ABCB

National Construction Code

Handbook

Cross-connection control

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Preface

The Inter-Government Agreement (IGA) that governs the Australian Building Codes Board (ABCB) places a strong emphasis on reducing reliance on regulation, including consideration of non-regulatory alternatives such as non-mandatory handbooks and protocols.

This Handbook is one of a series produced by the ABCB developed in response to comments and concerns expressed by government, industry and the community that relate to the built environment. The topics of Handbooks expand on areas of existing regulation or relate to topics which have, for a variety of reasons, been deemed inappropriate for regulation. They provide non-mandatory advice and guidance.

The Cross-connection control Handbook assists in fostering awareness and understanding of cross-connection control. It addresses issues in generic terms, and is not a document that sets out regulatory requirements or detailed technical specifications. It is expected that this Handbook will be used to guide the development of solutions relevant to specific situations in accordance with the generic principles and criteria contained herein.

Acknowledgements

The ABCB acknowledges the valuable contribution of the United States Environmental Protection Agency (US-EPA), who kindly granted the ABCB permission to reproduce and adapt content from the US-EPA Cross-Connection Control Manual in this Handbook.

Contents

REMINDER

This Handbook is not mandatory or regulatory in nature and compliance with it will not necessarily discharge a user's legal obligations. The Handbook should only be read and used subject to, and in conjunction with, the general disclaimer at page i.

The Handbook also needs to be read in conjunction with the relevant legislation of the appropriate State or Territory. It is written in generic terms and it is not intended that the content of the Handbook counteract or conflict with the legislative requirements, any references in legal documents, any handbooks issued by the Administration or any directives by the Appropriate Authority.

1 Background

The NCC is a performance-based code containing all Performance Requirements for the construction of buildings. To comply with the NCC, a solution must achieve compliance with the Governing Requirements and the Performance Requirements. The Governing Requirements contain requirements about how the Performance Requirements must be met. A building, plumbing or drainage solution will comply with the NCC if it satisfies the Performance Requirements, which are the mandatory requirements of the NCC.

This Handbook was developed to provide guidance to practitioners seeking to demonstrate compliance with the cross-connection control requirements in NCC Volume Three – also known as the Plumbing Code of Australia (PCA).

1.1 Scope

This Handbook has been developed to assist PCA users in understanding and applying cross-connection control. It will be of interest to all parties who are involved in selecting or assessing elements of buildings that must comply with the NCC.

The Handbook is structured to first provide the reader with an understanding of important terms and terminology used in the PCA and then an overall introduction to the concept of cross-connection controls.

Further reading on this topic can be found with the references located in the body of this Handbook.

1.2 Design and approval of Performance Solutions

The design and approval processes for cross-connection control solutions is expected to be similar to that adopted for demonstrating compliance of other PCA Performance Solutions. The design approval process for Performance Solutions varies between the responsible State and Territory governments and requirements should be checked for the relevant jurisdiction.

Notwithstanding the quantified input and acceptance criteria, other qualitative aspects of cross-connection controls, which are discussed in this Handbook, require assessment and analysis throughout the design and approval process. The advice of an appropriately qualified person should be sought to undertake this assessment and analysis where required, and may be aided by early involvement from regulatory authorities, peer reviewer(s) and / or a technical panel as appropriate to the State or Territory jurisdictions.

1.3 Using this Handbook

General information about complying with the NCC and responsibilities for building and plumbing regulation is provided in Appendix A of this Handbook. Acronyms and symbols used in this Handbook are provided in Appendix B. Some terms used in this Handbook have a specific meaning. Definitions for these terms can be found in:

- Schedule 3 of NCC Volume Three (the PCA); or
- AS/NZS 3500.0 Plumbing and drainage—Glossary of terms.

Different styles are used in this Handbook to identify types of content that have different purposes. Examples of these styles are provided below:

NCC extracts

Examples

Alerts

Reminders

2 Cross-connections and backflow prevention

This chapter defines, in general terms, cross-connections, backflow prevention and the different roles and responsibilities of cross-connection control. It also explains the role of Hazard Ratings.

2.1 What is a cross-connection?

Cross-connections are defined in AS/NZS 3500.0 as any connection or arrangement, physical or otherwise, between any drinking water supply system either directly or indirectly connected to a water main, and any fixture, storage tank, receptacle, equipment or device through which it may be possible for any non-drinking water, used, unclean, polluted or contaminated water, or any other substance, to enter any part of such drinking water system under any conditions.

In essence, cross-connections are the links through which it is possible for contaminants to enter a water supply. The contaminant enters the water supply when the pressure at the source of contamination exceeds the pressure of the water supply. This action may be called backsiphonage or backpressure. Essentially, it is a reversal of the hydraulic gradient (flow direction) that can be produced in a variety of circumstances. A cross-connection may be any actual or potential connection between two separate water supplies.

Cross-connections can exist not only between water supplies from different sources, e.g. drinking water and recycled water, but also between a water supply and any source of contamination to which it may be connected. These sources can include used or unclean water, solids, gases or any other substance that would be considered a contaminant should it enter a water supply.

There are two basic types of cross-connection. The first is a direct cross-connection where backflow may be induced by way of either backpressure or backsiphonage. The second is an indirect cross-connection, which will only enable backflow to occur when induced by backsiphonage. Cross-connections can be controlled, i.e. rendered safe, by the installation of backflow prevention. Backflow prevention is described at 2.2 below.

2.2 What is backflow prevention?

Backflow is defined in AS/NZS 3500.0 as: (1) flow in a direction contrary to the normal or intended direction of flow; or (2) the unintended flow of water from a potentially polluted source into a drinking water supply. There are two ways that backflow can occur; through backpressure and backsiphonage. Backpressure is caused by the difference between the pressure within a water service and a higher pressure within any vessel or pipework to which it is connected. Backsiphonage is caused when the water supply pressure falls below atmospheric pressure. Backpressure and backsiphonage are explained in more detail in Chapter 3.

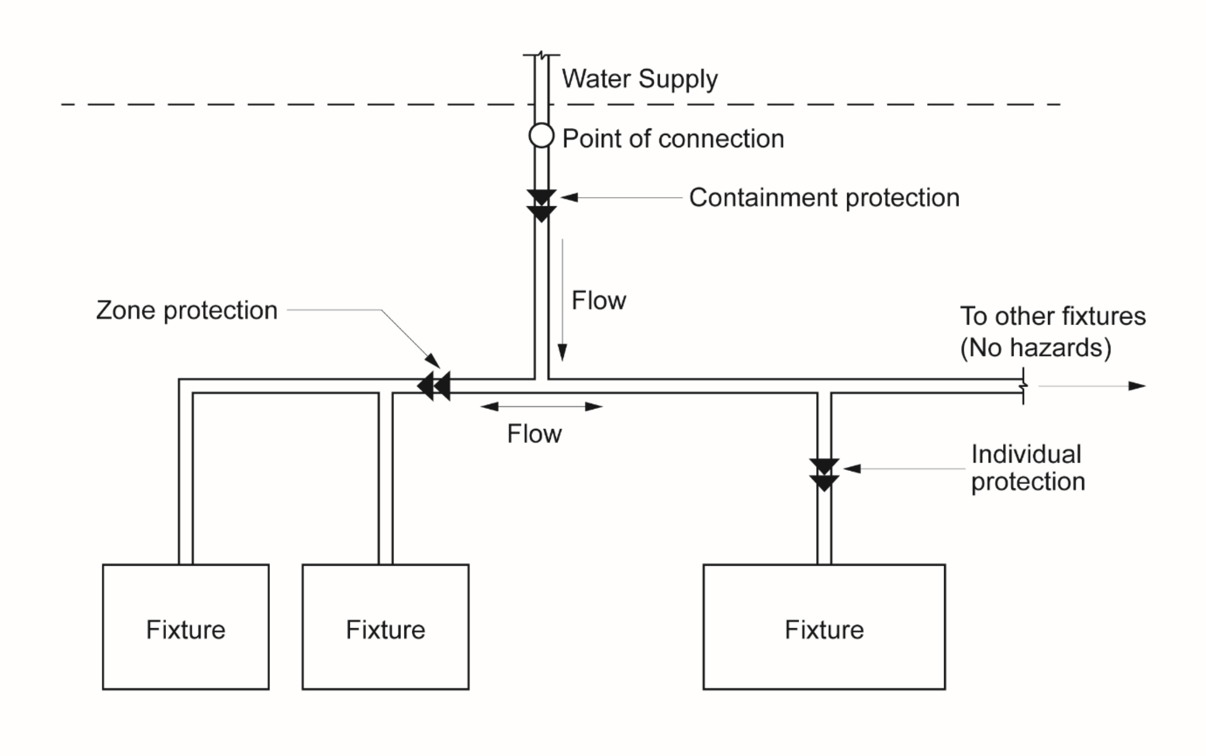
A backflow prevention device is a device installed to prevent the reversal of flow extending beyond a given point within the water service. A backflow prevention device may be an air gap, break tank or mechanical device designed to prevent the reversal of flow of water or contaminants into the water service or water supply.

There are three levels of backflow prevention:

- Individual protection, being the installation of a backflow prevention device at the point where a water service connects to an individual fixture or appliance.
- Zone protection, being the installation of a backflow prevention device at specific sections of a water supply system within a building or facility where there are multiple fixtures or appliances, with no individual backflow prevention devices installed or devices not compliant with the Hazard Rating.
- Containment protection, being the installation of a backflow prevention device at the point of connection of a Network Utility Operator's (NUO) water supply to a site. Water downstream of a containment device is considered to be drinking water unless there are unprotected hazards within the premises. The use of individual protection and / or zone protection devices against these hazards is provided to prevent contamination of the drinking water supply.

Figure 2.1 shows the different roles of individual, zone and containment protection.

Figure 2.1 Individual, zone and containment protection



2.3 Roles and responsibilities

Containment protection is usually regulated by NUOs (water authorities, councils and the like), while zone and individual protection falls within the role of State and Territory plumbing regulatory authorities.

Alert

The information in this section is intended as general information only that reflects a common arrangement of roles and responsibilities for cross-connection control. Advice on the specific arrangements in each State or Territory should be sought from the authority having jurisdiction.

2.4 Use of Hazard Ratings

A 'Hazard Rating' describes the potential health consequences of water contamination occurring via a cross-connection. In the PCA, cross-connections are rated according to three levels of hazard, which take into account the toxicity of the potential contaminant and the consequences of it entering a water supply.

The three levels of Hazard Rating are as follows:

- **High Hazard**: where contamination of the water supply has the potential to cause death.
- **Medium Hazard**: where contamination of the water supply has the potential to endanger health.
- **Low Hazard**: where contamination of the water supply would cause a nuisance, but would not endanger health.

These terms are defined in Schedule 3 of the PCA and in Section 4 of AS/NZS 3500.1. Hazard Ratings are used to determine the selection of backflow prevention for each cross-connection and, in some States and Territories, as a trigger for certain devices to be included in registration and testing programs.

The Hazard Rating process is applied on two levels; first to address specific hazards that may exist on the premises (zone and individual protection), and second to address the overall hazard posed by the premises to the water supply to which it is connected (containment protection).

Alert

In some jurisdictions, the highest Hazard Rating identified within the premises determines the lowest Hazard Rating which can be assigned to the site. For example, if the highest rating used for zone protection within the premises is Medium Hazard, the lowest level of containment protection must be at least Medium Hazard.

In the PCA, Hazard Ratings are used in the Deemed-to-Satisfy (DTS) Provisions of Part B5 (explained in Chapter 4).

Most backflow prevention devices are certified and authorised according to AS/NZS 2845.1, which sets out the level of Hazard Rating that different devices are suitable to protect against.

The WaterMark Schedule of Products (WMSP) contains a comprehensive list of products which, through a risk assessment, have been predetermined as requiring WaterMark certification[1]. Likewise, the WaterMark Schedule of Excluded Products (WMEP) lists products that have been predetermined as not requiring WaterMark certification. The WaterMark Administration[2] updates the WMSP and WMEP as new products undergo risk assessment and as product specifications are approved for use or suspended.

Alert

For more information on the WaterMark Certification Scheme and to view the WMSP, WMEP and WMPD, visit the ABCB website (abcb.gov.au).

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[1] The WaterMark Certification Scheme (Scheme) is a mandatory certification scheme for plumbing and drainage products to ensure they are fit for purpose and appropriately authorised for use in plumbing and drainage installations.

[2] The ABCB manages and administers the Scheme as a national scheme. The NCC, Volume Three requires certain plumbing and drainage products to be certified (listed on the Product Database) and authorised for use in a plumbing or drainage installation. These materials and products are certified and authorised for use.

3 Theory of backflow and backpressure

This chapter explains the hydraulic factors that cause backflow, including backsiphonage and backpressure. Understanding these factors is important for identifying potential cross-connections and deciding on appropriate backflow prevention.

3.1 General principles

Cross-connections are the links through which it is possible for contaminants to enter a water supply. The polluting substance, in most cases a liquid, tends to enter the water supply if the net force acting upon the liquid acts in the direction of the water supply. Two factors are therefore essential for backflow to occur. First, there must be a link between the two systems. Second, the resultant force must be toward the water supply.

An understanding of the principles of backpressure and backsiphonage requires an understanding of the terms frequently used in their discussion. Force, unless completely resisted, will produce motion. Weight is a type of force resulting from the earth's gravitational attraction. Pressure (P) is a force-per-unit area, such as kilopascals (kPa). Atmospheric pressure is the pressure exerted by the weight of the atmosphere above the earth.

Pressure may be referred to using an absolute scale, kPa absolute (kPaA), or gauge scale, kPa gauge (kPaG). Absolute pressure and gauge pressure are related. Absolute pressure is equal to the gauge pressure plus the atmospheric pressure. At sea level the atmospheric pressure is 101.3 kPaA. The formula below demonstrates the relationship between kPaA and kPaG:

$$P_{\text{absolute}} = P_{\text{guage}} + 101.3 \text{ kPa}$$

or

$$P_{\text{gauge}} = P_{\text{absolute}} - 101.3 \text{ kPa}$$

In essence, absolute pressure is the total pressure. Gauge pressure is simply the pressure read on a gauge. If there is no pressure on the gauge other than atmospheric, the gauge would read zero and the absolute pressure would be equal to 101.3 kPa, which is the atmospheric pressure.

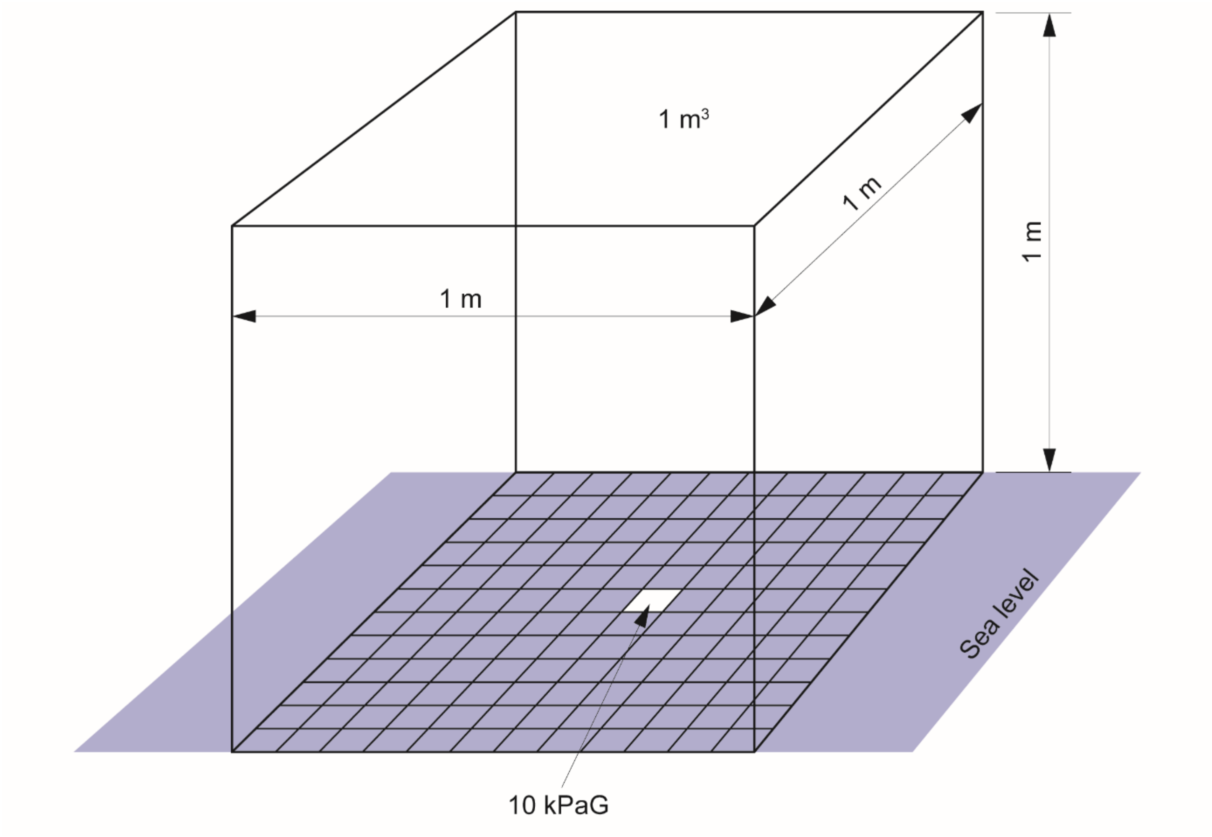
The term ‘vacuum’ indicates that the absolute pressure is less than the atmospheric pressure and that the gauge pressure is negative. A complete or total vacuum would mean a pressure of 0 kPaA or -101.3 kPaG. Since it is impossible to produce a total vacuum, the term vacuum, as used in this Handbook, will mean all degrees of partial vacuum. In a partial vacuum, the pressure would range from slightly less than 101.3 kPaA (0 kPaG) to slightly greater than 0 kPaA (-101.3 kPaG).

