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Cross Connection Control and Backflow Prevention, Opportunities for Improvement in the Australian Plumbing Industry

Peter Wenning

2015 Higher Education and Skills Group International Fellowship Report

An International Specialised Skills Fellowship

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i. EXECUTIVE SUMMARY

Public health is inextricably linked to safe drinking water. This precious resource is managed by water authorities and delivered under pressure to properties for a wide range of purposes including irrigation, food production and manufacturing.

Drinking water is supplied through various methods of connection to industrial processes and other systems where there may be toxic chemicals or potentially harmful bacteria present. Those processes and systems are so diverse, evolving and complex that it is virtually impossible for plumbers to make assumptions on risks of backflow. Therefore, plumbers must be properly trained on examining the operation of equipment, identifying risks, chemical and biological hazards, and implementing control measures to prevent contamination of the drinking water supply.

The Fellow has identified deficiencies in:

- Training competencies within the National Plumbing Training package that specify the requisite knowledge and skills for designing and installing water supply systems
- Currency of knowledge and skills of registered and licensed plumbing practitioners
- Australian Standard AS/NZS 3500.1: 2015 Plumbing and drainage Part 1: Water services which specifies requirements for Cross Connection Control and Backflow Prevention
- Australian Standard AS/NZS 2845.1: 2010 Water supply—Backflow prevention devices Part 1: Materials, design and performance requirements
- Australian Standard AS 2845.3 - 2010 Water supply—Backflow prevention devices Part 3: Field testing and maintenance of testable devices
- National Construction Code 2016 Volume Three Plumbing Code of Australia.

Through research in Australia and the United States, the Fellow has identified numerous opportunities to address these deficiencies including:

- Amendments and additions to training competencies (attached as Appendix 1) which is recommended to Artibus Innovation for the Construction, Plumbing and Services Industry Reference Committee assigned responsibility for the Construction, Plumbing and Services Training Package
- Support from state and territory plumbing regulatory authorities to improve training competencies and Australian Standards that specify the requirements for installation of plumbing, and the manufacture, field testing and maintenance of backflow devices
- Recommendations to Australian Standards Joint Technical Committee WS-014 for amendments to AS/NZS 3500.1:2015 (attached as Appendix 2)
- Recommendations to Australian Standards Committee WS-023 for amendments to AS/NZS 2845.1: 2010 and AS 2845.3: 2010 (attached as Appendices 3, 4 and 5)
- Recommendations to the Australian Building Codes Board (ABCB) for amendments to National Construction Code 2016 Volume Three Plumbing Code of Australia
- Further consideration by the ABCB in relation to the recommendations raised in their report titled, 'Backflow Prevention Research Report' published November 2016 which essentially splits the requirements and guidance for cross connection control and backflow prevention into different documents.[1]

Whilst amendments to the training competencies will be relatively simple, training organisations will face the task of incorporating additional skills and knowledge into existing training resources and assessing competence. This will essentially be the 'low hanging fruit' in achieving a training objective

1 ABCB, The Backflow Prevention Research Report, November 2016, released by the Australian Building Codes Board on behalf of the Commonwealth of Australia and States and Territories of Australia, Print Version 1, Release date: November 2016

of this Fellowship, where a learning guide can be developed through cooperation between Backflow Prevention Association of Australia (BPAA) and National Plumbing Services Plumbing Training Advisory Group (NPSTAG) where it can be made available to training organisations.

There are barriers to achieving the recommendations for improvements to Australian Standards for plumbing. The issues are more complex and time consuming as it involves consultation with stakeholders and approval of committees that have divergent interests.

Australian Standards are adopted through regulations which vary between Australian state and territories. Plumbing Code of Australia (NCC Volume 3) has been adopted in all states except Western Australia. The ABCB has influence on input to Australian Standards that are specified as Deemed to Satisfy Provisions in NCC Volume 3.

The ABCB has recently published a report titled, 'Backflow Prevention Research Report' published November 2016, containing recommendations for improvements in backflow prevention. The ABCB has an opportunity to consult with practitioners and associations such as the Backflow Prevention Association of Australia and to facilitate amendments to standards considering the additional technical information and recommendations in this report.

