OPTIMAL ECONOMICS

Analysis of Data on Sprinkler and Water Mist Systems

Final Report

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Contents

Executive Summary

Introduction

1. This report analyses the Ministry of Housing, Communities and Local Government (MHCLG) dataset covering primary fire incidents with a sprinkler or water-based fire suppression system in England between 2018/19 and 2023/24. The analysis considers the characteristics of these fires and whether the data support an analysis of the comparative performance of the two types of safety system.

2. The two measures of safety system performance relate to operational reliability (which measures the degree to which the systems operated as designed when required) and performance reliability (which measures the effectiveness of the systems when activated).

3. The key to understanding both these performance measures is disaggregation of the data by whether the system operated or not. If the system operated, the analysis of effectiveness is based on the impact of the system i.e. whether it extinguished or contained/controlled the fire. If the system did not operate, there is no impact on the fire, but the analysis of reliability must consider why the system did not operate as there could be reasons why the system could not be expected to operate e.g. insufficient heat.

4. Sprinkler and water mist systems are both forms of automatic fire suppression systems which aim to protect people and property from fire. However, they differ in their operation and applications. While sprinkler systems are permanently installed, whole-building fire protection systems, water mist systems comprise a range of different system types with varying design intent and application. Some water mist systems are built into the fabric of the building to provide life safety with potential building and property protection, but others provide personal or local protection. This means that any comparison of operational reliability and effectiveness must be made on an appropriate basis.

Fires with Sprinkler or Water Mist Systems

5. There were 2,924 Incident Recording System (IRS) reported fires with suppression between 2018/19 and 2023/24 where either a sprinkler or water mist system was present. These fires are dominated by sprinkler systems which accounted for 2,438 fires (83%).

6. The characteristics of fires between the two systems are quite different. The majority of sprinkler and water mist fires are in non-residential buildings, but while industrial premises account for almost half of non-residential fires, water mist fires are dominated by incidents in custodial settings (74% of non-residential fires and 59% of all water mist fires). Sprinkler fires in dwellings are concentrated in incidents in purpose-built flats or maisonettes, particularly those with more than ten storeys, while water mist incidents are primarily in low-rise dwellings.

7. With one exception, sprinkler fires were broadly distributed across Fire and Rescue Service (FRS) areas in proportion to all building fires whereas water mist fires were more prevalent in some FRS areas.

8. In the majority of sprinkler incidents, the system was located in the room of origin of the fire whereas with water mist incidents, the system was located on the same floor as the fire.

Data Issues

9. The different characteristics of fires between the two safety systems raises concerns about the dataset and the ability to undertake a comparative analysis of system performance.

10. **Portable versus fixed systems**: Sprinkler systems are 'fixed' systems whereas water mist systems can include personal protection systems and mobile lance type systems. Personal protection and mobile systems are not directly comparable with fixed sprinkler systems, but the dataset does not provide details on the specifics of the safety system installed.

11. The lack of system specific information is a major limitation of the data, but the analysis of characteristics can illustrate the issue. The majority of water mist fires are in custodial settings where manual hose-reel or lance type systems are used. Analysis of the location of the system in relation to the fire finds that in 71% of water mist incidents where the system operated, the fire was located on the same floor as the system and not in the room of origin.

12. Water mist fires in dwellings are concentrated in single occupancy bungalows/housing or self-contained sheltered housing where personal protection systems can reflect local policies and be used to protect vulnerable people. Personal protection systems are normally located in the area where a person spends most of their time or where they are exposed to the greatest hazard. The analysis supports the finding that a significant proportion of incidents in dwellings involving water mist represent personal protection systems. As a result, not all fires with water mist systems are comparable to fires with sprinkler systems, particularly for other public buildings and dwellings.

13. **Building versus local protection**: Related to the specifics of the system, is the issue of what is being protected e.g. a whole room/building or a specific piece of equipment. Industrial premises account for the largest number of non-residential sprinkler fires (663 incidents), particularly in factories, recycling centres and warehouses. Sprinklers are usually used in industrial premises to provide life safety with potential building and property protection. There were 69 water mist fires in industrial premises, primarily in food and drinks processing activities, recycling and factories. In food manufacturing, water mist is often used to provide local protection of industrial cooking equipment.

14. In addition, while there are established standards for the design of sprinkler systems for area-wide protection, there are no design criteria for general area protection of industrial premises using water mist. Hence, a comparative analysis of performance of area-wide sprinklers and local protection from water mist systems would not be valid.

15. **Number of observations**: Notwithstanding the issues around 'like for like' comparisons between the two systems, there is also an issue with the number of observations in the dataset. While there are thousands of sprinkler incidents, there are less than 500 water mist incidents and the majority are in custodial settings using portable equipment where comparisons are not appropriate.

16. The analysis of the performance of the systems (both effectiveness and reliability) requires the dataset to be disaggregated by several categories. When custodial fires are excluded, the water mist sample falls below the levels required for robust analysis and conclusions.

Conclusions

17. Detailed analysis of the characteristics of fires with safety systems has identified data issues which cannot be resolved by the available data. The IRS dataset does not contain two comparable populations of building-wide automatic suppression systems. While the sprinkler data refers to building-wide suppression systems, the water mist data includes building-wide automatic suppression systems, local area protection systems and portable and manual devices.

18. This leads to the conclusion that a robust comparative analysis of the two systems is not possible. Any claims that MHCLG incident data demonstrate superior effectiveness of water mist systems compared to sprinklers are not supported by the evidence and arise from invalid comparisons between fundamentally different types of fire suppression systems.

1. Introduction

1.1 Introduction

1.1.1 The Ministry of Housing, Communities and Local Government (MHCLG) has published an extract of primary fire incidents where a sprinkler or water mist safety system was present[1]. The data covers England and the period 2018/19 to 2023/24.

1.1.2 This report provides an analysis of these data and seeks to examine the characteristics of fires with safety systems and compare the performance of the two safety systems. The two main measures of performance of safety systems relate to operational reliability (which measures the degree to which the systems operated as designed when required) and performance reliability (which measures the effectiveness of the systems when activated).

