STANDARDS
NEW ZEALAND
Paerewa Aotearoa

NZS 4515:2003

New Zealand Standard

Fire Sprinkler Systems for Residential Occupancies

Superseding NZS 4515: 1995

NZS 4515:2003

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COMMITTEE REPRESENTATION

This Standard was prepared by the Fire Protection – Automatic Fire Sprinkler Installations Committee (P 4515) for the Standards Council established under the Standards Act 1988.

Standards New Zealand wishes to thank the following nominating organizations for their representation on Committee P 4515:

Building Industry Authority of New Zealand
Building Research Association of New Zealand Inc.
Fire Protection Association, New Zealand
Fire Protection Contractors' Association of New Zealand
Institution of Professional Engineers New Zealand
Insurance Council of New Zealand
Master Plumbers, Gasfitters & Drainlayers New Zealand Inc.
New Zealand Fire Equipment Association Inc.
New Zealand Fire Service
Society of Fire Protection Engineers
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The Institution of Fire Engineers

and the other individuals who were co-opted onto the committee.

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AMENDMENTS

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REFERENCED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 3106:1986	Code of practice for concrete structures for the storage of liquids
NZS 3501:1976	Specification for copper tubes for water, gas, and sanitation
NZS 4203:1992	General structural design and design loadings for buildings
NZS 4219:1983	Specification for seismic resistance of engineering systems in buildings
NZS 4442:1988	Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 4505:1977	Specification for fire-fighting waterway equipment
NZS 4512:2003	Fire detection and alarm systems in buildings
NZS 4517:2002	Fire sprinkler systems for houses
NZS 4521:1974	Specification for boxes for fire brigade connections
NZS 4541:2003	Automatic fire sprinkler systems
NZS 4711:1984	Qualification tests for metal-arc welders
NZS 4781:1973	Code of practice for safety in welding and cutting
NZS 7643:1979	Code of practice for the installation of unplasticized PVC pipe systems

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 1221:1997	Fire hose reels
AS/NZS 1477:1999	PVC pipes and fittings for pressure applications
AS/NZS 2566:- - - - Part 2:2002	Buried flexible pipelines Installation
AS/NZS 4130:2003	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131:2003	Polyethylene (PE) compounds for pressure pipes and fittings

AS/NZS 4765(Int): 2000	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

AMERICAN STANDARDS

ASTM A 53/A53M-02	Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless
ASTM A 135-01	Standard specification for electric-resistance-welded steel pipe
ASTM A 312-02	Specification for seamless and welded austenitic stainless steel pipes
ASTM A 403-02	Specification for wrought austenitic stainless steel piping fittings
ASTM A 795-00	Specification for black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for fire protection use
ASTM D 1998-97	Standard specification for polyethylene upright storage tanks
ASTM F 438-02	Specification for socket-type chlorinated poly (vinyl chloride) (CPVC) plastic pipe fittings, Schedule 40
ASTM F 439-02	Specification for socket-type chlorinated poly (vinyl chloride) (CPVC) plastic pipe fittings, Schedule 80
ASTM F 442-99	Specification for chlorinated poly (vinyl chloride) (CPVC) plastic pipe, (SDR-PR)

AUSTRALIAN STANDARDS

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 4118:- - - -	Fire sprinkler systems
Part 2.1:1995	Piping – General
AS 4441(Int):2003	Oriented PVC (PVC-O) pipes for pressure applications

BRITISH STANDARDS

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 EN ISO 9906: 2000	Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1 and 2
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

OTHER PUBLICATIONS

Building Industry Authority	New Zealand Building Code Handbook and Approved Documents
NFPA 13 – 2002	Installation of sprinkler systems
NFPA 22 – 1998	Water tanks for private fire protection

NEW ZEALAND LEGISLATION

Building Regulations 1992
Electricity Act 1992
Electricity Regulations 1997
Fire Safety and Evacuation of Building Regulations 1992
Fire Service Act 1975
Hazardous Substances and New Organisms Act (HSNO) 1996
New Zealand Building Code 1992
Resource Management Act 1991

LATEST REVISIONS

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards approved as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual Standards New Zealand *Catalogue* which is supplemented by lists contained in the monthly magazine *Standards Update* issued free of charge to committee and subscribing members of Standards New Zealand.

FOREWORD

NZS 4515:1995 has been divided into two Standards, NZS 4515:2003, which covers residential occupancies and NZS 4517:2002 for domestic occupancies. NZS 4515:2003 supersedes NZS 4515:1995.

This version of the Standard incorporates a number of technical changes from the requirements of NZS 4515:1995. Furthermore, it has been reformatted to separate the technical from the administrative requirements.

This Standard applies to buildings used solely as a residence. It 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 1995 version, at less than 500 m^2. The number of storeys has been increased from 2 to 3.

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 4541:2003 *Automatic fire sprinkler systems*.

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 upon 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 due to achieving early control of the fire. Practical experience in New Zealand and the North American experience confirms this. The overall improvement in life safety is further enhanced by the addition of smoke alarms and the preparation of effective evacuation procedures.

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 6020.

NEW ZEALAND STANDARD

FIRE SPRINKLER SYSTEMS FOR RESIDENTIAL OCCUPANCIES

1 GENERAL

1.1 Scope

1.1.1
This Standard specifies minimum requirements for the design, material, fabrication and installation of fire sprinkler systems for residential 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 residential occupancy.

1.1.2
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. It 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 fire fighting response will arrive at the building.

1.1.3 *Building limits*

1.1.3.1
Residential occupancies include a care institution, hostel, boarding house, apartment building, motel, retirement home, rest home, supported accommodation house and hospital ward areas (see 1.4). These buildings may be protected in accordance with this Standard, if:

(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 – A domestic occupancy would normally be protected to the requirements given in NZS 4517; if a higher level of protection is required then NZS 4515 can be used.

1.1.3.2
If the sprinkler system has a water supply which can provide at least a 60-minute flow at the 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 above limits 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.

1.1.4
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 residential fire 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 minimize fire and smoke damage to property.

1.3 Interpretation

1.3.1
For the purposes of this Standard the word “shall” refers to practices which are mandatory for compliance with the Standard. The word “should” refers to practices which are advised or recommended.

1.3.2
This Standard contains 'normative' appendices which form an integral part of the Standard. For reasons of convenience, the appendices are placed after the body of the text of this Standard.

1.4 Definitions

1.4.1
For the purposes of this Standard, the following terms and definitions shall apply:

APPROVED. Approved by the sprinkler system certifier (SSC) unless specified otherwise in this Standard.

DOMESTIC OCCUPANCY. A domestic occupancy is the home of not more than one household and includes any attached self-contained unit (e.g. granny flat). Multiple adjoining occupancies are considered to be included provided they are separated by fire rated walls (e.g. townhouses).

DRENCHER. A sprinkler purpose designed to wet the external face of a building or window.

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 (e.g. 60/60/30). Fire resistance rating is sometimes referred to as fire resistance level (FRL).

FIRE SEPARATION. The separation of parts of a building by a fire-resistant construction.

LISTED. Specific makes and models of equipment, materials, procedures, organizations and facilities required or permitted by this Standard, means that such has been examined by the sprinkler system certifier and found to meet relevant standards and/or has otherwise been demonstrated to be adequate for the intended application.

NOTE – Examples of test and approval bodies are the Insurance Council of NZ (ICNZ), Factory Mutual (FM), Loss Prevention Council (LPC), Scientific Services Laboratory (SSL) and Underwriters Laboratories (UL). ICNZ hold a register of listed equipment, components and materials.

QUICK RESPONSE SPRINKLER. A sprinkler with a high thermal sensitivity and listed as a quick response sprinkler.

RESIDENTIAL OCCUPANCIES. Rooms arranged for the purposes of habitation or co-habitation, other than those defined as a domestic occupancy. These include hospital ward areas, rest homes, care institutions, prisons, police cells, motels, hotels, hostels, residential boarding schools, flats and apartments.

RESIDENTIAL SPRINKLER. A sprinkler designed and listed as a residential sprinkler for the protection of residences.

NOTE – A sprinkler listed as quick response but not as a residential sprinkler is not acceptable for use as a residential sprinkler.

RESPONSE TIME INDEX (RTI). A measure of sprinkler sensitivity expressed as:

$$RTI = \tau u^{0.5} \ (m.s)^{1/2}$$

where

τ is the time constant of the heat responsive element in seconds, and

u is the gas velocity in metres per second.

NOTE – RTI can be used in combination with the conductivity factor to predict the response of a sprinkler in fire environments defined in terms of gas temperature and velocity versus time.

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 INSTALLATION. That part of the system downstream from, and including, the main stop valve.

SPRINKLER SYSTEM. A system including:

(a) A sprinkler system water supply pipes from the boundary of the protected premises to the sprinkler valves;

(b) A sprinkler system static water supply on the protected premises;

(c) A sprinkler system pumping unit providing water;

(d) Control valves and all fittings;

(e) The main stop valve anti-interference devices;

(f) Any fire alarm signalling device;

(g) Pipework, sprinklers and fittings downstream of the control valves;

(h) Any fire rated wall, door or partition required by this Standard.

SPRINKLER SYSTEM CERTIFIER (SSC). Responsible for certification of the sprinkler system including, but not limited to:

(a) Auditing design;

(b) Auditing installation;

(c) Auditing commissioning;

(d) Approving contractors;

(e) Approving listed components;

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

(g) Maintaining records;

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

NOTE – The Insurance Council of New Zealand currently fulfils the role as the SSC. Equivalent organizations may be used if they have been independently accredited by an internationally recognized accreditation body to AS/NZS ISO/IEC 17020 as competent to certify to NZS 4515.

STANDARD RESPONSE SPRINKLER. A sprinkler head listed as a standard response sprinkler head.

1.5 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 A, B, C and D. Requirements for listing are given in Appendix E.

1.6 Listing of sprinkler contractors

In order for a sprinkler system to comply with this Standard, it shall be installed by a contractor evaluated and listed by the SSC in accordance with Appendices F and G.

1.7 Seismic resistance

1.7.1

All units of a sprinkler system shall be designed and supported to resist without damage or impairment of function, earthquake loadings specified in NZS 4203. 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.

1.8 Welding

1.8.1 *Qualification of welders*

Welding shall be performed by certified welders holding current certification in terms of NZS 4711 for the type of welding employed.

1.9 Status of systems designed to superseded Standards

1.9.1 *NZS 4515:1990*

An existing sprinkler system which, to the satisfaction of the sprinkler system certifier, can be demonstrated as complying with NZS 4515:1990 shall be deemed to comply with NZS 4515:2003.

1.9.2 *NZS 4515:1995*

An existing sprinkler system which, to the satisfaction of the sprinkler system certifier, can be demonstrated as complying with NZS 4515:1995 shall be deemed to comply with NZS 4515:2003.

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 electric 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 unauthorized 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 (i.e. an exposure) and which:

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

(b) Is within 10 m of the protected building where the exposure hazard is an industrial, commercial or residential building or an accumulation of combustibles (e.g. 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 sprinkler system certifier considers it unlikely that fire could enter or ignite the protected building.

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 without any openings on the protected building;

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

(c) By 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.

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 with 4.3. Where conditions are prone to freezing, external sprinklers shall be supplied by pipes filled with anti-freeze in accordance with 2.2.3 to 2.2.7. To determine the number of external sprinkler heads which, for the purpose of water supply calculation are deemed to operate simultaneously, see 5.1.1.

2.2 Types of system

2.2.1
Systems shall be of the wet pipe or anti-freeze type. Dry pipe and other types of systems shall not be permitted.

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 sprinkler system certifier are not prone to freezing.

2.2.3
An anti-freeze 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 anti-freeze solution complying with table 2.1. No other anti-freeze 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) The anti-freeze design temperature must be 10 ºC lower than the expected lowest external temperature.

(2) Thoroughly premix anti-freeze mixtures before putting them into the sprinkler system pipework.

(3) For additional design guides on anti-freeze systems refer to NFPA 13 chapter 4, section 5 Anti-freeze systems.

Table 2.1 – Anti-freeze solutions

Material	Solution (by volume)	Freezing point (ºC)	DENSITY			
			5 ºC	10 ºC	15 ºC	20 ºC
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 anti-freeze mixture is critical when measuring the density and shall be ±1 ºC.

(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
Where the entire installation is filled with anti-freeze solution, the installation shall comply with the requirements of figure 2.1.

