EUROPEAN FIRE SPRINKLER NETWORK

Background paper on European sprinkler & water mist standards

February 2025

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Introduction

Standards are an essential element of our campaigns to see water-based suppression systems such as sprinklers and water mist systems more widely used in Europe. When we seek to convince regulators or others to call for sprinklers to be installed in buildings they in turn need a reference to clarify what they mean by sprinklers. Standards provide that. They are consensus documents drafted and reviewed by experts that set out in detail how a sprinkler system must be designed and installed, as well as the performance and durability that must be demonstrated by the key system components. Under CEN membership rules, CEN standards must be published by each member, meaning that a CEN standard then becomes a national standard in the 34 countries whose national standards body is a CEN member. Not only that, CEN members must also withdraw any standards with the same scope. We therefore achieve a consistent approach across Europe.

We are often asked why we need European standards when there are NFPA standards, FM data sheets and UL standards already available. An important reason is that many government regulators will not refer to a foreign standard, whereas a CEN standard is a national standard, often translated into the national language. Also, governments know that national experts attend CEN meetings and that they can send government delegates to CEN technical committee meetings and CEN supervisory committee meetings. We have not seen any government delegates in meetings of CEN Technical Committee 191 Working Group 5 on sprinklers nor Working Group 10 on water mist, but they do attend meetings of passive fire protection working groups.

Another reason is that European standards meetings allow participation of Europeans in their drafting, whereas the above US documents are either private or it is difficult for Europeans to participate when meetings are all held in the US. While much technical content in European standards draws on US research and US standards or guidance documents, not everything is the same in Europe. For example, electrical regulations are different, and we have some risks that may not exist in the US. Unlike for NFPA, in Europe component (product) standards are also drafted by CEN and can have legal force under the Construction Products Regulation[1], which is part of European Union law and further applied in several countries that neighbour the EU. CEN standards are national standards referenced by regulators in 34 countries with a population of 625 million, far more than the 330 million in the US where NFPA and UL are the most common standards referenced by State law. Yet despite a larger population in Europe, more sprinklers are installed each year in the US. A positive way to see this is that there is a greater scope for market growth in Europe. Standards are needed to support that process. On several occasions products or design concepts have been rejected by regulators because they are not in a national standard and they will not accept NFPA or FM data sheets. We have also seen regulators insist that products either be CE-marked or carry a national quality mark. CEN product standards, even when not harmonised, can serve as the starting point for the process of CE-marking using the European Technical Assessment route[2] or as the test protocol for a national quality mark.

As well as regulators, insurers are a key stakeholder in the uptake of sprinklers. For European standards to be widely applied, it is therefore essential that insurers also accept them. Fortunately, insurers have been deeply involved in drafting European sprinkler standards, not only directly but also through laboratories owned by insurers or with strong insurance links. An employee of an insurance company is the convenor of the CEN working group that drafts all European sprinkler standards.

[1] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

[2] See www.eota.eu

Many people have spent thousands of hours on the development of European sprinkler standards. Huge progress has been made in recent years and we are close to completing the suite of modern standards that reflect the state of the art in sprinkler systems and their components, based on international technology and adapted to the wide variety of European circumstances. Europe will have standards on which it can depend, which will continue to adapt as risks evolve, and which will make the use of other standards unnecessary.

Sprinkler system design standards

The first European sprinkler system design, installation and maintenance standard, EN 12845, was published in 2003. It was largely based on BS 5306-2, the British standard for sprinkler systems[3], which itself was based on the 29th edition of the Fire Offices' Committee from the UK, last revised in 1985, with input from CEA, the European insurance association, as well as good practice from other European countries. Two amendments were made and a revised edition was published in 2015. Among other changes, the 2015 edition introduced ESFR sprinklers and CMSA sprinklers, both as standalone annexes, and larger k-factor sprinklers. A small amendment was made in 2019 to clarify that an annual inspection should be made by a qualified person, with an informative annex to recommend that these inspections should be conducted by an independent body. While a major improvement on the 2004 edition, the 2015 standard did not fully address the plastic content of stored goods, had some outdated designs for special hazards and the ESFR and CMSA annexes did not include the latest developments. It was also felt to have too many annexes. A revision was needed.

EN 12845-1 – Sprinkler system, design, installation and maintenance

Introduction

It took many years to create a new draft of EN 12845. In the process we recognised that the EFSR and CMSA guidance in the standard was likely to need more frequent revision. To enable focussed revisions of this guidance, we decided to separate that part of the standard into a separate document. Hence most of the standard became EN 12845-1, to be used for the design of all systems, while EN 12845-2 is a complementary standard only needed for the design of ESFR and CMSA systems.

We also realised that the pump section of the standard needed dedicated attention so we created a new pump set standard, EN 17451, drafted by a focussed task group and moved much of the existing text about pump sets from the 2019 edition of EN 12845 into EN 17451.

Risk assessment and hazard classification

EN 12845-1 changes the sequence of chapters to follow the sequence in which they would be used for a project. CEN requires that every standard begins with the scope, standards references and definitions. Next comes risk assessment and classification of the hazard. This is the first step in any design. The process of risk assessment set out in EN 12845-1 is based on NFPA 13 and FM data sheets and results in a hazard classification that links to design criteria against which sprinklers and sprinkler system designs were tested before they were introduced in NFPA 13 and FM data sheets. This will greatly facilitate updates to EN 12845-1 and EN 12845-2 because a common approach is being taken on both sides of the Atlantic.

The risk assessment process in EN 12845-1 leads to five options, Fire Hazard 1-5, for non-storage applications, reduced from nine options in the 2015 edition. It also offers distinctions in hazard classification for different areas or where the fire load varies. This is clarified in tables for common

[3] BS 5306-2: 1990 Fire extinguishing installations and equipment on premises. Specification for sprinkler systems

activities where hazard classifications are advised for different processes or conditions that can be expected on the site. As the ceiling becomes higher, a larger fire is needed to operate the sprinklers and therefore more water is needed to deal with that larger fire. This is clarified in EN 12845-1, with design density and area of operation linked to the ceiling height.