The Fellow believes that the ABCB report is comprehensive and to some degree has considered stakeholder input. However, it does not contain detailed analysis of probability of backflow, for example due to back-siphonage caused during the significant number of water main bursts around Australia, and not only the 5000 bursts p.a. reported by Sydney Water. The 2016 ABCB report also fails to acknowledge the significant volume of information in Manual of Cross Connection Control 10th Edition published by University of Southern California in 2014.[2]

2 University of Southern California Foundation for Cross Connection Control and Hydraulic Research 2009, Manual of Cross Connection Control, 10th edition, USC, California

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ii. ABBREVIATIONS/ACRONYMS

ABCB	Australian Building Codes Board
ABPA	American Backflow Prevention Association
AWWA	American Water Works Association
BPAA	Backflow Prevention Association of Australia
NCC	National Construction Code
NPSTAG	National Plumbing Services Training Advisory Group
RTO	Registered Training Organisation
USC	University of Southern California
USCFCCCHR	University of Southern California Foundation for Cross Connection Control and Hydraulic Research

iii. DEFINITIONS

Backflow

Flow in a direction contrary to the normal or intended direction of flow. The unintended flow of water from a potentially polluted source into a potable water supply.

Cross connection

Any connection or arrangement, physical or otherwise, between any potable 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-potable, used, unclean, polluted or contaminated water, or with any other substance, to enter any part of such potable water system under any conditions.

The above definitions are extracts from AS/NZS 3500.0: 2003 Australian/New Zealand Standard™ Plumbing and drainage Part 0: Glossary of terms

1. ABOUT THE FELLOW

Name

Peter Noel Wenning

Employment

- Hydraulic Services Consultant, Wenning Technical Services
- On-line Plumbing Lecturer, TAFE Queensland

Qualifications

- Certificate IV Plumbing and Services, Chisholm Institute, 2011
- Certificate IV Training and Assessment, Chisholm Institute, 2007
- Licensed Plumbing Practitioner
- Certified Cross Connection Control Program Specialist, University of Southern California, 2016

Memberships

- Member - (MAHSCA) Association of Hydraulic Services Consultants Australia (Vic)
- Member - (MASBC-CPC) Australian Society of Building Consultants
- Fellow - (FIPA) – Institute of Plumbing Australia
- Member – National Plumbing Services Training Advisory Group
- Member - American Backflow Prevention Association
- Member & Technical Advisor – Backflow Prevention Association of Australia

Biography

Peter is a Hydraulic Services Consultant and Director of Wenning Technical Services, a business based in Melbourne, Victoria and established in 1999 to provide specialist consulting services to government, owners' corporations, insurance companies and legal firms. Services include insurance loss assessing, complex investigations and plumbing inspection and testing.

Prior to 1999, Peter was employed in various roles including Plumber, Plumbing Inspector, Project Manager, Quality Manager and Hydraulic Services Designer.

From 2006 to 2016, Peter was employed part-time as a Plumbing Teacher at Chisholm Institute, Victoria where he developed and delivered two courses in Backflow Prevention. Peter has been employed by TAFE Queensland since 2014 delivering units on-line in Diploma of Hydraulic Services Design.

2. AIM OF THE FELLOWSHIP PROGRAM

The aims of this Fellowship are:

- To review the relevant competencies in the current Plumbing Training Package, and identify gaps in training requirements in relation to backflow prevention and cross connection control and to make recommendations for improvements
- To review Australian Standards that specify requirements for installation of plumbing and to make recommendations for improvements
- To review Australian Standards that specify requirements for manufacture, field testing and maintenance of backflow devices and to make recommendations for improvements.

Whilst Australia has a population of approx. 24 million, the USA has a population of approx. 320 million and has invested considerable resources in establishing standards and training in backflow prevention and cross connection control. Australia has gaps in entry level training and in the skills and knowledge of plumbing practitioners.

Improvements are needed in Australian Standards to ensure that they are clear, useful and readily accessible to the end users who are apprentices and registered and licensed practitioners.

The Fellowship study in the USA has assisted in identifying procedures and practices which can be taken up to enhance skills and knowledge in Australia.

3. THE AUSTRALIAN CONTEXT

The plumbing industry in Australia is well regulated as most practitioners have completed an apprenticeship where practical skills and theoretical knowledge have been gained in a Registered Training Organisation (RTO) and practical experience is gained in the workplace.

Generally, three years training is required to be registered and employed as a plumber, whilst additional education and/or examinations are required for a plumber to be licensed and supervise plumbing work or operate as a contractor. At both registration and license level there is very little study on the requirements for installation, testing and maintenance of backflow prevention devices, or in identifying cross connections. In addition, there is no mandatory requirement for Continuing Professional Development. Nevertheless, registered or licensed plumbers may install backflow devices and are required to connect the drinking water supply to industrial processes and other systems where there may be toxic chemicals or potentially harmful bacteria present.