1.1.3 Sprinkler and water mist systems are both forms of automatic fire suppression which aim to provide life safety with potential building and property protection from fire. However, they differ in their operation and applications. The report begins with an overview of the two systems before setting out the framework for the analysis.

1.2 Sprinkler and Water Mist Systems

1.2.1 As automatic sprinkler and water mist systems can be installed in different ways and to different standards, it is important to consider the type of protection they offer and how that applies to different building types if appropriate comparisons of the reliability and effectiveness of the two systems are to be made.

1.2.2 Sprinkler systems are relatively homogeneous in that they consist of a network of pipes, valves and sprinkler heads that work together to automatically release water when a fire is detected. They are heat activated, are installed in a variety of settings and work to specific standards.

1.2.3 For domestic or residential buildings, they are usually installed to meet BS 9251 and offer life safety with potential building and property protection in the areas in which they are installed. For commercial or industrial buildings, sprinklers are usually installed to BS EN 12845 and offer building protection in the areas in which they are installed.

1.2.4 Hence, sprinkler systems are built into the fabric of the building to a widely recognised standard and tend to offer building protection as well as personal or local protection.

[1] MHCLG 'Fire and Rescue Incident Statistics England, 2018/19 to 2023/24: ad hoc data table. Table 60: Primary fires with sprinkler or water mist safety systems' 2025

1.2.5 Water mist systems can also consist of a network of pipes and nozzles which work by releasing tiny droplets or 'mist' over the fire. As with sprinkler systems, water mist systems are generally heat activated but there are several different types of system.

1.2.6 In UK domestic or residential settings, water mist systems used to be installed to BS 8458 to provide life safety. In commercial or industrial settings water mist systems can be installed to BS 8489 for specific situations to provide life safety and building protection. These are fixed systems built into the fabric of the building to a recognised standard. Following the withdrawal of BS 8458 and the imminent withdrawal of BS 8489, BS EN 14972 will be the sole UK water mist standard.

1.2.7 However, there are also other standardised or non-standardised water mist systems, some of which provide building protection in both domestic/residential and commercial/industrial settings and some of which provide personal protection in domestic/residential settings (i.e. mist personal protection systems) and local protection for specific items of equipment in commercial/industrial settings (e.g. conveyors, trommels in waste handling areas etc.).

1.2.8 Personal protection systems are not built into the fabric of the building and can be quickly installed and removed as they are free standing or portable systems. They are usually provided to protect an individual who is particularly vulnerable from fire e.g. people with mobility issues and/or in a high-risk group in the event of a fire which could include people with an alcohol or substance dependency. These systems would be located to provide the individual with protection in a fixed position where they usually sit or sleep.

1.2.9 From the descriptions of the two systems, there are a range of different types of water mist system. The fixed systems which are installed to the appropriate BS standards for building wide area protection in domestic or a light hazard commercial installation are directly comparable with sprinkler systems. However, the comparison of a personal protection water mist system or a discrete installation for a specific piece of equipment with a sprinkler system designed for area protection would not be appropriate.

1.2.10 Given the nature of the two safety systems, it is important that any comparisons of operational reliability and effectiveness are made on an appropriate basis.

1.3 Framework for Analysis

1.3.1 The MHCLG dataset includes five key fields from the Incident Reporting System (IRS) which are important for the analysis of reliability and effectiveness of the two systems:

- Did the system operate? (Q7.14).
- What was the location of the system in relation to the fire? (Q7.13).
- How many heads were activated? (Q7.15).
- What was the impact (i.e. extinguished, contained/controlled) on the fire? (Q7.16).
- In cases where the system did not operate, what was the reason the system did not function? (Q7.17).

1.3.2 Information on property type and fire damage are also included within the MHCLG dataset which helps with understanding the characteristics of the system on the fires.

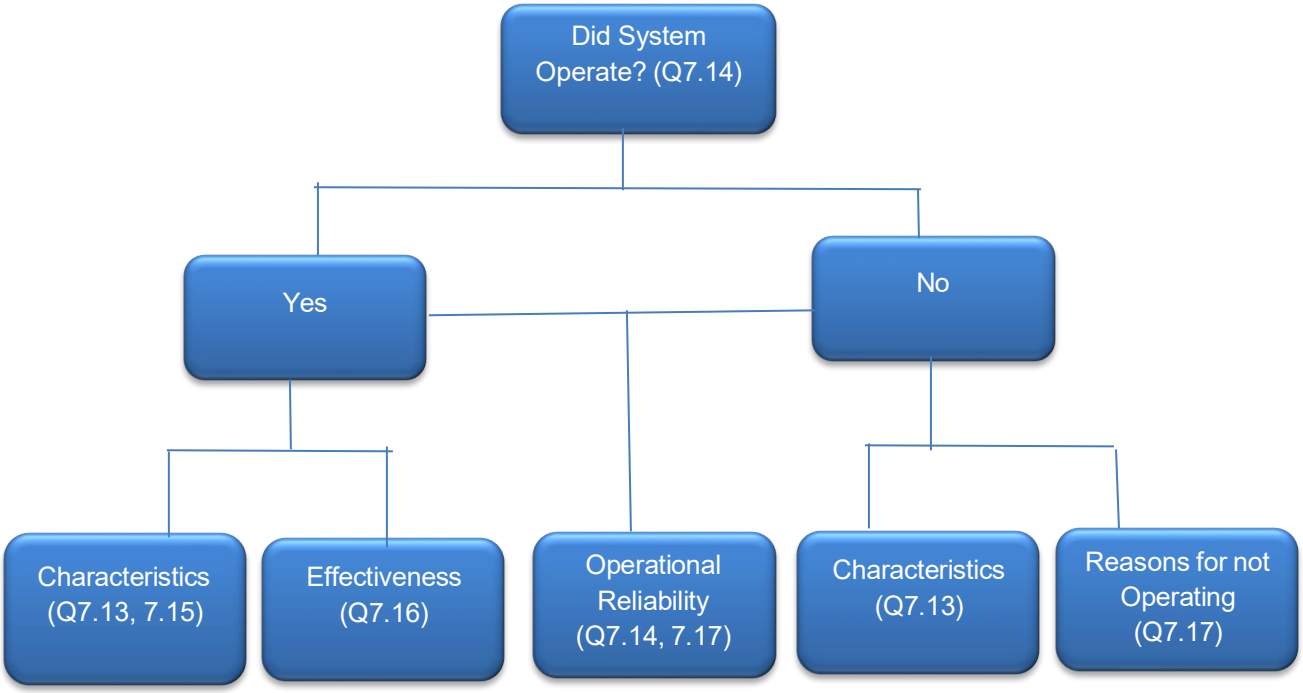
1.3.3 The framework for the analysis is shown in Figure 1.1. The performance reliability of the system measures the effectiveness of the system when it is activated and is defined as the proportion of fires where the safety system operated which are contained/controlled or extinguished. The impact of the system (i.e. whether it extinguished or contained/controlled the fire) can only feed into the analysis of operational performance if the system operated and the impact is known. If the system did not operate, there will be no impact on the fire and if the impact is not known, the data must be excluded as it is not known whether the system was successful in controlling the fire or not.