Five hazard classes are available for storage applications, instead of the four in the 2019 edition which did not adequately address the plastic content of stored goods. The new classes distinguish between cartoned and non-cartoned goods, the plastic content and whether plastics are expanded or not. An extensive review of the list of stored goods offers a classification for many goods, with a flow chart available for goods that are not listed.

Many common storage configurations are addressed, for different types of racks and shelving, with tables specifying the maximum storage height, design density and area of operation. By using the same protection criteria for solid pile and rack storage EN 12845-1 has simplified the approach in NFPA and FM, with fewer tables.

Installation criteria

Obstruction rules in EN 12845-1 follow those in NFPA 13, which are based on fire testing. The standard includes guidance on designs for areas prone to freezing. Zoning is carefully addressed, as is the protection of concealed spaces and where to install in-rack sprinklers. Some jurisdictions require smoke vents in many applications and there is a concern that these could delay operation of the sprinklers or draw hot gases over sprinklers not above the fire, so that the wrong sprinklers operate. EN 12845-1 addresses this issue and contains clear guidance for sprinkler system design and limits on smoke control systems to avoid negative interactions.

Pipe

There are many different European standards for steel pipe and within them different wall thicknesses are possible. We know that sprinkler pipe can corrode, so EN 12845-1 specifies minimum wall thicknesses that include an allowance for corrosion (strength reduction as well as flow restriction), for the different applicable pipe standards.

Steel is not the only material used for sprinkler pipe, and welding, threading or grooved couplings are not the only methods to make connections. EN 12845-1 includes guidance for CPVC and copper, and for press-fit connections. CPVC – chlorinated poly vinyl chloride – has fire resistant characteristics in wet pipe installations.

Water supplies

EN 12845-1 offers guidance for the selection of water supplies, related to the hazard class and number of sprinklers. This was not in the 2015 edition. Some countries had national guidance published on behalf of insurers but many did not, so this guidance is intended to fill that gap. There is also a specification for hydrant and hose-reel demand where connected to the same water supply. This is common practice in some countries but not in others.

We were keen to make sprinkler systems more economic where possible. EN 12845-1 bases the water demand on the flow at the most unfavourable area of operation (Q_{100}) rather than at the most favourable area of operation (Q_{max}), which means the tank can be smaller. It also permits a higher velocity in the pump suction pipe, meaning its diameter can be smaller.

Inspections

EN 12845-1 has much more detail than previous editions on what should be inspected and when. A table summarises this, with reference clauses to the details in the text. During drafting meetings it

became clear that the periodicity of inspections varied considerably between countries, with some countries that show the highest sprinkler system reliability conducting inspections less often than others. We decided to adopt the majority view and go for those lower frequencies, leaving local regulators or insurers to call for greater frequency if they wish. One example is the frequency of inspection for dry sprinklers, which was set to five years following major issues in the past with dry sprinklers failing to open. Manufacturers have since changed their designs, removing o-ring seals, so that these sprinklers are no longer so likely to fail to open. As in other standards, we increased the period between inspections of dry sprinklers.

Foam sprinkler systems

EN 12845 has never included guidance for the design, installation, inspection and maintenance of foam sprinkler systems, nor does EN 13565-2, the CEN foam system standard. In the EN 12845-1 draft we included some guidance for the inspection and maintenance of foam systems but this has been removed since it is based on AFFF, which is being banned and phased out. At present there is no European guidance for the design of foam-sprinkler systems Working Group 2 (Fixed foam systems) of CEN Technical Committee 191 is drafting a review of EN 13565-2, the design, installation and maintenance standard for foam systems. At the time of writing the draft includes guidance on application density for foam sprinkler systems. It has been proposed that in the future there be a dedicated part of EN 12845 for foam sprinkler systems to address other design criteria.

EN 12845-2 – Design and installation of CMSA and ESFR sprinkler systems

As stated above, we recognised that new sprinklers and design concepts for storage application using control mode special application (CMSA) and early suppression fast response (ESFR) sprinklers are introduced more frequently than for most other sprinklers. We therefore decided to create a separate standard so that changes could be introduced without opening the entire sprinkler design standard to comment – so allowing for more rapid delivery and less overall disruption. EN 12845-2 is based on the design and installation guidance in NFPA 13 and FM data sheet 8-9.

When using EN 12845-2 the design process begins with the hazard classification in EN 12845-1, which was reproduced in EN 12845-2 because it was published first. CMSA and ESFR sprinklers are large orifice sprinklers usually installed at the ceiling to avoid the need for in-rack sprinklers. It is therefore even more critical than for other sprinklers that their sprays are unhindered, so water can get from the ceiling onto the stored goods and prevent fire spread. EN 12845-2 improves and simplifies the obstruction rules found in other documents for these sprinklers, based on recent research from NFPA's Property Insurance Research Group. Wherever possible the same obstruction guidance is applied for both CMSA and ESFR sprinklers. The ceiling to sprinkler measurement is based on the thermal element rather than the deflector, since this reflects actual response to heat spread and the distance from the deflector to the thermal element can differ between manufacturers. Where designs with fewer than 12 sprinklers have been included, they come with additional design and obstruction guidance, based on that in FM data sheets.

Note that by adopting the criteria of UUP (unexposed unexpanded plastic) and CUP (cartoned unexpanded plastic) to lead to HHS3, HHS 4 and HSS5 classifications, all the future solutions of NFPA and FM can be adopted, since the research results would match the hazard classification criteria in the European standard. In addition the obstruction rules for ESFR designs are the same as for NFPA and FM, so that it is easier to achieve compliance with all three standards with fewer mistakes.

EN 12845-3 Earthquake protection of sprinkler systems

Parts of Europe are at high risk of earthquakes. We know from experience that major earthquakes often lead to fires as tanks, gas pipes and electrical connections are broken. It is then even more

important that installed sprinkler systems can move with the building and continue to be functional. Yet EN 12845 did not include any design guidance for earthquake bracing. This gap has been filled by EN 12845-3, a complementary standard to parts 1 and 2 of EN 12845. Originally this was a Technical Specification, TS 17551, published in 2021. It contained some errors, so needed a revision, and it was decided to upgrade it to a full CEN standard.