Backflow prevention is a specialised category of plumbing, where practitioners may achieve an additional qualification to test and maintain backflow devices. This involves study on all theoretical and practical aspects of installation, testing and maintenance of backflow devices and identifying cross connections.

The Backflow Prevention Association of Australia having a membership consisting of manufacturers, water authority representatives and backflow device testers, have noticed a high percentage of defective and substandard installations which can result in the task of properly testing and maintaining backflow devices difficult, if not impossible.

The disparity is primarily due to a lack of education and training of registered and licensed plumbers, both at entry level and throughout their careers. Of more concern is that there is a lack of understanding of cross connection control and the potential for contamination of our drinking water. Throughout most of Australia, there is no compulsory requirement to register and test backflow devices within private plumbing systems, there is no monitoring of any connections of the drinking water supply to industrial processes and other systems where there may be toxic chemicals or potentially harmful bacteria present.

There have been numerous instances of backflow where drinking water supplies have been contaminated. For example, backflow from a Melbourne Mortuary to the mains water supply occurred in the early 1990s. At that time, the Fellow was employed as a Plumbing Inspector with Melbourne Water and was required to proactively inspect mortuary connections and specify backflow devices to be fitted at the outlet of mortuary water meters. Other instances of backflow have occurred within private plumbing systems. For example, water containing corrosion inhibitor flowed into the drinking water supply in a Melbourne office building and in a Ringwood service station, car wash recycled water and sewage flowed into the drinking water supply to drink machines.

The above evidence of backflow and substandard plumbing work highlights a need for additional training, skills and knowledge at levels of both plumbing apprentice and tradesperson. Improvements are also needed to plumbing regulations and Australian Standards.

3. THE AUSTRALIAN CONTEXT

SWOT Analysis

Strengths

- National Training Package and Industry Reference Committee.
- Water authorities acknowledge deficiencies and support change.
- Backflow Prevention Association of Australia as a central organisation supports the need to improve knowledge and skills.
- Universal recognition that Australian Standards need improvement.

Weaknesses

- Industry resistant to change.
- No compulsory continuing professional development.
- Lack of consistency in state and territory plumbing regulations.
- Lack of expertise and understanding at regulatory level.

Opportunities

- Processes and procedures have been established in the USA.
- Recent release of Australian Building Codes Board Plumbing Code Development Research Report: Backflow Prevention.

Threats

- Wasted time, expense and resources on reworking plumbing.
- Apathy of plumbing practitioners.
- Low interest and confidence in using Australian Standards.
- Perception of low risk to health and safety (lack of education).
- Contamination of drinking water supplies.

The benefits of additional training, skills and knowledge will reduce the incidence of substandard installations and rework at water meter assemblies where testing of backflow devices is generally compulsory. More importantly, a better understanding of cross connection control will improve compliance with Australian Standards and reduce the potential number of cross connections within properties, where backflow and contamination of the drinking water can occur.

Improvements to Australian Standards relating to backflow prevention and cross connection control would benefit the plumbing industry by improving confidence, and providing standards that technically accurate and useful.

4. IDENTIFYING THE SKILLS AND KNOWLEDGE ENHANCEMENTS REQUIRED

The required skills enhancement areas are:

a) Identifying cross connections and taking appropriate action to reduce the risk of contamination of the drinking water supply

b) Identifying the degree of hazard prior to connecting the drinking water supply to any outlet, system, appliance, fixture or process

c) Selecting an appropriate backflow prevention device based on the degree of hazard, pressure and flow requirements

d) Installing a backflow prevention device in a safe location that ensures sufficient access for testing, maintenance and replacement

e) Installing line strainers and resilient seated isolation valves that are approved and comply with Australian Standards installation requirements

f) Installing backflow devices and associated line strainers and isolation valves in the correct sequence

g) Registration of all testable backflow devices

h) Testing backflow prevention devices in accordance with Australian Standards, including recording and reporting test results

i) Maintenance of backflow devices in accordance with manufacturer instructions to ensure reliable operation and compliance with Australian Standards test acceptance criteria.

