NZS 4515:2009

STANDARDS
NEW ZEALAND
PAEREWA AOTEAROA

New Zealand Standard

# Fire sprinkler systems for life safety in sleeping occupancies (up to 2000 m²)

**Superseding NZS 4515:2003**

NZS 4515:2009

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BRANZ Ltd
Consumer representative
Department of Building and Housing
Fire Protection Association of New Zealand
Fire Protection Industry Contractors' Association of New Zealand
Institution of Fire Engineers
Insurance Brokers Association of New Zealand
IPENZ – Institution of Professional Engineers New Zealand
Master Plumbers, Gasfitters and Drainlayers NZ Inc.
New Zealand Fire Equipment Manufacturers' Association
New Zealand Fire Service
New Zealand Plumbers, Gasfitters, and Drainlayers Board
Property Council of New Zealand Inc.
Society of Fire Protection Engineers New Zealand Chapter
Sprinkler inspection agencies interest group
Water New Zealand

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NZS 4515:2009

New Zealand Standard

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**Superseding NZS 4515:2003**



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| NZS 1170.5:2004 | Structural design actions – Earthquake actions – New Zealand |
| NZS 3501:1976 | Specification for copper tubes for water, gas, and sanitation |
| NZS 4219:2009 | Seismic performance of engineering systems in buildings |
| NZS 4503:2005 | Hand operated fire-fighting equipment |
| NZS 4510:2008 | Fire hydrant systems for buildings |
| NZS 4512:2003 | Fire detection and alarm systems in buildings |
| NZS 4517:xxxx | Fire sprinkler systems for houses (in preparation) |
| NZS 4541:2007 | Automatic fire sprinkler systems |
| NZS 4781:1973 | Code of practice for safety in welding and cutting |
| SNZ PAS 4505:2007 | Firefighting waterway equipment |
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## JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

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| AS/NZS 1221:1997 | Fire hose reels |
| AS/NZS 1477:2006 | PVC pipes and fittings for pressure applications |
| AS/NZS 2032:2006 | Installation of PVC pipe systems |
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| AS/NZS 2566:- - - - Part 2:2002 | Buried flexible pipelines<br>Installation |
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| AS/NZS 3500.1:2003 | Plumbing and drainage – Water services |
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| AS/NZS 4130:2009 | Polyethylene (PE) pipes for pressure applications |
| AS/NZS 4441:2008 | Oriented PVC (PVC-O) pipes for pressure applications |
| AS/NZS 4765:2007 | Modified PVC (PVC-M) pipes for pressure applications |
| AS/NZS ISO/IEC 17020:2000 | General criteria for the operation of various types of bodies performing inspection |

## INTERNATIONAL STANDARD

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| ISO 6182-1:2004 | Fire protection – Automatic sprinkler systems – Part 1: Requirements and test methods for sprinklers |

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| ASTM A312/A312M-09 | Standard specification for seamless, welded, and heavily cold worked austenitic stainless steel pipes |
| ASTM A403/A403M-07a | Standard specification for wrought austenitic stainless steel piping fittings |
| ASTM A53/A53M-07 | Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless |
| ASTM A795/A795M-08 | Standard specification for black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for fire protection use |
| ASTM F438-09 | Standard specification for socket-type chlorinated poly (vinyl chloride) (CPVC) plastic pipe ittings, Schedule 40 |
| ASTM F439-09 | Standard specification for socket-type chlorinated poly (vinyl chloride) (CPVC) plastic pipe fittings, Schedule 80 |
| ASTM F442/F442M-09 | Standard specification for chlorinated poly (vinyl chloride) (CPVC) plastic pipe, (SDR-PR) |

**AUSTRALIAN STANDARDS**

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| AS 1074:1989 | Steel tubes and tubulars for ordinary service |
| AS 1530:- - - - | Methods for fire tests on building materials, components and structures |
| Part 3:1999 | Simultaneous determination of ignitability, flame propagation, heat release and smoke release |
| Part 4:1997 | Fire-resistance tests of elements of building construction |
| AS 2149:2003 | Starter batteries – Lead-acid |
| AS 2417:2001 | Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1 and 2 |
| AS 4118:- - - - | Fire sprinkler systems |
| Part 2.1:1995 | Piping – General |
| AS TR 5058:2009 | Temperature rerating of PVC pressure pipes operating at elevated temperatures |

**BRITISH STANDARDS**

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| BS 1387:1985 | Specification for screwed and socketed steel tubes and tubulars and plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads |
| BS ISO 3046.1:2002 | Reciprocating internal combustion engines. Performance. Declarations of power, fuel and lubricating oil consumptions, and test methods. Additional requirements for engines for general use |

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### OTHER PUBLICATIONS

| | |
|---|---|
| Australian Building Codes Board | International fire engineering guidelines, 2005 |
| NFPA 13–2007 | Standard for the installation of sprinkler systems |
| NFPA 13D–2010 | Standard for the installation of sprinkler systems in one-and two-family dwellings and manufactured homes |
| NFPA 13R–2007 | Standard for the installation of sprinkler systems in residential occupancies up to and including four stories in height |
| NFPA 20–2010 | Standard for the installation of stationary pumps for fire protection |
| NFPA 22–2008 | Standard for water tanks for private fire protection |
| NFPA 101–2009 | Life safety code |
| UL 199 Ed.5 (2008) | Standard for automatic sprinklers for fire-protection service |
| UL 1626 Ed.4 (2008) | Residential sprinklers for fire-protection service |

### NEW ZEALAND LEGISLATION

Building Act 2004

Building (Forms) Regulations 2004

Chartered Professional Engineers of New Zealand Act 2002

Electricity Act 1992

Electricity Regulations 1997

Fire Safety and Evacuation of Building Regulations 2006

Fire Service Act 1975

Hazardous Substances and New Organisms (HSNO) Act 1996

Health Act 1956

New Zealand Building Code (NZBC) 1992 and Compliance Documents

Resource Management Act 1991

### WEBSITES

http://www.legislation.govt.nz

http://www.ecbcs.org/

## LATEST REVISIONS

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on www.standards.co.nz.

## REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6140.

# FOREWORD

NZS 4515 is a sprinkler Standard that has been developed where the primary purpose is to provide life safety to buildings primarily used for sleeping occupancies. The Standard was first published in 1995 as a result of a need to provide cost effective fire protection for aged care facilities, following a number of multiple fire deaths in such buildings. It was revised a few years later, at which stage the Standard was split into two Standards, NZS 4515:2003, (which was still primarily aimed at smaller commercial sleeping occupancies) and NZS 4517:2002 *Fire sprinkler systems for houses*, which provided an even more affordable alternative for private houses.

The 2009 version of the Standard places a greater emphasis on the life safety characteristics of sprinkler systems, as opposed to their property protection characteristics. With this in mind, it should be noted that all compliant sprinkler systems provide high levels of life and property protection, as these two aspects are interlinked.

The design criteria of the Standard are now more closely aligned to the design criteria of the equivalent American Standard. The ability to adequately protect isolated areas of a higher fire load or challenge has been introduced into this revision of the Standard. Guidance on where residential sprinklers are not suited because of architectural features has been provided in the form of an appendix (Appendix A) courtesy of the United States of America's National Fire Protection Association. Aspects of the Standard, such as the Sprinkler System Certification regime and fire pump technical specifications have been aligned with the most recent edition of NZS 4541:2007 *Automatic fire sprinkler systems*.

This Standard applies to buildings used solely as a residence. NZS 4515 includes care institutions, hostels, boarding houses, apartment buildings, motels, retirement homes, rest homes, transitional houses, and hospital ward areas. The sum of the areas of all the floors remains the same as the 2003 version, at less than 500 $m^2$. If special provisions are met, the limit to 4 storeys and 2000 $m^2$ is permitted; this provision remains the same in this Standard. For sprinkler systems that exceed the stated limitations, refer to NZS 4541:2007.

It is important to install sprinkler heads throughout the protected building with the exception of a few carefully defined areas. The small design water flow permitted is entirely dependent for validity on rapid control of fire wherever it occurs. If a fire grows, for example, because of a gap in the sprinkler head coverage, the water discharge rates from surrounding sprinkler heads would be insufficient to control the fire. More sprinkler heads would open and the water supply would be quickly overcome. It is also stressed that the Standard is an integrated set of requirements; each is dependent on other measures for technical validity.

This Standard recommends the use of residential sprinkler heads as a number of important benefits are derived from their rapid response and fire control:

(a) The amount of smoke and toxic gases produced by the fire is typically well below life threatening threshold levels;

(b) The amount of heat produced by the fire is smaller and less water is needed to cool and control the fire. This provides substantial cost benefits by way of reduced pipe sizing, easier installation, and smaller system water demand.

In contrast with conventional sprinkler heads which have similar performance characteristics irrespective of make, residential sprinkler heads have markedly different water spray characteristics depending on the design pressure and make of head. This means the ➤

design of residential sprinkler systems is very 'head specific' and is based on the approval listing data issued by the sprinkler head manufacturer.

Experimental evidence from the international use of this technology demonstrates that fatalities from fires in buildings protected by residential sprinkler heads are extremely unlikely when achieving early control of the fire. Practical experience in New Zealand and in North America confirms this. The overall improvement in life safety is further enhanced by the addition of smoke alarms and the preparation of effective evacuation procedures.

## OUTCOME STATEMENT

Systems designed to NZS 4515:2009 will contribute to the prevention of the loss of life, and provide better protection of sleeping occupancies for all New Zealanders, by specifying the minimum requirements for the design, material, manufacture, and installation of fire sprinklers systems in sleeping occupancies.

New Zealand Standard

# Fire sprinkler systems for life safety in sleeping occupancies (up to 2000 m²)

## 1 GENERAL

### 1.1 Scope

This Standard specifies minimum requirements for the design, material, fabrication, and installation of fire sprinkler systems for life safety in sleeping occupancies, and advises on periodic testing and maintenance approval of these fire sprinkler systems. This Standard provides a specification for use by purchasers or specifiers of a fire sprinkler system for buildings, used solely as a sleeping occupancy.

#### 1.1.1 Inclusions

This Standard assumes that occupancies contain residential fire loads as would normally be expected in a residence found in New Zealand. Where fire loads are found to be abnormally high, extra precautions should be taken. NZS 4515 is aimed at controlling a fire occurring in a building so that survivable conditions are maintained throughout the building for at least 20 minutes.

NOTE – In the selection of a 20-minute period during which fire control must be maintained, it is assumed that an orderly evacuation can and will be undertaken within the duration of the water supply, and that a supporting firefighting response will arrive at the building. Administration areas within the sleeping occupancy and related to the facility are also included.

#### 1.1.2 Exclusions

This Standard is not suitable for protecting community halls, prisons (other than self-care units), hospitals (other than those without operating theatres and recovery suites), churches, wharenui, and similar occupancies. Refer to NZS 4541.

#### 1.1.3 Building limits

This Standard is for life safety protection in sleeping occupancies where persons within the building at the time of a fire can evacuate the building, with or without assistance, to a ‘safe place’ (as defined in the New Zealand Building Code), within 20 minutes.

The four operating residential sprinkler and discharge density design criteria in this Standard were developed under flat smooth ceilings at 2.4 m high.

The use of residential sprinkler design criteria may not be suitable in rooms which have the following features:

(a) Unusually high ceilings (>3 m flat ceilings);

(b) Steep sloping ceilings (> 37.5°);

(c) Features that may interfere with the rising hot gases or the sprinkler discharge pattern; ➤

(d) Fire loads within rooms that have a higher than normal residential occupancy;

(e) Where contents within a room have a high spread of flame index or are manufactured from highly combustible material;

(f) Configuration of the contents such as free-standing screens, privacy curtains, and furniture used as room dividers that will disrupt the sprinkler discharge pattern.

See Appendix A for more information on residential sprinkler development limitations.

NOTE – In protecting areas with the features set out in 1.1.3(a) to (f) within a sleeping occupancy, designers should take guidance from Appendix B, an SSC, sprinkler manufacturers' data sheet, sprinkler manufacturers' residential design guide, or the NFPA's 13R and 13D Handbooks.

In areas where residential sprinklers are not suitable, reference can be made to 3.2.2, 3.2.3, 4.4.1, and 5.1.2.

#### 1.1.3.1

Sleeping occupancies (see 1.5.1 for the definition) include a rest home for the elderly, care institution, hostel/backpackers/boarding house/guesthouse/bed and breakfast facility, apartment building, motel, retirement home, supervised accommodation home, and sleeping areas in hospital wards. This could also include self-care units in for example, prisons or other institutions.

Unless the provisions of 1.1.3.2 apply, protection of these buildings in accordance with this Standard is limited to those where:

(a) The sum of the areas of all the floors does not exceed 500 $m^2$; and

(b) The height does not exceed three storeys.

NOTE – The four residential sprinklers discharge design criteria and residential sprinklers are not suitable to be used for protection of risks within sleeping buildings such as store rooms, linen stores, retail areas, operating theatres, and recovery rooms. See 4.4.

#### 1.1.3.2

If the sprinkler system has a water supply which can provide at least a 60-minute flow at the highest design flow and pressure, and the system is fitted with a fire brigade alarm (see 3.9) and a fire sprinkler inlet (see 6.8), then the limits of 1.1.3.1 may be increased as follows:

(a) The sum of the area of all the floors shall not exceed 2000 $m^2$; and

(b) The height shall not exceed four storeys.

#### 1.1.3.3 Compliance with the New Zealand Building Code

This Standard is incorporated by reference as an acceptable solution for compliance with the New Zealand Building Code (NZBC) fire safety clauses for buildings within the defined scope as described in this section. In addition, the incorporation has amendments as detailed in Appendix D of the Compliance Document for the NZBC fire safety clauses.

**1.1.3.4**

The surface finish of interior walls and ceilings shall comply with the requirements of the Acceptable Solution C/AS1 of the Compliance Document for the NZBC fire safety clauses.

NOTE – The results of small-scale fire testing such as defined in AS 1530.3 cannot be used in isolation as evidence of compliance with this clause.

**1.1.3.5**

A building exceeding the limits specified in 1.1.3 should have a system designed and installed in accordance with NZS 4541.

NOTE – For the purpose of determining both floor area and number of storeys, a basement of up to 50 $m^2$, (including an underfloor garage) may be disregarded provided that it does not include sleeping facilities. Such basements, however, need to be protected by the sprinkler system (see 4.4).

## 1.2 Objective

The objective of this Standard is to provide the building owner, specifiers, users, manufacturers, suppliers, installers, and maintenance persons with requirements and guidance to assist in the design, construction, and maintenance of a life safety sprinkler system. The purpose is to reduce risk to occupants in the event of a fire by maintaining conditions at a level to facilitate a safe evacuation, and to minimise fire and smoke damage to property.

## 1.3 Interpretation

For the purposes of this Standard, the word 'shall' refers to requirements that are essential for compliance with the Standard, while the word 'should' refers to practices that are advised or recommended.

The terms normative and informative have been used in this Standard to define the application of the Appendix to which they apply. A normative appendix is an integral part of a Standard while an informative appendix is only for information and guidance.

## 1.4 New technologies

A sprinkler system certifier (SSC) may deem new technology to comply with the Standard. A SSC must be satisfied that the new technology will detect, reduce the loss of life from the effects of fire, and control fires with at least the same adequacy and reliability as existing technology permitted by this Standard.

## 1.5 Definitions and abbreviations

### 1.5.1 Definitions

For the purposes of this Standard, the following definitions apply:

**Approved** — Approved by the SSC unless specified otherwise in this Standard

**Domestic occupancy** — The home of not more than one household and includes any attached self-contained unit. Multiple adjoining occupancies are considered to be included provided they are separated by fire rated walls (for example, townhouses)

**Drencher** — A sprinkler that is designed to wet the external face of a building or window

**Extra light hazard** — Non-industrial occupancies, as defined in NZS 4541, where the amount and combustibility of the contents is low

**Fire resistance rating (FRR)** — The resistance in minutes determined in accordance with AS 1530.4 (or other fire resistance testing Standard proved to be not less suitable) for stability (structural adequacy), integrity, and insulation. It is expressed in the same order (for example, 60/60/30)

**Fire separation** — The separation of parts of a building by fire-resistant construction

**Listed** — Specific makes and models of equipment, materials, procedures, organisations, and facilities required or permitted by this Standard, which have been examined by the a SSC and found to meet relevant standards and/or have otherwise been demonstrated to be adequate for the intended application

NOTE – Examples of test and approval bodies are Factory Mutual Global (FM), Loss Prevention Council (LPC), Australian Commonwealth Scientific and Research Organisation (CSIRO), and Underwriters Laboratories (UL).

**Ordinary hazard** — Occupancies of fire loads similar to commercial and industrial occupancies involving the handling, processing, and storage of mainly ordinary combustible materials unlikely to develop intensely burning fires in the initial stages

NOTE – NZS 4541 provides additional information describing this type of occupancy.

**Point of supply** — As defined in the Health Act

**Quick response sprinkler** — A sprinkler with a high thermal sensitivity and listed as a quick response sprinkler

| | |
|---|---|
| **Residential sprinkler** | A type of fast-response sprinkler having a thermal element with a time index of 50 $(m.s)^{1/2}$ or less and which has been specifically investigated to enhance survivability in the room of fire origin, and is listed as such<br><br>NOTE – Listed residential sprinklers are normally listed against the requirements of UL1626 for residential sprinklers for fire protection service. |
| **Sleeping occupancies** | A building primarily used for the purposes of habitation or cohabitation, see 1.1.3.1 |
| **Special response sprinkler** | A sprinkler listed as having a thermal element with an RTI of more than 50 $(m.s)^{1/2}$ and less than 80 $(m.s)^{1/2}$ |
| **Sprinkler protected** | Buildings shall be deemed to be sprinkler protected if they are certified as complying with NZS 4515 or NZS 4541 or other sprinkler system Standard approved by an SSC |
| **Sprinkler installation** | That part of the system downstream from, and including, the main stop valve |
| **Sprinkler system** | A system including:<br>(a) A sprinkler system water supply pipe from the boundary of the protected premises to the sprinkler valves;<br>(b) A sprinkler system static water supply on the protected premises;<br>(c) A sprinkler system pumping unit providing water;<br>(d) Control valves and all fittings;<br>(e) The main stop valve anti-interference devices;<br>(f) Any fire alarm signalling device;<br>(g) Pipework, sprinklers, and fittings downstream of the control valves;<br>(h) Any fire rated wall, door, or partition required by this Standard |
| **Sprinkler System Certifier (SSC)** | An organisation accredited by an internationally recognised accreditation body to AS/NZS ISO/IEC 17020 as a Type A inspection body as competent to fulfil the roles as defined in this Standard |
| **Standard response sprinkler** | A sprinkler listed as a standard response sprinkler |
| **Water supply authority** | The network utility operator responsible for water supply as defined by 'Networked Supplier' in the Health Act |

### 1.5.2 Abbreviations

Abbreviations used in this Standard have the following meaning:

| | |
|---|---|
| Ah | Ampere-hours |
| BPV | Back pressure valve |
| FBA | Fire brigade alarm |
| FBIM | Fire brigade intervention model |
| FM | Factory Mutual |
| FRR | Fire resistance rating |
| h | Hours |
| ID | Internal diameter |
| IQP | Independent qualified persons |
| LED | Light-emitting diode |
| LPC | Loss Prevention Council |
| L/s | Litres per second |
| m | Metre(s) |
| m/s | Metres per second |
| NPSH | Net positive suction head |
| NZBC | New Zealand Building Code |
| NZFS | New Zealand Fire Service |
| OEM | Original equipment manufacturer |
| PRV | Pressure relief valve |
| RPM | Revolutions per minute |
| RTI | Response time index |
| s | Second(s) |
| SDR | Standard dimension ratio |
| SIN | Sprinkler identification number |
| SSC | Sprinkler system certifier |
| UL | Underwriters Laboratories |

## 1.6 Roles and responsibilities of SSC

A SSC shall be responsible for certification of the sprinkler system. That role shall include, but not be limited to:

(a) Auditing design;

(b) Auditing installation;

(c) Auditing commissioning;

(d) Listing of contractors;

(e) Listing of equipment;

(f) Approving equivalent variations in the design and/or components;

(g) Maintaining records;

(h) Certification that the system complies with this Standard.

A SSC shall employ an appropriately qualified chartered professional engineer for the purpose of such certification.

Where the Standard refers to a SSC it shall be the SSC responsible for the certification of the particular automatic fire sprinkler system under consideration.

NOTE –

(1) It is desirable that the chartered professional engineer be a professional member of Institution of Professional Engineers New Zealand in the fire practice college.

(2) Chartered professional engineers are as defined in the Chartered Professional Engineers of New Zealand Act.

## 1.7 Sprinkler system certification

To determine the compliance of a sprinkler system design and installation, a listed contractor shall submit to the SSC the information detailed in Appendices C, D, E, and F. Requirements for listing are given in Appendix G.

For systems installed to this Standard, a SSC shall make available to listed contractors the information contained in Appendices C, D, E, and F, subject to receipt of consent from the building owner.

NOTE – It would usually be reasonable to infer that if the owner of the building has instructed a contractor to carry out work on the protected building, that this is deemed as obtaining consent from the building owner to access this information.

An application form for approval of a residential system is provided in Appendix H.

## 1.8 Listing of sprinkler contractors

In order for a sprinkler system to comply with this Standard, it shall be installed under the supervision of a contractor evaluated and listed by the SSC in accordance with Appendices J and K.

## 1.9 Seismic resistance

All units of a sprinkler system shall be designed and supported to resist without damage or impairment of function, earthquake loadings specified in NZS 1170.5. In the case of chlorinated PVC or any other pipe listed and conforming to AS 4118.2.1, installation complying with a manufacturer's listed installation system shall be deemed to satisfy this requirement.

NOTE –

(1) An acceptable means of compliance for the installation pipework is to follow the pipe support system requirements described in NZS 4541.

(2) Refer to NZS 4219 for requirements on tanks, pumps, and seismic connections between buildings.

## 1.10 Welding

### 1.10.1 Qualification of welders – Steel

Welding shall be performed by certified welders.

### 1.10.2 Plastic pipes

Plastic pipes shall be joined strictly in accordance with the requirements of the relevant manufacturer's listing criteria.

## 1.11 Status of systems designed to superseded Standards

An existing sprinkler system which can be demonstrated to comply with NZS 4515:1990, NZS 4515:1995 or NZS 4515:2003 shall be deemed to comply with NZS 4515:2009, subject to any pump coupling complying with 6.5.1.4(e).

NOTE – Field failures of pump couplings of the type not complying with 6.5.1.4(e) indicate the need to retrospectively replace such units to ensure that the reliability of the sprinkler systems is maintained.

# 2 GENERAL DESIGN REQUIREMENTS

## 2.1 Extent of protection

**2.1.1**

The protected building shall be sprinklered throughout except in concealed spaces as follows:

(a) Concealed spaces between ceilings and roofs (including those at the apexes and sides of buildings) where the following criteria are met:

(i) The space is subdivided by fire separations of -/30/30 FRR at not more than 15 m x 15 m, and

(ii) The distance from the underside of the roof sheathing to the top of the ceiling lining does not exceed 0.8 m.

(b) Concealed spaces between ceilings and floors above where the following criteria are met:

(i) The space is subdivided by fire separations of -/30/30 FRR at not more than 15 m x 15 m, and either

(ii) The distance from the underside of the floor to the top of the ceiling lining does not exceed 0.8 m, or

(iii) The space has all its bounding surfaces wholly formed of non-combustible materials and contains no combustibles other than electrical and communication cables and water supply and disposal piping.

(c) Concealed spaces between the ground and the floor or deck immediately above where either of the following criteria is met:

(i) The floor or deck is of concrete and any openings are protected by fire separations of -/30/30 FRR and the space is not used for storage, or

(ii) The floor or deck is other than concrete and of tight construction, and the space is not accessible for storage purposes, or for the entrance of unauthorised persons and does not contain equipment that could be a source of ignition, with the exception of electrical wiring. The space shall be protected from the accumulation of debris. Flammable liquids are not permitted to be stored on the floor or deck above.

**2.1.2**

Where some other building, structure, or accumulation of combustibles which is not itself sprinklered (that is, an exposure) is:

(a) Within 3 m of the protected building where the exposure hazard is a domestic occupancy; or

(b) Within 10 m of the protected building where the exposure hazard is an industrial, commercial or sleeping occupancy building or an accumulation of combustibles (such as stacks of sawn timber),

provision shall be made to prevent the spread of fire to, and/or the operation of the sprinklers inside, the protected building, unless the SSC considers it unlikely that fire could enter or ignite the protected building.

Exposing buildings protected to NZS 4517 and under the same control as the protected ➤

building shall not be deemed to be an exposure hazard. In such cases the voluntary maintenance requirements of NZS 4517 shall be adhered to.

**2.1.3**

The provisions to prevent fire spread from exposure fire loads shall be one of the following:

(a) A wall of 60/60/60 FRR with any openings on the protected building having a fire rating of not less than - /60/60;

(b) A solid concrete, concrete block or masonry wall which prevents the spread of radiant heat from the unprotected building or combustibles;

(c) Installation of external sprinklers on those parts of the wall of the protected building not conforming to 2.1.3(a) or 2.1.3(b) and which are within 3 m or 10 m respectively. This alternative cannot be applied if the separation distance is less than 1 m, or if the exposure is a passageway enclosed by two side walls and a roof;

(d) Where a building has an unprotected linking passageway a sprinkler shall be installed on the unprotected side of the doorset.

Alternatively a submitted fire engineering design shall demonstrate a fire will not spread from the exposure into the protected building as approved by the SSC.

In all other cases the exposing building shall be sprinklered or the combustible material moved away.

**2.1.4**

External sprinklers, where required, shall be installed to conform to 4.3.

Where conditions are prone to freezing, one or more of the following shall apply:

(a) External sprinklers shall be supplied by pipes filled with antifreeze in accordance with 2.2.3 to 2.2.7;

(b) Dry barrel sprinklers shall be installed;

(c) Heat tracing shall be employed if approved by the SSC; or

(d) Other means of protection against freezing approved by the SSC shall be used.

To determine the number of external sprinklers which, for the purpose of water supply calculation are deemed to operate simultaneously, see 5.1.1.

The maintenance provisions for any heat tracing systems shall be included in the compliance schedule.

**2.1.5**

Where an extension to an existing system results in the protected floor area exceeding 2000 $m^2$ a NZS 4541 compliant sprinkler system should be used, or a second NZS 4515 system shall be installed, subject to the fire separation being compliant.

A second NZS 4515 system is only permitted when an extension is a horizontal extension complying with 1.1.3.1 or 1.1.3.2. Separate NZS 4515 systems shall not be installed in vertically separated fire cells.

Where an additional NZS 4515 system is to be installed, a minimum fire cell separation of 60/60/60 FRR shall be provided between systems, with any openings having a FRR of not less than -/60/60.

Where buildings are linked, separation shall be by:

(a) A 60/60/60 separation at the end of the link where the two sprinkler systems adjoin, extending at least 3 m either side of the link; or

(b) 30/30/30 separations at both ends of the link, extending 3 m either side of the link or 3 m into the link.

Doors are permitted in separation walls between joining or linked fire cells provided they have FRR no less than the wall itself and any hold open devices automatically close the doors on activation of either the sprinkler system, or the building fire alarm system.

Where systems protect separate buildings, whether linked or not, and separation distance between buildings is less than 3 m then 30/30/30 passive separation or external sprinklers are required between buildings, unless the separation distance complies with NZBC C/AS1 for unsprinklered fire cells.

Systems may share a common connection to a water supply provided the branch to each system is separately valved, to allow either valve set to be serviced without disabling the supply to the other system.

Where a building is intended to exceed the limits of 1.1.3.2, either initially or as the result of known future extension plans, a NZS 4541 compliant sprinkler system shall be installed.

## 2.2 Types of system

**2.2.1**

Systems shall be

(a) Wet pipe;

(b) Antifreeze type; or

(c) Specifically listed systems for life safety of sleeping occupancies.

**2.2.2**

A wet pipe system shall be a system permanently charged with water both above and below the installation control valves. It may be used only for systems, or parts of systems, which in the opinion of the SSC are not prone to freezing.

**2.2.3**

An antifreeze system, if required, shall be a system in which the whole or part of the system downstream of the installation control valves is charged with antifreeze solution complying with table 2.1. No other antifreeze materials shall be permitted. Propylene glycol ➤

solutions shall not be used in chlorinated PVC pipe systems. In such systems, approved arrangements shall be made to protect the installation control valves and fittings and the water supply against freezing.

NOTE –

(1) Thoroughly premix antifreeze mixtures before putting them into the sprinkler system pipework.

(2) For additional design guides on antifreeze systems refer to 7.6 of NFPA 13:2007.

**Table 2.1 – Antifreeze solutions**

| Material | Solution (by volume) | Freezing point (°C) | Density | | | |
|---|---|---|---|---|---|---|
| | | | 5°C | 10°C | 15°C | 20°C |
| Glycerine | 50% water | –26.1 | – | – | 1.133 | – |
| Propylene glycol | 70% water | –12.8 | 1.030 | 1.028 | 1.027 | 1.023 |
| | 60% water | –21.1 | 1.039 | 1.037 | 1.034 | 1.031 |
| | 50% water | –32.2 | 1.048 | 1.045 | 1.041 | 1.038 |

NOTE –

(1) Glycerine shall be not less than 96.5% purity.

(2) The temperature of the antifreeze mixture is critical when measuring the density and shall be ±1°C.

(3) Hydrometer scale for glycerine should be 1.000 to 1.200, in 0.005 increments.

(4) Hydrometer scale for propylene glycol should be 1.000 to 1.120, in 0.002 increments.

**2.2.4**

The antifreeze solution shall have a freezing point at least 10°C below the minimum expected temperature. The density of the solution shall be determined by a hydrometer of suitable scale with the solution at 15°C. A suitable hydrometer shall be provided at the installation control valves.

**2.2.5**

Where the entire installation is filled with antifreeze solution, the installation shall comply with the requirements of figure 2.1.