While EN 12845-3 has been written for earthquake protection of sprinkler systems it can also be used for other water-based fire protection systems.

EN 12845-3 references EN 1998-1[4], where a peak ground acceleration above 0.08g is considered an earthquake risk. Some countries have national annexes to clarify where earthquake protection is needed for sprinkler systems.

Seismic design loads are to be calculated using EN 1998-1 and peak ground accelerations reference the European Seismic Hazard Map[5]. The standard then gives guidance for the bracing of sprinkler piping to minimise differential movement with the building yet provide flexibility where differential movement is expected. It also provides guidance for clearance to prevent impact damage.

EN 16925 Design, installation and maintenance of residential sprinkler systems

With this standard Europe has a reference for residential and domestic sprinkler systems. The guidance is based on NFPA 13R and 13D, with input from BS 9251 in the UK and INSTA 900-1 in the Nordic countries, both of which were also based on the NFPA standards. There was also a lot of practical input, particularly around water supplies, from the UK and Nordic countries which already had significant residential sprinkler markets.

In some European countries regulators had already imposed minimum design criteria on national residential sprinkler design standards, so it was not possible to agree on one set of criteria across Europe. For this reason there are two tables that offer flexibility. Table 1 opens the possibility for countries to apply the standard in residential buildings higher than 18 m, which is the height limit in NFPA 13R. Table 2 has a range of design densities and number of design sprinklers, with each country able to select within the ranges in a national annex. Several countries have written national annexes to clarify these points, while others have done so directly in the text during translation. Clearly the higher the minimum application density and the greater the number of design sprinklers, the more robust the system will be. Against that, it will become harder to supply the system from the water main. Regulators and national sprinkler experts are aware that fitting a pump(s) and tank can significantly increase the cost of the system, in particular in domestic and small residential buildings, so have taken account of what flow and pressure is typically available in their country when drafting these national annexes. None asks for less than required by NFPA 13D and NFPA 13R, with the documented statistical success of systems designed to these being central to the case for requiring residential and domestic sprinkler systems in Europe.

Another area where there are great differences between national jurisdictions is in the transmission of alarms, with some countries requiring they go to a fire station and others to an alarm receiving centre. The text accommodates both. With this document Europe has a reference to support the EFSN's campaigns for residential sprinkler systems to be required in high-rise residential buildings and care homes.

[4] EN 1998-1: Eurocode 8: Design of structures for earthquake resistance

[5] European Seismic Hazard Map, European Commission, Directorate General for Research and Innovation

TS 14816 Design, installation and maintenance of water spray systems

Technical Specification 14816 covers the design, installation and maintenance of water spray systems. It was published in 2008 and after two years a decision should have been taken on whether to convert it to a European standard. CEN has since allowed Technical Specifications to be confirmed for three-year periods but that was last done for this TS in 2011. Consequently, it would appear to be invalid. Nevertheless, it contains design guidance that may still be useful.

While the scope is claimed to be limited to the sprinklers in EN 12259-1, the document includes designs with medium velocity nozzles or high velocity nozzles. It has guidance for deluge sprinkler object protection in the timber industry, conveyor belts, cable trays inside buildings, oil-filled transformers, power stations, incineration plants and solid piled combustibles. It also has design guidance using medium velocity sprayers to protect flammable liquids with a flashpoint below 66°C and using high velocity sprayers to protect flammable liquids with a flashpoint of 66°C and above. Finally, there is an extensive annex on exposure protection, of pressure vessels, flammable liquid storage tanks, structures, pipe racks, cable trays, transformers and vertical surfaces of buildings.

This document has been largely forgotten and there are currently no plans to update it.

EN 17451 Pump Sets

The 2015 edition of EN 12845 contains some guidance for the design of pump sets but it is silent on many technical points. Recognising the need for more complete guidance, and for expert input, a separate Task Group was established to draft a pump set standard, EN 17451. As it is an assembly standard rather than a component standard it is not part of the EN 12259 series, although it does refer to EN 12259-12, the standard for sprinkler pumps (without the driver and controller). During drafting it became clear that practices differ between countries. It was decided that all solutions approved by recognised laboratories and long established on the market should be included. Thus the standard allows variable speed drives and circuit-breakers as an option to fuses, although in some countries neither are accepted as a viable option.

Amendment 2 to EN 12845:2015

Now that EN 12845-2, EN 12845-3 and EN 17451 are published, there is a need to invoke them in sprinkler contracts. Eventually this will be done from the umbrella standard, EN 12845-1, but that standard is still some years from publication since it will require a second enquiry which is also likely to produce many comments. Until then the plan is to publish a second amendment to the 2015 edition of EN 12845 that will insert the appropriate references and remove the material that is covered in the new standards. This is largely an editorial amendment and the intention is that it should be published as soon as possible.

Sprinkler component standards – EN 12259 series

Component standards support the design standards that set out how to design, install and maintain sprinkler systems so that they will control or extinguish reasonable worst case fire scenarios. It is the component standards that set out the fire control performance that sprinklers must achieve. They also define other performance characteristics that are key to the ability of sprinklers and other components to deliver that performance over their lifetime, such as strength, corrosion resistance and resistance to water hammer, vibration and shock. In Europe key sprinkler components carry recognised approvals, such as from FM, LPCB, UL and VdS and products that meet them have been proven to be reliable over decades in installed systems. While insurers will insist that sprinkler

components carry one or more of these approvals, regulators in many countries are not permitted to require that products carry private approvals. The test protocols from these organisations have therefore been used to draft European component standards. These are referenced in the EN 12845 series of sprinkler system design and installation standards, which in turn are referenced by regulators. The International Fire Suppression Alliance has published a video[6] in many languages to explain the benefits of approvals and risks from unapproved products.

Parts 1 to 5 of EN 12259 are harmonised standards, meaning that the European Commission had them cited in the Official Journal of the European Union. They are part of European law and products offered for sale in the EU that fall within the scope of harmonised standards must be CE-marked. For these five standards, that means that the sprinklers within the scope of EN 12259-1, wet alarm valves assemblies, dry alarm valve assemblies, water motor alarms and flow switches must be assessed by an accredited laboratory, pass all the tests and comply with other criteria in these standards. It is illegal to offer to sell these products within the EU without a CE-mark.

