Fire Suppression

Design Consideration

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Peter Trzebinski (Balmoral Tanks)
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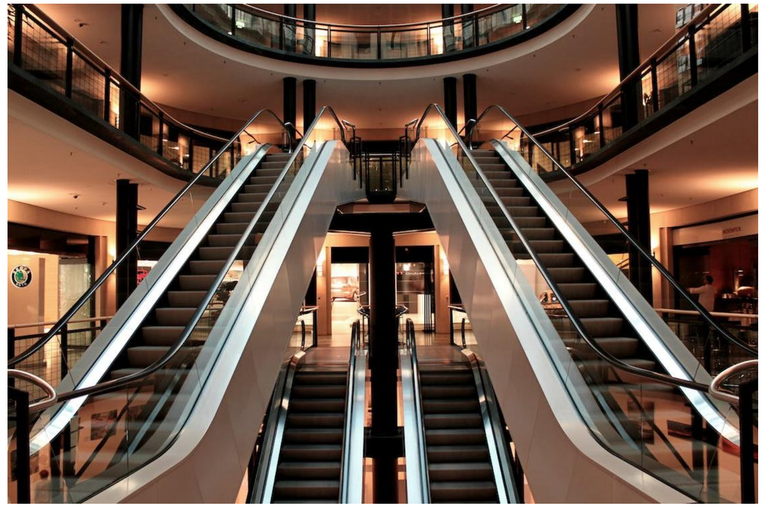
Fixed Fire Suppression Systems

Residential (& mixed use)

Industrial/Commercial
(Property Protection)



Public Access Buildings
(Enhanced Systems)

Code Standards

Residential Sprinklers

BS 9251:2021
BS EN 16925: 2018

Commercial/Industrial Sprinklers

BS EN 12845:2015
LPC Rules (BS12845+TBs)

Watermist

BS 8458
BS 8489
EN 14972

Why change a winning team?

Construction
Architectural

Sociological
Technological

Political
Environmental

Non-Residential Areas for BS 9251:2021

General Comments

BS 9251 is a life safety standard only (not property protection)

Third party approval is desirable but not required

Clears up a grey area from previous versions

Limit is 100m^2

FREE areas

These areas can be covered with no additional discharge density or area of operation required. For example:

- CCTV rooms
- Self catering kitchen hubs
- Site management areas

EXTRA areas

These areas can be covered with system criteria boosted. For example:

- Cafés
- Bin stores
- Car parks

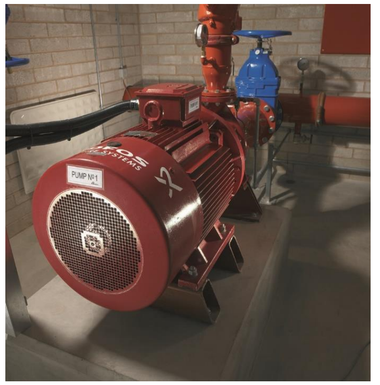
Residential Categories

Table 1 – BS 9251:2021

CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4
Individual dwelling house	Blocks of flats <18m*	Dormitories	All buildings >18m
Individual flat/maisonette*	Small Residential care homes <10 residents	Large Residential care homes >10 residents	
Transportable Home	Sheltered housing*	Student accommodation	
HMOs*		Hostels	
Bed & Breakfast*			
Boarding Houses*			

* Additional notes not shown

Enhanced water supply for Category 4 Systems



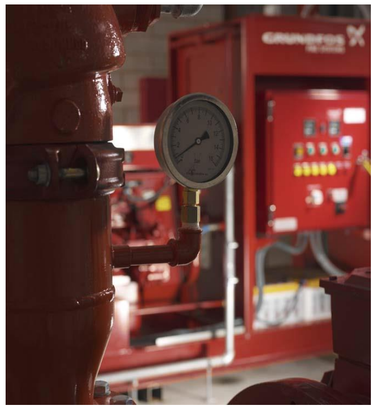
WHAT IS CONSIDERED TO BE A CAT 4 SYSTEM?

All residential buildings 18 m or higher as defined by 9251.

WHAT SHOULD BE TAKEN INTO ACCOUNT WHEN DESIGNING A CAT 4 SYSTEM?

1) increasing the duration of the water supply

Guarantee 60 Minutes water supply for each pump.



2) improving the resilience of the water supply, by including for

A) back-up power supply to pumps.

B) additional standby pump to be installed.

3) Remote monitoring of critical system components

By installing a repeat alarm panel in a permanently maned area

Enhanced water supply for Category 4 Systems

For all category 4 systems an enhanced water supply should be used which provides additional reliability. An enhanced water supply should conform to the requirements for water supplies.

OPTION 1 (5.12.2)

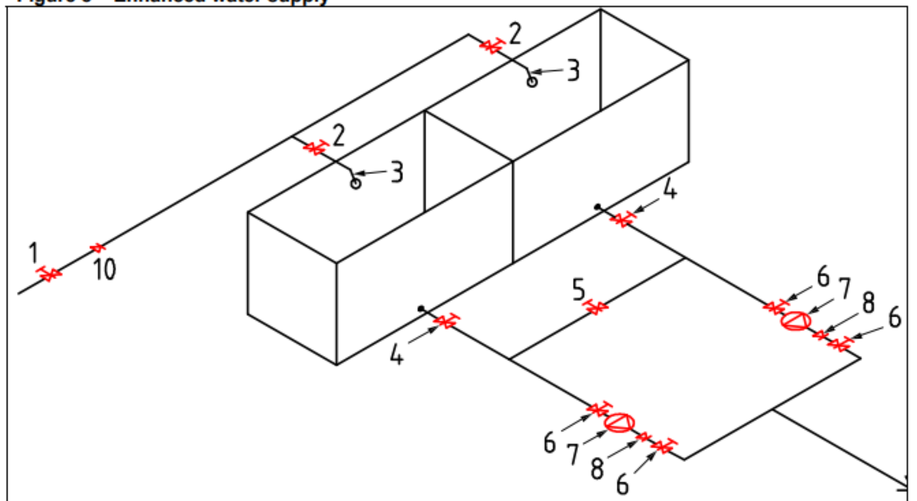
- Mains water supply fed from both ends should be in accordance with the following conditions for a dedicated pump and tank design.