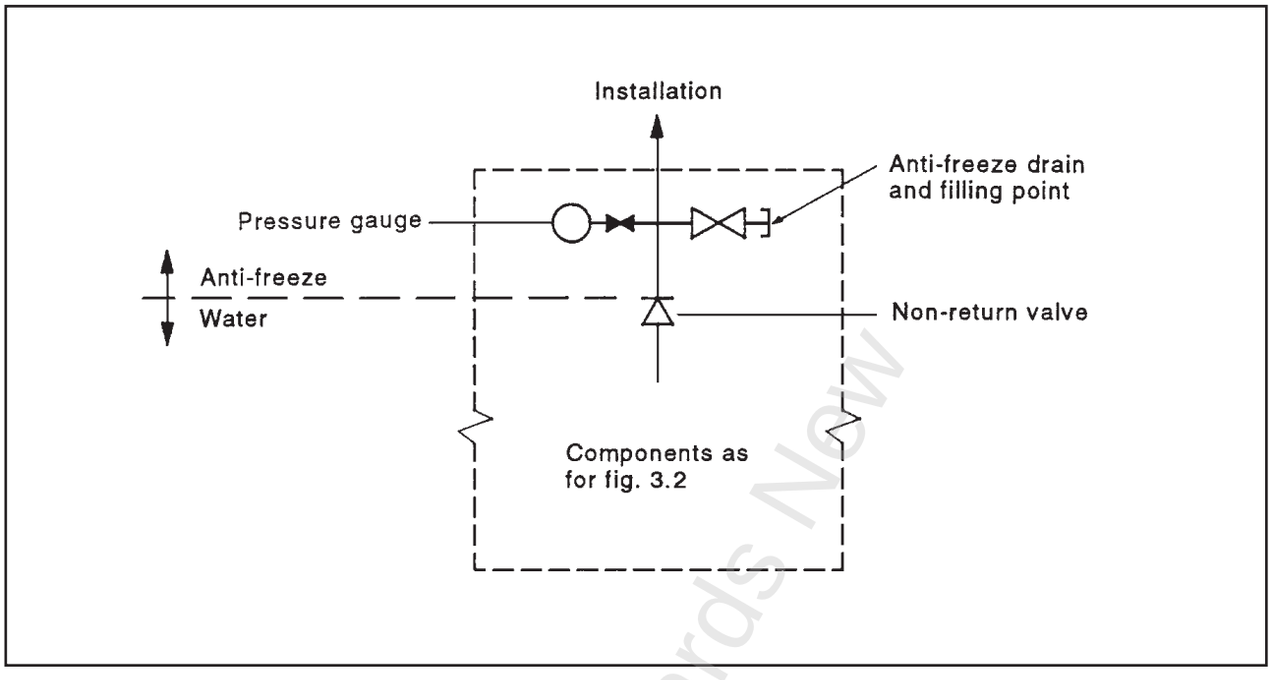



**Figure 2.1 – Required components for antifreeze installation control valves**

**2.2.6**

Sections of wet pipe systems serving up to 12 sprinklers may be protected from freezing by means of tail-end antifreeze systems which shall be in the form shown in figure 2.2.

For tail end systems, where greater than 12 heads, specific design will be required to size an expansion chamber.

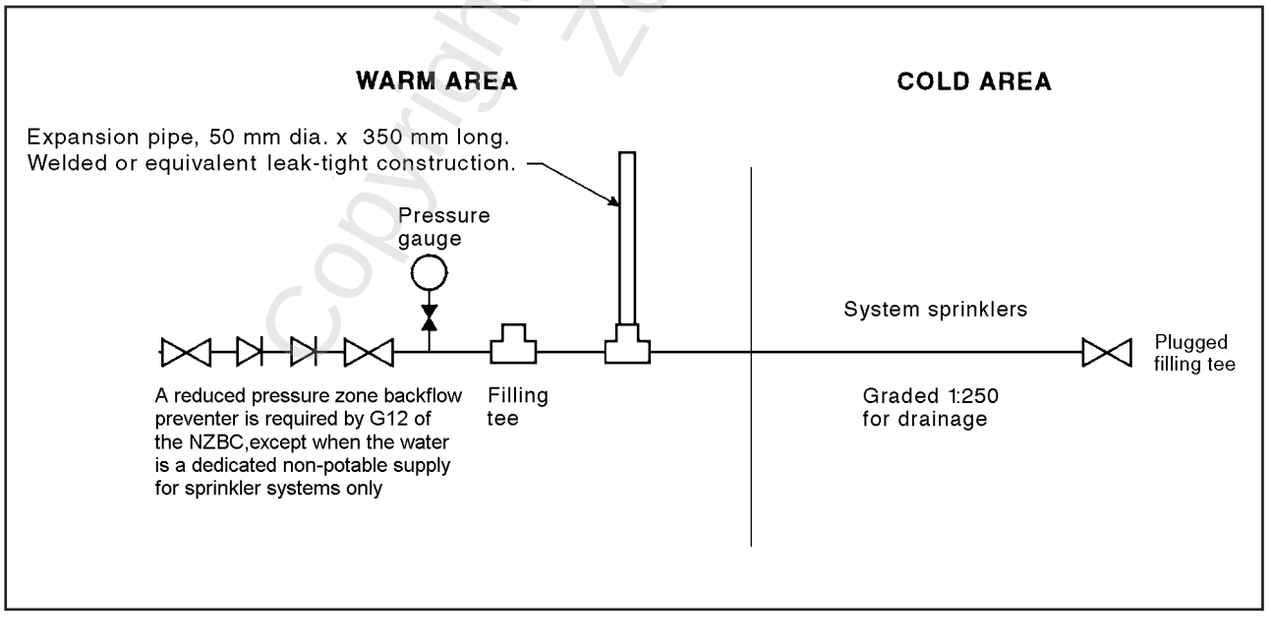



**Figure 2.2 – Small tail-end antifreeze systems**

**2.2.7**

Pipes filled with antifreeze shall be sloped to drain, so as to discharge into an antifreeze reservoir. This reservoir shall be of materials compatible with the antifreeze solution and be at least 125% of the capacity of installation pipework. Roof space sprinklers and external sprinklers on pipes filled with antifreeze shall be installed upright.

## 2.3 Materials with a high spread of flame index

Where the surface of the walls, or the underside of any roof, ceiling, or mezzanine floor is of foamed plastic, the surfaces shall be protected from ignition by complying with the requirements of the Acceptable Solution C/AS1 of the Compliance Document for the NZBC fire safety clauses.

NOTE – The results of small-scale fire testing such as defined in AS 1530.3 cannot be used in isolation as evidence of compliance with this clause.

# 3 SYSTEM COMPONENTS

All components used shall be suitable for the correct functioning of the sprinkler system, and shall be new unless otherwise approved by the SSC. Only new sprinklers shall be installed. Component selection shall take into consideration the expected environmental conditions. Proprietary or listed equipment shall be used when called for in this Standard or as required by the SSC.

## 3.1 Maximum operating pressure

### 3.1.1 General

No component of a sprinkler system shall be subjected, either during normal conditions or during operation, to pressures in excess of that for which the component is rated. Such rating may arise from the particular technical standard with which the component complies or as a condition of any specific approval of that component.

NOTE –

(1) This requirement will be particularly relevant where there is a high standing pressure in the reticulated water supply.

(2) High temperatures in roof spaces may cause over-pressurisation in systems of small total pipe volume unless means for limiting this are provided. Acceptable methods include:

  (a) A pressure relief valve (not suitable for antifreeze) located at the control valves with the discharge piped to an appropriate place;

  (b) A gas over water expansion chamber sized and fitted as outlined in Appendix L.

### 3.1.2 Automatic jockey pumps

In any sprinkler system that requires to be pumped up to a standing pressure that is higher than can be achieved by the diesel engine driven booster pump, an electric motor-driven super-pressure pump can be connected at the installation control valves downstream of the flow switch, so that the water pressure in the installation can be raised to a minimum of 100 kPa above the system's required standing pressure.

The super-pressure pump shall be configured as shown in figure 3.1. A pressure relief valve shall be fitted between the pump and the isolation valve. The pressure relief valve shall be set to limit the maximum pump output pressure to 100 kPa above the system's designed standing pressure.

The super-pressure pump may be positive displacement or roto-dynamic (centrifugal). The pump electric motor shall be fitted with a thermal overload switch. If not hard wired, a power outlet must be installed adjacent to the pump.

The super-pressure pump shall be configured for automatic operation via a pressure switch and will have its discharge restricted by a 3 mm orifice to prevent flow through the jockey pump masking the operation of a sprinkler.

A bypass shall be provided around the restricted orifice and shall be fitted with a monitored valve which shall be monitored to generate a defect call via the FBA when opened.

With the approval of the SSC an automatic jockey pump may be used as an alternative to a gas over water expansion chamber to overcome thermally induced pressure fluctuations in the sprinkler system.

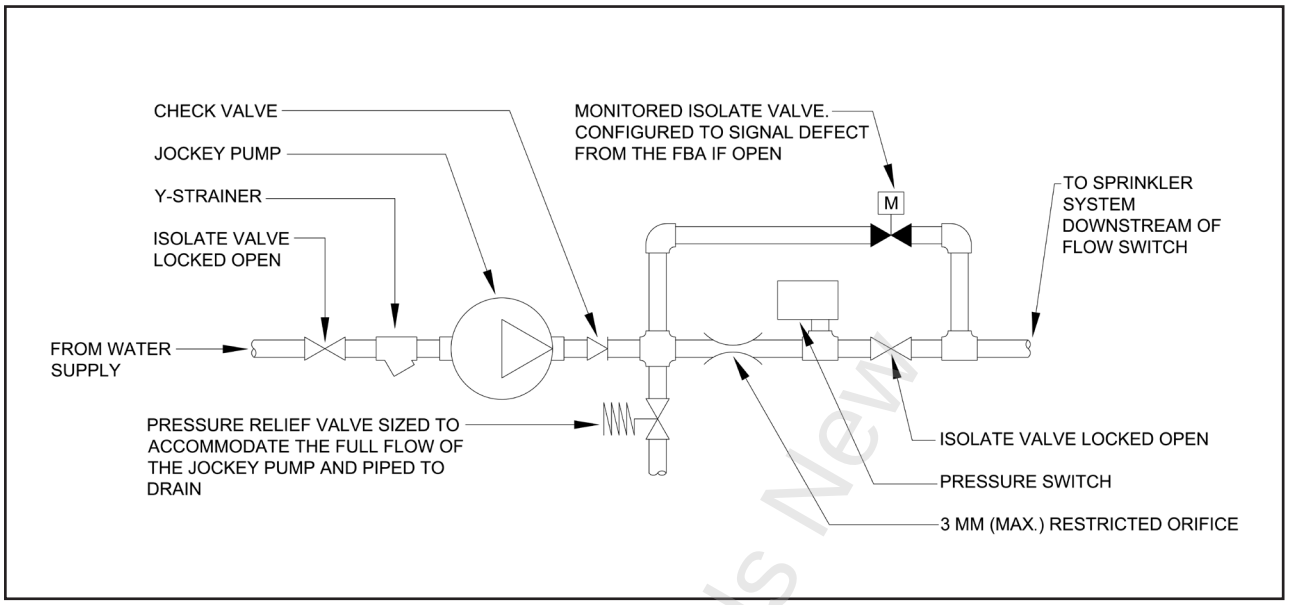



**Figure 3.1 – Automatic jockey pump**

## 3.2 Sprinklers

### 3.2.1

Sprinklers shall be listed makes or models. The following types of sprinkler shall be used in the situations specified, as shown in table 3.1.

**Table 3.1 – Types of situations and sprinklers**

| Situation | Type of sprinkler |
|---|---|
| Rooms, including cupboards and porches | Residential; or<br><br>Quick response spray 15 mm if allowed by 3.2.2 |
| Roof spaces, ceiling spaces, skylights, underfloor spaces, high temperature environments (for example cooking hoods), and dry sprinklers in freezers | Standard or special response, non-residential, conventional, or spray 15 mm |
| Laundries, commercial kitchens, surgical areas, basements, vehicle garages, and non-residential storage areas | Quick response conventional or quick response spray 15 mm |

External protection sprinklers shall be any of the following types and orientation:

(a) Pendent spray (SP) – mounted horizontally with the deflector towards the window or wall;

(b) Upright spray (SU) – mounted horizontally with the deflector away from the window or wall;

(c) Pendent sidewall (WP) – mounted pendent and oriented to direct the spray towards the window or wall; or

(d) Sprinklers specifically designed for the purpose and located and spaced in accordance with their listing.

Conventional sprinklers (CU/P) shall not be used, except in the case of protection beneath roof overhangs. Sprinklers beneath roof overhangs shall not be considered a substitute for protection of walls.

Sprinkler system discharge coefficients (*K* -factors) shall be as follows:

10 mm sprinkler .....5.7 ± 0.3 L/min(kPa)$^{0.5}$

15 mm sprinkler .....8.0 ± 0.4 L/min(kPa)$^{0.5}$

Residential .....as per listing

The *K*-factor is the constant in the formula $Q = K\sqrt{P}$

where

$Q$ is the flow (L/min)

$P$ is the pressure (kPa).

**3.2.2**

Quick response spray sprinklers may be used to protect rooms used for sleeping, when:

(a) Owing to obstructions to heat flow, residential sprinklers would be required to be spaced closer than 3 m apart;

(b) The installation of these sprinklers is approved by the SSC.

NOTE – In unusual circumstances such as in the protection of rooms with exposed timber beam construction, excessive numbers of sprinklers would be required to be installed to comply with sprinkler listing criteria. It is recognised that use of sprinklers may not necessarily provide life safety characteristics equivalent to residential sprinklers. The requirements for use of these sprinklers is therefore intentionally restrictive.

**3.2.3**

Quick response pendent or sidewall sprinklers which are resistant to tampering and commonly known as 'institutional sprinklers' may be used with the specific approval of the SSC where the use of this type of sprinkler is required by the owner.

**3.2.4**

Sprinklers shall have a deflector suited for the orientation of the sprinkler, that is, either upright, pendent or horizontal.

**3.2.5**

The temperature rating of sprinklers shall be at least 30°C above the highest ambient temperature.

In rooms in which there is a solid fuel burning heating appliance, only sprinklers with an operating temperature of 68°C or higher shall be used. Such sprinklers shall not be located closer than 1.5 m, and preferably 2 m, from the edge of the appliance or flue measured horizontally, or as per their listing requirements. ➤

All sprinklers installed within a room shall have the same heat response element and temperature rating, except if installed adjacent to an area of elevated temperatures, necessitating a higher temperature rating.

**3.2.6**

Sprinklers shall be painted only by the manufacturer.

## 3.3 Sprinkler guards

Any sprinkler in a position which is vulnerable to accidental impact shall be protected by a listed or approved guard.

NOTE – Listed guards are currently not manufactured to suit listed residential sprinklers.

## 3.4 Stock of replacement sprinkler

Two spare sprinklers of each type used on the system shall be installed in a permanent bracket at the installation control valves. When replacing sprinklers, the same type of sprinkler or one of the same design criteria shall be used.

NOTE –

(1) The purpose of those spare sprinklers is to permit rapid recommissioning of the system.

(2) Sprinklers are not interchangeable with sprinklers of different performance characteristics.

**3.4.1**

The following components shall be listed:

(a) Isolating valves including anti-tamper features;

(b) Check valve or backflow preventer;

(c) Water supply strainers if required as part of any backflow prevention device;

(d) Water flow switch;

(d) Pressure sensor to detect low water pressure;

(e) Alarm equipment.

NOTE –

(1) This clause is not intended to mandate the installation of any strainer installed as part of a backflow prevention device.

(2) See Appendix M for the listing criteria for any strainer.

## 3.5 Pipework

### 3.5.1 Minimum pipe size

The minimum acceptable pipe size shall be 20 mm internal diameter (ID). The following types of pipes and jointing options as shown in table 3.2 are permitted:

**Table 3.2 – Pipe jointing options**

| Underground pipe work | |
|---|---|
| **Pipe** | **Jointing options** |
| Unplasticised polyvinyl chloride (PVC-U) to AS/NZS 1477, modified polyvinyl chloride (PVC-M) to AS/NZS 4765 or oriented polyvinyl chloride (PVC-O) to AS/NZS 4441 | Solvent cement, elastomeric seal, or flanged joints; all shall be installed to AS/NZS 2032 |
| Polyethylene to AS/NZS 4130 | Butt-fusion, socket-fusion, electro-fusion jointing, or mechanical compression using fittings to AS/NZS 4129, installed to AS/NZS 2033 |
| Polybutylene to AS/NZS 2642.2 | Butt-fusion, socket-fusion, electro-fusion jointing, or by using mechanical compression fittings to AS/NZS 2642.3 |
| Ductile iron in combination with polyethylene sleeving such as for connections and risers | Flanged, full faced with 316 stainless steel bolting |
| **Above ground pipe work** | |
| **Pipe** | **Jointing options** |
| Mild steel to:<br>BS 1387 or AS 1074 (roll Groove ASTM Schedule 10 Light only)<br>BS 1387 or AS 1074 Medium<br>BS 1387 or AS 1074 Heavy<br>ASTM Schedules 20, 30 & 40 | <br>Flanged, mechanical coupling (roll grooved only)<br>Screwed, flanged, mechanical coupling (roll grooved only)<br>Screwed, flanged, mechanical coupling |
| ASTM Schedule 5, 20 – 50 mm dia. | Proprietary systems listed by FM or UL |
| Copper to NZS 3501 | Brazed joint or capillary fitting |
| Chlorinated polyvinyl chloride (PVC-C) to ASTM F442 with SDR of 13.5 | Solvent cement with PVC-C fittings to ASTM F 438 or F 439 Subject to limitations of 3.5.2.1 |
| Stainless steel to ASTM A 312.<br>Schedules 10, 40 and 80<br>All sizes | Welded joints or fittings to ASTM A 403 subject to the limitations of 3.5.2.3 |
| Any other pipe listed and meeting the requirements to AS 4118.2.1 | |
| NOTE – For ASTM Standards refer to ASTM A 795, ASTM A 53, and ASTM A 135. | |

### 3.5.2 Specific piping requirements

#### 3.5.2.1 Chlorinated polyvinyl chloride pipe and fittings

Chlorinated polyvinyl chloride (PVC-C) pipe, fittings, and solvent cements are permitted when:

(a) They are listed for fire sprinkler use;

(b) The manufacturer's recommended cure time prior to the pressurisation of the system does not exceed 6 h at 15.5°C; or

(c) The system is installed and supported in accordance with the manufacturer's requirements.

Sprinklers shall not be fitted to PVC-C pipework before the jointing cement has cured, to avoid rundown of cement into the sprinkler.

NOTE – The listing of PVC-C pipe for fire protection use requires the pipe to contain water.

#### 3.5.2.2 Unplasticised polyvinyl chloride pipework

Polyvinyl chloride (PVC) pipework may be used downstream of the installation valve only when completely buried underground, and the depth of cover and installation complies with AS/NZS 2032, and subject to the following limitations:

(a) The pipework is laid by the open trench method in accordance with AS/NZS 2566.2, with granular bedding and surround fill, and no part is encased in concrete;

(b) PVC to PVC joints shall be solvent cemented or use elastomeric seals;

(c) PVC to metal joints shall be either:

(i) Threaded, using solvent cemented moulded thread adaptors with the PVC-U being the male thread, or

(ii) Flanged using solvent cemented socket stub flanges with metal backing rings.

(d) Pipework pressure rating shall be 1.5 times the system maximum pressure, but not less than 1200 kPa. Working pressures shall be derated as per AS TR 5058 for soil temperatures above 20°C (such as in the New Zealand geothermal belt);

(e) The soil, at the depth of the pipe, is not subject to frost.

#### 3.5.2.3 Stainless steel pipework

Stainless steel pipe is permitted provided that:

(a) Pipe and fittings are only grades 304, 304L, 316, and 316L;

(b) Threaded joints are used only for schedule 40 and 80 pipes of up to 50 mm diameter;

(c) Welded joints and joints made with welded fittings are post heat treated as required by ASTM A 312 for the grade of steel concerned.

### 3.5.3 Underground protection

Underground pipes shall be protected against corrosion where necessary. Where pipes are carried under vehicle traffic areas, the pipe embedment and trench fill shall be such as to maintain the load on the pipe within safe tolerances.

### 3.5.4 Underground riser connections

It is permitted to terminate polyethylene, polybutylene, PVC-U, PVC-M, and PVC-O underground pipe work above ground to allow a suitable connection to be fitted. The riser pipe from underground shall not exceed more than 400 mm above the finished floor level and shall have suitable mechanical and UV protection provided.

### 3.5.5 Pipe fitting involving hot work

Gas cutting, welding, grinding, brazing, soft and hard soldering, and the fusion welding of plastics pipe work introduces a risk of accidental ignition. The following precautions shall be observed:

(a) Have charged hose reels or water type extinguishers on hand;

(b) Remove or cover combustibles in the immediate vicinity of the work;

(c) Post an observer during the actual hot work;

(d) Re-check the area 1 h after completion of the hot work;

(e) Comply with NZS 4781 where cutting or welding is undertaken.

NOTE – In existing buildings, the consent of the building owner should be obtained before any hot work is undertaken.

### 3.5.6 Concealment of pipework

Where pipes are installed in concrete, fittings other than tees or bends supplying sprinklers shall not be permitted under the concrete and the pipework shall be hydrostatically tested before the concrete is poured.

### 3.5.7 Earthing

The use of any sprinkler installation pipe as an earthing continuity conductor is not permitted. A thimble stud may be welded upstream of the check valve in each metal underground water supply pipe to permit earth bonding.

NOTE –

(1) Attention is drawn to the need to comply with the requirements of the Electricity Act and Regulations.

(2) If an electrical hazard is suspected, an earth strap should be fitted across any installed pipes before they are cut.

### 3.5.8 Pipework not to be used as support

Electrical wiring or other services, fittings or fixtures shall not be attached to, or supported by, sprinkler pipework.

### 3.5.9 Pipe supports

#### 3.5.9.1

Fixings shall be heat and corrosion resistant, and installed so that they will not deflect more than 5 mm when loaded to five times the weight of the water-filled pipe to be supported. Supports shall allow for thermal and seismic movement without failure of the system in normal service.

**3.5.9.2**

Copper or plastic pipes shall be supported according to the manufacturer's recommendations or the Acceptable Solution G12/AS1 of the Compliance Document for the NZBC Clause G12. Steel pipes shall be supported in accordance with table 3.3.

**Table 3.3 – Pipework supports for steel pipes**

| Pipe size (mm) | Maximum spacing (m) | Minimum hanger diameter (mm) |
|---|---|---|
| 20 | 2.4 | 10 |
| 25 | 3.7 | 10 |
| 32 to 50 inclusive | 4.0 | 10 |
| 65 to 100 inclusive | 5.0 | 10 |
| NOTE – The unsupported length between the end sprinkler and the last support on a pipe with two sprinklers or more shall not be more than 900 mm. | | |

Notwithstanding the provisions of this clause, the pipework adjacent and attached to the sprinkler shall be fixed to prevent movement of the sprinkler when it discharges.

**3.5.9.3**

Pipes of 50 mm diameter and above shall be braced against earthquake induced movement in any direction by U-bolts, clamps or by single rods with less than 150 mm between the pipe and building members. Alternatively every alternate support shall be prevented from sideways movement by:

(a) Clamping to the structure;

(b) Fitting a rigid bracket;

(c) Fitting two hangers in the vee formation; or

(d) Clamping side branches within 300 mm of main pipe.

## 3.6 Installation control valves

**3.6.1**

Each system shall be provided with a set of installation control valves comprising the components shown in, and arranged in the order depicted in figure 3.2. Where fitted with a fire brigade alarm (FBA) the location of the valve shall be agreed with the New Zealand Fire Service National Commander or delegated authority. The valves shall be located in an easily accessible position not likely to be exposed to a fire in the building, or frost, or an external fire hazard.

NOTE – Significant areas of New Zealand are subject to freezing conditions. This will require that adequate precautions be taken to ensure that any valve sets and associated pipework external to the building are protected against freezing. See 2.2.3.

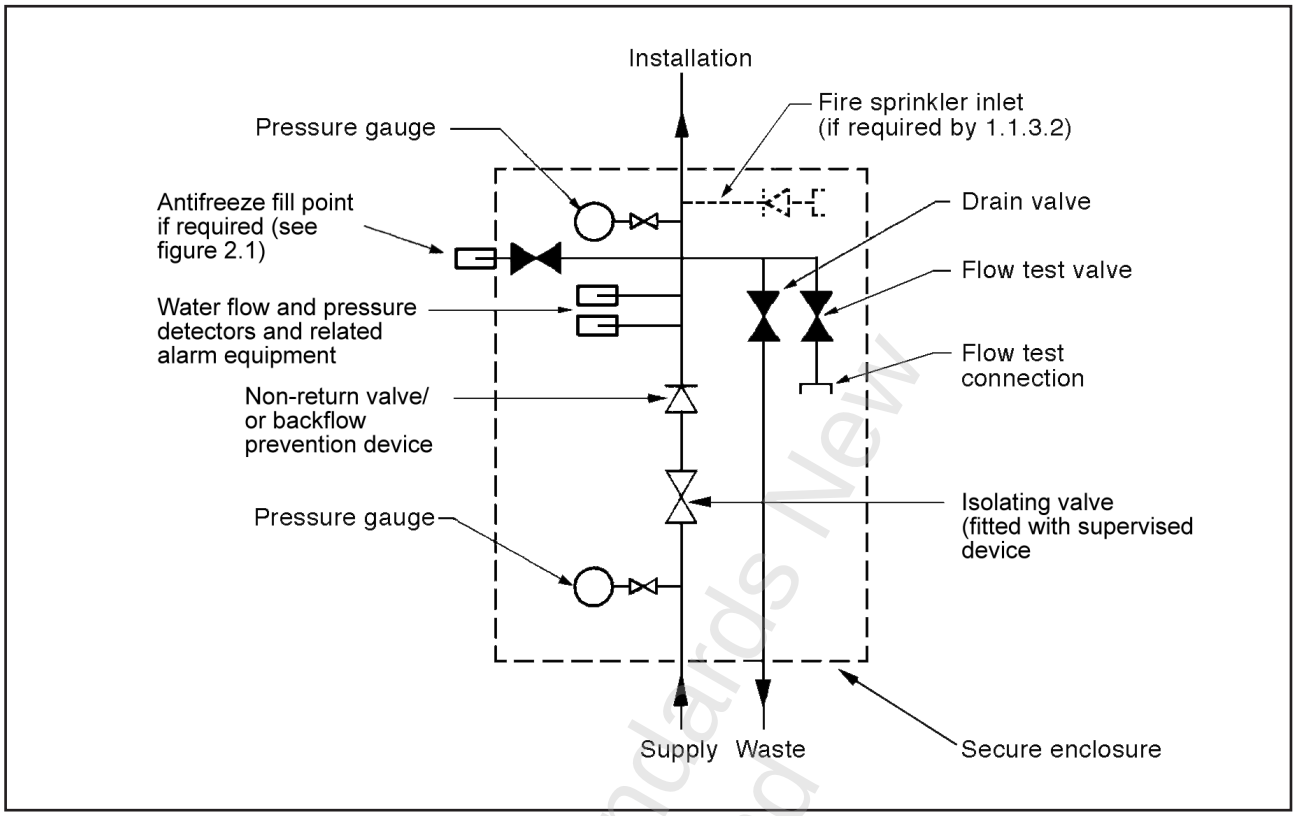



**Figure 3.2 – Required components and hydraulic layout of installation control valves**

**3.6.2**

The installation control valves shall be housed in a lockable enclosure exclusive to the sprinkler system. If there is a fire brigade alarm, the isolating valve shall be monitored by that alarm so that if less than 95% open a fire alarm is transmitted. On other systems it shall not be possible to close the door of the enclosure if the valve is less than 95% open. The door shall be labelled 'FIRE SPRINKLER SYSTEM CONTROL VALVES'. The lock shall either comply with the requirements of NZS 4541 for the triangular key type or use a key system agreed with the New Zealand Fire Service National Commander or delegated authority.

**3.6.3**

The isolating valve shall be padlocked open.

**3.6.4**

The following components shall be listed:

(a) Isolating valves including the supervised features;

(b) Check valve or backflow preventer;

(c) Water flow switch;

(d) Pressure sensor to detect low water pressure;

(e) Alarm equipment.

The 'as installed' flow switch shall be tested and the flow and time delay (if fitted) measured and recorded.

NOTE –

(1) Correct selection of flow switches is a vital element in the life safety performance of sprinkler systems. The flow switch provides an early warning alarm initiation for building occupants and generates a call to the New Zealand Fire Service.

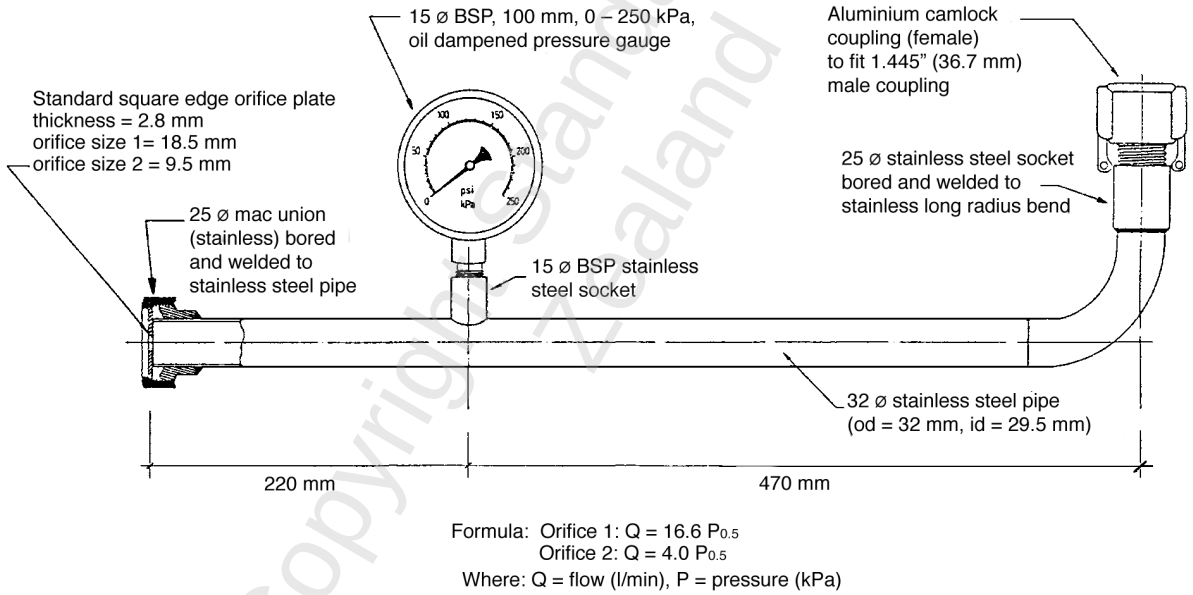
(2) The purpose of the low water pressure detector is to signal an alarm if a sprinkler operates while the water supply is isolated. The set pressure of this pressure switch does not need to be above the highest design fire pressure, but needs to be a nominal 100 kPa above the static pressure that will be exerted on the pressure switch if the highest sprinkler in the installation operates.

**3.6.5**

It shall also be permitted to locate any pressure reducing or pressure sustaining valve required for the system within the enclosure.

**3.6.6**

A flow test connection compromising a 25 mm NB male camlock coupling shall be positioned and installed in the vertically down orientation to permit the direct connection of a flow test apparatus as shown in figure 3.3.