The legal basis for the CE-mark requirement was the Construction Products Directive, CPD, superseded by the Construction Products Regulation, CPR[7]. Several countries that border the EU but are not members also apply the CPR or, in the case of the UK, similar legislation. Under the CPD it was possible to draft standards that set out what performance a product must achieve. However, construction regulations are the responsibility of the Member States (national governments) of the EU so under the CPR the ability of technical experts to define performance in harmonised standards was withdrawn. Test methods can be included but there is no requirement to assess a product to all the tests in a standard, nor can a standard define pass criteria or other aspects of a construction product. This has been difficult for technical experts to accept but as a result more recent component standards in the EN 12259 series have not been harmonised. This has allowed technical experts to define the performance of a good product, although it also means it cannot be CE-marked under the standard.

EN 12259-1 Sprinklers

Published as a harmonised standard in 1999 and with a third amendment in 2006, EN 12259-1 is a specification standard for a basic range of sprinklers. It includes water spray distribution and physical property tests for sprinklers with a nominal orifice of 10, 15 and 20 mm and corresponding k-factors of 57, 80 and 115. Conventional, pendent and upright spray, flat spray and dry sprinklers are within the scope, as are sidewall and concealed sprinklers. This basic range of sprinklers was adequate for sprinkler system design concepts that were used until the 1970s but it omits larger orifice sprinklers, other storage sprinklers and residential sprinklers that began to be introduced in the 1980s. Additional standards were drafted for those sprinklers (EN 12259 Parts 13, 14 and 15).

EN 12259-2 Wet alarm valve assemblies

EN 12259-2 *Fixed firefighting systems – Components for sprinkler and water spray systems – Part 2: Wet alarm valve assemblies* was published as a harmonised standard in 1999, with a second amendment in 2005. Among other changes, the second amendment clarified what metallic materials should be used, or if other materials were to be used, their performance under fire conditions. This standard is consistent with ISO 6182-2.

[6] https://www.ifsaglobal.org/resources/certification-programs/

[7] Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

EN 12259-3 Dry alarm valve assemblies

EN 12259-3 *Fixed firefighting systems – Components for sprinkler and water spray systems – Part 3: Dry alarm valve assemblies* was published as a harmonised standard in 1999, with a second amendment in 2005. Among other changes, the second amendment clarified what metallic materials should be used, or if other materials were to be used, their performance under fire conditions. This standard is consistent with ISO 6182-2.

EN 12259-4 Water motor alarms

EN 12259-4 *Fixed firefighting systems – Components for sprinkler and water spray systems – Part 4: Water motor alarms* was published as a harmonised standard in 2000, with an amendment in 2001.

EN 12259-5 Water flow detectors

EN 12259-5 *Fixed Firefighting systems. Components for sprinkler and water spray systems – Part 5: Water flow detectors* was published as a harmonised standard in 2002.

EN 12259-9 Deluge alarm valves

EN 12259-9 *Fixed Firefighting systems. Components for sprinkler and water spray systems – Part 9: Deluge alarm valves* was published in 2019. A first draft was produced some 15 years earlier but work on other standards took priority. This is a non-harmonised standard, so cannot be used for CE-marking. Its scope is limited to clapper and diaphragm type valves; it is not applicable to elastomeric sleeve type valves, which are now more commonly used in deluge systems. A draft is referenced in TS 14816 but at the time of writing there are no plans to update that document, nor EN 12259-9.

EN 12259-12 Pumps

EN 12259-12 *Fixed firefighting systems. Components for sprinkler and water spray systems – Pumps* was published in 2023. It is a standard for the sprinkler pump without the driver and controller. Due to technical disagreements between sprinkler pump experts from different countries, as well as drafts for a proposed harmonised standard not being compliant with the CPR, it took a very long time for this standard to be published. To resolve the compliance challenge it was decided to produce a non-harmonised standard. Although this meant the standard could not be used for CE-marking, it also meant that it need not comply with the CPR and it was then possible to specify performance criteria. Involving a wider group of sprinkler experts enabled technical consensus to be reached.

EN 12259-13 ESFR sprinklers

Although the 2015 edition of EN 12845 contained design guidance for ESFR sprinkler systems there was no European standard to define the performance an ESFR sprinkler must demonstrate. That gap has been filled with the publication of EN 12259-13, which is based on the fire test protocol from FM Approvals plus the physical property tests in EN 12259-1. It covers ESFR sprinklers with k-factors up to 480, while EN 12845-2 contains system design guidance using these sprinklers. EN 12259-13 is not a harmonised standard, so it cannot be used for CE-marking. However, manufacturers can apply to one of the laboratories notified to EOTA[8] for a European Technical Assessment[9] for CE-marking against EAD 100002-00-2016[10], which contains the same tests as in EN 12259-13.

[8] European Organisation for Technical Assessment https://www.eota.eu/

[9] European Technical Assessments offer manufacturers a voluntary route to CE-marking when the product is not covered by a harmonised standard under the Construction Products Regulation (EU) No 305/2011

[10] European Assessment Document 100002-00-2016, Early Suppression, Fast Response (ESFR), K202 to 480, Upright and Pendent Automatic Fire Sprinkler, EOTA, Brussels, March 2016.

EN 12259-14 Residential sprinklers

This standard for residential sprinklers has adopted, with permission, the fire tests in UL 1626 the Standard for Residential Sprinklers for Fire-Protection Service[11], now merged into UL 199[12], along with the physical tests in EN 12259-1. It was published by CEN in 2019 with amendments to reduce the scope so as not to include o-ring seals in 2021 and to correct an important typo in 2023. It is not a harmonised standard, so cannot be used for CE-marking. Residential sprinklers that comply with EN 12259-14 spray water higher up the wall than the sprinklers in parts 1, 13 and 15 of EN 12259. This is needed to wet curtains, bookshelves and other combustible materials on walls. They must also pass the fire tests, which represent the reasonable worst case scenario of a shielded fire with combustible wall materials. To be successful, residential sprinklers must prevent fire spread to the ceiling, limit temperatures at the ceiling and at head height, and cool gases leaving the room so that they do not activate a third sprinkler at the exit. Residential sprinkler spacings and the density used in the fire tests form the design guidance for their use in the manufacturer's data sheet.