Backsiphonage results in fluid flow in an undesirable or reverse direction. It is caused by atmospheric pressure exerted on a pollutant liquid forcing it toward a water supply system that is under a vacuum. Backpressure refers to the reversal of flow produced by the differential pressure existing between two systems, both of which are at pressures greater than atmospheric.

3.2 Water pressure

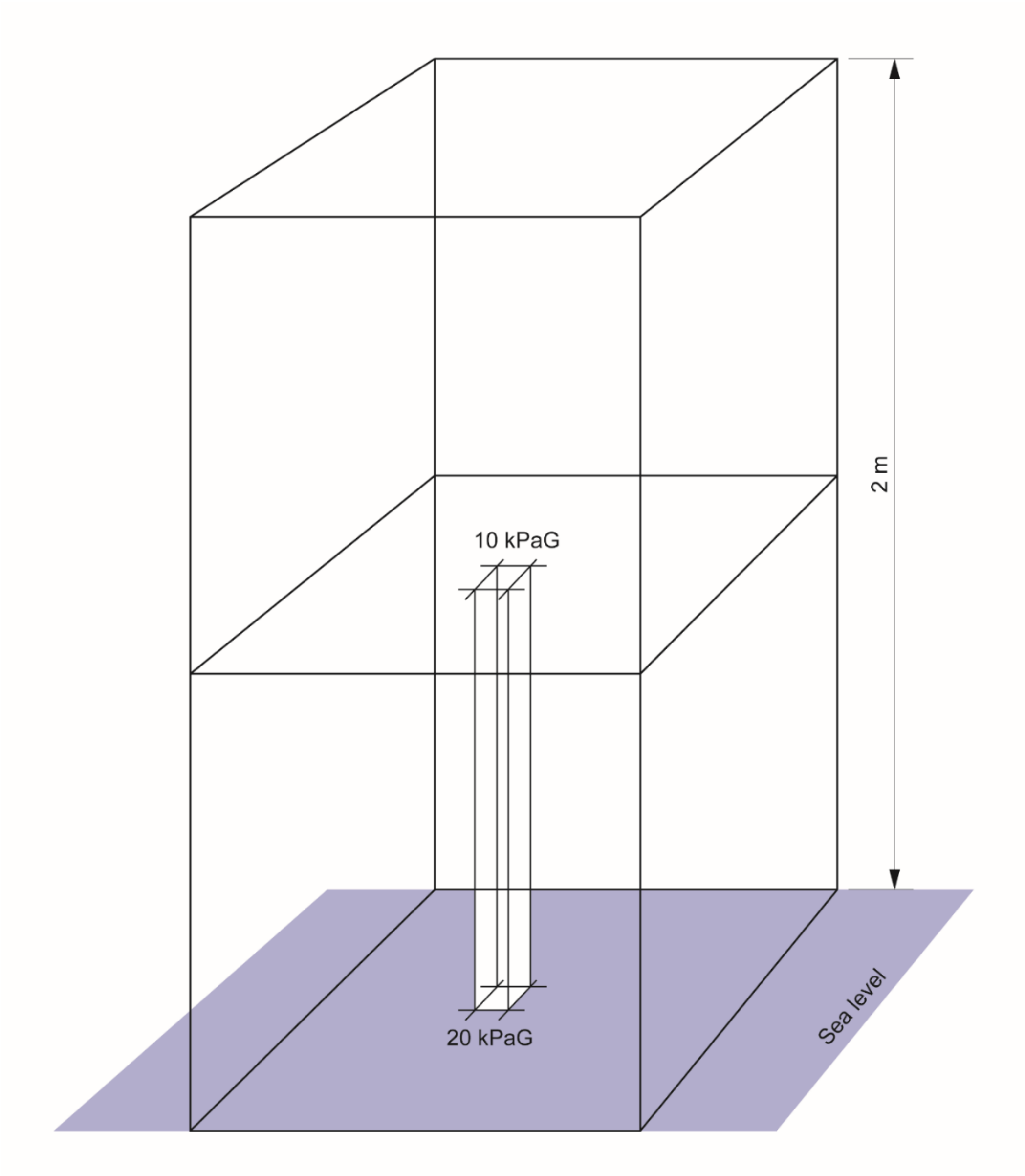
For an understanding of the nature of pressure and its relationship to water depth, consider the pressure exerted on the base of a cubic metre of water at sea level (see Figure 3.1). The average pressure exerted by a cubic metre of water is 10 kPa (i.e. 10 Pascals per millimetre of height). This applies regardless of the shape or area of the base — the only variable is the height.

Figure 3.1 Pressure exerted by 1 metre of water at sea level



Suppose another cubic metre of water was placed directly on top of the first (see Figure 3.2). The pressure on the top surface of the first cube which was originally atmospheric, or 0 kPaG, would now be 10 kPaG as a result of the superimposed cubic metre of water. The pressure on the base of the first cube would also be increased by the same amount to 20 kPaG, or two times the original pressure.

Figure 3.2 Pressure exerted by 2 metres of water at sea level



If this process was repeated with a third cubic metre of water, the pressures at the base of each cube would be 30 kPaG, 20 kPaG, and 10 kPaG, respectively. It is evident that pressure varies with depth below a free water surface; in general each metre of elevation change, within a liquid, changes the pressure by an amount equal to the weight-per-unit area of 1 metre of the liquid. The rate of increase for water is 10 kPaG per metre of depth.

Frequently, water pressure is referred to as ’head pressure‘ or just ’head’, and is expressed in units of metres of water. One metre of head would be equivalent to the pressure produced at the base of a column of water 1 metre in depth. 1 metre of head or 1 metre of water is equal to 10 kPaG. One hundred metres of head is equal to 1000 kPaG.

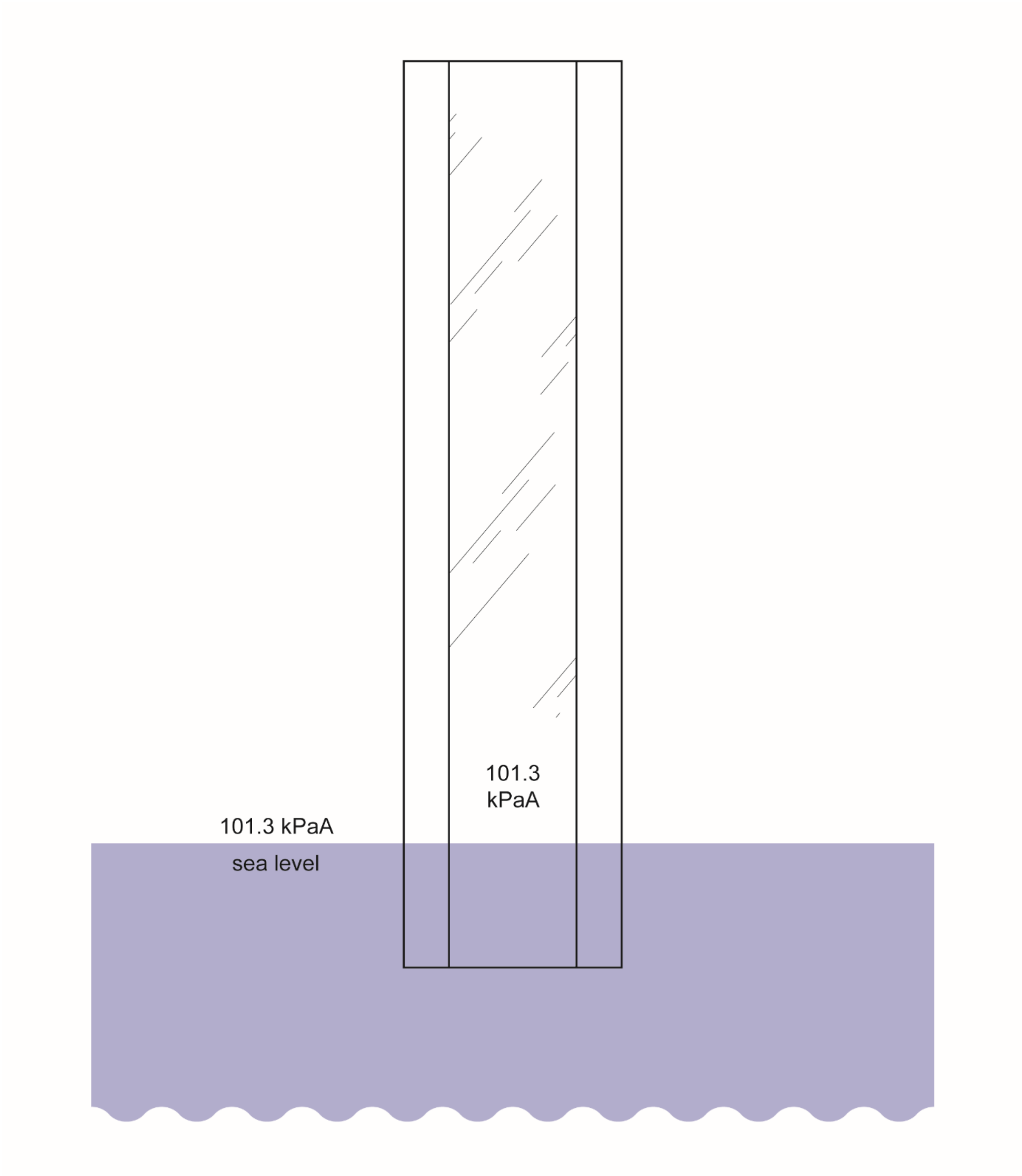
Reminder

The pipe sizing calculations used in AS/NZS 3500.1 are based on water pressure in terms of metres of ‘head’. 1 metre of head is equivalent to 10 kPa of pressure, calculated in the way described above.

3.3 Siphon theory

Figure 3.3 depicts the atmospheric pressure on a water surface at sea level. An open tube is inserted vertically into the water; atmospheric pressure, which is 101.3 kPaA, acts equally on the surface of the water within the tube and on the outside of the tube.

Figure 3.3 Pressure on the free surface of a liquid at sea level



If, as shown in Figure 3.4, the tube is slightly capped and a vacuum pump is used to evacuate all the air from the sealed tube, a vacuum with a pressure of 0 kPaA is created within the tube. Because the pressure at any point in a static fluid is dependent upon the height of that point above a reference line, such as sea level, it follows that the pressure within the tube at sea level must still be 101.3 kPaA. This is equivalent to the pressure at the base of a column of water 10.33 m high and with the column open at the base, water would rise to fill the column to a depth of 10.33 m. In other words, the weight of the atmosphere at sea level exactly balances the weight of a column of water 10.33 m in height. The absolute pressure within the column of water in Figure 3.4 at a height of 3.5 m is equal to 66.9 kPaA. This is a partial vacuum with an equivalent gauge pressure of -34.5 kPaG.

As a practical example, assume the water pressure at a closed tap on the top of a 30.5 m high building to be 137.9 kPaG; the pressure on the ground floor would then be 436.4 kPaG. If the pressure at the ground were to drop suddenly due to a heavy demand in the area to 229.6 kPaG, the pressure at the top would be reduced to -68.9 kPaG. If the building's water system was airtight, the water would remain at the level of the tap because of the partial vacuum created by the drop in pressure. However, if the tap was opened, the vacuum would be broken and the water level would drop to a height of 23.5 m above the ground. Thus, the atmosphere was supporting a column of water 7.01 m high.

Figure 3.4 Effect of evacuating air from a column

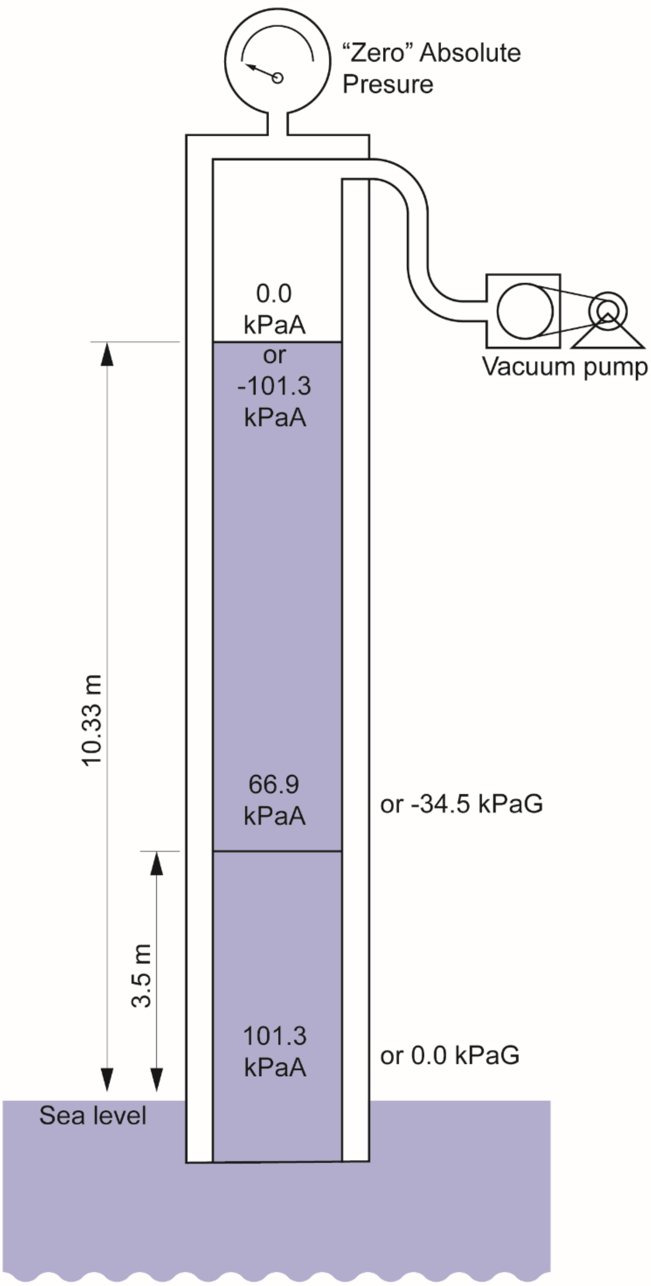
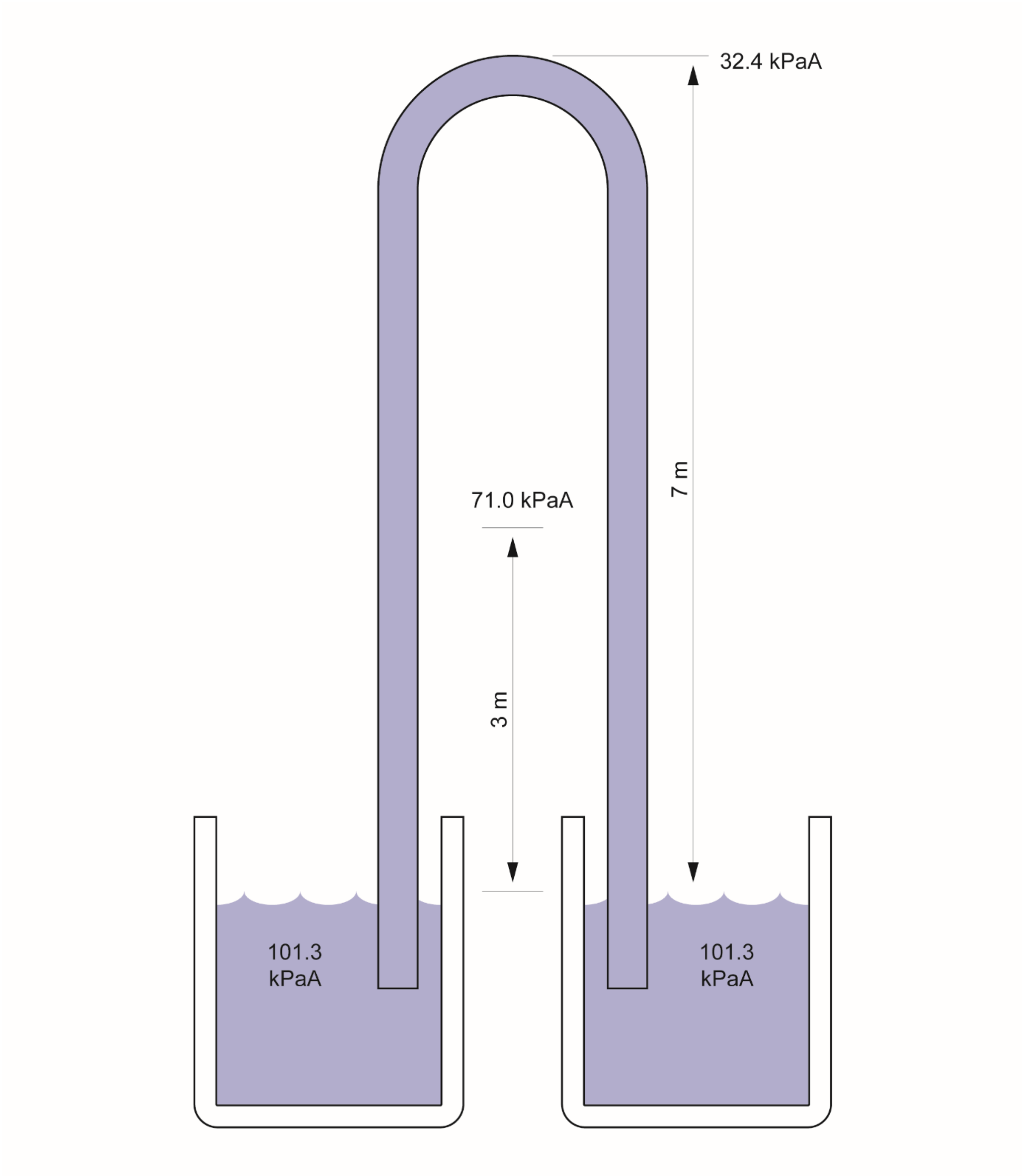


Figure 3.5 is a diagram of an inverted U-tube that has been filled with water and placed in two open containers at sea level.