a) each end should be capable of satisfying the flow demands of the system without the use of booster pumps;

b) it should be fed from two or more water sources; and

c) it should be independent at any point on a single, common trunk main

Figure 8 – Enhanced water supply



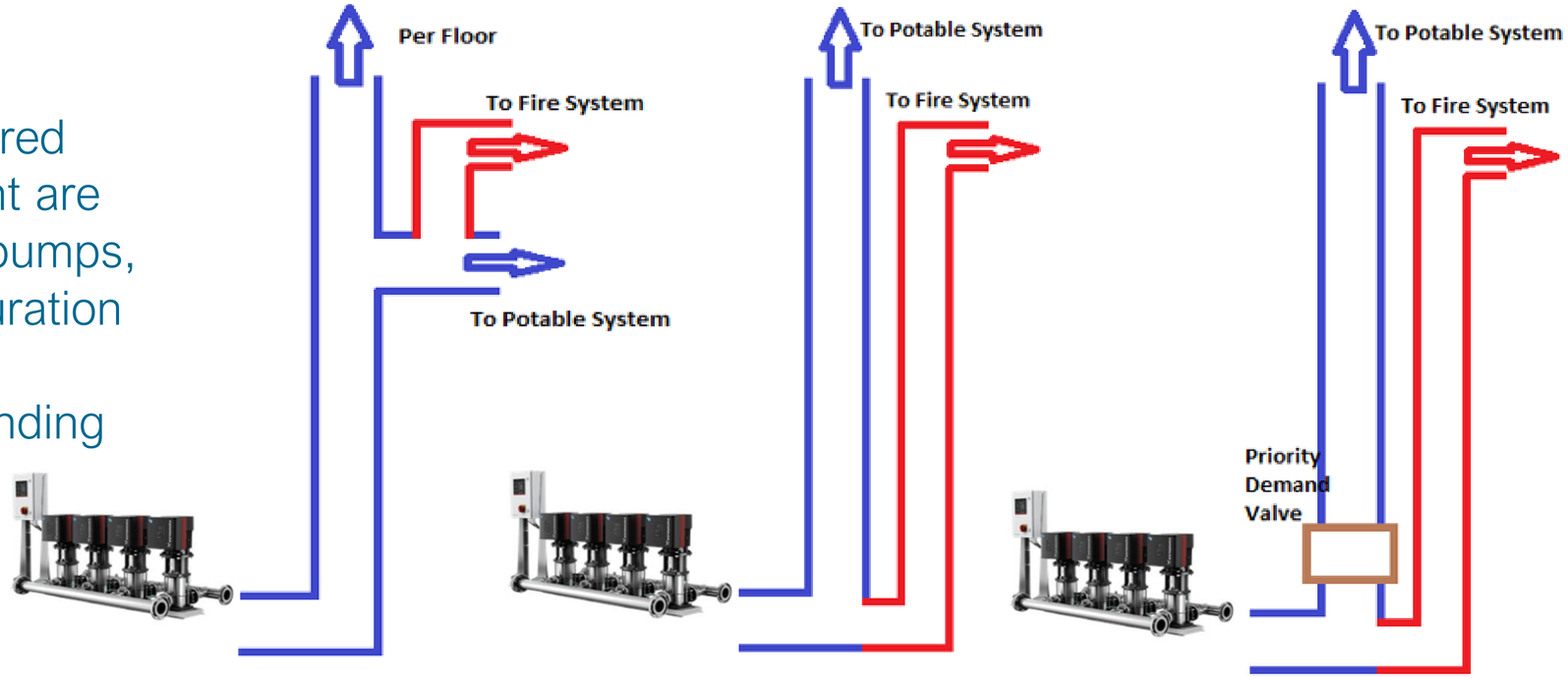
Key

1	Water provider's stop valve
2	Float valve isolation stop valve
3	Float valve with suitable backflow prevention device
4	Lockable tank isolation stop valve
5	Lockable bypass stop valve
6	Lockable pump isolation valves
7	Pump
8	Non-return valve
9	Pump delivery to sprinkler installation
10	Check valve

Enhanced water supply for Category 4 Systems

Option 2 (5.12.5.3 / TG 1 – C 23)

“Various configurations of a typical shared boosted cold-water supply arrangement are possible, provided there are sufficient pumps, pumping capacity, and suitable configuration of the equipment is possible to achieve suitable redundancy at the most demanding pressure and flow conditions.”



Single Riser option

Separate Riser option

Separate Riser with Priority Demand Valve option

Enhanced water supply for Category 4 Systems

WHAT SHOULD BE CONSIDERED WHEN USING A COMBINED SYSTEM EITHER WITH OR WITH OUT A PDV.
(Complex area under review. Today the following is accepted being sourced by a split or separate tank connected to opposite sides of the suction manifold.)