EN 12259-15 Large k-factor, EC and CMSA sprinklers

EN 12845-1 and EN 12845-2 include sprinkler design concepts that use sprinklers for which there was no European standard. EN 12259-15 fills that gap. It is a standard for '*Spray pattern sprinklers with a k-factor of at least K160, extended coverage sprinklers of at least K80 and control mode special application sprinklers*'. The first draft was based on the test protocol from FM Approvals, again with the physical property tests from EN 12259-1. This is not a harmonised standard so cannot be used for CE-marking. EN 12259-15 is expected to be published in 2025.

EN 12259-16 Internal polymer corrosion-protected pipe

EN 12845-1 introduces the use of pipe systems with an internal polymer corrosion protection coating, allowing designers to use a c-factor of 140 for hydraulic calculations, avoiding age-related losses for corrosion. Not all coatings are equally effective so EN 12259-16 will clarify what performance they must achieve. At the time of writing, EN 12259-16 is in the preliminary phase of its drafting. The intention is to base the first draft on test protocols from FM Approvals and VdS. The standard will not be harmonised.

Water mist system design standard – EN 14972-1

EN 14972-1 is the European standard for the design, installation, inspection and maintenance of water mist systems. It was published by CEN at the end of 2020 and by national standards bodies in 2021. The standard replaced CEN/TS 14972: 2011. The scope states, '*The document covers only applications and occupancies which are covered by the fire test protocols of the EN 14972 series.*' In 2021, when EN 14972-1 was published, few of the sixteen fire test protocols had also been published. Meanwhile most have been published and the remainder are expected to be published by the end of 2025. Limits of applicability for the fire test protocol standards were not included in EN 14972-1, perhaps because these standards were not available. Instead, the scopes of the few protocols that were available gave guidance about the limits of their applicability. Now that most of the protocols have been published

[11] UL 1626, the Standard for Residential Sprinklers for Fire-Protection Service, Underwriters Laboratories Inc., Northbrook Illinois, USA

[12] UL 199, the Standard for Automatic Sprinklers for Fire-Protection Service, Underwriters Laboratories Inc., Northbrook Illinois, USA

and draft are available for the remainder, an amendment to EN 14972-1 has been drafted to include in it details of the limits of applicability for each fire test protocol.

Each water mist manufacturer has a bespoke design for each of the fire test protocols. This is very different to sprinkler systems, where EN 12845 sets out all the design criteria, including application density, sprinkler spacing, area of operation, water supply duration, how to deal with obstructions and how to perform hydraulic calculations. Commercial hydraulic calculation packages are available to perform these calculations and could also be used for low pressure systems. EN 14972-1 requires the same area of operation and water supply duration as sprinklers in EN 12845 but application density, nozzle spacing and how to deal with obstructions are specific to each manufacturer. High pressure systems will also require a dedicated hydraulic calculation software package. These and other important design guidance are to be in the manufacturer's design, installation operation and maintenance (DIOM) manual. EN 14972-1 sets out in detail what is to be included in the DIOM manual and clarifies that a DIOM manual is required for each application.

EN 14972-1 has guidance to determine storage categories as a function of the plastic content, using the same approach as in EN 12845: 2015. The water duration for fire control/suppression is the same as for sprinkler systems, except for water mist extinguishing systems, where it is twice the extinguishing time in the fire test for wet benches (EN 14972-13) with a minimum of two minutes and for all other extinguishing system applications the greater of twice the test extinguishing time or 10 minutes. The amendment to EN 14972-1 increases the duration for apartment buildings up to 18 m high to 30 minutes, and for greater heights requires 60 minutes, in line with EN 16925 and EN 12845.

While the DIOM manual specifies the spacing of pipe supports, EN 14972-1 sets maximum values. High pressure and some low pressure water mist systems do not have the alarm valves of sprinkler systems. Consequently, flow switches are used to indicate an alarm. In some European countries this is also the approach taken for sprinkler systems, while in others the alarm valve is also used to operate a pressure switch and/or a gong.

Water mist system fire test protocols – EN 14972 series

As all manufacturers create and apply water mist differently, their systems also demonstrate different performance on fires. It has therefore not been possible to write a standard that specifies all the design criteria. Instead, these must be determined based on the results of standardised fire testing. Fire test protocols define the performance that a system must achieve to be applied under EN 14972-1 to protect different occupancies or hazards. All manufacturers face the same fire challenges but meet them differently. The current 16 standards in the EN 14972 series, parts 2 to 17, cover a wide range of applications, although more are likely to be drafted in the future. Most are based on protocols from insurers or organisations with insurance links.

EN 14972-2 Shopping areas for automatic nozzle systems

EN 14972-2 is still in the drafting phase so what follows may change.

The scope of EN 14972-2 states, '*This document specifies the evaluation of the fire performance of water mist systems for shopping areas, adjacent storage areas, and similar areas. This document is only applicable for horizontal, solid, flat ceilings with heights of 2,6 m and above.*

This document does not cover storage with movable racks or shelves.'

The fuel package is based on the cartoned unexpanded plastic fuel package used in testing for NFPA standards and FM data sheets. The rack storage configurations are ST5 (solid or slatted shelves 1 m or less wide) and ST6 (solid or slatted shelves over 1 m and no more than 6 m wide) from EN 12845:2015, while the block storage configuration is ST1 from that standard. Ignition sources for ST5 and ST6 include the transverse and longitudinal flues, face of the rack and within the rack, while for ST1 it is in the flue.

As for many parts of EN 14972, this test protocol compares the fire test performance of water mist to sprinklers. The sprinklers are to deliver 5,75 mm/min with each sprinkler covering 12 m^2 on a square grid at 3,5 m spacing. The pressure during the test is controlled so as not to exceed this density. In a real system the first sprinkler to operate will receive the full force of the pump and will apply a higher density. Some experts have therefore queried whether the sprinklers perform less well in the reference test than in a real system. The water mist system must match or better the sprinkler system in terms of damage to the goods, average ceiling gas temperatures and area of nozzles activated.