If the open containers are placed so that the liquid levels in each container are at the same height, a static state will exist and the pressure at any specified level in either leg of the U-tube will be the same.

Figure 3.5 Pressure relationships in a continuous fluid system at the same elevation



The equilibrium condition is altered by raising one of the containers so that the liquid level in one container is 1.5 m above the level of the other (see Figure 3.6). Since both containers are open to the atmosphere, the pressure on the liquid surfaces in each container will remain at 101.3 kPaA. If it is assumed that a static state exists, momentarily, within the system shown in Figure 3.6, the pressure in the left tube at any height above the free surface in the left container can be calculated. The pressure at the corresponding level in the right tube above the free surface in the right container may also be calculated.

As shown in Figure 3.6, the pressure at all levels in the left tube would be less than at corresponding levels in the right tube. In this case, a static condition cannot exist because fluid will flow from the higher pressure to the lower pressure; the flow would be from the right tank to the left tank. This arrangement will be recognised as a siphon. The crest of a siphon cannot be higher than 10.33 m above the upper liquid level, since atmosphere cannot support a column of water greater in height than 10.33 m.

Figure 3.6 Pressure relationships in a continuous fluid system at different elevations

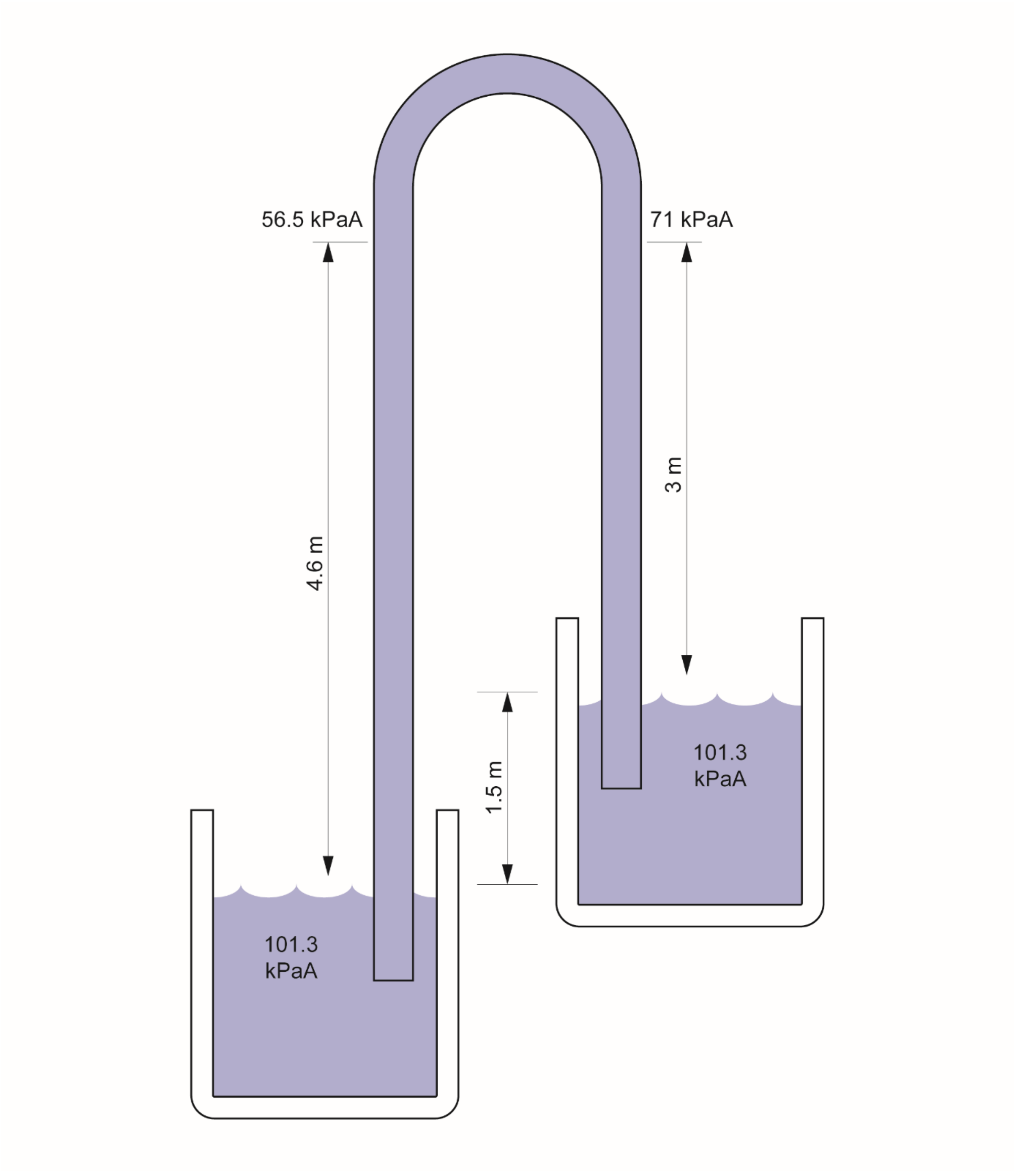
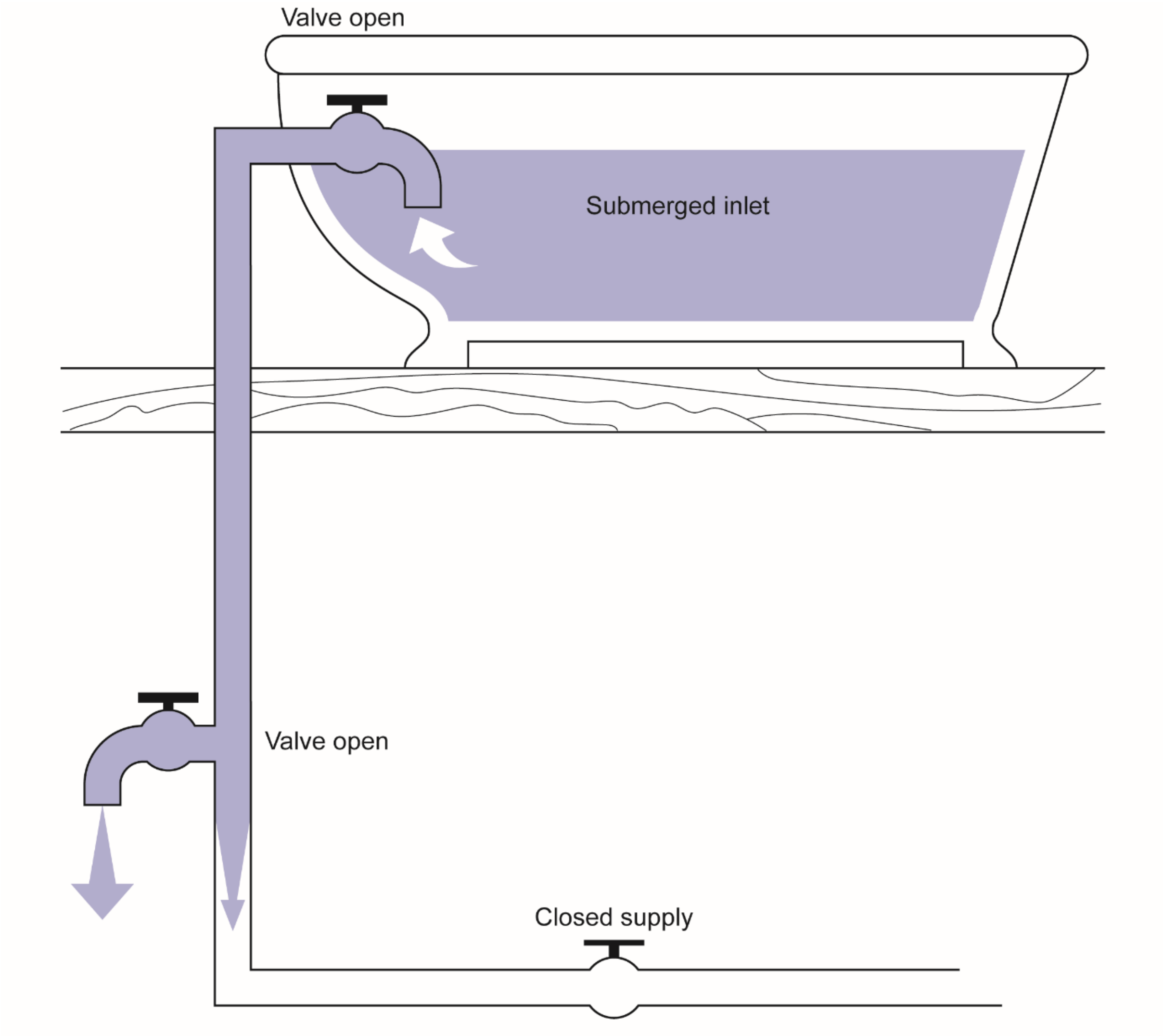


Figure 3.7 shows how this siphon principle can be hazardous in a plumbing system. If the supply valve is closed, the pressure in the line supplying the tap is less than the pressure in the supply line to the bathtub. Therefore flow will occur through siphonage, from the bathtub to the open tap.

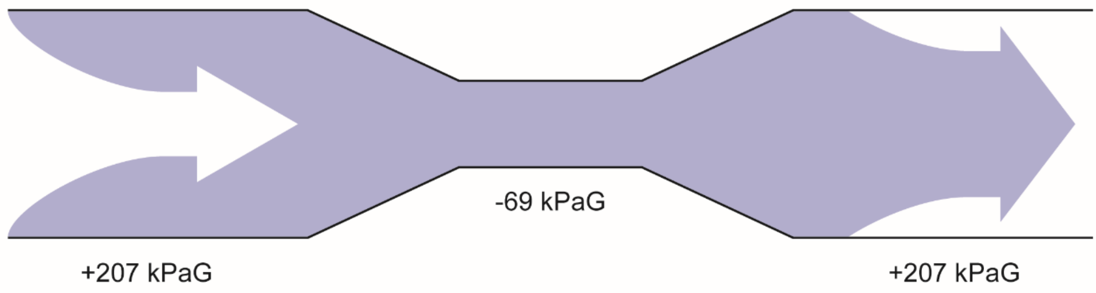
Figure 3.7 Backsiphonage in a plumbing system



The siphon actions cited have been produced by reduced pressures resulting from a difference in the water levels at two separated points within a continuous fluid system.

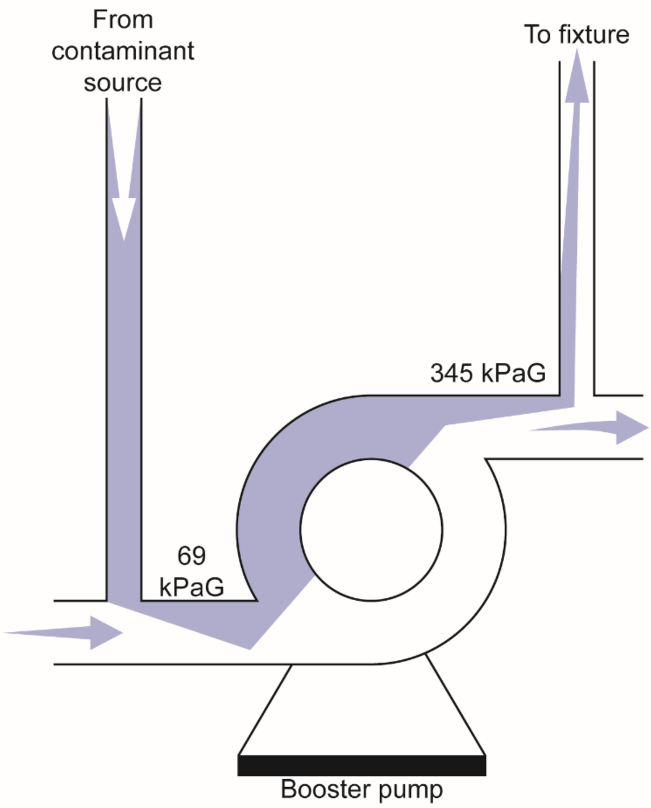
Reduced pressure may also be created within a fluid system as a result of fluid motion. One of the basic principles of fluid mechanics is the principle of conservation of energy. Based upon this principle, it may be shown that as a fluid accelerates, as shown in Figure 3.8, the pressure is reduced. As water flows through a constriction such as a converging section of pipe, the velocity of the water increases; as a result, the pressure is reduced. Under such conditions, negative pressures may be developed in a pipe. The simple aspirator is based on this principle. If this point of reduced pressure is linked to a source of contamination, backsiphonage of the contaminant can occur.

Figure 3.8 Negative pressure created by constricted flow



One of the common occurrences of dynamically reduced pipe pressures is found on the suction side of a pump. In many cases similar to the one illustrated in Figure 3.9, the line supplying the booster pump is undersized or does not have sufficient pressure to deliver water at the rate at which the pump normally operates. The rate of flow in the pipe may be increased by a further reduction in pressure at the pump intake. This often results in the creation of negative pressure at the pump intake. This negative pressure may become low enough in some cases to cause vaporisation of the water in the line. In the illustration shown, flow from the source of pollution would occur when pressure on the suction side of the pump is less than pressure of the pollution source; this is backpressure, which is discussed below.

Figure 3.9 Dynamically reduced pipe pressures



The preceding discussion has described some of the means by which negative pressures may be created and which frequently occur to produce backsiphonage. In addition to the negative pressure or reversed force necessary to cause backsiphonage and backflow, there must also be the cross-connection or connecting link between the water supply and the source of contamination. Two basic types of connections may be created in piping systems. These are the solid pipe with valve connection and the submerged inlet.

Figure 3.10 and Figure 3.11 show solid connections. This type of connection is often installed where it is necessary to supply an auxiliary piping system from the water supply. It is a direct connection of one pipe to another pipe or receptacle.

Figure 3.10 Valved connection between drinking water and non-drinking water

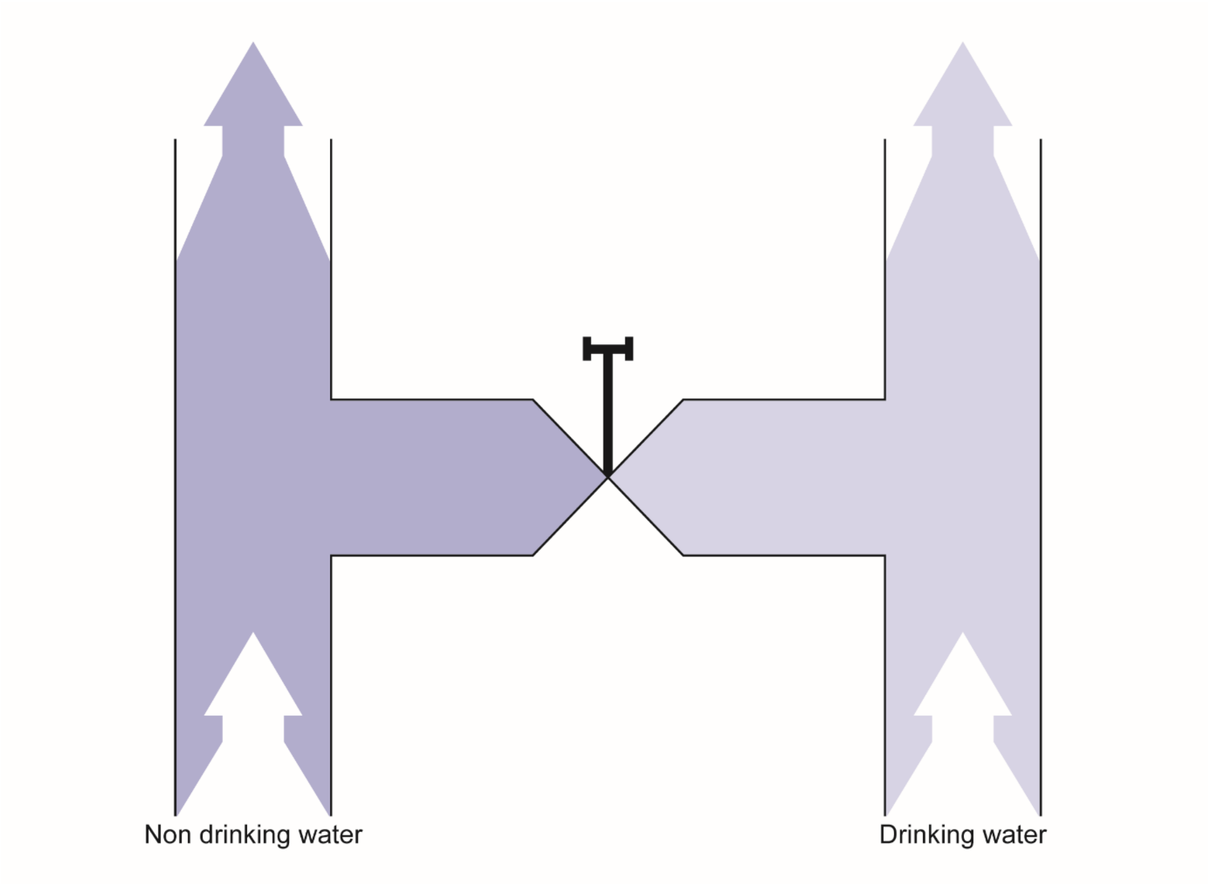
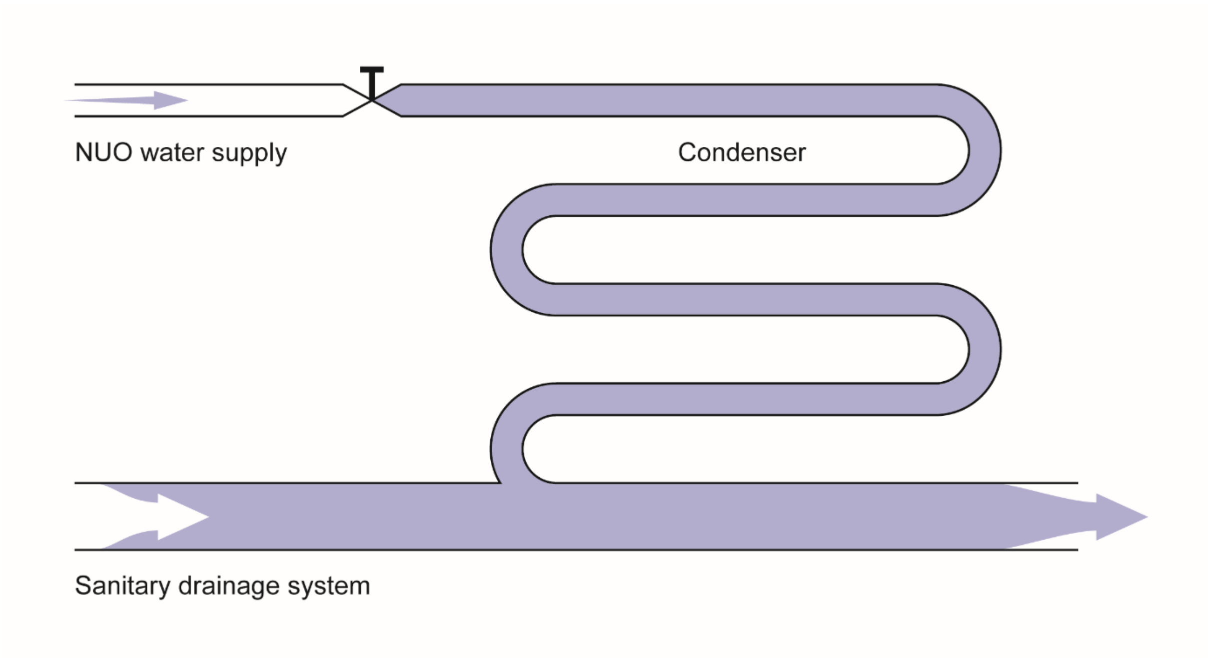


Figure 3.11 Valved connection between water supply and sanitary drainage system



Submerged inlets are found on many common plumbing fixtures and are sometimes necessary features of the fixtures if they are to function properly. Examples of this type of design are siphon-jet urinals or water closets, flushing rim slop sinks, and dental cuspidors.