- **WITH PRIORITY DEMAND VALVE**
  - 2 pump booster set with each pump achieving a minimum of 100% of the residential fire pump duty and a single controller
  - 3+ pump booster set with each pump **achieving** a minimum of 50% of the residential fire pump duty and a single controller

- **WITHOUT PRIORITY DEMAND VALVE**
  - 2 pump booster set with each pump achieving a minimum of the peak performance of the potable water of the building plus 100% of the residential fire pump duty and a single controller
  - 3+ pump booster set with each running pump being able to achieve the peak performance of the potable water of the building plus 50% of the residential fire pump duty, a standby pump and a single controller.

Enhanced water supply for Category 4 Systems

POINTS TO NOTE WHEN USING A SHARED BOOSTED COLD WATER ARRANGEMENT.

1. care should be taken to ensure no unwanted functionality is implemented which could adversely affect the performance of the sprinkler system in a fire
2. Where possible boosters should have a secondary “Fire Mode” functionality. where this function is available) and then pumps should remain in fire mode run until manually stopped and reset.
3. No protection functionality (e.g. leak detection, overheat protection, load balancing, etc) should be able to impair the operation of the pumps to feed the sprinkler system at the required pressure and flow rate.
4. In addition, the design of the shared boosted cold-water supply arrangement should make it possible to achieve all of the following:
   - isolation of individual pump units for maintenance purpose, without disabling the sprinkler system
   - Replacement of pump unit(s), without disabling the sprinkler system
   - Isolation, drain-down and maintenance of individual tanks, without disabling the sprinkler system
   - Isolation of pipework for pipework replacement
   - Two independent sources of power, with automatic changeover functionality, shall be available to all pump supplying the sprinkler system

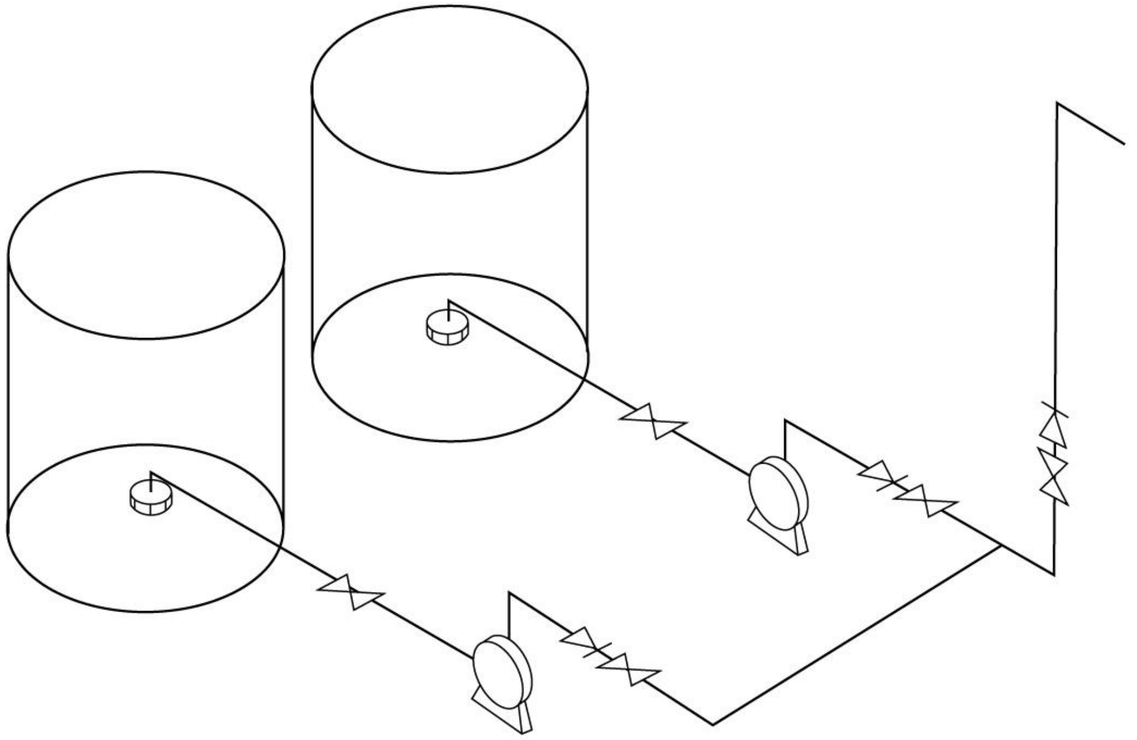
Water supplies intended to comply with ADB

TB233.2.1

Systems intended to comply with life safety requirements of regulations, which may incorporate the requirements of BS EN 12845 Annex F ‘Additional measures to improve systems reliability and availability’.

EXTRA AVAILABLE

EXTRA RELIABLE



Supplying Residential Systems from Commercial Pumps

CIBSE

BALMORAL

spp PUMPS

MARIOFF

PROJECT FIRE®

GRUNDFOS

THE SOCIETY OF PUBLIC HEALTH ENGINEERS

Residential Supplies from Commercial Pumps

Current rules allow for Residential Sprinkler Systems to be take their water supply from commercial pumps.

Whilst this may seem like a good way to save a little space, it actually presents some problems:

RESIDENTIAL VS. COMMERCIAL

For high rise residential systems, typically we see high pressure demands and very low flows (relative to commercial sprinklers).

For low-rise commercial systems, we would expect relatively low pressures and higher flows.

This can be problematic…

DIFFERENT CONCEPTS

Pumps are designed for specific purposes.

For low flow / high pressure, typically a multistage pump would be used: that's what would be used in a residential system.

For high flow and low pressures, a single stage pump (end-suction or split-case) pump would be the norm.