NOTE –

(1) Orifice size 1 is suitable for flows up to 250 L/min. For design flows in excess of this value, alternative arrangements shall be made to allow full design flow testing. Orifice size 1 is not to be used for testing the operation of the flow switch at at the single sprinkler flow rate as the pressure gauge will generally be outside its accurate range at these low flows;

(2) Orifice size 2 is suitable for testing at lower flow rates such as the single sprinkler flow rate at which the flow switch is required to operate at;

(3) Formula shown above is indicative, calibration of flow by verification against a meter with known characteristics is required for accurate testing.

**Figure 3.3 – Standard flow test apparatus**

**3.6.7**

The flow switch shall initiate a signal at the lesser of 38 L/min or 80% of the lowest one sprinkler flow specified in the design for the sprinkler system.

**3.6.8**

The following items shall be provided in a permanent position within the installation control valve enclosure:

(a) Block plan;

(b) Spare sprinklers and spanner suited for each type of sprinkler used in the system;

(c) Standard instructions;

(d) Antifreeze system instructions;

(e) Pressure reducing or pressure sustaining valve instructions; and

(f) Any valve handle required to operate the water supply valves. (If the handle is too large for the enclosure, secure stowage close to the enclosure is acceptable.)

**3.6.9**

The block plan shall be a sealed plan of the protected building oriented to the viewing position and showing:

(a) Address of the protected building;

(b) The area protected by each installation;

(c) Location of the control valves and fire service inlets;

(d) A diagram of the water reticulation network with connections to the street main or site fire main;

(e) The location of any pumps and tanks forming part of the water supply;

(f) A North point;

(g) Any external sprinklers;

(h) All relevant design flows and pressures;

(i) Fire separations, fire doors, and self-closing doors required by this Standard;

(j) Location of any drain valves;

(k) Scale;

(l) Location of any sections of antifreeze filled pipework and dry barrel sprinklers;

(m) Location of any domestic or other approved take-offs and their associated isolation valves;

(n) The location of any pressure sustaining, pressure reducing, listed domestic shut-off valves and backflow prevention units;

(o) Where different types of sprinklers are used in the installation to allow the correct types of sprinklers to be used for service work or for installations. The form of this information is shown in table 3.4.

**Table 3.4 – Block plan sprinkler information**

| Location | Sprinkler manufacturer | Model | SIN number | *K*-factor | Maximum area per head(*) | Maximum spacing per head(*) | Minimum orifice pressure(*) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

* These columns relate to the specific installation and are not to be the generic capabilities of the sprinkler in question. The maximum allowable area and spacing per sprinkler can be limited by the available water supply pressure and as a result may be less than the maximums stated in the manufacturer's listing sheet.

The block plan shall be updated as necessary following any extensions or alterations to the system.

When the valve controlling the sprinkler system water supplies is buried, in a toby box or valve pit, the diagram of the water supplies in (d) shall include sufficient dimensions to allow the street valve to be located if the valve is obscured during road resealing or similar events.

Water supply reference information shall be provided on the block plan generally in the manner shown in figure 3.4. In the case of a new system, the reference pressures shall be established at the time of final inspection of the sprinkler system and agreed with a SSC. In the case of an existing system, it is recommended that they shall be established in the course of a routine inspection (see 8.2.4) and shall be agreed with a SSC.

The reference pressures shall be as follows:

(p) The design pressure for each area of the protected building;

(q) The pressure shown on the installation gauge when the water supply is discharging separately through the fully open installation drain valve;

(r) The pressure shown on the installation gauge when the design flow is passed through the alarm valves from each water supply;

(s) The pump pressure with the pump bypass fully open;

(t) Pressure control valve set pressures (such as relief or reducing valves);

(u) Pressure switch set pressures.

Reference pressures shall be tabulated for all gauges, listing the range of expected gauge pressures, and what action is required if the measured pressure falls outside acceptable levels.

This information shall be provided in the form of gauge schedules, which shall be located as follows:

(v) Valve room or valve enclosure – all sprinkler control valve gauge information;

(w) Pump room – all pump room gauge information;

Where such locations are co-located, the gauge schedules may be combined in a single document.

An indicative reference pressure schedule is shown in table 3.5.

**Table 3.5 – Typical reference pressure schedule**

| Agreed hydraulic requirements | | |
|---|---|---|
| **For the most demanding** | **Design flow** (L/min) | **Design pressure** (kPa) |
| Residential area of operation | 225 | 475 |
| External sprinklers | 285 | 410 |
| **Reference pressures** | | |
| **Item** | **Normal pressure** | **Comments** |
| Low installation pressure switch | 500 kPa | – |
| Diesel pump start | 550 kPa | – |
| Town's main static pressure | 300 – 400 kPa | Report if less than 250 kPa |
| Diesel test bypass pressure boost (Discharge – Suction) | 450 kPa | Report if less than 300 kPa |
| Town's main drain test | 200 kPa | Report if less than 430 kPa |
| Pump main drain test | 660 kPa | Report if less than 430 kPa |
| Tail-end antifreeze system standing pressure | 900 kPa | Report if less than 800 kPa |

**HYDRAULIC REFERENCE PRESSURES MEASURED AND ACCEPTED ON APPROVAL DATE**

Installation: ..... Approval date: .....

Flow test date: ..... Test time:.....

| **Flow** (kPa) | **Installation gauge pressure** (kPa) | **Suction gauge pressure** (kPa) | **Discharge gauge pressure** (kPa) | **Engine speed** (RPM) |
|---|---|---|---|---|
| 0 | 700 | 300 | 700 | 2865 |
| 100 | 675 | 280 | 680 | 2860 |
| 200 | 620 | 245 | 627 | 2855 |
| 300 | 525 | 180 | 535 | 2845 |
| 400 | 400 | 100 | 435 | 2845 |
| Fully open drain | 465 | 145 | 500 | 2845 |
| Pump test circuit | N/A | 300 | 665 | 2850 |

**Note – To establish the drain test curve**

1. Mark the point of intersection on the graphed water supply curve of the installation pressure when the water supply is discharging through the fully open drain valve.
2. Draw a line from zero through the point of intersection. THIS IS THE DRAIN TEST CURVE.

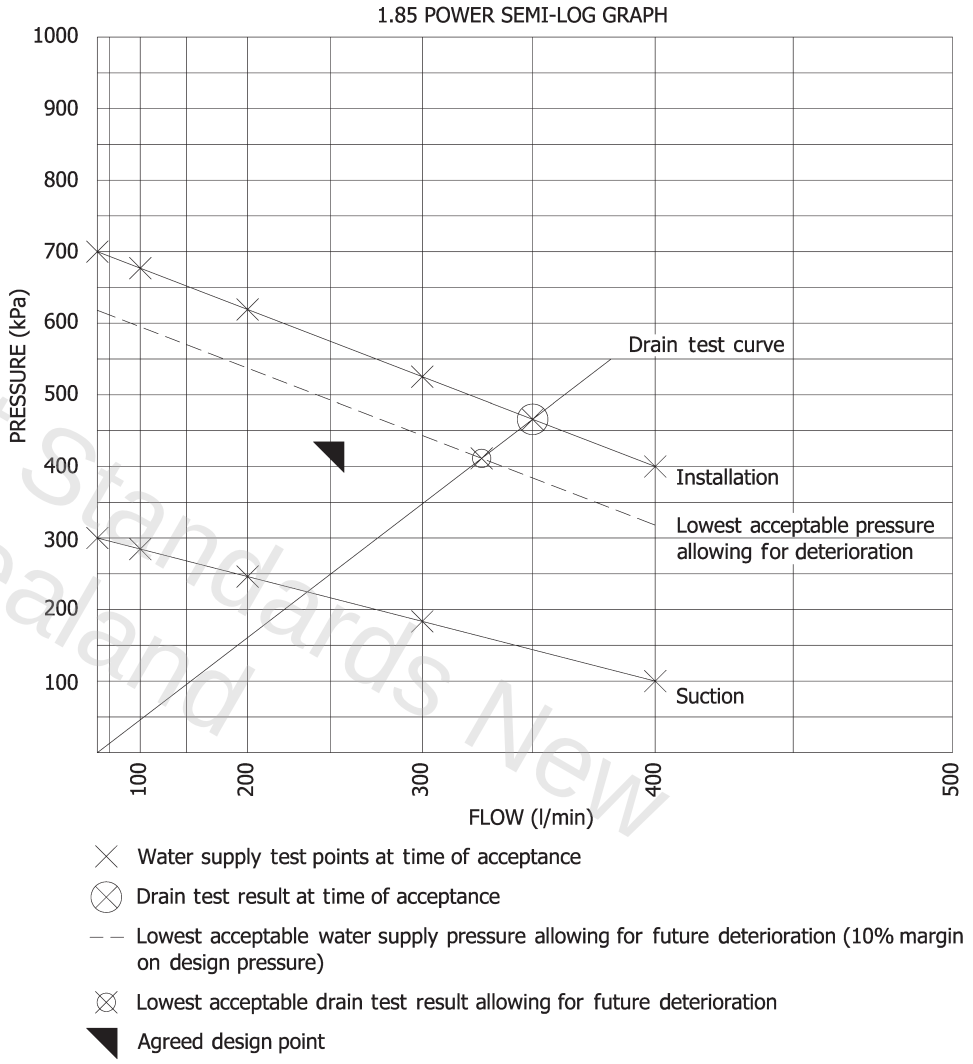



**Figure 3.4 – Display of water supply reference information**

**3.6.10**

The standard instructions shall include:

(a) Method of closing down and recommissioning the system including the words 'NEVER CLOSE OFF THE SYSTEM BEFORE THE FIRE BRIGADE ARRIVES AND/OR ALL PARTS OF THE BUILDING AND ROOF SPACE HAVE BEEN THOROUGHLY CHECKED AND THE FIRE IS TOTALLY OUT';

(b) Method of testing the water supply and alarms, and a reference test pressure for the fully open drain valve;

(c) Telephone number of the maintenance contractor and the water supply authority; and

(d) Data concerning any antifreeze solutions used in the system.

**3.6.11**

Instructions shall be included concerning the testing, operation, and settings of any pressure sustaining or pressure reducing valves.

## 3.7 Pressure gauge

Pressure gauges shall not be less than 65 mm nominal size. The design pressure shall be marked on the installation gauge. A means of isolating a gauge shall be provided immediately below each gauge. The installation gauge shall be fitted with a permanent plugged fitting between the gauge and the isolation valve to allow the attachment of a test gauge.

## 3.8 Alarms

### 3.8.1 General

**3.8.1.1**

Every installation shall include a sprinkler operating alarm and an evacuation alarm. Such alarms shall be actuated by each of the following devices:

(a) Water flow detector;

(b) Low installation pressure detector; or

(c) Anti-interference device.

**3.8.1.2**

Latching visual indication of the operation of sensors for 3.8.1.1 (a), (b), and (c) shall be provided by light-emitting diodes (LEDs). There shall be a means to isolate the 'sprinkler operating' indication and evacuation alarms, which may be achieved by a common switch, and it shall be possible to test each sensor individually.

**3.8.1.3**

Isolation of the sprinkler operated indicator and/or the evacuation alarm shall cause the following conditions to occur:

(a) Closure of the cabinet door operates a local audible alarm;

(b) If the system is brigade connected a defect signal is sent when the fire brigade alarm is reset.

### 3.8.2 Sprinkler operating indicator

Sprinkler system operation shall be indicated at the control valve cabinet by either an audible sounder or a blue flashing light.

The indicator shall be located on the exterior of the building, adjacent to or on the control valve cabinet, and shall be labelled 'Sprinkler Alarm'. In the case of an audible alarm the sounder may be located within the control valve cabinet provided the cabinet is labelled 'Sprinkler Alarm Inside'.

Labelling shall be indelible and easily read from the normal viewing position.

Indicators shall be designed for exterior use if mounted outside the cabinet.

A labelled, interlocked, isolating device shall be provided in the sprinkler control valve cabinet to allow isolation of the indicator (see 3.8.1.3).

### 3.8.3 Evacuation alarm

An evacuation alarm shall be provided as follows:

(a) Where a fire alarm system complying with NZS 4512 is installed in the building it shall be used to provide the evacuation alarm. A labelled, interlocked, isolating device shall be provided in the sprinkler control valve cabinet to allow isolation of the evacuation signal from the sprinkler system, without causing general isolation of the fire alarm system (see 3.8.1.3);

(b) Where a NZS 4512 alarm system is not installed in the building, sufficient audible alarms shall be installed throughout the building to provide 75 dBA at the bedhead in sleeping rooms and 65 dBA in all other areas. A labelled, interlocked, isolating device shall be provided in the control valve enclosure to allow isolation of the evacuation sounders (see 3.8.1.3).

NOTE – It is anticipated that this option would apply when a system is installed in a private residence, where a fire alarm system is not otherwise required for building code compliance. However because the life safety benefits of sprinkler protection rely on early warning and evacuation it is important to alert all occupants of system operation. It is recommended that the alerting device circuit is monitored and the alarm tone comply as closely as practicable with NZS 4512, however a voice message component should not be necessary if sounders are clearly labelled 'Fire Alarm'.

### 3.8.4 Power supply

The power source shall not be directly dependent on the mains supply and shall be either:

(a) The power supply of a fire alarm system complying with NZS 4512 within the protected building. The power supply shall be wired directly from the fire alarm battery in such a way that the sprinkler alarm circuit cannot be isolated within the fire alarm panel. A label shall be fitted in or on the fire alarm panel advising the sprinkler alarm is

connected. The fire alarm battery shall have sufficient capacity to supply all sprinkler and alarm system loads simultaneously under all operating conditions for 60 minutes, or longer if required by NZS 4512; or

(a) A source exclusive to the sprinkler system, consisting of a sealed lead acid battery, plus a charger incorporating a low battery capacity alarm which operates if the voltage is less than 2.03 V per cell. The low battery alarm shall be audible within the building. The battery shall have a minimum capacity of 7 Ah or sufficient capacity to operate the sprinkler operating indicator and evacuation sounders, plus any other battery loads, for a minimum of 20 min, or 60 min where the limits in 1.1.3 are exceeded, whichever is the greater.

#### 3.8.5 Monitored valves

Where an installation is connected to the New Zealand Fire Service monitoring system valves shall signal 'fire' or 'defect' as specified in this Standard.

Where an installation is not required to be brigade connected, monitored valves that are otherwise required to signal either fire or defect shall cause a local audible alarm to sound at the valve cabinet if an attempt is made to reset the system with a valve in an off-normal position.

## 3.9 Fire brigade alarm

#### 3.9.1

In residences housing people who are not capable of evacuating from the building without assistance (whether by virtue of physical disability, age or mental impairment), and it is not a building consent mandatory requirement to have a direct connection to the Fire Service, it is recommended that activation of the sprinkler system causes transmission of a fire call to the New Zealand Fire Service. The provisions of 1.1.3 should be noted for limitations with systems where there is no fire brigade alarm.

NOTE – A direct connection may be required under the NZBC or the Fire Safety and Evacuation of Buildings Regulations.

#### 3.9.2

The fire brigade alarm shall be listed and shall be activated by each of the devices specified in 3.8.1.1. It shall be capable of being independently isolated, reset, and tested at the fire sprinkler installation valves.

#### 3.9.3

Where the building has a fire alarm system connected to the Fire Service, the sprinkler system shall include a fire brigade alarm.

#### 3.9.4

The following are the acceptable methods of connection to the Fire Service:

(a) By means of a private fire alarm circuit and signalling device exclusive to the sprinkler system;

(b) By use of a multiple connection unit or common modulator and another private fire alarm system installed within the protected premises (for example, a manual fire alarm system).

## 3.10 Pressure reducing valve

**3.10.1**

In any situation where the water supply pressure exceeds the working pressure of the components (see 3.1), a pressure reducing valve shall be installed in the water supply upstream of the control valves.

**3.10.2**

Pressure reducing valves shall be listed and of a diaphragm type, with the pilot valve controlled by pressure on the downstream side. The high pressure supply to the pilot valve and controls shall be through a self-cleaning in-line strainer. Use of Y pattern strainers is not allowed in the trim to the pilot valve. Isolating valves are not permitted on the trim of the pressure reducing valves.

**3.10.3**

A listed pressure relief valve shall be fitted immediately downstream of any water supply pressure reducing valve, and set to relieve at a pressure 100 kPa less than the maximum working pressure of the lowest pressure rated component of the system. The drain from this relief valve shall be positioned so that its operation may be readily observed. A 15 mm pipe and normally closed stopcock shall be fitted to bypass the pressure reducing valve to enable the pressure relief valve operation to be tested.

## 3.11 Automatic pressure relief valve

With approval, a pressure relief valve may be used to limit the discharge pressure of a booster pump where the suction pressure may occasionally rise above normal pressures. The high pressure supply to the pilot valve and controls shall be through a self-cleaning in-line strainer. Use of Y pattern strainers is not allowed in the trim to the pilot valve. Isolating valves are not permitted on the trim of the pressure relief valves.

# 4 LOCATION OF SPRINKLERS

## 4.1 Rooms excluding basements, vehicle garages, and storage areas

### 4.1.1 Sprinkler type and location

Sprinklers shall be of the residential sprinkler type and located strictly in accordance with the manufacturer's listing instructions for the particular type of sprinkler and intended operating pressure. The listing requirements include:

(a) Distance between sprinklers;

(b) Distance from walls and obstructions;

(c) Distance from underside of ceiling; and

(d) Locating of sprinklers under sloping ceilings;

and (a) – (d) may vary according to design pressure.

NOTE – Some sprinkler manufacturers produce a comprehensive Residential Sprinkler Design/ Installation Guide. This provides essential additional sprinkler specific information covering:

(1) Installation requirements;
(2) Installation spanners;
(3) Areas of coverage, flow rates, pressures;
(4) Sprinkler location relative to adjacent sprinklers and obstructions;
(5) Design where ceiling beams are present;
(6) Location of sprinkler near heat sources;
(7) Sloping ceilings.

### 4.1.2 Cupboards and wardrobes

#### 4.1.2.1

Enclosures constructed as part of the building structure shall be protected as follows:

(a) All cupboards or wardrobes exceeding 2 $m^3$ in volume, including understair cupboards, cleaners' cupboards, linen cupboards, kitchen pantries, and so on shall be sprinkler protected.

(b) Enclosures less than 2 $m^3$ in volume do not require sprinkler protection where (i) to (iii) or (iv) apply:

(i) The enclosure has all internal linings constructed of a flame barrier complying with the Compliance Documents of the NZBC

NOTE – 10 mm gypsum plasterboard meets this requirement.

(ii) The enclosure is provided with a vent into the sprinkler protected area by a clear opening of at least 0.02 $m^2$ free area in the top of the enclosure

(iii) The enclosure does not house electrical equipment referred to in (c).

OR

(iv) The enclosure is a cleaner's cupboard, utility cupboard, kitchen pantry, linen cupboard or similar storage space which does not have a ceiling and is open to a sprinkler protected concealed space above, in which sprinklers give unobstructed coverage to the enclosure. Circuit breaker panels serving individual residential units may be located in such enclosures;

(c) All enclosures housing electrical switchboards, circuit-breaker panels or other potential sources of ignition, such as water heaters, clothes washers, clothes driers, and the like shall be sprinkler protected.

NOTE – Where an enclosure has shelving or other obstructions installed, sprinklers shall be located to provide adequate detection and protection. Additional sprinklers or venting of internal partitions may be required to achieve this requirement.

#### 4.1.2.2 Joinery units

Cupboards, wardrobes, kitchen units, and the like that are constructed as joinery units and installed independently of the building structure, whether extending to ceiling height or not, do not require sprinkler protection where:

(a) No individual storage compartment exceeds 2 $m^3$;

(b) There are no electrical switchboards, circuit-breaker panels or other potential sources of ignition, such as water heaters, clothes washers, clothes driers, and the like; and

(c) The walls and ceiling of the surrounding building structure have linings constructed of a flame barrier complying with the Compliance Documents of the NZBC.

NOTE – 10 mm gypsum plasterboard meets this requirement.

Where the above conditions are not met sprinklers shall be installed to the approval of the SSC to best protect the specific risk. This clause does not apply to under bench appliances.

### 4.1.3 Skylights

Skylight shafts shall be protected except where:

(a) The skylight projects through a sprinkler protected concealed space and is less than 1 m deep with a cross-sectional area of less than 1 $m^2$; or

(b) The volume of the skylight shaft is less than 1.5 $m^3$.

Sprinklers in skylights shall be of the non-residential type and located as required by 4.5.

### 4.1.4 Obstructions

Beams, light fittings, smoke detectors, ceiling appendages, fans, air conditioning outlets, shaped ceilings, or other features may adversely affect the distribution of water from the sprinkler. Additional sprinklers, spaced according to 4.5.1 and 4.5.2, may be used to achieve complying sprinkler coverage.

NOTE – Information provided in the manufacturer's data sheet and installation guidelines will provide guidance as to the application of this clause. Some residential sprinklers are listed for use below ceiling beams that would otherwise obstruct sprinkler discharge. Refer to the listed data sheet for design and location criteria.

### 4.1.5 Decks and patios

Where a deck or patio is partially or wholly covered by a verandah, wide eave, or similar feature exceeding 1.5 m wide, sprinklers are required over the deck in these areas. Hydraulic calculations may be undertaken on the basis of two sprinklers operating unless otherwise required by the SSC.

## 4.2 Roof, ceiling, and underfloor spaces

Sprinklers in roof, ceiling, and underfloor spaces shall be of the non-residential type as required by 3.2.1 and located as required by 4.5.

## 4.3 External sprinklers

### 4.3.1 Sprinkler type

External sprinklers shall be listed quick response 93°C sprinklers or window wall drenchers and be located at the highest point of the wall of the protected building so as to wet the portion of walls and windows which would be exposed to radiant heat. Where two levels of external sprinklers are required, protective hoods shall be installed over the lower sprinklers.

For water supply purposes and the design number of sprinklers see 5.1.3. Guidance for design can be obtained from NZS 4541:2007.

### 4.3.2 Specifically listed external sprinklers

Specifically listed external sprinklers shall be spaced to conform to the listing for the particular sprinkler.

Spray or sidewall sprinklers shall be spaced in accordance with table 4.1.

**Table 4.1 – Sprinkler spacing and location**

| Distance | Position | Maximum | Minimum | Point of measurement |
|---|---|---|---|---|
| Distance between sprinklers | Horizontally | 2.5 m | 1.8 m (see Note) | Centre of sprinkler |
| | Vertically | 4.0 m | N/A | Deflector to deflector |
| Horizontal distance from wall | Horizontal sprinkler | 100 mm | 50 mm | Sprinkler deflector |
| | Pendent sprinkler | 300 mm | 100 mm | Centre of sprinkler |
| Vertical distance below top of protected surface | Horizontal sprinkler | 100 mm | 50 mm | Centre of sprinkler |
| | Pendent sprinkler | 100 mm | 50 mm | Sprinkler deflector |

NOTE – The 1.8 m minimum distance may be reduced where sprinklers are separated by a baffle or building feature which will prevent cooling from an adjacent operating sprinkler.

## 4.4 Basements, vehicle garages, and storage areas

### 4.4.1 Design criteria – small non-residential rooms

The fire loads in small storage rooms, drying rooms, and garages require higher discharge densities than normally applied in residential occupancies (see Appendix A).

Any such rooms, which are separated from other areas by full height partitions or walls, and which are of an area that may be protected by up to six sprinklers spaced at not more than 12 $m^2$ shall be protected by 15 mm sprinklers. Pipework shall be sized to ensure that the density is not less than 5 mm/min.

### 4.4.2 Design criteria – larger non-residential rooms

Any storage room, drying room, or garage larger than the area specified in 4.4.1, shall be regarded as a separate occupancy and guidance shall be sought from NZS 4541 and the SSC for the protection of this hazard.

### 4.4.3 Ceiling obstructions

The requirements of 4.1.4 shall apply to any ceiling obstruction.

## 4.5 Non-residential sprinklers

### 4.5.1 Maximum spacing

Non-residential sprinklers maximum spacing shall be as listed in table 4.2.

**Table 4.2 – Maximum spacing and coverage of non-residential sprinklers**

| Sprinkler | Maximum distance between sprinklers (m) | Maximum area of coverage ($m^2$) | Minimum orifice pressure (kPa) |
|---|---|---|---|
| 15 mm spray pattern | 4.6 | 21 | 50 |
| 15 mm conventional pattern | 4.0 | 16 | 50 |

### 4.5.2 Distance to adjacent sprinklers

Sprinklers shall not be closer to one another than 1.8 m if the discharge from one could wet the adjacent sprinkler.

### 4.5.3 Spacing between sprinklers and walls/partitions

The maximum distance between sprinklers and walls or partitions shall be one-half of the distances specified in 4.5.1.

### 4.5.4 Distance of sprinklers below ceiling

#### 4.5.4.1

The heat activated element of sprinklers shall be located for optimal sensing of convected heat from a fire close to the location of the sprinkler, and having regard for the heat ponding and channelling effect of structural or architectural projections below the ceiling.

Sprinklers shall be positioned below the underside of ceilings, roofs, or equivalent surfaces in accordance with the listing details for the sprinkler.

If there are no specific limitations described within the listing, and the room is not normally used for sleeping the centre line of the heat activated element shall be located not greater than 150 mm below the underside of any ceiling, roof or equivalent surface, or 150 mm under the continuous structural or architectural members, contiguous with the ceiling, roof or equivalent surface above. Under the following circumstances, this distance may be increased up to the maximums shown below:

(a) Continuous structural or architectural members contiguous with the ceiling, roof or equivalent surface above, running in two directions, forming bays of area:

(i) Not greater than 30 $m^2$ .....450 mm

(ii) Greater than 30 $m^2$ but less than 100 $m^2$.....350 mm

(b) Continuous structural or architectural members contiguous with the ceiling above, running in one direction only:

(i) At spacing on centres not greater than 900 mm .....450 mm

(ii) At spacing on centres greater than 900 mm but less than 2300 mm .....350 mm.

The placement of sprinklers below any ceilings, roofs or equivalent surfaces that do not conform to the above criteria shall be specifically approved. In determining acceptance, the SSC shall consider whether the speed of detection is slower than would be the case with one of the options detailed in (a) or (b).

If the primary purpose of the room is for sleeping the centre line of the sprinkler heat activated element shall be no greater than 150 mm below the ceiling.

#### 4.5.4.2

Deflectors of sprinklers shall be parallel to the slope of the ceiling, roof, or incline of stairs. Conventional pattern sprinklers installed upright shall have at least 25 mm clearance between their deflectors and any plane surface directly above them.

### 4.5.5 Vertical obstruction to sprinkler discharge

Special requirements apply in relation to residential sprinklers. Some residential sprinklers have been listed for use under obstructed construction such as ceiling beams. Refer to the manufacturer's data sheet and design guide.

Where the deflectors on non residential sprinklers are above the level of the bottom of the beams, joists, light fittings or ducts, the sprinklers shall either be at a sufficient horizontal distance (as defined by table 4.3, and figure 4.1) for the relative levels of the deflector and base of the obstruction as not to cause undue interference with the discharge pattern, or the obstruction treated as a wall or partition.

NOTE – Attention is drawn to the need to comply with 4.5.4.

**Table 4.3 – Non-residential sprinkler distances from obstruction**

| | Maximum height of sprinkler deflector above bottom of obstruction | |
|---|---|---|
| **Minimum horizontal distance from sprinkler to side of obstruction** (mm) | **Conventional sprinklers installed upright** (mm) | **Spray sprinklers (upright and pendent types) and conventional sprinklers installed pendent** (mm) |
| 100 | – | 17 |
| 200 | 17 | 40 |
| 300 | 25 | 70 |
| 400 | 34 | 100 |
| 500 | 42 | 150 |
| 600 | 51 | 200 |
| 700 | 60 | 250 |
| 800 | 68 | 300 |
| 900 | 78 | 360 |
| 1000 | 90 | 415 |
| 1100 | 110 | 440 |
| 1200 | 135 | 460 |
| 1300 | 170 | 460 |
| 1400 | 200 | 460 |
| 1500 | 230 | 460 |
| 1600 | 265 | 460 |
| 1700 | 300 | 460 |
| 1800 | 340 | 460 |

### 4.5.6 Sloping ceilings

Under sloping ceilings or roofs the spacing measurements shall be taken horizontally.

### 4.5.7 Sawtooth ceilings

Where both the slopes are greater than one in three, a line of sprinklers shall be fixed at the apex unless there is a row of sprinklers not more than 750 mm distant radially from the apex. The valley at the intersect of the projection of such roof slopes shall be deemed to be the line of a wall for the purpose of 4.5.3.

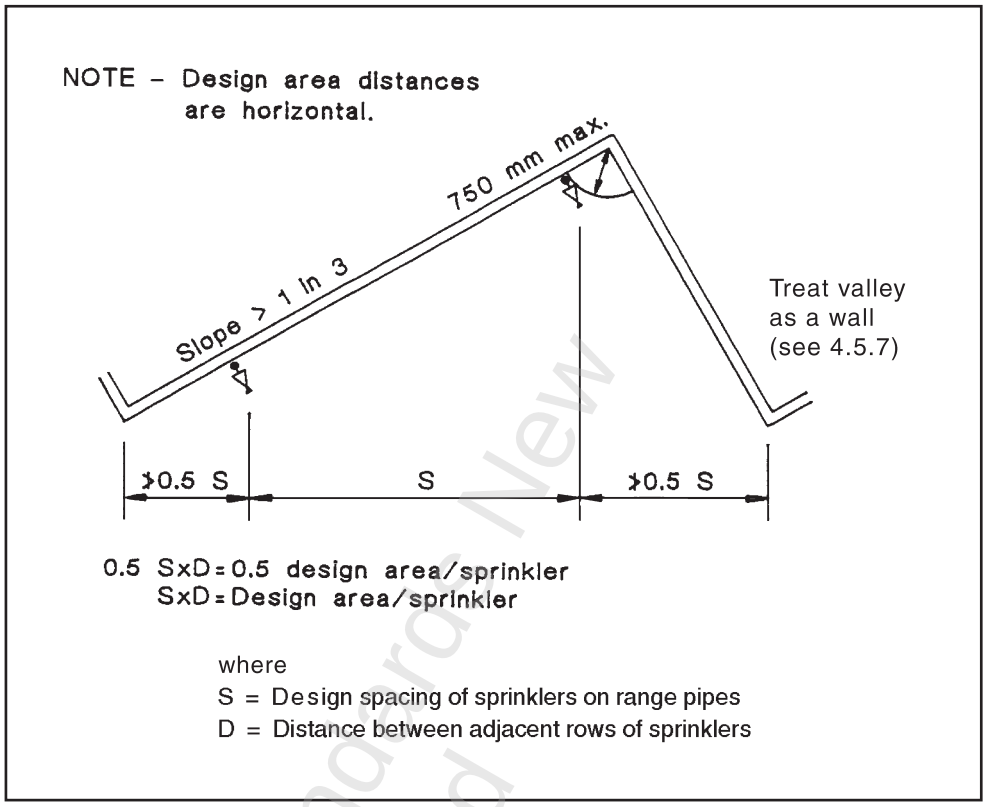



**Figure 4.1 – Location of non-residential sprinklers in sloping roofs**

# 5 DETERMINATION OF WATER SUPPLY REQUIREMENTS

## 5.1 Method

The design flow and design pressure (system demand) shall be calculated in accordance with 5.1.1, 5.1.2, and 5.1.3 using the procedures set out in section 7. The reference point for the system demand shall be the installation gauge connection immediately on the downstream side of the check valve that forms part of the installation control valves.

