishants referred to in CEN/TR 15276-1 should not be used on fires involving the following unless relevant testing has been carried out to the satisfaction of the Authority:

a) chemicals containing their own supply of oxygen, such as cellulose nitrate;

b) mixtures containing oxidizing materials, such as sodium chlorate or sodium nitrate;

c) chemicals capable of undergoing autothermal decomposition, such as some organic peroxides;

d) reactive metals (such as sodium, potassium, magnesium, titanium and zirconium), reactive hydrides, or metal amides, some of which may react violently with the extinguishants;

e) oxidizing agents such as nitric oxides and fluorine;

f) pyrophoric materials such as white phosphorous or metallo-organic compounds.

The above list may not be exhaustive.

4.2.2 Extinguishing mechanism

Condensed aerosol is an extinguishing media consisting of finely divided solid particles (e.g. 40 % by mass) typically based on alkali metal salts and gases (e.g. 60 % by mass), mainly comprised of nitrogen, carbon dioxide and water vapour.

Aerosol extinguishes fires chemically, interfering with the flame chain reaction by removing the reactive free radicals and physically, by cooling the seat of the fire. Both actions take place mainly on the surface of the aerosol particles, and as such, the finer the particles the more effective the extinguishment.

4.3 Potentially explosive atmosphere

Under certain conditions the potential for explosive atmospheres may exist. Areas where such potential may exist are classified as hazardous. Condensed aerosols may be used in hazardous areas subject to the manufacturer obtaining the specific listings and approvals for such areas from the appropriate authorities.

Where aerosol generators are used in potentially explosive atmosphere, the compatibility of the generator to the atmosphere for the determined lifetime should be assessed.

IMPORTANT — The EU Directive 94/9/EC (ATEX Directive) should be taken into consideration.

4.4 Temperature limitations

All devices should be designed for the service they will encounter and should not readily be rendered inoperative or susceptible to accidental operation.

Devices normally should be designed to function properly from – 20 °C to + 50 °C, or marked to indicate temperature limitations, or in accordance with manufacturers' specifications which should be marked on the name-plate, or (where there is no name-plate) in the manufacturer's instruction manual.

For condensed aerosols a special care should be used to determine the maximum ambient temperature at which the aerosol generator can be installed, without risk of actuation by temperature itself.

The condensed aerosol generators should not be employed at less than the minimum thermal clearance distances specified in the manufacturer's instruction manual.

5 Safety

5.1 Hazard to personnel

Any hazard to personnel created by the actuation and discharge of the condensed aerosol generators should be considered in the design of the protection in particular with reference to the hazards associated with particular extinguishants. When selecting a condensed aerosol extinguishant a careful consideration should be given to independent occupational health and safety data.

Adherence to this document does not remove the user's statutory responsibility to comply with the appropriate safety regulations.

The discharge of a condensed aerosol generator may create serious hazards for personnel in both the protected area and areas to which it may migrate. These hazards include the following:

a) *Reduced visibility:* when activated, condensed aerosol generators reduce visibility both during and after discharge period.

b) *Potential toxicity:* when activated, condensed aerosol generators may produce toxic levels of gases such as carbon monoxide, nitrogen oxides and ammonia, which are typical by-products of the aerosol generating reaction. Actual concentrations of these by-products depend on the chemical compositions of the solid aerosol-forming compound and coolant, engineering design of the aerosol generators and conditions of the enclosure under protection. Maximum allowable exposure to a design factor of the aerosol under conditions of a sealed enclosure should be provided for each agent by its manufacturer. Any possible adverse effects on humans that may be experienced at the indicated allowable exposures should be described. The information should be supported by the appropriate test results on chemical composition of the aerosol and its short term "acute" adverse effects. The results should be endorsed by an independent testing laboratory having an appropriate authority.

c) *Thermal hazard: a* condensed aerosol discharges at the elevated temperatures. Depending on the intended application(s) of the aerosol system, the temperature at the reasonable minimum clearance from the discharge outlet, as specified by the manufacturer of the aerosol generators, should not exceed 75 °C for persons, 200 °C for combustible material and 400 °C for construction structures respectively. Immediately after discharge the aerosol generators can be hot, therefore, protective gloves shall be worn before handling generators up to 15 min after discharge.

d) *Turbulence:* turbulence caused by high-velocity discharge from the nozzle may be enough to dislodge substantial objects directly in its path, such as ceiling tiles and light fittings. Therefore, tiles and light fittings should be properly secured. Aerosol discharge may also cause enough general turbulence to move unsecured paper and light objects.

NOTE In order to assess the potential human health effects manufacturers should conduct the toxicity testing for use. This requires direct toxicity assessment on the aerosol after discharge of the system at the maximum design factor.

5.2 Safety precautions

5.2.1 General

Reduced visibility during and after discharge together with potential toxicity restricts the use of a condensed aerosol total flooding system to normally unoccupied and unoccupiable areas only. In any proposed use of condensed aerosol where there is a possibility that people may enter the protected enclosure or be close to

the protected risk, suitable safeguards such as personnel training, warning signs, pre-discharge alarms and system isolate switches should be provided. Means of ventilation after fire should be readily available.

Unnecessary exposure to a condensed aerosol should be avoided.

Following the use of a condensed aerosol, personnel should not enter the protected area until it has been thoroughly ventilated. Venting of the post-fire atmosphere should be to an open-air area, where possible, to prevent the inadvertent exposure of personnel to any combustion products of the fire and aerosol-generating reaction. In case of fire involving unknown products it is imperative to check the concentration of carbon monoxide and other potentially toxic gases before entering the premises.

Following a system discharge the aerosol that has settled should be removed in accordance with the manufacturer's recommendations. Protective clothing including gloves and goggles should be worn. A respirator or mask may be required.

Venting in to an open-air area should also prevent contamination/migration of extinguishant to other areas than the protected area.