Limits of applicability

EN 14972-1 clarifies that, '*Systems tested according to EN 14972-2 are limited to the maximum ceiling height tested with a minimum ceiling height of 2,6 m.*

The minimum distance between the storage height and the ceiling shall be 0,5 m.

If the glass bulb temperature used in the fire test is less than 68 °C, the fire test protocol is only applicable to that glass bulb temperature.'

For ST1 EN 14972-1 requires aisles of at least 2,4 m width to divide storage into blocks of no more than 150 m^2. For ST5 there must be aisles at least 1,2 m wide between rows and for ST6 the storage layout must be specifically tested. EN 14972-1 also limits the height of storage depending on the fuel load and plastics content.

EN 14972-3 Office, school classrooms and hotel for automatic nozzle systems

The scope of EN 14972-3 states, '*This document is applicable for horizontal, solid, flat ceilings with heights of 2 m and above, up to the maximum tested ceiling height.*'

The protocol includes two scenarios. The first is representative of an office with a desk, chair, cabinet and files, while the second has a collection of sofas to represent a hotel. The scenarios are based on VdS 3883-1, although the sofa scenario originated in an International Maritime Organisation (IMO) test protocol. EN 14972-3 also compares the performance of the water mist system to that of sprinklers, again at a density of 5,75 mm/min with a coverage of 12 m^2 per sprinkler on 3,5 m square spacing. The pressure during the test is controlled so as not to exceed this density. In a real system the first sprinkler to operate will receive the full force of the pump and will apply a higher density. Some experts have therefore queried whether the sprinklers perform less well in the reference test than they do in systems installed in real buildings.

Limits of applicability

EN 14972-1 states that, '*If the glass bulb temperature used in the fire test is less than 68 °C, the fire test protocol is only applicable to that glass bulb temperature.*' EN 14972-1 limits the applicability of EN 14972-3 to areas such as apartments, hotel bedrooms, offices, restaurants, kitchens and museums. In technical plant rooms of low fire load, i.e. comparable to the office test scenario, it requires a minimum design area of 144 m^2.

EN 14972-4 Non-storage occupancies for automatic nozzle systems

The scope of EN 14972-4 states, '*This document specifies the evaluation of the fire performance of water mist systems for lightly loaded non-storage and non-manufacturing occupancies with ordinary combustibles, such as offices, schools, hospitals and hotels.*

This document is applicable to ceiling mounted automatic nozzles to be used in restricted and/or unlimited areas.

This document is applicable for horizontal, solid, flat ceilings with heights of 2 m and above, up to the maximum tested ceiling height.'

The protocol includes three enclosures: an open space of at least 80 m^2 where the oxygen concentration is maintained above 20%, a small enclosure of 3 m x 4 m x 2,4 m height containing bunk beds and having an open doorway to a corridor; and a large enclosure containing the residential fuel package and room layout from EN 12259-14 (i.e. from UL 199). The small room enclosure is based on the IMO cabin scenario while the entire test protocol is based on FM 5560 Hazard Class 1.

To pass the bunk bed test, which first appeared as the IMO cabin test, damage to the cushions on the lower bunk bed, which is partially shielded from the nozzles, shall not exceed 40% by volume or dry weight, the maximum ceiling temperature shall not exceed 260 °C and the maximum gas temperature 75 mm below the ceiling shall not exceed 315 °C. These temperature criteria are also in EN 12259-14.

The large compartment also applies these temperature criteria and the EN 12259-14 requirement that a nozzle by the doorway shall not activate.

For the open space test, no more than five nozzles shall activate and at least one nozzle more remote from the fire than each activated nozzle shall not activate; damage to the sofas shall not exceed 50% and the above ceiling temperature limits shall be met.

Limits of applicability

EN 14972-1 limits the applicability of EN 14972-4 to enclosures of up 2,4 m height and to open areas up to 5 m in height. Systems which pass EN 14972-4 can be used to protect apartments, hotel bedrooms, offices, meeting rooms, museums, hospitals and churches. These are many of the same applications as for EN 14972-3, the reason for the duplication or overlap being that EN 14972-3 is based on a VdS fire test protocol while EN 14972-4 is based on an FM fire test protocol. Both are accepted in the market and manufacturers have invested to gain approvals to them. The fire loads are not identical so it may be useful to specify a fire load limit for systems installed based on each protocol.

EN 14972-5 Car garages for automatic nozzle systems

The scope of EN 14972-5 states that it, '*is applicable for horizontal, solid, flat ceilings with heights of 2 m and above.*'

EN 14972-5 is based on VdS 3883-4 and again compares the performance of water mist to that of sprinklers. Three real cars are used in each test, however all operating fluids (e.g. fuel and brake fluid) are discharged (removed) and justification is provided for deflating the tires prior to the test. Two ignition scenarios are assessed, under one sprinkler or nozzle, and between four. The sprinkler system is designed to OH2 with a 15% margin, i.e. 5,75 mm/min with each sprinkler covering 12 m^2 on a square spacing of 3,5 m. The pressure during the test is controlled so as not to exceed this density. This is compared to the sprinkler test results; in a real system the first sprinkler to operate will receive the full force of the pump and will apply a higher density, so some experts have queried whether the sprinklers perform less well in the reference test than they would in real system installed in a car park.

To pass, the water mist system must allow no more damage to the cars than the sprinkler system, prevent fire spread to the target cars, limit the average ceiling gas temperature to 350 °C (to prevent concrete spalling and weakening of structural steel) and not exceed the area of sprinklers activated.

Limits of applicability

EN 14972-1 limits the applicability of EN 14972-5 to the maximum height tested and '*to parking garages that are enclosed on all sides and underground garages. It does not apply to automatic garages or to stackable garages.*'

EN 14972-6 False floors and false ceilings for automatic nozzle systems

This standard is based on a VdS test protocol. Two layers of cable trays are placed in a long, narrow enclosure and ignited by a fire in a pan of heptane. The test is first conducted with sprinklers designed to OH1 but at a density of 5,75 mm/min and 12 m^2 area coverage per sprinkler. Water mist must control ceiling temperatures as well as the sprinkler system and lead to the same or less damage.