Non-sleeping occupancy rooms/spaces shall be protected throughout as an extra light hazard risk (2.7 mm/min, up to four sprinklers operating) or an ordinary hazard risk (5 mm/min, up to six sprinklers operating). If the number of sprinklers in the space exceed these numbers consult with the SSC.

NOTE – The basis for system demand calculation is according to the number of sprinklers in the room. For roofs, ceilings, and underfloor spaces (not used for storage), where more than one sprinkler is present, the basis for calculation is two sprinklers operating at the minimum pressure required by 4.5.1.

### 5.1.1 Residential sprinklers

The design basis for residential sprinklers shall be calculated based on all sprinklers in any room, allowing for a maximum of four sprinklers operating at the listing pressure (see Appendix A).

### 5.1.2 Standard spray sprinklers

The design basis for non-residential (standard spray) sprinklers in sleeping areas shall be based on the number of the sprinklers in any room, with a maximum of four sprinklers operating at the minimum pressure as nominated in table 4.2.

The design basis for non-residential (standard spray) sprinklers in storage areas shall be in accordance with 4.4.1 for rooms containing not more than six sprinklers, with all of the sprinklers in the room operating at the minimum pressure as nominated in table 4.2.

### 5.1.3 External sprinklers

The basis for system demand calculation shall be the number of quick response sprinklers (the design number) which the SSC determines could operate simultaneously if the exposure was fully involved in fire.

Standard or sidewall spray sprinklers (15 mm orifice) shall be fully hydraulically designed so that the flow from any external sprinkler shall be not less than 75 L/min when the required maximum number of external sprinklers are operating.

Where the area to be protected by an individual sprinkler is less than 2.5 m wide, the flow rate may be reduced proportionally subject to a minimum end sprinkler pressure of 70 kPa.

Sprinklers specifically listed for window and wall drenching shall be designed in accordance with their listing requirements.

## 5.2 Room

For the purposes of determining water supply requirements, 'room' shall mean a space enclosed by walls, ceiling or roof, floor, and a door lintel at least 200 mm deep. Where any space does not fulfil these criteria, the spaces on either side of the doorway shall be part of the same room.

## 5.3 Extrapolation

Listing data for residential or drencher sprinklers shall not be interpolated between or extrapolated beyond the values provided in the listing.

## 5.4 Design flows

The design flows are defined as the water flows calculated in accordance with 5.1.1, 5.1.2, or 5.1.3 appropriate to the area concerned. However, the design flow shall not be less than the flow required to operate any single sprinkler at its listed pressure.

## 5.5 Design pressures

The design pressures are defined as the pressures required at the control valves installation gauge to produce the design flows for the appropriate areas when calculated in accordance with section 7. However the design pressure shall not be less than the pressure required at the control valves' installation gauge to operate any single sprinkler at its listed pressure.

# 6 WATER SUPPLY

## 6.1 Basic requirements

### 6.1.1 General

Each sprinkler system shall have at least one water supply that, on sprinkler system activation, provides automatically at the installation control valves, at least the design flows at the design pressure when measured or evaluated as described by this Standard.

NOTE – Although the provisions in this Standard are deemed to comply with the protection of potable water supplies, refer also to the Compliance Document for the NZBC Clause G12.

### 6.1.2 Acceptable water supplies

Only the following sources of supply specified may be used as a water supply:

(a) A connection to a reliable town or city reticulated water supply, subject to the approval and requirements of the water supply authority (see 6.2);

(b) A privately-owned elevated reservoir;

(c) A pumped supply complying with 6.5 taking water from a source permitted by 6.4.1. Where this is the only water supply for the sprinkler system, the pump shall be driven by a diesel engine meeting the requirements of 6.5.3.

### 6.1.3 Duration

Every water source shall be able to maintain the design flow at the design pressure for the design duration specified in 1.1.3 and shall be able, by practicable means, to be replenished within 6 h.

### 6.1.4 Contaminants

Water supplied to sprinkler systems shall be free from particulate or dissolved matter that could adversely affect any part of the system.

## 6.2 Reticulated water supply

### 6.2.1 General

A water supply may be taken directly from a reticulated water supply or from the pipe which supplies the domestic water supply to the protected building provided that:

(a) The pipe is in sound condition, adequately buried or protected against freezing, impact damage, subsidence, corrosion and malicious damage;

(b) The pipe is not less than 20 mm ID; and

(c) The point of connection to the domestic supply is downstream of any valve which, if closed, will interrupt the supply of water to the protected building, and upstream of the water meter; and

(d) Every valve which controls the supply of water to the sprinkler system shall indicate the direction of closing and be affixed with a label bearing the embossed or engraved words ‘FIRE SPRINKLER SUPPLY – CLOSURE WILL REMOVE SPRINKLER PROTECTION’; and

(e) Either:

(i) The connection to the reticulated water supply shall be capable of supplying simultaneously the design flow and pressure requirements of the sprinkler system and the 'domestic demand' when calculated in accordance with tables 6.1 and 6.2 for sleeping occupancies. In all situations with exceptional demands (for example, lawn sprinklers) such demands need to be added to the design flow to ascertain the design flow and pressure

(ii) There is installed a listed automatic pressure sustaining valve or listed residential domestic shut-off valve with adequate fittings for testing and demonstrating its correct function. These valves shall cause the restriction or shut off of the domestic water supply so as to maintain the design pressure required for the sprinkler system (see figure 6.1), or

(iii) The SSC shall specify the demand used in the design.

**Table 6.1 – Loading units of domestic fixtures' values**

| Fixture/appliance | Flow rate (L/min) | Loading units |
|---|---|---|
| Basin (spray tap) | 1.8 | 0.5 |
| Basin (standard outlet) | 6 | 1 |
| Bath or bathroom group (basin, bath, bidet, shower, WC) | 18 | 8 |
| Hose tap (15 nom. size) | 12 | 4 |
| Hose tap (20 nom. size) | 18 | 8 |
| Laundry tub | 7 | 3 |
| Mains pressure water heater | 12 | 8 |
| Shower | 6 | 2 |
| Sink | 7 | 3 |
| Washing-machine/dishwasher | 12 | 3 |
| Water closet cistern | 6 | 2 |

NOTE –

(1) This table is based on AS/NZS 3500.1 table 3.1.

(2) In the case of valves and appliances where test information indicates that they will function satisfactorily with a flow rate less than that shown in table 6.1, the tested flow rate may be substituted and the loading units adjusted accordingly.

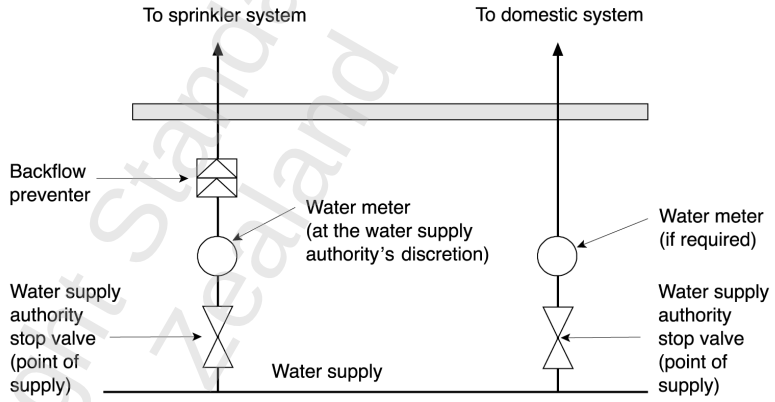
(3) domestic water demand is to be established as follows:

(a) List all of the fixtures that are present and determine the number of load units for each fixture from table 6.1;
(b) Determine the reasonable worst case group of fixtures that could be in concurrent operation and total the number of load units for this reasonable worst case group;
(c) Look up the total number of flow units in table 6.2 for the reasonable worst case group of fixtures that could be in concurrent operation and determine the total estimated domestic demand. Where necessary interpolate between values in table 6.2;
(d) Details of the fixtures present and the determination of what is the reasonable worst case group of fixtures that could be in concurrent operation shall be agreed with the SSC.

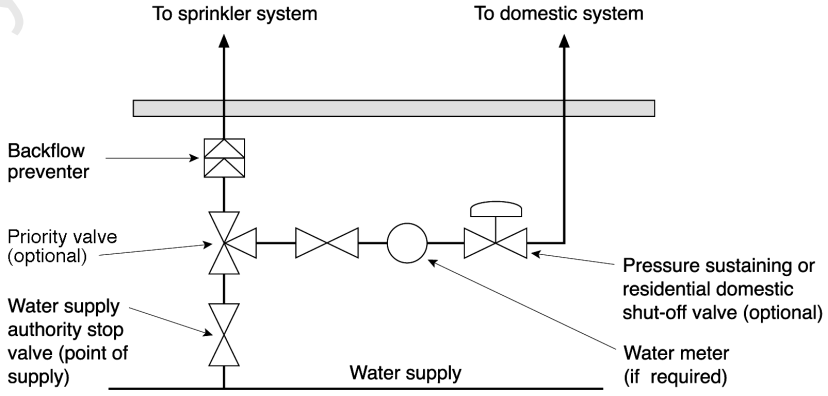
**Table 6.2 – Probable simultaneous flow rates**

| Loading units | Probable simultaneous flow rate (L/s) | Loading units | Probable simultaneous flow rate (L/s) |
|---|---|---|---|
| 10 | 15.6 | 140 | 63.0 |
| 20 | 22.8 | 160 | 67.8 |
| 30 | 28.2 | 180 | 72.0 |
| 40 | 33.0 | 200 | 76.2 |
| 50 | 37.2 | 250 | 85.8 |
| 60 | 40.8 | 300 | 94.2 |
| 70 | 43.8 | 350 | 102.0 |
| 80 | 47.4 | 400 | 109.2 |
| 90 | 50.4 | 450 | 116.4 |
| 100 | 52.8 | 500 | 123.0 |
| 120 | 58.2 | | |

NOTE – This table is based on AS/NZS 3500.1 table 3.3.




(a) Acceptable arrangement




(b) Preferred arrangement

NOTE – Backflow prevention is required in accordance with the Compliance Document for the NZBC Clause G12/AS1.

**Figure 6.1 – Acceptable reticulated water supply arrangements**

### 6.2.2 Town's main water supply

The town's main shall be part of a reticulation system under the control of the water supply authority and which has been approved by a SSC after first determining that the system:

(a) Is in good order with a record of reliable operation including periods of drought;

(b) Is supplied by an inexhaustible source of water or has sufficient stored capacity to meet the normal needs of the area served for a 48-hour period during peak demand; and

(b) Has, where pumps are used to provide or supplement pressure, at least 50% of the pumping capacity independent of the local network utility operator for its electrical power supply.

NOTE –

(1) The town's mains are likely to be significantly impaired following a maximum credible earthquake event. The building owner may wish to consider a more reliable water supply to cater for such an event.

(2) The water supply authority may not guarantee supply for 100% of the time, and supply may be less reliable after major natural events such as earthquakes.

### 6.2.3 Derating of water supplies

For design purposes, the flow and pressure characteristics of a reticulated water supply shall be determined by Method 1 or Method 2 of Appendix N. The SSC may require the use of Method 2.

Where the supply pipe connected to the protected premises is not fitted with hydrants (as may be the case with smaller bore subsidiary mains) then the friction loss for the total water demand (see 6.2.1(e) shall be calculated from the point of test to the control valves, including all pipework and fittings associated with the subsidiary main.

Either Method 1 or Method 2 may be used in the normal manner on a subsidiary main if suitably sited test connection(s) are available (in lieu of a hydrant) on the subsidiary main, so that the characteristics of the subsidiary main can be determined at the point of connection to the protected premises.

If the static pressure of the main exceeds 1000 kPa, full particulars shall be submitted to the SSC including any proposed use of automatic pressure control valves.

Additionally, installed reticulated water supplies shall provide at least 120% of the required design pressure for each design flow, when tested through the alarm valve. This requirement may be reduced to 110% of the required design pressure if the water supply is satisfactorily assessed in accordance with Method 2.

### 6.2.4 Strainers

Except in the case of a supplemented reticulated water supply, a listed strainer shall be installed on every reticulated water supply where previous experience or test results indicate a need to eliminate particulate matter which could block a sprinkler or other system orifice.

NOTE – Appendix M provides the listing requirements for strainers.

In such cases, the contractor may obtain an early ruling on the need for a strainer, by the submission of appropriate information to, or by facilitating demonstrative tests for, the SSC. ➤

Ordinarily, it will not be necessary to require a strainer if the reticulated water supply is 100 mm ID or larger.

### 6.2.5 Pipework

The pipework of a connection to a reticulated water supply shall comply with 3.5.

### 6.2.6 Connections for hose reels

The point of connection for the water supply to any hose reel shall be either:

(a) On the domestic supply feed downstream of the water meter but upstream of any pressure sustaining valve, or residential domestic shut-off valve; or

(b) On the sprinkler system supply pipe upstream of the sprinkler control valves in which case the supply to the hose reel shall commence with a valve labelled 'FIRE HOSE REEL – DO NOT CLOSE'; and

(c) The valve shall be padlocked in the open position.

In calculating the sprinkler demand (see 5.1), a flow of 14 L/min shall be added to the design flow in those pipes common to both systems. This flow is based upon the requirements of AS/NZS 1221. If hose reels manufactured to another Standard are being used, then the flow appropriate to those hose reels shall be used.

### 6.2.7 Stop valves and toby boxes

A stop valve enclosed in a toby box shall be provided, at the point of connection to the reticulated water supply or rider main (see 6.2.1), with the direction of closing indicated and a label according to 6.2.1(d) provided.

NOTE – With the agreement of the water supply authority, the underside of the toby box lid should be painted with a colour distinctive to fire sprinkler connections.

### 6.2.8 Boosted reticulated water supply

#### 6.2.8.1 General

In any situation where a reticulated water supply, which otherwise complies, cannot meet the necessary pressure requirements, an automatic starting diesel pump unit may, with the agreement of the SSC, be used to boost the pressure to meet the relevant design pressure requirements. (See figure 6.2 for typical layout.)

NOTE – Backflow prevention is required in accordance with the Compliance Document for the NZBC Clause G12/AS1.

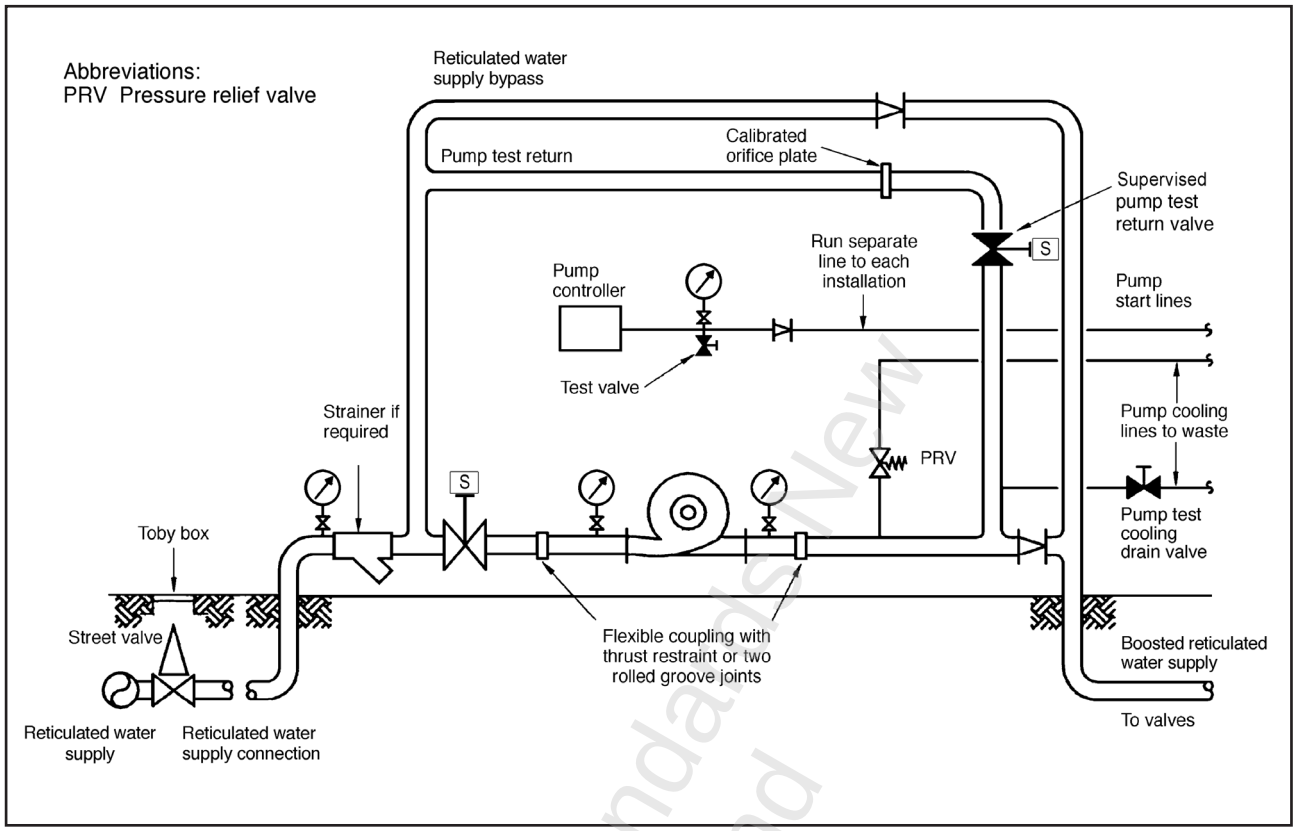



**Figure 6.2 – Typical arrangement for boosted reticulated water supply**

#### 6.2.8.2 Pump unit

The combined output of the reticulated water supply (when measured in accordance with Method 1 or 2 of Appendix J) and pump shall meet the pressure and flow requirements of the system. The pump unit shall comply with 6.5.

#### 6.2.8.3 Reticulated water supply pressure

The residual pressure in the reticulated water supply when meeting the highest design flow shall not fall below 100 kPa at the point of connection to the town's main and shall be positive pressure between that point and the suction point of the pump. This figure is not subject to derating in Appendix N.

#### 6.2.8.4 Bypass

A bypass shall be provided around the pump of the same diameter as the reticulated water supply connection and shall be fitted with a non-return valve to prevent recirculation.

#### 6.2.8.5 Pump test return

A pump test return pipe shall be taken from the pump delivery (downstream of the flexible coupling) to the pump suction (upstream of the flexible coupling). This pipe shall be fitted with a normally closed, locked and labelled, indicating stop valve fitted with a supervisory device. A normally closed pump cooling drain may be required in accordance with 6.5.2.4 and figure 6.2. An orifice plate, sized to induce at least 100% of the design flow, shall be fitted in the pump test return unless the hydraulic characteristic of the pipework causes 110% of the design flow to be induced. The pump test return valve shall be supervised to signal defect when more than 5% open (see also 6.5.3.2(d)).

## 6.3 Storage tank capacity and refilling

### 6.3.1 Storage tank capacity

Where a water supply incorporates a storage tank, the minimum capacity shall be the greatest design flow for 20 min or for 60 min where the limits in 1.1.3 are exceeded as permitted by 1.1.3.2. Where the water storage tank provides water supply to fire hydrants the tank capacity shall be increased by 45 $m^3$.

#### 6.3.1.1

The effective capacity shall be measured as follows:

(a) Where the storage tank or elevated tank is used exclusively as a water source for the sprinkler supply, the capacity shall be measured between a horizontal plane 50 mm below the overflow and the top of the anti-vortex plate; or

(b) The capacity of a storage tank or elevated tank that also provides water for other purposes is the volume contained in the depth by which the sprinkler anti-vortex plate is below the other purposes outlet.

#### 6.3.1.2

Where the design number of external sprinklers creates a flow requirement in excess of that specified in 5.1.1 or 5.1.2, the capacity of any storage tank shall be sufficient to permit a 30 min discharge at the highest design flow imposed by the design number (see 5.1.3) of external sprinklers.

### 6.3.2 Refilling and topping up

#### 6.3.2.1

Provision shall be made on all storage tanks and elevated tanks to:

(a) Automatically keep the tank topped up; and

(b) Manually refill the tank after emptying.

#### 6.3.2.2 Topping up

Topping up may be:

(a) From a reticulated or other continuous water supply through a 15 mm ID pipe controlled by a float operated valve via an air gap of at least 40 mm or by other suitable device incorporating appropriate backflow prevention;

(b) By an electrically driven 20 L/min pump taking suction from a reliable source, powered from a circuit exclusive to the sprinkler apparatus and automatically switched by a level controlled switch; or

(c) Where there is not a reticulated water supply, by a continuous overflow controlled supply from rain-water or other less reliable source.

#### 6.3.2.3 Refilling

The following requirements may apply:

(a) Refilling may be provided by a connection to a town's main, or from another reliable source; and

(b) Refilling shall be achieved in 6 hours; or

(c) If the 6-hour refilling time cannot be achieved, then alternative contingency plans shall be submitted for consideration to a SSC.

#### 6.3.2.4 Rainwater

Where rainwater or other unfiltered water is used to top up or refill, it shall first pass through a debris and sludge trap.

#### 6.3.2.5 Float-operated valves

Float-operated valves shall be accessible for maintenance without requiring significant water storage depletion.

## 6.4 Pumped supplies – Water sources

### 6.4.1 Acceptable sources

The following are acceptable sources of water for pump units, provided they satisfy the detailed requirements set out in this Standard:

(a) Reticulated water supply;

(b) Tanks;

(c) Wells and artesian bores; and

(e) Open water.

In each case, the water shall be clean, free from sediment and debris.

### 6.4.2 Reticulated water supply

Reticulated water supply providing water for a pump shall meet the requirements for boosted reticulated water supplies.

### 6.4.3 Tanks

See figure 6.3 for a typical arrangement for a pump and tank supply.

NOTE – For potable supplies, backflow prevention is required in accordance with the Compliance Documents for the NZBC Clause G12/AS1.

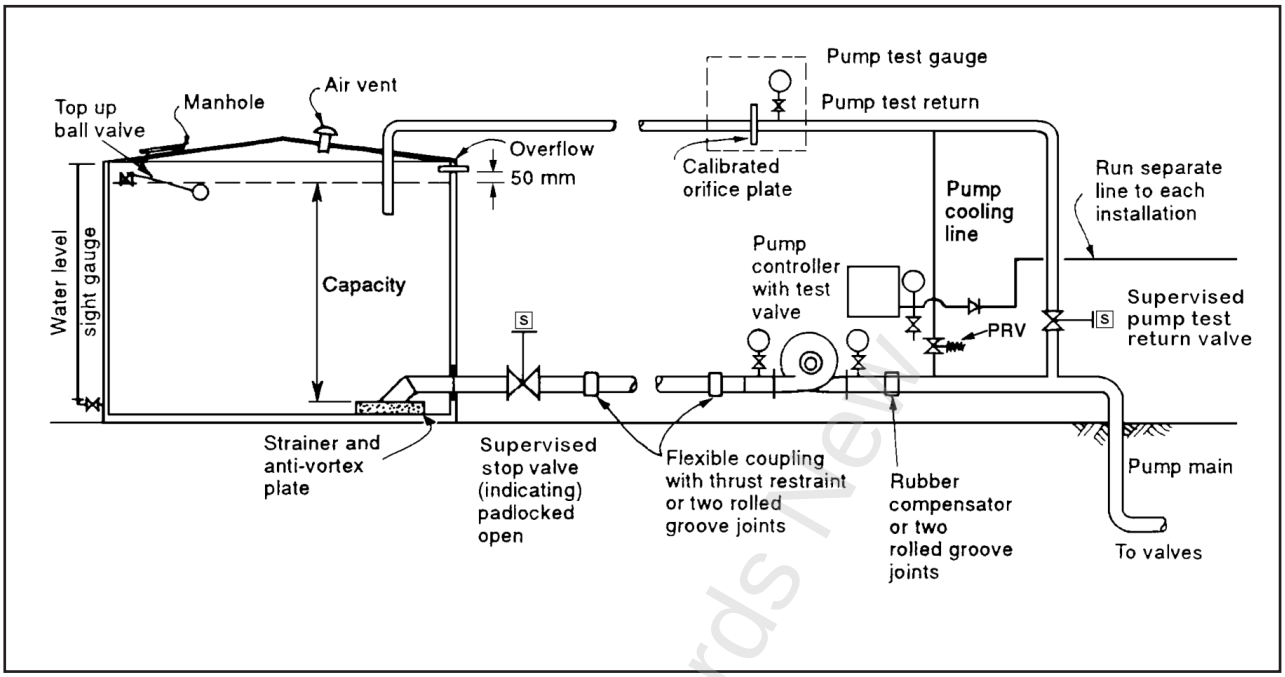



**Figure 6.3 – Typical arrangement for pump and tank supply**

#### 6.4.3.1 Design and manufacture

Tanks of the following types may be used provided they are either of a design and manufacture approved by a chartered professional engineer or comply with the appropriate Standard:

(a) Roofed concrete tanks;

(b) Roofed wooden tanks;

(c) Roofed steel tanks constructed of stainless or protected mild steel;

(d) Swimming pools provided that:

(i) The drain valve is chained and padlocked shut, and labelled in 12 mm high white letters on a red background 'FIRE SPRINKLER PUMP WATER SUPPLY. DO NOT DRAIN BEFORE NOTIFYING SPRINKLER CONTRACTOR'

(ii) A grating additional to the suction inlet strainer is installed to prevent foreign matter reaching the strainer

(iii) The water is kept clean at all times by an effective filtration unit

(iv) The purification system does not utilise sodium chloride or other corrosive materials;

(e) Any other tank where evidence is provided in the form of a design certificate from a chartered engineer.

A chartered professional engineer shall sign a declaration that certifies that the tank and its foundations have been designed in accordance with NZS 1170.5.

NOTE – A producer statement (design) can act as such a declaration.

#### 6.4.3.2 Refilling and topping up

The tank capacity and the refill and topping up arrangements shall comply with 6.3.

#### 6.4.3.3 Location

Tanks shall be:

(a) Positioned so that they are not likely to be exposed to fire; and

(b) Combustible tanks, or tanks with a combustible supporting structure shall not be located within 10 m of an exposure unless the exposure is protected by sprinklers or a passive fire rated barrier agreed to by the SSC; and

(c) Supported on adequate foundations at, or below, ground level; and

(d) Constructed to meet the requirements of NZS 4219 or NZS 1170.5 for seismic design.

#### 6.4.3.4 Access

Safe permanent access, secured against unauthorised entry, shall be provided to inspect and maintain the fittings and fixtures of every tank.

#### 6.4.3.5 Level indicator

The tank shall be fitted with an indicator showing the contents above the level of the vortex plate.

#### 6.4.3.6 Overflow pipe and air vent

A tank overflow pipe of suitable size shall be provided. The overflow shall discharge in an observable place. An air vent of suitable size shall be fitted.

#### 6.4.3.7

In situations where water is likely to freeze, the tank, together with the inlet and suction pipes, pump test return, and level indicator shall be protected against freezing.

#### 6.4.3.8 Suction pipe inlet

Suction pipes shall commence with:

(a) A screen having a net cross section open area of four times the cross-sectional area of the suction pipe and openings in the screen shall not have a major dimension larger than 8 mm; and

(b) An anti-vortex plate having a minimum dimension, measured from the centre of the outlet pipe to the outside edge of the plate, of 0.2 m.

#### 6.4.3.9 Suction pipe

The following requirements apply for suction pipes:

(a) The size and position of the suction pipe shall be such that, at the highest design flow, the water velocity does not exceed 4.0 m/s and the total pressure loss between the entry to the suction pipe and the inlet of the pump (including any permissible static lift) does not exceed the NPSH required minus 20 kPa when the water is at the level of the anti-vortex plate;

(b) A supervised stop valve fitted with an open and shut indicator and chained and padlocked open shall be located in the suction pipe upstream of any flexible coupling; ➤

(c) Butterfly valves shall not be placed within 10 pipe diameters of the pump suction inlet;

(d) The suction pipe should be laid so that no air may be trapped in it. Where this is impracticable, provision shall be made for the automatic release of trapped air;

(e) Provision shall be made to accommodate differential settlement and seismic movement between the tank and pump, and between tanks that are interconnected.

NOTE – The velocity limitation specified in this clause does not apply to the 10 pipe diameter length of pipe attached directly to the pump casing, as specified in 607.2.3(d) of NZS 4541.

#### 6.4.3.10 Flooded suction

The location of the tank and suction pipe in relation to the pump shall be such that the centre line of the suction inlet of the pump is at least 650 mm below the overflow and any other-purposes outlet on the tank.

#### 6.4.3.11 Priming devices and foot valves

Automatic priming devices and foot valves shall not be used.

#### 6.4.3.12 Pump test return

A pump test return shall be taken from the pump delivery (downstream of the flexible coupling) to the tank. This pipe shall terminate below the normal water level in the tank so no air entrainment will take place during the pump testing.

When it is not practicable to pipe the test return back to the tank then, with specific approval, the test line shall be piped back into the pump suction pipe so that it enters the suction pipe at an angle of 90° at least 10 pipe diameters upstream of the pump suction flange.

The test return pipe shall be fitted with a normally closed, locked, and labelled stop valve fitted with a supervisory device. An orifice plate, sized to induce approximately 110% of the design flow, shall be fitted in the pump test return unless the hydraulic characteristic of the pipework causes approximately 110% of the design flow to be induced. The pump test return valve shall be supervised to signal defect when more than 5% open (see figure 6.3).

### 6.4.4 Wells and artesian bores

#### 6.4.4.1 Approval required

Wells and artesian bores may be used as a source of water for a pump unit only with SSC approval. Any application for approval shall set out full details of the hydrological history of the proposed aquifer or one close to it and provide details of the water quality and well design.

#### 6.4.4.2 Well development

The well development flow shall be at least 150% of the highest design flow. At completion of development at such flow, the number of sand grains lifted shall not exceed 50 per litre.