Older style bathtubs and lavatories had supply inlets below the flood level rims, but modern sanitary design has minimised or eliminated this hazard in new fixtures. Chemical and industrial process vats sometimes have submerged inlets where the water pressure is used as an aid in diffusion, dispersion and agitation of the vat contents. Even though the supply pipe may come from the floor above the vat, backsiphonage can occur as it has been shown that the siphon action can raise a liquid such as water almost 10.5 m.

Some submerged inlets that are difficult to control are those which are not apparent until a significant change in water level occurs or where a supply may be extended below the liquid surface by means of a hose or auxiliary piping. A submerged inlet may be created in numerous ways, and its detection in some of these subtle forms may be difficult.

3.4 Backpressure

Backpressure, as described in this Handbook, refers to reversed flow due to backpressure other than siphonic action. Any interconnected fluid systems in which the pressure of one exceeds the pressure of the other may have flow from one to the other as a result of the pressure differential. The flow will occur from the zone of higher pressure to the zone of lower pressure. This type of backflow is of concern in buildings where two or more piping systems are utilised. For example, the drinking water service is usually under pressure from the NUO’s water main.

Occasionally, a booster pump is used. The auxiliary system is often pressurised by a centrifugal pump, although backpressure may also be caused by gas or steam pressure from a boiler. A reversal in differential pressure may occur when pressure in the NUO’s water supply drops, for some reason, to a pressure lower than that in the plumbing system to which the water supply is connected.

The most positive method of avoiding this type of backflow is the total or complete separation of the two systems. Other methods used involve the installation of mechanical devices.

Dual piping systems are often installed for extra protection in the event of an emergency or possible mechanical failure of one of the systems. Fire protection systems are an example. Another example is the use of dual water connections to boilers. These installations are sometimes interconnected, thus creating a health hazard.

4 PCA Performance Requirements for cross-connection control

This chapter explains the mandatory Performance Requirements of the PCA that must be met for any plumbing installation.

4.1 Overview of the Performance Requirements

Performance Requirements specify the minimum level of performance for all plumbing and drainage installations. This includes relevant materials, components, design factors, and construction methods. The Performance Requirements set the level of performance that must be achieved by any compliance solution. The PCA Performance Requirements relevant to cross-connection control are explained in Sections 4.2 to 4.4.

The PCA provides options for satisfying the Performance Requirements. These are a Performance Solution, a DTS Solution, or a combination of both. This allows flexibility as well as innovation.

A Performance Solution is any solution that can meet the Performance Requirements, other than a DTS Solution. A Performance Solution may differ in whole or in part from the DTS Provisions, but will still meet the Performance Requirements as long as it can be successfully demonstrated how this will be achieved.

A DTS Solution uses the DTS Provisions and any documents referenced in the NCC. These provisions include prescriptive specifications, which if followed in full are deemed to comply with the Performance Requirements.

Alert

Further information about complying with the NCC is provided in Appendix A.

4.2 Cold water, heated water, non-drinking water and fire-fighting water services

The relevant Performance Requirement for cross-connection control is BP5.1(1), which is as follows:

BP5.1 Contamination control

(1) Water services must be designed, constructed and installed to avoid contamination.

Application 1:

BP5.1 applies to cold water, heated water, non-drinking water and fire-fighting water services.

BP5.1(1) has two components; protection of the drinking water service on-site, and protection of any NUO's drinking water supply that is connected to the site.

BP5.1(1) does not make any reference to individual, zone or containment backflow prevention as these are only included in the DTS Provisions. However, a Performance Solution may be designed and assessed along these lines if appropriate, and in any case must provide the two components of contamination prevention noted above.

Figure 4.1 sets out how the two components of BP5.1(1) are applied to cold water services.

Figure 4.1 Application of BP5.1(1) to cold water services

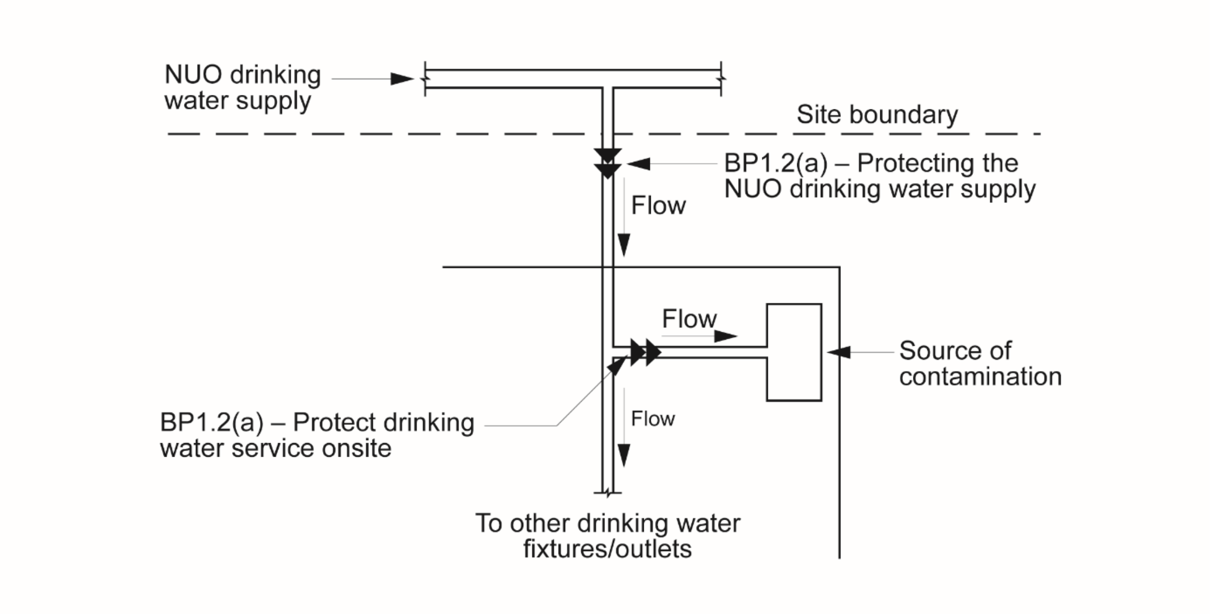
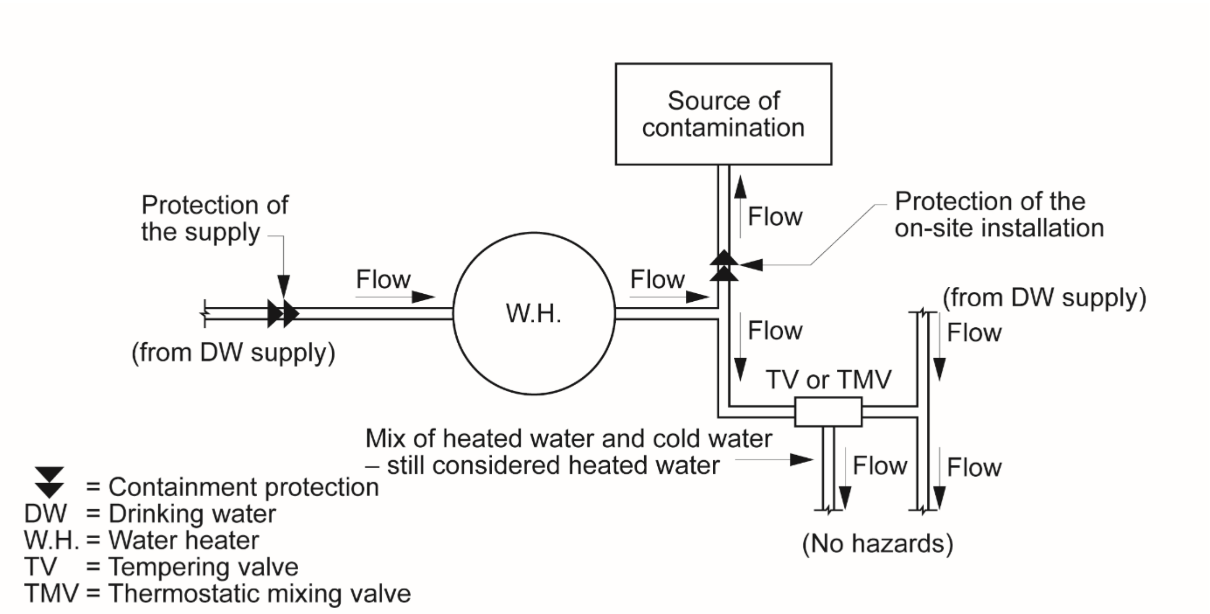


Figure 4.2 sets out how the two components of BP5.1(1) are applied to heated water services.

Figure 4.2 Application of BP5.1(1) to heated water services

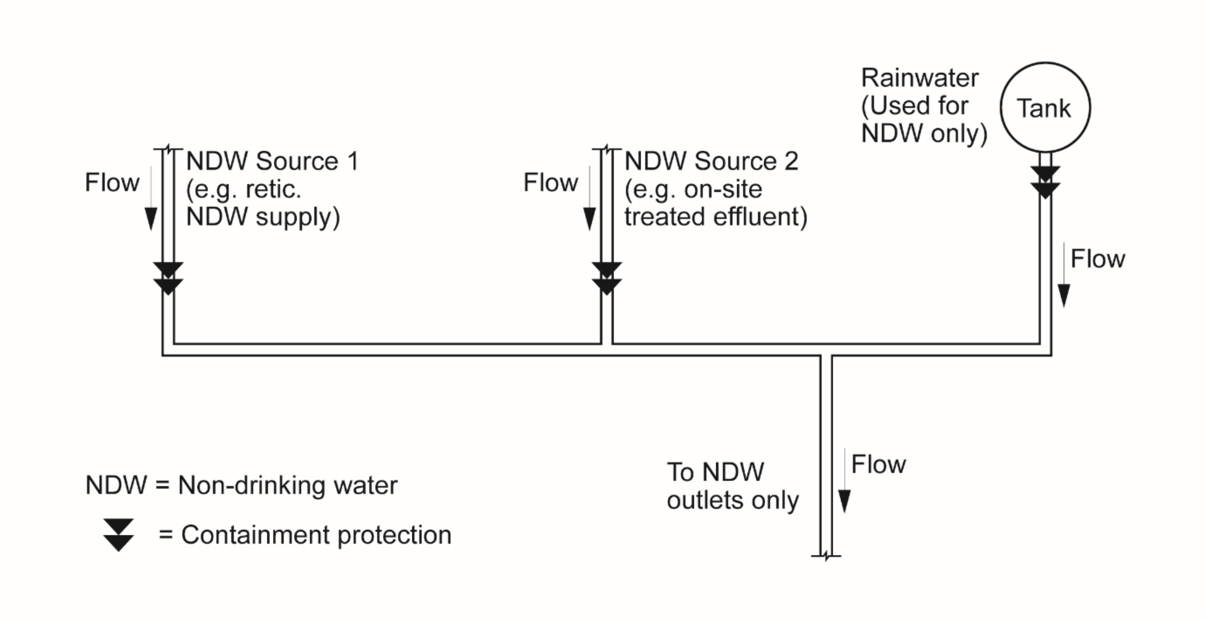


Alert

BP5.1(1) is not limited to heated water lines directly connected from the water heater. It also applies to lines that carry tempered water (a combination of heated water and cold water in the same pipe). This is because the PCA defined term “heated water” includes any water “that has been intentionally heated”, even if the same water is then tempered to reduce its delivery temperature, e.g. to reduce the likelihood of scalding. So long as the water was intentionally heated, then under the PCA it is considered to be heated water.

Figure 4.3 sets out how the two components of BP5.1(1) are applied to non-drinking water services.

Figure 4.3 Application of BP5.1(1) to non-drinking water services



For fire-fighting water services, BP5.1(1) applies at the point where the fire-fighting water service is connected to a drinking water supply. It does not require any additional protection upstream of this point because the water within the fire-fighting water service is no longer considered to be drinking water.

Reminder

Requirements for fire-fighting water services for Class 2 to Class 9 buildings are also set out in NCC Volume One.

4.3 Rainwater harvesting systems

BP5.1(1) applies at two key points in a rainwater harvesting system; the point of connection between a rainwater tank and the water service downstream, and the connection between a top-up line and a rainwater tank. A top-up line is a pipeline from the NUO's drinking water supply, used to top-up the rainwater tank if, due to lack of rain, the water level in the tank falls below a set level (usually 20%).

4.4 Isolation and access for maintenance

In addition to BP5.1(1), the PCA contains several Performance Requirements that become relevant once a solution for the provision of cross-connection control has been chosen. These are BP1.2(1)(b) and (c), BP2.3(1)(b) and (c), BP3.3(1)(b) and (c), BP4.1(1)(b) and (c), and BP6.2(1)(e) and (f).

These Performance Requirements are intended to ensure access for maintenance for mechanical backflow prevention devices, as well as the ability to isolate them from the water supply, should they need to be removed or replaced.

To provide flexibility for designers and installers, the exact specification for the required access and means of isolation are not prescribed in the Performance Requirements.

5 PCA DTS Provisions

This chapter explains the DTS Provisions, including Specification B5.1. These DTS Provisions are a prescriptive set of rules for cross-connection control, compliance with which is called a DTS Solution, and is deemed to meet the relevant Performance Requirements

5.1 What are DTS Provisions?

The DTS Provisions are prescriptive provisions set out in the PCA to provide a predetermined means of meeting the mandatory Performance Requirements.

Whenever plumbing or drainage is done in accordance with the DTS Provisions, it is deemed to have met the Performance Requirements. This is called a DTS Solution. The use of DTS Solutions as a compliance option is explained in clauses A2.1 and A2.3 of the PCA.

The DTS Provisions are either within the PCA itself, or include reference to other documents such as the AS/NZS 3500 series of standards. Referenced documents are listed in Schedule 4 of the PCA.

5.2 Cross-connection control

The DTS Provisions that are relevant to cross-connection control, for different types of plumbing installations, are explained in Water services of this Handbook. Specification B5.1 of the PCA, which is also part of the DTS Provisions, is explained in About Specification B5.1.

5.3 Water services

This section explains the DTS Provisions that apply to cross-connection control for drinking water, non-drinking water, and fire-fighting water services.

5.3.1 General requirements

Section 4 of AS/NZS 3500.1 deals with cross-connection control and backflow prevention. However, certain clauses in Section 4 are altered, or overruled, by the PCA. These clauses are:

- **Clause 4.3**: Hazard Ratings are no longer determined using this clause. Instead, the Hazard Ratings set out in Specification B5.1 must be used.
- **Clause 4.4.1**: The first paragraph of this clause must be read in conjunction with the hazard identification provisions of B5.2(1).
- **Clause 4.4.2(a)**: The reference in this subclause to clause 4.3 must be read as if it were a reference to Specification B5.1.
- **Table 4.4.1**: The Hazard Ratings shown in the “Cross-connection Hazard Rating” column are the Hazard Ratings determined using Specification B5.1.

Important terms such as “cross-connection” and “Hazard Rating” are defined in Schedule 3 of the PCA.