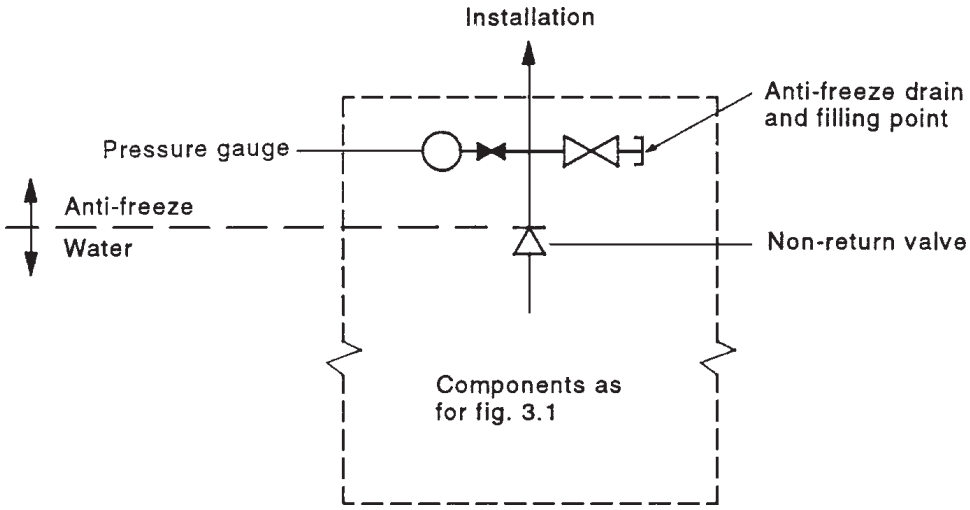
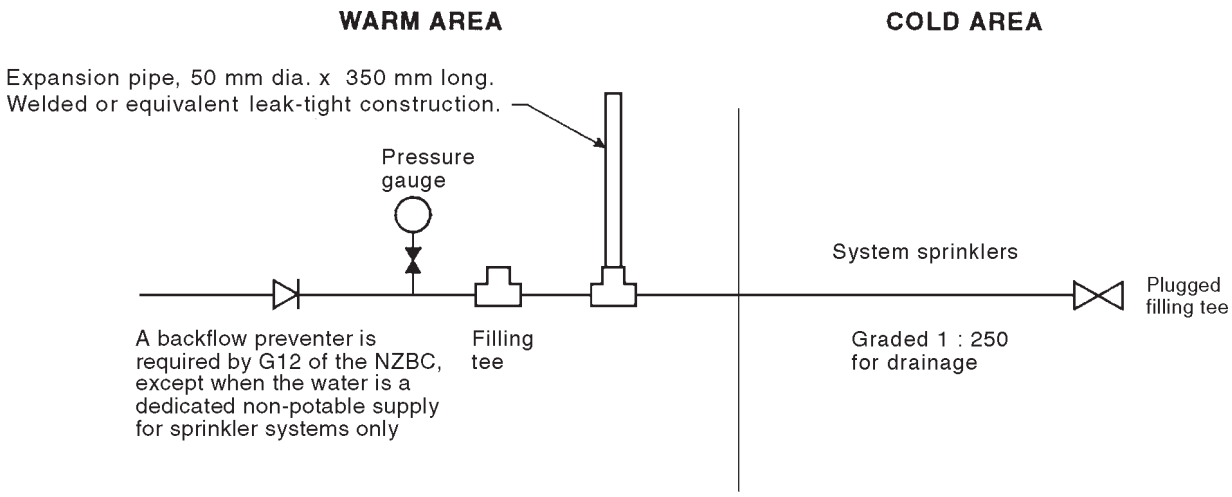


Figure 2.1 – Required components for anti-freeze installation control valves

2.2.5
Sections of wet pipe systems serving up to 12 sprinkler heads may be protected from freezing by means of tail-end anti-freeze systems which shall be in the form shown in figure 2.2.



NOTE – Dimensions are typical for small systems of up to 12 sprinkler heads. A larger system may require a larger volume expansion pipe.

Figure 2.2 – Small tail-end anti-freeze systems

2.2.6
The anti-freeze solution shall have a freezing point at least 10 ºC below the minimum expected temperature. The density of the solution shall be determined by a hydrometer of suitable scale with the solution at 15 ºC. A suitable hydrometer shall be provided at the installation control valves.

2.2.7
Pipes filled with anti-freeze shall be sloped to drain, so as to discharge into an anti-freeze reservoir. This reservoir shall be of materials compatible with the anti-freeze solution and be at least 125 % of the capacity of installation pipework. Roof space sprinklers and external sprinklers on pipes filled with anti-freeze shall be installed upright.

2.3 Materials with a high spread of flame index

2.3.1
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 Approved 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

3.1 Maximum operating pressure

3.1.1
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 above 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-pressurization 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 anti-freeze) located at the control valves piped to an appropriate place;

(b) A gas over water hydraulic accumulator sized and fitted as per NFPA 13, clause 4.5.3.2.

3.2 Sprinkler heads

3.2.1
Sprinkler heads shall be listed makes or models. The following types of sprinkler head 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
Roof spaces, ceiling spaces, skylights, underfloor spaces, high temperature environments (e.g. cooking hoods) and dry sprinklers in freezers	Standard or special response, non-residential, conventional or spray pattern 10 mm or 15 mm
Laundries, commercial kitchens, surgical areas, basements, vehicle garages and non-residential storage areas	Quick response conventional or quick response spray pattern 10 mm or 15 mm
Rooms, if allowed by 3.2.2	Quick response spray pattern 10 mm or 15 mm
External protection	Drencher

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

and unless otherwise noted in the listing:

6 mm drencher .....2.5 ± 0.2 L/min (kPa) $^{0.5}$
10 mm drencher .....4.6 ± 0.2.L/min (kPa) $^{0.5}$.

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, when:

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

(b) The sprinklers are located as close as possible to the ceiling and the thermal element positioned no greater than 150 mm below the ceiling; or

(c) 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 head listing criteria. It is recognized that use of quick response spray heads may not necessarily provide life safety characteristics equivalent to residential heads. The requirements for use of these heads is therefore intentionally restrictive.

3.2.3
Quick response pendant or sidewall sprinkler heads which are resistant to tampering and commonly known as ‘institutional heads’ 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 head, i.e. either upright, pendant or horizontal.

3.2.5
The temperature rating of sprinkler heads shall be at least 30 ºC 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 ºC or higher shall be used. Such heads 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 sprinkler heads 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 head guards

Any sprinkler head 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 sprinkler heads.

3.4 Stock of replacement sprinkler heads

Two spare sprinkler heads 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 head or one of the same design criteria shall be used.

NOTE –

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

(2) Sprinkler heads are not interchangeable with heads of different performance characteristics.

3.5 Pipework

3.5.1

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

Table 3.2 – Pipe jointing options

Upstream of installation non-return valve	
Pipe	**Jointing options**
Unplasticized polyvinyl chloride (UPVC) to AS/NZS 1477, modified polyvinyl chloride (MPVC) to AS/NZS 4765 or oriented polyvinyl chloride (OPVC) to AS 4441 (buried pipe only)	Proprietary jointing methods
Galvanized steel to: BS 1387 or AS 1074 Heavy and medium ASTM Schedules 20, 30 & 40	Gibault, flanged, screwed, or mechanical coupling (medium weight roll grooved only)
Concrete lined steel to NZS 4442	Gibault, or flanged
Copper to NZS 3501	Brazed joint or capillary soldered fitting
Polyethylene or polybutylene (buried pipe only) to AS/NZS 4130, AS/NZS 4131, AS/NZS 2566.2	Butt fusion, socket fusion, electrofusion jointing, or by using mechanical compression fittings
Downstream of installation non-return valve	
Pipe	**Jointing options**
Mild steel to: BS 1387 or AS 1074 Light ASTM Schedule 10 BS 1387 or AS 1074 Medium BS 1387 or AS 1074 Heavy ASTM Schedules 20, 30 & 40	 Flanged, mechanical coupling (roll grooved only) Screwed, flanged, mechanical coupling (roll grooved only) 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 soldered fitting
Unplasticized polyvinyl chloride (UPVC) to AS/NZS 1477, modified polyvinyl chloride (MPVC) to AS/NZS 4765 or oriented polyvinyl chloride (OPVC) to AS 4441 (buried pipe only)	Subject to the limitations of 3.5.2.2
Chlorinated polyvinyl chloride (CPVC) to ASTM F442 with SDR of 13.5.	Solvent cement with CPVC fittings to ASTM F 438 or F 439 Subject to the limitations of 3.5.2.1
Stainless steel to ASTM A 312 Schedules 10, 40 and 80 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 of 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 (CPVC) pipe and fittings*
Chlorinated PVC 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 pressurization of the system does not exceed 6 h at 15.5 ºC; or

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

Sprinkler heads shall not be fitted to CPVC pipework before the jointing cement has cured, to avoid rundown of cement into the sprinkler.

3.5.2.2 *Unplasticized polyvinyl chloride (UPVC) pipework*
UPVC pipework may be used downstream of the installation valve only when completely buried underground, and the depth of cover and installation complies with NZS 7643, and subject to the following limitations:

(a) The pipework is laid by the open trench method, with granular bedding and surround fill to Type D of Appendix D of NZS 7643, and no part is encased in concrete;

(b) UPVC to UPVC joints shall be solvent welded or use elastomeric seals;

(c) UPVC to metal joints shall be either:

  (i) Threaded, using solvent welded moulded thread adaptors with the UPVC being the male thread; or

  (ii) Flanged using solvent welded 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 NZS 7643 for soil temperatures above 20 ºC (e.g. 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 covering shall be such as to maintain the load on the pipe within safe tolerances. All steel pipe and fittings upstream of alarm valves shall be galvanized or concrete lined

internally and where installed underground provided with an exterior protective coating to the territorial authority requirements.

3.5.4 *Pipe fitting involving hot work*
Gas cutting, welding, grinding, brazing, soft and hard soldering, and the fusion welding of plastics pipework 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 a watchman 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.

3.5.5 *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.

3.5.6 *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 1992 and Regulations 1997.

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

3.5.7 *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.

3.5.8 *Pipe supports*

3.5.8.1
Fixings shall be heat and corrosion resistant, and installed so that they will not deflect more than 5 mm when loaded to 5 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.

3.5.8.2
Copper or plastic pipes shall be supported according to the manufacturer's recommendations or the Acceptable Solution G12/AS1 of the Approved 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 head and the last support on a pipe with 2 sprinkler heads or more shall not be more than 900 mm for 25 mm pipe and 1200 mm for 32 mm pipe and larger. Supports are not required on steel pipes cantilevered up to 600 mm.		

Notwithstanding the provisions of 3.5.8.2, the pipework adjacent and attached to the sprinkler head shall be fixed to prevent movement of the sprinkler head when it discharges.

3.5.8.3
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 2 hangers in the vee formation; or

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

For longitudinal bracing see NZS 4219.

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 on figure 3.1. Where fitted with a fire brigade alarm (FBA) the location of the valve shall be agreed with the New Zealand Fire Service. 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.

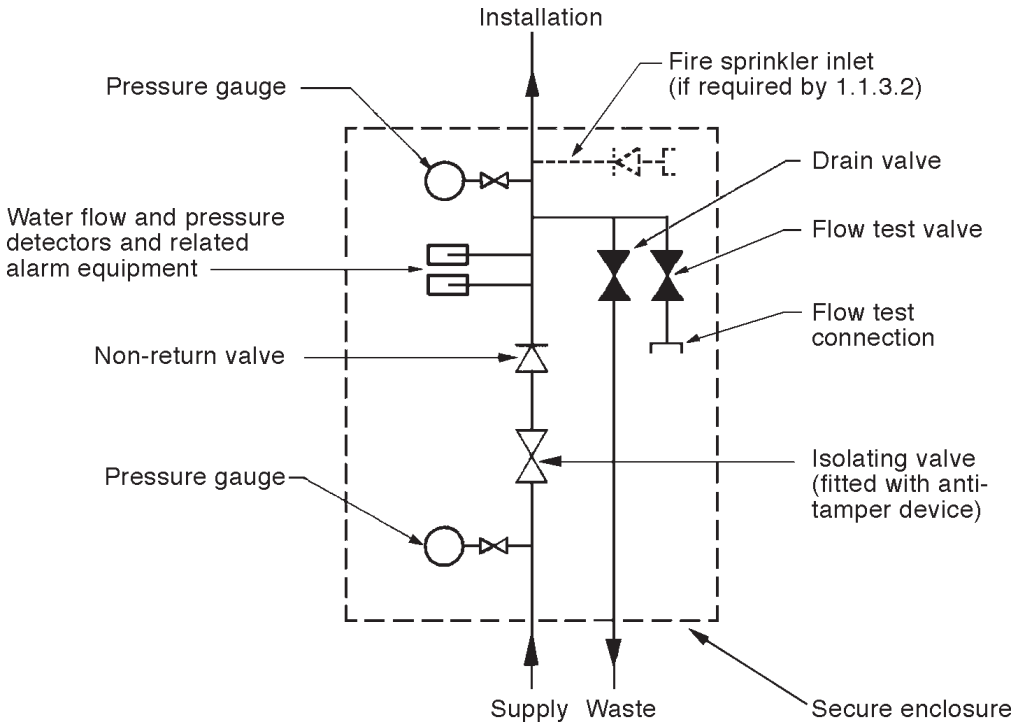


Figure 3.1 – Required components and hydraulic layout of residential occupancy installation control valves

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 4521 for the triangular key type or use a key system agreed with the New Zealand Fire Service.

3.6.3
The isolating valve shall be padlocked open.

3.6.4
The following components shall be listed:

(a) Isolating valves including the anti-tamper features;

(b) Water flow detector;

(c) Low water pressure detector; and

(d) Alarm equipment.

NOTE – Careful selection and fitting of flow switches is essential. The size must be appropriate for the pipe diameter and the flow detector must move freely through its operating arc. (See also 3.6.7.)

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
The flow test connection shall be so positioned, orientated and of a design to permit the direct connection of the standard flow test apparatus as shown in figure 3.2.