#### 6.4.4.3 Well construction and accessories

The following requirements apply for well construction and accessories:

(a) The well shall have a screen with a sealed bottom;

(b) The velocity of water through the screen shall not exceed 0.05 m/s;

(c) There shall be no foot valves;

(d) The top of the inlet to the pump or dip pipe shall be submerged at least 2 m at all conditions of flow up to and including the highest design flow;

(e) An approved device to measure draw-down level under all flow conditions shall be permanently fitted;

(f) Adequate facilities shall be available for withdrawal of the dip pipe and, where needed, the submersible pump.

#### 6.4.4.4 Pumps

Where submersible pumps are used, the requirements for vertical shaft pumps and submersible electric pumps shall be complied with (see 6.5.2.5).

#### 6.4.4.5

Where an artesian well provides the highest design flow at the surface, above-ground pumps may be used provided that such flow is delivered to the pump at a pressure of at least 10 kPa.

#### 6.4.4.6 Pump test return

A pump test return similar to that described in 6.4.3.12 shall be installed. The point of discharge should be back to the well casing.

### 6.4.5 Open water

#### 6.4.5.1 Approval required

With approval and subject to any conditions imposed, water for a pumping unit may be taken from a river, lake, pond or reservoir for which an appropriate water consent is held.

NOTE – The Resource Management Act requires a water consent application.

#### 6.4.5.2 Design details

Design details shall be submitted for approval to a SSC on the:

(a) Quality of the water;

(b) Design of the suction pit, settlement chamber, and water entry;

(c) Capacity and available flow at all times;

(d) Flood protection arrangements; and

(e) Lowest and highest known water levels.

#### 6.4.5.3 Flooded suction

The lowest known water level of the water source shall be at least 650 mm above the pump centre line.

#### 6.4.5.4 Pump test return

A pump test return similar to that described in 6.4.3.12 shall be installed. The point of discharge should be back to the water source.

## 6.5 Pumped supplies – Pump units

### 6.5.1 General

#### 6.5.1.1 Pump selection

The published manufacturer's curve of the selected pump shall demonstrate that:

(a) At the design flow of every installation supplied, the pump will produce 110% of the additional pressure needed (at the point of connection to the water supply of the pump inlet flange) in order to meet the highest design pressure of each installation at the control valves, plus the pressure losses (or gains) due to difference in height and due to friction between the pump delivery and each alarm valve.

In determining the pressure available at the pump suction, the following shall be allowed for:

(i) On tanked or open water supplies, the pressure loss due to friction at the highest design flow in the suction pipe between the tank and the pump suction, plus allowance for the difference in elevation of the pump suction and the level of water (in tanks, when both full and empty)

(ii) For boosted reticulated water supply, the pressure differences due to friction loss (at the highest design flow) and due to static height, between the point at which the pressure measurement is taken to determine the characteristics of the reticulated water supply and the suction inlet of the pump;

(b) The NPSH required at the highest design flow is not more than the NPSH available minus 20 kPa at the suction inlet, measured or calculated as an absolute pressure having regard to the water temperature;

(c) At 150% of the highest design flow, the pump will produce at least 65% of the pressure available (on the manufacturer's curve) at the design flow and, when driven by the selected driver the pressure will fall progressively with the rate of flow.

#### 6.5.1.2 Component parts

A pump unit consists of a listed pump, listed motor, listed controller, and a unit frame.

#### 6.5.1.3 Unit manufacture

Pump units shall be manufactured by a manufacturer or contractor listed for that purpose and:

(a) When ordering a pump unit, a schedule of relevant information, including the data specified in Appendix F, shall be advised to the unit manufacturer;

(b) Before dispatch from the manufacturer's premises, every pump unit shall be inspected for compliance, including operation of control functions, and a flow test.

#### 6.5.1.4 Pump coupling and mounting

The pump unit and driver shall be assembled so that:

(a) The mounting on the frame shall allow either driver or pump to be removed without disturbing the other and the impeller to be withdrawn without removing the driver or pump body;

(b) There shall be ready access for checking the alignment of resilient couplings when the installation is complete;

(c) Oil resistant flexible pads, or other suitable means of vibration isolation shall be provided under the frame unless the manufacturer's instructions state otherwise. Care shall be taken not to distort the frame when bolting it down;

NOTE – The diesel engines used for residential sprinkler systems are often small two-cylinder units and can produce a significant level of vibration. It is necessary to ensure that adequate vibration isolation is provided between the pump unit and the structure and the pump unit and the system piping.

(d) The alignment shall be checked to be in accordance with the manufacturer's specification after the pump frame is installed, bolted down, and pipework connected;

(e) The pump and driver shall be in line direct or close coupled, and the coupling shall be rated for the maximum torque of the driver under all conditions, and of a design such that if any elastomeric element used in the coupling to absorb vibration should fail, that the pump shall continue to be driven under all operating conditions, except that a right angle gear drive may be used for vertical shaft pumps.

#### 6.5.1.5 Automatic starting

Automatic starting shall be provided and meet the following requirements:

(a) It shall be initiated by a listed pressure switch having dual enclosed contacts in parallel that close on a drop in pressure;

(b) Start pressure switches shall be located on the controller;

(c) Every time a drop in pressure closes the contacts of a start pressure switch, the pump, if it is not already running, shall start;

(d) A start pressure switch shall be provided for each sprinkler installation supplied by the pump;

(e) The start pressure switch shall be pressurised through a hydraulic line with a check valve (opening away from the pressure switch) in which a 2 mm orifice or equivalent score across the valve seat has been made. The hydraulic line shall also incorporate a drained test valve and pressure gauge arranged to permit accurate setting and testing of the pressure switch, unless, within easy reading distance, other test apparatus will serve the same purpose. Where a distant pump enclosure necessitates long hydraulic connections, such connections may be run in high density polyethylene pipe provided that the check valve is located close to the control valves;

(f) Start pressure switches shall close before the installation pressure drops to the highest design pressure;

(g) System pressurisation (to facilitate drop-in-pressure detection) shall be achieved by means of a permanently installed pressurising pump that may be any of the following:

(i) A hand operated pump

(ii) An electric motor driven pump

(iii) The fire pump provided that, at conditions of zero flow, the pump will produce 125% of the highest 'one sprinkler' design pressure.

There shall be incorporated into the system a gas over water expansion chamber of sufficient size (see Appendix L) to operate one sprinkler for the time taken to start the water supply pump and pressurise the system (see also 3.1.1) and to prevent changes in temperature causing the system pressure to drop to a level where the pump would ➤

start under no flow conditions. The accumulator shall be permanently labelled with its precharge pressure. This shall be in the form of an engraved label fixed to a prominent part of the accumulator tank.

Where a jockey pump is needed to pressurise the sprinkler system to above the start pressure of the pump an automatic jockey pump complying with 3.1.2 may be installed as an alternative to a gas over water accumulator.

#### 6.5.1.6 Manual starting

A labelled green manual start button shall be provided on the controller to energise the starter contactors directly.

#### 6.5.1.7 Stopping and isolation

Once started, every pump unit shall run until manually stopped at the pump unit. The use of a failsafe device such as an 'energised to stop' solenoid is accepted as meeting these requirements providing it meets the other requirements of this clause. Automatic or remotely-operated stopping is not permitted. The following facilities shall be provided:

(a) A red, clearly labelled, easily accessible stopping device that automatically resets or returns to its normal position;

(b) A manual means of individually isolating each start pressure switch. Only pressure switches that are closed may be isolated. Reopening the pressure switch shall automatically cancel the isolation.

#### 6.5.1.8 Gauges

The following gauges complying with 3.7 shall be provided:

(a) A compound pressure gauge complete with gauge cock connected to the suction of every pump, far enough from the pump not to be influenced by pump entry turbulence;

(b) A pressure gauge complete with gauge cock connected to the pump delivery.

#### 6.5.1.9 Pump running indicator

Every pump unit shall be provided with a device that indicates at an approved location that the pump is running. On diesel engine driven pumps, a SSC may agree to the omission of this alarm if the noise of the engine will serve the same purpose. A self-resetting device may be incorporated to suppress an electrically operated alarm for up to 60 minutes. Where the indication is made at a location that is not staffed at all times, a defect signal shall be generated through the FBA. The FBA control box used to generate the defect signal shall be clearly marked 'PUMP RUNNING ALARM CONNECTED TO THIS UNIT'.

#### 6.5.1.10 Pressure relief valves

Pressure relief valves may be used to limit pump discharge pressure where excessive pressures may be generated. If fitted to boosted reticulated mains or tank supplies, these valves shall not discharge to waste.

#### 6.5.1.11

The highest design flow of the pump unit shall be provided automatically (at the pressure designated on the pump curve) within 30 s of the pump start signal when tested under open discharge conditions.

### 6.5.2 Pumps

#### 6.5.2.1 Listing of pumps

A listed rotodynamic pump shall be used. Factors that shall be considered for any listing are:

(a) Materials and construction;

(b) Performance range and accuracy against the manufacturer's curve;

(c) Availability of documentation.

Every application for listing of a pump shall be accompanied by the following:

(d) Details of construction;

(e) The discharge versus power absorbed at duty speed;

(f) The NPSH required versus discharge at duty speed;

(g) The total head versus discharge at various speeds and impeller diameters; and

(h) The maximum impeller width and diameter.

#### 6.5.2.2 Measured performance of pump

Every pump shall be demonstrated by means of one of the methods specified in (a) to (c), to provide on test any flow (up to and including 110% of the highest design flow) at not less than 95% of the pressure available on the manufacturer's curve at that flow. The methods are:

(a) Production of a certificate, duly identified with the pump serial number, of a test conducted in accordance with AS 2417 or other approved equivalent;

(b) A bench test conducted in accordance with AS 2417, or other approved equivalent, witnessed by a SSC; or

(c) An *in situ* test of the installed pump unit using a certified test device (whether installed or portable) witnessed by a SSC.

Additionally, every pump forming part of an installed pump unit shall demonstrate on test when the design flow is induced through the sprinkler control valve of every sprinkler installation supplied by the pump unit that:

(d) On newly installed pump units, the available pressure at the sprinkler control valve is at least 105% of the highest design pressure for that installation; and

(e) Subsequently, that the available pressure at the sprinkler control valve is not at any time less than the highest design pressure for that installation.

NOTE – In evaluating the test results in items 6.5.2.2 (c), (d), and (e), the pressures recorded during flow tests need to be corrected to take account of variance in suction conditions, that is, tank or town's main minimum permitted suction condition.

#### 6.5.2.3 Waterway fittings

The following requirements apply:

(a) The pump suction and delivery shall be connected to the fixed piping through listed flexible couplings to prevent transmission of running vibration and seismic movement and to ensure that the pump alignment is not stressed by the pipes. Any elastomeric type couplings shall be mechanically restrained;

(b) Stop valves are not permitted between the pump delivery and the main stop valve;

(c) Pump suction isolation valves are to be supervised;

(d) Any valves or fittings which are so constructed that turbulence may be introduced through change in direction or obstruction of the waterway shall be located at least 10 nominal diameters of the suction inlet from the entry to the pump unless the pump's listing permits alternative arrangements. An uninterrupted length of 10 nominal diameters of pipe, the same diameter as the pump suction, shall be installed immediately upstream of the pump suction flange to effect this requirement. See figure 6.4;

(e) When a reducer is required in the pump suction pipework it shall be installed so that no air will be trapped in it, usually necessitating the use of eccentric style reducers. See figure 6.4.

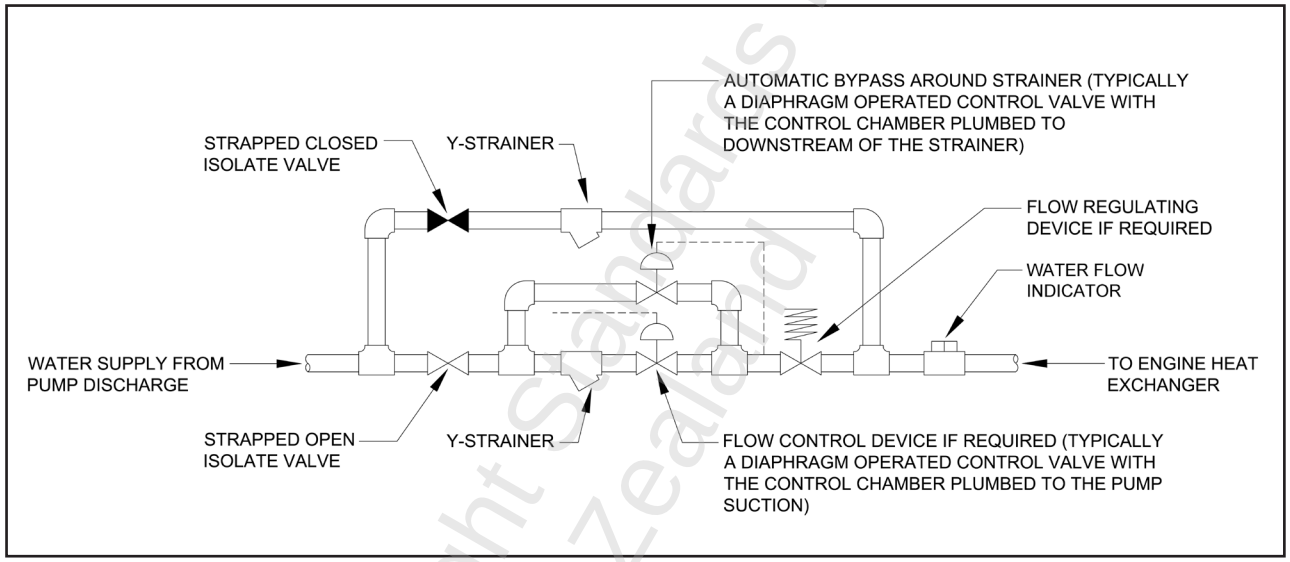



**Figure 6.4 – Pump suction waterway fittings**

#### 6.5.2.4 Pump case cooling

Pump casing cooling shall be provided to prevent the temperature of the water in the pump casing rising to more than 35ºC during nil or low flow discharge conditions. The following are acceptable methods:

(a) A pressure relief valve set to open at a pressure higher than the highest duty pressure;

(b) A differential pressure valve;

(c) The diesel motor cooling water supply;

(d) A normally open discharge line to a tank.

Where an around the pump test pipe is provided to allow full flow testing, either this device or an additional device (manual or automatic) shall be arranged to provide cooling of the pump casing at high flow rates (see figure 6.2) during pump testing. Manual devices shall be labelled.

#### 6.5.2.5 Vertical shaft pumps

Vertical shaft pumps shall be installed to the pump manufacturer's particular specifications and:

(a) Shall be constructed of materials suitable for the quality and acidity of water to be pumped;

(b) Vertical immersion, end suction, radial discharge pumps are not acceptable for installations requiring a shaft longer than 4 m. Where greater depths are involved, a vertical shaft turbine pump shall be used;

(c) Vertical shaft bearings shall be of the water lubricated type and the bearing taking the hydraulic thrust and shaft weight shall be of adequate capacity.

### 6.5.3 Diesel engine drivers

#### 6.5.3.1 Listing of engine

A listed diesel engine shall be used which shall be of a compression ignition direct injection type and may be naturally aspirated, super- or turbo-charged and/or intercooled. Engine intercooling shall be in accordance with the engine manufacturer's recommendations. Only those engines for which spare parts are likely to remain readily available may be listed.

#### 6.5.3.2 Power

The following requirements apply:

(a) The engine shall be able to produce 110% of the power requirement for the highest design flow when measured against the manufacturer's continuous power rating as defined in BS ISO 3046.1 or approved equivalent Standard.

The power requirement at the highest design flow shall include an allowance equal to the power absorbed by any supplementary devices driven by the engine and any angled drive. In the case of a diesel engine driving a boosted town's main pump, 'highest design flow' shall mean the higher of:

(i) The highest installation design flow, and

(ii) 110% of the maximum flow that can be induced in any pressure relief return loop that is provided to limit pump delivery pressure (607.1.10 of NZS 4541), at the selected setting of the pressure relief valve;

(b) Any ratings or deratings specified by the engine manufacturer shall be observed. In the absence of manufacturer's data the engine shall be derated in kilowatts at the rate of 1.5% for every 100 m of altitude over 200 m above sea level.

#### 6.5.3.3 Performance and commissioning

The engine shall be able to be started automatically at an engine room temperature of 5ºC and shall accept full load within 30 s of receiving the signal to start. On *in situ* commissioning, the pump unit shall be run for a period of at least one hour on increasing load up to duty flow. During this commissioning period at least 10 consecutive starts shall be completed.

#### 6.5.3.4 Governing

The engine shall be provided with a governor to control the engine speed within 10% of its rated value under all stable conditions of load up to full load rating.

To provide automatic control of excess pump delivery pressure, a listed device may be connected to the governor to automatically reduce the governed speed. Upon any failure of the automatic control, the driver shall resume the unit's maximum specified speed.

#### 6.5.3.5 Engine cooling

The engine shall be cooled by transferring the excess heat, either to air automatically vented to outside the pump house in a manner which complies with 6.5.3.6, or to water from the pump delivery discharged to waste, or returned to storage in a manner which complies with 6.5.3.7.

Under full load running conditions, with all doors and windows in their normal positions, the rise in ambient pump room air temperature, measured close to and at the level of the aspirating air intake, shall not exceed 18ºC over a 1 h period.

#### 6.5.3.6 Air cooling

Air cooled diesel engines shall be either:

(a) Direct

The fan for direct air cooling shall be mounted on the engine crankshaft or gear or multiple belt driven directly from the crankshaft. The rated capacity of the belts shall not be exceeded if one belt fails;

(b) Indirect

A radiator resiliently mounted in accordance with the motor manufacturer's recommendations, designed for stationary service and with all of the following facilities:

(i) A shaft, gear, or belt driven fan that pushes the cooling air away from the motor

(ii) A shaft, gear, or belt driven coolant circulating pump

(iii) A radiator header tank fitted with the motor manufacturer's overflow/make-up tank and with a means of readily checking the level of coolant in it

(iv) The engine manufacturer's coolant circuit

(v) The radiator may require to be adequately ducted to control pump enclosure temperatures and/or ensure that adequate fresh cooling air is drawn through the radiator;

(c) Ducting forming part of the air cooling arrangements shall be sized so that the pressure drop across the ducting does not exceed 80% of the maximum recommended by the manufacturer. Ducts shall discharge to a safe place outside the pump enclosure;

(d) Any louvre forming part of, or required by, the air cooling system shall operate automatically but shall not be dependent on electricity.

#### 6.5.3.7 Water cooling

Where motors are cooled by water the following requirements apply:

(a) Cooling water supply, control and discharge:

(i) Water to cool the engine shall be taken from the pump delivery to two isolation valves

(ii) One isolation valve shall be strapped open to supply the normal cooling circuit and be labelled 'MOTOR COOLING, normally open'

(iii) The cooling water shall then pass through an easily accessible strainer, labelled 'CLEAN MONTHLY'. It shall have a screen that can be removed without taking the strainer out of the pipework. The screen shall have holes in it not less than 2 mm or greater than 5 mm in any dimension and the total screen area shall be equivalent to at least eight times the cross section area of its supply pipe

(iv) The strainer shall be fitted with a listed device that automatically bypasses it should the strainer become blocked

(v) A flow-regulating device where required shall be fitted downstream of the strainer

(vi) Where the suction head would cause water to flow through the cooling circuit when the pump is not running, a listed flow control device may be fitted downstream of the strainer

(vii) The other isolation valve shall enable cooling water to bypass items (iii) and (iv) and shall be strapped shut and labelled 'OPEN FOR EMERGENCY COOLING, normally shut'. This valve shall discharge into the motor cooling system upstream of the flow indicator

(viii) The cooling water shall then flow through a listed water flow indicator

(ix) If the engine requires a coolant circulating pump it shall be shaft, gear, or belt driven

(x) The discharge pipe from the heat exchanger shall be at least one size larger than the inlet pipe. There shall be a flexible connection between the pipework and the engine cooling system or heat exchanger

(xi) The cooling water assembly shall be of an indirect heat exchanger type.

To comply with 6.5.3.7(a)(xi), a listed pump unit manufacturer may obtain a listing for a generic cooling system in which the makes and models of the components are nominated together with pipe sizing, fittings, and labelling requirements;

(b) Indirect heat exchangers:

The cooling water assembly may discharge into the secondary circuit of a suitably sized heat exchanger which shall be capable of withstanding the maximum supply pressure that can be applied.

The primary cooling circuit shall have a header tank with a water volume at least equivalent in capacity to the engine's cooling jacket. It shall be connected to a suitable automatic overflow/make-up tank.

The header tank shall have a means of readily checking the level of coolant in it; ➤

(c) No part of the engine's water-jacket shall be subjected to a pressure of more than 100 kPa;

(d) Each requirement in (a) to (c) should be agreed to by the engine manufacturer.

A typical diesel engine water cooling circuit is illustrated in figure 6.5.

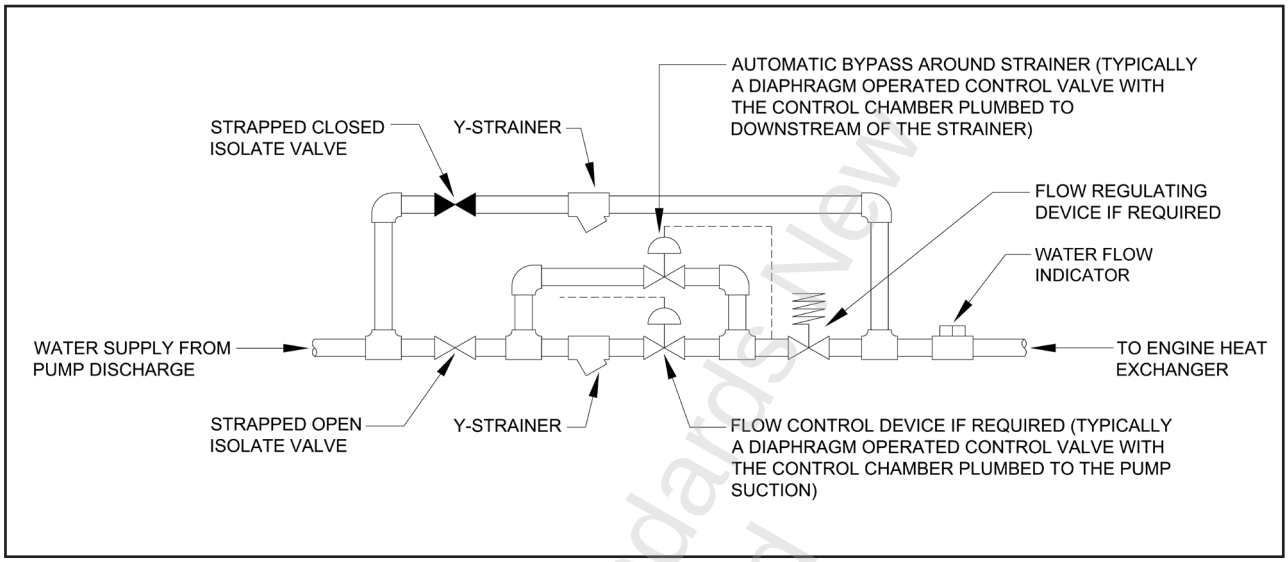



**Figure 6.5 – Typical diesel engine water cooling circuit**

#### 6.5.3.8 Electric starter motor

The engine shall be provided with the manufacturer's specified electric starter which shall be nominated in the motor listing. The electric starter motor shall be able to crank the engine continuously for 60 s followed by one restart, without failure.

#### 6.5.3.9 Emergency start device

In addition to a manually operated starting button, each diesel engine shall have an approved means by which it can be manually started in emergency. One of the following is acceptable:

(a) A manual crank handle provided that sufficient energy can be imparted to the fly wheel to enable it to carry the engine through at least two compression strokes when the decompression lever is released. Any device used to assist manual starting shall return to the automatic start position when released. The entire manual cranking operation shall be capable of being performed by one person;

(b) The electric starter motor used for automatic starting (or an additional listed electric starter motor) provided that it is fitted with an approved device which directly switches both batteries on to the solenoid of the starter motor. The operating lever for this device shall be labelled 'EMERGENCY STARTING' with an arrow to indicate the direction of operation and shall be painted green. It shall be spring-loaded and strapped in the released position;

(c) Listed inertia and spring driven starters engaging the main ring gear or a separate ring gear. The operating lever shall be painted green and labelled to indicate its function and method of operation. It shall be strapped in the released position;

(d) An original equipment manufacturer (OEM) rope pull start.

#### 6.5.3.10 Batteries

Two separate lead-acid starting batteries each capable of supplying the controller load for a period of not less than 24 h, and thereafter capable of cranking the engine for 60 s shall be provided and be indelibly marked 'A' and 'B' and with the date of installation.

Both batteries shall be normally electrically isolated on their non-earthed side and simultaneously connected to the starter motor only for starting. They shall be located so as to give ease of access for hydrometer testing where they are not of a sealed type, be adjacent to, but not over any part of, the pump unit and be protected with a strong non-conductive cover. They shall be secured in accordance with 1.9.

The batteries shall be suitable for continuous operations under float charge conditions, designed for stationary engine starting use, have a minimum service life of 3 years, and comply with AS 2149 or equivalent.

#### 6.5.3.11 Combustion air

The air intake shall be fitted with an adequate filter.

#### 6.5.3.12 Exhaust

Every engine shall have an exhaust which:

(a) Independently discharges to a safe location outside the pump unit enclosure, the outlet so positioned that it is guarded from the entry of rainwater and birds;

(b) Provides a flexible metallic connection between the exhaust manifold and the exhaust pipe. Where the exhaust pipe rises above the manifold, a means shall be provided to trap any condensate and prevent it flowing back into the engine;

(c) Is provided with a screwed and plugged manometer hole in the exhaust manifold outlet to facilitate the measurement of manifold pressure. Under full load conditions, the pressure shall not exceed 7.5 kPa except where the manufacturer recommends a lesser pressure;

(d) Has the exhaust pipe adequately supported from the building and kept at least 225 mm from combustible materials. Alternatively, it may be sleeved so that the pipe is at least 50 mm from the sleeve, the sleeve is at least 25 mm from combustibles and with the engine operating at full load, the temperature on the external surface of any exposed combustible material shall not exceed 70ºC;

(e) Is fitted with an adequate silencer, preferably outside the pump unit enclosure;

(f) Has the exhaust pipe guarded wherever it is within 2 m of the floor and could cause injury. Proprietary exhaust pipe wraps shall be permitted to the exhaust pipe only (not manifold, turbo, and so on) provided it is installed in accordance with the engine and the product manufacturers' instructions;

(g) Where the engine is fitted with an OEM muffler connected directly to the exhaust manifold this shall be acceptable provided that a condensate trap and manometer are provided downstream of the muffler (see (b) and (c)). A flexible connection shall be provided between the OEM muffler and the downstream exhaust pipework and the downstream exhaust pipe shall be adequately supported (see (d)).

#### 6.5.3.13 Drip tray

A drip tray of adequate size, suitable capacity and shape shall be provided under the engine.

### 6.5.4 Diesel engine controllers

#### 6.5.4.1 Component parts

A diesel engine controller shall be a listed device consisting of a cabinet housing or supporting instruments, a controller logic unit, battery chargers, listed start pressure switches, manually operated start switch, test logbook, nameplate and such manual controls and technical data sheets as are specified. The electrical connection between the controller and the engine shall be made with a mechanically restrained multicontact plug and socket and the entire controller shall be listed. Removal of the plug from the socket shall cause an indication at an approved location. Where the indication is made at a location which is not staffed at all times, a defect signal shall be generated through the FBA.

#### 6.5.4.2 Location

The controller shall be located in the pump unit enclosure close to, but physically separate from, the engine and pump. The controller shall be free from engine vibration. The requirements of NZS 1170.5 on restraint against seismic forces shall be met.

#### 6.5.4.3 Cabinet

The cabinet shall be robustly constructed and provided with adequate ventilation to facilitate dissipation of heat generated by electrical equipment. Cabinets shall include a dustproof compartment for the storage of technical data sheets and the test logbook.

#### 6.5.4.4 Instruments, manual controls, alarms, and lamps

The information in table 6.3 shall be displayed in an easily seen and read form on the face of the controller. Analogue displays shall indicate the acceptable duty range by green shading and unacceptable levels by red shading. Tachometers should be digital, with the minimum number of display digits as specified below, or an analogue tachometer of suitable scale.

The controller shall have instruments, manual controls, alarms, and lamps which shall enable the operator to determine the following information about the pumpset in an easily recognised manner.

(a) Digital displays shall have digits at least 15 mm high and comply with the requirements of table 6.3.

**Table 6.3 – Digital display requirements**

| Information | Min. no. of significant figures on digital displays |
|---|---|
| Pump suction pressure | 3 |
| Pump delivery pressure | 3 |
| Pump rotational speed | 4 |
| Engine run time (hourmeter) | 5 |
| Engine lubricant pressure | 3 |
| Engine block temperature | 3 |
| Voltage of each battery | 4 |
| Charging current to each battery | 3 |

(b) Optionally, a single digital display may be used to annunciate:

(i) The voltage and charging current for each battery

(ii) The engine lubricant pressure and engine block temperature provided the display automatically defaults to annunciate any parameter in an alarm condition;

(c) The following manually operated devices shall be provided in easily visible positions on the face of the controller:

(i) A manual start button

(ii) A push button device or devices to permit the isolation of each start pressure switch;

(d) The following lamps or LED indicators shall be provided in easily visible positions on the controller to indicate:

(i) Whether each battery charger is energised

(ii) Operation of pressure switch

(iii) The controller unit status

(iv) Closed or isolated state of each pressure start switch

(v) The start logic controller status;

(e) All instruments, controls, and lamps shall have their functions clearly labelled. Where duplicate instruments associated with batteries are provided they shall be labelled either 'A' or 'B';

(f) Where remote annunciation is provided for off-normal conditions, for example:

(i) Pump running

(ii) Battery charger off

(iii) High engine temperature

(iv) Engine heating failure

(v) Low engine oil pressure,

an alarm unit shall be provided and mounted on the controller to assemble and transmit such signals either individually or collectively. A timing device may be incorporated to suppress such alarms for a period of 1 h provided that it will automatically reset.

#### 6.5.4.5 Controller logic unit

The following requirements apply:

(a) A controller logic unit to control the automatic starting sequences of the pump unit shall be provided. Continuity of service and availability of spare parts for the unit shall be considered;

(b) The controller logic unit's functions shall comply with figure 6.6 including its notes;

(c) Crankshaft speed shall be measured by a sensor driven directly by the crankshaft or a layshaft gear driven from it. The sensor device shall be considered part of the controller logic unit.

If the unit incorporates polarity sensitive devices it shall be protected against or undamaged by reversal of its power supply polarity.