5.2.2 Normally unoccupied areas

If there are no regulations available, the following minimum requirements should be taken (see Table 1).

The maximum factor should not exceed the LOAEL for the extinguishant used unless a lock-off device is fitted.

It is recommended that systems where the NOAEL is expected to be exceeded be placed in non-automatic mode whilst the room is occupied.

Table 1 — Minimum safety precautions

Maximum factor	Time delay device	Automatic/manual switch	Lock-off device
Up to and including the NOAEL	Required	Not Required	Not Required
Above the NOAEL and up to the LOAEL	Required	Required	Not Required
LOAEL and above	Required	Required	Required
NOTE The intent of this table is to avoid unnecessary exposure of occupants to the discharged extinguishant. Factors such as the time for egress and the risk to the occupants by the fire should be considered when determining the system discharge time delay. Where national standards require other precautions, these should be implemented.			

In case of unknown NOAEL and LOAEL values, it should be presumed above LOAEL value (see Table 1).

WARNING — Any change to the enclosure volume, or addition or removal of contents that was not covered in the original design will affect the design factor. In such cases, the system should be recalculated to ensure that the system with the new design factor is consistent with Table 1.

The following general safety aspects should apply for areas protected by the condensed aerosol total flooding systems and which are capable of being occupied:

a) Time delay devices:

   1) extinguishing systems should incorporate a pre-discharge alarm with a time delay sufficient to allow personnel evacuation prior to discharge;

2) time delay devices should be used only for personnel evacuation or to prepare the hazard area for discharge.

b) Automatic/manual switch and lock-off devices at the entrance to the protected area where required in accordance with Table 1.

NOTE Although lock-off devices are not always required, they are essential in some situations, particularly for some specific maintenance functions.

c) Thermal automatic activation device should not be used in normally unoccupied areas.

d) Exit routes which should be kept clear at all times, and emergency lighting and adequate direction signs to minimise travel distances.

e) Outward-swinging self-closing doors which can be opened from the inside, including when locked from the outside.

f) Continuous visual and audible alarms at entrances and designated exits inside the protected area and continuous visual alarm outside the protected area which operate until the protected area has been made safe.

g) Appropriate warning and instruction signs.

h) Where required, pre-discharge alarms within such areas that are distinctive from all other alarm signals that will operate immediately upon detection of the fire.

i) Means for prompt natural or, where necessary, forcer-draft ventilation of such areas after any discharge of extinguishant. Care should be taken to completely dissipate hazardous atmospheres and not just move them to other locations.

j) Instructions and drills of all personnel within or in the vicinity of protected areas, including maintenance or construction personnel who may be brought into the area, to ensure their correct actions when the system operates.

In addition to the above requirements, the following are recommended:

— self-contained breathing apparatus should be supplied and personnel trained in its use;

— personnel should not enter the enclosure until it has been verified as being safe to do so.

5.2.3 Unoccupiable areas

The maximum factor may exceed the LOAEL for the extinguishant used, without the need for a lock-off device to be fitted.

5.2.4 Installer's responsibility

The installer should be responsible for the provision of the following:

a) Warning and instruction signs in accordance with 8.4.3 and 8.4.5.

b) Alarms within the area that will operate immediately on detection of fire.

c) Continuous alarms at the entrance to the protected area to be sounded until the atmosphere has been restored to normal.

d) Instruction to disarm the system during periods of inspection, maintenance or modification.

e) Instruction to the owner to remove aerosol generator(s) before allowing any hot work to be conducted inside the protected area.

f) System isolating switches / lock-off devices at least at one entrance to the protected area.

5.2.5 User's responsibility

The user should be responsible for the provision of the following:

a) Written procedures appropriate to the risk, instruction and drills of all personnel within or near the protected area.

b) Adequate aisles and routes of exit and keeping them clear at all times.

c) Only outward-swinging, self-closing doors at exit from protected areas and, where doors are latched, provision of panic hardware.

d) Safety features for other personnel as indicated by careful study of each particular situation.

e) Sufficient post-fire ventilation, natural or mechanical, of the protected area. Care should be taken to dissipate products of combustion and not merely move them to other locations which may be occupied at any time.

f) Maintenance of the system in accordance with Clause 11.

g) Any additional signage required to implement the procedures.

h) The user should arrange for the removal of the aerosol generators prior to the commencement of hot work in the area.

5.3 Electrical hazards

5.3.1 General

Where exposed electrical conductors are present, clearances no smaller than those given in EN 50110 should be provided, between the electrical conductors and all parts of the system that may be approached during maintenance. Where these clearance distances cannot be achieved, warning notices should be provided and a safe system of maintenance work should be adopted and described in the instructions for use.

The system should be so arranged that all normal operations can be carried out with safety to the operator.

5.3.2 Electrical earthing

Systems installed in electrical substations or switchrooms should be efficiently bonded and earthed to prevent the metalwork becoming electrically charged.

5.3.3 Electrostatic discharge

The system should be adequately bonded and earthed to minimise the risk of electrostatic discharge.

6 System design

6.1 General

This clause sets out the requirements for the specifications and system design calculations. It should be read in conjunction with the CEN/TR 15276 -1.

All ancillary systems and components should conform to the relevant national, European or International Standards.

6.2 Specifications, plans and approvals

6.2.1 Specifications for condensed aerosol systems should be prepared under the supervision of a person fully experienced in the design of such systems and, where appropriate, with the advice of the authority.

6.2.2 The specifications should include all pertinent items necessary for the proper design of the system such as the designation of the authority, variances from the standard to be permitted by the authority, design criteria, system sequence of operations, the type and extent of the acceptance testing to be performed after installation of the system and user training requirements.

6.2.3 Extinguishant specifications obtained according to CEN/TR 15276-1 for the specific extinguishant should be prepared.

