

Technical Guidance Note No 1 • **Second edition: November 2012**

ISBN 978-0-9571838-2-7

The Design and Installation of Residential and Domestic Sprinkler Systems

This Guidance Note includes:

Appendix 1: Water Supplies for Residential and Domestic Sprinkler Systems

Appendix 2: Maintenance of Sprinkler Systems installed to BS 9251: 2005

**Appendix 3: Statement of BAFSA's views on non-compliant sprinkler systems
in residential and domestic premises**

This document is issued for the guidance of BAFSA members and should be used in accordance with the contents of BS 9251: 2005. In providing this information BAFSA makes no warranties or undertakings as to its accuracy or completeness and assumes no liabilities in connection with the way the advice and information is used. Any deviations from BS 9251: 2005 should be agreed with the Authority Having Jurisdiction and any minor deviation recorded on the Certificate of Compliance should identify the originator of the deviation. BAFSA's advice is that Certificates of Compliance should not be issued where a system has been installed with major departures from the requirements of BS 9251: 2005.

Published by British Automatic Fire Sprinkler Association, Richmond House, Broad Street,
Ely CB7 4AH

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Introduction

The standard BS 9251: 2005: *Sprinkler systems for residential and domestic occupancies. Code of practice* has been in use for seven years, following the five years experience of its predecessor, BS DD 251. While the advice and information contained in the standard has been found to be generally sound, a number of clauses in the standard have given rise to differences and difficulties of interpretation, and it is generally agreed in the sprinkler industry that parts of the standard would benefit from clarification and amplification. **The relevant British Standards committee (FSH 18/2) will be commencing a review of BS 9251 in December 2012. BAFSA, as a member of that committee, will be proposing that the contents of this document should be considered during the review.**

This Technical Guidance Note is intended to supplement the contents of BS 9251 but it is not a substitute or replacement for that standard and users must refer to the actual text of BS 9251 when reviewing or designing/installing residential and domestic sprinkler systems.

BS 9251: 2005 is a British Standard Code of Practice and, as such, details best practice and should be complied with unless there are very good reasons for deviations. Where a client specification calls for BS 9251 then to comply with such specifications the sprinkler system must adhere to BS 9251. Designers and installers, however, must ensure that where a system design or installation deviates from the recommendations in BS 9251, such deviations are brought to the attention to the **Authority Having Jurisdiction (AHJ)** for acceptance. Deviations must be recorded in writing in the Certificate of Compliance issued by the installer to the owner of the premises. The deviations recorded should indicate who had originated or requested the deviations. Experience suggests that an improper understanding of how sprinkler systems operate occasionally results in a client, architect or building control official specifying partial protection for premises. This often takes the form of providing sprinkler coverage only on escape routes or in open plan living/kitchen spaces. It is BAFSA's view that such deviations from BS 9251 do not provide adequate protection of life and should be resisted by the designer/installer. Should this major deviation be insisted upon the designer and installer should not provide a Certificate of Compliance but should write to the client making it clear that the proposed system is non-compliant.

Technical Guidance Note No.1 (Second edition) has been produced from a wide range of contributions based on first hand experience in the use of the original BS Draft for Development DD 251 and BS 9251 over the past twelve years. In the guide, the term 'Residential sprinkler' is used to describe the sprinkler heads used in all BS 9251 systems, in both domestic and residential occupancies.

In the commentary that follows, sections C1 to C50 are linked to the appropriate headings of sections and clauses in BS 9251, working systematically through the standard. Only clauses where comments are made are addressed. The final item is an alphabetical index of the topics covered in this Guidance Note.

Foreword to BS 9251

C1 Objectives of residential systems. The primary objective of a residential/domestic sprinkler system is life safety, aiming to control any fire that occurs within protected premises to give time for occupants to escape or be rescued. The operation of any sprinkler system will also provide a significant degree of property protection by minimising damage to the room of origin of the fire and its contents. It is assumed in the standard that the sprinkler protection will form part of an integrated fire safety system as part of the building's design, and that a fire detection system or interconnected mains-operated smoke alarms will also be installed to give warning of a fire as early as possible.

C2 Sprinkler installation standards. Sprinkler protection has been in use in the UK for over 140 years for the protection of industrial and commercial occupancies. The current installation standard for such systems is BS EN 12845: 2009. The current standard for residential and domestic sprinkler systems is BS 9251: 2005 to which this guide is a companion document.

Care should be taken to use the requirements of the standard appropriate to the occupancy, that is Domestic or Residential. (Note, for example, that while the flats in an apartment block may be protected to BS 9251, the sprinklers in the block's car park and rubbish chute should be designed and installed to BS EN 12845.)

C3 Mixed occupancy protection. The protection of buildings with mixed occupancies, such as flats above shops, needs consideration on a case-by-case basis. Examples of approaches accepted by AHJs include using a BS 9251 system, but with the higher densities specified in BS EN 12845 for the shop area in low hazard, smaller premises where this can be demonstrated to be appropriate, and residential densities for the living accommodation.

Installers should be aware that in the case of systems designed in part to EN 12845 and in part to BS 9251, the water supplies should be designed and installed as specified in BS EN 12845.

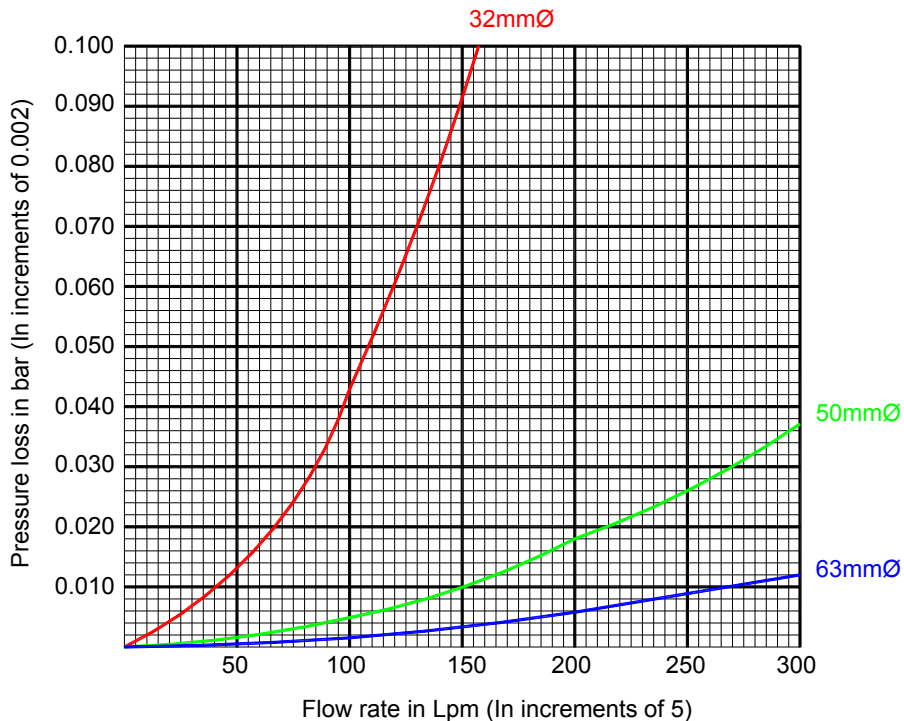
Introduction to BS 9251

C4 Water supply connections. Experience has shown that the required pressure/flows may not be met even when a town's main supply is considered adequate and the commonly used pipe sizes selected for the connection of 32mm (domestic) and 63mm (residential) in MDPE pipe are used.

It is essential that the friction and static pressure losses in a connection pipe to a system should be hydraulically assessed at the maximum anticipated flow rate, including any domestic demand if appropriate, and taken into account within the design requirements of the system. This is of particular importance when the distance from the town's main is unusually long.

To assist with the selection of a suitable sized connection based on the commonly used MDPE pipe type, it is recommended that the following guidance graph of pressure losses/metre run be used for assessing likely connection friction losses.

MDPE friction loss data for 32, 50 & 63mmØ pipe



The pressure losses indicated in the above graph are the friction loss/metre horizontal run of pipe. To evaluate the friction loss in a connection pipe, read off the loss/metre at the relevant flow rate for the selected pipe size and multiply by the pipe route length. For example, with a length of 12m and a flow of 98L/min, the friction loss in a 32mm connection would be (.041bar x 12 = 0.492 bar).

Note: the route length should include necessary equivalent length allowances for fittings/valves etc. (See section C23.)

Static pressure losses should be calculated from formula (A1) given in BS 9251, Annex A and added to/subtracted from the friction losses.