The other components of B5.1 are explained below:

- **B5.2(1)** defines the situations where a hazard exists in respect of a drinking water service:
  - **(a)** covers installations where it is possible for non-drinking water to backflow into the drinking water service or supply, and therefore backflow prevention would be required to protect the drinking water service or supply.
  - **(b)** covers installations where it is possible for rainwater (regardless of its quality) to enter a drinking water service or supply.
  - **(c)** covers alternative water supplies, which may be drinking water or non-drinking water, but from a different source as the main water supply to the site.
  - **(d)** covers cross-connections with swimming pool water. These pose a unique form of hazard in that, by definition, swimming pool water will come into contact with people and can be unintentionally ingested; therefore it is not captured by (e), below. However, for reasons of hygiene and due to its chlorination, there remains a clear need to prevent this water from entering the drinking water service/supply.

(e) covers other fixtures, equipment or substances not mentioned above that may pose a hazard to health.

- **B5.2(2)** refers to BS5.1.4 and BS5.1.5 of Specification B5.1 for determining the Hazard Rating applicable to each hazard identified using B5.2(1). Once the Hazard Rating has been determined, AS/NZS 3500.1 is then referenced for the selection and installation of the appropriate backflow prevention device.

It is important to note that B5.2(1) only applies to individual and zone protection Hazard Ratings for water services on-site. Containment protection is covered at B5.2(3); and fire-fighting water services at B5.4.

- **B5.2(3)** provides for the protection of the NUO's drinking water supply by way of containment protection. Once the Hazard Rating has been determined, AS/NZS 3500.1 is then referenced for the selection and installation of the appropriate backflow prevention device.

Alert

1. Not all backflow prevention devices are suitable for use in heated water services. To confirm the suitability of a backflow prevention device for use in a heated water service, refer to the WaterMark specification (AS 2845.1), or to the manufacturer's instructions.

2. In some States and Territories, B5.2(3) may be altered or replaced by specific regulations enforced by or on behalf of the NUO, under the relevant water supply legislation. Although such regulations are generally consistent with B5.2(3), they may take precedence over it in the event of an inconsistency.

- **B5.3:** Provides for the protection of drinking water services and supplies on sites which are also connected to a non-drinking water supply. It refers to BS5.1.6 of Specification B5.1 for determining the Hazard Rating applicable to the non-drinking water service. It then requires that an appropriate backflow prevention device be installed either at the drinking water supply meter or point of connection and on each external hose tap on a drinking water service. Overall, B5.3 is a requirement for containment protection.

- **B5.4:** Provides for the protection of the drinking water supply by isolating it from a fire-fighting water service and refers to BS5.1.7 of Specification B5.1 for determination of the Hazard Rating.

5.4 About Specification B5.1

This section explains Specification B5.1of the PCA.

5.4.1 What is a specification?

Alert

A specification in the PCA, for example Specification B5.1, is different to a WaterMark specification, such as AS/NZS 2845.1.

Information on WaterMark specifications can be found on the ABCB website (abcb.gov.au).

The role of a specification is to provide technical data in the PCA which is relied upon as a component of one or more DTS Provisions. A specification may be referenced by multiple DTS Provisions, wherever the same data needs to be referred to by different parts of the PCA. Including this common information in a single specification avoids the need to repeat the same information across multiple parts of the PCA.

Example

A specification could be best understood as playing a role in the PCA similar to that of a PCA referenced document (e.g. Australian Standards), in that both contain detailed, prescriptive, technical information which may be called up in several different DTS Provisions.

5.4.2 The role of Specification B5.1

Specification B5.1 of the PCA replaces the informative, i.e. advisory, Appendix F of AS/NZS 3500.1. The role of Specification B5.1 is to provide a regulatory solution for assigning Hazard Ratings (Low, Medium or High) to different installations or sites. Specification B5.1 forms a part of the PCA DTS Provisions.

5.4.3 Structure of Specification B5.1

Specification B5.1 has been structured according to the purpose of the protection required, i.e. individual, zone or containment protection, and then according to Hazard Ratings, i.e. Low, Medium or High Hazard.

5.4.4 Installations not listed in Specification B5.1

It is important to note that Specification B5.1 does not cover every possible situation in which cross-connection control may be required; like any other DTS Provision, it only covers the most common situations.

Where cross-connection control is required for a situation not listed in Specification B5.1, a Performance Solution will need to be developed and assessed against the relevant Performance Requirements.

The Performance Solution can be assessed using one of the methods listed in A5.0 of the PCA, such as:

- evidence of a type listed in Part A5; or
- an alternative Verification Method (must be acceptable to the authority having jurisdiction); or
- expert Judgement (defined in Schedule 3 of the PCA); or
- comparison with the DTS Provisions.

An alternative Verification Method may include:

- calculation, using analytical methods or mathematical models; or
- tests, using a technical procedure, either on-site or in a laboratory, to directly measure the extent to which the Performance Requirements have been met; or
- an inspection (and inspection report); or
- any other acceptable form of certification.

Reminder

Any Verification Method used must be acceptable to the authority having jurisdiction.

For Expert Judgement, contemporary and relevant qualifications and/or experience are necessary to determine whether a Performance Solution complies with the Performance Requirements. The level of qualification and/or experience necessary may differ depending on the complexity of the proposal and the requirements of the regulatory authority. Practitioners should seek advice from the authority having jurisdiction for clarification as to what will be accepted.

Comparison to the DTS Provisions may be a suitable approach where the situation in question is similar to, but not the same as, one listed in Specification B5.1.

6 Backflow prevention devices

This chapter explains the different types of backflow prevention devices that can be installed to comply with the PCA. It covers both testable and non-testable devices, including air gaps and break tanks. A diagram is provided following each explanation.

Alert

This chapter only provides explanations for the most commonly used backflow prevention devices; there may be other types of devices available which are not included here. For the full list of devices that can be installed using the DTS Provisions, refer to Table 4.4.1 of AS/NZS 3500.1. For further device-specific technical information, refer to AS/NZS 2845.1.

6.1 Choosing the appropriate backflow prevention device

A wide choice of devices exists that can be used to prevent backsiphonage and backpressure (collectively, “backflow”) from adding contaminants into a water supply. In the DTS Provisions, the selection of the correct device is based on the degree of hazard (Hazard Rating) posed by the cross-connection. Additional considerations are based upon piping size, location and the potential need to periodically test the device to ensure correct operation.

Reminder

Other ways of preventing backflow can also be used to comply with the PCA, under a Performance Solution. In such cases, the proposed backflow prevention must be assessed and shown to be able to meet the relevant Performance Requirements. The Assessment Methods are provided in the PCA, at clause A5.3.

There are five basic types of devices that can be used to correct cross-connections: air gaps/break tanks, vacuum breakers (both atmospheric and pressure type), dual check with intermediate atmospheric vent, double check valve assemblies and reduced pressure zone devices. Backflow prevention devices, except for air gaps and break tanks, are subject to the product certification and authorisation requirements of the PCA.

6.1.1 Hazard Ratings

Backflow prevention devices are classified according to the level of hazard they are able to protect against. This classification system corresponds with the Hazard Ratings that are applied to potential cross-connections.

Example

Industrial chemical mixing systems would be classified as High Hazard (see Specification B5.1), therefore the water supply would need to be protected with a High Hazard backflow prevention device (see AS/NZS 3500.1, Table 4.4.1).

6.1.2 Continuous or non-continuous pressure

Some backflow prevention devices are not suitable for use in installations that are under continuous pressure. “Continuous pressure” means that the water downstream of the device is under pressure for more than 12 of any 24 hours in a day, for example due to a downstream tap being closed for more than 12 hours at a time.

6.1.3 Testable and non-testable devices

Not all backflow prevention devices are testable. Generally, non-testable devices are only suitable for use in Low Hazard installations.

6.2 Product certification and authorisation

Part A5 of the PCA requires that materials and products used in a plumbing and drainage installation be “fit for purpose”. For a material or product to be recognised as “fit for purpose” it must be certified and authorised under the WaterMark Certification Scheme, or be listed on the WMEP.

All mechanical backflow prevention devices are listed on the WMSP and require certification and authorisation. Air gaps and break tanks are “excluded products”.

Alert

The WMEP and WMSP are available from the ABCB website (abcb.gov.au).

For backflow prevention devices, the relevant product standard is AS/NZS 2845.1 Water supply—Backflow prevention devices, Part 1: Materials, design and performance requirements.

Reminder:

Further information regarding the WaterMark Certification Scheme can be found at the ABCB website (abcb.gov.au).

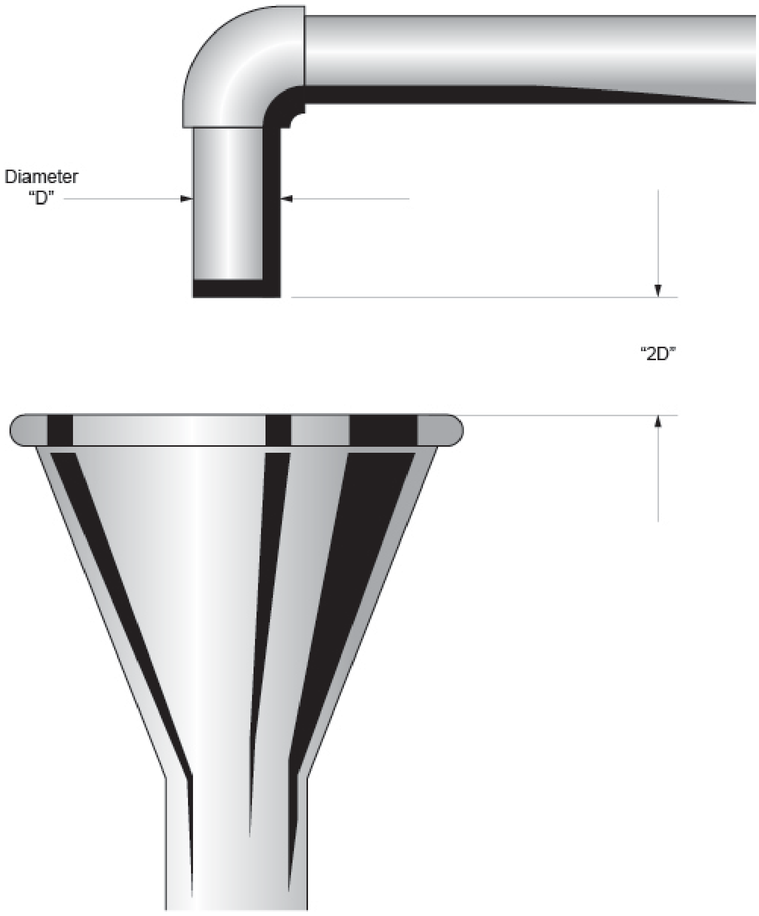
6.3 Air gaps and break tanks (AG/BT)

Air gaps and break tanks are non-mechanical backflow prevention devices that are very effective where either backsiphonage or backpressure conditions may exist. Unless they are registered (see Chapter 7), air gaps and break tanks are considered suitable for Low Hazard installations only.

For water services greater than DN 25, the minimum height of the air gap (the vertical distance between the water service and the spill level of the receiving tundish or break tank) is required to be not less than 2 times the diameter of the water service outlet (“2D”). This is explained in Figure 6.1.

For air gaps in water services up to and including DN 25, the minimum height of the air gap is given in Table 4.6.3.2 of AS/NZS 3500.1, which is referenced by the PCA DTS Provisions in Parts B1 and B3.

Figure 6.1 Air gap



An air gap, although an extremely effective backflow preventer when used to prevent backsiphonage and backpressure conditions, may cause a corresponding loss of pressure to downstream outlets. Consequently, air gaps are primarily used at end of line services where reservoirs or storage tanks are desired.

When assessing whether an air gap would be suitable, the following points should be considered:

- In a continuous piping system, each air gap requires the added expense of reservoirs (or break tanks) and secondary pumping systems, assuming gravity will provide adequate pressure.
- The air gap may be easily defeated in the event the "2D" requirement was purposely or inadvertently compromised. Excessive splash may be encountered in the event that higher than anticipated pressures or flows occur. The splash may pose a nuisance or hazard, e.g. by creating undue noise or splashing water

onto a nearby walkway. In these situations, the solution often used is to reduce the “2D” height by thrusting the supply pipe into the receiving funnel or tank, or by attaching a hose. By so doing, the air gap is defeated and an unprotected cross-connection is created.

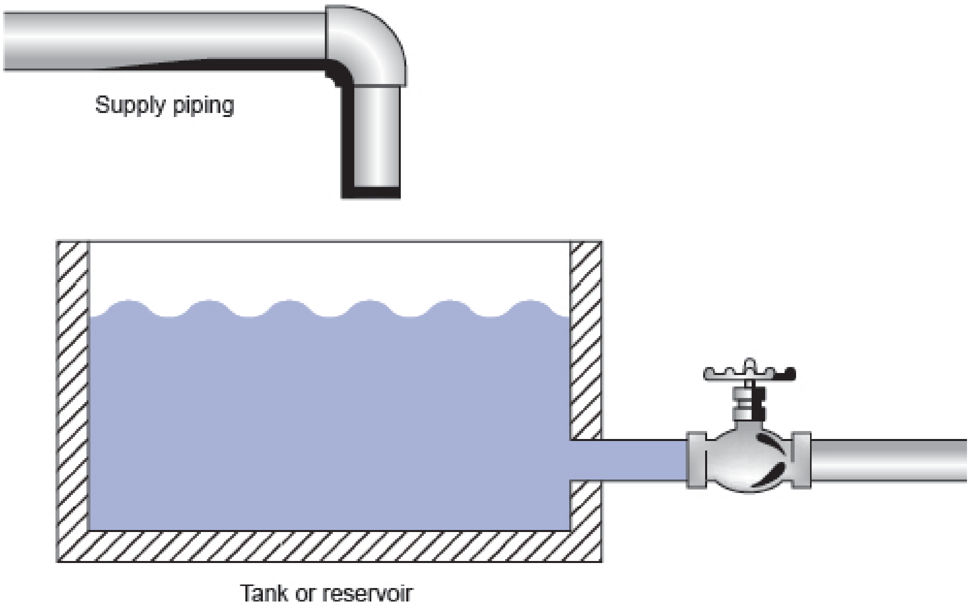
Alert

The ease by which air gaps can be defeated also means that in most jurisdictions, where an air gap is installed in a Medium or High Hazard situation, it must be registered with the local authority having jurisdiction. See Device registration, testing and maintenance of this Handbook for further details.

- At an air gap, water is exposed to the surrounding air with its inherent bacteria, dust particles and other airborne contaminants. In addition, the aspiration effect of the flowing water can drag down surrounding contaminants into the reservoir or break tank.
- Free chlorine can come out of treated water as a result of the air gap and the resulting splash and churning effect as the water enters the break tank. This reduces the ability of the water to withstand bacteria contamination during long-term storage.

Air gaps and break tanks may be fabricated from commercially available plumbing components or purchased as separate units. An example of an air gap with break tank is shown in Figure 6.2.

Figure 6.2 Air gap with break tank

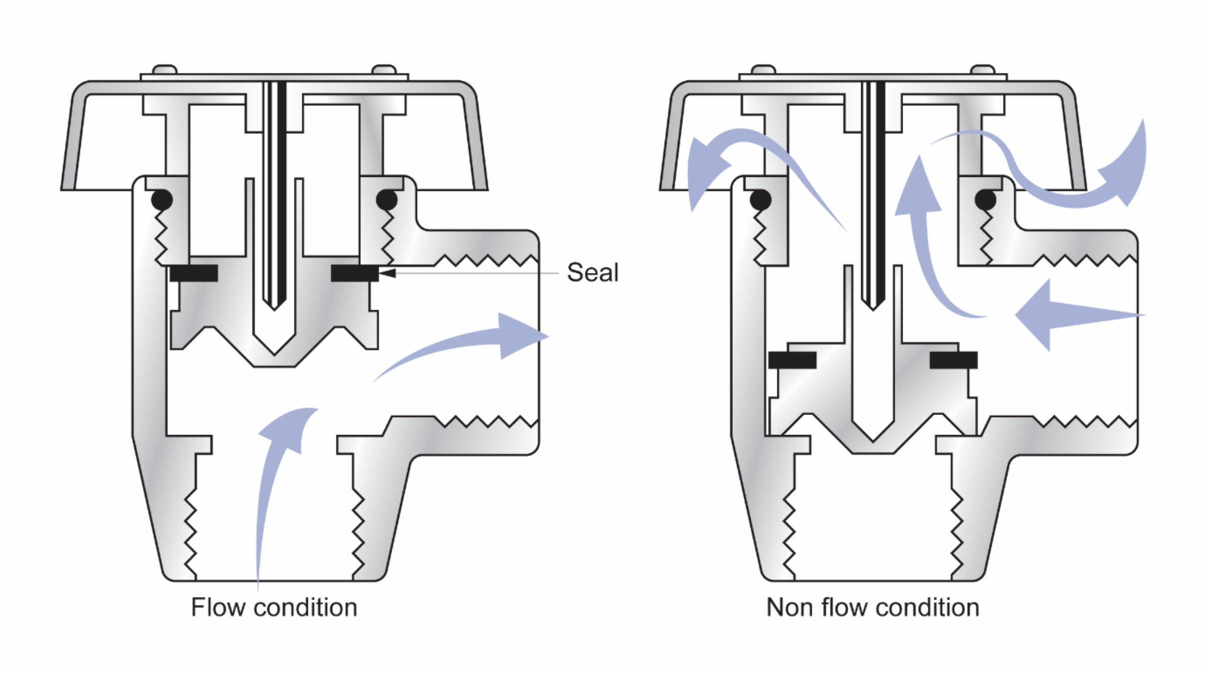


6.4 Atmospheric vacuum breakers (AVB)

Atmospheric vacuum breakers (AVB) are among the simplest mechanical types of backflow prevention device and when installed properly, can provide excellent protection against backsiphonage. However, AVBs cannot be used to protect against backpressure conditions and are not designed for use in water service installations that are kept under continuous pressure. AVBs are a non-testable device, and are only suited for use in Low Hazard installations.