#### 6.5.4.6 Battery chargers

A listed constant voltage current-limited battery charger shall be provided within the controller cabinet for each of the two starting batteries. The battery chargers shall each:

(a) Have automatic output control that maintains the battery fully charged within the 'float' levels specified by the battery manufacturer;

(b) Have automatic control to limit the output current to the maximum rated value of the unit when lead acid batteries discharged to 1.85 V per cell are connected;

(c) Be capable of restoring the full nominal Ampere-hour capacity of the battery within a period of 24 h while simultaneously supplying the full quiescent current (controller load);

(d) Be capable of tolerating continuous reversed polarity or short circuit on the output terminals without damage, and shall self-restore on removal of the chargers;

(e) Provide visual indication that the charger is energised.

The charger manufacturer shall specify any design constraints on charger output or the size and length of battery voltage sensing conductors. Compliance shall be required.

The 230 V mains supply for the controller and battery chargers shall be connected to a separate subcircuit on the building's main distribution board which is clearly labelled 'FIRE PUMP BATTERY CHARGERS'.

#### 6.5.4.7 Start pressure switches

Listed start pressure switches shall be mounted on the cabinet. They shall comply with 6.5.1.5. When they close, the initial current shall exceed 0.5 A.

#### 6.5.4.8 Nameplate

An engraved label shall be affixed to the face of the cabinet and give the following information:

(a) Name of the pump unit manufacturer;

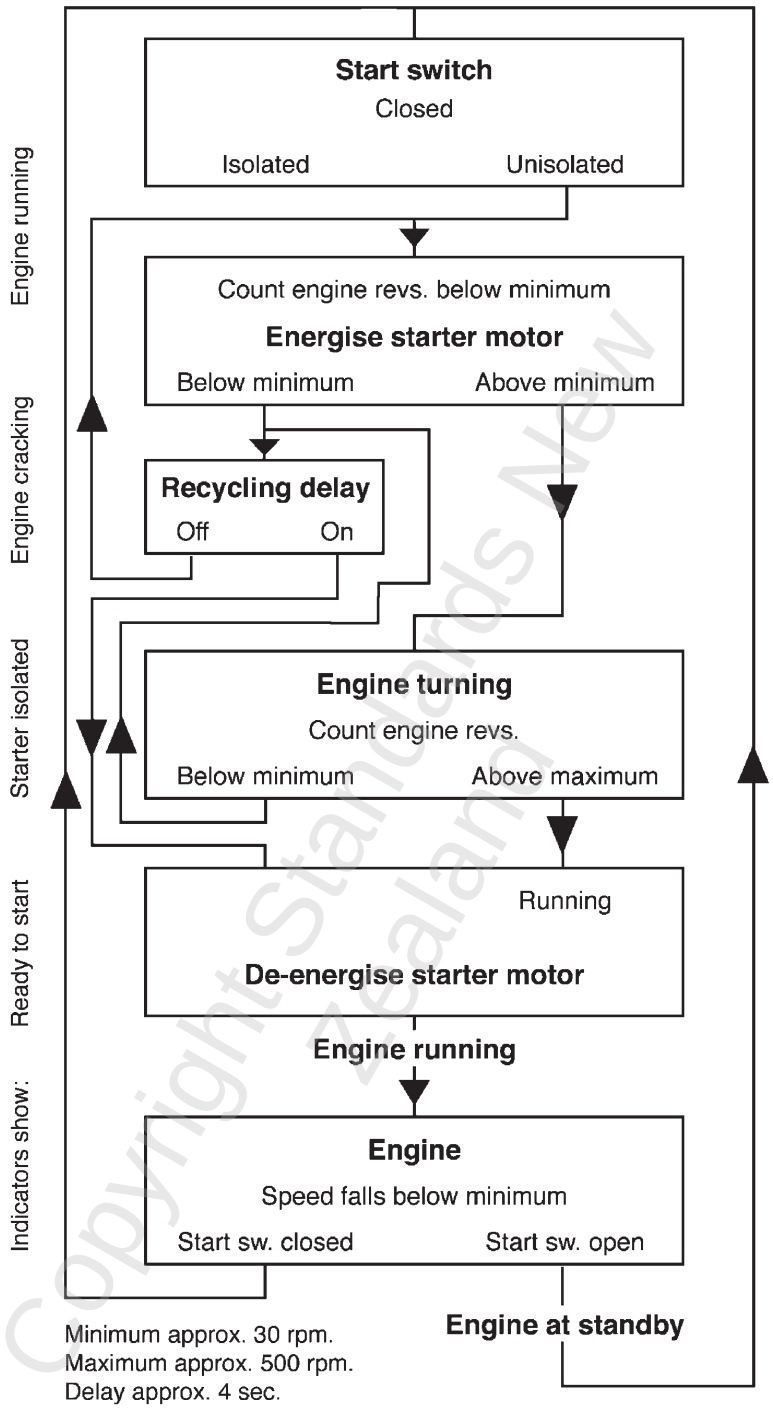
(b) Unit number;

(c) Duty speed;

(d) Engine make, model, and power at duty speed;

(e) Pump make, model, and impeller diameter;

(f) Flow and pressure at duty speed.




NOTE –

(1) 'Isolated' is a device which individually isolates each start pressure switch that is closed when the isolate button is manually operated. Each pressure switch then remains individually isolated until it reopens.

(2) '30 RPM' and '500 RPM' indicate that the crankshaft is rotating at approximately the stated speed. Actual speeds are to be adjusted in accordance with the engine manufacturer's recommendations.

(3) 'Energise' means simultaneously connecting both batteries to the starter motor.

(4) 'Ready to Start', 'Starter Isolated', 'Engine Cranking' and 'Engine Running' to be indicated by status lamps or LED indicators.

**Figure 6.6 – Diesel engine controller logic unit**

#### 6.5.4.9 Operator's handbook and logbook

The following shall be kept in the cabinet:

(a) A copy of the electrical circuits associated with the controller logic unit, battery chargers, and engine;

(b) Manufacturers' operator handbooks for the pump, controller, and engine unit;

(c) An approved logbook for recording all faults and the results of all tests including engine maintenance, oil changes, battery condition, hours run, fuel consumption, annual surveys.

A label showing the name and telephone number of the pump unit maintenance contractor shall be affixed to the inside of the cabinet.

### 6.5.5 Diesel engine fuel supply

#### 6.5.5.1 General requirements

Every pump engine shall have its own individual fuel supply tank.

NOTE – Attention is drawn to the need to comply with the relevant requirements of the HSNO Act, specifically those dealing with tank size and attachments, pipes, protection of fuel lines, oil level gauges, and fuel secondary containment provisions.

#### 6.5.5.2 Tank mounting

The tank may be mounted inside the pump house, but it shall be mounted separately from the engine with the fuel outlet not lower than the injector pump or more than 1 m above the injector pump, unless this voids the manufacturer's warranty. Tank mounting shall comply with 1.9.

#### 6.5.5.3 Tank capacity

The fuel capacity for tanks shall be assessed on the engine manufacturer's specified fuel consumption for the power absorbed by the pump unit at duty RPM for a period of 6 h. Where services other than fire sprinklers are being supplied the capacity shall be increased as required by the SSC to have regard to the possible or intended period of continuous function of the other service.

#### 6.5.5.4 Fuel gauge

The tank shall be fitted with a listed gauge. The gauge shall be marked indicating that the top half of the tank is fuel for test running and the bottom half is for fire duty running. It shall also indicate that the fuel level shall not normally fall below that allowed for testing.

#### 6.5.5.5 Tank construction

The tank shall be constructed of at least 1.25 mm stainless steel, or alternatively of at least.1.5 mm mild steel coated internally with a suitable anti-corrosive and oil resisting coating after it has been tested for leaks.

#### 6.5.5.6 Tank connections

The following connections, none of which shall be galvanised, shall be provided:

(a) A 25 mm vent pipe from the top of the tank that has a continuous upward grade to a down-turned flared and gauze-sealed vent outside the pump house;

(b) A minimum 20 mm filling pipe into the top of the tank. The tank may be filled only by pumping from a mobile tanker, storage tank or a portable drum. A minimum 20 mm filling pipe fixed into the top of the tank for use by a mobile tanker may be supplied, provided that this fill pipe shall extend to the outside of the building, or other suitable location and have a suitable threaded and sized locked valve attached at the delivery end. Suitable precautions shall be taken to ensure that if the tank is overfilled, by a mobile tanker, that diesel is not discharged into the pump house;

(c) A 25 mm overflow pipe from the top of the tank which shall be carried on a continuous downward gradient to discharge in a safe place – usually the storage tank or a portable drum;

(d) A sludge sump at the lowest part of the tank, fitted with a normally closed and plugged stopcock;

(e) A sealed opening not less than 100 mm diameter for tank cleaning purposes;

(f) A 10 mm fuel outlet drawing from at least 25 mm above the bottom of the sludge sump and fitted with a stop valve padlocked in the open position;

(g) A fuel return line sized and installed in accordance with the engine manufacturer's recommendations.

#### 6.5.5.7 Fuel lines

The fuel lines shall be at least 10 mm seamless copper or stainless steel tube with double ferrule compression fittings, brazed joints or black steel pipes and fittings and shall:

(a) Be well protected and supported, preferably in a continuous down-gradient to the engine. However, it is permissible to have one low point, provided there is a continuous rise from this point to both the engine and the fuel tank;

(b) Incorporate a transparent agglomerator bowl immediately downstream of the fuel line stop valve, to indicate the presence of water, and an accessible, engine mounted, filter;

(c) Terminate at the engine at a metal armoured flexible connection.

NOTE – This clause does not apply to any fuel lines forming part of the engine manufacturer's Original Equipment Manufacturer (OEM) equipment.

#### 6.5.5.8 Air lock avoidance

Care shall be taken to avoid air locks in the system. No air relief valves are permitted and where air relief is essential, screwed plugs shall be used.

### 6.5.6 Facilities for routine testing

#### 6.5.6.1 General

Pump units shall have facilities to allow routine test running under load and to prevent overheating in situations of nil or low discharge.

#### 6.5.6.2 Open water source

Where a pumping unit draws directly from a tank or open water supply a test return pipe shall be provided and sized to enable the unit to be tested to a minimum of 110% of the highest design flow (±10%). For pumps fitted with pressure relief valves complying with 3.11, test return pipework and valving may not be required if the pressure relief valve circuit ➤

produces at least 110% of the highest design flow (±10%). Attention is drawn to the pump curve proving option in 6.5.2.2 (c) which may require a larger pipe.

In the case of tank supplies the test return pipe shall terminate at least 1 m below normal water level to prevent air entrainment during testing and shall be restrained against jet reaction. If the same pipe is used for the pressure relief valve discharge then it shall be terminated at vortex plate level.

The test return pipe shall be fitted with a supervised, labelled indicating stop valve normally padlocked in the closed position. This valve shall signal 'defect' when opened more than 5%.

#### 6.5.6.3 Boosted reticulated water supply

A test return loop from the pump delivery to the pump suction shall be provided and sized to enable the unit to be routinely test run at least at 110% of the highest design flow (±10%). For pumps fitted with pressure relief valves complying with 3.11, test return pipework and valving may not be required if the pressure relief valve circuit produces at least 110% of the highest design flow (±10%).

The test return loop shall be fitted with a supervised, labelled, indicating stop valve normally padlocked in the closed position. This valve shall signal 'defect' when opened more than 5%.

During routine test running, the test running cooling valve shall be opened.

### 6.5.7 Pump unit enclosure

#### 6.5.7.1 General

Pump units shall be installed in a clean dry weathertight enclosure free from dust, preferably of fire resistive or non-combustible construction, exclusive to the sprinkler apparatus, and satisfactorily frost protected and ventilated.

It is recommended that the enclosure is provided with direct external access.

#### 6.5.7.2 Protection from hazards

The enclosure shall be situated where it is as free as possible from exposure to fire, explosion, flooding, and windstorm damage and, in the case of below ground enclosures, care shall be taken to avoid or deflect runoff stormwater from draining into it.

No liquid or gaseous fuels, except those required as a fuel source for the pump unit prime mover shall be reticulated or stored in the enclosure and a fire extinguisher appropriate to the hazard shall be provided.

#### 6.5.7.3 Plant rooms

With approval, a pump unit may be located in a screened area of a plant room protected by a sprinkler system complying with this Standard. In considering this application, the SSC should ensure there is:

(a) No boiler or other explosion hazard;

(b) No uncontrolled dust problem;

(c) No likelihood of water from other services discharging over the pump unit;

(d) No uncontrolled access by unauthorised persons to the pump unit;

All other requirements for pump unit enclosures shall be met.

#### 6.5.7.4 Sprinkler protection

All pump unit enclosures shall be sprinkler protected. Where the enclosure is a detached building and is some distance from the nearest protected building, the sprinklers in the enclosure may be supplied through a labelled and strapped stop valve from the hydraulic connection to the start pressure switches, provided that this has been suitably sized, or a connection is provided from the pump delivery, through a check valve, to a point downstream of the stop valve to boost the supply to the pump house sprinklers. Acceptable arrangements shall be provided to sound an alarm if such sprinklers operate.

#### 6.5.7.5 Enclosure size

The enclosure shall be of sufficient size to allow free access for testing and maintenance of all equipment inside.

#### 6.5.7.6 Access

Access shall be by a lockable door or hatch sufficiently large, and located in such a position, to allow the removal of any individual component of the pump unit without disturbance or damage to other components.

#### 6.5.7.7 Drainage

The floor shall be graded to drain. Any sump which may be required shall be emptied by means of a gravity drain or an automatic sump pump at a flow of at least 50 L/min. The sump shall be at least 600 mm deep and shall have a capacity of at least 0.05 $m^3$.

#### 6.5.7.8 Lighting

The enclosure shall be provided with artificial lighting.

#### 6.5.7.9 Ventilation

There shall be sufficient ventilation to prevent condensation, to provide aspiration for any diesel engines and to limit the temperature rise to 18°C above ambient under all conditions for a pump running period of 1 h.

Ventilation and/or louvres shall not be dependent on mains electrical power supply.

Powered ventilation systems utilising the diesel engine shall be permitted. The requirements of 6.5.3.2 shall be complied with.

#### 6.5.7.10 Heating

The enclosure shall be provided with a maximum/minimum type thermometer permanently fixed not more than 1.5 m from the floor, if diesel engine driven pumps are used. A reliable source of artificial heating shall be provided where necessary so as to maintain the temperature in the enclosure above 5°C at all times. If the temperature in the enclosures falls below 5°C either:

(a) An alarm shall be sounded at a remote monitored location (this alarm shall not be dependent upon mains power supply); or

(b) The pump shall be started automatically by a temperature sensitive start switch located not higher than 1 m above the floor and set to start at 3ºC.

## 6.6 Elevated tanks

Elevated tanks shall:

(a) Comply with 6.4.3;

(b) Be owned by and under the sole control of the owner of the sprinkler system or shall (under suitable written guarantees) be available at all times for the use by the owner of the sprinkler system;

(c) Be of sufficient capacity to comply with 6.3.1; and

(d) Be of sufficient height above the sprinkler control valves to supply without the use of pumps the requisite pressures at the design flows specified in section 5.

## 6.7 Gas pressurised water storage tanks

Gas pressurised water storage tanks may be used subject to the SSC specifically approving the arrangement.

## 6.8 Fire sprinkler inlet

### 6.8.1 General

A fire sprinkler inlet shall consist of a pipe connection to the sprinkler system downstream of the main stop valve terminating in a male 70 mm instantaneous coupling in accordance with SNZ PAS 4505 on the outer face of the building close to the control valves. There shall be a non-return valve in this pipe to prevent water discharge from the sprinkler system through the fire sprinkler inlet.

### 6.8.2 Inlet coupling

The inlet coupling shall be clearly labelled by means of an indelible sign 'FIRE SPRINKLER INLET'.

### 6.8.3 Systems not requiring a fire sprinkler inlet

Sprinkler systems that do not require a fire sprinkler inlet for compliance with 1.1.3 may also be fitted with such an inlet for use by the Fire Service to boost the water supply, or to permit temporary connection (using fire service hoses) of an alternative water supply in the event that the normal supply is temporarily unserviceable.

## 6.9 Water supply characteristics

The water supply shall be tested at commissioning, and shall have the residual water supply pressure recorded at the installation gauge when flowed through the fully open drain valves at the sprinkler control valves.

# 7 HYDRAULIC CALCULATIONS

## 7.1 General

### 7.1.1

Pipe diameters shall enable the available water supply characteristics to satisfy the demand requirements set out in section 5. Compliance with this requirement shall be determined by hydraulic calculation as set out in this section.

### 7.1.2

Pipework may be laid out in any configuration, for example, terminal, looped or gridded, or any combination of these.

## 7.2 General calculation methods

### 7.2.1 Listed residential sprinklers

Calculations shall be provided to verify the listed single operating sprinkler criteria for the number of sprinklers in any room, up to a maximum of four sprinklers.

The following calculation procedures apply:

(a) Identify the most hydraulically remote sprinkler in any room as defined in 5.2;

(b) Establish the number of sprinklers to be considered in accordance with 5.1.1, 5.1.2, or 5.1.3;

(c) Determine (from the listing criteria for the sprinklers used) the minimum pressure and flow;

(d) Starting with the most hydraulically remote sprinkler, calculate the total flow from the number of sprinklers assumed to be in operation, and establish the pressure required at the control valves.

Pipe size and configuration together with the elevation of the sprinkler shall be considered. The water supply characteristics shall be capable of meeting this and any other calculated requirements.

### 7.2.2 Non-residential sprinklers

The following calculation procedures apply:

(a) Determine the number of sprinklers considered to be in operation in the room or space as defined in 5.2;

(b) Consider the discharge at the minimum pressure appropriate to the sprinkler (see 4.4, 4.5.1, 5.1.2, 5.1.3). Assume a discharge from each sprinkler that will provide the minimum density over that area as specified in 5.1.2; and

(c) Starting at the most hydraulically remote sprinkler, calculate the total flow from the number of sprinklers considered to be in operation and establish the pressure required at the control valves.

#### 7.2.3 External sprinklers

For each array of external sprinklers deemed to operate simultaneously (see 5.1.3) calculate the flow and pressure required at the control valves so that each sprinkler in the array operates at not less than the minimum pressures specified in 5.1.3. The water supply shall be capable of meeting this and any other calculated requirement.

#### 7.2.4 Hydraulically remote areas

When it is clearly evident that the area selected for calculation in 7.2.1, 7.2.2, and 7.2.3, is the most hydraulically disadvantaged considering:

(a) Longest distance from control valves;

(b) Pipe diameter;

(c) Number of sprinklers in operation;

(d) Elevation of the sprinkler;

then other sprinklers may be assumed to be less hydraulically demanding.

When any of the above factors place a more onerous demand on the system, then further calculations shall be carried out to establish the maximum hydraulic demand in each case.

#### 7.2.5 Skylights

Sprinklers in skylights shall be included in the number of sprinklers calculated for the room.

### 7.3 Method of calculation

#### 7.3.1 Accuracy

##### 7.3.1.1

The following dimensions shall be expressed in the units and to the accuracy shown in table 7.1.

**Table 7.1 – Calculation accuracy**

| Dimension | Unit | Accuracy |
|---|---|---|
| Length and elevations | mm | Nearest whole unit (1) |
| Length and elevations | m | Three significant figures (0.001) |
| Flow rate | L/min | Nearest whole unit (1) |
| Pressure | kPa | Nearest whole unit (1) |
| Area | $m^2$ | Three significant figures (0.001) |

##### 7.3.1.2

Flows merging into a junction shall be estimated to within ±2 L/min of flows emerging from the junction.

**7.3.1.3**

When estimating the flows and pressure losses in each direction around a ring main or section of gridded network, the maximum acceptable difference in calculated pressure at any junction is 1 kPa.

**7.3.1.4**

The discharge from a sprinkler shall be calculated to within ±1 L/min using the formula and *K*-factors set out in 7.3.5.

**7.3.1.5**

To check for the effect of cumulative errors, the sum of the flows from the individual sprinklers shall be determined and shall be within ±1% of the calculated design flow.

### 7.3.2 Calculation of static pressure head

**7.3.2.1**

The static pressure equivalent of differences in height between sprinklers, junctions, and datums and so on, is to be taken as:

$P = h \times 10$

where

*P* is the gain or loss due to head (kPa)

*h* is the difference in height between sprinklers, junctions, and datums (m).

### 7.3.3 Calculation of pressure loss in pipes

**7.3.3.1**

Pressure losses due to water flow through pipes shall be determined using one of the following formulae, as appropriate.

**7.3.3.2**

Pressure losses in all types of pipe may be calculated using the Hazen-Williams formula:

$$P = \frac{0.605 \times Q^{1.85} \times 10^{8}}{C^{1.85} \times d^{4.87}}$$

where

*P* is the loss of pressure per metre of pipe (kPa)

*Q* is the flow rate of water through the pipe (L/min)

*d* is the mean internal diameter of pipe (mm)

*C* is a constant for the type of pipe, (the Hazen-Williams factor).

Typical values of the Hazen-Williams factor for various pipe types are:

| | |
|---|---|
| Cast iron | *C* = 100 |
| Steel, galvanised after fabrication | *C* = 110 |
| Steel (black or galvanised) | *C* = 120 |

| | |
|---|---|
| Steel, spun concrete lined | $C$ = 130 |
| Copper and plastics | $C$ = 140 |

**7.3.3.3**

Pressure losses in each metre of pipe may be calculated using the simplified formula:

$$P = R \times Q^{1.85}$$

where

$P$ is the loss of pressure per metre of pipe (kPa)

$Q$ is the flow rate of water through pipe (L/min)

$R$ is the appropriate value from table 7.2

**Table 7.2 – Values of 'R' for steel and PVC-C pipe**

| Nominal bore | Steel to BS 1387 | | | | Chlorinated PVC | |
|---|---|---|---|---|---|---|
| | Medium grade | | Heavy grade | | | |
| (mm) | Mean i.d. (mm) | Value of $R$ | Mean i.d. (mm) | Value of $R$ | Mean i.d. (mm) | Value of $R$ |
| 20 | 21.63 | $2.71 \times 10^{-3}$ | 20.41 | $3.60 \times 10^{-3}$ | 22.45 | $1.58 \times 10^{-3}$ |
| 25 | 27.31 | $8.73 \times 10^{-4}$ | 25.68 | $1.18 \times 10^{-3}$ | 28.17 | $5.11 \times 10^{-3}$ |
| 32 | 35.97 | $2.28 \times 10^{-4}$ | 34.34 | $2.86 \times 10^{-4}$ | 35.56 | $1.63 \times 10^{-4}$ |
| 40 | 41.86 | $1.09 \times 10^{-4}$ | 40.23 | $1.32 \times 10^{-4}$ | 60.69 | $8.37 \times 10^{-5}$ |
| 50 | 52.98 | $3.46 \times 10^{-5}$ | 51.36 | $4.02 \times 10^{-5}$ | 50.88 | $2.78 \times 10^{-5}$ |
| 65 | 68.67 | $9.78 \times 10^{-6}$ | 67.04 | $1.10 \times 10^{-5}$ | 61.54 | $1.09 \times 10^{-5}$ |
| 80 | – | – | – | – | 74.96 | $4.18 \times 10^{-6}$ |

### 7.3.4 Pressure loss in fittings and valves

**7.3.4.1**

Loss of pressure, due to water flow through pipe elbows, tees, and bends where the direction of water flow is changed through an angle of 45º or more (other than the change of direction into a sprinkler or sprinkler assembly or drop from an elbow or tee into which the sprinkler or sprinkler assembly is fitted), shall be calculated by multiplying the appropriate factor from table 7.3 by the internal diameter in mm of the smallest pipe in the fittings waterway. The length in metres of equivalent straight pipe thus derived shall be added to the actual lengths of pipe under consideration for use in the above pressure loss formula.

As an alternative to the equivalent length factors published in table 7.3 listed manufacturers' hydraulic loss data may be used.

**Table 7.3 – Hydraulic equivalent length factors for pipe fittings**

| **Hazen-Williams Factor** *(C)* | **100** | **110** | **120** | **130** | **140** |
|---|---|---|---|---|---|
| Tees into branches | 0.040 | 0.050 | 0.060 | 0.070 | 0.080 |
| Elbows | 0.020 | 0.025 | 0.030 | 0.035 | 0.040 |
| Bends | 0.010 | 0.0125 | 0.015 | 0.0175 | 0.020 |
| NOTE – A bend is any fitting where the radius divided by internal pipe diameter is greater than 1.5. | | | | | |

#### 7.3.4.2

Loss of pressure due to water flow through control valves, back pressure valves, stop valves, and so on, shall be calculated using the formula:

$$\Delta P = \left(\frac{Q}{K}\right)^2$$

where

$\Delta P$ is the loss of pressure through the component (kPa)

$Q$ is the flow through the component (L/min)

$K$ is the loss factor associated with the listing for the particular size and type of valve.

### 7.3.5 Calculation of discharge from a sprinkler

The discharge from a sprinkler shall be calculated using the following formula:

$$Q = K\sqrt{P}$$

where

$Q$ is the discharge from the sprinkler (L/min)

$P$ is the pressure at entry to sprinkler orifice (kPa)

$K$ is the constant having the values as shown in table 7.4.

**Table 7.4 – Sprinkler *K* values**

| **Nominal sprinkler size** | ***K* value** |
|---|---|
| 10 mm | 5.7 |
| 15 mm | 8.0 |
| Residential sprinklers | As per listing |

### 7.3.6 Calculation of flow from identical ranges

For the purpose of calculating the design flow for terminal pipe configurations, the flow from more favourably placed identical ranges may be determined by the formula:

$$Q_r = C\sqrt{P_n}$$

where

$C$ is the flow in the first range divided by the square root of the junction pressure at the start of that range

$P_n$ is the junction pressure of the range under consideration

$Q_r$ is the flow in the range under consideration.

### 7.3.7 Velocity head

The velocity head may be ignored in these hydraulic calculations. If the velocity head is used, it shall be incorporated in calculations for all distribution and range pipes.

# 8 PERIODIC TESTING, MAINTENANCE, AND ROUTINE INSPECTION

## 8.1 General

A sprinkler system shall not be deemed to comply with this Standard unless, after completion of installation, it is tested, maintained, and inspected on a regular basis, in the manner required.

For the purposes of this Standard service and maintenance shall be undertaken or authorised by a person who is:

(a) Employed by a listed contractor; and

(b) An independently qualified person (IQP) as defined in the NZBC handbook.

NOTE –

(1) 1.8 defines the requirements of listing of contractors.

(2) Section 8 allows the owner to carry out some of the regular checks if deemed competent to do so by the listed contractor/IQP.

(3) Section 8 refers only to an IQP as the person conducting the inspection, testing, and maintenance.

### 8.1.1 Regulatory matters

This requirement shall, if the system is installed in a building that is not a single household unit (as defined in the Building Act), be incorporated in the inspection, maintenance, and reporting procedures in the compliance schedule for the building containing the residential sprinkler system.

The system shall be maintained so that it remains effective throughout the life of the building. In order to achieve this, the system shall be regularly inspected, maintained, and tested as specified in section 8 to ensure that the building is adequately protected.

The nature of the control and alarm equipment requires specialist knowledge in order to maintain the system; therefore a listed contractor shall be engaged to do this work. Other aspects of the inspection, maintenance, and testing regime may be carried out by the owner or his agent as described in this section.

A 'Certificate of Compliance', (Form 12A in the Building (Forms) Regulations 2004) is issued by an IQP (a listed contractor in the case of sprinkler systems) to certify that the system has been maintained in accordance with the compliance schedule. This certificate allows the building owner to issue a building warrant of fitness (Form 12).

### 8.1.2 Deficiencies

All deficiencies shall be rectified in a timely manner.

Any deficiency of the system means that the system does not comply with the Standard. However, some deficiencies do not necessarily mean that the sprinkler system will not operate or be effective. Examples of such deficiencies would be a missing sprinkler escutcheon plate, missing sign or a missed or unlogged routine inspection.

Deficiencies which would lead to a significant probability of system failure shall be urgently attended to, to ensure that the system will operate reliably. Examples of such deficiencies ➤

include a significant deficiency in the water supply, or a significant increase in the fire load beyond the capability of the system. A Form 12A shall not be issued if such deficiencies exist.

Moderate deficiencies which would lead to the system underperforming shall be rectified immediately so that the system is returned to working order as soon as possible.

Minor deficiencies that do not affect the performance of the system should be rectified as soon as practicable. Existence of these types of deficiencies should not preclude the ability of a Form 12A to be issued if the minor deficiencies are in the process of being rectified. Such deficiencies could include a minor water supply deficiency, individual areas with heads out of rule, pressure gauges requiring recalibration and the like. If such deficiencies appear on subsequent inspection reports, a Form 12A shall not be issued until such deficiencies are rectified.

An element of judgment is required in ascertaining if other deficiencies should preclude the issuing of a Form 12A.

NOTE – Particular attention is drawn to the need to check whether any building alteration necessitates alterations to the sprinkler system in order to maintain conformity. It is essential that there is no area within the building, other than those specifically exempted, which is not within the area of discharge of a sprinkler.

## 8.2 Inspection, maintenance, and reporting

The following inspection, maintenance, and reporting procedures shall be carried out and recorded in accordance with 8.3, at the intervals specified, by the nominated person. The owner may undertake procedures where noted as permitted, only if they can demonstrate competence to the IQP.

### 8.2.1 Weekly

Diesel engine-driven pumps shall be tested in accordance with Appendix P1.1, at weekly intervals by the IQP or the owner.

### 8.2.2 Monthly

The following procedures shall be carried out at monthly intervals by the IQP or the owner:

(a) Diesel engine-driven pumps shall be tested in accordance with Appendix P1.2; and

(b) Water supply static/no-flow pressure; and

(c) The correct operation of sprinkler operated alarms shall be verified; and

(d) The correct operation of anti-interference supervisory devices shall be verified.

### 8.2.3 Three-monthly

The following procedures shall be carried out at three-monthly intervals by the IQP:

(a) The monthly procedures as described in 8.2.2; and

(b) Drain test to verify block diagram water supply information; and

(c) Battery condition shall be tested.

#### 8.2.4 Annually

The following procedures shall be carried out annually by the IQP:

(a) Full inspection of protected building and sprinkler system, assuming no change of use or alteration to the building has occurred in the previous twelve months; measurement of water supply flow and pressure through the test connection; operation and settings of automatic pressure control valves; check of pump set, check of test record book;

(b) Diesel-engine driven pumps shall be tested in accordance with Appendix P1.3;

(c) Testing of the backflow prevention devices forming part of the water supply system; being supplied with potable water;

NOTE – Automatic backflow preventors, and fire sprinkler systems are required to be tested in accordance with the procedures on the Compliance Schedule issue by the BCA.