SQUARE PEGS & ROUND HOLES

A small multistage pump of the type usually used for residential fire pump sets is simply not able to deliver the flows required to service commercial sprinkler systems.

A commercial-type pump would need to achieve the higher pressures needed for high-rise residential sprinklers; this means much bigger pumps and motors.

Example

The example curves on the next slide illustrate the consequences of sizing a commercial pump to supply the residential system in a fairly typical new building:

Overall building height ~45m:

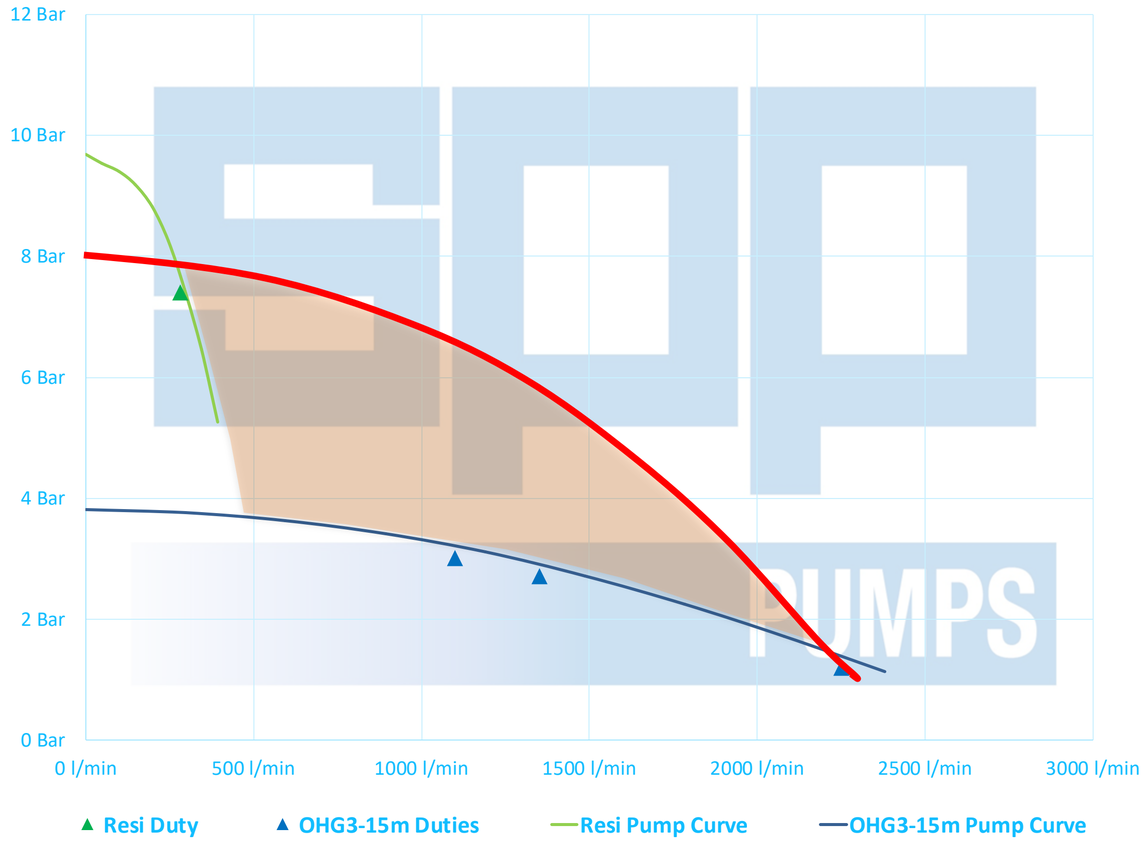
1 x Floor Basement
2 x Floors Retail & Offices
8 x Floors Residential

Commercial:
OHG3-15m

Resi to BS 9251

This is the layout of a project for which SPP have supplied pumpsets.

Example



RESIDENTIAL & COMMERCIAL – SEPARATE PUMPSETS

Residential pumpset (in green) requires a 5.5kW electric motor.

OHG3-15m pumpset (in blue) requires an 11kW electric motor.

RESIDENTIAL & COMMERCIAL – COMBINED PUMPSET

Combined pumpset (in red) requires a 45kW electric motor.

SUMMARY

By upsizing the commercial pumpset to provide the pressure needed for the residential system, we must oversize the pump and use an orifice plate to achieve OHG3-15m nominal.

By doing this, we cover an unnecessary area but a motor ~3x the power demand versus separate supplies from separate pumps.

Commercial Firepumps
Electric vs Diesel

CIBSE

BALMORAL

spp PUMPS

MARIOFF

PROJECT FIRE®

GRUNDFOS

THE SOCIETY OF PUBLIC HEALTH ENGINEERS

Why should we use diesel engine powered pumps?

The most common configuration for duty / standby fire pumps in urban settings is dual electric.

There are several benefits to considering diesel engine powered fire pumps:

POWER SUPPLIES

It should be considered that the electric power supply should be sized to accommodate the ‘worst case’ load.

When dual electric pumps are used, the electrical supply must be capable of delivering 1 x Locked Rotor Current (LRC) + 1 x Starting Current simultaneously.

GENERATOR SIZE

Generators capable of delivering 1 x LRC + 1 X Starting Current are big.

When a diesel pumpset is used, the generator doesn’t need to be sized to accommodate the electric pump set at all: *If the main power supply fails, the diesel pump is fully independent.*

ENVIRONMENTAL IMPACT

Large diesel powered generators are neither small nor clean.

Whilst every site is different, typically we would expect that a small diesel engine powered pump set and smaller generator would have a smaller environmental footprint than a large diesel generator.