Limits of applicability

EN 14972-1 states that, '*Systems tested according to EN 14972-6 are limited to 0,3 m up to 0,8 m height of the concealed space.* Above this height the space would be considered a room and would require a bespoke solution.

If the glass bulb temperature used in the fire test is less than 68 °C, the fire test protocol is only applicable to that glass bulb temperature.'

EN 14972-7 Commercial low hazard occupancies for automatic nozzle systems

The scope of EN 14972-7 is for *'commercial low hazard occupancies up to 5m ceiling height'*. This is very similar list to the scope for EN 14972-3 and EN 14972-4. In this case the fire test standard is based on a British Standard test protocol. As for EN 14972-4 one of the fire test scenarios is bunk beds in a small room leading onto a corridor, while another is the residential corner fire scenario in that standard, as well as in EN 12259-14 and UL 199. There is also an open space scenario with fuel packages comprising sofas or to represent an office. Instead of a comparison with sprinklers, this standard sets pass criteria for the maximum amount of damage as well as maximum temperatures at the ceiling and 76 mm below it. The same criteria are applied as in EN 14972-4 to the same tests. EN 14972-7 has an office scenario different to that in EN 14972-3. It includes plywood walls and one of the pass criteria is that damage to these plywood walls does not extend to their full height. In addition, files stored above the table may not be totally destroyed and the ceiling temperature may not exceed 160 °C for more than three minutes for a 3 m high ceiling and 80 °C for a 5 m high ceiling.

Limits of applicability

EN 14972-1 limits the height to 5 m. It also restricts the fuel load, area of the hazard and its height depending on which combinations of fuel package and room were tested.

EN 14972-8 & 9 Machinery in enclosures exceeding and respectively up to 260 m^3 for open nozzle systems

These test protocols are based on IMO test protocols that were also developed into FM 5560. Part 8, for machinery spaces exceeding 260 m^3, comprises a series of diesel spray and/or pool fires, a heptane flowing fire and a wood crib and heptane pool fire. To pass, all the fires must be extinguished. Part 9, for machinery spaces up to 260 m^3, contains a series of diesel and heptane spray and pool fires, all of which must also be extinguished.

Limits of applicability

EN 14972-1 limits systems that pass these test protocols to machines such as generators, pump units, compressors and test rigs that contain combustible liquids with a flash point above 55 °C, if the tests were conducted with diesel, or up to two 208 litre barrels of combustible liquids with a flash point above -4 °C if tested with n-heptane.

EN 14972-10 Atrium protection with sidewall nozzles for open nozzle systems

This test standard is not based on an established test protocol. Its scope is limited to low and medium fire loads, defined as less than 150 MJ/m^2 and 150-500 MJ/m^2 respectively.

For the test protocol wall-mounted nozzles apply water to three sofas in a line, either against a wall of the enclosure or against a panel at half or the full nozzle coverage distance. The atrium area shall be at least 12 m x 12 m. To pass, the protocol limits the amount of damage to the end sofas.

Limits of applicability

EN 14972-1 limits '*nozzle installation heights between the minimum and maximum nozzle installation heights tested.*' It also limits applicability, '*to systems released automatically by an electronic fire detection system.*

This test protocol covers spaces with low or medium fire load, such as hotel lobbies, reception and recreation areas, where the fire load and the obstructions do not extend over 1,5 m in height.

This procedure is applicable to atriums without building elements projecting from the wall plane, e.g. cornices or beams having an impact on the spray pattern of the nozzles.

The test method covers water mist systems using open nozzles, which are spraying from atrium walls into the atrium volume.'

EN 14972-11 Cable tunnels for open nozzle systems

This standard is based on VdS 3883-8. Eight layers of cables of different diameters are laid on trays in a tunnel at least 18 m long and 2,35 m wide. Ignition is with a propane burner with longitudinal ventilation of at least 1 m/s. For automatic systems the pre-burn time is five minutes. To pass, the water mist system must bring the temperatures in the enclosure below 100 °C within five minutes following expiry of the pre-burn period, at least 500 mm of all the cables at each end must be undamaged and no reignition must occur after turning off the water mist system.

Limits of applicability

EN 14972-1 limits installed systems to the maximum ceiling height and cross-section tested, and the dimensions of the trays and depth of cables to those in EN 14972-11. It also excludes vertical or sloped cable tunnels or shafts, as well as obstructions. If the fire compartment area is larger than 100 m^2, '*the system shall be designed for at least 100 m^2 or for 3 adjacent sections with the largest water demand, whichever is greater. The maximum section length shall be limited to 60 m.*'

EN 14972-12 Commercial deep fat cooking fryers for manually operated open nozzle systems

The scope of EN 14972-12 states, '*This document includes protection of the cooking area, filters, exhaust hood, and duct against fires originating from the fryer.*' The standard is strictly limited to manually operated systems. It does not cover automatic systems, which are covered in EN 17446.

It is based on ISO 15371:2015 with modifications to make it more suitable for water mist systems.

If the duct length is greater than 22,9 m, the system may be installed without a limit on the duct length. The standard specifies the duct, its slope, the hood mock-up and the blower performance. Fire is initiated by heating the vegetable shortening above its auto-ignition temperature. To pass, after a pre-burn time of two minutes the water mist system is activated and must extinguish the fire within one minute while not causing grease droplets larger than 5 mm diameter to splash.

Limits of applicability

EN 14972-1 states that, '*Forced ventilation and exhaust ducts are not addressed in the test protocol. There shall be no obstructions in front of the spray heads.*'

It also states, '*The entire surface of the fryer shall be protected.*'

EN 14972-13 Wet benches and other similar processing equipment for open nozzle systems

As this is one of the newest fire test standards in the CEN format its scope only states that it applies to the title application, since EN 14972-1 addresses the limits of applicability for all fire test standards. EN 14972-13 is based on the test protocol in FM 5560.