Figures 1 to 6 in BS 9251 show examples of acceptable water supply connections. These arrangements have been agreed with Water UK, the trade association of the water companies, and are featured in the document *Guidelines for the supply of water to fire sprinkler systems*, published by the Fire Protection Association. The document can be downloaded from: www.bafsa.org.uk/pdfs/publications/00000033.pdf

For detailed information on water supplies, see Appendix 1.

C5 Water meters. The principle that water meters could be bypassed for the sprinkler supply, where the system is provided with a local alarm actuated by a flow of water, was agreed with the representatives of the water industry. See section 4.2 of *Guidelines for the supply of water to fire sprinkler systems*. However, some water companies now will not accept all of the guidelines and in all cases the water company should be approached before a connection is made.

Some water companies are assessing the use of ‘bulk’ (40mm) flow meters which allow measurement of larger flows without significant friction loss in the meter.

1. Scope

C6 Building height. The recommended height limitation of 20m was introduced in BS 9251, although it was not included in DD 251. However, the guidance note to the 2010 edition of the Building Regulations for England and Wales, Approved Document B, in Volume 2, states:

8.14 Blocks of flats with a floor more than 30m above ground level should be fitted with a sprinkler system in accordance with paragraph 0.16.

Note: Sprinklers need only be provided within the individual flats, they are not required in the common areas such as stairs, corridors or landings. For the purposes of this paragraph the limit on the scope of BS 9251: 2005 to buildings below 20m in height can be ignored.

However, this does not mean that BS 9251 can be used without restriction in residential blocks of any height. When following the above guidance the written authority of the AHJ must be sought.

(Note that Scottish Building Standards require sprinkler protection when a height limit of 18m has been exceeded).

Where buildings over 20m in height are protected by BS 9251 sprinkler systems then the entire building should be sprinkler protected, and the system be designed as ‘Residential’, with a minimum of 30 min duration of water supply. Where such properties are fitted with a pumped water supply, BAFSA suggests that dual pumps with independent electrical supplies be installed with a stored water supply of at least 30 minutes duration. Alternatively, the premises might be better protected with a sprinkler system designed and installed to BS EN 12845: 2009.

The actual duration should be agreed in writing with the AHJ and should reflect the time needed to evacuate occupants from upper levels of the building under fire conditions. In all cases where the building height exceeds that given in BS 9251 a risk assessment should be made of the building for or by the AHJ. Appropriate additional equipment specified such as dual electric pumps fed from independent electrical supplies should be provided if this is indicated as being necessary in the fire risk assessment.

When sprinklers are to be installed in buildings outside the scope of BS 9251 it is BAFSA’s view that such sprinkler systems must be risk assessed and may need to be installed to BS EN 12845.

Designs and water supply provision should also be agreed with the AHJ, whichever standard is adopted.

C7 Flats: occupancy classification. Flats are covered in the Scope, and in the Definitions. In both, individual flats are ‘Domestic’ and blocks of flats ‘Residential’. The intention was that if only one or two flats per block were sprinklered, and no

corridors or common spaces were to be protected, then Domestic requirements would be appropriate. Guidance to the Building Regulations and Scottish Building Standards suggests that only individual flats need protection, that is, that common areas do not need to be protected. However, it is BAFSA's view that acceptance of protection only to the individual flats is unwise and unwarranted by experience which suggests that fires in common areas are not infrequent. Where more than four flats are to be protected in a single block, then the Residential requirements of BS 9251 should be complied with, including protection of the common areas, giving a water supply duration of a minimum of 30min.

2. Normative References

C8 Sprinkler head component standards.

BS 9251 calls for sprinkler heads approved in accordance with DD 252 which has now been withdrawn and replaced with BS 9252. Work has been approved to start developing a European standard for residential sprinkler heads, EN 12259-14 which should take into account current test standards including BS 9252, plus any new factors felt necessary by CEN. There are as yet no sprinkler heads tested or listed in accordance with the requirements of DD 252, BS 9252 or EN 12259-14 at the time of writing this Technical Guide. There are however, two internationally recognised standards for residential sprinkler heads that have been in use globally, including in the UK for some years:

- Underwriters Laboratories Standard UL 1626, *Residential Sprinklers for Fire-Protection Service*.
- FM Approvals Standard Class No 2030, *Approval Standard for Residential Automatic Sprinklers for Fire Protection*.

Currently only sprinklers listed by Underwriters Laboratories to UL1626 are available in the UK and until such time as there are sprinklers listed and available which comply with BS 9252 test requirements, it is BAFSA's view that listed sprinkler heads which have passed the UL1626 test will need to continue to be used in systems installed to BS 9251.

3. Terms and Definitions

3.4 backflow prevention device

C9 Backflow prevention devices (check valves). UK Water Regulations allow for a single check valve for potable (Class 2) water. If the system is filled with water containing additives, such as anti-freezing agents, or anti-corrosion additives, then a double check valve conforming to Water Regulations Advisory Service specification and listed by them is required. Backflow prevention devices restrict water flow, double check valves significantly more than single check valves, and their resistance or friction loss must be taken into account in hydraulic calculations.

3.5 cistern

C10 Cisterns. A cistern is a water tank with cover where the contents are at atmospheric pressure. The Water Regulations give requirements for cisterns. Water

tanks should always be covered to prevent the entry of foreign objects, birds etc and, for sprinkler use, should always be protected from freezing.

3.7 domestic occupancy

C11 Room size, domestic occupancies. BS 9251: 2005 - Clause 3.7 stipulates a maximum room size of 40m², but it is BAFSA's opinion that the domestic classification could be equally appropriate for rooms larger than 40m² provided a fire risk assessment has been made with particular regard to the likely fire load and other hazard characteristics of the room and that there are no more than two sprinklers in the room. Should there be a fire load greater than that normally found in domestic premises in such rooms then it is BAFSA's view that the premises should be protected to the Residential recommendations of BS 9251 or BS EN 12845, whichever is more appropriate for the fire load involved.

3.8 experienced sprinkler contractor

C12 Sprinkler contractor. The standard recommends that contractors be 'qualified and experienced'. All sprinkler contractors should be in possession of third-party accreditation (for example, by listing under the LPCB's LPS 1301 scheme or under Warrington Certification's FIRAS scheme) and demonstrate that appropriate staff members have the competence to design and install systems to BS 9251. Attendance at appropriate training courses that are endorsed by BAFSA or one of the UKAS-listed sprinkler installer certification bodies would be an effective way to demonstrate compliance with this requirement. Residential sprinkler protection is a relatively new discipline, and installers should ensure that their staff are fully trained and are fully conversant with the design and installation practices of Residential and Domestic sprinkler systems and can demonstrate competency within this scope of work. Suitable courses are listed on the BAFSA website as and when dates are published. Where installation contractors are certified by the LPCB under LPS 1048 to install systems to BS EN 12845 and their listing includes carrying out their own full hydraulic calculations, then it is LPCB's view (shared by BAFSA) that this certification is also adequate to allow the design and installation of sprinkler systems to the requirements of LPS 1301 – the system they use for certifying installers competent to undertake installations to BS 9251.

3.9 fire pump

C13 Pumps. Pumps for sprinkler use should be continuously rated and electrically driven. To ensure the necessary degree of reliability, it is essential that they have an automatic system to ensure pump starting at least once every 60 days. To avoid the possibility of a pump not starting upon sprinkler activation it is not sufficient to rely on the annual maintenance test. If the pump is not fitted with such an automatic starting mechanism then it should be started manually not less than once every 60 days and run for a few seconds. The automatic start test should preferably be initiated by emulating a drop in pressure as if a sprinkler head had operated and an alarm should be raised if the pump fails to start.

It is not necessary to specify a 'fire pump' as defined in BS EN 12845. Specialised pump packages suitable for domestic and residential sprinkler systems are available from a number of manufacturers.

Pumps should normally be installed solely to supply the sprinkler system. Where pumps are to be used for dual purposes, then the electrical supply should be installed in accordance with the recommendations in BS 9251 and the pump rating shall be sufficient to supply the maximum sprinkler requirement and the maximum requirement for other services simultaneously.

3.14 quick response sprinkler

C14 Quick response sprinklers in residential occupancies. Please note that the requirement for approved sprinkler heads within BS 9252 is fully covered in **C8** above.

- 3.17 ‘Residential’ sprinklers are not classified in the same way as standard sprinklers in terms of response. Although the requirements are similar to those for quick response sprinklers, the term ‘quick response’ is not applied to Residential sprinkler heads in the US where virtually all of these are manufactured. In addition to the same response tests which standard sprinklers undergo, Residential sprinklers must also meet extra requirements specific to residential sprinklers such as passing performance-based room fire tests. All residential sprinklers heads must meet the same requirements and, in terms of response, are simply classified as ‘Residential’ or ‘Residential Occupancy’.