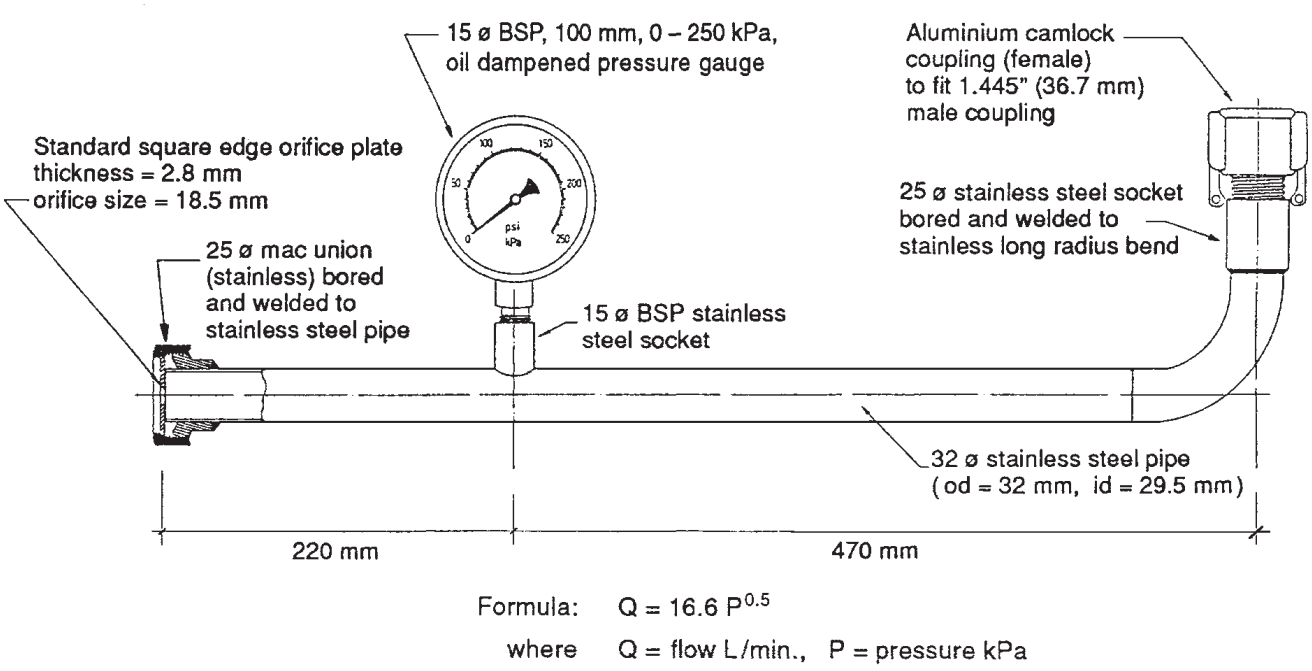


Figure 3.2 – Standard flow test apparatus

NOTE – Suitable for flows up to 250 L/min. For design flows in excess of this value, alternative arrangements shall be made.

3.6.7
When tested, the flow switch shall operate at a flow less than the lowest single head design flow 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 sprinkler heads and spanner suited for each type of head;

(c) Standard instructions;

(d) Anti-freeze 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) Extent of the protected building;

(c) Any sections of anti-freeze filled pipework and drops;

(d) Design flow and design pressure;

(e) Water supply route including all valving;

(f) Location of any pressure sustaining or pressure reducing valves; and

(g) Water supply characteristics graph.

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 with respect to the fully open drain valve;

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

(d) A circuit diagram of the alarm system; and

(e) Data concerning any anti-freeze 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.

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
The power source shall not be directly dependent upon the mains supply. 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 independently isolate the "sprinkler operating" and evacuation alarms, to individually test each sensor and to test the state of the batteries.

3.8.1.3
The isolation of either the sprinkler operating or evacuation alarm shall be arranged to cause at least one of the following conditions:

(a) The cabinet door cannot be closed;

(b) Closure of the cabinet door resets the alarm;

(c) Closure of the cabinet door operates the "sprinkler operating" alarm if the alarm is not reset; or

(d) If the system is brigade connected, and the isolate switch is key operated, a defect signal is sent when the alarm is restored.

3.8.1.4
Acceptable circuit diagrams to achieve 3.8.1.1, 3.8.1.2 and 3.8.1.3 in a manner complying with the following clauses are provided as in figures 3.3 and 3.4.

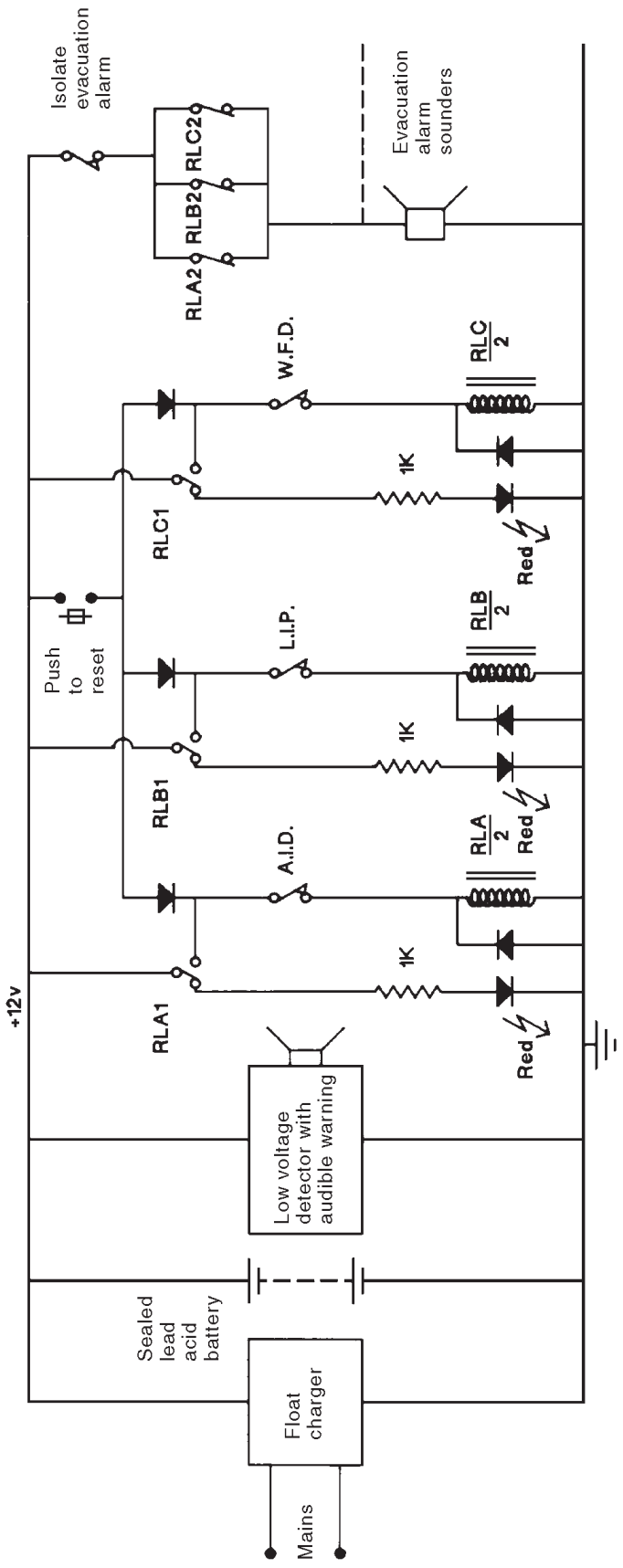


Figure 3.3 – Typical arrangements for connecting a sprinkler alarm using dedicated alarm arrangements

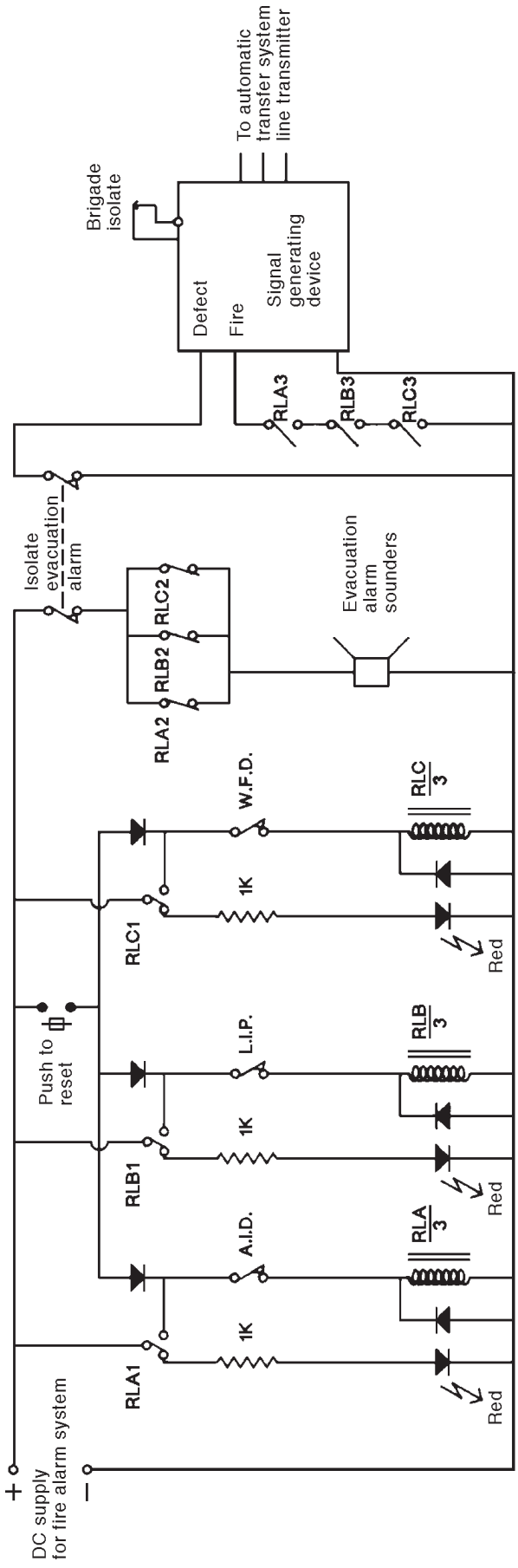


Figure 3.4 – Typical arrangements for connecting a sprinkler alarm utilizing a building's manual fire alarm

3.8.2 *Sprinkler operating alarm*

3.8.2.1 *Location*
The sprinkler operating alarm shall be located on the exterior of the protected building, adjacent to, or inside the control valve cabinet. The sounder shall be labelled "Sprinkler Alarm". If the alarm is on the inside of the control valve cabinet, the cabinet shall be labelled "Fire sprinkler alarm inside".

3.8.2.2 *Power source*
The power source for the sprinkler operating alarm shall be either a source exclusive to the sprinkler system or the power supply of a fire alarm system installed within the protected building which complies with NZS 4512. If an exclusive power source is used, it shall be either:

(a) A sealed lead or acid battery and charger incorporating a low battery capacity alarm audible within the building and triggered if the voltage is less than 2.03 V per cell; or

(b) Dry cell batteries of 1 h capacity for the connected alarm load. A built-in ammeter with red and green scale shading and push-to-test switch shall be provided to indicate when the battery capacity has decreased to the point at which it can no longer operate the alarms for 20 min and needs to be replaced.

The power source shall be in a dry, secure location with the component parts affixed to resist seismic movement. If a fire alarm power source is used, it shall be wired in such a way that the sprinkler operating alarm circuit cannot be isolated in the manual fire alarm panel.

If the sprinkler system operating alarm is powered from the fire alarm system, a warning label to that effect shall be located in, or on, the fire alarm panel.

3.8.2.3 *Evacuation alarm*
The evacuation alarm shall be audible throughout the protected building. In health care facilities where it is considered undesirable to sound a generally audible alarm, alternative arrangements to alert staff are acceptable provided these are distinctive and cover the entire building. The evacuation alarm may be any of the following:

(a) The "sprinkler operating" alarm but incorporating additional sounders; or

(b) A fire alarm complying with NZS 4512 provided that a distinctive, labelled isolating device is incorporated into the sprinkler control valve cabinet. This device shall not cause the general isolation of the fire alarm system.

NOTE – For systems installed before November 1994, a type C manual fire alarm complying with NZS 4561:1973 *Manual fire alarm systems for use in buildings* (whether connected to the Fire Service or not) may be used subject to the same conditions as for alarms complying with NZS 4512.

3.9 Fire brigade alarm

3.9.1
In residences housing persons 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 with respect to limitations in relation to systems where there is no fire brigade alarm.

NOTE – A direct connection may be required under the NZBC or Fire Safety and Evacuation of Buildings Regulations 1992.

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 (e.g. a manual fire alarm system);

(c) By use of a manual fire alarm system or automatic fire detector alarm system installed within the protected building – without the use of a common modulator or multiple connection unit, provided that, in all cases:

(i) It is possible, within the sprinkler control valve cabinet, to isolate the alarm activation inputs from the signalling device by means of a labelled switch, so positioned that it cannot be left in the isolated position when the cabinet door is closed

(ii) Where transmission of the sprinkler fire brigade alarm is associated with any other alarm system, each system is capable of independent isolation without disabling the alarm transmission capability of the other 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.