6.3 Enclosures

6.3.1 Protected enclosure

The protected enclosure should have sufficient structural strength and integrity to contain the extinguishant discharge. Venting should be provided to prevent excessive over- or under-pressurization of the enclosure. A calculation method to estimate a minimum vent area should be provided by the manufacturer. Type and location of the pressure relief vents should ensure maximum possible containment of the extinguishing agent during and after its discharge.

6.3.2 Openings

To prevent loss of extinguishant through openings to adjacent hazards or work areas, openings should be permanently sealed or equipped with automatic closures. Where reasonable confinement of extinguishants is not practicable, protection should be extended to include the adjacent connected hazards or work areas.

6.3.3 Unclosable openings

The area of unclosable openings should be kept to a minimum. The presence of unclosable openings in the ceiling should be avoided. Any loss of extinguishant through unclosable openings or necessary ventilation systems should be compensated for by providing additional quantities of extinguishant at a rate required to maintain the design factors.

NOTE 1 Particular attention should be given to openings around cable and duct entries into the space, return air louvres and the like.

NOTE 2 In some cases additional extinguishant will only increase the rate of loss through unclosable openings.

6.3.4 Ventilation and services

Air-handling systems serving the protected area should generally be shut down or isolated by dampers. Where it is necessary for air-handling systems to be kept operating to provide cooling for equipment, particular attention should be paid to extinguishant quantities and discharge rates to maintain the desired factors.

Any services within the enclosure, such as fuel valves and pumps, heating appliances and paint sprayers which if left running would impair the efficiency of condensed aerosol, should be shut down prior to or simultaneously with the release of the extinguishant.

6.3.5 Venting requirements

When an aerosol is discharged into a closed volume, a significant overpressure may be developed due to the amount of gases generated and the effects of increased temperature of the atmosphere.

Later, the combined volume of aerosol and air will become greater than the initial room volume, the final result will increase the pressure or will exhaust the excess volume through vent openings. The air temperature is increased during the discharge but will return to normal levels as heat is adsorbed from solids surfaces in the room.

The designer/installer should provide reliable calculations for venting requirements for each system if applicable.

6.4 Design factor requirements

6.4.1 The minimum design factor for each Class B fuel should be the extinguishing factor multiplied by a safety factor of 1,3, when tested in accordance with CEN/TR 15276-1.

Other fuels than heptane should be tested in accordance with CEN/TR 15726-1:2009, A.6.2, using the relevant fuel.

6.4.2 The minimum design factor for Class A fires should be the extinguishing factor multiplied by a safety factor of 1,3, when tested in accordance with CEN/TR 15276-1.

Other fuels have to be tested in accordance with CEN/TR 15276-1:2009, A.6.1 and/or A.6.3, using the relevant fuel. Minimum extinguishing factor for Class A fuels should be highest of the extinguishing factors determined in accordance with A.6.1, A.6.3 and A.6.4.

6.4.3 The minimum design factor for EDP rooms, telecommunication and electronic risks should be the highest determined extinguishing factor from the results of test scenarios when tested in accordance with CEN/TR 15276-1:2009, A.6.3, multiplied by a safety factor of 1,3.

NOTE 1 Until the final test description is available, the design factor should be 95 % of the heptane design factor.

NOTE 2 Where electrical equipment shut down may be delayed, higher factors, longer hold times, or other fire protection systems can be considered.

6.4.4 The safety factor of 1,3 relates to the increase of 30 % from the extinguishing factor to the design factor, which results in additional quantity of extinguishant. Circumstances which may not be adequately covered by this factor (although in some cases they are covered by other requirements in this standard) and which may need allowance for additional extinguishant (i.e. more than 30 %) are included but not limited to the following:

a) Where leakage occurs from a non-tight enclosure.

b) Where leakage occurs due to doors being opened during or immediately after discharge. This should be covered by operational protocols for individual risks.

c) Where excessive leakage occurs from an enclosure due to expansion of the extinguishant.

d) Where metal surfaces, heated by the fire, may act as an ignition source if not adequately cooled during extinguishant discharge and hold time.

WARNING 1— Under certain conditions, it may be dangerous to extinguish a burning gas jet. As a first measure, shut off the gas supply.

WARNING 2— Additional extinguishant required to compensate for one of the above mentioned circumstances may increase potential toxicity of a condensed aerosol. Care should be taken to prevent any possibility of personnel exposure to the high initial factor of the aerosol.

6.5 Design factor adjustment

6.5.1 Effects of altitude

The design calculations of the extinguishant should be adjusted to compensate for ambient pressures that vary more than 11 % (equivalent to approximately 1 000 m of elevation change) from standard sea level pressure (1,013 bar absolute). The ambient pressure is affected by changes in altitude, pressurization or depressurization of the protected enclosure, and weather-related barometric pressure changes.

Unlike gaseous extinguishants, where volumetric concentrations are used for design calculations, condensed aerosols refers to mass factor only. As such, altitude has no effect on the design factor (density) calculations. However, the parameter which may be affected by altitude is the extinguishant gas-like three-dimensional distribution in a given enclosure.

At elevations above sea level, condensed aerosol expands to a greater specific volume because of the reduced atmospheric pressure. Hence, a system designed for sea level conditions will provide, at the same design factor, a higher coverage at elevations above sea level. A reduction in extinguishant quantity is however not recommended as it may result in lower extinguishant performance.

For elevations below sea level, condensed aerosol may compress to a lower specific volume because of increased atmospheric pressure. This may result in lower coverage compared to that achieved under sea level conditions, but the likelihood of this occurring should be low, due to a high velocity and elevated temperature of aerosol being released.

At elevations below sea level, the quantity indicated at sea level conditions should be increased to compensate for a lower coverage. Design factor determined at sea level should be multiplied by correction factor to obtain correct values.

$$e^{-\rho_0 g h / P_0} \tag{1}$$

where

ρ_0 aerosol density at sea level, in kilogram per cubic metre;

g 9,81 m/s^2;

h sea level height, in metre (e.g. 1 000 m);

P_0 pressure exerted by a specific condensed aerosol at sea level, in Pascal.