5. THE INTERNATIONAL EXPERIENCE

Destination 1 - American Backflow Prevention Association National Conference, Handlery Hotel, San Diego, California

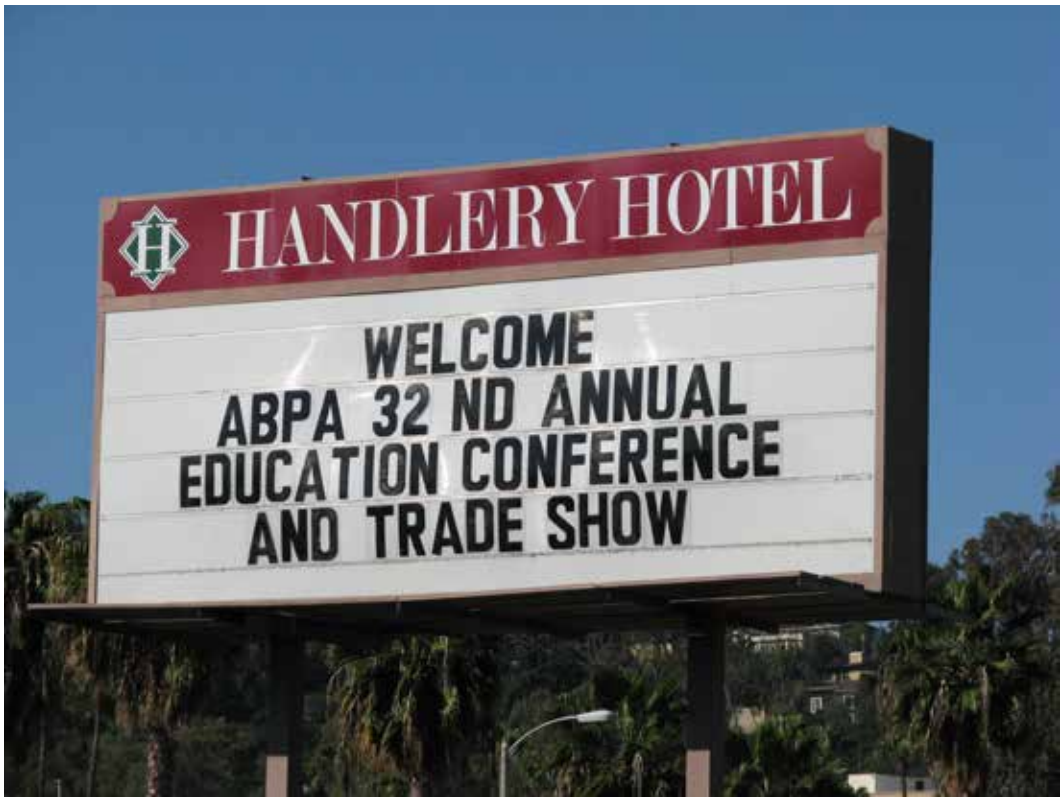

Image 1: ABPA Conference, San Diego, 2016

Contacts

- Tim Brown, Environmental Compliance Specialist, Albemarle County Service Authority
- John Graham, Water Quality Program Manager, California Water Service Company
- Kenneth J. Kerr, International Past President, American Backflow Prevention Association

Objectives

The American Backflow Prevention Association is an organisation with members having a common interest in protecting drinking water from contamination through cross-connections. ABPA is an organisation dedicated to education and technical assistance. Through its network of 12 regions and sub-chapters, local needs and interests are supported with the resources of the national organisation. ABPA is committed to advancing all aspects of backflow prevention for the continued protection of all water users.

The objectives of the Fellow were to attend education sessions to gain a greater understanding of the subject matter.

Knowledge and Experience Gained

5. THE INTERNATIONAL EXPERIENCE

(a) 'Risk Management in a Cross Connection Control Program', by Peter W. Peters BA Sc

Mr Peters is the Cross-connection control Coordinator for Cucamonga Valley Water District. The San Bernardino County covers 54 sq miles with a population of 200,000 and a register of 5400 backflow prevention devices.

The process of risk management involves assessing and prioritising risks through:

- Assessing plans for new building projects
- Surveying existing properties
- Inspecting and testing backflow assemblies.

It is essential to identify where the water authority jurisdiction and risk ends whether at:

- The water meter
- Inside the building
- To the last free flowing tap
- Liability for different parts of the water supply system.

A key component is also defining failure, as this does not necessarily mean backflow or contamination of the water supply is occurring.

Risk management involves considering:

- What activities present the greatest risk
- Whether the property owner understands or can be trusted
- Qualifications of handymen and others working on internal property plumbing
- Whether there is maintenance on internal property plumbing
- Whether test results are genuine and valid
- Qualifications and currency of tester certification.

Most water purveyors need private testers as they do not have the resources of funding.