Generator Sizing Example

Example of Generator Requirement:

DUAL ELECTRIC CONFIGURATION

A typical sprinkler pump for a building of approx. 50m, the pump would use a 55kW electric motor:

The generator should be able to accommodate:

1 x Locked Rotor Current (LRC)
1 x Starting Current

LRC = 774 A
Starting Current = 290 A (Based on Star Delta Start)

Generator must then be capable of supplying 1,064 Amps.

This is in addition to other life safety power requirements.

ELECTRIC & DIESEL CONFIGURATION

The fire pump supply requirement can be disregarded from the generator sizing.

As such, the generator will supply life safety systems such as smoke extraction, emergency lifts etc. but not the pump sets.

THERE'S MORE…

The example provided assumes a building of <55m (approx.) which will use dry risers.

If wet riser pumps are also needed, the generator must then accommodate an additional set of pumps, which are typically equal or larger in electrical demand to the sprinkler pumps.

For Balance…

Diesel engine powered fire pumps do have some challenges which need to be considered:

FUELLING

Diesel engines need fuel; this means that fuel must be moved to the fire pump room to be pumped into the fuel tank.

Fuel barrels are significant in size and weight, a clear path and suitable equipment is needed to move fuel to the fire pump room.

PHYSICAL SPACE

Diesel fire pumps are physically larger than electric fire pumps; as such, more space is required in the plantroom.

As well as the being larger pump sets, we recommend a larger space around the engine be available for maintenance access.

EXHAUST ROUTING

Diesel engines must discharge exhaust gas to atmosphere.

A suitable route to for the flue must be found, which can be tricky from the basement of tall building.

VENTILATION

Due to the heat radiated by a diesel engine, it is necessary to ensure that adequate ventilation is provided to the fire pump room to ensure that there is not excessive temperature rise when the pump is in operation.

What drives Sprinkler innovations?

Architects?

Public Health Engineers?

Mechanical engineers?

End users?

Building Managers?

Insurers?

Fire and Rescue Services?

Sprinkler innovation

Automated testing
Remote monitoring (preventative maintenance)
Faster installation
Sprinkler head aesthetics
Reducing pipework
Reducing water wastage (circulation)
Long term inspection techniques

Reducing water storage?

Tank Capacity & Sizing

- Capacity = Effective only
- Water capacity is dependent on a number of factors applicable to individual applications.
- Duration of water supply
- Full holding or reduced capacity
- Code standard requirements = eg. =
- Ordinary Hazard Group 1 – minimum full capacity 27,500 – 40,000 litres.
- New regulations to take into account new technology normally means more capacity

Sprinkler Tank Locations

Basement

Ground floor

Outside

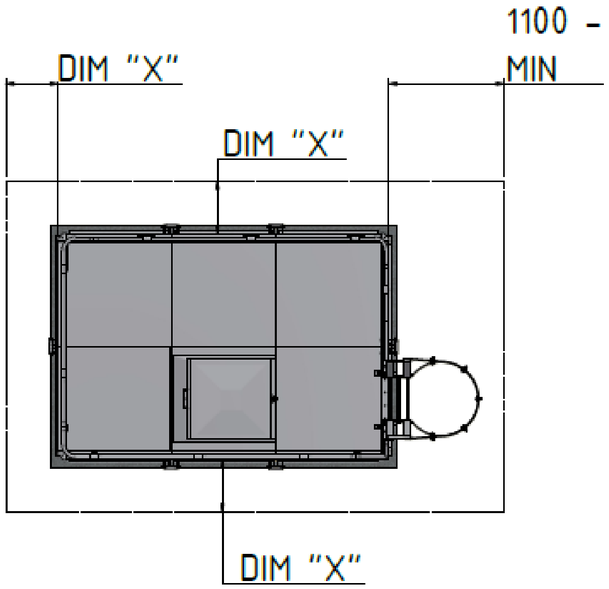
Common Design Problems

1. Tank height not taking into account high safety handrail.
2. Tank sizing not taking into account installation and maintenance space.
3. Size of tank not taking into account the correct freeboard and dead water.
4. Support bases raising up the tank and reducing the overhead space.

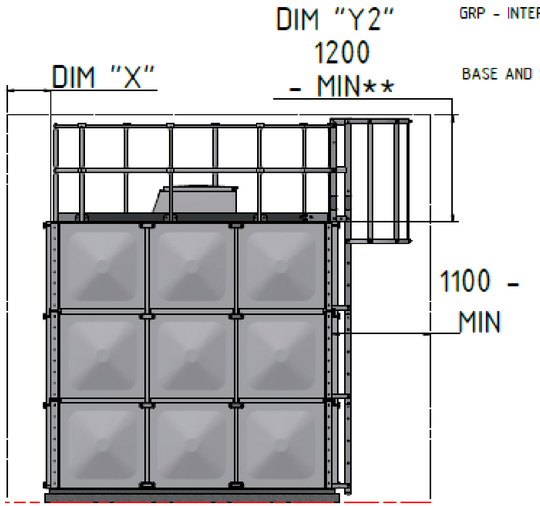
The Standard

How much space is needed?