6.5.2 Effects of temperature

Temperature, as with altitude, has no effect on condensed aerosol design factor calculations, but it affects the extinguishants spatial distribution.

At elevated temperatures aerosol expands to a greater specific volume. A system designed for standard conditions will therefore develop, at the same design factor, a higher distribution at elevated temperatures. Reduction in quantity of extinguishant is, however, not recommended, as it may result in lower extinguishant performance.

At lower temperatures aerosol may compress to a lesser specific volume. This may result in lower coverage compared to that achieved under standard temperature conditions. The likelihood of this should be low due to a high velocity and the elevated temperature of aerosol being released.

At temperatures below zero, the quantity indicated at room temperature should be increased to compensate for a lower coverage. Design factor determined at room temperature should be multiplied by a correction factor.

6.5.3 Effects of ventilation

All ventilation systems should be shut down prior to the actuation of condensed aerosol system.

However, the possibility of aerosol discharge into an enclosure that is ventilated should also be considered. In such enclosures some extinguishant will be lost with the ventilating air. Assuming that ventilation continues during and after discharge, a greater amount of extinguishant is required to develop a given design factor.

Also, to maintain the design factor at a given level requires continuous extinguishant discharge for the duration of the holding period.

The designer/installer should provide reliable calculations for each system if applicable.

6.5.4 Compensation for Leakage through enclosure openings

If a condensed aerosol system is designed for an enclosure with openings that cannot be closed (example may be a conveyor belt penetrating an enclosure wall), yet even these openings can sometimes be closed using suitable devices. Aerosol discharged into an enclosure for total flooding will result in an air and extinguishant mixture that has a lower specific gravity than the air surrounding the enclosure. Therefore, any openings especially in the ceiling and higher portions of the enclosure will allow condensed aerosol to flow out.

The designer/installer should provide reliable calculations for each system if applicable.

6.6 Design quantity

The quantity of the extinguishant should be sufficient to achieve the design factor in the protected enclosure and should be calculated by the following formula:

$$m = c \times V \qquad (2)$$

where

m is the quantity, in grams;

c is the adjusted design factor, in grams per cubic metre;

V is the protected volume of the hazard, in cubic metres.

The protected volume of the hazard should include any extension of the coverage for the adjacent connected hazards or work areas (see 6.3.2).

In case of different fuel, the highest of the design factors should be used.

In addition to these calculated total flooding quantities, additional quantities of extinguishant may be required by national standards to compensate for any special conditions that would adversely affect the extinguishing efficiency or, if required, by the physical characteristics of the extinguishant.

6.7 Unit size and quantity of aerosol generators

6.7.1 Aerosol generator size selection

6.7.1.1 In case of the need of more than one aerosol generator to protect a volume, generators of the same family should be used.

NOTE As each condensed aerosol generator contains a distinct amount of the solid aerosol-forming compound, there may be a few options in regards to the unit size and number of the aerosol generators that would be adequate to achieve the required design quantity.

6.7.1.2 The selected unit sizes should conform to the maximum distance and area coverage and maximum or minimum protected height limitations as specified for each unit. The maximum and minimum height and coverage distance for each unit size of the aerosol generators are determined by area coverage fire tests as described in CEN/TR 15276-1.

6.7.1.3 The selected unit sizes should be appropriate for the protected area in terms of the minimum thermal clearance from the discharge outlets. If the protected area is congested or contain temperature sensitive equipment, it would be appropriate to select several smaller units that require less minimum clearance although one large unit may be adequate in terms of achieving the required design quantity.

The following general criteria should apply:

— for locations, where personnel may be situated, the minimum thermal clearance should refer to the temperature not exceeding 75 °C;

— for locations, where combustible materials or equipment may be situated, the minimum thermal clearance should refer to the temperature not exceeding 200 °C;

— for locations, where non-combustible equipment may be situated, the minimum thermal clearance should refer to the temperature not exceeding 400 °C.

6.7.1.4 In some applications such as cable ducts and trenches several smaller units of the same family evenly spread along the protected enclosure would provide better distribution and faster achievement of the minimum design factor throughout the area although one large unit may fulfil the agent quantity requirement.

6.7.1.5 Certain protected enclosures may have very specific permissible mounting locations. This may influence the quantity and size of the units selected.

6.7.2 Quantity of aerosol generator

6.7.2.1 General

Quantity of aerosol generator's units needed to protect a room may be increased in order not to exceed maximum coverage distance.

6.7.2.2 Same unit size

$$n = \left\lceil \frac{m}{m_g} \right\rceil \tag{3}$$

where

n is the rounded up integer number of aerosol generators of one size;

m is the design quantity, in gram;

m_g is the mass of the aerosol-forming compound in one generator, in gram.

6.7.2.3 Different unit size

If different sizes of aerosol generators should be selected, the total mass of the aerosol-forming element should be not less than the design quantity.

The height of the protected enclosure should not exceed the maximum height limitation listed for the smallest unit size selected, unless uniformity of the aerosol distribution for the greater height has been proved by a discharge test.

6.8 Duration of protection

6.8.1 It is important that an effective design factor is not only achieved, but is maintained for a sufficient period of time to allow effective emergency action. This is equally important in all classes of fires since a persistent ignition source (e.g. an arc, heat source, oxyacetylene torch, or "deep-seated" fire) can lead to resurgence of the initial event once the extinguishant has dissipated.

6.8.2 It is essential to determine the likely period during which the extinguishing factor will be maintained within the protected enclosure. This is known as the hold time.

6.8.3 The holding time should be not less than 10 min, unless otherwise specified by the authority.

The predicted hold time should be determined based on the following criteria:

a) At the start of the hold time, the concentration throughout the enclosure should be the design concentration.

b) At the end of the hold time, the extinguishant concentration at 10 %, 50 % and 90 % of the enclosure height should be not less than 85 % of the design concentration.