3.10.2
Pressure reducing valves shall be listed and of a diaphragm type, 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.

3.10.3
A listed pressure relief valve shall be fitted immediately downstream of any water supply pressure reducing valve, and set to relieve any supply pressure that may leak up to within 100 kPa of the maximum working pressure of the lowest pressure rated component of the system. The drain from this relief valve shall be positioned such that its operation may be readily observed. A 15 mm pipe and normally closed stop cock shall be fitted to by-pass 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.

4 LOCATION OF SPRINKLERS

4.1 Rooms excluding basements, vehicle garages and storage areas

4.1.1
Sprinklers shall be of the residential sprinkler type and located strictly in accordance with the manufacturer's listing instructions for the particular type of head 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.

4.1.2
The following cupboards or wardrobes shall be protected:

(a) Cupboards inside the building housing electrical switchboards;

(b) Cleaners' cupboards;

(c) Cupboards and wardrobes which exceed 2 m^3 in volume;

(d) Wardrobes and/or cupboards at ceiling height in bedrooms which are not vented into the sprinklered area by a clear opening of at least 0.02 m^2 in the top of the door;

(e) Full height cupboards and/or wardrobes less than 2 m^3 in volume which do not have an FRR -/15/15 on their ceiling; and

(f) Understair cupboards.

4.1.3
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
Beams, light fittings, shaped ceilings or other features may adversely affect the distribution of water from the sprinkler. To counter this, additional sprinkler heads may be used to achieve proper sprinkler system coverage.

NOTE – Information provided in the manufacturer's data sheet and installation guidelines will provide guidance as to the application of this clause.

4.1.5
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 2 sprinklers operating unless otherwise required by the sprinkler system certifier.

4.2 Roof, ceiling and underfloor spaces

Sprinklers in ceiling, roof 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
External sprinklers shall be listed standard response sprinklers within the range 68 ºC to 93 ºC (according to ambient conditions) 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 2 levels of external sprinklers are required, protective hoods shall be installed over the lower heads.

4.3.2
External sprinklers shall be spaced to conform to the listing for the particular head.

4.4 Basements, vehicle garages and storage areas

4.4.1
Sprinklers in basements, vehicle garages and storage areas shall be either 10 mm or 15 mm quick response non-residential type as required by 3.2.1 and located as required by 4.5.

NOTE – The above special requirements relate to the typically non-residential nature of the fire load and occupancy of such rooms.

4.4.2
The requirements of 4.1.4 shall apply to any ceiling obstruction.

4.5 Non-residential sprinklers

4.5.1
Non-residential sprinklers shall be located as follows in table 4.1.

Table 4.1 – Maximum distance and coverage of non-residential sprinklers

Sprinkler head	**Maximum distance between sprinkler heads** (m)	**Maximum area of coverage** (m^2)	**Minimum orifice pressure** (kPa)
10 mm spray pattern	4.6	21	100
10 mm spray pattern	4.0	16	70
15 mm spray pattern	4.6	21	50
15 mm conventional pattern	4.0	16	50

4.5.2
Sprinklers shall not be closer to one another than 2 m if the discharge from one could wet the adjacent sprinkler.

4.5.3
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, 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 2 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 above.

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*
Where sprinkler deflectors 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 4.2, and figure 4.1), with regard to 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. Special requirements apply in relation to residential sprinklers – refer to the manufacturer's data sheet.

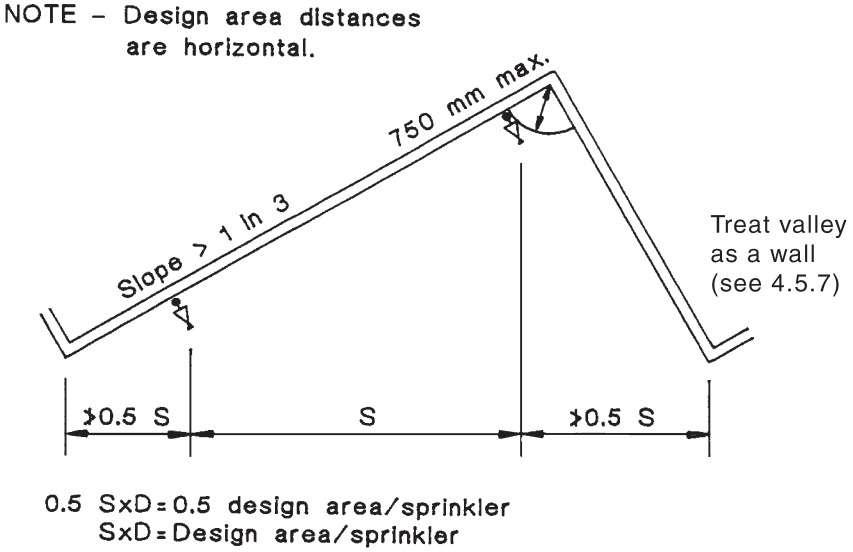
NOTE – Attention is drawn to the need to comply with 4.5.4.

Table 4.2 – Non-residential sprinkler distances from obstruction

Minimum horizontal distance from sprinkler to side of obstruction	Maximum height of sprinkler deflector above bottom of obstruction	
	Conventional sprinklers installed upright	Spray sprinklers (upright and pendant types) and conventional sprinklers installed pendant
(mm)	(mm)	(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
Under sloping ceilings or roofs the spacing measurements shall be taken horizontally.

4.5.7
On sloping ceilings where both the slopes are steeper than 1 in 3, a line of sprinkler heads shall be fixed at the apex unless there is a row of sprinkler heads not more than 750 mm distant radially therefrom. The valley at the intersect of the projection of such roof slopes shall be the line of a wall for the purpose of 4.5.3 (refer to figure 4.1). A sloping ceiling steeper than 1 in 3 intersecting a wall shall be treated in an identical manner.



where
S = Design spacing of sprinklers on range pipes
D = Distance between adjacent rows of sprinklers

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 table 5.1 and 5.1.1 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.

Table 5.1 – Water supply design flow and design pressure

Areas where residential sprinklers are used (rooms other than basements and vehicle garages)	
No. of sprinklers	**Basis of calculation**
1	1 sprinkler operating at the listing pressure
2	2 sprinklers operating at the listing pressure
3	3 sprinklers operating at the listing pressure
More than 3	3 sprinklers operating at 110 % of the listing pressure
NOTE – The basis for system demand calculation is according to the number of residential sprinklers in the room.	
Areas where non-residential sprinklers are used	
No. of sprinklers	**Basis of calculation**
1	1 sprinkler at the minimum pressure required by 4.5.1
2	2 sprinklers at the minimum pressure required by 4.5.1
More than 2	3 sprinklers at the minimum pressure required by 4.5.1
NOTE – The basis for system demand calculation is according to the number of sprinklers in the room. For roofs, ceilings and under floor spaces (not used for storage), where more than 1 sprinkler is present, the basis for calculation is 2 sprinklers operating at the minimum pressure required by 4.5.1.	

5.1.1 *External sprinklers*

The basis for system demand calculation shall be the number of standard response sprinklers (the design number) which the sprinkler system certifier determines could operate simultaneously if the exposure was fully involved in fire. Calculation shall be based on the following minimum operating pressures for each sprinkler presumed to be operating simultaneously:

10 mm sprinkler ..... 70 kPa
15 mm sprinkler ..... 50 kPa
drencher ..... listing pressure.

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 door does not fulfil these criteria, the spaces on either side of the door are 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 table 5.1 and 5.1.1 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 respective to 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 General

6.1.1
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 Approved Document for the NZBC Clause G12.

6.1.2
Only those sources of supply specified below may be used as a water supply:

(a) A connection to a reliable, approved town or city reticulated water supply (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 except that the pump may be driven by an electric motor complying with the requirements of 6.5.6 in the following case:

(i) A licensed rest home in which the source of water is a reticulated water supply which, due to daily fluctuations in pressure (as determined using method 2 of Appendix H), is unable to provide 118 % of the design pressure over the period 7 am to 8 pm but is able to provide 100 % of the design pressure over that period.

NOTE –
(1) Attention is drawn to the lower reliability of mains energy supply for electric motor driven pump units.

(2) In respect of 6.1.2(c)(i) it is emphasized that where the water supply cannot provide 133 % using method 1, or 118 % using method 2 of Appendix H, respectively outside 7 am to 8 pm or 100 % within that period, a diesel engine driven pump unit must be used.

(3) The relaxation permitted in item 6.1.2(c)(i) acknowledges the unique nature of licensed rest homes.

6.1.3
Every water source shall be able to maintain the design flow at the design pressure for at least 20 min and shall be able, by practicable means, to be replenished within 6 h.

6.1.4
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
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 NB;

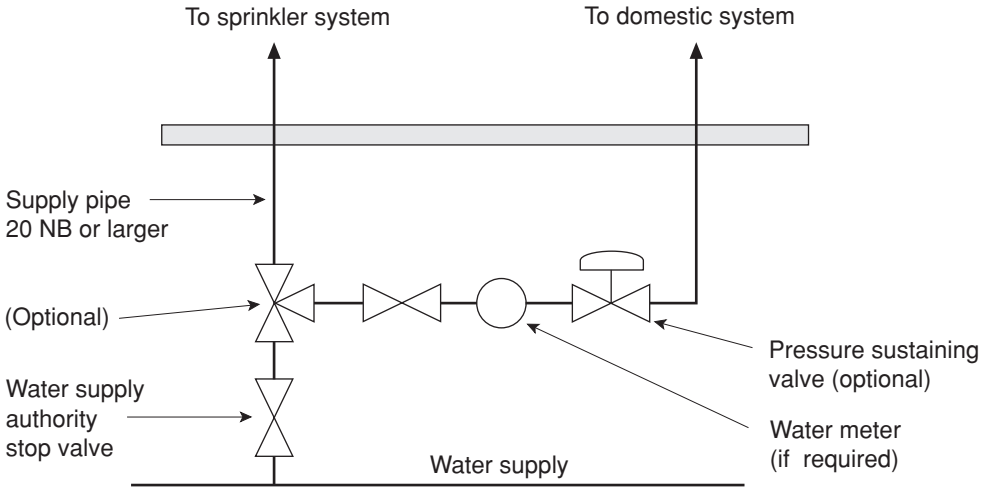
(c) The point of connection to the domestic supply is downstream of any valve which, if closed, will interrupt the supply of water to the protected building, and upstream of the water meter;

(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”;

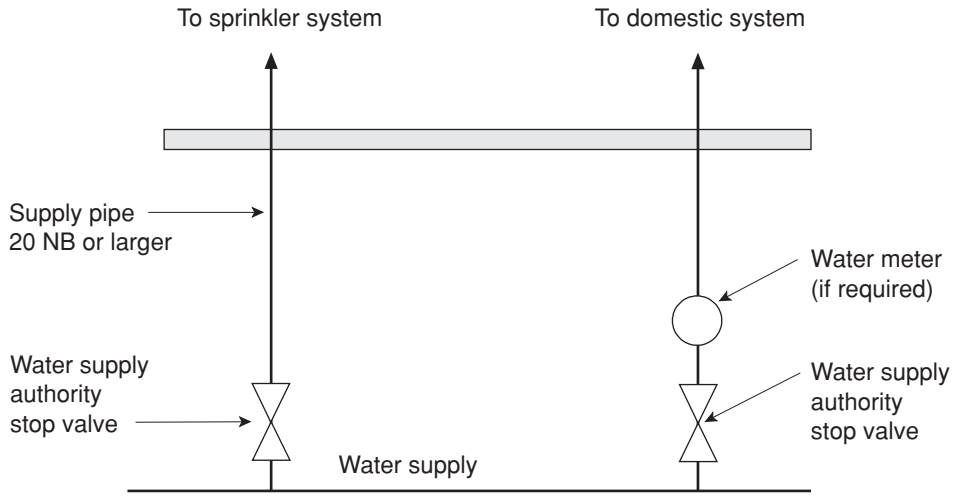
(e) Either (i) or (ii):

(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 residential occupancies. In all situations with exceptional demands (e.g. lawn sprinklers) such demands need to be added to the design flow to ascertain the design flow and pressure, or

(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 shutoff of the domestic water supply so as to maintain the design pressure required for the sprinkler system (see figure 6.1).



(a) Acceptable arrangement with SSC approval



(b) Preferred arrangement

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

Figure 6.1 – Acceptable reticulated water supply arrangements

Table 6.1 – Fixture load values

Private facilities (within individual dwelling units)	Unit	Public facilities	Unit
Bathroom group with flush tank (including washbasin, water closet, and bath with shower)	6	Bath	4
Bathroom group with flush valve	8	Drinking fountain	0
Bath	2	Kitchen sink	4
Dishwasher	1	Washbasin	2
Kitchen sink	2	Service sink	3
Laundry trays	3	Shower head	4
Washbasin	1	Urinal with 25 mm flush valve	10
Shower	2	Urinal with 6 mm flush valve	5
Washing machine	2	Urinal with flush tank	3
Water closet with flush valve	6	Washing machine (8 lb) (3.6 kg)	3
Water closet with flush tank	3	Washing machine (16 lb) (7.3 kg)	4
Hose reel	1	Water closet with flush valve	10
Garden hose	1	Water closet with flush tank	5
		Hose reel	1
		Garden hose	1

Table 6.2 – Total estimated domestic demand

Total fixture load units (from table 6.1)	For systems with predominantly flush tanks (L/min)	For systems with predominantly flush valves (L/min)
1	1	–
2	19	–
5	38	57
10	57	95
20	76	133
35	95	171
50	114	190
70	133	228
100	171	266
150	209	304
200	247	342
250	285	380
350	380	475
500	475	570
750	665	665
1000	760	760

6.2.2
The reticulated water supply shall be part of a system under the control of the territorial authority and which has been approved by the sprinkler system certifier 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 h weekday period;

(c) Has not more than 50 % of its water supply solely dependent upon electric motor driven pumps; and

(d) Is free from critical elements that are seismically vulnerable.