1.3.4 Hence, whether the system operated and the known impact are crucial for the appropriate analysis of the effectiveness of the system. Information on the location of the system and the number of heads operating provide additional information on the characteristics of the fires where the system operated.

1.3.5 Operational reliability measures the probability that the system will operate as designed when required and is calculated as the number of incidents where the system operated as a proportion of the number of incidents where the system could be expected to operate.

1.3.6 Understanding why the system did not operate is a key component of the calculation of operational reliability as there could be reasons why the system could **not** be expected to operate e.g. because there was insufficient heat to activate the sprinkler heads. Hence, the assessment of operational reliability of the system takes account of circumstances where the system could not be expected to operate. As with the analysis of effectiveness, care must be taken interpreting the data where the reason for the system not operating is unknown. Additional analysis provides further understanding of the characteristics of the fires when the system did not operate e.g. the location of the system in relation to the fire.

Figure 1.1: Framework for Analysis



1.4 Report Structure

1.4.1 The remainder of this report is set out as follows:

- Section 2 provides an overview of the number of sprinkler and water mist fires over 2018/19 to 2023/24 to understand the characteristics of the incidents under the two systems.
- Section 3 draws on the characteristics of the incidents to discuss the issues which may impact on a comparative analysis of system performance. Due to data limitations, a comparative analysis of the performance of the two systems has not been undertaken.

2. Fires with Sprinkler or Water Mist Safety Systems

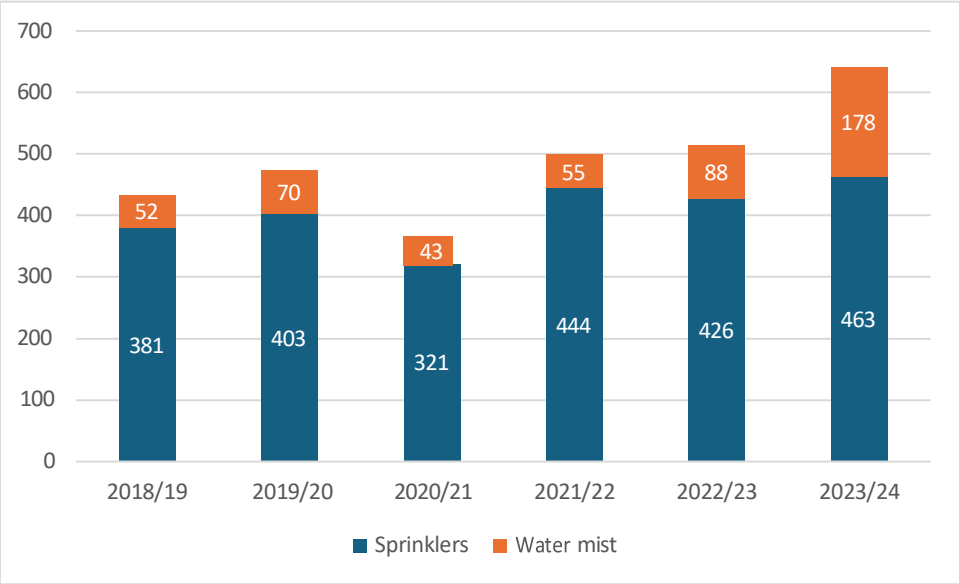
2.1 Introduction

2.1.1 This section provides an overview of the characteristics of the incidents involving safety systems over 2018/19 to 2023/24. It considers building type, geographical area and the location of the system in relation to the fire.

2.2 Number of Incidents

2.2.1 Across the six-year period (2018/19 to 2023/24), there were a total of 2,924 fires where a sprinkler or water mist safety system was present – 2,438 with sprinkler systems and 486 with water mist systems. The total number of fires with these safety systems increased over the period but much of the increase occurred between 2022/23 and 2023/24 when there was a sharp increase in water mist fires. Details are shown in Figure 2.1.