NOTE As the factor of a condensed aerosol cannot be measured directly by a gas analysis technique, other physical properties proportional to the factor, such as optical transmittance, could be measured providing the adequate calibration between such property and the design factor can be effected. The measuring technique, procedure and calibration method should be listed or approved by an appropriate authority.

6.8.4 Any significant air leaks that could result in a failure of the enclosure to hold the specified extinguishant factor level for the specified hold time period should be effectively sealed.

6.9 System discharge

6.9.1 Discharge time

The discharge time should not exceed 90 s from the actuation at 20 °C, or as otherwise accepted by the authority.

6.9.2 Extended discharge

When an extended discharge is necessary, the rate should be sufficient to maintain the desired factor for the required hold time. In such applications the condensed aerosol generators may be activated in sequence.

6.10 Plans

Plans should contain sufficient detail to enable an evaluation of the protected enclosure or enclosures and the effectiveness of the system. Details should include the materials involved in the hazards, the location of the hazards, the enclosure limits and isolation of the hazards, and exposure from adjacent hazards.

Any special features should be adequately explained.

Where a system is installed an installation drawing should be provided and should be located on or adjacent to the manual release point, or where manual release points are not provided, at each entrance to the protected enclosure.

The installation drawing should be in the form of a permanent diagram which is water-resistant and fade-resistant and should consist of the following:

a) A layout plan of the protected area(s);

b) A location drawing showing aerosol generators locations:

1) visual and audible alarms;

2) exit routes;

3) system isolate switch;

4) manual control;

5) electrical ignition device;

6) thermal ignition device;

c) The year of installation of the system, any major extension and any unusual features of the installation; and

1) names of both the contractor who installed the system, and the organization responsible for the maintenance of the system;

2) words "CONDENSED AEROSOL SYSTEM";

3) number and type of aerosol generators installed;

4) total mass of the aerosol-forming composition in grams.

7 System installation

7.1 General

The installation of aerosol generators in total flooding applications should be designed with due consideration for the materials involved, the nature of the expected fire and the geometry of the enclosure, any of which may effect the quantity and the discharge of the generators. Suitable brackets or other means of fixing the generator(s) should be provided.

7.2 Aerosol generator arrangement

The number and unit size of the condensed aerosol generators should be appropriate for a protected enclosure in relation to the maximum area and distance coverage and height limitations as listed for each generator unit size.

Arrangements should be made for aerosol generators and accessories to be accessible for inspection, testing and other maintenance when required.

Aerosol generators should be adequately mounted and suitably supported according to the systems installation manual so as to provide for convenient individual servicing of the generator.

Aerosol generators are normally located within the enclosure they protect. Some applications may require that generators are located outside the enclosure.

Aerosol generators should not be located where they will be subjected to severe weather conditions or to potential damage due to mechanical, chemical or other causes. Where potentially damaging exposure or unauthorised interference are likely, suitable enclosures or guards should be provided.

Aerosol generators should be adequately located to ensure that the possibility of damage due to heat of the discharge is minimised. The correct minimum clearance appropriate for the type of risk under protection should be observed.

In order to minimize the possibility of lifting or displacement of lightweight ceiling tiles, precautions should be taken to securely anchor tiles located within a direct path of the aerosol discharge.

There should be no combustible material or equipment within the minimum distance from the generator's discharge outlet as specified in the listing.

7.3 Operating conditions

In-service operating conditions, such as temperature, humidity and vibration, should be within ranges specified by the manufacturer.

7.4 Installation recommendations

The following recommendations apply:

a) generators should be located in such a way as to orient the aerosol discharge to clear obstructions and not across any route of exit;

b) if there are any unclosable openings such as exits, doors and apertures, aerosol discharge should be directed across the likely fire zone and not towards those openings;

c) if there are any obstacles which could obstruct the free flow of the aerosol, it is preferable to install several small generators instead of one large one, should design limitations for smaller units allow such a replacement. If it is not possible, the distance from the nozzle to the obstacle should be not less than the minimum distance given in the listing. In case of multiple obstacles the design factor should be increased, such increase to be determined by preliminary tests conducted in the premises concerned;

d) the aerosol generator should be mounted in a way that a free outflow of aerosol is possible. The manufacturer should define the minimum distance from the generator outlet to the first obstacle.

7.5 System operation

7.5.1 General

Condensed aerosol systems should be activated automatically, manually or both.

7.5.2 Automatic operation

Should be performed either electrically upon activation of the detection circuit initiating a signal from the control panel to the generator(s) electrical ignition device, or thermally by action of an in-built thermal ignition device or by both. Any other ignition device should be used if it conforms to CEN/TR 15276-1.

7.5.3 Manual operation

Should be performed electrically by manual release point or any other devices listed for use with aerosol generators, or mechanically by any mechanical release devices listed for use with aerosol generators. Where provided, manual release points or mechanical release devices should be protected from accidental operation. Any other manual release device should be used if it conforms to CEN/TR 15276-1.

7.5.4 System isolate switch (lock off device)

The discharge of electrically operated condensed aerosol generators in total flooding applications in normally unoccupied areas should be capable of being excluded by means of a lock off device.

The device should be manually operated when personnel are present in the protected area or the adjacent area which could be rendered hazardous by the discharge of extinguishant.

The lock off device should be situated outside the protected area or adjacent to the main exit from the area and protected from an accidental operation.

While the lock off device is active and the discharge of the system is inhibited, the fire detection and alarm systems should continue to function and the system should return to its operation control when the device is reactivated. An indication should be given at the control panel.

The operation of the lock off device should electrically isolate and put to earth each conductor of the wiring from the generator.