Interference and problems with backflow assemblies occurs such as:

- Theft of backflow devices and emergency reconnection without consideration for backflow protection
- Some thieves are re-plumbing so that theft goes unnoticed for months
- Thieves cutting out detector check by-pass assemblies and closing by-pass isolation valves
- Connections to backflow valve test cocks for building works and gardening.

Processes to monitor private testers:

- Reviewing five to 10 per cent of test reports

- Checking discrepancies on valves and locations
- Verifying meter numbers
- Requiring testers to submit test kit calibration reports
- Talking to customers about notifications from testers to shut down supply for testing
- Confirming testers qualifications and currency with the regulatory authority.

Where testers are not completing the testing as required or reported, liaise with the regulatory authority to potentially revoke or suspend tester licenses.

Backflow devices can be installed by any plumber, but testers are separately licensed.

(b) 'Ethics in the Backflow Industry', by Michael Ahlee

Testers

- Testers should ideally be certified every three years.
- Backflow testers are protecting the distribution system.
- Should sign a code of ethics.
- Unethical behavior does exist, such as overcharging but there are often extenuating circumstances involving cutting concrete, moving other services, permits and shut downs.

Water suppliers

- Recognise that without testers there is no cross-connection control program.
- Some water authorities require installation but don't enforce testing with a policy that non-mandatory testing is better than no testing. This gives a false sense of security.
- Water suppliers can lose control at the point of connection.
- Customers trust that the water supply is pure.
- Dealing with 26 types of test forms is not conducive to consistency and reliability.

Customers

- Should be made aware of waterborne contamination through the history of backflow incidents (as listed in USC 10th Edition).
- Should be made aware of the penalty for cross connections and backflow.
- Reinforce that backflow is real and not a scam.

Educators

- Instructors must cover ethical issues and be competent to ensure that students meet the required underpinning knowledge and testing outcomes.

Regulators

- Play a part in ensuring that the requirements for installation are cost effective.

- Must ensure public health and safety.

Manufacturers

- Must have quality control.
- Responsive to consumer complaints.
- Provide education and assistance.

Certification organisations

- Must verify that manufacturers are meeting material specifications and performance requirements.

Professional associations

- Pursue excellence.
- Maintain standards.
- Setting aside personal agendas to achieve the mission statement.

(c) Irrigation system hydraulics, design and backflow prevention

The main change to irrigation practice is installation of deeper emitters which minimises losses due to evaporation and wind. This also promotes deeper root growth which stabilises trees and plants.

(d) Irrigation hazards in a cannabis facility

The growth of marijuana has now been legalised in several states including Colorado and Washington state.

This type of facility, like many others where there is research and development, is sensitive to contamination between different facilities – such as mold, fungi and insects. The quarantine and access conditions can make it difficult to carry out cross connection control surveys and inspections.

For the potential risks to the facility, the same analogy can be made for the risks to the public water supply, and to the health of workers exposed to the internal water supply.

(e) Conducting an effective cross connection control survey

Firstly, establish all known water sources. For example, in one facility there were eight different water supplies:

- Domestic
- Fire
- Well
- Rain
- Heating
- Cooling

- Recycled
- Ground water.

When establishing a point of contact, identify the person most knowledgeable about the plumbing and operations (usually not the manager).

Visits should be by appointment, and planned, where the point of contact is made fully aware of the process for the survey. A form should be prepared that includes all relevant equipment.

Equipment required for a survey:

- Personal Protective Equipment
- Pressure gauges (and sealant tape)
- Chlorine test kit
- Differential pressure gauge (backflow test kit)
- Gatic (inspection chamber cover) lifters
- Socket wrench set
- Screwdrivers
- Camera and phone
- Mirror
- Torch.

Commence the survey, with two people at the metered connections, and from there check all other different water sources and storages.

Check all recycled water services and ideally carry out a cross connection inspection by turning off recycled water and running drinking water outlets.

Check for cross connections, such as equipment connected without air gaps.

Take the time to educate. For example, providing for backflow at hose taps when connecting equipment with chemical injection to hoses.

Check that any pressure readings are consistent with the relevant water supply.

Educate about the potential for discharge from reduced pressure zone device relief ports inside buildings.

Ensure that all piping for non-potable water is appropriately labelled.

Look around for potential causes of damage to backflow devices.

Check that backflow device isolation valves are open, and make enquiries about any valves that are closed.

Inspect for unprotected by-passes around water supply connections to filters, regulators and other equipment.