Figure 2.1: Trends in Fires with Sprinkler and Water Mist Systems, 2018/19 to 2023/24

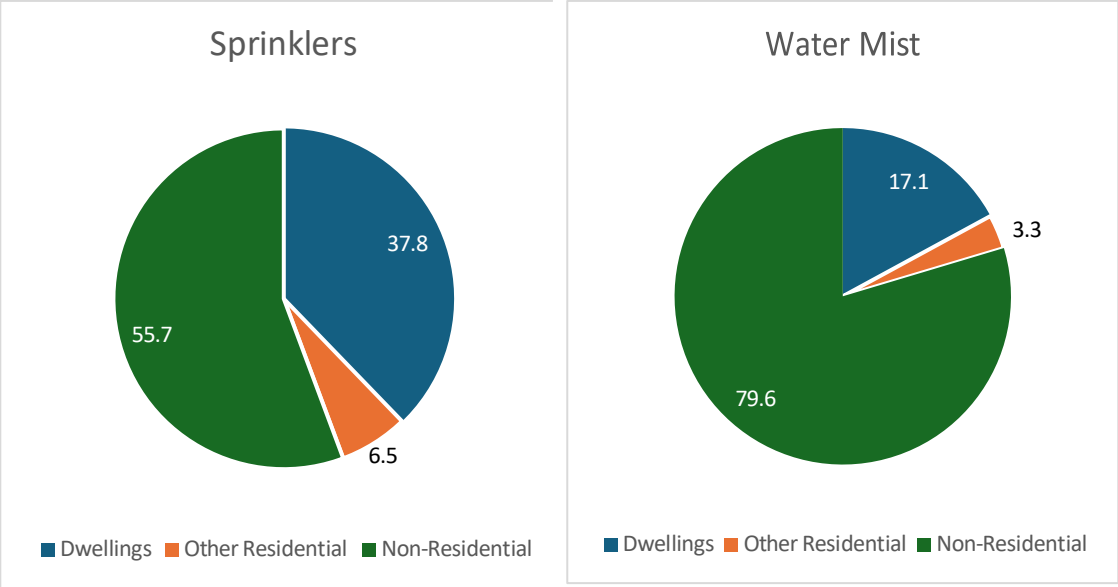


2.2.2 Sprinkler systems account for the majority of these safety system fires across the period (83%). In 2023/24 the number of fires with water mist systems was more than double the previous year and the source of this growth is considered further in paragraphs 2.3.6 to 2.3.7.

2.3 Building Type

2.3.1 Fire incident data are classified by three building types – dwellings[2], non-residential and other residential[3]. Figure 2.2 shows that the distribution of fires across building types varies by safety system. For sprinkler systems, almost 56% of sprinkler fires are in non-residential buildings with 38% in dwellings. This compares to water mist systems where almost 80% of fires are in non-residential buildings with only 17% in dwellings.

Figure 2.2: Distribution of Fires by System and Building Type, %

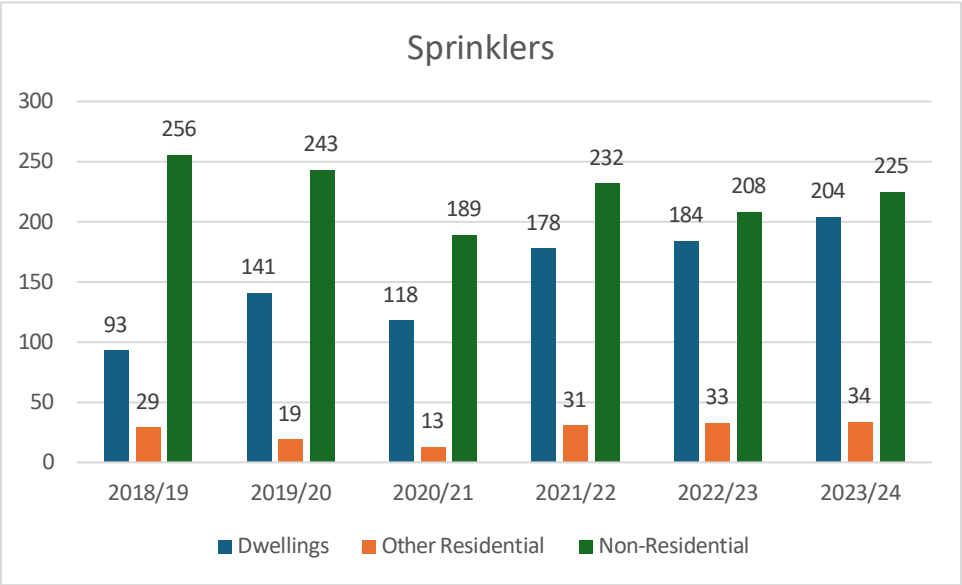


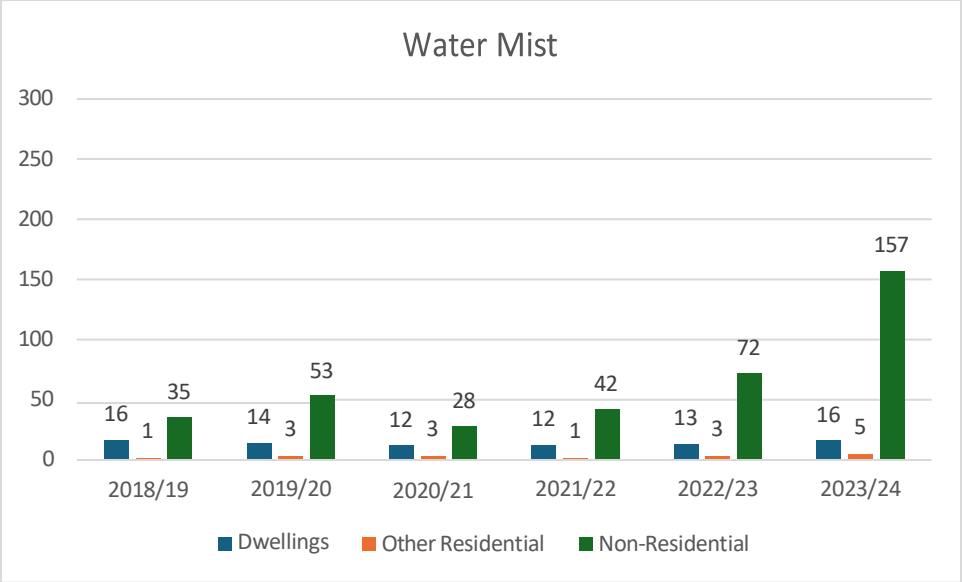
2.3.2 Figure 2.3 shows the number of incidents each year by safety system and building type. The number of dwelling fires with sprinklers has increased over the period while the number of non-residential sprinkler fires has fluctuated around an average of approximately 225 fires per annum. The number of sprinkler fires per annum in other residential buildings is relatively low at around 30 in recent years.