NOTE – In considering 6.2.2(d), the sprinkler system certifier may rely on advice from the Institute of Geological and Nuclear Sciences concerning the seismic hazard of the town's location and may also make due allowance for any improvements to seismic resistance which are planned for implementation over the coming 5 year period.

6.2.3
For design purposes, the flow and pressure characteristics of a reticulated water supply shall be determined by method 1 or method 2 of Appendix H. The sprinkler system certifier may require the use of method 2.

Where the pipe, to which is connected the supply to the protected premises, is not fitted with hydrants (as may be the case with domestic rider or subsidiary mains) then:

(a) Method 1 shall be used to evaluate the main supplying the rider main but only 60 % of the available

pressure may be presumed to be available for supply and the friction loss for the total water demand (6.2.1(e)(ii)) calculated from the point of test to the control valves;

(b) Method 1 shall be used to evaluate the main at the time of greatest domestic demand in the rider main (as established by investigation that satisfies the sprinkler system certifier as to its accuracy). In this case, 70 % of the available pressure may be presumed to be available for supply with friction losses calculated as in 6.2.3 (a); or

(c) Either method 1 or method 2 may be used in the normal manner if suitably sited test connection(s) are available (in lieu of a hydrant) on the rider main so that the characteristics of the rider main at the time of greatest demand and at the point of connection to the protected premises can be determined.

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

Additionally, installed reticulated water supplies shall provide at least 125 % of the required design pressure for each design flow, when tested through the alarm valve. This requirement may be reduced to 115 % of the required design pressure if the water supply is satisfactorily assessed in accordance with method 2.

6.2.4
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.

In such cases, the contractor may obtain an early ruling regarding the need for a strainer, by the submission of appropriate information to, or by facilitating demonstrative tests for, the sprinkler system certifier.

Ordinarily, it will not be necessary to require a strainer if the reticulated water supply is 100 mm NB 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

(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”.

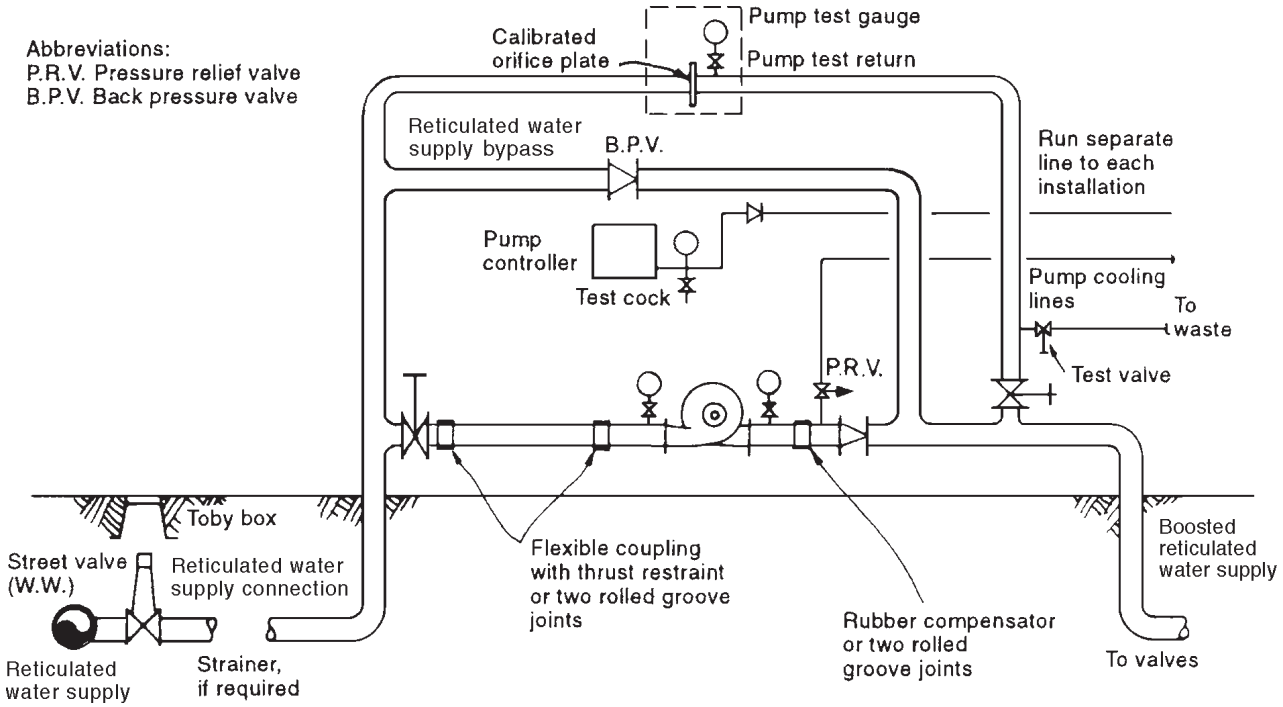
In calculating the sprinkler demand (see 5.1), a flow of 14 L/min shall be added to the design flow in those pipes common to both systems. This flow is based upon the requirements of AS/NZS 1221. If hose reels manufactured to another Standard are being used, then the flow appropriate to those hose reels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

With the agreement of the territorial 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 or, to the extent permitted by 6.1.2 (c) an automatic starting electric pump may, with the agreement of the territorial authority, 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 Approved 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 H) 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. This figure is not subject to derating in terms of Appendix H.

6.2.8.4 *By-pass*
A by-pass 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 and a normally closed pump cooling drain, arranged as shown in figure 6.2. An orifice plate, sized to induce at least 100 % of the design flow, shall be fitted in the pump test return.

6.3 Storage tank capacity and refilling

6.3.1 *Storage tank capacity*

6.3.1.1
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 1.1.3.1(a) or (b) are exceeded as permitted by 1.1.3.

6.3.1.2
The 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.

6.3.1.3
Where the design number of external sprinklers create a flow requirement in excess of that specified in table 5.1, 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 5.1.1) 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 by either:

(a) A float operated valve or other suitable device controlling a 15 mm NB pipe connected to a reticulated water supply or other continuous water supply;

(b) 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, a continuous overflow controlled supply from rainwater or other less reliable source.

6.3.2.3 *Refilling*
Refilling may be provided by:

(a) A connection to a reticulated water supply, provided that this will not deplete a reticulated water supply to the system in the event of the system operating, or from some other reliable source of water; or

(b) With approval, a reticulated water supply which is unable to meet the maximum refilling time, or a less reliable source of water (such as rainwater). In such cases, the amount of storage specified shall be increased by 33 % and shall be kept in more than one tank. Such tanks shall be interconnected with valves so that not more than one tank at a time need be emptied.

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;

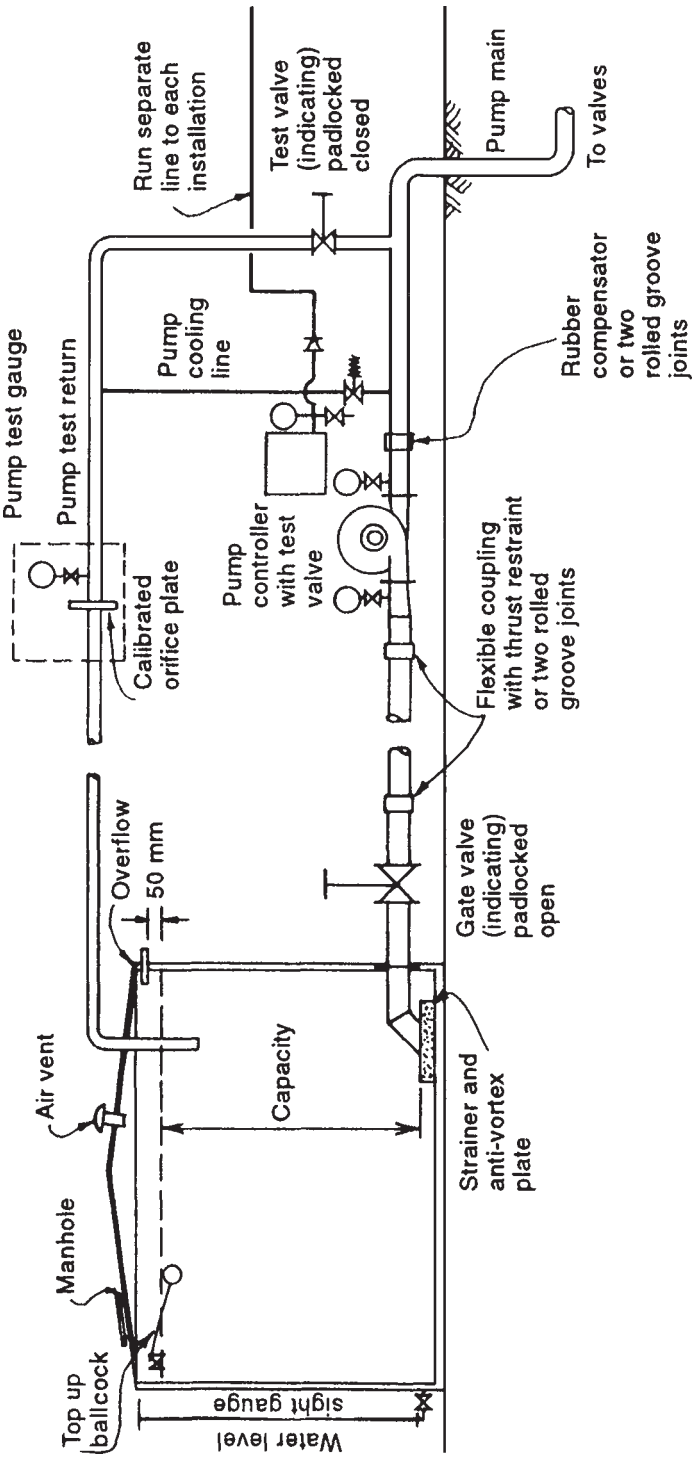
(c) Wells and artesian bores; and

(d) 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*
Refer to 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 Approved Documents for the NZBC Clause G12/AS1.

Figure 6.3 – Typical arrangement for pump and tank supply

6.4.3.1
The following types of tank may be used providing they meet all other requirements of this Standard. Acceptable Standards are stated if applicable.

(a) Roofed concrete tanks (NZS 3106);

(b) Roofed wooden tanks (NFPA 22);

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

(d) Roofed rotary moulded polyethylene tanks (ASTM D1998);

(e) Roofed fibre reinforced plastic tanks;

(f) Swimming pools meeting the appropriate requirements of the territorial authority, 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”

(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 utilize sodium chloride or other corrosive materials

(v) The pool is fitted with a roof if the sprinkler system certifier considers that contamination from leaves etc. creates a contamination problem.

6.4.3.2
The tank capacity and the refill and topping up arrangements shall comply with 6.3.

6.4.3.3
Tanks shall be:

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

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

(c) Meet the requirements of NZS 4219 with respect to seismic design.

6.4.3.4
A safe permanent access facility, secured against unauthorized entry, shall be provided for entry into the tank.

6.4.3.5
The tank shall be fitted with an indicator showing the contents above the level of the vortex plate.

6.4.3.6
A tank overflow pipe of suitable size shall be provided which discharges in an observable place. An air vent of suitable size, including a light trap shall be fitted on roofed tanks.

6.4.3.7
Where conditions may cause the water to freeze, the tank, together with the inlet and suction pipes and level indicator, shall be protected to prevent freezing.

6.4.3.8
Suction pipe inlets shall be fitted with:

(a) A screen having a net cross section open area of 4 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
The following requirements apply for suction pipes:

(a) A lockable 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;

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

(c) 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;

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

(e) The total pressure loss between the entry to the suction pipe and the inlet of the pump (including any permissible suction lift) does not exceed 45 kPa when the water is at the level of the vortex plate.

6.4.3.10
The location of the tank and suction pipe with respect 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.

6.4.4 *Wells and artesian bores*

6.4.4.1
Application for approval for use with residential occupancies should provide 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
The well development flow shall be at least 150 % of the highest design flow. At completion of development at such flow, not more than 50 sand grains shall be lifted per litre.

6.4.4.3
The following requirements apply for well construction and accessories:

(a) The well shall have a sealed bottom with the water entering through a screen;

(b) The velocity of water through the screen shall not exceed 50 mm/s;

(c) Foot valves shall not be used;

(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 flow under all flow conditions shall be permanently fitted;

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

6.4.4.4
Where submersible pumps are used, attention is drawn to the need to comply with the requirements for vertical shaft pumps and submersible electric pumps.

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.

