Saving lives with backflow prevention

The 2017 Backflow Conference will be held in Tauranga

3rd–4th August

Peter McLennan, general manager, Brencliff, and regional manager, Apollo Valves (and president of The Backflow Prevention Association of Australia) reviews the design, installation and hydraulics of backflow prevention devices with a focus on pressure drop and flow restrictions.

Backflow prevention devices are like smoke detectors. They both save lives. Ignorance in understanding how they operate is not an excuse when the coroner knocks at your door.

Backflow prevention devices have become an integral part of the water supply asset. With the protection of drinking water being paramount, backflow prevention is required by Plumbing Codes in both New Zealand and Australia at any connection that is subject to being affected by a cross connection.

The operation and subsequent restraints backflow prevention devices present is not well understood. This article discusses the design requirements and the performance characteristics of Reduced Pressure Zone backflow prevention devices so that device owners and installers can be cognisant with potential issues before they occur.

Backflow Basics

Backflow is the term used to describe the reversal of flow in a water supply pipe or system. Backflow prevention devices are used to protect drinking water from contamination where cross connections occur.

A backflow prevention device is a safety valve that protects the drinking water supply. It is estimated that there are more than 500,000 testable backflow prevention devices installed across Australasia. But, other than a few in the plumbing industry, many people responsible for managing and maintaining drinking water systems know little of backflow and how the devices affect the system.

Whether a plumber, hydraulic designer, plumbing consultant, water officer, water engineer, contractor or property owner, there are several things you must understand when considering installing or requiring the installation of a backflow prevention device.

The following areas need to be understood and addressed when considering the use of a Reduced Pressure Zone Valve (RPZ) backflow prevention device.

The Plumbing Code

AS/NZS3500.1-2015 is referenced in Australia in the National Construction Code, Volume 3, the Plumbing Code of Australia and in New Zealand G12. Section 4 is Cross Connection Control and lays out the backflow prevention requirements when installing a drinking water piping system. When a State or Territory references the National Construction Code in its plumbing regulations, unless otherwise stipulated, it makes the use of backflow prevention devices mandatory. The adoption in New Zealand of the Boundary Backflow Prevention for Drinking Water Suppliers Code of Practice serves a similar function.

The Standard

Backflow prevention devices are WaterMarked to AS/NZS2845.1-2010 or AS/NZS2845.1-1998. The WaterMark is your assurance that the device has been manufactured and tested in accordance with the relevant Standard. If it does not have a WaterMark it should not be installed in the drinking water network. In New Zealand devices approved to the USA ASSE Standards are also permitted under G12.

Hazard Ratings

The AS/NZS3500 Standard identifies three levels of hazard (the contamination or pollutant that can come in contact with the drinking water).

- High Hazard – The pollutant or contaminant if ingested could kill you. Facilities connected to the water supply likely to have this level of potential contamination would include mineral processing, meat processing plants, hospitals, mortuaries, plating works, etc.
- Medium Hazard – The pollutant or contaminant if ingested is unpleasant and may make you ill. Facilities connected to the water supply likely to have this level of potential contamination include commercial buildings, schools, public parks, food processing plants etc.
- Low Hazard – The pollutant or contaminant is non-toxic but is objectionable and should not be present in drinking water. Facilities connected to the water supply likely to have this level of contamination include residential homes, rainwater tanks etc.

Cross connections within the piping system are how backflow contamination occurs. There are two types of cross connections.

1) A direct connection. This is where the cross connection is 'hard piped' and is often installed by people unaware of the possible consequences. It could be a bypass line or a submerged tank filling connection.
2) An in-direct connection. The most common cross connection is a hose. A hose is an in-direct connection as the outlet can be used and left in all sorts of situations. For example, drain cleaning, chemical mixing, pipe flushing, pool filling etc.

Once the piping system is cross connected, should a backflow event occur, the chance of contaminants entering the drinking water escalate significantly.

Two types of Backflow

Backsiphonage – the pressure in the supply line is reversed causing the water to be sucked or run backwards. This is usually caused by a water main break in the street but can be caused by mechanical devices that rely on venturi action to draw water from the supply line.

Backpressure – the water pressure within the facility is greater than the supply pressure. Causes can include high head pressure found in high rise buildings and at the top of hills and mechanical equipment failures.

Pressure Drop & Flow Rates

Backflow prevention devices rely upon pressure drop across the check valves for effective operation. The minimum spring differentials are stipulated in the AS/NZS2845.1 Standard and all WaterMarked devices must comply. Testable backflow prevention devices are field tested for effective operation upon commissioning and at least annually by an accredited tester trained in backflow prevention. Always check the manufacturer's published literature for the pressure drop curve to ensure you have enough available pressure to supply the amount of water required. It is especially important where a fire connection is concerned.

These examples are from manufacturers' published literature and should be used as a minimum.

- 100mm RPZ Valve at 20 L/s has a head loss of 68 kPa
- 100mm Double Check Valve at 20 L/s has a head loss of 20 kPa
- 100mm Double Detector Check Valve at 20 L/s has a head loss of 68 kPa.

Reference: All Valve Industries, Apollo Valves Backflow Prevention Catalogue. Pages 6 – 8 & 11. bit.ly/AllValveBackflowCatalogue.