2.3.3 The number of water mist incidents in dwellings and other residential buildings is very low at around 14 and three per annum respectively. The number of water mist fires in non-residential buildings more than doubled between 2022/23 and 2023/24.

[22] Dwellings cover residential homes and houses of multiple occupation including houses, flats, maisonettes, self-contained sheltered housing and caravans/houseboats if used as a permanent dwelling.
[3] Other residential covers hotels, hostels, B&Bs, residential homes, student halls of residence/boarding school accommodation, caravan sites and other holiday residences

Figure 2.3: Number of Fires by Safety System and Building Type, 2017/18 to 2023/24





Dwellings

2.3.4 There were 918 sprinkler fires and 83 water mist fires in dwellings across the six-year period. The distribution of these fires is shown by safety system and building type in Table 2.1. There is considerable variation in the distribution of fires by dwelling type between the two systems. Fires with sprinkler systems are concentrated in purpose-built flats or maisonettes (788 fires or 86%) with the majority in buildings with more than 10 storeys (62%). The 83 water mist dwelling fires have a broader distribution across the various dwelling categories.

Table 2.1: Number of Fires by Dwelling Category and Safety System				
	Sprinklers		**Water Mist**	
	No.	**%**	**No.**	**%**
Bungalow – single occupancy	9	1.0	12	14.5
Converted Flat/Maisonette – single occ.	30	3.3	2	2.4
Dwelling – multiple occ.	6	0.7	-	-
House – single occ.	29	3.2	20	24.1
Other Dwelling	56	6.1	15	18.1
Purpose Built Flat/Mais – 10+ storeys	566	61.2	8	9.6
Purpose Built Flat/Mais – 4 to 9 storeys	45	4.9	10	12
Purpose Built Flat/Mais – up to 3 storeys	177	19.3	16	19.3
Total	**918**	**100.0**	**83**	**100.0**
Average per annum	**153**		**14**	

Non-Residential

2.3.5 Non-residential fires are the largest category of both sprinkler and water mist system fires with 1,353 and 387 incidents respectively. The non-residential building category has ten sub-sectors with Table 2.2 showing the distribution of fires by sub-sector and safety system.

2.3.6 As with dwelling fires, the distribution of fires across non-residential categories is quite different for the two systems. Almost 50% of fires with sprinkler systems are in industrial premises with a further 23% in retail premises. On the other hand, non-residential fires with water mist systems are dominated by fires in other public buildings (75% of non-residential water mist fires). There are very few fires with water mist systems in any of the other non-residential categories.

2.3.7 Of the 289 fires in other public buildings with water mist systems, 282 were in prisons and six were in young offenders' units. The large increase in water mist fires in non-residential premises between 2022/23 and 2023/24 (Figure 2.1) was driven by an increase in fires in prisons which increased from 51 to 139 between the two years.

Table 2.2: Number of Fires by Non-Residential Category and Safety System				
	Sprinklers		**Water Mist**	
	No.	**%**	**No.**	**%**
Agricultural premises	3	0.2	1	0.3
Education	51	3.8	2	0.5
Entertainment	39	2.9	2	0.5
Food & drink	65	4.8	15	3.9
Hospitals & medical	57	4.2	1	0.3
Industrial	663	49.0	69	17.8
Offices & call centres	41	3.0	2	0.5
Other public buildings	105	7.8	289	74.7
(*of which prisons/young offenders*)	*(39)*	*(2.9)*	*(288)*	*(74.4)*
Private non-residential	14	1.0	-	-
Retail	315	23.3	6	1.6
Total	**1,353**	**100.0**	**387**	**100.0**
Average per annum	**226**		**65**	

2.3.8 All the non-residential categories can be disaggregated further. Almost half (663 or 49%) of all non-residential sprinkler fires are in industrial premises which can be further sub-divided into 20 different property types. Table 2.3 provides a summary of the number of sprinkler and water mist fires in these sub-categories. Although there were sprinkler fires in all industrial categories, the three largest industrial categories were factories, recycling and warehousing which accounted for almost 57% of fires.

2.3.9 There were only 69 water mist fires in industrial properties and many of the industrial sub-categories did not have any water mist fires. The main sub-categories for water mist fires were food and drink processing, recycling and factories which accounted for almost 70% of industrial water mist fires.

Table 2.3: Number of Fires by Industrial Sub-Category and Safety System				
	Sprinklers		**Water Mist**	
	No.	**%**	**No.**	**%**
Animal Products	7	1.1	-	0.0
Assembly	26	3.9	2	2.9
Chemicals	25	3.8	3	4.3
Electricity Power Station	5	0.8	3	4.3
Engineering	51	7.7	6	8.7
Factory	175	26.4	12	17.4
Food and Drink Processing	42	6.3	22	31.9
Gas	1	0.2	-	0.0
Gas Works	1	0.2	-	0.0
Hazardous Materials	2	0.3	-	0.0
Lab/research Establishment	6	0.9	-	0.0
Mill	29	4.4	2	2.9
Mines & Quarries (above ground)	1	0.2	-	0.0
Oil Refinery	1	0.2	-	0.0
Other	50	7.5	4	5.8
Printing	14	2.1	-	0.0
Recycling	115	17.3	14	20.3
Vehicle Repair	4	0.6	-	0.0
Warehouse	86	13.0	-	0.0
Waste	22	3.3	1	1.4
Total	**663**	**100.0**	**69**	**100.0**

Other Residential

2.3.10 The number of other residential incidents over the six-year period is relatively low – 159 fires with sprinkler systems (27 per annum) and 16 with water mist systems (3 per annum). Given the low number of incidents, this category has not been analysed in detail.

2.4 Geographical Area

2.4.1 An analysis of the distribution of sprinkler and water mist fires by Fire and Rescue Service (FRS) has been undertaken. The distribution of all building fires[4] across each FRS area has been compared to the FRS areas share of population.