6.4.5 *Open water*

6.4.5.1
Water for a pumping unit may be taken from a river, lake, pond or reservoir subject to appropriate resource consents.

NOTE – The Resource Management Act 1991 requires a water consent application.

6.4.5.2
Design details shall be submitted for approval to the sprinkler system certifier concerning:

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

6.5 Pumped supplies – pump units

6.5.1 *General*

6.5.1.1
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 net positive suction head (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;

(d) The duty requirements of the pump unit shall be provided automatically within 30 s of demand.

6.5.1.2
A pump unit consists of a listed pump, listed motor, listed controller and a unit frame.

6.5.1.3
The pump unit and driver shall be either close coupled or direct coupled, and mounted on a rigid frame in which case the following requirements apply:

(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) Cement grout or oil resistant flexible pads shall be provided under the frame unless the manufacturer's instructions state otherwise. Care shall be taken not to distort the bedplate when bolting it down;

(d) With approval, a right angle gear drive may be used for vertical shaft pumps.

6.5.1.4
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 pressurized 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 pressurization (to facilitate drop-in-pressure detection) shall be achieved by means of a permanently installed pressurizing 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 hydraulic accumulator of sufficient size to operate one sprinkler for the time taken to start the water supply pump and pressurize 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.

6.5.1.5
A labelled green manual start button shall be provided on the controller to energize the starter contactors directly.

6.5.1.6
Pump units shall run until manually stopped at the pump unit. 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) 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.

6.5.1.7
The following gauges complying with 3.7 shall be provided on the pump controller:

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

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

6.5.1.8
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, the sprinkler system certifier 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 min. Where the indication is made at a location that is not manned at all times, a defect signal shall be generated through the fire brigade alarm (FBA). The FBA control box used to generate the defect signal shall be clearly marked "PUMP RUNNING ALARM CONNECTED TO THIS UNIT".

6.5.1.9
Pressure relief valves may be used to limit pump discharge pressure where excessive pressures may be generated.

6.5.1.10
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
A listed pump shall be used. Only rotodynamic pumps with spare parts readily available in New Zealand are acceptable for listing.

(a) Factors that shall be considered for listing are:

(i) Materials and construction

(ii) Performance range and accuracy against the manufacture's curve; and

(iii) Availability of documentation.

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

(i) Details of construction

(ii) The total head, efficiency, power absorbed and net positive suction head (NPSH) versus discharge for the proposed impellor diameter

(iii) The total head, power and efficiency versus discharge for the full impellor diameter at various speeds, and for various impellor diameters at the duty speed; and

(iv) The proposed impellor diameter and sphere diameter.

6.5.2.2
Every pump shall be demonstrated by means of one of the methods specified below, 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 BS EN ISO 9906; or

(b) A bench test conducted in accordance with BS EN ISO 9906 witnessed by the sprinkler system certifier; or

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

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

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

(e) Subsequently, that the available pressure at the alarm 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.

6.5.2.3
The following requirements apply to waterway fittings:

(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;

(b) Where a reducer is required between the pump and the suction pipe it shall be eccentric with a taper and shall be installed so that no air will be trapped in it;

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

(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 diameters of the suction pipe from the entry to the pump.

6.5.2.4
Pump casing cooling shall be provided to prevent the temperature of the water in the pump casing rising to more than 35 ºC 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; and

(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 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; and

(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
A listed diesel engine shall be used which shall be of a compression ignition direct injection type and may be naturally aspirated or super or turbo charged. Engine intercooling is permitted only if specifically permitted by the listing. Only those engines for which spare parts are likely to remain readily available may be listed.

6.5.3.2
The engine shall be able to produce at least 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 and when:

(a) The power requirement at the highest design flow includes an allowance equal to the power absorbed by any supplementary devices driven by the engine, and any angled drive or by any alternator set solely and directly driving a submersible electric motor driven pump; and

(b) The engine is derated in kilowatts at the rate of 1.5 % for every 100 m of altitude over 200 m and any ratings or deratings specified by the engine manufacturer are observed.

6.5.3.3
The engine shall be able to be started automatically at an engine room temperature of 5 ºC and shall accept full load within 30 s of receiving the signal to start.

6.5.3.4
The engine shall be provided with a governor to control the engine speed within 5 % of its rated value under all stable conditions of load up to full load rating.

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 6.5.3.5.1, or to water from the pump delivery discharged to waste, or returned to storage in a manner which complies with 6.5.3.5.2.

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 18 ºC.

6.5.3.5.1
Air cooled diesel engines shall be either:

(a) Direct – whereby the fan for direct air cooling shall be mounted on the engine crankshaft or is gear or multiple belt driven directly from the crankshaft. The rated capacity of the belts shall not be exceeded if one belt breaks; or

(b) Indirect – whereby a radiator resiliently mounted in accordance with the motor manufacturer's recommendations and designed for stationary service, shall be fitted with:

  (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 or makeup tank. This header tank shall have a means of readily checking the level of coolant in it

  (iv) The engine manufacturer's coolant circuit.

(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.

6.5.3.5.2
Water cooled diesel engines shall be installed to operate and meet the following requirements:

(a) Cooling water supply, control and discharge shall be installed as follows:

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

(ii) One isolating valve shall be strapped open to supply the normal cooling circuit and be labelled "MOTOR COOLING, NORMALLY OPEN"

(iii) The cooling water shall 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 orifice area shall be equivalent to at least 8 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 isolating valve shall enable cooling water to by-pass items 6.5.3.5.2(a)(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 engine or 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) If clamp type cooling hose connections are unavoidable, pairs of stainless steel clamps shall be provided and the tube accepting the hose shall incorporate a ridge between the clamps and the end of the tube, and

(xii) The cooling water assembly may supply water either to a direct water cooling system or an indirect heat exchanger.

(b) Direct water cooling systems may have the engine directly cooled by passing clean water through a listed control device, directly into the engine's cooling jacket provided the motor manufacturer agrees with this method and the water is free from harmful properties;

(c) Indirect heat exchangers may have the cooling water assembly discharge to 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 and be connected to a suitable automatic overflow or make-up tank. The header tank shall have a means of readily checking the level of coolant in it;

(d) The water jacket shall not be subjected to a pressure greater than 100 kPa.

6.5.3.6
The engine shall be provided with a listed electric starter of the pre-engagement type, i.e. the starter pinion shall not automatically disengage when driven by the ring gear. The surface temperature of the starter motor case shall not rise more than 20 ºC within 60 s of the completion of the 60 s engine cranking test.

6.5.3.7
In addition to a manually operated starting button, each diesel engine shall have an approved means by which it can be manually started in an emergency.

6.5.3.8
Two separate lead-acid starting batteries shall be provided, each capable of cranking the engine for 60 s 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, be adjacent to, but not over any part of, the pump unit, and be protected with a strong non-conductive cover.

6.5.3.9
The air intake shall be fitted with an adequate filter.

6.5.3.10
Every engine shall have an exhaust that:

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

(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) Provides for 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 70 ºC;

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

(f) Has the exhaust pipe guarded wherever it is within 2 m of the floor and could cause injury. Close packed insulation, such as mineral fibre rope, around the exhaust pipe is not permitted.

6.5.3.11
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
A controller consists of a cabinet housing or supporting instruments, a listed controller logic unit, listed battery chargers, listed start pressure switches, manually operated start switch, spare parts, 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 multi-contact plug and socket, and the entire controller shall be listed.

6.5.4.2
The controller shall be located in the pump unit enclosure close to but physically separate from the engine and pump. It shall be free from engine vibration. Attention is drawn to the need to comply with NZS 4219 with respect to restraint against seismic forces.

6.5.4.3
The cabinet shall be robustly constructed and provided with adequate ventilation to facilitate dissipation of heat generated by electrical equipment. It shall include a dustproof compartment for the storage of spare parts, technical data sheets and the test logbook.

6.5.4.4
Instruments, manual controls, alarms and lamps on the diesel engine controller shall have:

(a) The information in the following table 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 except for tachometers that have a green radial line on the scale to indicate duty speed.

Digital displays shall have digits at least 15 mm high, comply with the requirements of the following table, and (except for engine run time) have the numerical duty or safe operating range engraved immediately adjacent to each display.

Information on digital displays	**Minimum number of digits**
Pump suction pressure	3
Pump delivery pressure	3
Pump rotational speed	4
Engine run time (hourmeter)	5
Engine lubricant pressure	3
Engine block temperature ^{o}C	3
Voltage of each battery	4
Charging current to each battery	3

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.

(b) The following manually operated devices with 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.

(c) The following lamps or light-emitting diode (LED) indicators provided in easily visible positions on the controller to indicate:

(i) Whether each battery charger is energized

(ii) Operation of pressure switch

(iii) The controller unit status

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

(v) The start logic controller status.

(d) All instruments, controls and lamps clearly labelled as to their function. Where duplicate instruments associated with batteries are provided, they shall be labelled either “A” or “B”;

(e) Remote indication, if provided, for off-normal conditions such as:

(i) Pump running

(ii) Battery charger off

(iii) High engine temperature

(iv) Engine heating failure

(v) Low engine oil pressure.

For remote indication an alarm unit shall be provided and mounted on the controller to assemble and transmit signals either individually or collectively. A timing device may be incorporated to suppress such signals for a period of 60 min provided that it will automatically reset. If the remote alarm includes signalling of low temperature in the pump house the remote alarm shall not be dependent on mains power.

6.5.4.5
The controller logic unit shall meet the following requirements:

(a) A listed 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) Its functions shall comply with figure 6.4;

(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;

(d) 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
A listed constant voltage battery charger for each of the two starting batteries shall be provided and fitted into the cabinet. Listed battery chargers shall:

(a) Be able to automatically maintain the battery in a fully charged condition and be capable of accepting continuous reversed polarity or short circuit on the terminals without damage;

(b) Automatically maintain the battery at a constant voltage irrespective of power fluctuations. The output shall automatically shut down to a maintenance current when the voltage per cell rises to 2.20 V. When the voltage per cell falls to 2.12 V, the charger output shall rise to at least 10 A;

(c) Provide indication of whether each charger is energized; and

(d) Have any devices controlling the 230 V subcircuit to the chargers clearly labelled “FIRE PUMP BATTERY CHARGERS”.

6.5.4.7
Listed start pressure switches shall be mounted on the cabinet and conform to 6.5.1.4. The initial current for closing shall exceed 0.5 A.

6.5.4.8
An indelible label affixed to the face of the cabinet shall provide 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 impellor diameter;

(f) Flow and pressure at duty speed.

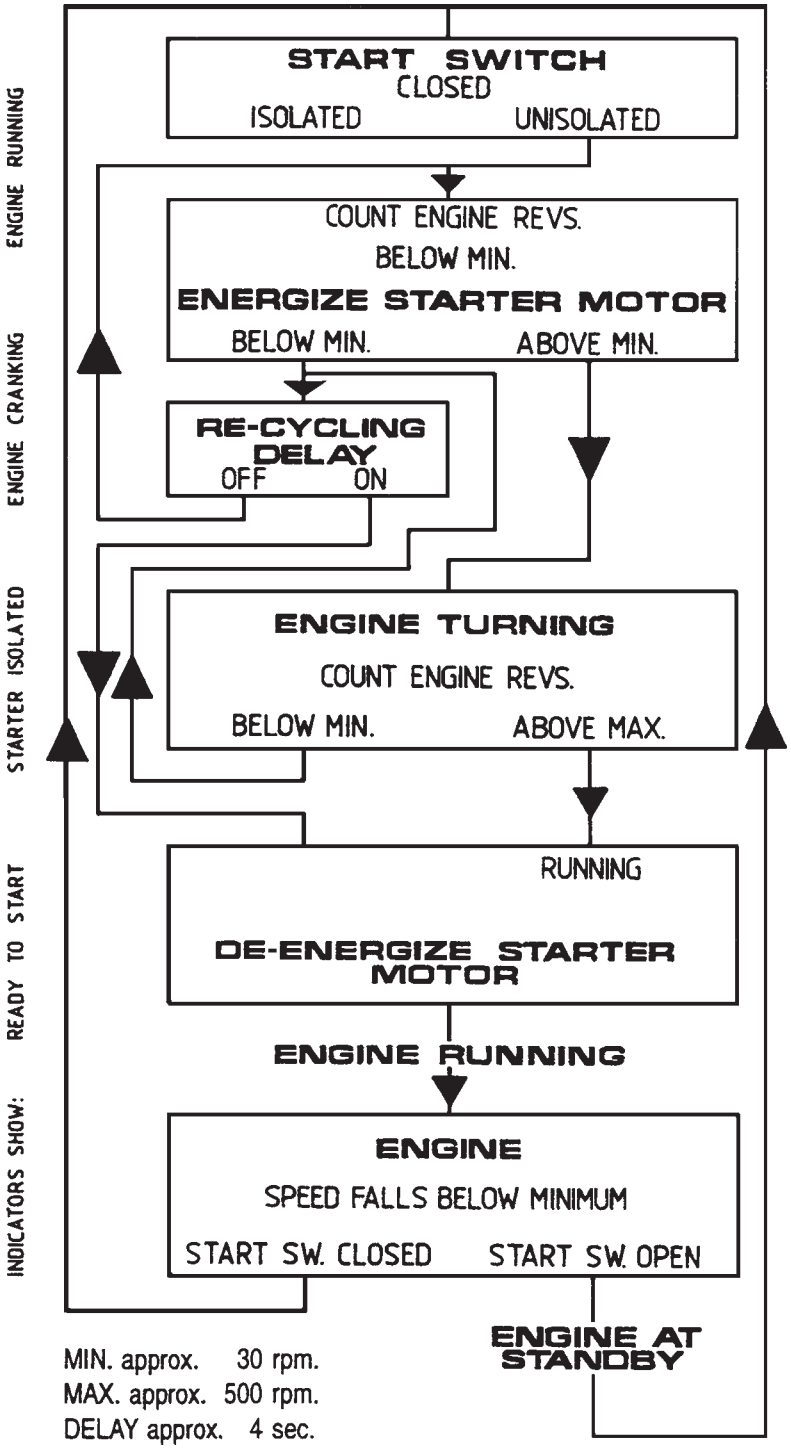


Figure 6.4 – Diesel engine controller logic unit

6.5.4.9
Spare parts should be located in the cabinet along with a list of the parts. The spare parts should include:

(a) One set of fuel filter elements and seals;

(b) One set of lubricating oil filter elements and seals;

(c) One air filter element;

(d) One set of belts where used;

(e) One complete set of engine joint gaskets and hoses;

(f) Two injectors complete except that for two cylinder engines, one injector is sufficient;

(g) Sufficient tools to replace spares 6.5.4.9 (a), (b), (c) and (d);

(h) A hydrometer for the battery; and

(i) Spare gland packing for the pump.