C15 Height and room size limitations in residential occupancies. The limitations regarding height and room size were introduced in BS 9251 as a cautionary measure. This matter will be addressed at the upcoming revision of BS 9251 which is imminent. Approved Document B (AD-B) of the Building Regulations 2010 accepts the use of BS 9251 in buildings higher than those envisaged in the standard. AD-B also accepts the use of BS 9251 in specific instances for buildings higher than allowed by the BS 9251. Where AD-B is called up, care must be taken to ensure compliance with it or the Scottish Technical Handbooks and where a Certificate of Compliance cannot be issued because of deviations the matter should be recorded in an exchange of correspondence with the AHJ and/or the client or their representative.

3.22 subsidiary alternate system

C16 Dry or part air-charged systems. Subsidiary alarm valves allow air-filled sprinkler pipework in areas subject to freezing. Their use is deprecated because residential sprinklers heads are designed to respond swiftly to heat and the use of systems partly or wholly charged with air will result in a delay in water being discharged after the operation of a sprinkler head. This could allow many sprinklers to operate, in excess of the design number, which may result in the sprinkler system not operating as intended. It is BAFSA’s view that dry or part air-charged systems should not be specified for residential or domestic installations.

3.23 upright sprinkler

C17 Upright sprinklers. At present, there are no listed upright residential sprinklers, although upright and pendant industrial sprinklers may be used for the protection of loft spaces while some specialised sprinklers have been designed for this purpose. In those cases where upright or pendant industrial sprinklers or specialised sprinklers are used for this purpose, the systems should be designed and the sprinklers installed according to their listings or approvals.

5.1.1 *Types of supply*

C18 Stored water. Swimming pools, underground tanks, lakes and wells may be used as a source of stored water, provided that they are of sufficient capacity to meet the system's requirements as indicated by BS 9251. Where tanks are installed for multiple service use, the draw-off point for other services should ensure that the required volume of the water for the sprinkler system is not impaired.

5.1.2 *Supply characteristics*

C19 Water mains supply connections. BS 9251 recommends that when using an existing service pipe the pressure should be checked and flow rate ascertained at the point of entry to the building.

Where new connections are proposed to town's main supplies they should be of the full bore type. All endeavours should be carried out in order to verify the town main's suitability before its use is proposed. Customers should always be advised of the system's required flow/pressure requirements and informed in writing, that a town's main supply cannot be guaranteed in the future and that no liability can be given by the sprinkler contractor of continued suitability of the town main.

At the commissioning of the system a full flow/pressure test should be conducted to ensure that the system design requirements can be met.

Before the test, the pressure required at the valves must be determined, together with the calculated design flow rate of the system for the most hydraulically unfavourable area. The pressure requirement will be that of the most hydraulically remote sprinkler head, plus the pressure loss/gain due to elevation and pressure losses in the intervening pipework.

For more information on carrying out testing see item C47 and Section 4 of Appendix 2 below.

5.2.3 *Extent of sprinkler protection*

C20 Bathrooms. Bathrooms with a floor area of less than 5m² are a permitted exception to full protection of the building. Shower rooms and toilets can be considered as coming under this recommendation. (It should be noted that acrylic baths and other furniture in a bathroom or shower room can provide a substantial fire load.)

C21 Loft and attic protection. BAFSA strongly recommends that lofts and attics should be sprinkler protected in all domestic or residential premises if used for storage.

While fires in lofts and attics are relatively rare, the protection of loft spaces may be considered principally as a property protection benefit unless the area is used as living or sleeping space. It may be possible to omit protection of loft spaces if these are effectively 'sterile' and there is suitable passive fire separation between the habitable areas and the loft space.

Where loft spaces are to be (or are likely to be) used for storage then sprinkler protection should be provided. The use of lofts for storage renders them particularly

fire hazardous and, should a fire occur, as has been found in practice, can seriously affect the efficiency of the sprinkler protection in the remainder of the property.

If consideration is given to omitting sprinkler protection, such as when determined to be a crawl space under BS 9251, or under the specific instruction of the AHJ, it is strongly recommended that a fire alarm detection system be installed into the loft space. (A 'crawl space' is interpreted by BAFSA as a space that is less than an average of 800mm high at the highest point.)

The omission should be confirmed in writing to the AHJ, referenced on all design drawings, relevant documentation and identified as a 'deviation' on any certification.

If loft spaces are to be protected, then 'attic type' or 'Residential' sprinkler heads listed for use on the appropriate ceiling slopes should be used. Where the loft slopes exceed the listed maximum permitted slopes for these sprinklers, suitable standard industrial sprinklers may need to be employed.

Care should be taken to protect sprinklers installed in lofts and attics from freezing and, where the loft space is frequently accessed, against physical damage.

C22 Integral garages. BAFSA strongly recommends that integral garages should be protected whether or not there is an internal connecting door. In the case of car parks, sprinkler protection should be undertaken to BS EN 12845: 2009

5.2.4 *Hydraulic calculations*

C23 Friction losses in valve sets. BS 9251 only requires pipe friction losses to be calculated downstream of the valves, and care should be taken to allow for the losses in water supply connections and valve arrangements. Failure to do this has led to several cases where system demand requirements have not been attained at commissioning tests leading to unnecessary contractual disputes. In the absence of equivalent hydraulic lengths for valves and flow switches within BS 9251, and if the information is not available from a supplier, it is recommended that the following tables be used as guidance.

<i>COPPER: Equivalent hydraulic lengths in metres of a flow switch and check valves</i>				
Description	Nominal diameter in mm			
	28	35	42	54
Flow switch (notes 1 and 4)	2.5	3.2	4.0	5.5
Swing check type NRV (note 2)	1.6	2.1	2.7	3.2
Mushroom type NRV (note 2)	8.0	12.6	13.2	16.0
Disc type NRV (notes 3 and 4)	8.0	12.6	13.2	16.0

<i>CPVC/MDPE: Equivalent hydraulic lengths in metres of a flow switch and check valves</i>				
Description	Nominal diameter in mm			
	25	32	40	50
Flow switch (notes 1 and 4)	3.1	4.0	4.7	6.1
Swing check type NRV (note 2)	1.8	2.4	3.0	3.6
Mushroom type NRV (note 2)	9.1	14.4	15.0	18.2
Disc type NRV (notes 3 and 4)	9.1	14.4	15.0	18.2

Note 1: *Flow switch equivalent lengths have been derived on the basis of UL 346 test parameters where UL listed flow switches are required to have a maximum loss of 3.0 psi (0.207 bar), at a flow rate equivalent to a velocity of 15ft/sec, (4.6m/sec).*

Note 2: *Swinging and mushroom type check valve equivalent lengths have been interpolated from BS EN 12845, Table 23 where the lengths are given for a Hazen-Williams C value of 120 and adjusted to reflect the pipe type C value correction values of 1.33 for copper and 1.51 for CPVC/MDPE pipe.*

Note 3: *Spring assisted disc type check valves are considered to have similar characteristic to mushroom type check valves and the same values applied.*

Note 4: ***To be considered temporary values until verified.*** *The results gained from a series of preliminary verification tests undertaken by a third-party certification body to determine actual pressure losses across popular flow switches and disc type check valves of 25, 32 and 50 diameter imply that the measured pressure loss across these devices is significantly greater than anticipated. On completion, the recommended equivalent lengths may be re-calculated to reflect the test findings.*

5.2.5 System flow rate

C24 Discharge rates. The flow rates required at the operating sprinklers are clearly identified in BS 9251 and these should be considered the minimum water discharge rates to be used in sprinkler system designs for residential and domestic hazards. Where residential pattern sprinkler heads are used they should either meet these minimum flow rates or their approved listed discharge performance, whichever is the greater.

The system must be designed to provide the minimum approved flow and pressure from the design number of sprinklers at the hydraulically most unfavourable location, with reference to the hydraulic pressure variation across the appropriate sprinkler array. See also C31.