2.4.2 Analysis of all dwelling and building fires by FRS shows that the number of incidents is broadly aligned with the population in each area. For example, the proportion of incidents in Greater London, Greater Manchester, West Midlands and West Yorkshire is almost 34% over the period which compares to 30% of the population living in these four areas.

2.4.3 Analysis of fires with sprinkler systems finds that one FRS is over-represented in their share of fires compared to all building fires. The proportion of sprinkler fires in the West Midlands in dwellings is dominated by incidents in purpose built flats and maisonettes, particularly those with ten or more storeys. This concentration in flats and maisonettes reflects a local policy to retrofit sprinklers to high-rise blocks[5].

2.4.4 Analysis of fires with water mist systems finds that five FRS areas are over-represented in their share of fires with water mist systems compared to all building fires. Cambridgeshire, Derbyshire, Dorset and Wiltshire, Kent and Northamptonshire account for 36% of fires with water mist systems, but only 9% of all building fires.

2.4.5 More detailed analysis finds that the water mist system fires are particularly prevalent in dwellings in Cambridgeshire and Derbyshire with these two areas accounting for 45% of dwelling fires with water mist systems. These two areas also account for 55% of incidents where the system was reported to have operated. Across all dwelling fires, Cambridgeshire and Derbyshire account for less that 3% of fires. Analysis of the Cambridgeshire and Derbyshire water mist dwelling fires finds that almost 68% are in single occupancy housing or self contained sheltered housing. This is likely a reflection of local policies[6] [7] to protect vulnerable people with personal protection systems. These systems are not 'fixed systems' but are portable or semi portable systems and therefore not comparable to fixed sprinkler systems.

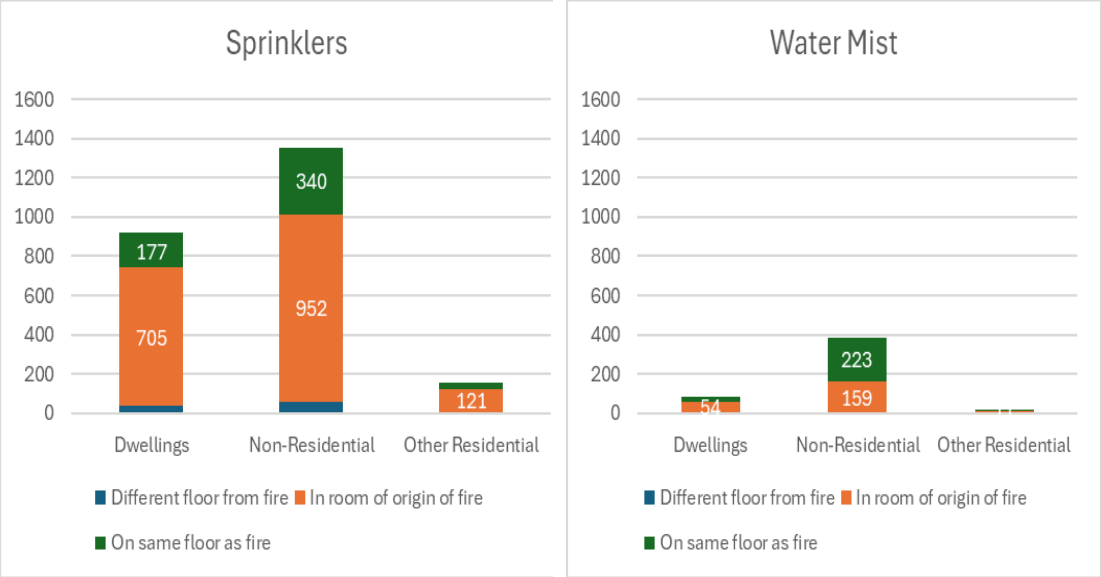
[4] All dwelling and other building fires, regardless of whether there was a safety system present
[5] WMFS supports sprinkler fitting - West Midlands Fire Service
[6] Our Year 2021/22 (Annual Report) :: Derbyshire Fire and Rescue Service
[7] Cambridgeshire FRS annual-report-2020-21.pdf

2.4.6 Dorset and Wiltshire, Kent and Northamptonshire accounted for 29% of non-residential water mist fires compared to 7% of all other building fires. More detailed analysis finds that almost all (97%) of the water mist fires in non-residential buildings in these areas were in prisons.

2.5 Location of System in Relation to Fire

2.5.1 Figure 2.4 shows the location of the safety system for sprinkler and water mist fires by building type. For sprinkler fires, the safety system is located in the room of origin of the fire in the majority of cases (70% to 77% depending on building type). With water mist systems, the position is quite different, particularly for non-residential buildings where the safety system was located in the room of origin of the fire in only 41% of incidents.

Figure 2.4: Location of Safety System by System and Building Type, %



2.6 Conclusions

2.6.1 The MHCLG dataset covers 2,924 fires over 2018/19 to 2023/24 where either a sprinkler or water mist system was present. These fires are dominated by sprinkler systems which accounted for 2,438 fires over the period (83%).

2.6.2 The analysis found the characteristics of fires are quite different between the two systems:

- The majority of sprinkler and water mist fires are in non-residential buildings, but while industrial premises account for almost half of non-residential fires water mist fires are dominated by incidents in custodial settings (74% of non-residential fires and 59% of all water mist fires).

- Sprinkler fires in dwellings are concentrated in incidents in purpose-built flats or maisonettes, particularly those with more than ten storeys, while water mist incidents are primarily in low-rise dwellings.
- Sprinkler fires were broadly distributed across FRS areas in proportion to all building fires. The only exception was the West Midlands where there was a relatively high proportion of sprinkler fires in purpose-built flats or maisonettes.
- Water mist fires were more prevalent in some FRS areas. In Cambridgeshire and Derbyshire, there were above average concentrations of fires in single occupancy housing and self-contained sheltered housing while Dorset and Wiltshire, Kent and Northamptonshire incidents were dominated by prison fires.
- In the majority of sprinkler incidents, the system was located in the room of origin of the fire whereas with water mist incidents, the system was located on the same floor as the fire.

