BS 9251:2014 Fire Sprinkler Systems For Domestic And Residential Occupancies - Code Of Practice

21st January 2015
Paul Kennedy
Contents...

• About Automatic
• BS 9521 ‘versus’ LPC BSEN 12845
• Mixed Residential and Commercial

• BS 9251
  ▪ Preliminary Work and Consultation
  ▪ Design
  ▪ Commissioning
  ▪ Maintenance
  ▪ Annex B : Vulnerable People
About Us…

• The Group…

• Established in 1981, 100% Irish Owned and Managed
• Irelands only Full Integrated Solutions provider
• LPS 1048 Level 4 Approved Sprinkler Contractor
• ISO 9001 Certified Contractor
• SafeT Certified Contractor
• Full In-house Design, Engineering & Installation Resources
• 24/7 Emergency Response Service
• IEI CPD Registered Training Provider
BS 9251 : 2014 versus LPC BSEN 12845
BS9521 § 4.1 Note 2 states that...

In buildings where there is a mix of residential and commercial use (e.g. where apartments are above shops / offices), it is generally appropriate to protect the residential parts using **BS 9251**, and the commercial parts using **BS EN 12845**.

This does not preclude the use of either of these standards being applied throughout such a property subject to full **evaluation, consultation and agreement** with AHJs.
BS 9251 CODE
Systems designed to BS 9251 are primarily for the protection of life and not intended for the protection of property or commercial risks…

BS 9251 is a code of practice…

A code of practice provides practical guidance and recommendations…

Should not be quoted as if it were a specification…

Particular care should be taken to ensure that claims of compliance are not misleading (complying with BS 9251 alone may not provide sufficient / adequate protection…)

The 2014 Revision includes...

- introduction of **building categorization** based on occupancy risk;
- change of **building height** limit;
- variation in sprinkler head **design density**;
- increase in sprinkler head **spacing**;
- expanded guidance on **preliminary work and consultation**;
- expanded guidance on **water supplies**;
- additional measures for **vulnerable people**.

The code consists of **7 Sections & Annex A - F**, each of which has its own merits / standing...

- Section 1: **Scope** of the document
- Section 2: **Normative references** relating to other codes and standards
- Section 3: **Terms and definitions**
Achieving a fully functional Engineered System is a multi stage Process…

1. **Preliminary work and consultation** [Section 4]
   a) Evaluate Initial considerations
   b) Consultation with AHJ
   c) Establish Category of System
   d) Define if System is required as a Compensatory Feature
   e) Evaluate Special Circumstances

2. **System Design** [Section 5]

3. **Installation, commissioning and documentation** [Section 6]

4. **Maintenance** [Section 7]
Preliminary work and consultation
a) Evaluate Initial Considerations…

Prior to specifying the System, the following factors should be evaluated…

- the risks to be protected, including the fire loading
- the type of occupancy of the property
- the water supply requirements and availability
- any special circumstances

b) Consultation with AHJ…

Consultation should take place with the appropriate AHJ, there may be multiple AHJ’s, including, but not necessarily limited to …

- the Water Authority
- the Fire Authority
- the Licensing Authority
- the Building Control Body
- the Insurer(s) [building & contents]
- the Client
### BS 9251: Preliminary work and consultation

**c) Establish Category of system...**

Should be established at an early stage as this has an affect on various design criteria (water supplies) of the System.

<table>
<thead>
<tr>
<th>Category of system</th>
<th>Description of building/occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Single family dwellings such as: Individual dwelling house, flat, maisonette or Transportable home</td>
</tr>
<tr>
<td></td>
<td>Houses of multiple occupation (HMOs)</td>
</tr>
<tr>
<td></td>
<td>Bed and breakfast accommodation</td>
</tr>
<tr>
<td></td>
<td>Boarding Houses</td>
</tr>
<tr>
<td></td>
<td>Blocks of flats 18 m or less in height and with a maximum total floor area of 2 400 m²</td>
</tr>
<tr>
<td>2</td>
<td>Blocks of flats greater than 18 m in height</td>
</tr>
<tr>
<td></td>
<td>Small residential care premises with ten residents or fewer</td>
</tr>
<tr>
<td></td>
<td>Sheltered and extra care housing</td>
</tr>
<tr>
<td>3</td>
<td>Residential care premises with more than ten residents</td>
</tr>
<tr>
<td></td>
<td>Dormitories (e.g. attached to educational establishments)</td>
</tr>
<tr>
<td></td>
<td>Hostels</td>
</tr>
</tbody>
</table>
c) Establish Category of system… cont.