The introduction of sprinkler head approval standard BS 9252 will mean that these provisions in BS 9251 with regard to discharge rates from sprinklers may be amended. However, as there are no sprinkler heads yet available that have been tested to BS 9252 and until BS 9251 is reprinted to reflect availability, the continued use of sprinkler heads approved to either UL 1626 or FM Standard - Class Number 2030 is recommended. Where UL 1626 or FM Standard - Class Number 2030 design

parameters are used, it is essential that their approved listed discharge flow rates are adhered to and fully in accordance with current BS 9251 requirements

5.2.5.2 Residential pattern sprinklers

C25 Types of sprinklers to be used in BS 9251. Only residential type sprinkler heads should be used in the habitable parts of the dwelling. Residential type sprinklers have a discharge pattern which ensures a high degree of wall wetting. Other types of fast response sprinkler may be used, if appropriate, in uninhabitable parts of the building, such as roof spaces, provided they are installed according to their listings and approvals.

5.2.5.3 Minimum operating pressure

C26 Minimum operating pressure. The recommended minimum operating pressure at any sprinkler head of 0.5bar is not related to hydraulic factors. It is to ensure release of the sprinkler valve at any time in the life of the system. In some instances, the manufacturers' specifications call for a minimum pressure at the sprinkler head of less than 0.5bar. In such instances a minimum pressure of 0.5bar should be applied at the hydraulically most remote sprinkler, and the increased flow rate addressed in the hydraulic calculations for this and other operating sprinklers.

5.2.6 Flow rate requirements for mains water supply connections

C27 Minimum mains supply pressures. Available flow rates and pressures should be assessed at the times of peak demand on the service mains, where the pressure to the sprinkler system is likely to be at its lowest. Only 85 per cent of the available pressure should be taken, giving an allowance for the possibility that water pressure may be reduced at some point in the future.

Where the 85 per cent requirement cannot be met by supply from the service mains alone then a booster pump, a pump and tank or other alternative supply should be used.

C28 Number of dwellings on one supply. Where a service mains supply serves more than one dwelling, it can be assumed that a fire would affect only one dwelling at any one time unless the AHJ or the fire risk assessment suggests otherwise.

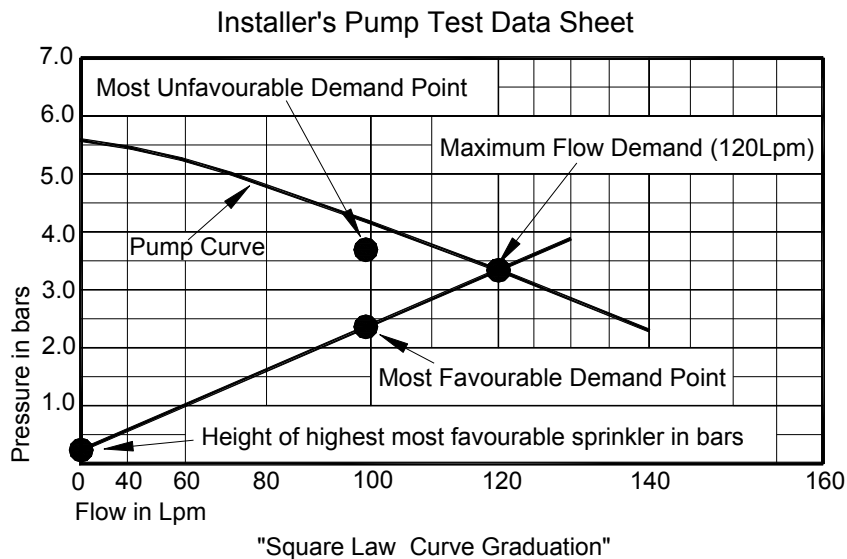
5.2.7 Stored water capacity

C29 Discharge durations. The minimum effective storage capacity of stored water supplies should meet the minimum discharge durations of 10min (domestic) and 30min (residential) as given in BS 9251, at the maximum calculated flow rate for the most favourable area of operation. This is defined as:

‘That flow as determined from the intersection point of the calculated flow/pressure demand of the sprinklers located at the most favourable position and the available water supply flow/pressure characteristics when the water storage tank is at its normal high water level.’

The following graph indicates an example of how to determine the maximum flow to be used for calculating a tank capacity using a square law graduation graph where:

- The Pump Curve characteristic shown is that as tested at the system's calculated demand point when the tank is full.
- The most unfavourable demand point is 98L/min @ 3.6bar
- The most favourable demand point is 98L/min @ 2.4bar
- The highest operating sprinkler in the favourable area is at 2.0m ° (equivalent to) .2 bar
- For a domestic system the effective tank capacity: 10 x 120L = 1200L
- For a small residential system the effective tank capacity: 30 x 120L = 3600L



For particularly high, large or complex premises such as high rise flats or residential care homes, longer times may be needed for escape or to allow the rescue of occupants. It is important that the AHJ is consulted over the duration of supply requirement in these cases. This may also be the case for premises remote from local fire stations. Residents in care homes and similar premises may be unable to make an unaided escape and therefore any fire will need to be controlled for longer while they are being rescued.

5.2.9 *Sprinkler coverage and location*

5.2.9.1 *General*

C30 Sprinkler location. It is essential that sprinkler heads are installed in accordance with the manufacturers' instructions. Manufacturers' data sheets deal with sloped ceilings, location of sprinklers in relation to beams and other requirements specific to each sprinkler head.

5.2.9.2 *Sprinkler spacing*

C31 Sprinkler area coverage.

Until sprinkler heads are available for use which have been tested to BS 9252 and the revision to BS 9251 completed, it is recommended that the current maximum spacing limitations of BS 9251 or UL1626 approved listed areas of coverage should be strictly adhered to.

If it is proposed to exceed the maximum area coverage given in BS 9251 and the UL1626 parameters used, then the maximum area protected by each sprinkler head should be in accordance with its approved listing performance, as shown on the manufacturers' data sheet. Although each sprinkler is listed as being effective over a range of areas of coverage; commensurate with the appropriate flow rates and pressures at which fire control has been demonstrated in tests, it should be understood that this is a deviation from BS 9251: Clause 5.2.9.2 and all documentation, including quotations, design drawings and Certificates of Conformity should clearly identify it as such. The standard areas of coverage at which sprinkler performance has been assessed in fire tests are given in Table 1 below

Table 1. Spacings and areas at which residential sprinkler heads are tested in UL1626.

<i>Pendent, recessed, flush and concealed sprinklers</i>	
Spacing, metres	Area coverage, square metres
3.7 x 3.7m	13.69m ²
4.3 x 4.3m	18.49m ²
4.9 x 4.9m	24.01m ²
5.5 x 5.5m	30.25m ²
6.1 x 6.1m	37.21m ²
<i>Sidewall sprinklers</i>	
3.7 x 3.7m	13.69m ²
4.3 x 4.3m	18.49m ²
4.9 x 4.9m	24.01m ²
5.5 x 5.5m	30.25m ²
6.1 x 6.1m	37.21m ²
4.9 x 5.5m	26.95m ²
4.9 x 6.1m	29.89m ²
5.5 x 6.1m	33.55m ²
4.9 x 6.7m	32.83m ²
4.3 x 7.9m	33.97m ²

Each specific sprinkler type is tested over a range of floor areas, the water flow to the sprinkler being increased as the floor area increases. This ensures the same degree of fire control performance irrespective of room size.

The figures in Table 1 are for rooms with flat ceilings. For sloped ceilings, the manufacturer's design criteria must be applied.

It is vital that the actual listed flows and pressures for the specific sprinklers are used as a minimum in hydraulic design.

The approach adopted by Underwriters' Laboratories in respect of sprinkler head coverage allows for the optimum spacing of sprinklers to be used at flow rates at which the sprinklers have demonstrated that they can meet the fire test requirements of UL

1626. The agreement of the AHJ should be sought and suitably documented if the UL approach is to be used and must be recorded on the Certificate of Conformity.

Where the BS 9251 recommended maximum area of coverage of 15m² per sprinkler is applied, the manufacturers' listed flow rate for the 4.3 x 4.3m (18.49m²) should be used, as a minimum.

All sprinklers should be installed in accordance with their stated performance for flow rate, pressure and spacing relative to the appropriate hydraulic characteristics of the system. The maximum distance from all walls should not exceed half of the listed sprinkler spacing. The distance between sprinklers should not be less than 2.4m in accordance with manufacturer's instructions.

5.2.9.1 Sprinkler positioning

C32 Concealed and recessed sprinklers. One of the main findings of research undertaken by BRE on behalf of the ODPM/CLG (*Effectiveness of sprinklers in residential premises*, see Sources of information, page 19), showed that listed, concealed and recessed sprinklers *are* suitable for life safety applications. Given this, it is BAFSA's view that the Special Note in BS 9251 is no longer necessary. However, BAFSA believes it is necessary for such sprinklers to be tested and approved and it would still be advisable to gain the approval of the AHJ for the use of such heads. Concealed and recessed sprinklers usually require an air flow through the sprinkler assembly for the frangible bulb to operate properly and therefore these type of sprinkler heads should not be boxed in above unless this is specifically permitted in the relevant manufacturer's data sheet.