3. Issues Arising from the Analysis of Incidents

3.1 Introduction

3.1.1 The analysis of characteristics of fires with safety systems in Section 2 raises several issues regarding the dataset and the ability to undertake a comparative analysis of the two safety systems.

3.2 Portable versus Fixed Systems

3.2.1 Section 1.2 highlighted the possibility that not all fires with water mist systems would be comparable to fires with sprinkler systems, particularly if personal protection or mobile systems are used. Unfortunately, the incident data does not provide details on the specifics of the safety system installed which is a major limitation of the data. However, the brief overview of the characteristics of fires with safety systems can be used to illustrate some of these issues.

3.2.2 Table 2.2 shows that the majority of non-residential water mist fires are in custodial buildings (i.e. prisons or young offender units). In these settings, manually deployed hose-reel or lance type systems are usually used where a port is unlocked in a cell door and water mist is deployed into the cell. These are not 'automatic fire suppression systems' and are not comparable to fixed sprinkler systems.

3.2.3 Detailed analysis of fires in prisons and young offender's units with water mist systems finds that in 71% of incidents, the water mist system was located on the same floor as the fire and not in the room of origin. This would support the use of hose-reel or lance type systems which would not be located in the room of origin of the fire. By comparison, in 75% of incidents where the sprinkler system operated, the system was located in the room of origin of the fire. Further details are shown in Table 3.1.

Table 3.1: Number of Fires in Prisons and Young Offenders Units by Location of System and Safety System where the System Operated

	Sprinklers		**Water Mist**	
	No.	**%**	**No.**	**%**
In room of origin of fire	12	75.0	73	28.3
On same floor as fire	4	25.0	184	71.3
Different floor from fire	0	0.0	1	0.4
Total	**16**	**100.0**	**258**	**100.0**

3.2.4 This analysis is further supported by the Crown Premises Fire Safety Inspectorate[8] which reports that "*44% of cells still do not have suitable in cell fire detection*". The 2024/25 Annual Report also highlights that "*Effective early fire detection is critical in protecting inmates and staff from fires and preventing damage to the premises*." This implies the fire suppression is not fixed and automatic but deployed by staff when a fire is detected.

3.2.5 The majority of all water mist incidents in the dataset relate to custodial settings where manually deployed hose-reel or lance systems are used. Where a safety system is manually deployed, portable or activated by staff intervention rather than automatic thermal response, it does not meet the definition of an automatic fire suppression system and must be excluded from any comparative effectiveness analysis.

3.2.6 The findings in paragraph 2.4.5 found Cambridgeshire and Derbyshire account for 45% of dwelling fires with water mist systems. Both Cambridgeshire and Derbyshire FRSs' are known to use portable protection systems to protect vulnerable people. This, along with the finding that the majority of water mist fires in dwellings were in single occupancy bungalows/houses or self-contained sheltered housing, suggests that a proportion of these incidents are personal protection systems which are used to protect vulnerable people rather than fixed systems.

3.2.7 This can be confirmed by further examination of the location of the system relative to the fire. Table 3.2 shows the location of the system relative to the fire for dwelling incidents where the safety system operated. Sprinklers are more likely to be in the room of origin of the fire (94% of incidents where the sprinkler operated) compared to water mist systems where only 71% of incidents where the system operated were in the room of origin.

Table 3.2: Number of Fires in Dwellings by Location of System and Safety System where the System Operated

	Sprinklers		**Water Mist**	
	No.	**%**	**No.**	**%**
In room of origin of fire	492	93.9	35	71.4
Same floor as fire	23	4.4	11	22.4
Different floor from fire	9	1.7	3	6.1
Total	**524**	**100.0**	**49**	**100.0**

[8] Crown_Premises_Fire_Safety_Inspectorate___CPFSI__annual_report_2024_to_2025.pdf

3.2.8 Personal protection systems are normally located in the area where a person spends most of their time or where they are exposed to the greatest hazard. This is usually a sitting room or bedroom. However, fire statistics for England highlight that the highest frequency of fire incidents involves cooking appliances[9].

3.2.9 Table 3.3. shows the location of the system relative to the fire for incidents when the system operated in response to a fire starting in the kitchen. The Table shows that water mist systems are in the room of origin of the fire if the fire started in the kitchen in 46% of incidents compared to almost 98% for sprinkler systems. These data support the potential for the majority of water mist fires in dwellings where the fire started in the kitchen to be personal protection systems.

Table 3.3: Number of Fires in Dwellings originating in the Kitchen by Location of System, Safety System and whether System Operated

	Sprinklers		Water Mist	
	No.	**%**	**No.**	**%**
In room of origin of fire	141	97.9	10	45.5
Same floor as fire	3	2.1	11	50.0
Different floor from fire	0	0.0	1	4.5
Total	**144**	**100.0**	**22**	**100.0**

3.2.10 Tables 3.2 and 3.3 and the discussion in 2.4.5 supports the finding that there is a significant proportion of incidents involving water mist systems that do not represent the operation of a fixed system. The evidence indicates that the water mist incidents may include portable protection systems. Unfortunately, there is no means to identify fixed and portable systems within the data, but these portable or semi-portable systems are not comparable to fixed sprinkler systems.

3.2.11 This deeper analysis suggests that a comparative analysis of the performance of sprinkler and water mist systems is not appropriate for all building types as the specific systems in place will be different. This is particularly the case for dwellings and other public buildings and treating these incidents as equivalent would fundamentally distort any assessment of system effectiveness.

[9] Detailed analysis of fires and response times to fires attended by fire and rescue services, England, April 2024 to March 2025 - GOV.UK

3.3 Building versus Local Protection

3.3.1 The largest number of non-residential fires where sprinkler systems were present are in industrial premises (663 incidents), particularly in factories, recycling centres and warehouses. Although the industrial category is the second largest category for non-residential water mist fires, there are a limited number of incidents (69) and these are concentrated in food and drinks processing activities, recycling and factories.