INSTALLED VIEW



FLOAT VALVE CHAMBER AND LADDER/HANDRAIL



FLOAT VALVE CHAMBER AND LADDER/HANDRAIL

GRP - INTERNALLY FLANGED BASE TANKS (IFB)
- CLOSE CENTER BASE STEELS
LENGTHWAYS - BY BALMORAL
BASE AND SPATIAL REQUIREMENTS - OPTION 2

SPATIAL REQUIREMENTS

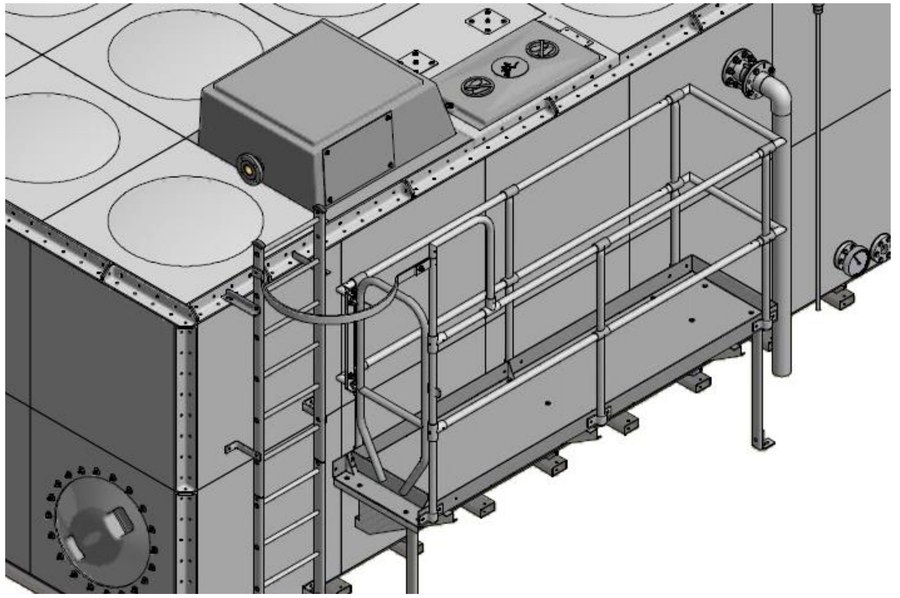
NOTES:
OD IS TAKEN FROM
EXTERNAL PANEL TO EXTERNAL PANEL
E.G - 3M TANK LENGTH - OD = 3160mm

* IF Y1 IS LESS THAN 750mm
BUT GREATER THAN 400mm
THEN SIDE ACCESS PLATES ARE
REQUIRED ON THE FLOAT VALVE CHAMBER

** IF Y2 IS LESS THAN 1200mm
BUT GREATER THAN 550mm
THEN HALF HEIGHT HANDRAIL/CAGE
IS REQUIRED.
(N/A FOR LPCB TANKS)

SPATIAL REQUIREMENTS - IFB	
TANK HEIGHT (m)	DIM X (mm)
1	OD + 500
1.5	OD + 500
2	OD + 500
2.5	OD + 650
3	OD + 650
3.5	OD + 850
4	OD + 850

Space Saving – The Roof



Remove the access to the roof altogether!

- Side Access Manways – low level so no work at height risk. People can be pulled out to safety.

- Side access Platforms – Stand safely in an enclosed area eliminating falling from height and making maintenance much easier.

- Side access float valve chambers – Rather than access to the top ensure the FVC is side plated.
- Maintenance hatch for high level switch from side access

Space Saving – The walls

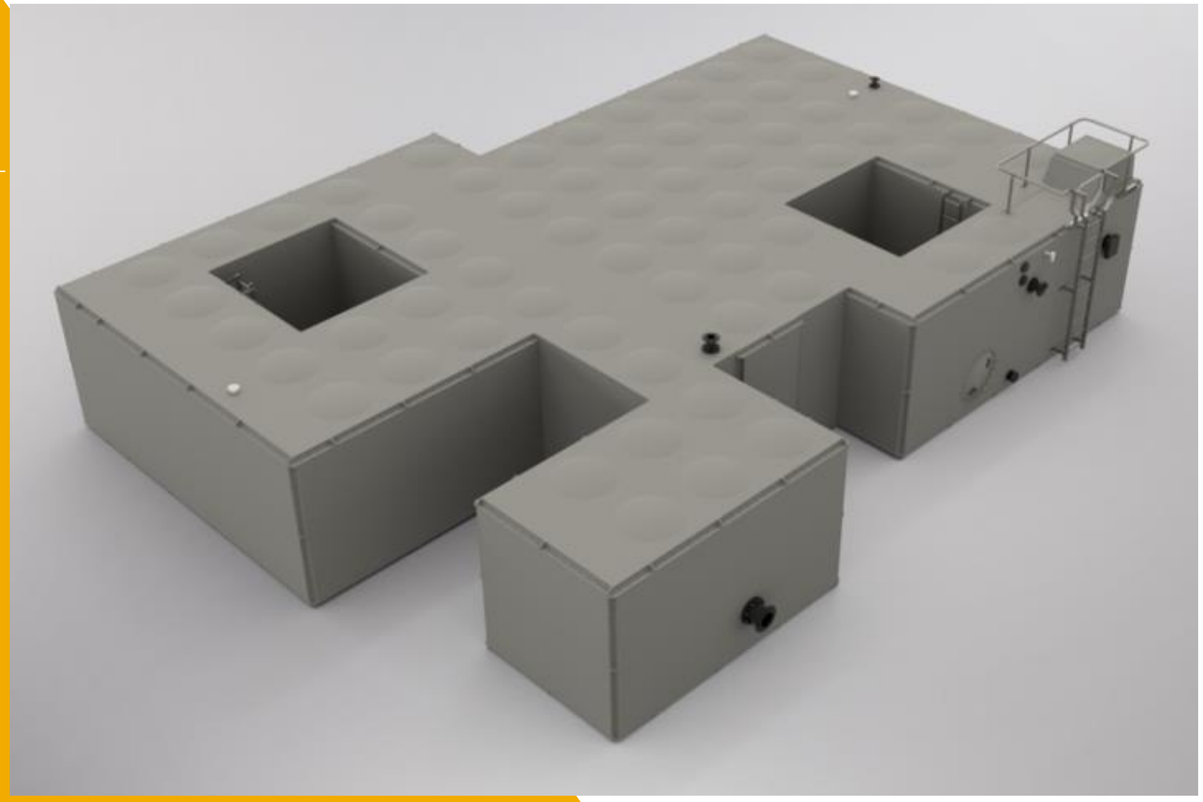
Internally Build Tanks (IBT)

- Can be built up to 50mm off one wall.
- Can be built up to 50mm off 2 adjacent walls.
- Can be built right up to columns.
- No special parts required.