5.3.1.1 General

C33 Residential type sprinklers. All sprinklers used within the habitable areas of the building should be of Residential type. See **C25**.

C34 Sprinkler test standards and approvals. See **C8**.

5.3.1.3 Temperature rating of sprinklers

C35 Colour coding of fusible link sprinklers. The reference in BS 9251 to the colour coding of soldered strut type sprinkler heads is no longer appropriate since the practice referred to is obsolete. The temperature rating for all sprinkler heads (of whatever type) is marked or stamped at a suitable point on the head, usually on the deflector.

C36 Temperature ratings. BS 9251 gives the suggested nominal temperature ratings for glass bulb sprinklers. The thermally-responsive element of Residential sprinkler heads may be either a glass bulb or a fusible link and their respective operating temperatures have been carefully selected by the manufacturer to pass the performance requirements of the relevant test standards.

5.3.2 *Pipes and fittings*

C37 CPVC plastic pipe. Special care must be taken when installing plastic piping. Correctly fixed joints using solvent cement approved by the pipework manufacturer is essential. Training is available from manufacturers, suppliers and distributors and all staff involved must complete an appropriate training course before installing pipework. Pipework must be installed in full compliance with the pipe supplier's or manufacturer's instructions.

C38 Exposed CPVC plastic pipe. CPVC fire sprinkler systems may be installed 'exposed' if located close to a flat ceiling, provided that the operating temperature of the Residential sprinkler heads is not greater than 74°C. CPVC pipe may also be installed 'exposed' in loft spaces (subject to suitable arrangements for frost protection). Suppliers should be consulted for detailed requirements.

5.3.3.2 *Alarm device*

C39. Alarm devices. BS 9251 allows electrical or mechanical alarm devices to be fitted, but in practice only electrically operated alarms are used. (The typical mechanical/hydraulic devices used in industrial/commercial sprinkler systems require a flow of at least 20L/min to be effective.)

It should be noted that where alarms are to be provided in large and/or multi-storey buildings, the owners or the AHJ may specify different alarm arrangements to suit the particular needs of the occupants. The advice of the AHJ should be sought at the design stage.

C40 Battery capacity of alarm systems. Where the protection is for a single family dwelling, a small HMO or a residential care home, then the sprinkler alarm system will be mains powered and have a back-up battery. In such cases the battery should have sufficient capacity to support both the alarm and associated equipment (such as the priority demand valve) for 24hr plus 10min from the time the mains supply becomes unavailable. An alarm indication that the system has switched over to its battery supply should be given immediately the changeover has occurred.

For larger buildings, or where the sprinkler alarm is linked to the automatic fire alarm and detection system, then the battery back-up needs also to meet the requirements of the whole system. The usual manner of linking in would be a changeover volt-free contact which has no impact on the building's alarm system.

C41 Detection and sprinkler combined alarms. In domestic premises the provision of both sprinkler and smoke alarms may well be unnecessary and in some cases bring confusion. In residential premises the AHJ may require that the sprinkler alarm be linked to a smoke alarm or fire detection system, with the location of the fire indicated on the alarm panel. Where sprinklers and fire detection are linked to the same alarm care should be taken to ensure that the standby battery capacity is sufficient to support the additional sprinkler alarm requirements.

5.3.3.3 Valves

C42 Stop valves. It is essential that the main stop valve should be clearly marked and secured in the open position to prevent accidental or malicious shutting-off of the water supply to the system.

C43 Drain and test valve. The drain and test valve used for the flow test is that referred to in 5.3.3.3(e) and Item 14 on Figure 4 of BS 9251. This drain and test valve should be suitably sized to check the maximum flow rate for the system design but it should also be fitted at the lowest point to allow complete draining of the system pipework.

The **alarm test valve** referred to in 5.3.3.3(d) of BS 9251 located at the end of the hydraulically most remote range pipe is rarely installed, this having been found to be impracticable due to access problems. In larger buildings, a drain-off facility at a remote point might be of value.

C44 Valve set - pipe sizing. The pipes forming the test arrangement should be sized appropriately to allow the maximum flow rate of the system to be tested.

5.3.4 Electrically operated devices

C45 Mains failure. The second paragraph of 5.3.4 of BS 9251 is not intended to apply to the power supply to the pump itself, only to alarms and priority demand valves. However, in large and/or high buildings where duplicate pumps are used, it is recommended that each has a separate mains electrical power supply.

6. Frost protection (see 5.2.2)

C46 Frost protection. Section 6.1.4 of BS 9251 requires that 'any water filled pipework which may be subjected to low temperatures should be protected against freezing at all times'. The most effective way of ensuring this is to install the sprinkler pipework within the heated envelope of the dwelling. Since sprinkler pipes have no flow in them except when a sprinkler operates, protection of the pipes may be necessary where freezing temperatures are likely. Note 1 of BS 9251's 6.1.4 suggests that electrical trace heating and/or lagging or antifreeze solutions may be used to prevent freezing. In some cases lagging alone may be sufficient.

In April 2011 the NFPA issued a definitive guidance note¹ which details the precautions which must be taken when using antifreeze in residential and domestic sprinkler systems; it includes information on the concentrations which should be provided for different agents. Due consideration should be given, not only to ensure the correct initial concentration levels, but also to the maintenance of those levels following periodic testing which discharge water to waste, possible consequential environmental issues and the installation of a sampling facility to expedite a planned checking procedure.

¹ http://www.nfpa.org/assets/files/NFPA_Safety_Alert_on_Antifreeze_April_2011.pdf. The current position is shown at: <http://www.nfpa.org/itemDetail.asp?categoryID=2064&itemID=48038>

6.2.2 Hydraulic test

C47 Flow test for systems connected to service mains. For a flow test to be conducted through the drain and test point labelled 14 in Figure 4 of BS 9251, the pressure/flow rate required at that point must as a minimum correspond with 117 per cent of the system's demand point requirement in the hydraulically most unfavourable area. This must be calculated and include static loss. The flow test should demonstrate that the full pressure at the flow requirement of the design point of the system plus 17 per cent can be met, with the pressure not dropping below that required at the most hydraulically unfavourable area plus 17 per cent. The flow test should be carried out when the system is commissioned, and during the annual maintenance check, and a record kept in the system logbook. The sprinkler system will not be acceptable if the foregoing conditions are not met and the AHJ should be advised accordingly.

For additional information about the conduct of flow tests see Section 4 of Appendix 2 below.

Spare sprinkler heads

C48 Spare sprinkler heads. BS 9251 recommends that the householder is left with spare sprinkler heads and a sprinkler spanner. It is BAFSA's view based on substantial experience that in most cases this practice is undesirable. Where it is proposed to waive the requirement, the views of the AHJ and/or fire and rescue service should be sought.

Supports for plastic piping

C49 Spacing of typical, listed cpvc pipe supports. The manufacturer's data sheets should be used in preference to the data in Table B3 of BS 9521. The recommendations are:

Nominal diameter (mm)*	Horizontal run (m)*	Vertical run (m)*
20	1.7	3.0
25	1.8	3.0
32	2.0	3.0
40	2.1	3.0
50	2.4	3.0
65	2.7	3.0
80	3.0	3.0

*The data shown is that for Blazemaster ®.

C50 Partial protection. It should be recognised that from time to time some AHJs consider that the general requirements of the Building Regulations or Scottish Building Standards can be met by the use of a partial sprinkler system. Sometimes such systems have involved the installation of a single sprinkler on an escape route or in an open-plan kitchen. BAFSA deprecates any use of partial sprinkler protection as this may lead to failure of the system and loss of life. When carrying out an installation providing only partial protection the whole of any open plan area, together with any

interconnecting areas or rooms which not fitted with a fire door offering a minimum of 30min fire and smoke resistance, should be protected. It is not satisfactory to place a single sprinkler head only on a direct route of escape as this would not prevent smoke logging from a fire starting elsewhere within the unprotected area or rooms.

Where partial protection systems are specified by the AHJ, then this non-compliance and the potential inadequacy of the system needs to be made clear in writing to the AHJ, the client and the client's professional advisers. BAFSA advises that Certificates of Compliance should not be issued unless the deviations from BS 9251 are clearly documented. In the case of major non-compliances or divergence from BS 9251 it is BAFSA's view that a Certificate of Compliance should not be issued and the installer needs to make it clear that the protection provided may be inadequate.