(d) Drain down antifreeze (and tail end) systems, check specific gravity, correct, and refill;

(e) The precharge pressure of any air over water accumulator shall be checked and adjusted to meet specified requirements (see 6.5.1.5).

## 8.3 Records

#### 8.3.1

A written copy of all tests and maintenance shall be made in a form approved by a SSC. A copy of the record shall be retained at the control valves or other suitable location on the site. If the records are not kept at the control valves, an indelible sign shall be provided at the control valves stating where they are kept.

#### 8.3.2

Where test results are recorded electronically a hard copy shall be provided and retained on site, as required by 8.3.1. If a hard copy cannot be provided at the time of testing, a copy shall be returned to the site at the time of the next routine testing visit, if not before.

#### 8.3.3

A full report on each annual inspection shall be sent to the owner. The SSC may in writing require a copy of the report.

#### 8.3.4

Where the fire sprinkler system is connected to a reticulated water supply, a copy of the flow and pressure test record shall also be provided to the water supply authority if required.

## 8.4 Precautions when system impaired

**8.4.1**

The following shall be notified of impairment to the system:

(a) The New Zealand Fire Service;

(b) The building consent authority;

(c) The building owner (who shall inform their insurers or insurance brokers);

(d) The responsible person on site (if not the building owner).

NOTE –

(1) Sufficient time should be allowed to permit temporary and alternative fire safety measures to be implemented.

(2) In the event of an extensive interruption to the water supply, the possibility of arranging a temporary supply should be investigated.

(3) Information may be provided in the form shown in figure 8.1.

.

## Fax Back Form From:

Date: _____

Building name: _____

Contractor: _____

Contractor telephone contact details: _____

**To:** Customer: _____

Attention: _____ No. of pages: _____

Phone Number: _____ Fax Number: _____

## FIRE PROTECTION SYSTEM SHUTDOWN

**INSTRUCTIONS:**

- 24 hours notification of all programmed isolations shall be given in writing to the Fire Service and the Building Owner prior to a sprinkler system being rendered inoperative.
- If an emergency compels immediate action to render a system inoperative, such notification shall be given as soon as possible afterwards.
- NZS 4541 & 4515 (sprinkler systems), 4512 (fire alarm systems), 4510 (fire hydrants), 4503 (hose reels), require Sections A and B to be completed and sent to the New Zealand Fire Service or their agents prior to a fire sprinkler shutdown. Section B requires OWNERS APPROVAL and for the Owners to notify their insurers if the systems are isolated for more than 12 hours.

NOTE –

1. Partially isolated systems – If a section or zone of a fire sprinkler system is isolated, blanked off or left impaired while the main system is restored a tag label shall be attached to the main sprinkler stop valve indicating which sections are affected. Building owners must inform NZFS and their insurers that the system has been partially restored and must inform the Fire Service and their insurers when the isolated sections have been restored.
2. Send completed forms and notifications to the New Zealand Fire Service by email: fireinfo@fire.org.nz or by fax 09 309 8223. For more information phone 0800 FIREINFO (0800 347 346).

**OWNERS** – Please **sign** your approval of this shutdown in **Section B** of this form and fax to your insurer/broker/agent.

NZFS Fax: _____ Date: ____/____/_____ Building owner's insurance Fax: _____ Date: ____/____/_____

### Section A Fire System / Site Detail

**SYSTEM**

PFA No: _____

Building name: _____

Address: _____

Fire system: Sprinkler 4541 ☐ Sprinkler pumps ☐ Sprinkler 4515 ☐ Fire alarm 4512 ☐ Hydrants 4510 ☐ Hose reels 4503 ☐

Areas affected: _____

**SHUTDOWN**

Shutdown date: _____ Shutdown time: _____ Reinstated daily: _____

Reinstatement date: _____ Reinstatement time: _____ Continuous shutdown: _____

**SECTION OF SYSTEM LEFT ISOLATED WHILE MAIN SYSTEM RESTORED**

Date due for completion: _____ Date completed: _____

Work to be completed during system shutdown: Alterations: ☐ Damage to system: ☐ Maintenance work: ☐

Other: _____

**OWNERS** – Please use this form to notify your '**building insurers**' of all shutdowns, reinstatements and of any sections of a system left isolated.

NOTE – If a section or zone of a fire sprinkler system is isolated, blanked off or left impaired while the main system is restored, a tag label must be attached to the main sprinkler stop valve indicating which sections are affected.

### Section B Owner's Approval

Date: _____ Name: _____ Insurers Notified: Yes ☐ No ☐

Time: _____ Signature: _____ Date: _____

NOTE – Failure by the owner to notify insurers of an impairment or partial isolation of an alarm system or sprinkler installation may void insurance cover.

**☑ OWNER SAFETY PRECAUTIONS FOR FIRE SYSTEM SHUTDOWN**

- ☐ Forbid smoking in the area affected by the fire system shutdown
- ☐ Stop hazardous processes
- ☐ Where sprinklers are installed ensure they are operative
- ☐ Ensure all smoke stop doors are closed
- ☐ Ensure Alarm Company can re-establish evacuation sounders if required
- ☐ Where other systems (lifts, air conditioning, and so on) are affected by shutdown, manual controls need to be checked
- ☐ Arrange to notify others who may use the building during the period of isolation
- ☐ Ensure building occupiers know that they must dial '111' for FIRE
- ☐ Detail 'FIRE WARDENS' to patrol affected area. (One person per 1000 $m^2$)
- ☐ No 'HOT WORK' by any parties while the fire system is shutdown.

NOTE – If your building has smoke detectors be aware that dust, heat, and fumes from building work may activate your fire alarm.

Service company name: _____ Phone: _____ Fax: _____

Any queries, please contact: Name: _____ Phone: _____ Cell phone: _____





**Figure 8.1 – Typical form for notifying that an installation is to be rendered inoperative**

**8.4.2**

A tag label as shown in figure 8.2 or similar shall be used to identify sections of a sprinkler system left isolated. The tag card shall be affixed by the contractor to the main sprinkler stop valve.

Part A shall be completed whenever a sprinkler system is isolated and the sprinkler control valve enclosure is left unattended.

When a section or zone of a sprinkler system is isolated Part B shall be completed by the contractor and the isolation card affixed to the main stop valve. The card shall remain attached to the main stop valve until the whole system is restored.

Tag Number .....

**Sprinkler system isolation**

**Part A**
Impairment notice number:

Date: _____/ _____/ _____

Contractor: _____

Work permit number: _____

Sprinkler system number _____ isolated.

**Part B**
Section of sprinkler system isolated:
(Give location of isolated valve or blanking plate used) and area of building not covered)

_____

_____

_____

Date of isolation: ____/ _____/ _____

Proposed date of reinstatement: ____/ _____/ ____

Contractor: _____

Signed: _____



**Figure 8.2 – Typical form for isolation tag card**

**8.4.3**

Hot work (such as gas cutting, welding, brazing, or grinding) should not be undertaken when the sprinkler system is not functional.

## 8.5 Testing of sprinklers

**8.5.1**

Where sprinklers have been in service for 50 years, or 20 years for quick response sprinklers, or 10 years for dry barrel sprinklers they shall be either:

(a) Replaced; or

(b) Representative samples from one or more sample areas shall be submitted to a recognised testing laboratory acceptable to a SSC for field service testing. Testing shall be repeated at 10-year intervals.

NOTE –

(1) Dry barrel sprinklers are often called dry drops in New Zealand. The term dry barrel sprinkler includes dry sprinklers designed for all orientations, including pendent, upright, and sidewall orientations.

(2) Appendix Q provides guidance on the requirements for testing sprinklers.

**8.5.2**

Representative samples of solder-type sprinklers with a temperature classification of 163ºC or greater that are exposed to semi-continuous to continuous maximum allowable ambient temperature conditions shall be tested at 5-year intervals

**8.5.3**

A representative sample of sprinklers shall consist of a minimum of not less than 10 sprinklers or 1% of the number of sprinklers in an individual sample area, whichever is greater.

**8.5.4**

Where one sprinkler within a representative sample fails to meet the test requirement, all sprinklers represented by that sample shall be replaced.

# APPENDIX A – UNITED STATES OF AMERICA RESIDENTIAL SPRINKLER DEVELOPMENT: LIMITATIONS AND FIRE DEATH STATISTICS

(INFORMATIVE)

Annex A of NFPA 13R *Installation of sprinkler systems in residential occupancies up to and including four stories in height* is included here as it explains the background to 1.1.3, 4.4, and section 5.

To achieve fire suppression reliability it is important that fire engineering consultants, sprinkler system designers, and building owners observe these limits when specifying and designing systems.

NFPA 13R Annex A explains the fire testing carried out by NFPA in the process of developing the residential sprinkler concept and NFPA 13R. It also includes the 1996 – 1990 USA apartment fire/death/injury record.

Annex A (A.1.1 to A1.2) is reproduced here with permission from NFPA 13R, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the Standard in its entirety.

**Annex A – Explanatory Material**

Annex A is not a part of the requirements of this NFPA document but is included for information only. This annex contains explanatory material, numbered to correspond with the applicable test paragraphs.

**A.1.1**

NFPA 13R is appropriate for use as an option to NFPA 13, Standard for the Installation of Sprinkler Systems, only in those residential occupancies, as defined in this Standard, up to and including four stories in height. It is the intent of this Standard that if NFPA 13R is appropriate for use, that it be used throughout the entire building. It is recognised than an occupancy incidental to the operations of the residential occupancy might exist within that residential occupancy. Such incidental occupancy would be considered part of the predominant (residential) occupancy and subject to the provisions of the predominant (residential) occupancy by 6.1.14.2 of NFPA 101, Life safety code, and similar provisions in many local building and fire codes. Use of NFPA 13R throughout the entire building in this case is allowed.

Where buildings are greater than four stories in height, or where building are of mixed use where residential is not the predominant occupancy, residential portions of such buildings should be protected with residential or quick response sprinklers in accordance with 8.4.5 of NFPA 13. Other portions of such buildings should be protected in accordance with NFPA 13. Where buildings of mixed use can be totally separated so that the residential portion is considered a separate building under the local code, NFPA 13R can be used in the residential portion while NFPA 13 is used in the rest of the building.

The criteria in this Standard are based on full-scale fire tests of rooms containing typical furnishings found in residential living rooms, kitchens, and bedrooms. The furnishings were arranged as typically found in dwelling units in a manner similar to that shown in figure

A1.1(a), figure A1.1(b), and figure A1.1(c). Sixty full-scale fire tests were conducted in a two-story dwelling in Los Angeles, California, and 16 tests were conducted in a 14 ft (4.3 m) wide mobile home in Charlotte, North Carolina. Sprinkler systems designed and installed according to this Standard are expected to prevent flashover within the compartment of origin where sprinklers are installed in the compartment. A sprinkler system designed and installed according to this Standard cannot, however, be expected to completely control a fire involving fuel loads that are significantly higher than average for dwelling units [10 lb/ft$^2$ (49 kg/m$^2$)], configurations of fuels other than those with typical residential occupancies, or conditions where the interior finish has an unusually high flame spread index (greater than 225).

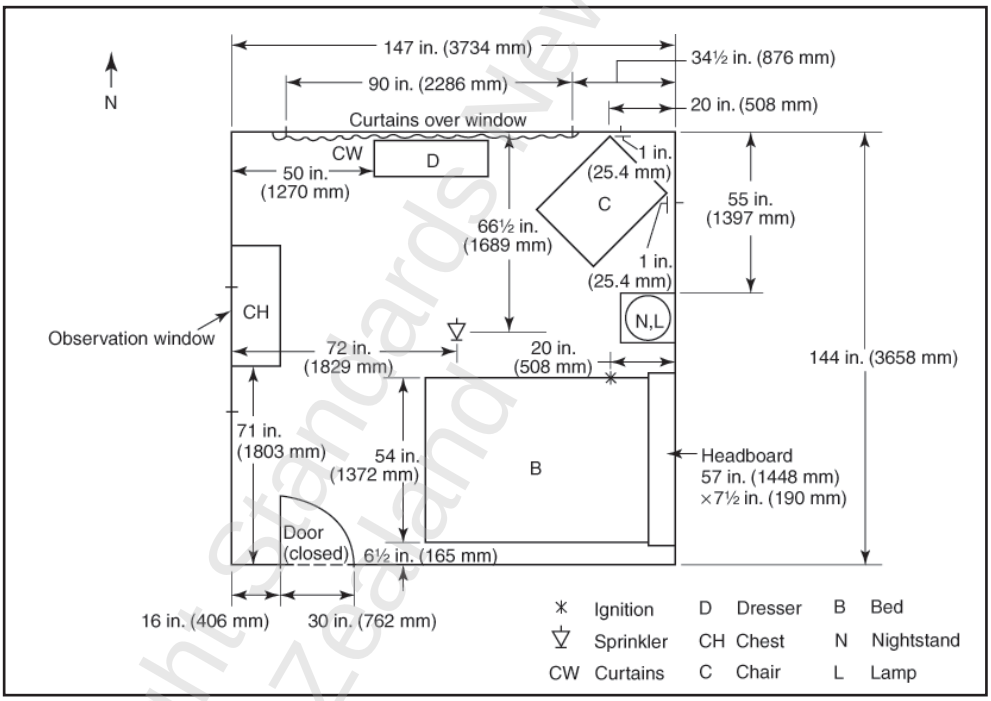



**Figure A.1.1(a) – Bedroom**

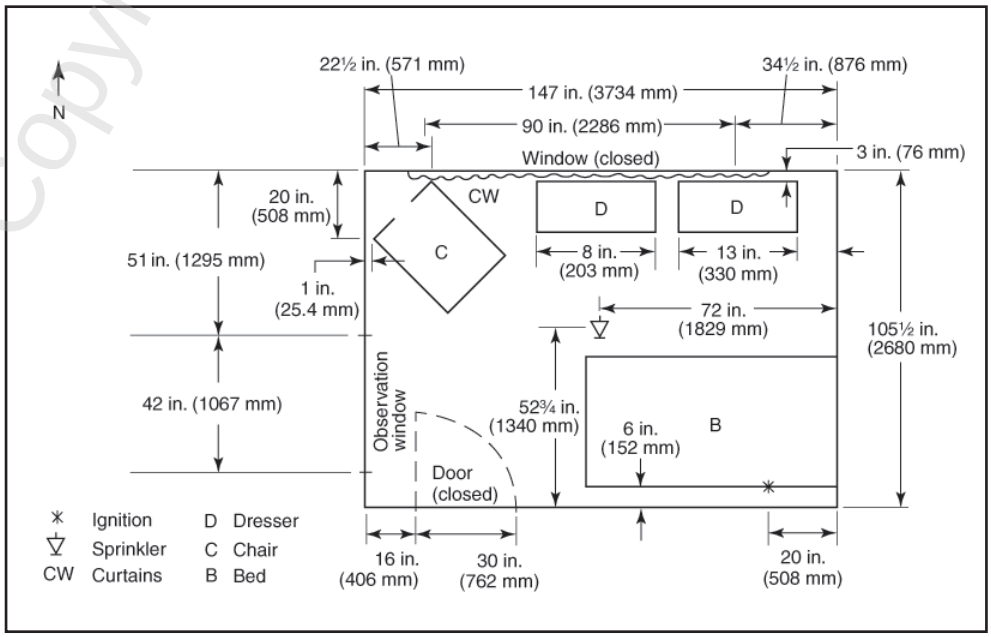



**Figure A.1.1(b) – Manufactured home bedroom**

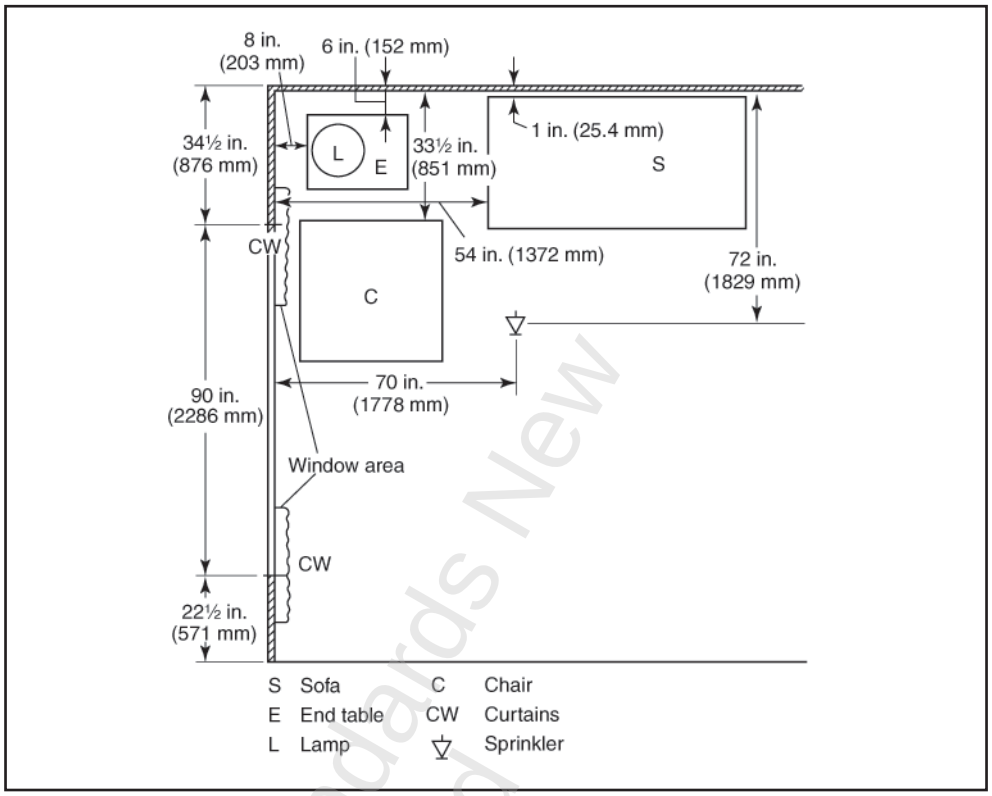



**Figure A.1.1(c) – Living room**

To be effective, sprinkler systems installed in accordance with this Standard need to open the sprinklers closest to the fire before the fire exceeds the ability of the sprinklers discharge to extinguish or control the fire. Conditions that allow the fire to grow beyond that point before sprinkler activation or that interfere with the quality of water distribution can produce conditions beyond the capabilities of the sprinkler system described in this Standard. Unusually high ceilings or ceiling configurations that tend to divert the rising hot gases from sprinkler locations or change the sprinkler discharge pattern from its standard pattern can produce fire conditions that cannot be extinguished or controlled by the systems described in this Standard.

**A.1.2**

Various levels of sprinkler protection are available to provide life safety and property protection. This Standard is designed to provide a high, but not absolute, level of life safety and a lesser level of property protection. Greater protection to both life and property could be achieved by sprinklering all areas in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, which permits the use of residential sprinklers in residential areas.

This Standard recommends, but does not require, sprinklering of all areas in the building; it permits sprinklers to be omitted in certain areas. These areas have been proved by NFPA statistics to be those where the incidence of life loss from fires in residential occupancies is low. Such an approach provides a reasonable degree of fire safety. (*See table A.1.2 for deaths and injuries in multifamily residential buildings.)*

It should be recognised that the omission of sprinklers from certain areas could result in the development of untenable conditions in adjacent spaces. Where evacuation times could be delayed, additional sprinkler protection and other fire protection features, such as detection and compartmentation, could be necessary.

**Table A1.2 – Fires and associated deaths and injuries in apartments by area of origin; Annual average of 1986-1990 structure of fires reported to U.S.A. fire departments**

| Area of origin | Civilian deaths | Civilian per cent | Fires | Per cent | Injuries | Per cent |
|---|---|---|---|---|---|---|
| Bedroom | 309 | 33.9 | 17,960 | 15.8 | 1,714 | 27.2 |
| Living room, family room, or den | 308 | 33.8 | 10,500 | 9.3 | 1,272 | 20.2 |
| Kitchen | 114 | 12.5 | 46,900 | 41.4 | 1,973 | 31.2 |
| Interior stairway | 29 | 3.2 | 1,040 | 0.9 | 91 | 1.4 |
| Hallway or corridor | 23 | 2.6 | 3,130 | 2.8 | 165 | 2.6 |
| Exterior balcony or open porch | 17 | 1.8 | 1,880 | 1.7 | 69 | 121 |
| Dining room | 10 | 1.1 | 800 | 0.7 | 69 | 121 |
| Closet | 9 | 1.0 | 2,120 | 1.9 | 116 | 1.8 |
| Multiple areas | 9 | 1.0 | 780 | 0.7 | 38 | 0.6 |
| Tool room or other supply storage room or area | 8 | 0.9 | 1,250 | 1.1 | 53 | 0.8 |
| Unclassified area | 8 | 0.9 | 480 | 0.4 | 29 | 0.5 |
| Exterior stairway | 8 | 0.8 | 870 | 0.8 | 22 | 0.4 |
| Bathroom | 7 | 0.7 | 2,510 | 2.2 | 101 | 1.6 |
| Heating equipment room or area | 6 | 0.6 | 2,510 | 2.2 | 75 | 1.2 |
| Exterior wall surface | 5 | 0.5 | 2,150 | 1.9 | 26 | 0.4 |
| Laundry room or area | 4 | 0.4 | 3,380 | 3.0 | 89 | 1.4 |
| Crawl space or substructure space | 4 | 0.4 | 1,490 | 1.3 | 62 | 1.0 |
| Wall assembly or concealed space | 3 | 0.3 | 1,020 | 0.9 | 21 | 0.3 |
| Attic or ceiling/roof assembly or concealed space | 3 | 0.3 | 1,100 | 1.0 | 18 | 0.3 |
| Ceiling/floor assembly or concealed space | 3 | 0.3 | 560 | 0.5 | 19 | 0.3 |
| Garage or carport* | 3 | 0.3 | 1,290 | 1.1 | 36 | 0.6 |
| Lobby or entrance way | 3 | 0.3 | 670 | 0.6 | 31 | 0.5 |
| Unclassified structural area | 3 | 0.3 | 520 | 0.5 | 32 | 0.5 |
| Unclassified storage area | 3 | 0.3 | 430 | 0.4 | 22 | 0.3 |
| Unclassified function area | 3 | 0.3 | 250 | 0.2 | 13 | 0.2 |
| Laboratory | 2 | 0.3 | 80 | 0.1 | 3 | 0.0 |
| Elevator or dumbwaiter | 1 | 0.2 | 220 | 0.2 | 4 | 0.1 |
| Sales or showroom area | 1 | 0.2 | 110 | 0.1 | 3 | 0.1 |
| Exterior roof surface | 1 | 0.1 | 1,040 | 0.9 | 15 | 0.2 |
| Unclassified means of egress | 1 | 0.1 | 180 | 0.2 | 6 | 0.1 |
| Office | 1 | .1 | 120 | 0.1 | 4 | 0.1 |
| Chimney | 1 | 0.1 | 980 | 0.9 | 2 | 0.0 |
| Personal service area | 1 | 0.1 | 40 | 0.0 | 4 | 0.1 |
| Library | 1 | 0.1 | 10 | 0.0 | 0 | 0.0 |
| Other known area | 2 | 0.2 | 5,000 | 4.4 | 115 | 1.8 |
| | | | | | | |
| **Totals** | **912** | **100.0** | **113,390** | **100.0** | **6,313** | **100.0** |

NOTE – Fires estimated to the nearest 10; civilian deaths and injuries are estimated to the nearest 1.

* Does not include dwelling garages coded as a separate property. (Source: 1986-1990 NFIRS and NFPA survey.)

# APPENDIX B – CONSIDERATIONS ON LIMITS OF APPLICATION

(INFORMATIVE)

The purpose of NZS 4515 is to provide fire control in sleeping occupancies where persons within the building at the time of a fire can evacuate the building, with or without assistance, to a 'safe place' within 20 minutes. It is therefore principally a life safety Standard.

In applications where occupants cannot evacuate with or without assistance within 20 minutes a higher standard of sprinkler protection such as that provided by NZS 4541 may be warranted.

This Standard is not intended to be used for community halls, churches, wharenui, and similar occupancies or in applications where there is an abnormally high fire load, surface finishes that will spread flame quickly, high ceilings, and high occupant densities compared with what would normally be expected in a New Zealand residence (1.1.2 and 1.1.3).

The Standard assumes that New Zealand Fire Service (NZFS) response will occur within 20 minutes of sprinkler system activation (Note to 1.1.1). This response cannot be assured, particularly outside urban fire districts. In such cases NZFS response can be estimated by application of the Fire Brigade Intervention Model (FBIM). This model utilises specific fire engineering design in accordance with the methodology referred to in the *International fire engineering guidelines*. A higher standard of sprinkler protection and/or extended water supplies may be warranted to extend sprinkler control to meet NZFS response.

NZFS response to a sprinkler controlled fire with an adequate firefighting water supply (SNZ PAS 4509) is likely to significantly enhance property protection. Where insufficient water is available for NZFS operations then consideration should be given to the provision of additional water for firefighting in accordance with SNZ PAS 4509.

# APPENDIX C – RESIDENTIAL SYSTEMS – DETERMINATION OF COMPLIANCE

(NORMATIVE)

## C1 General

Appendix C provides information on the determination of compliance for a residential sprinkler system.

## C2 Sleeping occupancies

The sprinkler system is deemed to comply with this Standard when the SSC has reviewed the design, and the physical installation of the system by an appropriately qualified contractor as determined by the SSC, and confirmed this by issuing a certificate of compliance stating the following matters comply with the requirements of the Standard:

(a) The design of the system has been documented and shown to conform to this Standard;

(b) All components which are required to be listed have been listed;

(c) The physical installation complies in all aspects (whether as evidenced by a first or subsequent inspection);

(d) The water supply and components thereof have been tested and shown to comply;

(e) The flow switch, and other alarm, and monitoring functions operate correctly;

(f) There is evidence of ongoing testing, servicing, and annual inspection arrangements and that these comply.

## C3 Certificate of compliance

The form of certificate of compliance is that set out in Appendix F and a copy should be displayed adjacent to the system control valves.

## C4 Approval of basic design decisions

Prior to commencement of installation, the contractor shall submit for approval the basic design decisions incorporating the data and information specified in Appendix D. On the basis of the information supplied, the SSC shall indicate approval, or otherwise, of the following basic design decisions:

(a) Applicability of this Standard;

(b) Separation of the protected building from other buildings or fire exposures;

(c) The adequacy of the water supply;

(d) The adequacy of the alarm arrangements;

(e) A copy of the current data sheet for each type of residential sprinkler used.

NOTE – A contractor may agree to an administrative procedure with the SSC whereby a data sheet reference may be used when that authority has the data sheet on file.

# APPENDIX D – RESIDENTIAL SYSTEMS DOCUMENTATION PRIOR TO FINAL INSPECTION

(NORMATIVE)

The following documentation shall be provided by the contractor to the SSC prior to final inspection (for the purposes of design audit and system documentation):

(a) A notice of completion;

(b) As-built sprinkler and pipe layout plans which show the following:

  (i) A node, or pipe reference system, that provides unique identification for pipes, bends, junctions, sprinklers, and other pipe fittings which require hydraulic consideration

  (ii) Distribution pipes and diameters

  (iii) Type of pipes used and '*C*' factor

  (iv) Pipes that require hydraulic consideration, and their diameter

  (v) Sprinklers assumed (in accordance with the Standard) to operate simultaneously imposing the greatest hydraulic demand

  (vi) Flow through each sprinkler and pipe between junctions

  (vii) Pressures at each end of each pipe and at the entry to each sprinkler assumed to be operating

  (viii) Height of each such node above or below datum;

(c) Calculation data sheets and/or computer print-outs to support the installation schematic diagrams and plans. For gridded and looped installations, these data shall be provided for each sample (candidate) area of operation considered;

(d) The following details for each operating sprinkler in each candidate area:

  (i) Node or reference number

  (ii) Nominal orifice size

  (iii) Flow from sprinkler (L/min)

  (iv) Pressure at entry to sprinkler (kPa);

(e) The following details for each hydraulically significant pipe:

  (i) Node or reference number

  (ii) Internal diameter (mm)

  (iii) Formula used to determine pressure loss (see 7.3.3)

  (iv) Flow through pipe (L/min)

  (v) Length (m)

  (vi) Number of tees, elbows, crosses, and other hydraulically significant fittings

(vii) Total hydraulic length (m)

(viii) Static head change in pipe (kPa)

(ix) Pressure at each end of pipe (kPa)

(x) Friction loss in pipe (kPa)

(xi) Direction of flow;

(f) Any other relevant information.

# APPENDIX E – RESIDENTIAL SYSTEM ACCEPTANCE AND COMPLETION DOCUMENTATION

(NORMATIVE)

## E1 General

The installing contractor shall notify the SSC and owner's representative of the time and date of the testing. The installing contractor shall perform all the required tests and complete the appropriate forms.

## E2 Flushing of pipes

Underground connections, and connections between the point of supply and the sprinkler control valves shall be flushed at a velocity in excess of 3 m/s before connection is made to sprinkler piping, pumps, or control valves.

## E3 Hydrostatic tests

All interior piping shall be hydrostatically pressure tested at 1.5 times the working pressure for a period of not less than 2 hours. There shall be no drop in gauge pressure and no visual evidence of leakage.

## E4 Documentation

### E4.1

The contractor shall supply to the SSC on completion of the sprinkler system a plan and typical cross sections of the sprinklered building showing:

(a) Name and location of the protected residence;

(b) Name and address of owner;

(c) Name of contractor;

(d) A plan and a cross section of the protected building identifying:

  (i) General forms of construction and materials used

  (ii) Location of any external exposures

  (iii) Disposition of the water supply

  (iv) Location of alarm valves

  (v) The height of the highest sprinkler relative to the alarm valves;

(e) A dimensioned drawing of the pipe layout showing the design pressure of each sprinkler and referencing the make, model, orifice size, metric *K*-factor, temperature rating, and year of manufacture of each sprinkler;

(f) The design flows and pressures;

(g) A summary of the hydraulic calculations including a node diagram;

(h) The type of water supply provided;

(i) A graph showing details of the water supply performance including test data and duty points;

(j) Data on stored water and any pump or other method of pressurisation, if used.

**E4.2**

The residential SSC shall supply the installing contractor with a certificate of compliance as set out in Appendix F.

**E4.3**

The sprinkler system designer shall supply the building owner with a diagram showing the configuration of the sprinkler system pipework. This shall be retained on the sprinkler protected premises with the certificate of compliance.

# APPENDIX F –
# RESIDENTIAL SPRINKLER SYSTEM CERTIFICATE OF COMPLIANCE

(NORMATIVE)

## RESIDENTIAL SPRINKLER SYSTEM CERTIFICATE OF COMPLIANCE

An inspection of the as-built plans and hydraulic calculations and a physical inspection on

..... (date) and ..... (date) and ..... (date) of the sprinkler system installed at

.....