8 Detection, alarm and control systems

8.1 General

Detection, actuation and control systems may be either automatic or manual. Where they are automatic, provision should also be made for manual operation.

Detection, actuation, alarm and control systems should be installed, tested and maintained in accordance with appropriate national standards.

Unless otherwise specified in a national standard, 72 h minimum standby sources of energy should be used to provide for operation of the detection, signalling, control and actuation requirements of the system.

8.2 Automatic detection

Automatic detection should be by any method or device acceptable to the authority and should be capable of early detection and indication either of heat, flame, smoke, combustible vapours, combinations of that or any abnormal condition in the hazard that is likely to produce fire.

NOTE 1 Detectors installed at the maximum approved spacing for fire alarm use may result in excessive delay in extinguishant release, especially where more than one detection device is required to be in alarm before automatic actuation results.

NOTE 2 Smoke detectors may be activated by aerosol extinguishing media.

8.3 Operating devices

8.3.1 General

Operating devices such as system isolate switches and ancillary equipment, including shutdown equipment, dampers and door closures, required for successful system performance should be considered integral parts of the system. All ancillaries should incorporate manual reset facilities.

8.3.2 Automatic operation

Automatic systems should be controlled by automatic fire detection and actuation systems suitable for the system and hazard, and should also be provided with a means of manual operation.

If more than one generator is used in one volume, the difference of activation time should not exceed 5 s.

Electrically operated fire detection systems should conform to the appropriate part of EN 54. The electric power supply should be independent of the supply for the hazard area, and should include an emergency secondary power supply with automatic changeover in case the primary supply fails.

When two or more detectors are used, such as those for detecting smoke or flame, it is preferable for the system to operate only after signals from two detectors have been received.

8.3.3 Manual operation

Provision should be made for manual operation of the fire-fighting system by means of a control situated outside the protected space or adjacent to the main exit from the space.

In addition to any means of automatic operation, the system should be provided with the following:

a) one or more means, remote from the containers, of manual operation; or

b) a manual device for providing direct mechanical actuation of the system; or

c) an electrical manual release system in which the control equipment monitors for abnormal conditions in the power supply and provides a signal when the power source is inadequate.

NOTE 1 National standards may not require a manual release, or may require the release to operate via the pre-discharge alarms and time delay.

The manual operation device should incorporate a double action or other safety device to restrict accidental operation. The device should be provided with a means of preventing operation during maintenance of the system.

NOTE 2 The choice of the means of operation will depend upon the nature of the hazard to be protected. Automatic fire detection and alarm equipment will normally be provided on a manual system to indicate the presence of a fire.

8.4 Control equipment

8.4.1 Electric control equipment

Electric control equipment should be used to supervise the detecting circuits, manual and automatic releasing circuits, signalling circuits, electrical actuating devices and associated wiring and, when required, cause actuation. The control equipment should be capable of operation with the number and type of actuating devices utilized.

8.4.2 Pneumatic control equipment

Where pneumatic control equipment is used, the lines should be protected against crimping and mechanical damage. Where installations could be exposed to conditions that could lead to loss of integrity of the pneumatic lines, special precautions should be taken to ensure that no loss of integrity will occur.

8.4.3 Operating alarms and indicators

Alarms or indicators, or both, should be used to indicate the operation of the system, hazards to personnel, or failure of any supervised device. The type (audible, visual or olfactory), number, and location of the devices should be such that their purpose is satisfactorily accomplished. The extent and type of alarms or indicator equipment, or both, should be approved.

NOTE National regulations for personnel safety are valid, if available, regarding type, number, location and minimum operation time of alarm devices.

Audible, and if required, visual pre-discharge alarms should be provided within the protected area to give positive warning of impending discharge. The pre-discharge alarms should operate immediately on commencement of time delay upon detection of fire or manual operation of the system. The operation of the warning devices should be continued after extinguishant discharge, until positive action has been taken to acknowledge the alarm and proceed with appropriate action, at least for 30 min.

Alarms indicating failure of supervised devices or equipment should give prompt and positive indication of any failure and should be distinct from alarms indicating operation or hazardous conditions.

8.4.4 Time delay device

To warn people in the flooding zone of an imminent discharge, the discharge should be delayed for at least 10 s.

In normally non-occupied areas, time delay devices should be used with a delay time long enough to allow people to evacuate the area without undue haste. This is:

a) to avoid unnecessary exposure of people to extinguishant;

b) to ensure doors are closed before extinguishant release thus property protection objectives are achieved.

Time delay devices should be used only for personnel evacuation or to prepare the hazard area for discharge.

The time delay should be no longer then necessary to ensure safe evacuation and/or preparation of hazard for discharge.

Regarding personnel safety, national regulations apply if available.

Automatic fire detection, alarm and control systems for condensed aerosol should conform to the relevant requirements of this document.

Any approved device, or combination of devices appropriate to the fire risk and airflow in the protected area that are selected and sited in accordance with, may be used for automatic detection. Additional detectors may be required.

8.4.5 Control and indicating equipment

Aerosol systems should incorporate control and indicating equipment conforming to EN 12094-1 and the following:

a) *Power supplies.* In addition to the requirements of EN 54-4, power supplies and batteries should each be sized to provide enough power to operate all ancillary equipment fitted, including illuminated signs.

b) *Supervision.* The control circuit for the extinguishant discharge device should be supervised. The supervision should cause the panel to initiate an audible and visible fault indication upon loss of continuity of the circuit and, if a short-circuit occurs, there should be a visible yellow or amber indication.

c) *Aerosol discharge indicator.* A red visual indicator should be provided to indicate extinguishant discharge. An indication that a signal has been sent to initiate the extinguishant discharge device does not conform to this requirement.

d) *Maintenance isolate switch.* A switch secured from unauthorized use should be provided to prevent the automatic discharge of extinguishant during maintenance. The switch should be installed on the fire indicator panel and its location should be clearly identified at the local control station. Operation of the maintenance isolate switch should electrically isolate each conductor of the wiring to the extinguishant discharge device and initiates a yellow or amber visual indicator at the Control Stations.