Engineering Solutions

Irregular Polygon Tanks (IPTs)

- Internal Corners as well as external
- Can move to the shape of the wall
- Can step in for curved walls
- Can go around corners
- Can go around columns



As easy as ABC

A. Know the space needed around the tank.
B. If not enough space then use the options available for standard tanks to limit space
C. If still not enough space then where there is a will there is a way.

Questions

Andrew Fisher (Project Fire)
Wayne Weber (Grundfos)
Robert Speakman (SPP Pumps)
Peter Trzebinski (Balmoral Tanks)
Gregor Toland (Marrioff)

What System should I consider?

Note – The requirements on combined and dedicated power supplies differ and are not interchangeable

DESCRIPTION	COMBINED SYSTEMS (OPTION 1)	DEDICATED SYSTEMS (OPTION 2)
SPACE	Saves space	Needs more space for an additional pump set & water tank
POWER	Power is routed from plant room distribution board, which can create a vulnerability in the event of a fire	Dedicated power source from main site breaker in to sprinkler pump unit
ALARMS	Alarms will come only from system flow switches, and not from pump set.	Specific fire and fault alarms created by residential pump set, to alert site of any issues or activation.
TESTING / RUNNING	As the pump is run on a continuous basis, the pumps require less testing	Residential pump sets have built-in weekly test modes, requiring only annual manual testing
RESILIENCE	Any issues with a pump (or reduction in water supply) will result in this being powered off and a fault indication raised. Failure of control panel may result in all pumps being unavailable.	Designed to run to destruction in event of activation ignoring any faults and/or dry running.

What System should I consider?

Note – The requirements on combined and dedicated power supplies differ and are not interchangeable

DESCRIPTION	COMBINED SYSTEMS (OPTION 1)	DEDICATED SYSTEMS (OPTION 2)
DESIGN	Requires to be calculated with various parties upfront to ensure the potable booster is suitably sized	Easy to calculate with single contact.
RETROFIT	Dependent on existing system and peak demands	Easy to retrofit into existing premises. Smaller units can be connected direct to the mains water supply.
CONTAMINATION	A sprinkler system is a dead leg of stagnant water. This will then be connected to the main drinking water supply.	Completely separate from the drinking water supply, posing the lowest risk of contamination.
WATER SUPPLY	The tank must be suitable for day tank demands along with a fire water reserved which cannot be jeopardised. Increases the complexity in tank selecting and configurating.	Dedicated water tank means sized specifically for the fire system.

Key Components of a Sprinkler System

Water storage tank(s)

Pump(s)

Installation Control Valve(s) and trim

Piping network

Zone Isolation Valves

Flow-switches, pressure switches etc. (Activation detectors)

Sprinkler heads (actuation and discharge)

Additional drainage and flushing valves

Sprinkler Protection in Car Parks

BS EN 12845:2015

Listed as OH2
5 mm/min (144m^2 AMAO)
K80 or K115 heads
12m^2 max spacing
Separate un-zoned installation
Wet or dry installation
CPVC pipework possible

FPA technical bulletins

Listed as HHP3
12.5 mm/min (260m^2 AMAO)
K115 or K160 heads
9m^2 max spacing
Separate un-zoned installation
Wet or dry installation
CPVC pipework not permitted

BS 9251: 2021

Permitted up to 100m^2
5 mm/min (100m^2 AMAO)
K80 heads
12m^2 max spacing
Sperate zone recommended
Wet system
CPVC permitted

The problem with Car Parks

Sprinkler code standards (like many other regulations) have to keep up with changing trends and technologies.

Cars are now more problematic for fire than they were previously due to:

- Increased size, weight & volume
- Increased use of plastics
- Increased amount of electrical systems
- Increased use of batteries and charging technology

Multi-storey and underground car parks are particularly high risk as there are many cars parked close together and hot gases cannot easily escape.

- NFPA 88A (2023) now requires sprinkler protection for all covered car parks.
- NFPA 13 (2023) has increased discharge density in car parks by 33%
- IBC (2021) have introduced stricter rules for car parks