EN 14972-13 sets the dimensions of the wet bench enclosure and of the wet bench within it. The mock-up has openings and blowers for an air flow of at least 840 m^3/h per linear metre of wet bench. For each water mist manufacturer a worst case location for a fire is found using pans with fires of polypropylene beads, ignited with a glow plug. The tests are then repeated with various liquid fuels. Separate tests are run for the plenum, wet bench and unventilated spaces. In all tests the fire must be extinguished.

Limits of applicability

EN 14972-1 clarifies that the test protocol is applicable for open-face wet benches and mini-environment enclosures. It also states that, '*The installation in open face wet benches typically covers the plenum, working surface and electrical compartment(s). The installation in larger automatic benches additionally covers the robot areas, shuttles, and loading/unloading areas.*'

EN 14972-14 & 15 Combustion turbines in enclosures exceeding and up to 260 m^3

EN 14972-14 and 15 are based on IMO test protocols that were developed and included in FM 5560. Part 14, for enclosures over 260 m^3, comprises a series of diesel spray and pool fires, a heptane flowing fire and a wood crib and heptane pool fire. To pass, all the fires must be extinguished. An optional spray cooling test first directs burning heptane at a steel plate before turning it off and applying water mist to the other side. There are also optional saturated insulation mat fire tests, with and without a pool fire. Part 15, for turbine enclosures up to 260 m^3, contains the same shielded and unshielded diesel spray fires and the diesel pool fire, all of which must also be extinguished. It also contains the optional cooling test and the saturated mat fire tests.

Limits of applicability

EN 14972-1 states that systems which pass the test protocols in EN 14972-14 can also be used to protect '*steam turbines in enclosures and accessories like oil pumps, oil tanks, fuel filters, generators and hydraulic aggregates.*' It also states, '*There shall be no forced ventilation and any openings shall be closed upon system actuation; doorway screening spray heads may not be used in lieu of automatic closing devices.*

Only water mist systems that have passed the saturated mat test can be applied for thermally insulated turbine protection.'

EN 14972-1 further limits the applicability of systems tested to EN 14972-15 to enclosures of 5 m height and 260 m^3 volume.

EN 14972-16 Industrial oil cookers for open nozzle systems

EN 14972-16 is based on the test protocol in FM 5560. Three mock-ups are used, with the ratio of the width to the length of the pan being 1, 2 and 3. Oil inside the pans is heated to its auto-ignition temperature. To pass, the water mist system shall extinguish the fire within one minute with the cooker hood up or down, prevent serious damage to the cooker, bring the oil below its flashpoint temperature and not cause excessive flare-ups, micro-explosions of oil, splashing of oil or spillage.

Limits of applicability

EN 14972-1 states, '*Forced ventilation is not addressed in the test protocol and obstructions are not allowed.*' It therefore requires exhaust air fans to automatically shut down when the system operates.

If extending the length of cooker tested did not change the number of nozzles or application density per unit area, nor affect the extinguishment time by more than 30%, there is no maximum length to which the system can be applied.

The system can only be used to protect '*cooking oils with flash points and auto-ignition temperatures less than or equal to the one used during the fire tests*.'

EN 14972-17 Residential occupancies for automatic nozzle systems

EN 14972-17 in its scope limits the application of the standard to, '*fire protection of domestic and residential occupancies up to a maximum ceiling height of 5,5 m.*'

The fire test protocol is the same as for EN 12259-14.

Limits of applicability

EN 14972-1 also limits the application of these systems to a ceiling height of 5,5 m and to residential buildings up to 45 m in height. This reflects that in EN 12845-1 above this height the hazard classification changes to FH2 (OH3 in the old classification system), requiring a higher application density and much greater design area.

EN 14972-1 requires that various authorities be consulted, as they may impose additional requirements. These may be enhancements to water supplies, the monitoring of pump operation, the provision of duplicate power supplies, increased design density, increased area of operation or reduced nozzle spacings.

Water mist component standards – EN 17450 series

While the fire tests assess the performance of a water mist system when new, the performance of key components is critical to the ability of the system to deliver that performance over its lifetime. Low pressure water mist systems are very similar in their design to sprinkler systems, with k-factors close to those for residential sprinklers and working below 12 bar, the usual pressure limit for sprinkler components. They can use the same pumps and pipework, and possibly other sprinkler components. High pressure water mist systems cannot use any sprinkler system components and require different pumps, valves, pipework and switches. The EN 17450 series is intended to set the minimum

performance for the key water mist components to ensure system reliability. Two standards are available with more to come. As yet there are no plans for a standard for high pressure pumps.

EN 17450-1 Product characteristics and test methods for strainer and filter components

EN 17450-1 was published in 2021. It limits the scope of its application to filtration grades up to 6 mm. A strainer is defined as being designed '*to retain larger particles with dimensions larger than 1 mm*', while a filter is to retain particles smaller than 1 mm. The standard tests the product for strength, flow, pressure loss and impact resistance but not for corrosion. Filtration performance is assessed from the manufacturer's data sheet.

EN 17450-2 Product characteristics and test methods for nozzles

EN 17450-2 was published in 2024. It uses the same test protocol as IMO and VdS. As well as many of the physical property test methods in EN 12259-1, it requires nozzles to be fitted with a filter if their orifice diameter is below 2,5 mm. There are optional heat ageing and low temperature tests, which were required in the UK but not elsewhere. A mandatory functional test for nozzles with blow-off caps is included.

EN 17450-3 Requirements and test methods for check valves

This standard subjects the check valve to corrosion, strength and vibration tests, as well as 3 000 cycles of operation. There is no equivalent standard for sprinkler system check valves, although there are harmonised standards for sprinkler system alarm valve assemblies, which are check valves. The draft of EN 17450-3 passed the CEN enquiry in 2024 and the standard is expected to be published in 2025.

EN 17450-4 Requirements and test methods for control deluge valves and actuators

A first draft of this standard has yet to circulated to the CEN working group.

EN 17450-5 Requirements and test methods for pressure switches

A first draft has yet to circulated of this standard. There is also no sprinkler system standard for pressure switches.