Sources of information

BRE Research Project: *Effectiveness of sprinklers in residential premises*, Office of the Deputy Prime Minister, 2006.

BS 9251: *Sprinkler systems for residential and domestic occupancies. Code of practice*, British Standards Institution, 2005.

BS Draft for Development (DD) 252: *Components for residential sprinkler systems. Specification and test methods for residential sprinklers*, British Standards Institution, 2001.

BS 9252: *Components for residential sprinkler systems. Specification and test methods for residential sprinklers*, British Standards Institution, 2011.

BS EN 12845: *Fixed firefighting systems - Automatic sprinkler systems - Design, installation and maintenance*, British Standards Institution, 2009.

FIRAS scheme for residential sprinkler systems, Warrington Certification Ltd.

FM Approvals Standard, Class No 2030, *Approval Standard for Residential Automatic Sprinklers for Fire Protection*, FM Global, 2009.

Guidelines for the supply of water to fire sprinkler systems, Fire Protection Association, 2004.

Loss Prevention Standard (LPS) 1301: *Requirements for the approval of sprinkler installers in the UK and Ireland for residential and domestic sprinkler systems*, LPCB/BRE Certification Ltd, 2007.

LPC Rules for automatic sprinkler installations incorporating BS EN 12845, Fire Protection Association, looseleaf publication – 2003 onwards.

NFPA: *Alert Regarding Antifreeze* – 5 April 2011: Important safety information in NFPA sprinkler standards regarding antifreeze in new and existing fire sprinkler systems.

Scottish Water Byelaws 2004, Scottish Water, August 2004.

UL Standard 1626, *Residential Sprinklers for Fire-Protection Service*, Underwriters Laboratories, 2002.

Water Industry Act 1999, c.9, HMSO.

Water Supply (Water Fittings) Regulations, SI 1999, No. 1148, HMSO.

Water Supply (Water Fittings) (Amendment) Regulations, SI 1999, No. 1506, HMSO

Appendix 1

Water supplies for residential and domestic sprinkler systems

1. Scope

This Appendix provides information on the water supplies for sprinklers systems designed and installed to BS 9251: 2005: *Sprinkler systems for residential and domestic occupancies. Code of practice* and covers:

- (a) the minimum water flow and pressure requirements for residential and domestic installations;
- (b) acceptable sources of supply;
- (c) suggested flow testing procedure;
- (d) information required by water companies before undertaking an installation.

2. Minimum system requirements in terms of pressure and flow

Before undertaking a system design, the pressure/flow requirements for the specific system under consideration must be assessed. The requirements can be found in BS 9251.

The standard gives the requirements for sprinkler systems designed to provide life safety for the occupancy of two classes of residential premises, Domestic and Residential. Domestic dwellings are those designed for single-family occupancy, and Residential dwellings for multi-occupancy. Examples of occupancies in the first group are bungalows and semi-detached houses and, in the second group, residential care homes and blocks of flats. The water supply requirements differ for the two classes of occupancy.

BS 9251 systems can either be directly mains-fed with a booster pump or supplied from a tank with a pump (see below). For mains-fed supplies in both Domestic and Residential occupancies, it is essential to ensure that the water pressure/flow requirement available is sufficient to achieve the pressure/flow required at the hydraulically most remote sprinkler(s), plus 15 per cent. For Domestic occupancies the flow requirement is for one, or a maximum of two sprinkler heads (if there is more than one sprinkler head in a any room). For Residential occupancies it is between one and four sprinkler heads depending on the maximum number of heads in a any room. Where the same water supply also provides the property's domestic requirements and there is an automatic valve arrangement to shut off water to the domestic supply (called a Priority Demand Valve (PDV) in BS 9251), then the water flow as calculated in the above paragraph is the total requirement. If, however, there is no PDV, then an additional flow of 25L/min for Domestic occupancies and 50L/min for Residential occupancies must be allowed for in the tests.

Once the pressure/flow requirements at the valve of the system have been calculated, then the local water supply company should be contacted, and the appropriate 'application for supply' forms should be completed. There should be no bar to their supplying water for a sprinkler system from the water mains.

3. Sources of water supply

The water supply can come from the following sources:

- a town mains water supply;
- a pressure tank or vessel;

- an automatic pump drawing from a stored water facility;
- an automatic booster pump drawing water from a town service mains water supply (formerly town mains) or from an elevated storage tank (more properly, a cistern);
- a gravity-fed, stored water system located within a high rise building.

4. Water supply from the water company mains to the occupancy

Mains-fed sprinkler systems have proved to be very reliable over many years and in most cases will be the cheapest most cost-effective way to meet the pressure/flow requirements for Domestic and Residential sprinkler systems. If, however, the requirements cannot be met from the service mains supply, then alternative means of supply are available.

Where the system is to be fed from the mains supply, an assessment should be made to ensure that, at the time of its lowest capability to provide water, the service mains will still be able to meet the pressure/flow requirement of the system. The water supply company should be able to provide details of the mains supply, in terms of the size of the nearest service mains supply pipe, and time of day of lowest pressure. If at this time of lowest mains pressure, the supply is capable of meeting the system requirements, then steps should be taken to measure the pressure/flow at the input to the point where the supply pipe will connect to the sprinkler system.

The connecting pipe from the water mains to the occupancy (the service pipe) will be, for recently built or new-build properties, MDPE plastic pipe. It is recommended that it should be at least of 32mm OD for Domestic, and 63mm OD for Residential occupancies. To minimise the friction loss between the mains and the sprinkler system, the connection to the mains should be a full-flow, low friction loss type. Older properties may have copper or lead supply pipes of smaller diameter. Unless the mains pressure is substantially higher than 3bar, the service pipe will need to be replaced with a new MDPE pipe of the sizes given above. If this is necessary, then care must be taken to ensure that the connection to the mains is of the full-flow type. The cost of the work will need to be taken into consideration, since in some cases this can be equivalent to the cost of the entire sprinkler system in Domestic occupancies.

It is important actually to measure the pressure/flow at the end of the service pipe to ensure that the minimum system requirements are met, before proceeding with the installation. Where the distance from the water main to the property is long, then the pressure loss in the supply pipe may be too great to allow adequate pressure/flow to be achieved. In such cases a booster pump or alternative means of supplying the system will be needed.

5. Booster pumps

Booster pumps are small electric pumps installed 'in-line' between the service pipe and the sprinkler system. The express permission of the water supply company is required for the use of a booster pump, which like all components on any mains-connected system should be WRAS approved. These are of use when the mains are of an adequate capacity, able to supply the flow requirement, but the pressure is below that required for the system. The service pipe must be of at least as large a diameter as the inlet diameter of the pump. Given the system supply requirements, and the lowest likely mains pressure, the pump manufacturer will specify a pump suitable for the application. Booster pumps must start automatically upon the operation of a sprinkler. To ensure this, pumps must be provided which are fitted with an automatic mechanism to start (and stop) the pump for a very short time at least once every 60

days. If there is no automatic mechanism, the pump should be started for a short time manually at least once every 60 days.

6. Pump and tank supplies

Where the mains supply is not suitable, either directly or boosted, the most usual alternative is to use a tank (cistern) of adequate capacity, together with a pump that will meet the system demand requirements.

For systems supplied from tanks of limited capacity, the basic pressure/flow requirements are the same as for mains fed systems, but there are minimum duration requirements of the water supply. These are 10min for domestic properties, and 30min for residential occupancies. These times relate to the underlying life safety objective of the standard, which is that it should either be possible for a person in the room of origin to escape or, if incapacitated, to be rescued within the times stated. The sprinklers should suppress or contain the fire, allowing tenable conditions for the occupants until rescue can be effected. This should also be so for all other persons in the building at the time of fire.

Building control officers, guided by the fire authority, may specify longer durations for a number of reasons, including: a longer than usual fire and rescue service attendance time; where the building is large, high or complex; or where occupants are likely to be unable to evacuate easily.

If the water tank is also used for the property's domestic water supply, an additional 10 per cent capacity above that required for the sprinkler system must be added and the domestic supply should be taken above the level reserved for sprinklers.

Where the available space for a tank is limited, and the inflow to the tank is adequate, a smaller tank may be used, providing that the design water supply requirement can be met for the 10min or 30min duration required. The minimum tank capacity allowed is 60 per cent of the total volume. Before this approach is used, the inflow to the tank should be measured to ensure that it is adequate

Where tanks might be subject to freezing, then precautions must be taken to prevent this. Means of achieving this include lagging, or the use of a sump heater, and often both. All tanks should be covered to prevent the ingress of foreign materials, such as birds, which might restrict the outflow to the pump.