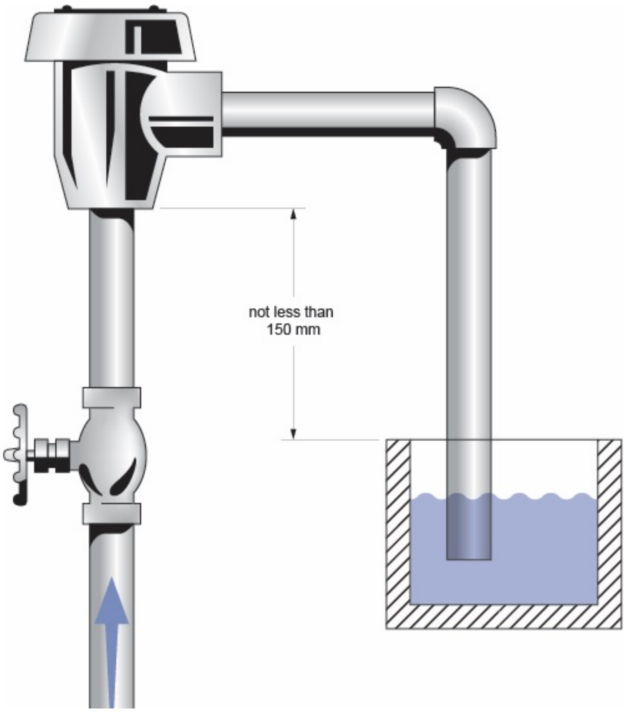
AVBs are usually constructed of a polyethylene float which is free to travel on a shaft and seal in the uppermost position against atmosphere with an elastomeric disc. Water flow lifts the float, which then causes the disc to seal. Water pressure keeps the float in the upward sealed position. Cutting off the water supply will cause the disc to drop down venting the unit to atmosphere and thereby opening the downstream piping, thus preventing backsiphonage. Figure 6.3 shows how a typical AVB operates.

Figure 6.3 Atmospheric vacuum breaker (AVB)



AVBs should be installed vertically and should not have any shutoffs downstream of the device. They should be installed at least 150 mm higher than the highest downstream outlet. Figure 6.4 shows the typical installation of an AVB. Note that no shutoff valve is installed downstream of the device that would otherwise keep the AVB under continuous pressure.

Figure 6.4 Atmospheric vacuum breaker—typical installation

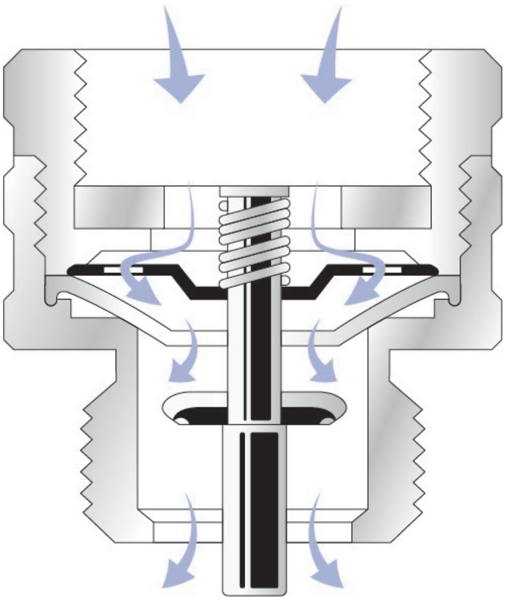


6.5 Hose connection vacuum breaker (HCVB)

Hose connection vacuum breakers (HCVB) are a specialised type of AVB. They are usually attached to hose taps and in turn are connected to hose supplied outlets such as garden hoses, slop hopper hoses, spray outlets and the like. However, HCVBs cannot be used to protect against backpressure conditions and are not designed for use in water service installations that are kept under continuous pressure. HCVBs are a non-testable device and are only suited for use in Low Hazard installations.

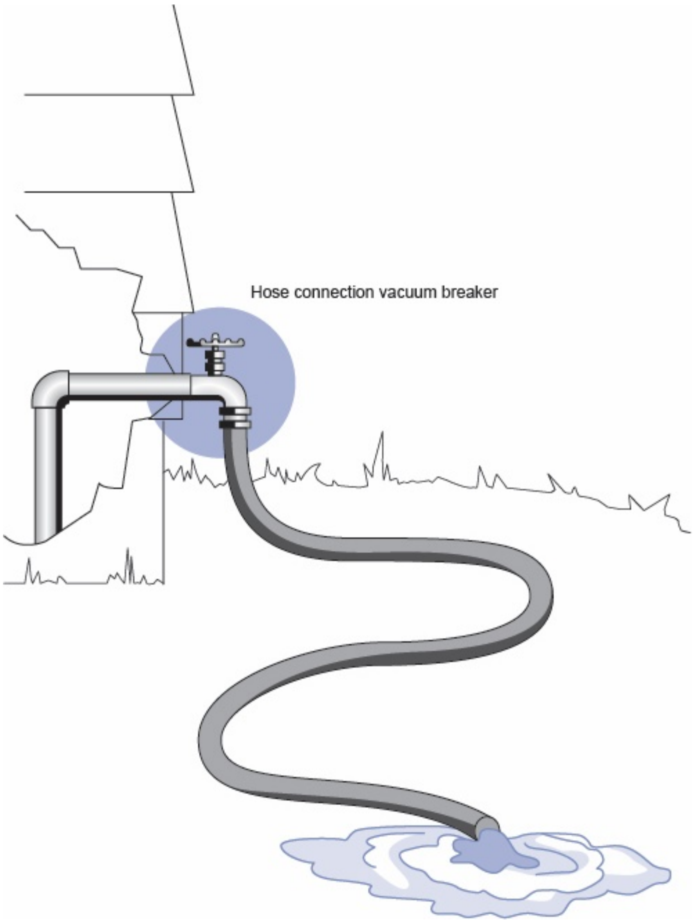
HVCBs consist of a spring-loaded check valve that seals against atmospheric pressure when the water supply pressure is turned on. The operation of a HCVB is shown in Figure 6.5.

Figure 6.5 Hose connection vacuum breaker (HCVB)



When the water supply is turned off, the device vents to atmosphere, thus protecting against backsiphonage conditions. Typical installation is shown in Figure 6.6.

Figure 6.6 Hose connection vacuum breaker—typical installation



6.6 Pressure vacuum breaker (PVB)

The pressure vacuum breaker (PVB) is an outgrowth of the atmospheric vacuum breaker (AVB) and evolved in response to the need to have an AVB that can be utilised under constant pressure and that can be tested in-line. This is achieved through a spring on top of the disc and float assembly, two added isolation valves, test cocks and an additional first check. The workings of the PVB are shown in Figure 6.7.

6.6.1 General

PVBs are a testable device. They provide protection against backsiphonage and are suitable for use in Low Hazard or Medium Hazard installations that are under continuous pressure. PVBs do not protect against backpressure.

Typical installations of a PVB, in agricultural and industrial situations, are shown in Figure 6.7 and Figure 6.8

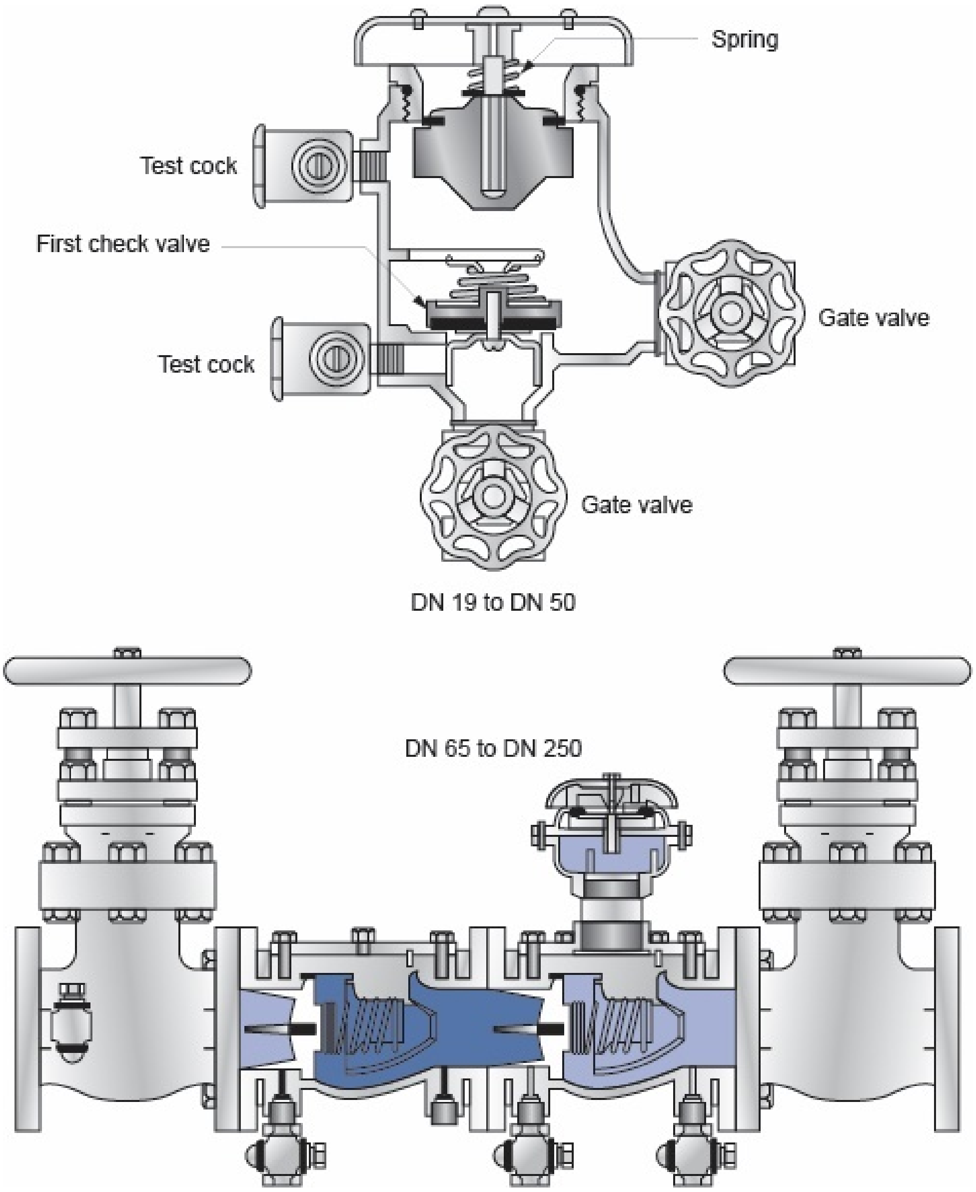


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Figure 6.7 Pressure vacuum breaker (PVB)

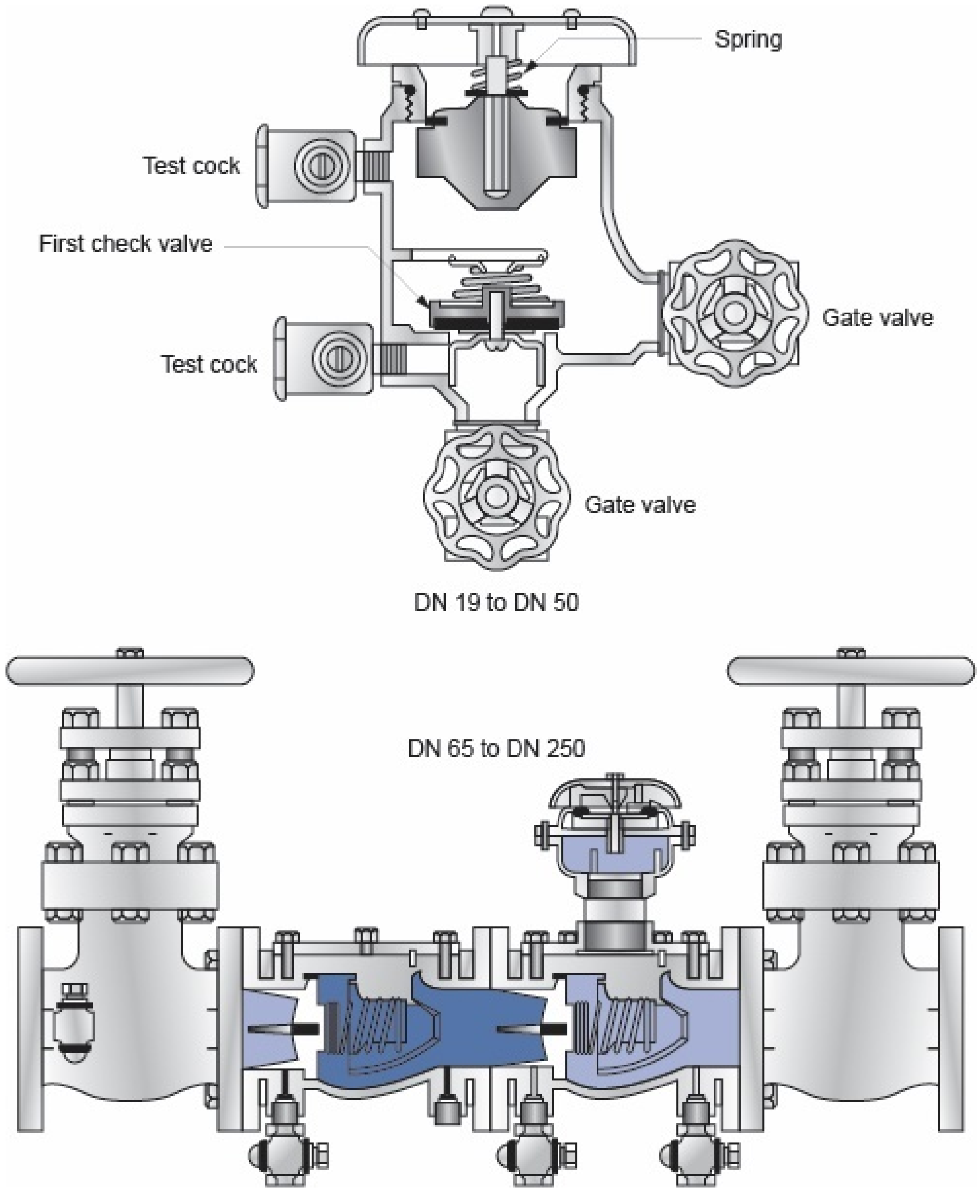
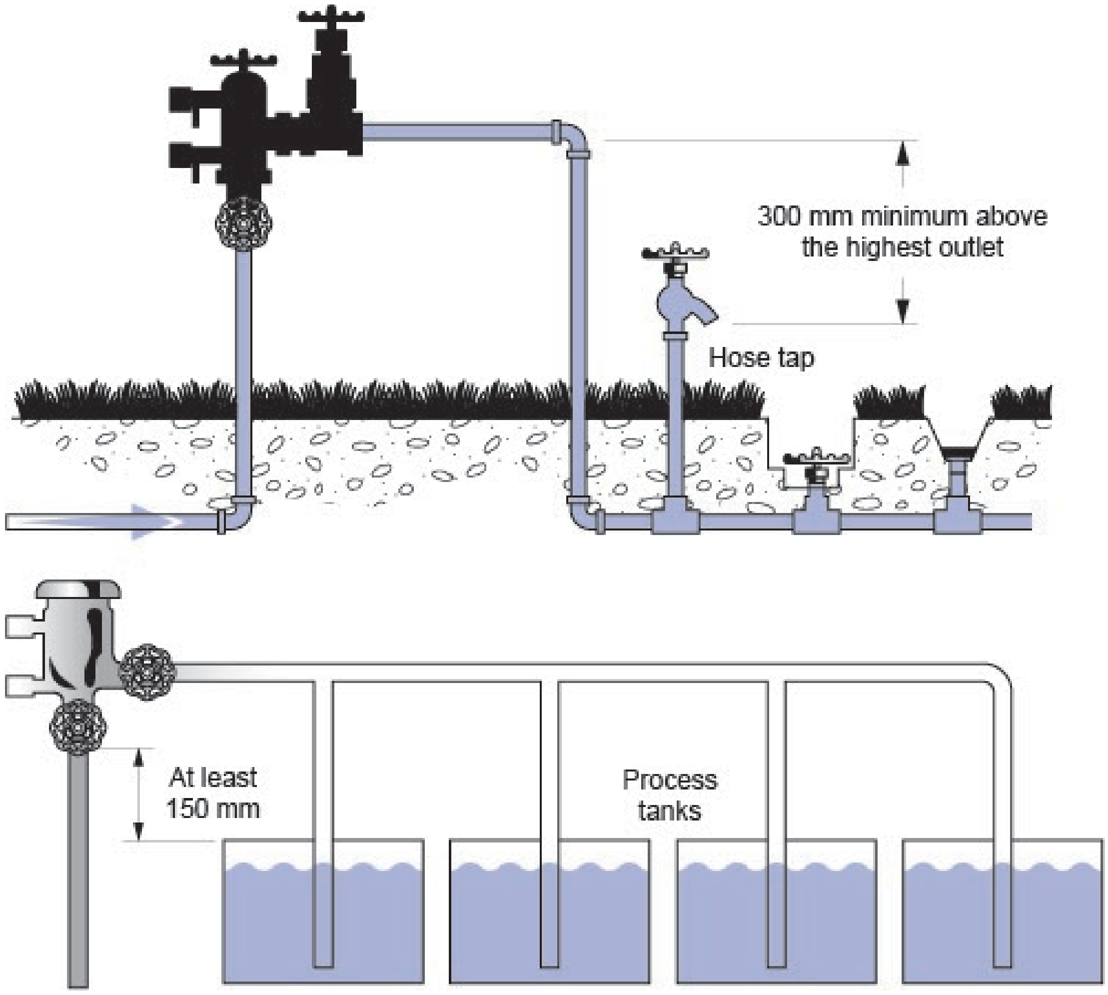


Figure 6.8 Pressure vacuum breaker - typical installation



6.6.2 Spill-resistant type (SPVB)

Spill-resistant pressure vacuum breakers (SPVB) are also available as an alternative to the standard type PVB. SPVBs are specifically designed to minimise water spillage in the event that the backflow prevention mechanism of the device is activated. This type of device can be used in installations where the device is to be located inside a building, where water spillage could cause damage to property or pose a safety hazard.