9 Commissioning and acceptance

9.1 General

This clause sets out the minimum requirements for the commissioning and acceptance of the aerosol system.

The type of enclosure occupancy (normally unoccupied or unoccupied) should be checked against that indicated in the design documentation.

9.2 Tests

9.2.1 General

The completed system should be reviewed and tested by a competent person to meet the approval of the authority. Only equipment and devices designed to European or national standards should be used in the systems. To determine that the system has been properly installed and will function as specified, the tests specified in 9.2.2 to 9.2.9 should be performed.

WARNING — A lock-off device inhibiting the discharge of condensed aerosol generators should be operated prior to entering the protected enclosure.

9.2.2 Enclosure check

Determine that the protected enclosure is in general conformance with the plans. The actual enclosure volume and dimensions should be checked against those indicated on the system design specifications. Fan rundown and damper closure time should be taken into consideration.

Should pressure relief vents have been designed for the selected application, determine that the effective vent area is in conformance with the system design calculations. Ensure the vents are of an appropriate type and their location within the risk area is in accordance with the design recommendations to provide maximum possible containment of the aerosol during and after its discharge.

9.2.3 Review of mechanical components

The number and unit size(s) of the condensed aerosol generators should be checked for conformance to the system design. The number should be adequate to produce the specified design factor. The unit size(s) should be appropriate in relation to maximum height and area coverage limitations.

The arrangement of the aerosol generators should be checked for conformance to the system design as specified in 7.2. The orientation of the generators should be in such a manner that optimum extinguishant dispersal can be effected.

The aerosol generators should be installed in such a manner that they will not potentially cause injury to personnel. Minimum clearances from the discharge outlets as specified for the protected risk should be adhered to. Extinguishant should not directly impinge on areas where personnel may be found in the normal work area, or on any loose objects or shelves, cabinet tops, or similar surfaces where loose objects could be present and become missiles.

A discharge test for extinguishants is generally not recommended. However, it may be conducted if acceptable to the authority. Care should be taken when dealing with potentially explosive atmospheres. Other assessment methods for the hold time may normally be used to reduce unnecessary discharge into the environment.

Aerosol generators and mounting brackets should be securely fastened in accordance with the manufacturer’s requirements. Correct mounting brackets or supports should be used for each unit size of the aerosol generator.

9.2.4 Review of enclosure integrity

All total flooding systems should have the enclosure checked to locate and then effectively seal any significant air leaks that could result in a failure of the enclosure to hold the specified extinguishant factor level for the specified holding period (see also 6.5).

9.2.5 Review of electrical components

All wiring systems should be properly installed in conformity with the appropriate European or national standard and the system drawings. AC and DC wiring should not be combined in a common conduit unless properly shielded and grounded.

All field circuitry should be tested for ground fault and short circuit condition. When testing field circuitry, all electronic components (such as smoke and flame detectors or special electronic equipment for other detectors, or their mounting bases) should be removed and jumpers properly installed to prevent the possibility of damage within these devices. Replace components after testing the circuits.

Adequate and reliable primary standby sources of energy which conform to 6.4 should be used to provide for operation of the detection, signalling, control and actuation requirements of the system.

All auxiliary functions (such as alarm sounding or displaying devices, remote annunciators, air handling shutdown, power shutdown, etc.) should be checked for proper operation in accordance with system requirements and design specifications.

Alarm devices should be installed so that they are audible and visible under normal operating and environmental conditions.

Where possible, all air-handling and power cut-off controls should be of the type that once interrupted require manual restart to restore power.

Check that for systems using alarm silencing, this function does not affect other auxiliary functions such as air handling or power cut-off where they are required in the design specification.

Check the detection devices to ensure that the types and locations are as specified in the system drawings and are in accordance with the manufacturer's requirements.

Check that manual release devices are properly installed, and are readily accessible, accurately identified and properly protected to prevent damage.

Check that all manual release devices used to release extinguishants require two separate and distinct actions for operation. They should be properly identified. Particular care should be taken where manual release devices for more than one system are in close proximity and could be confused or the wrong system actuated. Manual release devices in this instance should be clearly identified as to which hazard enclosure they protect.

Check that for systems with a main/reserve capability, the main/reserve switch is properly installed, readily accessible and clearly identified.

Check that the control panel is properly installed and readily accessible.

Check that for systems using system isolate switches these are located at least at one entrance to the protected area, properly installed and clearly identified.

9.2.6 Preliminary functional tests

Activate a lock-off device before entering the protected area. Disconnect the wiring at each aerosol generator so that activation of the release circuit will not activate the generator(s). Reconnect the release circuit with a functional device in lieu of each aerosol generator release mechanism.

For electrically actuated release mechanisms, these devices may include suitable lamps, flash bulbs or circuit breakers. Pneumatically actuated release mechanisms may include pressure gauges. Refer to the manufacturer's recommendations in all cases.

Check each resettable detector for proper response.

Check that polarity has been observed on all polarized alarm devices and auxiliary relays.

Check that all required end-of-line devices have been installed.

Check all supervised circuits for correct fault response.

9.2.7 System functional operational test

Operate the detection initiating circuit(s). All alarm functions should occur according to the design specification.

Operate the necessary circuit to initiate a second alarm circuit if present. Verify that all second alarm functions occur according to design specifications.

Operate the manual release device. Verify that manual release functions occur according to design specifications.

Operate the system isolate switch, where fitted. Verify that functions occur according to the design specifications. Confirm that indication is properly indicated.

Check pneumatic equipment, where fitted, for integrity to ensure proper operation.

9.2.8 Remote monitoring operations (if applicable)

Disconnect the primary power supply, then operate one of each type of input device while on standby power. Verify that an alarm signal is received at the remote panel after the device is operated. Reconnect the primary power supply.