.....

*(Name of building and full street address)*

confirmed that this system conforms to the requirements of NZS 4515:2009 in all respects.

The required flow at the alarm valves is ..... L/min at a pressure of ..... kPa, which includes an allowance of ..... L/min for simultaneous domestic flow.

Signed ..... Name .....
*(Print)*

Sprinkler System Certifier (SSC): .....

Date..... To have effect from.....

Certificate No. ..... Expires .....

The following makes and models of sprinklers are used in this system:

| | Residential type | | Special response | | Quick response | | External | | Standard response | |
|---|---|---|---|---|---|---|---|---|---|---|
| Make: | | | | | | | | | | |
| Model: | | | | | | | | | | |
| Metric *K*-factor: | | | | | | | | | | |
| Orifice size: | | | | | | | | | | |
| Temperature rating: | | | | | | | | | | |
| Year of manufacture: | | | | | | | | | | |
| NOTE – Sprinklers are not to be interchanged with models of different performance characteristics. | | | | | | | | | | |

# APPENDIX G – REQUIREMENTS FOR LISTING

(NORMATIVE)

**G1**

In listing equipment, materials, procedures, organisations, persons, or facilities, the SSC shall determine that any specific requirements of this Standard have been met and there is sound evidence to indicate reliability of performance.

**G2**

Items of equipment having Underwriters Laboratories (UL), Factory Mutual (FM), or Loss Prevention Council (LPC) approval or listing for equivalent service, can on presentation of evidence of such approval or listing to the SSC, be listed pursuant to this Standard unless the SSC considers that the approved or listed item is not suitable or insufficiently reliable. Reasons for any decision not to list shall be provided by the SSC.

**G3**

The SSC shall withdraw the listing of any listed equipment, material, procedure, organisation, person, or facility in the event that the item is found on examination to be defective or to have performed inadequately or in an unreliable manner unless there is clear evidence of adequate remedial action.

**G4**

Listings shall be limited to the tenor and qualifications of the SSC's listing document and cease to have effect from the date of any signed notice of withdrawal of listing issued by the SSC.

**G5**

Evidence of listing for any particular item of equipment, material, procedure, organisation, or facility shall be the production of an original document to that effect, signed by an authorised officer of the SSC or inclusion in a schedule of listed items published by the SSC.

# APPENDIX H – APPLICATION FOR APPROVAL

(NORMATIVE)

## APPLICATION FOR APPROVAL OF RESIDENTIAL SPRINKLER SYSTEM TO NZS 4515:2009

Name of premises

Address .....

Name of owner .....

Principal use: such as rest home, hospital, private residence .....

Number of beds .....

Construction: No. of storeys : .....

Roof : .....

Ceilings : .....

Floors : .....

External walls : .....

Total floor area ..... $m^2$ + Concealed spaces ..... $m^2$

Exposure: (a) Are there fire loads within 10 m of the protected area?
(If 'yes' show on block plan and explain nature as necessary)

(b) Are there concealed spaces in the protected area greater than 225 $m^2$?
(If 'yes', is the concealed space constructed of, or contains, combustibles?)

(c) Will the concealed space be – sprinklered? .....

– draught stopped? .....

Separation: (a) .....
(b) .....

RESIDENTIAL TYPES TO BE USED

| Make. Model No. | Max. area of coverage $m^2$ | Design pressure (1 head) kPa |
|---|---|---|
| ..... | ..... | ..... |
| ..... | ..... | ..... |

Water supply .....

Pump .....

Attach hydraulic graph for supply with highest design flows and pressures indicated. Show valves closed for purposes of test.

Attach sketch of (or show on block plan) all valves between source and alarm valve.

Alarm

How will alarm be given? .....

If Fire Brigade is connected state type of receiving equipment.

.....

Valve set size & listing numbers .....

First aid appliances

Estimated number and type proposed .....

.....

**ATTACHMENTS**

These should preferably be on A4 paper

Check and initial

| | | | | |
|---|---|---|---|---|
| 1. | Block plan ..... | 2. | Cross sections | |
| | Scale ..... | | | |
| | North point ..... | 3. | Hydraulic graph of supply | ..... |
| | Fire doors ..... | | Design flows and pressure | ..... |
| | Fire walls ..... | | Details of test point | ..... |
| | Externals ..... | | Date and time of test | ..... |
| | Water supplies ..... | | | |
| | Stop valves ..... | 4. | Others: (Specify) | ..... |

Route of power supply and switchgear .....

Highest head .....

Area protected by installation .....

Location of alarm, Fire Service inlet and valve .....

..... ..... Date .....

(Signature) (Company)

# APPENDIX J – GUIDELINES FOR EVALUATION OF CONTRACTORS BY THE SPRINKLER SYSTEM CERTIFIER

(NORMATIVE)

## J1

NZS 4515 is drafted on the basis that contractors undertaking and having responsibility for the roles allocated by the Standard have acquired a general understanding of fire sprinkler technology and will possess sufficient experience, resources, competence, and organisation to permit the informed application of the requirements of the Standard.

## J2

A listed contractor should have the necessary attributes at all times and not simply at the time of evaluation.

Accordingly, it is envisaged that:

(a) Listing may be withdrawn at any time but that 30-days' notice of any shortcoming would be given by the SSC before withdrawing listing, to afford an opportunity to the contractor to remedy same;

(b) Listing routinely lapses 24 months from the date of granting and that:

  (i) The date of 'routine expiry' would be included in the listing

  (ii) Responsibility for applying for re-listing would lie with the contractor

  (iii) Re-listing would be based on the ability to satisfy criteria and standards of competence relevant at the time bearing in mind current technological and trade practices.

## J3

Any request for listing (or re-listing) would be accompanied by a completed standard schedule of information as follows:

### J3.1

Schedule of information for contractors:

(a) Name of contracting company, and office, and postal address;

(b) Name of manager, contact address, and phone number;

(c) Date from which listing is sought;

(d) Details of previous experience as sprinkler contractor (including as appropriate, examples of work done);

(e) Method by which contractor proposes to keep abreast of fire sprinkler technology;

(f) Names and curriculum vitae (CV) information of persons responsible for:

  (i) Design

  (ii) Installation supervision

  (iii) Fabrication shop (if operated by contractor)

  (iv) Service and maintenance work;

(g) Cities in which the contractor will have permanent facilities;

(h) Copy of written quality system (that is, the practices, policies, and procedures by which the contractor will ensure adequacy of design, materials, fabrication, installation, documentation, and calculation);

(i) Location and ownership of pipe fabrication facilities; and

(j) Makes of listed hardware intended to be used.

## J4

Evidence of listing may be in the form shown in Appendix K.

# APPENDIX K –
# CERTIFICATE OF LISTING OF CONTRACTOR

(NORMATIVE)

## CERTIFICATE OF LISTING OF CONTRACTOR

This is to confirm that, on the basis of the information supplied in the Application for Listing as Contractor dated ....., this organisation, as the nominated Sprinkler System Certifier, considers that the requirements of Appendix J of NZS 4515:2009 have been adequately met for the purposes described in that Standard.

Certificate number ..... is to have effect from..... (date) for 24 months unless withdrawn after 30 days' notice.

Signed ..... Name .....
(Print)

Sprinkler System Certifier .....

# APPENDIX L – EXPANSION CHAMBERS

(INFORMATIVE)

**L1**

When the water in the sprinkler system is heated it expands and compresses the air trapped in the sprinkler system causing the installation pressure to rise. Similarly when the water in the sprinkler system is cooled it contracts allowing the air trapped in the sprinkler system to decompress causing the installation pressure to drop.

**L1.1**

The extent of the temperature induced pressure changes will vary depending on both the size of the temperature fluctuation and the percentage of trapped air versus water in the sprinkler system. If the sprinkler system is prone to water-logging or is subject to large temperature fluctuations then the installation pressure may rise to a level where it exceeds the rated working pressure of the sprinkler systems components during times of high temperature, similarly during periods of low temperature the installation pressure may fall to the point where it causes spurious pump starts or fire calls.

One method of overcoming problems caused by thermal expansion is the installation of a gas over water expansion chamber as shown in figure L1.

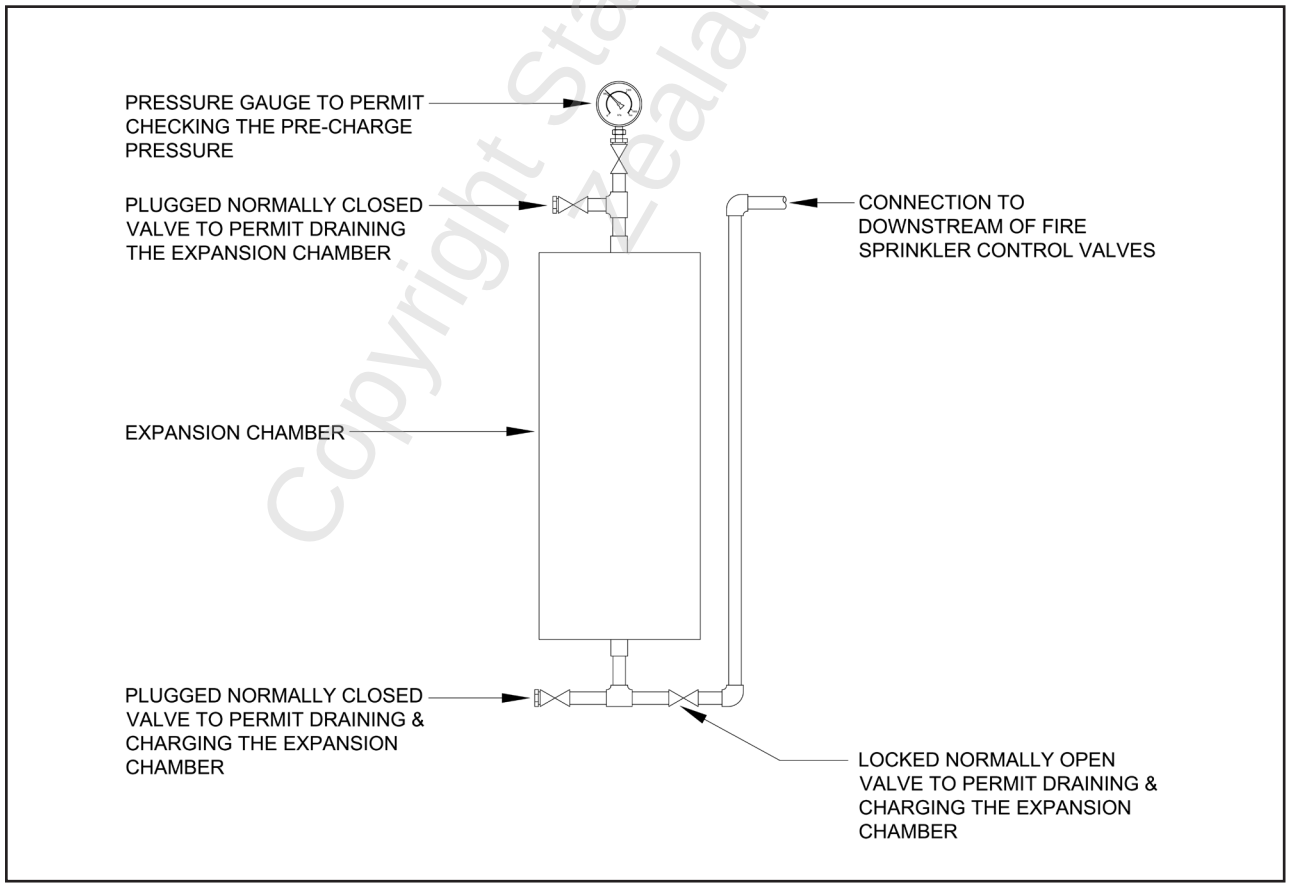



**Figure L1 – Gas over water expansion chamber**

**L1.2**

The required size of the expansion chamber can be determined based on the use of the ideal gas law using the following formulae.

$$\Delta L = S_V\left(\frac{D_L}{D_H} - 1\right) \quad \text{(Eq. L1)}$$

$$\frac{P_0.V_0}{T_0} = \frac{P_L.V_L}{T_L} = \frac{P_H.V_H}{T_H} \quad \text{(Eq. L2)}$$

As the sprinkler system and expansion chamber form a closed system and the water in the system is incompressible the change in air volume within the expansion chamber will be equal to the change in water volume due to thermal expansion/contraction.

$$V_H = V_L - \Delta L \quad \text{(Eq. L3)}$$

If we make the assumption that there is no trapped air in the sprinkler system piping, then the only air in the system is in the expansion chamber. This is a conservative assumption as in reality there will be some air trapped in the sprinkler system piping which will assist with stabilising the sprinkler system standing pressure.

$$V_{EC} = V_0 \quad \text{(Eq. L4)}$$

The required volume of the expansion chamber can then be calculated using equation L5.

$$V_{EC} = \frac{P_L.T_0.P_H.\Delta L.T_L}{P_0.T_L\left(P_H.T_L - P_L.T_H\right)} \quad \text{(Eq. L5)}$$

Where:

$\Delta L$ = Change in water volume ($m^3$) due to thermal expansion/contraction.

$S_V$ = Volume ($m^3$) of the sprinkler system pipework not including the expansion chamber.

$D_L$ = Density ($kg/m^3$) of water at the lowest expected temperature.

$D_H$ = Density ($kg/m^3$) of water at the highest expected temperature.

$V_{EC}$ = Minimum volume ($m^3$) required for the expansion chamber.

$V_O$ = Air volume ($m^3$) in the expansion chamber at precharge before connection to the sprinkler system. Generally this will be the empty volume of the expansion chamber.

$V_L$ = Air volume ($m^3$) in the expansion chamber when the sprinkler system is at it lowest expected temperature.

$V_H$ = Air volume ($m^3$) in the expansion chamber when the sprinkler system is at it highest expected temperature.

$P_O$ = Absolute precharge pressure (kPa) on the expansion chamber before connection to the sprinkler system.

$P_L$ = Absolute lowest pressure (kPa) that can be permitted for the sprinkler system. Generally this will be determined by the higher of the pump start or fire pressure switch setting.

$P_H$ = Absolute highest pressure (kPa) that can be permitted for the sprinkler system. Generally this will be determined by the listed / rated working pressure of the components installed in the sprinkler system (normally 1300 kPa absolute pressure).

$T_O$ = Ambient temperature (*K*) when the expansion chamber is precharged..

$T_L$ = Lowest expected temperature (*K*) that the sprinkler system will be exposed to.

$T_H$ = Highest expected temperature (*K*) that the sprinkler system will be exposed to.

NOTE – The pressures used in the preceding formulae are absolute pressure not gauge pressure. Absolute pressure is equal to the gauge pressure plus atmospheric pressure (101.3 kPa at sea level). The temperatures are in units of Kelvin, which equals the temperature in degrees Celsius plus 275.

Using the above formulae the expansion chamber can be sized as follows:

Step 1: Determine the lowest temperature ($T_L$) and highest temperature ($T_H$) that the sprinkler system will be exposed to. Estimate the ambient temperature when the expansion chamber is to be charged ($T_O$) based on normal ambient temperatures for the time of year when the expansion chamber is to be installed.

Step 2: Determine the density of the water in the sprinkler system pipework at the lowest temperature ($D_L$) and highest temperature ($D_H$) that the sprinkler system will be exposed to. The density of water over the range from 0°C to 100°C is given in table L1.

Step 3: Calculate the volume of the sprinkler system pipework ($S_v$). The volume per metre for medium grade steel pipe is provided in table L2. For other materials consult the manufacturer's data.

Step 4: Calculate the change in water volume ($\Delta L$) due to thermal expansion / contraction using Equation L1.

Step 5: Determine in units of absolute pressure the lowest ($P_L$) and highest ($P_H$) pressure that can be permitted for the sprinkler system. Generally these pressures will be determined by the higher of the pump start or fire pressure switch setting for $P_L$ and by the listed/rated working pressure of the components installed in the sprinkler system for $P_H$.

Step 6: Make an initial estimate in units of absolute pressure of the precharge pressure ($P_O$) on the expansion chamber. It is suggested that this should be approximately half way between ($P_L$) and ($P_H$). This can be further refined on an iterative basis if required.

Step 7: Calculate the minimum volume ($V_{EC}$) required for the expansion chamber using Equation L5. Note that if Equation L5 gives a negative answer it means that the lowest ($P_L$) and highest ($P_H$) pressure are too close together for an expansion chamber to be a practical solution.

**L2**

Where an expansion chamber is not workable either due to the difference between the highest and lowest system pressures being too small or the volume of the sprinkler system being too large an alternative approach would be the installation of an automatic jockey pump complying with 3.1.2.

**Table L1 – Density of water**

| **Temperature** (°C) | **Density** (kg/m$^3$) |
|---|---|
| 0 | 999.9 |
| 5 | 1000 |
| 10 | 999.7 |
| 20 | 998.2 |
| 30 | 995.7 |
| 40 | 992.2 |
| 50 | 988.1 |
| 60 | 983.2 |
| 70 | 977.8 |
| 80 | 971.8 |
| 90 | 965.3 |
| 100 | 958.4 |

**Table L2 – Volume of BS 1387 Medium grade steel pipe**

| **Nominal bore** (mm) | **Mean ID** (mm) | **Volume** (m$^3$/m) |
|---|---|---|
| 20 | 21.63 | 0.00037 |
| 25 | 27.31 | 0.00059 |
| 32 | 35.97 | 0.00102 |
| 40 | 41.86 | 0.00138 |
| 50 | 52.98 | 0.00220 |
| 65 | 68.67 | 0.00370 |
| 80 | 80.68 | 0.00511 |
| 100 | 105.14 | 0.00868 |
| 150 | 155.32 | 0.01895 |
| 200 | 209.54 | 0.03448 |
| 250 | 263.44 | 0.05451 |
| NOTE – The values for 200 mm and 250 mm pipe are based on API 5L pipe with a 4.78 mm wall thickness. | | |

# APPENDIX M – WATER SUPPLY STRAINERS

(INFORMATIVE)

**M1**

When strainers are required by this Standard or by the water supply authority in conjunction with a backflow prevention device, they should be listed by a SSC and comply with the requirements specified in this appendix.

NOTE – This appendix has been written to balance the requirement to protect the potable water supply against any risk of loss of life should a strainer, required for the installation of a backflow prevention device, block during a fire.

**M2**

Strainers should have an open screen area at least 25 $mm^2$ for each litre per minute of highest design flow, and not less than four times the cross section area of the supply pipe.

**M3**

The minimum dimension of the strainer mesh should be not less than 8 mm. This dimension should be the diameter of circular perforations, or the diagonal measurement of rectangular perforations.

**M4**

The strainer should be designed to allow the screen to be removed for cleaning.

**M5**

As part of the listing process, it should be demonstrated to a SSC that the strainer will not deform when subjected to its maximum design pressure.

NOTE – This test is not a leak test as such, but a deformation test, which may be demonstrated by a dynamic pressure test.

# APPENDIX N – TESTING OF RETICULATED WATER SUPPLY

(NORMATIVE)

## N1 General

Suitable arrangements for the test shall be made with the water supply authority before the test. The water supply authority requirements shall be observed during the test. Hydrants shall be opened and closed slowly to avoid possible damage through water hammer.

## N2 Method 1

### N2.1

The flow and pressure characteristics of the reticulated water supply are determined using a flow gauge and pressure gauge attached by independent connections, each going directly to the reticulated water supply, as close together as is practicable. Normally two adjacent fire hydrants will provide the points of attachment.

NOTE – Ensure that the design of sprinkler hydraulics is based upon minimum water supply pressure as stated in the (territorial authority's) district plan.

### N2.2

The test is made during periods of maximum daily draw-off. The flow gauge is so placed for the direction of water flow when the test is being conducted, to give the lower reading on the pressure gauge. This is important for a reticulated water supply that is fed from one end only.

### N2.3

Values of pressure and flow are recorded at not less than two and preferably three flow rates, one being as large as practicable, and used to prepare a graph relating pressure and flow. Pressure is plotted to a suitable scale on the ordinate ('y' axis) and the 1.85 power of the flow on the abscissa ('x' axis). The line relating pressure and flow (line A) shall be drawn (see figure N1).

### N2.4

An adjustment is made to all test pressure readings to allow for the difference in height between the proposed installation control valve location and the test pressure gauge. The difference (calculated at 1 m = 10 kPa) shall be marked on the 'y' axis of the graph above or below line A (as applicable). Line B is now drawn through this point parallel to line A.

### N2.5

A further adjustment is now made, using the Hazen-Williams formula and the known pipe diameter(s) and length(s), to allow for frictional pressure loss in all pipework from the reticulated water supply test point up to the installation control valves.

This will include all reticulated water supply pipe from the pressure test point up to and including the water supply toby valve, plus pipework between the toby valve and installation control valve. Where the supply is taken from a small diameter rider main, rather than the large diameter main being tested, the loss in the rider shall also be included.

This loss is calculated at the highest design flow, in accordance with Appendix N, and is plotted below line B at that flow. A new line (line C) is now drawn through this plotted point and the intersection of line B and the 'y' axis.

**N2.6**

The pressure available to meet the design requirements is taken as 80% of the pressure indicated by line C and is plotted as line D. Design pressures shall be below line D for all design flows.

**N2.7**

Where it can be established that proposed upgrading of the reticulation by the water supply authority will result in an improvement in the pressure and flow characteristics obtained at the time of the test, 100% of the pressure indicated by line C of the graph may be taken subject to the approval of the SSC.

## N3 Method 2

**N3.1**

The flow and pressure characteristics of the main are determined and a graph prepared as specified in N2.1 to N2.5 inclusive for Method 1.

**N3.2**

In addition, a pressure recording gauge is used to ascertain the static pressure, that is, at no sprinkler flow of the main at the level at which it is proposed to install the sprinkler valves. The record is made for at least 14 consecutive days. If the water supply system is liable to seasonal fluctuation the record is taken for at least 21 days during the season when the pressure is at its lowest. The contractor shall also check whether there is any evidence of downward fluctuation from year to year during the season of greatest demand. The SSC may require a further derating if such fluctuations occur.

**N3.3**

This pressure recording is inspected and the lowest pressure (other than transient low pressure readings occasioned by hydraulic shocks) noted. This pressure is marked on the graph where it intersects the 'y' axis and a line (line C2) drawn through this point, parallel to line C (see figure N1).

**N3.4**

The pressure available to meet the design requirements is taken as 90% of the pressure indicated by line C2 of the graph at the design flow required.

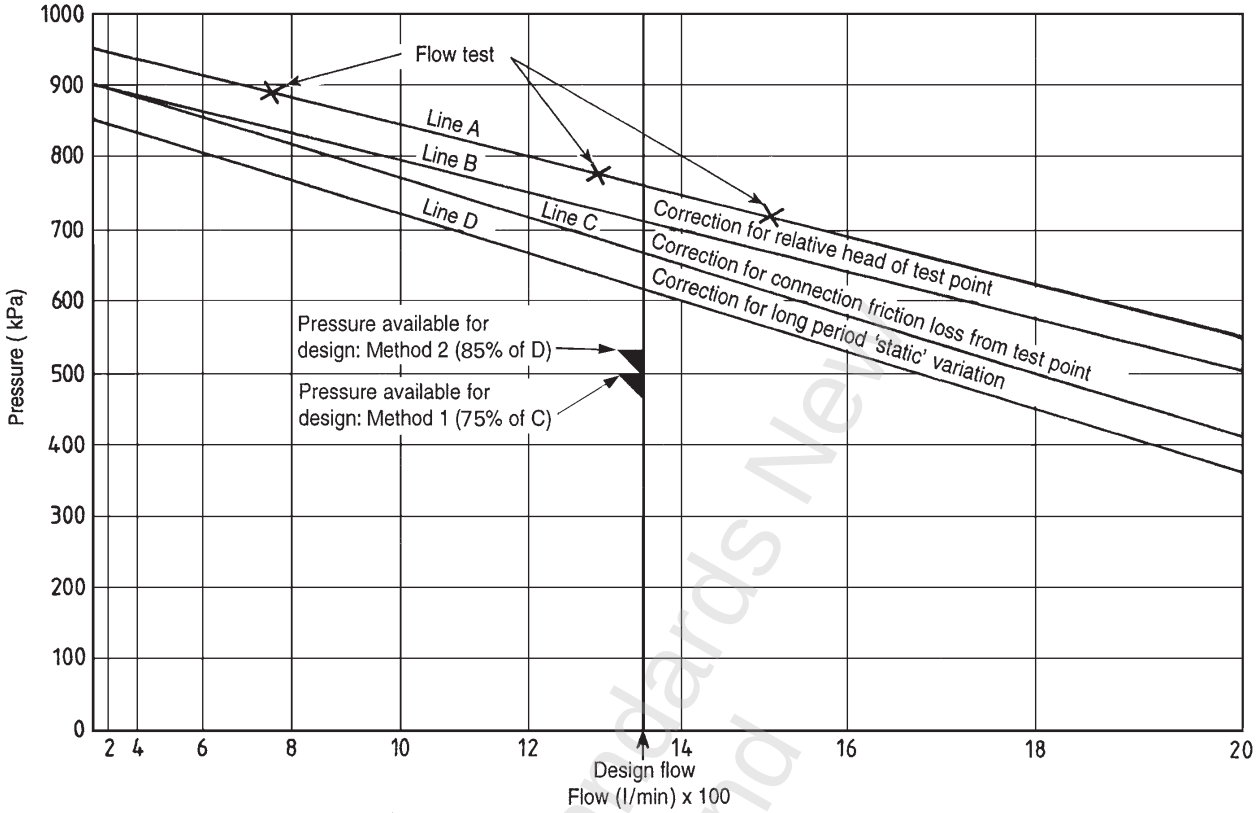



**Figure N1 – Water supply flow graph**

# APPENDIX P – ROUTINE SYSTEM TESTING OF PUMPS

(NORMATIVE)

## P1 Diesel engine driven pumps

### P1.1 Weekly test

The following tests shall be performed weekly:

(a) Pre-run check:

(i) Check pump enclosure temperature

(ii) Check valves to ensure each is either correctly open or closed

(iii) Check oil level and top up if necessary;

(b) 15-minute test run:

(i) Check the test bypass is fully open

(ii) Record the suction and delivery pressure and check against reference pressure

(iii) Record the oil pressure and engine temperature and check against reference data

(iv) Check and record battery voltage and charger functions

(v) Check the general health of the start and unit running;

NOTE – Use various methods of starting over a four-test cycle.

(c) Completion of test run:

(i) Check and record the rise in pump enclosure temperature

(ii) Check and record the fuel level and top up if necessary

(iii) Close the bypass and ensure all controls and functions are returned to normal; and

(iv) Check controller indicator lights for normal condition.

### P1.2 Monthly test

The following tests shall be performed monthly:

(a) The routine weekly test;

(b) Check the cell electrolyte level and specific gravity using a hydrometer and record results or in the case of sealed lead acid batteries in accordance with the manufacturer's instructions;

(c) Check the date of battery installation and last annual service;

(d) Clean and tidy the pump enclosure and engine;

(e) Check the fuel line agglomerator for water;

(f) Check the fuel filters for cleanliness and tightness;

(g) Check the drive belts for tightness.

### P1.3 Annual test

The following tests shall be performed annually:

(a) The routine monthly test;

(b) A measured flow test using the standard test connection to check at least three points on the pump curve;

(c) Check the cylinder compression;

(d) A cell load test on each battery;

(e) Replace all filters (cooling system belts and thermostats no greater than 4-yearly);

(f) Test run engine for two hours with the bypass open (concurrent with the monthly test run); and

(g) Change the engine oil.

# APPENDIX Q – GUIDANCE ON THE TESTING OF SPRINKLERS

(INFORMATIVE)

## Q1 Background

This Standard (see 8.5) requires that sprinklers undergo routine testing to ensure that their expected levels of reliability are maintained. This appendix provides guidance on tests and why such tests should be undertaken.

It has been argued that such testing is not necessary, as problems will be identified through tests carried out in other countries. There have been a number of international replacement programmes that have included sprinklers that required replacing in New Zealand. However, these international replacement programmes do not address site-specific conditions that may impact on sprinkler reliability. Such conditions include, but are not limited to, corrosion, paint or paint spray loadings, pipe scale forming in sprinkler orifices, and the like. Testing carried out by Underwriters Laboratories on dry sprinklers has indicated that the harsh environment that these sprinklers are usually installed in means that the sprinklers should be replaced every 10 years – or if used on a large scale, tested to ensure that they will provide reliable service.

## Q2 Recognised testing laboratories

This Standard requires that the sprinklers be tested by a 'recognised' testing laboratory. At the time of preparation of this Standard, no laboratory appeared to provide sprinkler-testing services in New Zealand. Sprinkler testing facilities are available from at least two laboratories in Australia, and from Underwriters Laboratories in USA.

The term 'recognised' implies a level of competence. However, it is unlikely that overseas laboratories would seek listing to operate within New Zealand's small market.

## Q3 Samples

Samples taken from a building should be representative of the occupancy of the building. For example, samples should be taken from both below ceiling and concealed space areas, if both sample area are subject to testing. It is imperative that environmentally dissimilar areas are considered when selecting samples, especially if a harsh environment is present.

In the situation where a small number of dry barrel sprinklers are used, it may be more cost effective to replace the sprinklers than to test them.

## Q4 Test regime

The samples should be subjected to a minimum of the following:

(a) A visual inspection;

(b) Release temperature testing, to ensure that they operate within tolerances specified in manufacturing standards;

(c) Leak resistance test to 1.5 times maximum working pressure (sprinkler manufacturing test pressures exceed this test pressure);

(d) Functional tests including seat release pressures;

(e) For fast or quick response sprinklers, a response time index (RTI) sensitivity test.

### Q5 Failure of sprinklers

Where one sample sprinkler fails to meet the test requirement, all sprinklers represented by that sample should be replaced (see 8.5.4). Before replacing all sprinklers, some order of subjectivity is required. For example, if a visual inspection indicates that the sprinkler has suffered mechanical damage, as witnessed by a bent deflector, then it would be reasonable to carry out a visual inspection of the other sprinklers in the area, and only replace those also exhibiting mechanical damage. However, if testing indicates excessive seat release pressures, then all similar sprinklers should be replaced.

### Q6 Further information

The following Standards may be useful in establishing performance criteria when evaluating sprinkler test results:

ISO 6182-1 Fire protection – Automatic sprinkler systems – Part 1: Requirements and test methods for sprinklers

UL 199 Standard for automatic sprinklers for fire-protection service

UL 1626 Residential sprinklers for fire-protection service.

Approved by the Standards Council on 16 December 2009, and the Minister of Internal Affairs on 7 December 2009, to be a Standard pursuant to the provisions of section 10 of the Standards Act 1988.

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