Similar to PVBs, SPVBs provide protection against backsiphonage and are suitable for use in installations that are under continuous pressure. PVBs do not protect against backpressure. However, unlike a PVB, an SPVB can also be used in High Hazard installations.

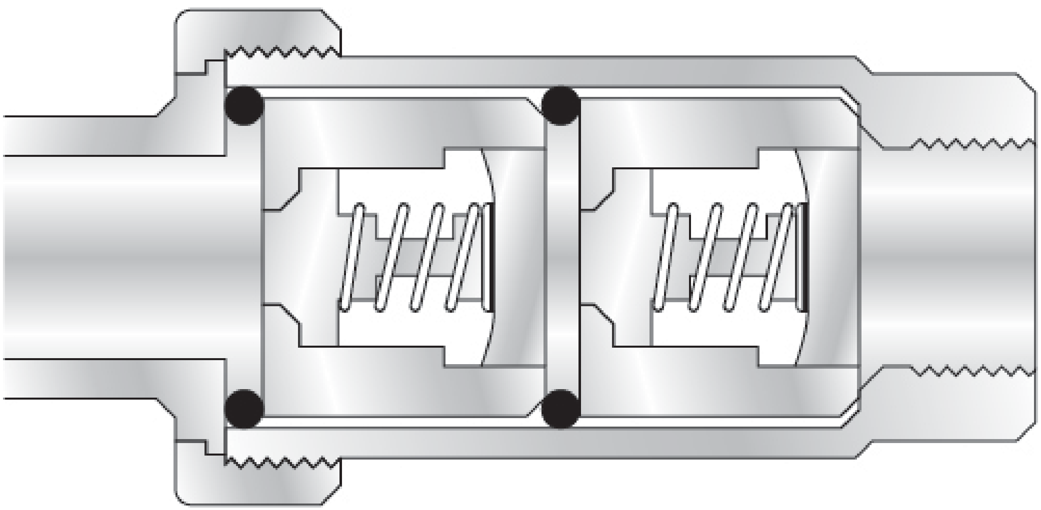
6.7 Dual check valve (DualCV)

The dual check valve (DualCV) provides a simple form of containment protection suitable for use at the point of connection from the NUO's drinking water supply to a single Class 1 dwelling.

DualCVs are designed to be installed immediately downstream of the water meter, or may be incorporated into the meter assembly itself. DualCVs are suitable for use in Low Hazard installations, can protect against backsiphonage or backpressure and can be used in systems that are under continuous pressure.

The workings of the DualCV are shown in Figure 6.9.

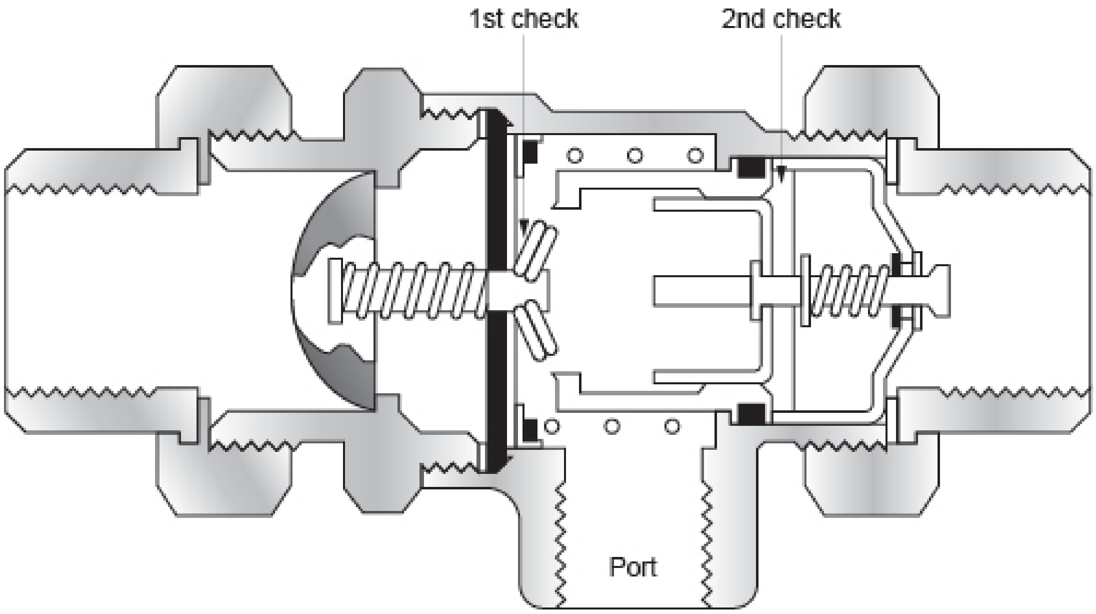
Figure 6.9 Dual check valve (DualCV)



6.8 Dual check valve with atmospheric port (DCAP)

The need to provide a compact device in DN 12 and DN 18 pipe sizes that protects against Low Hazard installations, is capable of being used under continuous pressure and that protects against backpressure, resulted in the dual check valve with atmospheric port (DCAP). In general, the DCAP is constructed of dual check valves with an atmospheric port inserted between the two checks. This is shown in Figure 6.10.

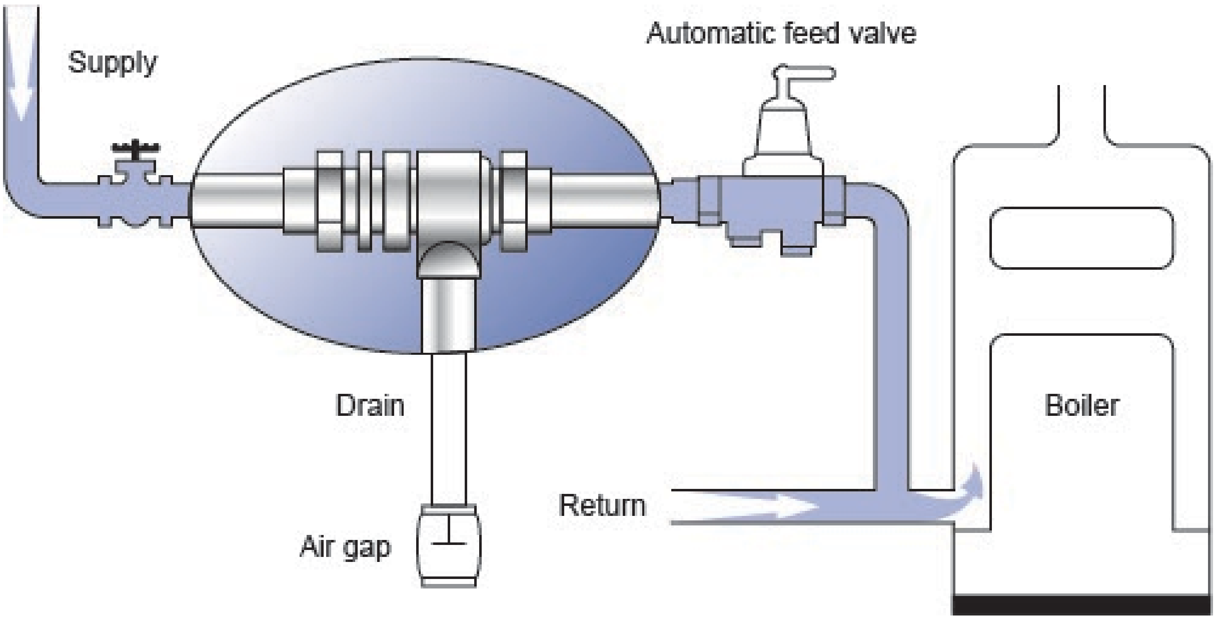
Figure 6.10 Dual check valve with atmospheric port (DCAP)



Line pressure keeps the vent port closed, but zero supply pressure or backsiphonage will open the inner chamber to atmosphere. With this device, extra protection is gained through the atmospheric venting capability.

Figure 6.11, below, shows a typical use of the device on a residential boiler supply line.

Figure 6.11 Dual check valve with atmospheric port—typical installation



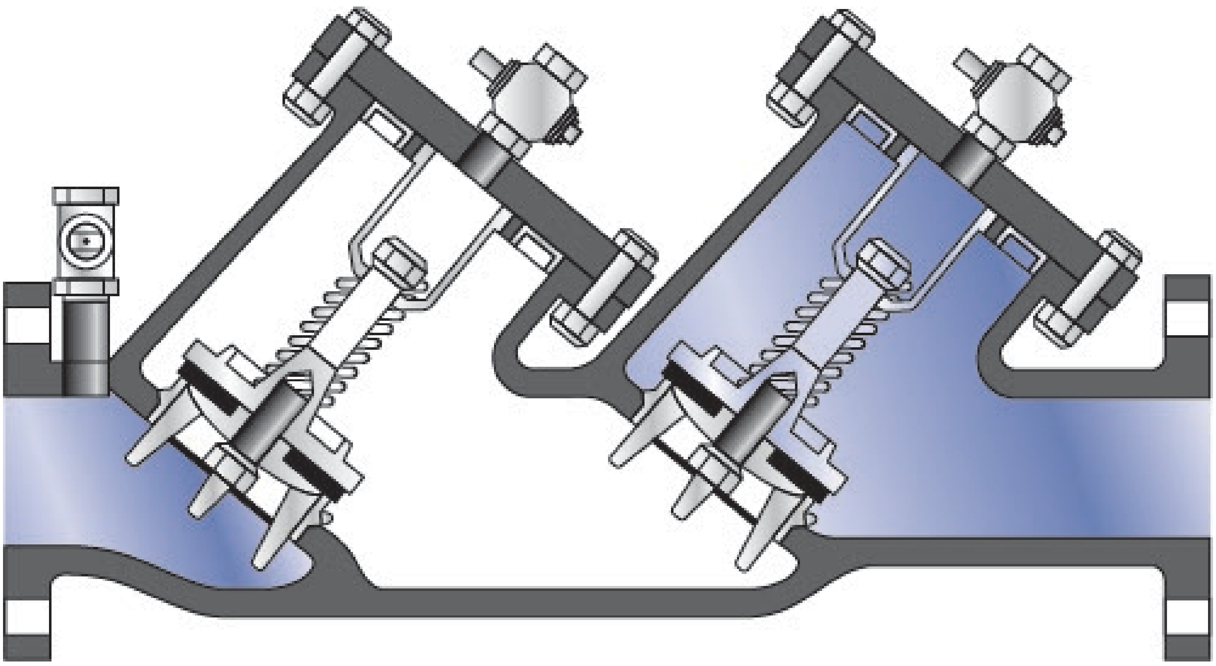
6.9 Double check valve (DCV)

A double check valve (DCV) is essentially two single check valves coupled within one body and furnished with test cocks. The test capability gives this device an advantage over the use of two independent check valves in that it can be readily tested to determine if either or both check valves are inoperative or fouled by debris. Each check is spring loaded in the closed position and requires approximately 7 kPa to open.

The spring loading provides the ability to “bite” through small debris and still seal; a protection feature not prevalent in unloaded swing check valves. Figure 6.12 shows a cross section of a double check valve complete with test cocks.

DCVs are suitable for use in Medium Hazard installations and can operate under continuous pressure. DCVs can protect against both backpressure and backsiphonage.

Figure 6.12 Double check valve (DCV)

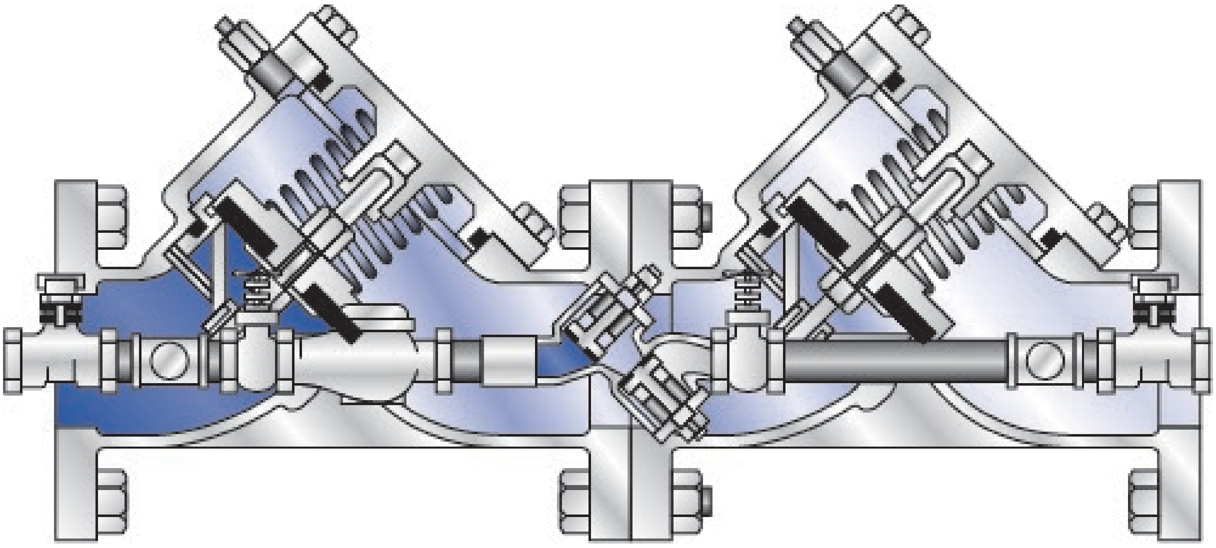


6.10 Double check detector assembly (DCDA)

The double check detector assembly (DCDA) is an outgrowth of the double check valve (DCV) and is primarily utilised in fire-fighting water service installations. It is designed to protect the drinking water service from possible contamination from chemical additives, backpressure from booster pumps, stagnant water that sits in fire-fighting water services for extended periods of time and the addition of raw water through outside fire pump connections. It is also able to detect water draw-offs from the fire-fighting water service caused by leakage or unauthorised water usage.

The DCDA is comprised of two spring loaded check valves, a bypass assembly with water meter and double check valve and two lockable isolating valves. The DCDA is suitable for use in Medium Hazard installations, including fire-fighting water services, and can protect against both backpressure and backsiphonage. DCDAs are designed for use under continuous pressure. The workings of the DCDA are shown in Figure 6.13.

Figure 6.13 Double check detector assembly (DCDA)

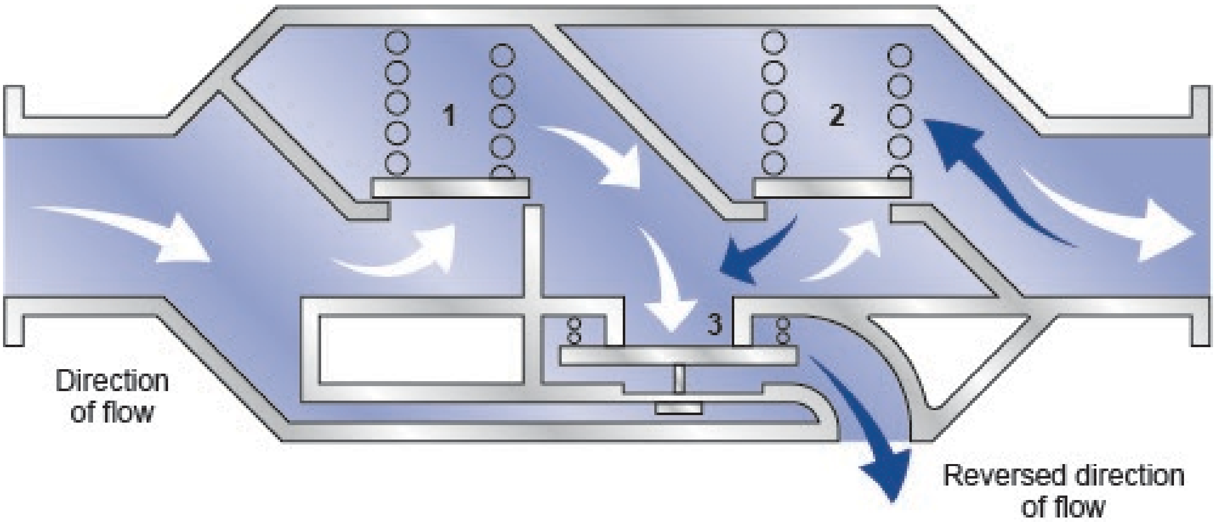


6.11 Reduced pressure zone device (RPZD)

Maximum protection is achieved against backsiphonage and backpressure by installing a reduced pressure zone device (RPZD). The RPZD is essentially a modified double check valve with an atmospheric vent capability placed between the two checks and designed such that the zone between the two checks is always kept at least 14 kPa lower than the supply pressure. With this design criteria, the RPZD can provide protection against backsiphonage and backpressure when both the first and second checks become fouled. RPZDs can be used under continuous pressure and are suitable for High Hazard installations. RPZDs are a testable device.

Figure 6.14 shows the principles behind the operation of an RPZD.

Figure 6.14 Reduced pressure zone device (RPZD)



The principles behind the operation of an RPZD, as depicted above, are as follows:

- Flow from the left enters the central chamber against the pressure exerted by the first check valve (1). The supply pressure is reduced by a predetermined amount. The pressure in the central chamber is maintained lower than the incoming supply pressure through the operation of the relief valve (3), which discharges to the atmosphere whenever the central chamber pressure becomes too close to the inlet pressure. The second check valve (2) is lightly loaded to open with a pressure drop of 7 kPa in the direction of flow and is independent of the pressure required to open the relief valve (3).
- In the event that the pressure increases downstream of the device, tending to reverse the direction of flow, the second check valve (2) closes, preventing backflow. Because all valves may leak as a result of wear or obstruction, the protection provided by the two check valves alone, may be insufficient. Therefore, in an RPZD, if some obstruction prevents the second check valve (2) from closing, the leakage back into the central chamber would increase the pressure in this zone, the relief valve (3) would open and flow would be discharged to the atmosphere.