7. Automatic pumps

Like the booster pumps described above, these are small electrically driven units. In most cases they can be powered from a single-phase 13 amp supply. For domestic applications, flow rates of up to 120L/min may be required, and in residential applications the flow rate required may be twice that. Pump output characteristics should be at least capable of meeting the hydraulic requirements of any part of the sprinkler system. For the larger flows a three-phase electrical supply may be needed. Pumps are manufactured with a wide range of pressure/flow characteristics to match the design requirements of domestic and residential sprinkler systems.

It is vital that water is instantly available when a sprinkler head operates, so it is essential that the pump will start when a signal is received from the flow switch and/or pressure switch that a sprinkler has operated. It is not sufficient to rely on the annual flow test in the maintenance schedule to achieve this. To minimise the possibility of a pump not turning starting when required, pumps should be fitted with an automatic system which rotates the pump for a short time at least once every 60 days. If this feature is not provided then there needs to be a

procedure in place to ensure that the pump's start sequence can be verified manually not less than every 60 days.

For high or large buildings it is recommended that two pumps be installed, with the electrical supply coming from two separate sources and with separate starting mechanisms.

Automatic pumps should be installed in locations where:

- they are unlikely to be affected by a fire;
- the temperature will be maintained above freezing;
- they are secure from interference.

Pumps should also be:

- protected electrically by suitable fusing;
- protected against the effects of fire;
- of sufficient capacity to ensure the design pressure and flow requirements for the whole system can be met.

8. Stored water

Swimming pools, underground tanks, lakes and wells may all be used as a source of stored water, provided that they are of sufficient capacity to meet the standard system's requirements. Where tanks are installed for multiple service use, the take-off point for other services should be located sufficiently high enough above the sprinkler take-off point to provide the specified volume of water for the sprinkler system.

9. Flow testing on commissioning and at annual maintenance checks

Guidance on conducting a pressure / flow test on the water supplies at commissioning stage and during the annual maintenance checks to ensure the system design criteria can be achieved is given in Appendix 2, Clauses 4.0 to 4.3

9.1 Information required by the Water Supply Company

All systems must be registered with the water supply company. Many water companies have standard forms for applicants to complete before a system is installed. Since the cooperation of the water company is essential, it is wise to approach them at the earliest possible opportunity.

The water company will require design details prior to commencement of the installation to confirm that :

- the system design complies with the requirements of the Water Supply (Water Fittings) Regulations 1999 for the distribution of drinking water;
- the non-metallic materials used within the wholesome water system comply with the requirements of the Water Supply (Water Fittings) Regulations 1999 for the distribution of drinking water.

Additional information required from the water company will include:

- confirmation that the sprinkler system will be adequately supported by the current level of water flow and pressure to a level in accordance with the water supplier's functional suitability assessment;
- water supply performance data for the area over the last 5 years including details of:

- total loss of supply;
- reduced pressures;
- reasons for problems;
- any known factors that may impact on future supplies such as leak reduction policy;
- that the requested supply pipe detailing is in accordance with the requirements of the system;
- water company policy in respect of the requirement for, and specification of, water meters.

Note that in many cases water companies will allow domestic water meters to be bypassed. Suggested supply pipe arrangements are shown in the Standard for installations with and without the meters being bypassed.

Appendix 2

Maintenance of sprinkler systems installed to BS 9251: 2005

1. Legal requirements

The maintenance of sprinklers installed to BS 9251 is neither onerous nor need it be costly but, it must be understood, it is essential. The sprinkler system should be subject to an annual inspection and test by a suitably qualified and experienced sprinkler contractor. The requirements are covered in section 7 of the standard.

In addition to the maintenance requirements of the standard, unless the system is installed in premises solely used as domestic premises, ongoing maintenance will be required under Article 17 of the Regulatory Reform (Fire Safety) Order 2005. The first clause of the RRO with regard to maintenance states that:

Where necessary in order to safeguard the safety of relevant persons the responsible person must ensure that the premises and any facilities, equipment and devices provided in respect of the premises under this Order ... are subject to a suitable system of maintenance and are maintained in an efficient state, in efficient working order and in good repair.

It would therefore be a criminal offence to fail to maintain any sprinkler system which is installed to protect life. It would also be an offence for a competent person undertaking such maintenance do this incorrectly or inefficiently.

BS 9251 requires that ‘systems should be inspected and tested annually, by a suitably qualified and experienced sprinkler contractor’. Such a contractor is one which has independent documentation providing evidence of capability and is likely to be third-party certificated by an appropriate UKAS-accredited certification body, such as FIRAS or a like certification body.

2. Maintenance and testing objectives

The objectives of the maintenance schedule are to check that:

- (a) the sprinklers’ heat sensing capacity and their spray pattern is not impeded;
- (b) the minimum flow rate recommended in the standard is achieved at the drain and test valve;

- (c) the alarm is effective and can be heard in all parts of the building, or otherwise as determined by the AHJ;
- (d) the system has not been modified except in accordance with the standard.

3. System examination and test procedures

To achieve these requirements, the system should be examined/tested as follows.

- Each sprinkler should be visually inspected to ensure that it is not damaged in any way, and, for concealed sprinklers, that the cover plate has not been painted over, nor sealed by any means to the ceiling.
- In checking the sprinklers, any obstructions to the sprinkler discharge, such as the installation of new partitions, lighting, other internal building alterations and the location of large items of furniture, such as wardrobes, should be reported.
- The system should be visually inspected wherever possible for leaks. Often there are tell-tale stains. If a leak is suspected the pipework may be pressure tested to 1.5 times working pressure for an adequate period, such as an hour, to detect the leak. If a leak is found, then it should be repaired before the system is re-commissioned.
- The alarm should be checked for audibility in all parts of the building. In large buildings the AHJ or the owners may have limited the alarm sounding to particular areas, in which case it is the audibility in these areas that should be checked. If there is an external audio/visual alarm, then the operation of this should also be checked.
- The stand-by battery for the alarm should be load tested to ensure that has not less than 60 per cent of its original capacity.
- The sprinkler system should be flow tested for a suitable time period at the drain and test valves to ensure that the pressure and flow at the valves meets or exceeds the calculated flow and pressure requirements for the system. For all systems, the operation of the drain valve to test the pressure and flow should also cause the operation of:
 - an automatic pump (if fitted);
 - the priority demand valve, to shut off the water supply to the domestic water system (if fitted); and
 - the alarm system - the alarm should be initiated between 12 and 37 seconds of the start of flow.

All the above can be checked during the course of the flow test.

- Both internal and external alarms should be left active.
- Stop valves should be exercised to ensure free movement. After the test, the stop valve should be secured in an open position.
- Where trace heating is installed, it should be checked for satisfactory operation.
- Where anti-freeze is used (glycerine where CPVC piping is used) the concentration should be checked and brought to the correct level if necessary.
- Where a pump is fitted, it should be checked that this has a means of automatically starting and stopping at not less than 60-day intervals. Where there is no automatic means of achieving this, a procedure should be in place to ensure that this is done manually.
- The person carrying out the inspection should complete and sign the Log Book as is recommended in section 7.3 of the standard.

Note: With regard to flow testing, it may not be necessary to conduct the test annually if water pressures have been maintained from the previous annual test. Also, in high rise blocks of flats, where a common water supply serves a good number of flats, then the requirement of flow testing in each flat is inappropriate.

4.0 Flow testing on commissioning and at annual maintenance checks

Hydraulic pressure/flow tests for residential and domestic sprinkler systems installed to BS 9251 must be conducted at the commissioning of each installation and at the time of annual maintenance. A test method is as follows.

Before the test, the pressure required at the valves must be determined, together with the design flow rate of the system. The pressure requirement will be that of the most remote sprinkler head, plus the pressure loss due to elevation and the intervening pipework. The flow rate and pressure necessary will be that flow rate achieved for the minimum listed pressure at the sprinkler head as given in the manufacturer's data sheet, multiplied by the design maximum number of sprinkler heads, normally 1, 2, 3 or 4 heads and pressure required by any anticipated operating number of sprinklers (from 1 to 4 heads) in accordance with the approved hydraulic design of the system.