However…

- If any buildings permanently house vulnerable people this should be taken into account in determining the building category.

- Buildings with more than two floors and five or more lettable bedrooms should be treated as Category 2.

- Where the total floor area is greater than 2400 m², then the building should be treated as Category 2.

- Where the fire strategy requires the communal rooms and corridors to be sprinkler protected, then the building should be treated as Category 3.
d) ‘Compensatory Feature’…?

Sprinkler Systems are usually required as a means of demonstrating compliance with Building Regulations.

However, there may also be occasions where a Sprinkler System is installed to compensate where a building is unable to achieve compliance with building regulations, for example…

- New / Older buildings where the minimum fire resistance cannot be achieved
- Buildings that cannot meet the access requirements for fire appliances
- Attic conversions where adequate secure escape is not practical or possible

Consultation is required with the AHJ to determine if the Sprinkler System is required as a ‘Compensatory Feature’ and if the System Characteristics should be enhanced to meet these requirements and documented on the Fire Certificate / Certificate of Compliance.
e) Evaluate Special Circumstances…

An assessment may be necessary to determine the existence of ‘special circumstances’…

a) buildings with a fire loading greater normal

b) buildings where the time for firefighters to commence firefighting might exceed the duration of water supply (remote location or building > 45m)

c) older buildings or buildings with hidden voids

d) buildings with adjacent unsprinklered areas

e) buildings housing vulnerable people

f) mixed use buildings

g) premises providing secure accommodation (*asylum / institutional*)
e) Evaluate Special Circumstances… *cont.*

Should ‘special circumstances’ exist, they may require…

- **ENHANCED PERFORMANCE**
- **IMPROVED RELIABILITY**
- **INTRODUCING GREATER RESILIENCE**

For Example:

a) extended duration of water supply

b) provision of redundancy in the pumping arrangements

c) back-up electrical supplies

d) fire service infill connection to a stored water tank

e) increasing the design discharge density or design area of operation

f) applying LPC BSEN 12845
BS 9251 : Preliminary work and consultation

When, and only when...

**Initial Considerations** have been evaluated,

**Consultation** with the AHJ has been finalized,

the **System Category** has been established,

any **Compensatory Features** have been recognized,

any **Special Circumstances** have been evaluated.

**Should the System Specification be developed.**
BS 9251: Preliminary work and consultation

Specialist Sprinkler Contractors ARE NOT considered as an AUTHORITY HAVING JURISDICTION
DESIGN
BS 9251 : Design

Who can design Systems to BS 9251…?

§ 5.1 States that… “A residential sprinkler system should be designed by a **competent** person and in accordance with the components manufacturers’ instructions.”

**System Type:** Wet System, permanently charged with water.

**System Zoning:** For ease of maintenance or reinstatement after a fire, each Zone should…

- a) not cover more than one floor
- b) have a lockable full-bore stop valve
- c) have a quarter turn test & drain valve
Design Density and Duration of Supply...

**Design density** is a measurement of the amount of water discharged over a designated area...

![Diagram of floor area](image)

**DESIGN DENSITY**

\[
\text{millimetres per min} = \text{Litres per minute per square metre}
\]
### BS 9251: Design

<table>
<thead>
<tr>
<th>Category of system</th>
<th>Minimum design discharge density [mm / min.]</th>
<th>Number of design sprinklers</th>
<th>Minimum duration of supply [min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.04</td>
<td>1 [or] 2</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>2.80</td>
<td>1 [or] 2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>2.80</td>
<td>2 [to] 4</td>
<td>30</td>
</tr>
</tbody>
</table>

**Number of Design Sprinklers** = number of Sprinklers in the design area operating simultaneously, if 1 calculate with 1, if greater than 2 calculate for 2.