6.5.4.10
The following shall be located in the cabinet or other suitable storage facility located in the pump house:

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

(b) The manufacturer's handbooks for the operation of 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 and annual surveys; and

(d) A label showing the name and telephone number of the pump unit maintenance contractor affixed to the outside of the cabinet.

6.5.5 *Diesel engine fuel supply*

6.5.5.1
Every pump engine shall have its own individual fuel supply tank. Engines supplied by the manufacturer with integral fuel tanks may be permitted.

NOTE – Attention is drawn to the need to comply with the relevant requirements of the Hazardous Substances and New Organisms Act 1996, specifically those dealing with tank size and attachments, pipes, protection of fuel lines and oil level gauges.

6.5.5.2
Stand alone type fuel tanks may be mounted inside the pump house but shall be mounted separately from the engine with the fuel outlet not less than 500 mm or more than 1000 mm above the injectors, unless this voids the manufacturer's warranty. Engines supplied with integral tanks of sufficient capacity may however be used subject to approval.

6.5.5.3
The fuel capacity for tanks shall be empirically assessed on the basis of 0.5 L/h/kW of 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 sprinkler system certifier to have regard to the possible or intended period of continuous function of the other service.

6.5.5.4
The tank shall be fitted with a listed dial type fuel gauge calibrated in litres. The dial shall be marked indicating that the top third of the tank is fuel for test running, the middle third is for fire duty running and the bottom third is a reserve of fuel. It shall also indicate that the fuel level shall not normally fall below that allowed for testing. Integral fuel tanks fitted with the manufacturer's fuel level indicator shall be acceptable.

6.5.5.5
Stand alone type fuel tanks shall be constructed 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 or alternatively of at least 1.25 mm stainless steel.

6.5.5.6
The following connections shall be provided for stand alone type fuel tanks (galvanized pipe shall not be used):

(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 20 mm filling pipe into the top of the tank. The tank may be filled only by pumping from a storage tank or a portable drum. There shall not be any removable cap or other device allowing refilling by open pouring of fuel;

(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; or

(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.

6.5.5.7
The fuel lines of stand alone type fuel tanks shall be at least 10 mm seamless copper tube. Flared compression fittings with double tapered sleeves or brazed joints shall be used for joining. The fuel lines shall:

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

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

6.5.5.8
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 *Electric motor driven pump*
Where permitted (6.1.2(c)), a mains powered electric motor driven pump unit may be used provided that the following requirements and those of 6.5.1 and 6.5.2 are met.

NOTE – Attention is drawn to the Electricity Regulations 1997 issued pursuant to the Electricity Act 1992.

6.5.6.1
The power supply to the motor shall be taken directly from the load side of the main switch that is directly fed from the load side of the meter. All load, other than the sprinkler pump, shall be supplied through a

protective device which is rated to discriminate against the rupture of the service cut out (a rating of 75 % or less of the service cut out is recommended).

6.5.6.2
The motor shall be direct coupled, drip proof and rated so as not to exceed the full rated load current under any conditions of pump discharge when the voltage at the motor terminals falls 10 % below the motor name plate voltage.

6.5.6.3
Every switch controlling the pump shall be indelibly labelled "SPRINKLER FIRE PUMP – DO NOT SWITCH OFF" in white letters on a red background.

6.5.6.4
The cable and protection supplying power to the pump unit shall be sized for a rating of at least six times the full load current of the motor and be supplied from the buildings main switchboard.

6.5.6.5
A listed controller shall be permanently mounted in the pump unit enclosure at least 450 mm above the floor and consist of the components specified below:

(a) A drip-proof cabinet supporting or enclosing items 6.5.6.5 (b) to (f);

(b) A labelled delivery pressure gauge (which may be omitted if the pump is co-located with the sprinkler system control valves) and a labelled compound suction and pressure gauge (except on submersible pumps);

(c) A listed drop-in-pressure start pressure switch;

(d) Manual start and stop buttons (see 6.5.6.6);

(e) A drip-proof, latching, direct on line start contactor with a current rating at least 125 % of the continuous full load current rating of the motor;

(f) A name plate displaying the following:

  (i) Name of manufacturer

  (ii) Unit number

  (iii) Make, model, turning speed and impellor diameter of the pump

  (iv) Duty flow and pressure.

6.5.6.6
Starting, stopping and alarms shall meet the following:

(a) Automatic starting shall be by pressure drop detection in the sprinkler system. If the pressure switch closes, the pump shall start;

(b) Manual starting shall be possible by means of a labelled green button on the controller; and

(c) A labelled red stop button shall be provided on the controller. No form of automatic or remote shut-down device is permitted. A labelled isolating switch in the pump unit enclosure is permitted.

6.5.6.7
The electric motor shall have an indelibly marked name plate fitted to include:

(a) The manufacturer's name;

(b) The type and serial number;

(c) Continuous rated power output;

(d) Working voltage and frequency;

(e) Revs/min at full load; and

(f) Full load current.

6.5.6.8
An auxiliary pumping-in point (which may be a fire sprinkler inlet) shall be provided and fitted with a 70 mm male instantaneous coupling and a non-return valve.

6.5.7 *Facilities for routine testing*

6.5.7.1
Pump units shall have facilities to allow routine test running under load and to prevent overheating in situations of nil or low discharge.

6.5.7.2
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. Attention is drawn to the pump curve proving option in 6.5.2.2 (c) which may require a larger pipe.

The test return pipe shall be fitted with connections to enable the test device specified by the sprinkler system certifier to be fitted at commissioning to establish the performance characteristics of the pumping unit unless a listed in-line measuring device has been permanently fitted.

In the case of tank supplies, the test return pipe shall terminate at least one metre below normal water level to prevent air entrainment during testing and shall be restrained against jet reaction.

The test return pipe shall be fitted with a labelled indicating stop valve normally padlocked in the closed position.

6.5.7.3
A boosted reticulated water supply shall have a test return loop from the pump delivery to the pump suction, and be provided and sized to enable the unit to be routinely test run at least at 100 % of the highest design flow. The test return loop shall be fitted with a labelled, indicating stop valve normally padlocked in the closed position. During routine test running, the test running cooling valve shall be opened.

6.5.8 *Pump unit enclosure*

6.5.8.1
Pump units shall be installed in a clean dry weather-tight enclosure free from dust, preferably of fire resistive or non-combustible construction, exclusive to the sprinkler apparatus and satisfactorily frost protected and ventilated.

6.5.8.2
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 run-off storm water 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.

6.5.8.3
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 sprinkler system certifier 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 unauthorized persons to the pump unit; and

(e) All other requirements for pump unit enclosures shall be met.

6.5.8.4
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.

6.5.8.5
The enclosure shall be of sufficient size to allow free access for testing and maintenance of all equipment therein.

6.5.8.6
Access shall be by a lockable door or hatch sufficiently large, and located in such a position, as to allow the removal of any individual component of the pump unit without disturbance or damage to other components.

6.5.8.7
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.

6.5.8.8
The enclosure shall be provided with artificial lighting.

6.5.8.9
There shall be sufficient ventilation to prevent condensation and to provide aspiration for any diesel engines. The pump unit enclosure air temperature shall not increase to beyond 18 ^oC above ambient temperature.

6.5.8.10
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 ºC at all times. If the temperature in the enclosures falls below 5 ºC 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 3 ºC.

6.6 Elevated tanks

6.6.1
An elevated tank 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 (in terms of 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 alarm valves to furnish without the use of pumps the requisite pressures at the design flows specified in section 5.

6.7 Gas pressurized water storage tanks
Gas pressurized water storage tanks may be used subject to the sprinkler system certifier specifically approving the arrangement.

6.8 Fire sprinkler inlet

6.8.1
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 to NZS 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
The inlet coupling shall be clearly labelled by means of an indelible sign “FIRE SPRINKLER INLET”.

6.8.3
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
Each water supply shall be tested at commissioning and shall have a water supply characteristic being the pressure characteristic of the supply when measured through the fully open drain valve at the control valves. The water supply characteristics shall not be less than any design flow and design pressure, and shall take account of the derating requirements specified in 6.2.3 and 6.5.2.2.

7 HYDRAULIC CALCULATIONS

7.1 General

7.1.1
Pipe diameters shall be such as to 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, i.e. terminal, looped or gridded, or any combination thereof.

7.2 General calculation methods

7.2.1 *Listed residential sprinklers*
Calculations shall be provided to verify the single operating sprinkler criteria, and all the multiple (2 or 3) operating sprinkler criteria where rooms contain two or more 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 sprinkler heads to be considered in accordance with table 5.1;

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

(d) Starting with the most hydraulically remote head, calculate the total flow from the number of sprinkler heads 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 sprinkler heads (1, 2 or 3) 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 head (see table 5.1). Assume a discharge from each sprinkler head that will provide the minimum density over that area as specified in table 5.1; and

(c) Starting at the most hydraulically remote sprinkler, calculate the total flow from the number of sprinkler heads considered to be in operation and establish the pressure required at the control valves. The water supply characteristics shall be equal, or better, as specified in section 6 for the calculated requirement.

7.2.3 *External sprinkler heads*
For each array of external sprinkler heads deemed to operate simultaneously (see 5.1.1) calculate the flow and pressure required at the control valves so that each sprinkler head in the array operates at not less than the minimum pressures specified in 5.1.1. The water supply shall be capable of meeting this and any other calculated requirement.

7.2.4
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 heads 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
Sprinkler heads in skylights shall be added to the 1, 2 or 3 head demand for the area being considered.

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 1.0 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 etc. 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 bore diameter (mm)

C is a constant for the type of pipe, i.e.:

Cast iron	$C = 100$
Steel, galvanized after fabrication	$C = 110$
Steel (black or galvanized)	$C = 120$
Steel, spun concrete lined	$C = 130$
Copper and UPVC	$C = 140$
Chlorinated PVC	$C = 150$.

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 CPVC pipe

Nominal bore		**Steel to BS 1387**				**Chlorinated PVC**	
		Medium grade		**Heavy grade**			
(mm)	(inches)	Mean i.d. (mm)	Value of R	Mean i.d. (mm)	Value of R	Mean i.d. (mm)	Value of R
20	0.75	21.63	2.71×10^{-3}	20.41	3.60×10^{-3}	22.45	1.58×10^{-3}
25	1.0	27.31	8.73×10^{-4}	25.68	1.18×10^{-3}	28.17	5.11×10^{-3}
32	1.25	35.97	2.28×10^{-4}	34.34	2.86×10^{-4}	35.56	1.63×10^{-4}
40	1.5	41.86	1.09×10^{-4}	40.23	1.32×10^{-4}	60.69	8.37×10^{-5}
50	2.0	52.98	3.46×10^{-5}	51.36	4.02×10^{-5}	50.88	2.78×10^{-5}
65	2.5	68.67	9.78×10^{-6}	67.04	1.10×10^{-5}	61.54	1.09×10^{-5}
80	3.0	–	–	–	–	74.96	4.18×10^{-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 nominal 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.

Table 7.3 – Hydraulic equivalent length factors for pipe fittings

Hazen-Williams Factor (*C*)	**100**	**110**	**120**	**130**	**140**	**150**
Tees into branches	0.040	0.050	0.060	0.070	0.080	0.090
Elbows	0.020	0.025	0.030	0.035	0.040	0.045
Bends	0.010	0.0125	0.015	0.0175	0.020	0.0225

NOTE – A bend is any fitting where the radius divided by nominal 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 etc. shall be calculated using the formula:

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

where

ΔP 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*

7.3.5.1
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 SURVEY INSPECTION

8.1 General

The sprinkler system shall be properly maintained in good working order and conform to the Standard.

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

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 be no area within the building, other than those specifically excepted, which is not within the area of discharge of a sprinkler head.