(f) ‘Survey of Military Facilities’, by Richard Carlson, Captain USNR (Retired)

5. THE INTERNATIONAL EXPERIENCE

Image 2: Richard Carlson gives a presentation of military backflow prevention programs, ABPA Conference, San

Diego, 2016

Military backflow prevention programs:

- Current Navy Programs are based on OPNAV Instruction M5090, dated January 10, 2014
- Other military branches have their own instructions.

Surveying has its unique challenges:

- Determining applicable codes and regulations
- Entering secured areas, ensuring all permissions are obtained and paperwork is completed
- Obtaining escorts if necessary
- Gaining access to areas to be inspected
- Forms and approval processes
- Building numbering systems can be very random
- Pre-and post-survey briefings
- Following protocols.

Facilities inspected:

- China Lake Naval Air Weapons Station
- Camp Lemonier Naval Expeditionary Base, Djibouti Africa
- Naval Support Activity, Manama, Bahrain
- United Arab Emirates –Fujairah, Jebel Ali
- Kadena Air Force Base, Okinawa, Japan
- Marine Corps Air Ground Combat Center, 29 Palms
- 'VA Hospital, La Jolla.

Numerous facilities were surveyed revealing many cross connections and lack of maintenance of backflow devices.

Destination 1 Outcomes

Whilst the Fellow has attended numerous ABPA Conferences in the United States, and presented at the 2007 ABPA National Conference in Reno, Nevada, there has always been opportunities for knowledge transfer to Australia. This has occurred through writing magazine articles, association presentations and directly to students in TAFE backflow prevention courses.

The ABPA conferences often vary in presenting situations in different locations, environments, technologies, knowledge, skills, administrative and management controls. A common theme however, is the lack of comprehension in the causes of backflow at all levels including engineering and management.

Education on backflow prevention and cross connection control should include training and assessment of knowledge and practical skills at apprentice level. Whilst there is currently no mandatory requirement for continuing professional education of plumbing practitioners in Australia, in the experience of the Fellow, and some water authorities, there are unacceptable levels of non-compliance and this indicates that further education is required. This issue should be addressed by authorities with responsibility for plumbing education, licensing and compliance.

5. THE INTERNATIONAL EXPERIENCE

Destination 2 - University of Southern California, School of Engineering, Foundation for Cross-Connection Control and Hydraulic Research, Los Angeles, California

Image 3: The Fellow stands with 'Tommy the Trojan', USC, Los Angeles, 2016

Contacts

- Henry W. Chang, Mechanical Engineer, Program Manager
- Paul H Schwartz, Chief Engineer
- Patrick A. Sylvester, Marketing/Communications Manager

Objectives

The objectives of the Fellow were to:

- Attend a course for the Training of Cross-Connection Control Program Specialists which is designed to train those who might be involved in administering a cross-connection control program, and provides a broad understanding from hydraulic principles and operation of backflow devices to policies, procedures, rules, regulations, record keeping, public relations, plan checks and site surveys
- Expand the knowledge of the Fellow to gain an insight into the gaps in training for those responsible for backflow prevention and cross connection control in Australia; specifically, educators, regulators and personnel in the water industry
- Garner information to support recommendations for amendments to Australian Standards.

Knowledge and Experience Gained

(a) Background

The knowledge of the Fellow was enhanced via learning about the following:

- The layout and function of water distribution systems
- The history, causes, and effects of cross-connections.
- The history of backflow prevention
- Different methods of preventing backflow.

(b) Hydraulic principles and causes of backflow

Before undertaking the course, the Fellow carried out preliminary study on the correlation between the US imperial units of measurement and SI (International System) derived units of measurement to participate in class discussion and pass the course assessment in the following:

(i) Definitions and Hydraulic Principles

- Absolute Pressure, Atmospheric Pressure, Gauge Pressure, and Negative (Vacuum) Pressure
- Pressure created by Static Head, Thermal Expansion, Pumps.
- Static Head (Pressure) Loss
- Flow Rates and Dynamic Head (Pressure) Loss
- Venturi Effect
- Water Hammer.

(ii) Calculations

- Static head in a column of water and resulting pressure
- Differential pressure (between two columns of water)
- Venturi Effect on pressure.

(iii)Hydraulic Theory

- The relationship between Absolute Pressure and Atmospheric Pressure
- Gauge Pressure and its relationship to Absolute Pressure
- Negative (Vacuum) Pressure) and its relationship to Atmospheric Pressure and Absolute Pressure
- Head Loss
- Static Head (Pressure) Loss
- Dynamic Head (Pressure) Loss
- Thermal Expansion
- Water Hammer.