- When the supply pressure drops to the minimum differential required to operate the relief valve (3), the pressure in the central chamber should be atmospheric. If the inlet pressure should become less than atmospheric, the relief valve (3) should remain fully open to the atmosphere to discharge any water that may be caused to backflow as a result of backpressure and leakage of the second check valve (2).
- Malfunctioning of one or both of the check valves (1), (2), or the relief valve (3), should always be indicated by the discharge of water from the relief port (below the relief valve).

Alert

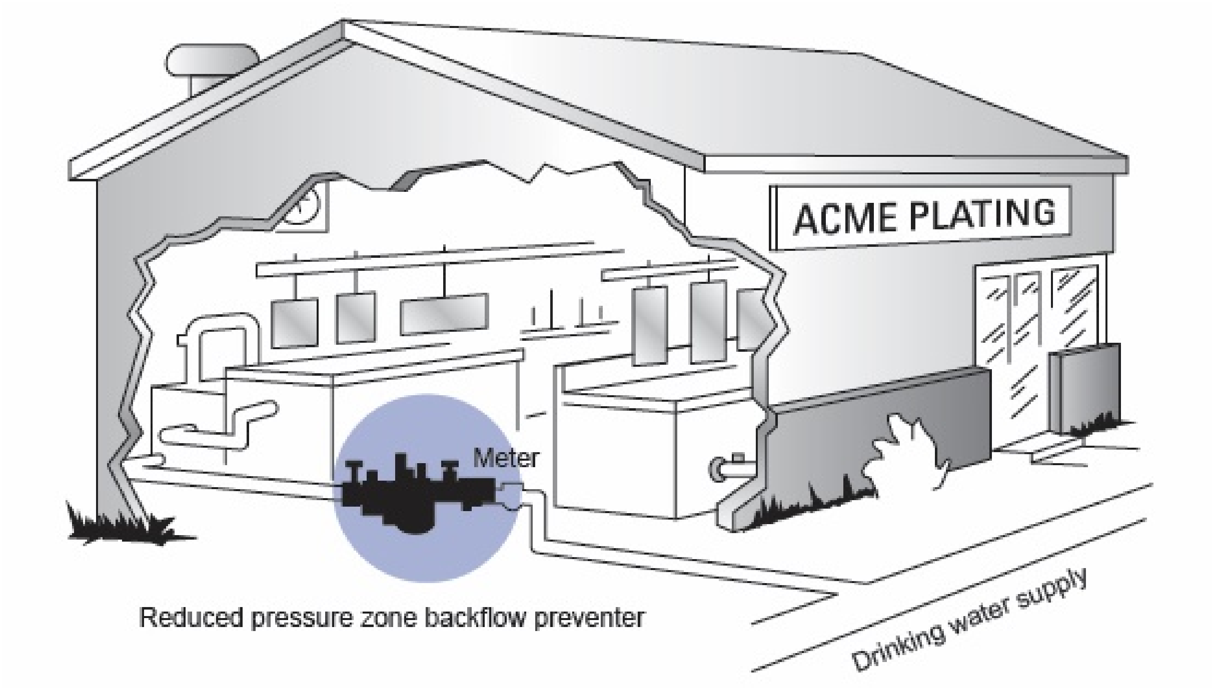
Under no circumstances should plugging of the relief valve be allowed, as the device depends upon an open port for safe operation.

The pressure loss through the device may be expected to average between 70 and 140 kPa within the normal range of operation, depending on the size and flow rate of the device.

Example

RPZDs are commonly installed on High Hazard installations such as plating plants, where they would primarily protect against backsiphonage, and car washes, where they would primarily protect against backpressure. These two examples are shown in Figure 6.15 and Figure 6.16, respectively.

Figure 6.15 Reduced pressure zone device—typical installation (example 1)



7 Device registration, testing and maintenance

This chapter explains the registration, testing and maintenance requirements that apply to some forms of backflow prevention. Because device registration schemes and ongoing testing and maintenance obligations for building owners/managers fall under State and Territory regulation, this chapter only provides a brief overview; more detailed information should be sought from the authority having jurisdiction.

Alert

Even if there appears to be no legislated obligation to register, regularly test or maintain backflow prevention devices, it is still advisable that testing and/or maintenance is carried out at regular intervals.

According to clause 4.4.6 of AS/NZS 3500.1, testable devices should be tested prior to beginning service, and at least once every 12 months thereafter.

7.1 Registration

Device registration is generally required under State/Territory or Local Government regulations for backflow prevention devices in Medium or High Hazard installations. This is because these installations can pose a significant threat to public health and safety if a backflow prevention device were to fail or be circumvented (inadvertently or otherwise).

Databases of registered testable devices may be kept by NOUs where the device is installed for containment protection, and/or by the State/Territory plumbing regulatory authority if the device is installed for zone or individual protection.

Air gaps and break tanks in Medium Hazard or High Hazard installations may also be required to be registered, even though these devices are not testable devices.

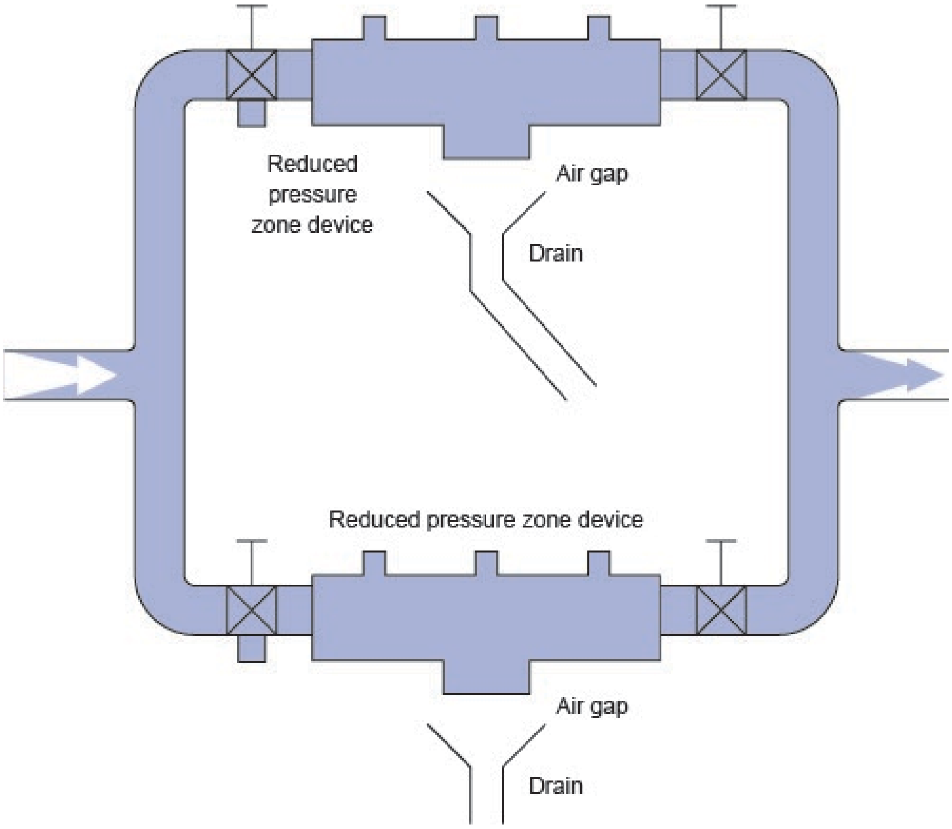
7.2 Testing

Testable backflow prevention devices are those that include features to enable the device to be tested in-situ, i.e. without the need to remove the device. According to AS/NZS 3500.1, the following types of backflow prevention devices are testable devices:

- Reduced pressure zone device
- Reduced pressure detector assembly
- Double check valve assembly
- Double check detector assembly
- Spill-resistant pressure-type vacuum breaker
- Pressure-type vacuum breaker
- Single check valve (testable)
- Single check detector assembly (testable).

Testing a backflow prevention device in-situ necessarily requires the water supply to the device to be shut off. Therefore, prior to conducting the test, it is important to alert the owner and/or occupants of the property concerned that their water supply will need to be shut off for a period of time, until the test is complete. In situations where it is not viable to shut off a water supply, e.g. hospitals or industrial premises that operate 24 hours/day, the backflow prevention device can be duplicated by installing a second, equivalent device, in a bypass, configured in a parallel arrangement with the primary backflow prevention device. This is called a protected bypass. Figure 7.1 shows how to configure a protected bypass.

Figure 7.1 Protected bypass configuration



Note: although Figure 7.1 depicts a protected bypass using reduced pressure zone devices, other devices can also be installed, provided that an isolation valve is installed at the end of each device to enable it to be isolated from the water supply, and removed if found to be defective.

Alert

Where the water supply to a building or part of a building is shut off to enable testing, it is important to advise building occupants not to open any upstream outlets during the test. This is because if an outlet is opened, the pressure in the water service pipework will fall to zero, which may lead to backsiphonage occurring elsewhere in the building. If backsiphonage does occur, the water service may become contaminated via a previously unknown and therefore unprotected cross-connection.

Detailed testing procedures relevant to each different type of testable device are set out in AS/NZS 2845.3 and in the device manufacturer’s instructions.

8 Bibliography

Documents that were used in the development of this Handbook are listed below.

Australian Building Codes Board (2016), *Backflow Prevention Research Report,* Canberra, ACT.

Australian Building Codes Board (2019), *National Construction Code Volume Three – Plumbing Code of Australia*, Canberra, ACT.

Office of Water, United States Environmental Protection Agency (2003) *Cross-Connection Control Manual*, Washington DC.

Standards Australia and Standards New Zealand (2018) *AS/NZS 3500 Plumbing and drainage* (Series).

Standards Australia and Standards New Zealand (2018) *AS/NZS 3500.0:2003 Plumbing and drainage – Glossary of terms.*

Standards Australia and Standards New Zealand (2018) *AS/NZS 3500.1:2018 Part 1: Plumbing and drainage – Water services.*

Standards Australia and Standards New Zealand (2010) *AS/NZS 2845.1:2010 Water supply – Backflow prevention devices – Materials, design and performance requirements.*

APPENDICES

Appendix A Compliance with the NCC

A.1 Responsibilities for regulation of building and plumbing in Australia

The NCC is an initiative of the Council of Australian Governments and is produced and maintained by the ABCB on behalf of the Australian Government and each State and Territory government. The NCC provides a uniform set of technical provisions for the design and construction of buildings and other structures, and plumbing and drainage systems throughout Australia. It allows for variations in climate and geological or geographic conditions.

Under the Australian Constitution, State and Territory governments are responsible for regulation of building, plumbing and development / planning in their respective State or Territory.

The NCC is given legal effect by building and plumbing regulatory legislation in each State and Territory. This legislation consists of an Act of Parliament and subordinate legislation, e.g. Plumbing Regulations which empowers the regulation of certain aspects of buildings and structures, and contains the administrative provisions necessary to give effect to the legislation.

Each State's and Territory's legislation adopts the NCC subject to the variation or deletion of some of its provisions, or the addition of extra provisions. These variations, deletions and additions are generally signposted within the relevant section of the NCC, and located within appendices to the NCC. Notwithstanding this, any provision of the NCC may be overridden by, or subject to, State or Territory legislation. The NCC must therefore be read in conjunction with that legislation.

A.2 Demonstrating compliance with the NCC

Compliance with the NCC is achieved by complying with the Governing Requirements of the NCC and relevant Performance Requirements.

The Governing Requirements are a set of governing rules outlining how the NCC must be used and the process that must be followed.

The Performance Requirements prescribe the minimum necessary requirements that must be met for buildings, building elements, and plumbing and drainage systems.

Three options are available to demonstrate compliance with the Performance Requirements:

- a Performance Solution;
- a DTS Solution; or
- a combination of a Performance Solution and a DTS Solution.

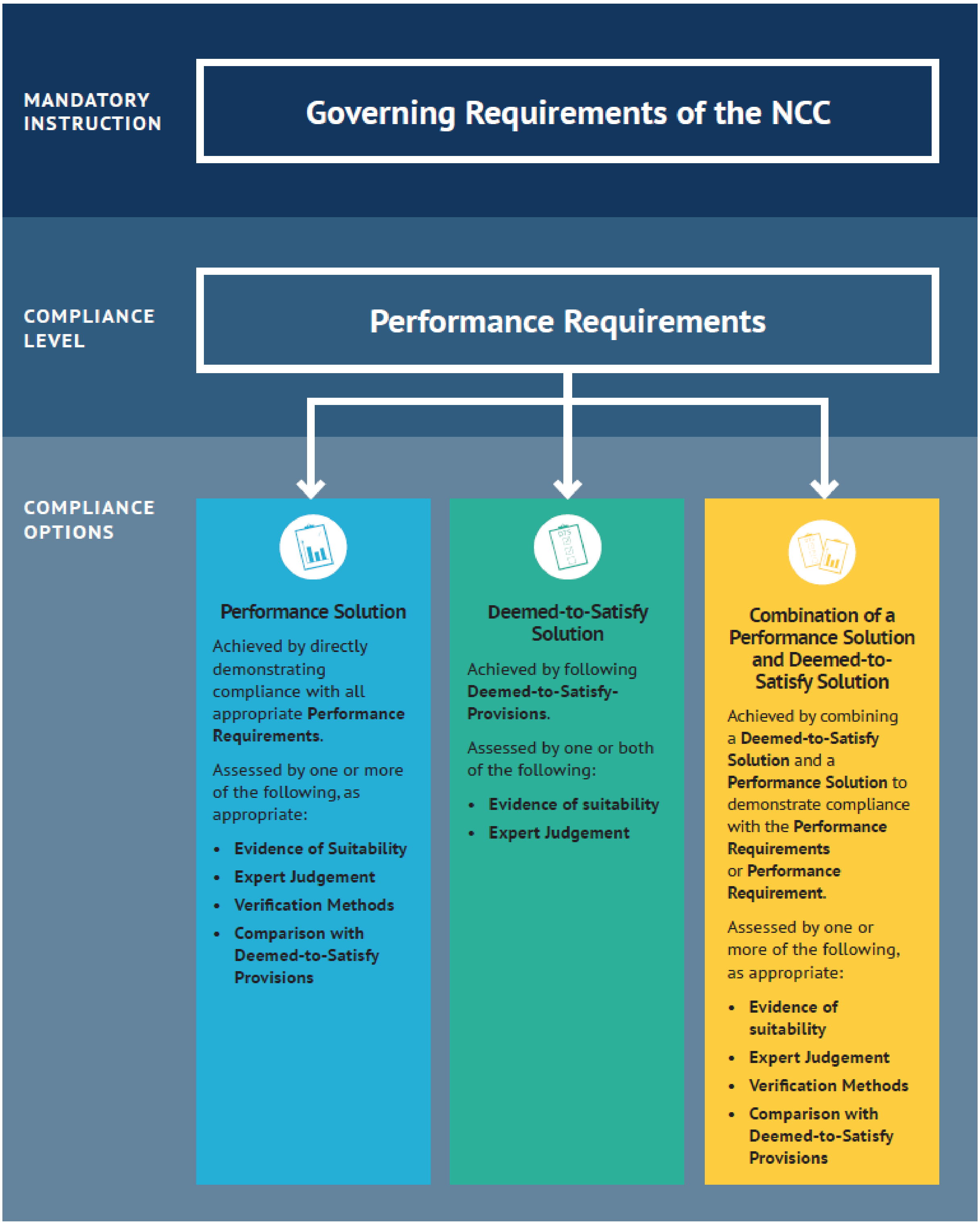
All compliance options must be assessed using one or a combination of the following Assessment Methods, as appropriate:

- Evidence of suitability
- Expert judgement
- Verification Methods
- Comparison with DTS Provisions.

A figure showing the hierarchy of the NCC and its compliance options is provided in Figure A.1. It should be read in conjunction with the NCC.

To access the NCC or for further general information regarding demonstrating compliance with the NCC, visit the ABCB website (abcb.gov.au).

Figure A.1 Demonstrating compliance with the NCC



Appendix B Acronyms and symbols

Table B.1 contains acronyms and symbolsused in this Handbook.

Table B.1 Acronyms and symbols

Acronym/Symbol	Meaning
ABCB	Australian Building Codes Board
AS/NZS	Australian Standard / New Zealand Standard
AG	Air gap
AVB	Atmospheric vacuum breaker
BCA	Building Code of Australia
BT	Break tank
COAG	Council of Australian Governments
DCAP	Dual check with atmospheric port
DCDA	Double check detector assembly
DCV	Double check valve
DualCV	Dual check valve
DTS	Deemed-to-Satisfy
DW	Drinking water
Handbook	Except in the Preface, means this Handbook
HCVB	Hose connected vacuum breaker
IGA	Inter-government agreement
kPa	Kilopascals
kPaA	Kilopascals (absolute)
kPaG	Kilopascals (gauge)
m	Metres
NCC	National Construction Code
NDW	Non-drinking water
NUO	Network Utility Operator

Acronym/Symbol	Meaning
P	Pressure
PVB	Pressure vacuum breaker
PCA	Plumbing Code of Australia
RPZD	Reduced pressure zone device
SPVB	Spill-resistant pressure vacuum breaker
SRVB	Spill-resistant vacuum breaker
TMV	Thermostatic mixing valve
TV	Tempering valve
US-EPA	United States Environmental Protection Agency
WH	Water heater
WMEP	WaterMark Schedule of Excluded Products
WMPD	WaterMark Product Database
WMSP	WaterMark Schedule of Products