3.3.2 Sprinkler systems are usually used in industrial settings to provide area-wide protection whereas water mist systems support more localised spot protection of specific hazards. For example, in the food manufacturing industry, water mist is often used to provide local protection of industrial cooking equipment e.g. fryers and ovens. This is protection for the piece of equipment but not the area protection which would be provided by a sprinkler system.

3.3.3 A similar point can be made regarding recycling incidents where sprinklers provide protection to an area while water mist provides specific protection e.g. to a grinding machine.

3.3.4 While European water mist standards such as EN 14972 provide a framework for system testing and application-specific approvals, there is no settled European standard offering prescriptive design criteria for general area protection of industrial, recycling or warehousing premises using water mist. This contrasts with mature sprinkler standards which provide established, hazard-based design rules for area-wide building protection.

3.3.5 Hence, a comparative analysis of the performance of area-wide sprinklers and predominantly localised water mist systems would not be on a like for like basis. Consequently, comparisons between water mist and sprinklers in most industrial occupancies are not simply data-limited, they are conceptually invalid because the systems are designed to protect fundamentally different things i.e. water mist being used for local protection of equipment such as conveyor belts and not general building protection.

3.4 Number of Observations

3.4.1 Notwithstanding the issues around comparing ‘like with like’ with sprinkler and water mist systems, there is also an issue with the number of observations in the dataset. While there are thousands of sprinkler incidents, there are less than 500 water mist incidents and the majority (59%) are concentrated in custodial settings where a mobile hose-reel or lance type system is likely to have been used.

3.4.2 As shown in Figure 1.1, an analysis of the reliability and effectiveness of safety systems requires the number of incidents to be disaggregated by several categories. The first 'cut' of the data is whether the system operated by building type. When the water mist dataset is disaggregated by operation, the number of incidents is very small for each building category. Details are shown in Table 3.4. Given the dominance of water mist incidents in custodial settings and the non-comparability of the mobile systems in these settings with sprinkler systems, custodial incidents are shown separately in Table 3.4.

3.4.3 There are only 61 incidents in non-residential buildings (excluding custodial settings) where the water mist system operated and 38 where it did not operate. For dwellings and other residential buildings, the number of incidents is even smaller.

Table 3.4: Number of Incidents by Building and Safety System and whether the System Operated

	Sprinklers		Water Mist	
Building Type	**Operated**	**Did not operate**	**Operated**	**Did not operate**
Dwellings	524	394	49	34
Non-residential - Custodial	16	23	258	30
Non-residential excluding custodial	543	771	61	38
Other residential	75	84	10	6
Unknown building type	2	6	-	-
Total	**1,160**	**1,278**	**378**	**108**
Total excluding custodial	**1,084**	**1,255**	**120**	**78**

3.4.4 The main concern regarding the small number of water mist observations is the greater potential for atypical results which could lead to erroneous interpretations and conclusions. In a small sample every incident carries more weight which can influence overall results. For example, if there are only 50 incidents, each incident carries a weight of two percentage points whereas in a sample of 500 incidents each incident carries a weight of 0.2 percentage points.

3.4.5 As discussed in Section 1, whether the system operated is the key to analysing the effectiveness and reliability of the systems. When custodial fires are excluded, the water mist sample falls below the levels required for robust analysis and conclusions. Any greater disaggregation would further exacerbate the problem of the small dataset in delivering robust analysis.

3.5 Comparative Analysis

3.5.1 To provide a robust analysis of the reliability and effectiveness of the two safety systems, it is important that the systems are compared on a like for like basis. Although there are situations where sprinkler and water mist systems are comparable (e.g. when providing area-wide coverage to a building to an appropriate standard), there are some types of water mist system which are not directly comparable to sprinkler systems (e.g. personal protection or mobile lance-type systems).

3.5.2 Even before accounting for data limitations, system-location patterns show materially different deployment for sprinklers and water mist systems. These divergences are consistent across occupancies and are not consistent with claims of functional equivalence.

3.5.3 Table 3.5 provides a summary by building type and safety system of the issues surrounding comparative analysis.

3.5.4 Any comparative performance claims between sprinklers and water mist systems derived from MHCLG IRS incident data which do not explicitly exclude mobile, personal protection and localised mist systems, and which do not control for protection intent, are methodologically invalid and should not be relied upon for regulatory policy or procurement decision-making.

Table 3.5: Issues Relating to Comparative of Safety Systems			
Property Type	**No. Obs. Sprinklers**	**No. Obs. Water Mist**	**Comment**
Dwellings	918	83	Not comparable due to potential use of Personal Protection Systems. Small number of observations cannot produce statistically reliable (or nationally representative) results.
Non-Residential: Custodial	39	288	Not comparable due to dominance of manual water mist system interventions.
Non-Residential: Excluding Custodial	1,314	99	Not comparable due to different protection offered in some sub-categories. Small number of observations cannot produce statistically reliable (or nationally representative) results.
Other Residential	159	16	Small number of observations cannot produce statistically reliable results.

3.6 Conclusions

3.6.1 The aim of the analysis was to provide a comparative analysis of the effectiveness and reliability of the two safety systems. However, detailed analysis of the characteristics of fires with safety systems has identified data issues which mean that the majority of the water mist fires may not be directly comparable to the sprinkler fires.

3.6.2 The dataset combines very different system classes under the heading of 'water mist' which leads to the conclusion that a robust comparative analysis of the performance of the two systems is not possible and MHCLG incident data cannot be used to demonstrate that either systems is more or less effective than the other. Any claim of equivalence or comparative performance between sprinklers and water mist based on IRS data is therefore invalid in principle, not simply inconclusive in practice

3.6.3 Robust comparisons would require system-level classification, consistent standards and sufficient sample sizes. Future IRS data collection should disaggregate fixed building-wide suppression, personal protection systems, local application protection and manually deployed custodial systems from the data. Without this, suppression policy risks being shaped by invalid evidence.