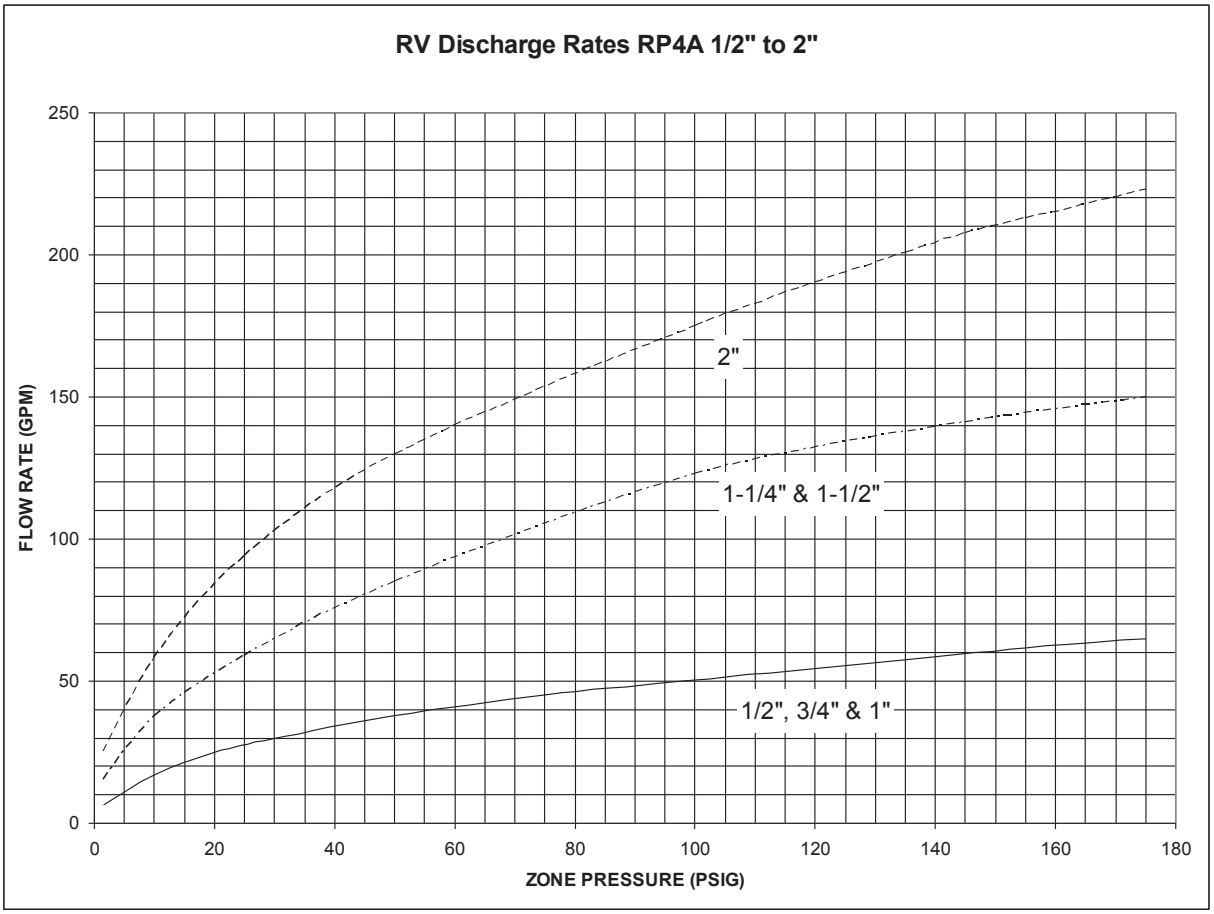
- 100 Single Check Valve Detector Testable at 20 L/s has a head loss of 57 kPa

Reference: Pentair ValVcheq Backflow Preventers Figure SCDA03. bit.ly/valves_emerson_SCDA03

These figures are devices only and do not include strainers or isolating valves. These values must be considered where pressure is limited. It is not unusual for a complete assembly comprising of isolating valves, strainer and the RPZ having a pressure drop close to 100 kPa.

Discharge from RPZ valves

All RPZ backflow prevention devices will dump water through the vent in the valve. It is a safety feature that ensures that if the device fails or there is a backflow event, the drinking water is protected.



Apollo Valves RPZ Discharge Rates.

The spillage of water is often inconvenient, but when installed where it cannot get away, it can become dangerous to property and humans.

All manufacturers publish the discharge rates applicable to their devices so be aware of these when you install an RPZ.

Otherwise you may have a flood on your hands as for example, a 50mm RPZ with a pressure of 700 kPa can discharge around 660 L/min, sufficient water to empty an Olympic sized swimming pool in six hours. See graph.

Installation guidelines

Backflow prevention devices are mechanical devices that require regular testing and maintenance. To facilitate this, they must be installed where ease of access is available. The Standard addresses some aspects, but each manufacturer outlines specific installation requirements in their published literature.

The three questions you need to ask yourself are:

1. Is the device I am installing suitable for vertical and horizontal installation or just horizontal? Reduced Pressure Zone backflow prevention devices are designed to discharge water either during pressure fluctuations or mechanical failure. To not compromise the level of safety, they are to be only installed in the horizontal plane. There is no WaterMarked RPZ device approved for vertical installation.

2. Is the device I am installing suitable for concealing in a valve box or pit? Due to the discharging of water, a valve box is susceptible to flooding. Once the water level covers the discharge vent, the valve is compromised and the safety reduced.

3. Does the device I am installing have ease of access for regular testing and maintenance without the need for special equipment or dismantling from the line? AS/NZS2845.1 2010 stipulates that testable backflow prevention devices are to be commissioned upon installation and tested at least annually to ensure effective operation. Workplace health and safety guidelines would dictate that backflow prevention devices not be installed in confined spaces, near hazards, in elevated positions or in ceiling cavities.

Understanding what backflow is and the limitations of the various devices will not only allow you to satisfy your duty of care where these devices are used, but to be able to understand the impacts the installation of these have within your network.

Backflow prevention devices are like smoke detectors. They both save lives. **WNZ**