4.1 Setting up the test

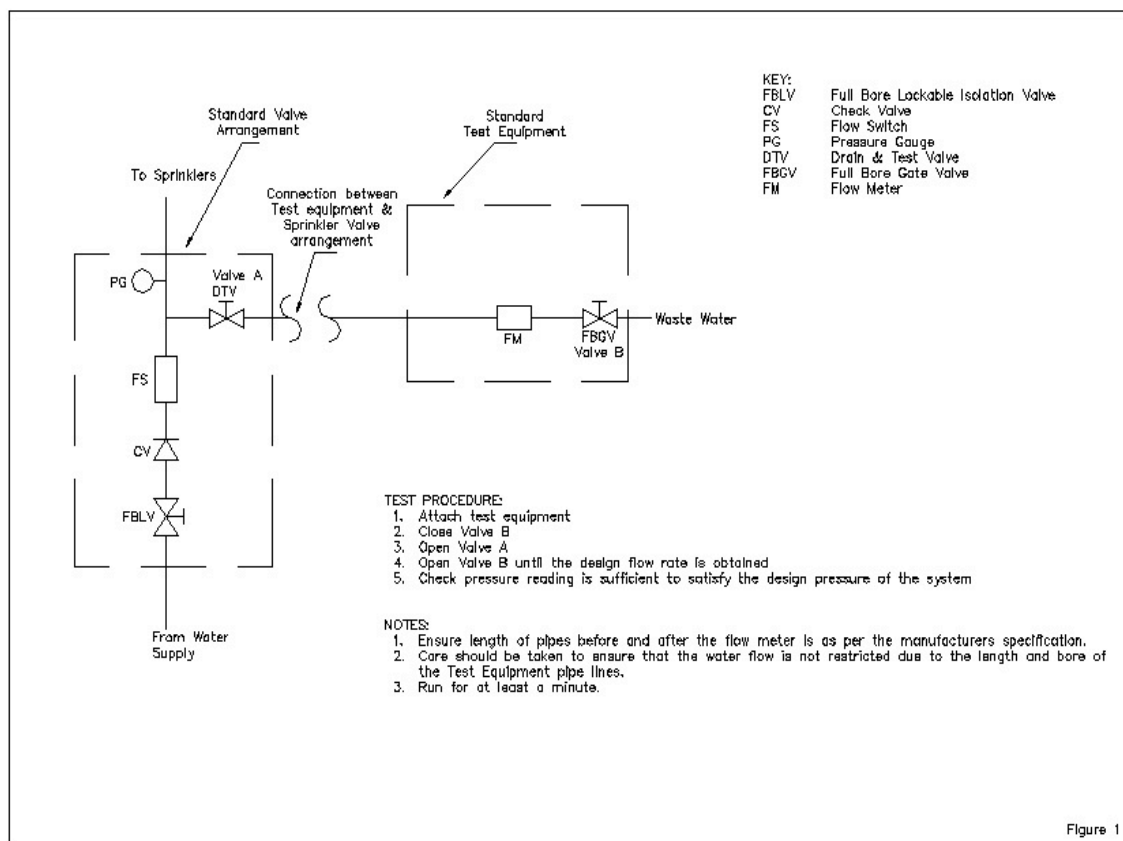


Figure 1. A flow test rig.

Using a test rig, as shown in Figure 1, connect it to the sprinkler control valve drain and test point as shown. An adequate length of hose of at least equal internal bore should be connected to the end of the test rig, with the open end run to a suitable drain point such as a

surface drain, or water tank. The hose should be as straight and level as practically possible. The open end of the hose should not be submerged.

4.2 Conduct of test with a flow meter

To perform the test, close valve B and open all other valves. Slowly open valve B until the required pressure is registered on the pressure gauge. Allow the water to flow for at least one minute to allow residual pressures to dissipate. Read the flow rate on the flow gauge, and check the pressure shown on the pressure gauge. Record the readings.

If the flow and pressure equals or exceeds the required minimum design flow rate and pressure for any part of the system, then the system can be said to comply with the requirements of the hydraulic test in BS 9251: 2005, section 6.2.2.

4.3 Conduct of test using a containing vessel

In this case the water will need to be collected in a calibrated tank over a timed period. To do the test in this way, proceed as above and set the pressure on gauge to the design pressure by adjusting valve B. Allow the system to stabilise and then allow 1 minute's flow or 100L of water, whichever is the lesser, to discharge into the calibrated tank and measure the time this takes with a stopwatch. As before, if the measured flow equals or exceeds the design flow then the system can be said to comply with the hydraulic test in section 6.2.2 of BS 9251

5. Log Book

The Log Book should be completed giving details of:

- (a) the date of inspection;
- (b) details of all tests conducted and their results;
- (c) confirmation or otherwise of the sprinkler system's operational status;
- (d) confirmation or otherwise of the alarm system's operational status;
- (e) details of any recommendations or comments.

Where the flow test does not achieve the required flow rate and/or pressure, then the matter should be reported directly to the owner/user of the system and the AHJ and fire brigade.

The Log Book should be retained on the premises in an easily identified location. Alternatively, for multiple occupancies covered by the same owners, such as a housing association, log books can be located in a central location, readily accessible to those responsible for the maintenance of the systems.

Appendix 3

Statement of BAFSA's views on non-compliant sprinkler systems in residential and domestic premises

BAFSA is often asked to express a view on the use of sprinkler systems that do not comply with BS 9251. It has to be understood that there is no legal obligation to comply with this, or indeed any other standard unless such requirement is written into law - as for example in the Technical Handbooks to the Scottish Building Standards or where building control or an Approved Inspector are being asked to consider alternative forms of compliance with Approved Document B of the Building Regulations 2010. That said, it is BAFSA's opinion that only sprinkler systems designed and installed to BS 9251: 2005 should be specified for residential and domestic premises since reliability and efficacy is a paramount issue for such occupancies.

There are available on the market a number of systems that purport to comply with BS 9251 or 'provide an equivalent degree of protection'. Such systems may be designed to other standards - or to none - but it is BAFSA's belief that they are unlikely to provide the same degree of certainty of reliable operation and levels of protection as systems designed and installed in accordance with BS 9251

Such non-standard-compliant systems include 'low-cost sprinkler protection' where the sprinkler heads are fed directly from the property's internal cold water distribution system, pre-action or 'double-knock' sprinkler systems and 'personal protection' systems fed from pressurised gas cylinders.

With regard to 'grey water' sprinkler systems and rainwater harvesting systems, BAFSA believes that unless and until such systems are specifically provided for in BS 9251, care should be exercised in their use since it is difficult to discern any substantive benefits in their use in a residential and domestic sprinkler system because such systems only discharge - and hence use water - in exceptional circumstances.

It should also be noted that all sprinkler systems supplied from a direct mains connection should, in addition, comply with the water regulations and it is BAFSA's opinion that where such systems are fed from a domestic appliance or where a WC or appliance is supplied by the sprinkler pipe network, such systems often do not comply with current regulatory provisions.

BAFSA also takes the view that certain proprietary systems, actuated by heat or smoke sensors, providing water spray protection for kitchens (and other spaces) cannot be said to comply with BS 9251.

It is BAFSA's opinion, endorsed by the manufacturers of watermist systems, that watermist systems intended for use in residential and domestic systems cannot and do not comply with BS 9251. Such systems now have their own specific design and installation standard in the form of a BS Draft for Development (DD) 8458: 2010: *Fixed fire protection systems - Residential and domestic watermist systems: Part 1: Code of practice for design and installation*. Note that equipment for watermist systems intended for use in residential and domestic premises should comply with Loss Prevention Standard 1283 (2012), *Requirements and test methods for the approval of watermist systems for commercial low hazard occupancies* until such time as an LPS covering components for residential and domestic watermist systems is available.

BAFSA's concerns for all such non-compliant systems relates to fears that these lack the 130 years' experience and constant refinement of 'conventional' sprinkler systems and may fail to operate as intended and thus cause the usefulness and reliability of sprinkler systems in general to be called into question.

Claims that systems or equipment comply with British Standards when they do not may amount to a breach of the Trade Descriptions Act 1968 and may also constitute an offence under the Sale of Goods and Services Acts.

As is made clear in BAFSA Technical Guidance Note No. 1, *The design and installation of residential and domestic sprinkler systems*, any systems that deviate in any significant way from BS 9251 must have the approval of the Authority Having Jurisdiction. It would therefore be the responsibility of the AHJ or other party specifying a system to ensure that an assessment of the proposed system is made to determine whether it will provide a level of protection equivalent to a fully-compliant BS 9251 system.

Specifiers or those involved in providing guidance on the procurement of non-standard systems (including the fire and rescue services) should also be aware that, at the time of writing, no third-party certification body, such as Warrington Certification Ltd or LPCB/BRE Certification Ltd, will allow a certificate of compliance or conformity to be issued for a non-compliant system. Those who propose or support the use of systems which do not comply with an appropriate standard must accept that they may incur an assumption of liability should such a system be discovered to be unfit for the purpose for which it was installed.

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