Compensatory Feature Systems increase the above Discharge Densities

The increased level of discharge density needed should be agreed with the AHJ prior to installation.
**Minimum Design Parameters**

<table>
<thead>
<tr>
<th>Category of system</th>
<th>Minimum design discharge density [mm / min.]</th>
<th>Number of design sprinklers</th>
<th>Minimum duration of supply [min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.04</td>
<td>1 [or] 2</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>2.80</td>
<td>1 [or] 2</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>2.80</td>
<td>2 [to] 4</td>
<td>30</td>
</tr>
</tbody>
</table>

**Design Parameters (compensatory feature)**

<table>
<thead>
<tr>
<th>Category of system</th>
<th>Minimum design discharge density [mm / min.]</th>
<th>Number of design sprinklers</th>
<th>Minimum duration of supply [min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a</td>
<td>2.80</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.04</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>4.00</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.80</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4.00</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>2.80</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4.00</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>2.80</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
BS 9251: Design

Extent of Sprinkler Protection …

Sprinkler protection should be provided in all parts of the premises.

The following however may be excluded by the Fire Strategy.

- bathrooms with a floor area of less than 5 m²
- cupboards and pantries with a floor area of less than 2 m² or where the least dimension does not exceed 1 m
- attached buildings (garages and boiler houses) without direct access from within the protected building
- crawl spaces and ceiling voids
- external balconies permanently open to the outside
- uninhabited loft/roof voids
Types of Sprinkler Heads...

- Sprinkler Heads shall be tested to **BS 9252**: Specification and test methods for residential sprinklers.

- BAFSA Technical Guidance Note No 1 Second edition: November 2012 recommends the use of sprinkler heads approved to either **UL 1626** or **FM Standard**

- Sprinkler heads shall be residential type quick response.

- The temperature rating shall be minimum 20°C above the highest anticipated temperature.
Sprinkler coverage and positioning...

- The maximum area 25 m² [or] manufacturers recommendation, whichever is the lesser.
- Not be more than 5.5 m apart and < 1/2 the spacing from any wall
- The distance between sprinklers should be not less than 2.4 m
- Not more than 100 mm below the ceiling
- The whole of the floor area and the walls up to 0.7 m below the ceiling should be wetted.
- Sprinklers should not be adversely affected by obstructions (smoke detectors, lights etc.)
- Sprinklers should be positioned a sufficient distance from any heat sources
BS 9251 : Design

Water Supplies…

Unlike BSEN 12845, Full hydraulic calculations shall be carried out for Residential / Domestic Sprinkler Systems to determine system flows and pressure.

Min. 2 Calculations; **Size Pump** = Most Unfavourable, **Size Tank** = Most favourable

The types of supply include:

- mains water supply
- mains water supply boosted by a pump
- **dedicated stored water supply**
- regulated pressurized vessel
- gravity-fed stored water system

Typically the effective capacity of stored water supplies for sprinkler systems is:

- category 1 systems: 1 m³ to 1.5 m³
- category 2 systems: 3 m³ to 4.5 m³
- category 3 systems: 6 m³ to 9.0 m³
BS 9251 : Design

Water Storage Tank…

Typically the **effective capacity** of stored water supplies for sprinkler systems is:

- category 1 systems: 1 m$^3$ to 1.5 m$^3$
- category 2 systems: 3 m$^3$ to 4.5 m$^3$
- category 3 systems: 6 m$^3$ to 9.0 m$^3$
**BS 9251: Design**

**Fire Pumps…**

Only pumps suitable for use in sprinkler systems shall be used and should be…

- of sufficient capacity to ensure that the system demand is achieved
- located / protected such that it is unlikely to be affected by a fire
- located where the temperature can be maintained above freezing (4°C)
- Supplied via reliable power source (and possibly back-up supply)
- operated automatically on demand, but manual shut down
- located such that it is unlikely to be affected by flooding
- designed to include an automatic test cycle (at least monthly)
- provide an alarm if (a) the power supply fails and (b) if the automatic test cycle fails
BS 9251 : Design

Pipes, Fittings & Supports...

Carbon Steel
[BS EN 10255]
32mm – 2.7m

Copper
[BS EN 1057:2006]
32mm – 2.4m

CPVC
[ASTM F442]
32mm – 2.0m
BS 9251 : Design

Pipes, Fittings & Supports...

Install Trace Heating & Lagging where risk of freezing exists
BS 9251: Design

Alarm Devices...

All Systems should have an Alarm device and shall be...

➢ an electrically operated flow switch,
➢ initiated by flow of a single sprinkler head with the lowest flow rate,
➢ connected to an internal audible alarm, or
➢ interfaced with an automatic fire detection and alarm system

In Multi-storey Apartment Blocks, the alarm may be...