Operate each type of alarm condition and verify receipt of fault condition at the remote station.

9.2.9 Control panel primary power source

Verify that the control panel is connected to a dedicated unswitched circuit and is labelled properly. This panel should be readily accessible but access should be restricted to authorised personnel only.

Test a primary power failure in accordance with the manufacturer's specification, with the system fully operated on standby power.

9.3 Completion of functional tests

When all functional tests are complete (see 9.2.7), reconnect each aerosol generator so that activation of the release circuit will release the extinguishant. Return the system to its fully operational design condition. Notify the central alarm station and all concerned personnel at the end-user's facility that the fire system test is complete and that the system has been returned to full service condition by following the procedures specified in the manufacturers' specifications.

9.4 Completion certificate and documentation

The installer should provide to the user a completion certificate, a complete set of instructions, calculations and drawings (see Annex A) showing the system as-installed, and a statement that the system conform to all the appropriate requirements of this standard, and giving details of any departure from appropriate recommendations. The certificate should give the design factors and, if carried out, reports of any additional test.

10 Inspection

10.1 General

This clause specifies the requirements for regular inspection and maintenance of a condensed aerosol fire-extinguishing system by a competent person which should be, if applicable, provided by the installer to the user with instructions for use.

10.2 Inspection

10.2.1 General

At least annually, or more frequently as required by the authority, all systems should be thoroughly inspected and tested for proper operation by competent personnel.

The inspection report with recommendations should be filed with the user.

The date of inspection, expiry date and the name of the company performing the inspection should be recorded on a tag attached to the aerosol generator.

The discharged aerosol generators should be collected and recycled or disposed of in an environmentally acceptable manner, and in accordance with existing laws and regulations.

At least every 6 months, the aerosol generators should be checked for the following:

— generator casing and actuator(s) are undamaged;

— generators are securely mounted;

— generators are free from corrosion;

— service life of the generator.

10.2.2 Enclosures

At least every 12 months it should be determined whether boundary penetration or other changes to the protected enclosure have occurred that could affect leakage and extinguishant performance.

Where the integrity test reveals increased leakage that would result in an inability to retain the extinguishant for the required period, remedial action should be carried out.

Where it is established that changes to the volume of the enclosure or to the type of hazard within the enclosure, or both, have occurred, the system should be redesigned to provide the original degree of protection.

It is recommended that the type of hazard within the enclosure, and the volume it occupies, be regularly checked to ensure that the required factor of extinguishant can be achieved and maintained.

Where pressure relief vents are installed they should be inspected for any mechanical damage and other impacts that could affect their operation. Effective vent area should be checked for conformance with the design calculations.

11 Maintenance

11.1 General

The installer should provide the user with instructions for use specifying the requirements for inspection and the training of personnel for safety measures.

The user should carry out a programme of inspection, arrange a service schedule, and keep records of the inspections and servicing.

The continued capability for effective performance of a fire-fighting system depends on fully adequate service procedures with, where possible, periodic testing. Installers should provide the user with a record in which inspection and service details can be entered.

11.2 User's programme of inspection

The installer should provide the user with an inspection programme for the system and components. The programme should include instructions on the action to be taken in respect of faults.

The user’s inspection programme is intended to detect faults at an early stage to allow rectification before the system may have to operate. A suitable programme is as follows.

a) Weekly: Visually check the hazard and the integrity of the enclosure for changes which might reduce the efficiency of the system. Carry out a visual check that there is no obvious damage to pipework and that all operating controls and components are properly set and undamaged. Check pressure gauges and weighing devices, if fitted, for correct reading and take the appropriate action specified in the users’ manual.

b) Monthly: Check that all personnel who may have to operate the equipment or system are properly trained and authorised to do so and, in particular, that new employees have been instructed in its use.

11.3 Service schedule

A service schedule should include requirements for periodic inspection and test for the complete installed system, as specified in the appropriate national standards.

The schedule should be carried out by a competent person who should provide to the user a signed, dated report of the inspection, advising any rectification carried out or needed.

During servicing, every care and precaution should be taken to avoid release of extinguishant.

12 Training

All persons who may be expected to inspect, test, maintain or operate fire-extinguishing systems should be trained and kept adequately trained in the functions they are expected to perform.

Personnel working in an enclosure protected by an aerosol extinguishant should receive training in the operation and use of the system, in particular regarding safety issues.

Annex A
(normative)

Working documents

A.1 General

These documents should be prepared only by persons fully experienced in the design of extinguishing systems.

Deviation from these documents should require permission from the authority.

A.2 Working documents

Working documents should include at least the following items:

a) drawings, to an indicated scale of aerosol generators distribution and location;

b) name of owner and eventually the occupant;

c) location of building in which hazard is located;

d) location and construction of protected enclosure walls and partitions;

e) enclosure cross-section, full height or schematic diagram, including raised access floor and suspended ceiling;

f) type of aerosol generators being used;

g) design factor;

h) description of occupancies and hazards to be protected against;

i) specification of aerosol generators used;

j) equipment schedule or list of materials for each piece of equipment or device, showing device name;

k) manufacturer, model or part number, quantity and description;

l) system calculation;

m) enclosure pressurization and venting calculations;

n) description of fire detection, actuation and control systems.

Bibliography

[1] EN 2, *Classification of fires*

[2] EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2008)*

[3] 94/9/EC, *Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres*

BSI - British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001 Email: orders@bsigroup.com You may also buy directly using a debit/credit card from the BSI Shop on the Website http://www.bsigroup.com/shop

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact Information Centre. Tel: +44 (0)20 8996 7111 Fax: +44 (0)20 8996 7048 Email: info@bsigroup.com

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001 Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsigroup.com/BSOL

Further information about BSI is available on the BSI website at http://www.bsigroup.com.

Copyright

BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/
standards