8.2 Weekly and monthly tests

The following tests are carried out, at the intervals specified, by either a listed contractor or the owner provided that the owner can demonstrate competence to the sprinkler system certifier.

Pumps integral to the sprinkler system shall be tested periodically as follows:

(a) Diesel engine driven – weekly;

(b) Electric motor driven – monthly;

(c) The test procedure shall conform to the relevant parts of Appendix K;

(d) For residential systems – water supply characteristic, correct operation of alarms, main stop valve open – monthly.

8.3 Periodic tests

The following tests are carried out by a listed contractor at the intervals specified.

8.3.1

Pumps integral to the sprinkler system to be tested as follows:

(a) Diesel engine driven – 6 monthly;

(b) Electric motor driven – annually;

(c) The test procedure shall conform to the relevant parts of Appendix K.

8.3.2

Water supply characteristics, correct operation of alarms, main stop valve open and battery condition to be tested as follows:

(a) Residential occupancies – 6 monthly;

(b) Full inspection of protected building and sprinkler system; 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 – annually;

(c) Drain down anti-freeze (and tail end) systems, check specific gravity, correct and refill – annually.

8.4 Records

The name and address of the system, the time and the name of the person carrying out the test will be permanently recorded in a log book which is kept at the control valves. The details and results of all tests will be recorded over the signature of the tester.

A copy of the test and inspection report of the tests specified in 8.3.2(b) should be forwarded to the owner and to the sprinkler system certifier.

8.5 Precautions when system impaired

8.5.1
Hot work (e.g. gas cutting, welding, brazing or grinding) should not be undertaken when the sprinkler system is not functional.

8.5.2
The person in immediate charge of the residence should be notified, and acceptance obtained, prior to the system being disabled.

NOTE – Sufficient time should be allowed to permit temporary and alternative fire safety measures to be implemented.

8.5.3
In the event of an extensive interruption to the water supply, the possibility of arranging a temporary supply should be investigated.

8.5.4
It is important that the Fire Service is notified of impairments.

APPENDIX A
RESIDENTIAL SYSTEMS – DETERMINATION OF COMPLIANCE

(Normative)

A1 General

This Appendix provides information on the determination of compliance for a residential sprinkler system.

A2 Residential occupancies

The sprinkler system is deemed to comply with this Standard when the sprinkler system certifier has reviewed the design, and the physical installation of the system by an appropriately qualified contractor as determined by the sprinkler system certifier, 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 on-going testing, servicing and surveying arrangements and that these comply.

A3 Certificate of compliance

The form of certificate of compliance is that set out in Appendix D and a copy should be displayed adjacent to the system control valves.

A4 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 B. On the basis of the information supplied, the sprinkler system certifier 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 head used.

NOTE – A contractor may agree to an administrative procedure with the sprinkler system certifier whereby a data sheet reference may be used when that authority has the data sheet on file.

APPENDIX B
RESIDENTIAL SYSTEMS DOCUMENTATION PRIOR TO FINAL INSPECTION

(Normative)

The following documentation shall be provided by the contractor to the sprinkler system certifier 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, sprinkler heads 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) Sprinkler heads 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) Nominal bore 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 C
RESIDENTIAL SYSTEM ACCEPTANCE AND COMPLETION DOCUMENTATION

(Normative)

C1 General

The installing contractor shall notify the sprinkler system certifier 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.

C2 Flushing of pipes

Underground mains and lead-in connections to system risers shall be completely flushed before connection is made to sprinkler piping.

C3 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.

C4 Documentation

C4.1

The contractor shall supply to the sprinkler system certifier 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 residence showing:

  (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

  (vi) Type and location of fire extinguishers

  (vii) Location of alarm sounders.

(e) A dimensioned drawing of the pipe layout showing the design pressure of each sprinkler head 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 pressurization, if used.

C4.2
The residential sprinkler system certifier shall supply the building owner with a certificate of compliance as set out in Appendix D.

C4.3
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 sprinklered premises with the certificate of compliance.

APPENDIX D
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 .....confirms that
(name of building and full street address)

this system conforms to the requirements of NZS 4515:2003 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: .....

Date .....

Certificate No. ..... To have effect from.....

The following makes and models of sprinkler heads 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 – Sprinkler heads are not to be interchanged with models of different performance characteristics.										

APPENDIX E
REQUIREMENTS FOR LISTING

(Normative)

E1

In listing equipment, materials, procedures, organizations, persons or facilities, the sprinkler system certifier shall determine that any specific requirements of this Standard have been met and there is sound evidence to indicate reliability of performance.

E2

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 sprinkler system certifier, be listed pursuant to this Standard unless the sprinkler system certifier 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 sprinkler system certifier.

E3

The sprinkler system certifier shall withdraw the listing of any listed equipment, material, procedure, organization, 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.

E4

Listings shall be limited to the tenor and qualifications of the sprinkler system certifier's listing document and cease to have effect from the date of any signed notice of withdrawal of listing issued by the sprinkler system certifier.

E5

Evidence of listing in respect of any particular item of equipment, material, procedure, organization or facility shall be the production of an original document to that effect, signed by an authorized officer of the sprinkler system certifier or inclusion in a schedule of listed items published by the sprinkler system certifier.

APPENDIX F
RESIDENTIAL SYSTEMS GUIDELINES FOR EVALUATION OF CONTRACTORS BY THE SPRINKLER SYSTEM CERTIFIER

(Normative)

F1 General

This Standard 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 organization to permit the informed application of the requirements of the Standard.

F2

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 sprinkler system certifier 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 having regard to technological and trades practice current at the time.

F3

Any request for listing (or re-listing) would be accompanied by a completed standard schedule of information as follows:

F3.1

Schedule of information for contractors:

(a) Name of contracting company, and office and postal address;

(b) Name of manager, contact address and phone;

(c) Date from which listing 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 survey work.

(g) Cities in which the contractor will have permanent facilities;

(h) Copy of written quality system (i.e. the practices, policies and procedures by which the contractor will ensure adequacy of design, materials, fabrication, installation, documentation, calculation);

(i) Location and ownership of pipe fabrication facilities; and

(j) Makes of listed hardware intended to be used.

F4
Evidence of listing may be in the form shown in Appendix G.

APPENDIX G
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 organization, as the nominated sprinkler system certifier, considers that the requirements of Appendix F of NZS 4515:2003 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 H
TESTING OF RETICULATED WATER SUPPLY
(Normative)

H1 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.

H2 Method 1

H2.1
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 2 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.

H2.2
The test is made during periods of maximum daily draw-off. The flow gauge is so placed with respect to 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.

H2.3
Values of pressure and flow are recorded at not less than 2 and preferably 3 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 E1).

H2.4
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.

H2.5
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 D, 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.

H2.6
The pressure available to meet the design requirements is taken as 75 % of the pressure indicated by line C and is plotted as line D. Design pressures shall be below line D for all design flows.

H2.7
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 sprinkler system certifier.

H3 Method 2

H3.1
The flow and pressure characteristics of the main are determined and a graph prepared as specified in H2.1 to H2.5 inclusive for method 1.

H3.2
In addition, a pressure recording gauge is used to ascertain the static pressure i.e. 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 sprinkler system certifier may require a further derating if such fluctuations occur.

H3.3
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 D) drawn through this point, parallel to line C. (See figure H1).

H3.4
The pressure available to meet the design requirements is taken as 85 % of the pressure indicated by line D of the graph at the design flow required.

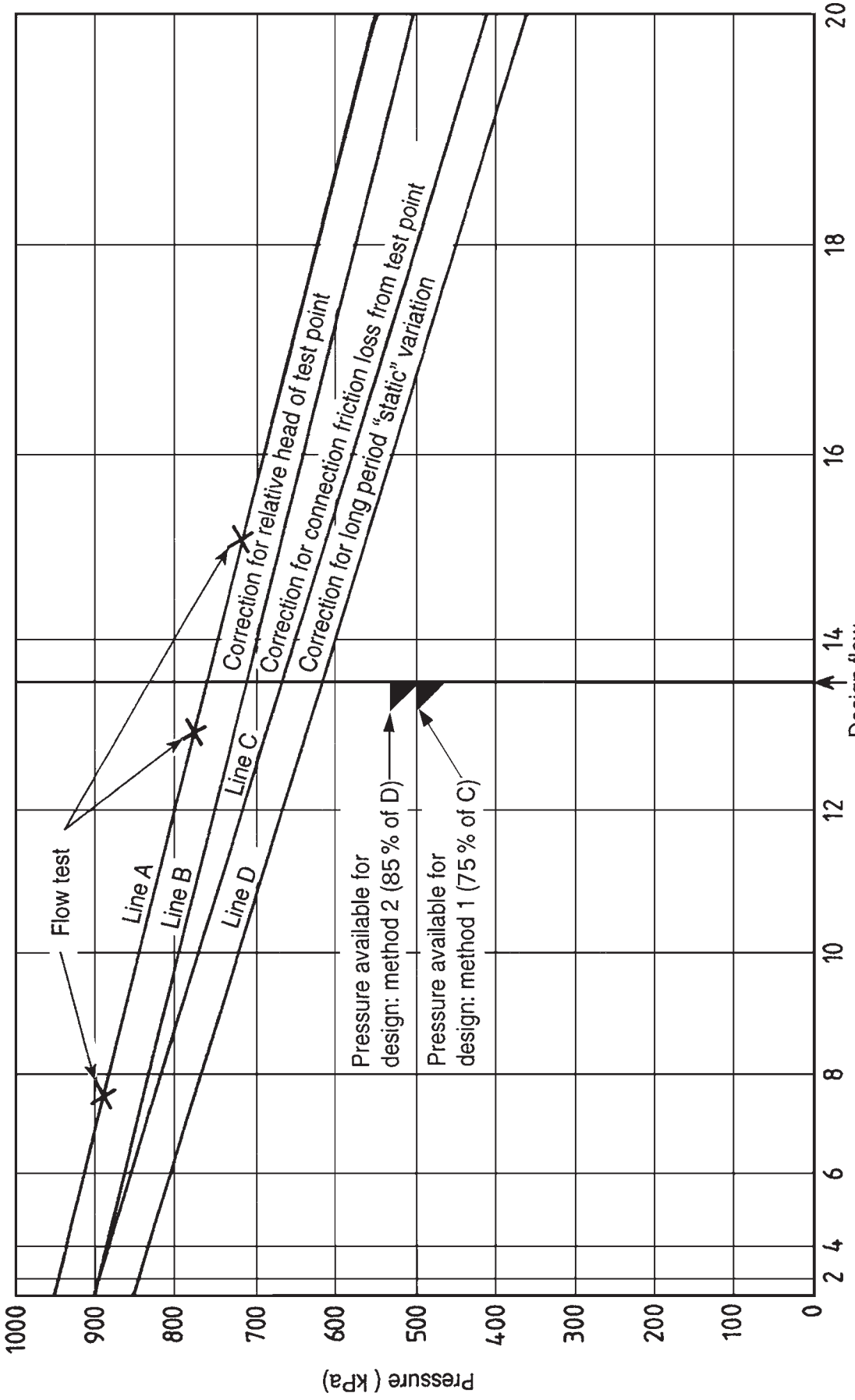


Figure H1 – Water supply flow graph

APPENDIX J
APPLICATION FOR APPROVAL

(Normative)

APPLICATION FOR APPROVAL OF RESIDENTIAL SPRINKLER SYSTEM TO NZS 4515:2003

Name of premises .....

Address .....

Name of owner .....

Principal use: e.g. rest home, hospital, private residence .....

No. 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 HEAD 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 Brigade connected state type of receiving equipment.

.....

Valve set size & listing No. .....

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 as to 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 .....

....
(Signature) (Company)

Date .....

APPENDIX K
ROUTINE SYSTEM TESTING OF PUMPS

(Normative)

K1 Diesel engine driven pumps

K1.1 *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 by-pass 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 4 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 by-pass and ensure all controls and functions are returned to normal; and

(iv) Check controller indicator lights for normal condition.

K1.2 *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;

(c) Check the date of battery installation and last annual overhaul;

(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; and

(h) Check spare parts inventory and re-order if necessary.

K1.3 *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 3 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 2 hours with the by-pass open (concurrent with the monthly test run); and

(g) Change the engine oil.

K2 Electric motor driven pump set

K2.1 *Monthly test*
The following tests shall be performed monthly:

(a) Start the pump by pressure drop and record the start pressure. Run the unit for 5 minutes with the by-pass fully open, then:

(i) Check the pump suction and delivery pressure against reference data and record results

(ii) Check the power supply monitoring devices are operational

(iii) Check the correct rotational direction of the pump unit

(iv) Check the position of pump delivery and suction valve.

(b) Close the by-pass at the completion of the test, and return all switches and controls to the normal ready to start condition.

K2.2 *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 3 points on the pump curve;

(c) Check all switches controlling the pump circuit to confirm that warning signs (see 6.5.6.3) are in place;

(d) Test run motor for 15 min with the by-pass open (concurrent with the monthly test run). It is recommended that a clip-on ammeter be used to check mains current draw; and

(e) Start the motor three times in quick succession to ensure the thermal overload protective devices are not set too low.

NOTES

Approved by the Standards Council on 12 November 2003 and the Minister of Internal Affairs on 14 October 2003 to be a New Zealand Standard pursuant to the provisions of section 10 of the Standards Act 1988.

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