➢ configured to serve an alarm zone, rather than each individual dwelling, provided...

   a) the alarm zone should cover no more than a single floor
   b) the individual dwellings should be fitted with an LD1 alarm system
   c) be connected to suitable control and indicating equipment
BS 9251: Design

Figure A.2 Elements of a typical single pump and tank sprinkler system

Key:
1. Mains water supply
2. Water provider’s stop valve
3. Lockable tank isolation valve
4. Float valve with suitable backflow prevention device
5. Tank overflow
6. Water storage tank
7. Tank lid
8. Lockable tank suction stop valve
9. Lockable pump isolation valves
10. Pump
11. Non-return valve
12. Pump controller
13. Electrical water flow switch
14. Test and drain valve
15. Installation pressure gauge
16. Sprinkler head
COMMISSIONING
BS 9251: Commissioning

Leakage Test…
- pressurized to a minimum pressure of 8 bar or to 1.5 times the maximum working pressure

Hydraulic Test…
- tested to check that at least the design flow rate can be achieved at the design pressure when measured at the combined drain and alarm test valve

Alarm Test…
- alarm device should be tested by opening the alarm test valve to ensure a flow of water and checking that the alarm operates as designed

Compliance certificate…
- a compliance certificate should be issued by the competent person in, which attests that the sprinkler system has been designed, installed and commissioned in accordance with the System Performance Specification
MAINTENANCE
Inspecting and testing…

The systems should be subject to an annual inspection and functional test by a competent person, and include as follows…

- Check whether all components are functioning as designed
- Any or all modifications have been carried out in accordance with the required standard
- Sprinklers & cover plates inspected to determine whether they have been tampered with or whether their spray pattern has been impeded.
- Valves are exercised to ensure free movement and any locking mechanism should be checked
- The test valve should be operated to determine whether the system’s design flow rate and pressure, as hydraulically calculated, is achieved
- Alarms should be tested to determine whether they function as designed, including remote monitoring arrangements where applicable.
- Where trace heating is installed, its operation should be checked
ENHANCED PERFORMANCE, RELIABILITY AND RESILIENCE
FOR SYSTEMS INSTALLED IN THE HOMES OF VULNERABLE PEOPLE
B1: Identifying the most vulnerable from fire...

Is a combination of hazard, likelihood and therefore a matter of risk

**Hazard** : the ignition source for a fire and materials to aid combustion

**Likelihood** : the probability of a fire starting

**Risk** : the person being unable to escape in sufficient time to avoid injury or death from fire.

People who are vulnerable from fire can be considered as...

- those with a higher than average likelihood of causing a fire
- those with poor reaction (mobility) in the event of a fire
- those with a lower than average appreciation of the danger presented by fire
BS 9251 : Annex B

B2 : Significant factors outlining Vulnerability...

The following factors are not deemed to be definitive, but might be primary indicators for concern.

a) likelihood:
- high fire risk activities or habits, such as careless disposal of smoking materials or leaving cooking unattended
- history of fire-setting behaviour
- history of previous fires or evidence of near misses, such as scorch marks on clothing or furniture
- threats of arson

b) inability or willingness to escape:
- impaired mobility affecting ability to escape
- impaired reaction to fire or warning devices
- impaired senses affecting ability to respond to alarm
- poor situational awareness
B3: Additional performance, reliability and resilience measures

Additional measures might be needed as part of the system design in order to address concerns with a higher than average risk profile...

- increasing the duration of application and/or the resilience of the water supply
- upgrading the system to a higher category or to BS EN 12845
- arrangements to maintain system integrity during maintenance or repair
- provision of a back-up power supply to pump(s)
- additional pumps to provide redundancy
- remote monitoring of critical system components
- automatic test facilities;
- installation of a fire and rescue service inlet to supplement the water supply.
In Conclusion…

BS 9251 is a code of Practice, providing guidance on the Design of an Automatic Sprinkler Systems for a particular risk.

All factors should be taken into consideration when deciding on the level of protection and system performance required.

BS9251 Sprinkler systems designed for the preservation of Life in the event of a fire and must perform as required, when required.

All intrinsic hazards and risks should be taken into consideration in preparation of the Fire Strategy and the Automatic Sprinkler System Specification.

The BS9251 Code may not be sufficient in itself and the appropriate Authorities Having Jurisdiction should be consulted in advance.
THANK YOU FOR YOUR ATTENTION