Car Parks

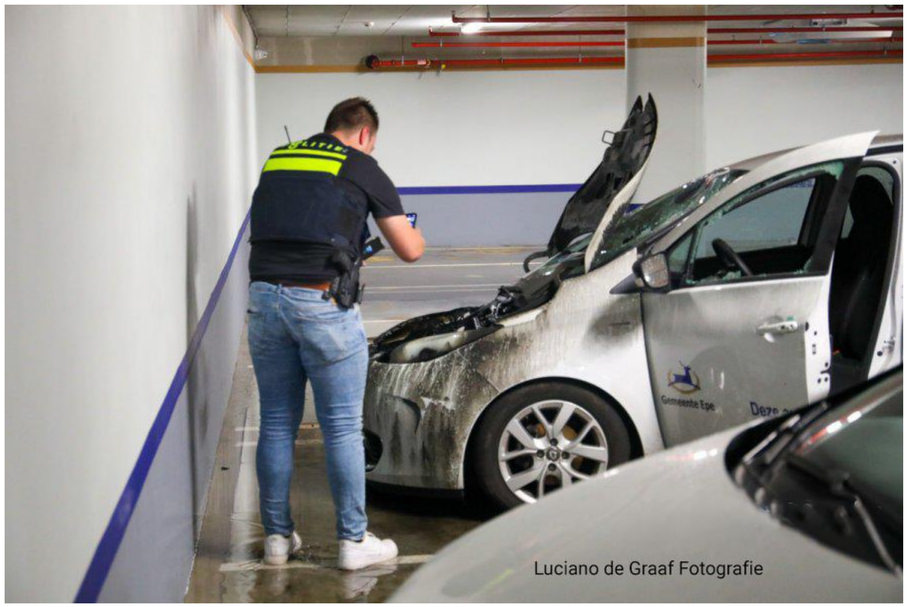
Fire Fighting in Car Parks

Established battery fires in electric cars are extremely difficult to deal with requiring large quantities of water over a long period of time. Water discharge is hindered by the common position of the battery on the underside of the car.

Batteries (and liquid fuel) does not spontaneously combust and so our aim is to stop a fire from taking hold of a car in the first place.

- Water run-off also requires careful consideration
- Improvements in battery technology are probably our best solution to this problem

Fire in underground car park with sprinkler protection in Epe (Netherlands)



Sprinklers in Car Parks

Higher Risk

No doubt risk has increased through wider cars, more plastics, more electrical systems, batteries and chargers.

More complex for F&RS.

Discharge Density

The sprinkler system is very likely to effective in preventing a small fire from taking hold in a battery.

Sprinklers at 12.5 or 5mm/min are unlikely to be effective in established car battery fires.

Technology Solution

Solid state batteries that do not rely upon a highly flammable electrolyte would be game changing.

Localised in-car fire protection is also a good option.

Common mistakes/issues

- Tank height sizing not taking into account handrail
- Tank sizing not taking into account installation/maintenance space
- Size of tank not taking into account the correct freeboard and deadwater
- Bases not suitable for the type of tank

- Smaller buildings mean smaller tanks and pump?
- Lack of coordination /with other trades or inaccuracy of drawings also positioning of mist/sprinkler heads vs other services.
- Location of key equipment and consequences of changing those locations, i.e. the tank might be below the pump therefore require booster pumps

Sprinkler Protection for Balconies

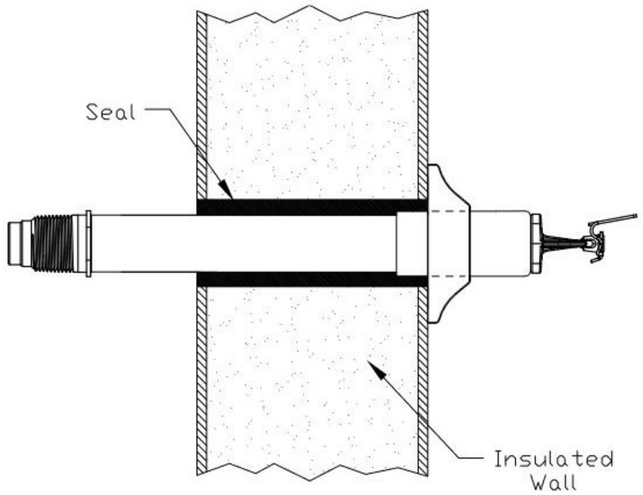
Balconies are listed as a permitted exception under BS 9251:2021.

However, this comes with the proviso that a risk assessment or fire strategy does not require it. A risk assessment would look at fire load, ignition source and potential use and misuse of the balcony area.

There have been several high-profile fires in high rise residential buildings (including Dubai) where a fire has started on a balcony and quickly spread up the building. Dubai now requires sprinkler protection on all balconies, under NFPA and IBC regulations, sprinkler protection can be required based on size and construction type.

Sprinkler Protection for Balconies

LFII Horizontal Dry Sprinklers
(Tyco)



Installation diagram
(Viking)

Other Solutions

Trace heating?
Insulated void space?
Tail-end dry pipework?
Actuated valve?

TB 202

(September 2022)

Sprinkler protection to buildings featuring residential occupancies – insurance requirements

“Sprinkler protection designed and installed in accordance with this Technical Bulletin will provide a minimum level of ‘Property Protection’ which is recognised by building insurers.

CIBSE

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TB202

- CPVC pipe usage limitations
- All bathrooms and external balconies protected
- Commercial areas can be protected via wet, dry or pre-action type installations
- Residential must be wet type installation
- Commercial to be pre-calculated or FHC methods
- Residential to be FHC calculated
- Residential areas to be protected using 5mm/min discharge density (up to 4 sprinkler heads)
- Car parks to be protected using new 12.5mm/min requirement (260m^2 AMAO)
- System to be zoned
- Separate ICVs for commercial and residential
- Water supplies to be superior single, superior twin or duplicate
- Car parks require 90min of duration (can be reduced capacity – town main fed)
- Fire and rescue service inlet required

Major Implications of TB202

Discharge Density

The discharge density of residential areas under 9251 is 2.8mm/min. TB202 brings the discharge density in line with OH occupancies to 5mm/min.

+

Commercial Car Parks

Car parks under TB202 will be protected just like a full commercial car park and require 12.5mm/min over an area of operation of 260m^2. Duration is 90mins.

=

Larger Water Storage

The increase in water storage could be a little to a lot. It mostly depends on the presence and size of any car park as this will be the highest area of demand.

Q & A

Slido.com

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