(iv)Definitions - Backflow Prevention

- Back-siphonage
- Backpressure
- Backflow
- Cross-connections (Difference between Direct and Indirect)
- Degree of Hazard
- Containment (Service) Protection
- Isolation (Internal) Protection
- Pollutants vs Contaminants.

(v) Cross Connections and Backflow Theory

- Backflow and conditions that can cause backflow
- Cross-connections and the conditions for Direct and Indirect Cross Connections
- Back-siphonage and the associated causes (e.g. Five fire hydrants per day burst / break in the Los Angeles area)
- Back-siphonage due to Venturi Effect (Velocity and flow relationship i.e. A X V = Q)
- Backpressure and the associated causes
- The difference between a Contaminant and a Pollutant
- Determining the degree of hazard
- Submerged Inlets to Tanks and Fixtures
- Containment (Service) and Isolation (Internal) Protection and the different conditions that cause backflow.

(vi) Recycled / Reclaimed (Non-drinking) Water, Grey Water and Fire Systems

- Hazards in Recycled and Reclaimed Water Systems
- Hazards in Grey Water Systems
- Hazards in Fire Systems.

(c) Administration of Cross-connection Control Programs

The Fellow gained a basic understanding of:

(i) Regulations and Codes for Cross-connection Control such as

- The Federal Safe Drinking Water Act
- State Regulations such as California Code of Regulations, Title 17; Nevada Administrative Code
- Applicable Plumbing Code(s) including Uniform Plumbing Code; California Plumbing Code CCR, Title 24, Part 5; Nevada Plumbing Code.

(ii) The Roles and Responsibilities in Cross-connection Control and Backflow Prevention

- Federal EPA (Safe Drinking Water Act Enforcement)
- Health Agencies (State and Local)

- Water Purveyor
- Cross-connection Control Specialist
- Plumbing Official (Administrative Authority)
- Backflow Prevention Tester
- Consumer.

(iii)Terms relating to Cross-connection Control

- Administrative Authority
- Accessible
- Approval
- Backflow due to Backpressure or Back-siphonage
- Grey Water
- Plumbing System
- Potable (Drinking) Water
- Non-Drinking (Recycled / Reclaimed) Water
- Water Distribution Main.

(iv)Cross-connection Control Programs

- Definitions of Laws, Regulations, Ordinances, Rules, Policies and Procedures
- The Difference between "Approved" and "Listed" including Listing Agencies and Approving Agencies
- Features of a Water Supplier's Cross-connection Control Program
- Containment (Service Connection) Backflow Prevention Program
- Internal Backflow Prevention Program
- Water Supplier avenues of action where a consumer fails to install Backflow Prevention
- Certification of Cross-connection Control Program Specialists and Backflow Prevention Device Testers. (e.g. Most areas require qualification as Tester. Arizona requires that the Specialist has a License. AWWA requires that Specialists obtain Continuing Education Units and are re-certified)
- Record Keeping/Reporting including Test Reports, identification of Backflow Devices, Field Test Results, Tester license, Retention of Records, Failed tests and substandard installations
- Continuing Education on Installation Requirements including Plumbing Codes, USC FCCC&HR Cross-connection Control Manual (currently 10th Edition), AWWA Manual M-14, EPA Cross-connection Control manual, Participating training and certification organisations.

(d) Cross-connection Control Surveying

The Fellow participated in theory and practical cross connection control survey of buildings at USC including:

- Kaprielian Hall (Civil and Environmental Engineering Department)
- Powell Hall (Engineering)
- Ronald Tutor Hall (Bioengineering and nanotechnology)
- Irani Hall (Laboratory and plant research facilities).

5. THE INTERNATIONAL EXPERIENCE

Subjects covered included:

1. The objectives of a Cross-connection Control Survey
   - » Identification of Cross-connections (e.g. The Navy requires survey of its facilities every five years)
   - » Hazard Assessment
   - » Selecting Method(s) of Protection.
2. Cross-connections (Actual vs Potential)
3. Plan Checks whilst conducting a Cross-connection Control Survey
   - » Design Drawings
   - » Symbols Used
   - » Plan, Elevation and Isometric View Drawings
   - » As Constructed Drawings.
4. Common water using fixtures and equipment
   - » Antibiotic Injectors
   - » Boilers
   - » Bidets
   - » Carbonated drink dispensing machines (Carbonated water reacts with copper, and copper leaches into water)
   - » Chemical Dispensers and Injectors (low and high toxicity)
   - » Heating and Cooling Circuits with Corrosion Inhibitors and BiocidesCleaning Systems using Soaps and Detergents
   - » Chemigation / Fermigation (application of agricultural fertilizers, soil additives and pesticides through irrigation water. Also, referred to as fertigation after fertilizer is injected into the irrigation water)
   - » Chillers
   - » Cooling Towers (a toxic environment for an air gap)
   - » Dishwashers
   - » Dental Equipment
   - » Mortuary Equipment
   - » Dirty Utility Room Equipment
   - » Garbage Disposals
   - » Hydraulic Lifts (e.g. water powered hoists)
   - » Photo Developing Equipment (Including X-ray Film Processors)
   - » Pre-rinse Units
   - » Solar Heating systems
   - » Portable and mobile tankers
   - » Trap primers
   - » Grey Water Systems
   - » Heat Exchangers (Single Wall vs Double Wall. e.g. A single wall heat exchanger is regarded as a cross connection)

- » Water Filters
- » Water Treatment Systems (including Ion Exchange and Reverse Osmosis).

5. Multi-Story Buildings
6. Interconnected Services (Multiple Service Connections to the same Allotment)
7. Cross-Connection (Shutdown) Testing
8. Types of Facilities presenting unique problems
   - » Alternative Water Sources (e.g., wells, lakes, streams, springs)
   - » Laundry and Dry Cleaning
   - » Food Retailers (e.g. Restaurants)
   - » Food Manufacturing / Processing
   - » Salons (e.g. Hairdressers and Barber Shops)
   - » Secondary Schools
   - » Car Washes / Smash Repair Workshops
   - » Manufacturing and Industrial Premises
   - » Oil Refineries
   - » Medical/Dental Facilities (e.g. Hospitals, Veterinary, Labs)
   - » Pet Grooming Facilities
   - » Mortuaries with Embalming Facilities
   - » Photo Processing (including X-Ray) Facilities
   - » Public Swimming Pools
   - » Non-Drinking (Recycled / Reclaimed) Water (Third Pipe)
   - » Sewage Treatment / Trade Waste Facilities
   - » Multi- Apartment Buildings
   - » Irrigation (e.g., Parks, Fields, Agriculture)
   - » Correctional Facilities
   - » Bottled Water Plants
   - » Multi-Purpose Buildings (Strip shopping malls that change tenancy)
   - » Retail Outlets.

(e) Arrangements and Options to Prevent Backflow

Whilst the Fellow came to the course with a good comprehension of arrangements and options to prevent backflow, he gained a greater understanding through using a different procedure of Hazard Assessment and studying the operation of different devices and test procedures.

1. Common methods not approved to protect against backflow:
   - » Swing check valves
   - » Single Check Valves
   - » Dual Check Valves (Vented and Not Vented)
   - » Other Assemblies/Devices that are not tested and certified.Backflow devices are not approved for recycled water

5. THE INTERNATIONAL EXPERIENCE

2. Common approved methods for preventing backflow include:
   - » Air Gap
   - » Barometric Loop (e.g. Elevation required to create relative vacuum at the top of a piped loop is approximately 33.9 ft)
   - » Anti-siphon Backflow Devices (including Atmospheric Vacuum Breaker (AVB), Pressure Vacuum Breaker (PVB) and Spill Resistant Vacuum Breaker (SVB)
   - » Double Check Valve Assembly (DC)
   - » Reduced Pressure Principle Assembly (RP). A design requiring a relief valve that is mechanically independent and hydraulically dependent.
   - » Detector Assemblies (including Double Check Detector Assembly (DCDA) and Reduced Pressure Detector Assembly (RPDA).
   - » Detector Assemblies designed to minimize pressure loss (including Double Check Detector Assembly (DCDA-II) and Reduced Pressure Detector Assembly (RPDA-II).
3. The considerations for application of each of the above methods to prevent backflow are:
   - » Protection against a Health Hazard (contaminant)
   - » Protection against a Non-Health Hazard (pollutant)
   - » Protection against Back-siphonage
   - » Protection against Backpressure.
4. Attributes of Backflow Assemblies:
   - » Standard Pipe Sizes
   - » Devices suitable for different pressure conditions (e.g. Devices suitable for downstream pressure operate on ‘Superior Pressure Principle’)
   - » Lists of Approved Assemblies (e.g. in accordance with USC FCCCHR; California Department of Health Services Approved List; Nevada Division of Health Protective Services Approved List). Assembly field evaluation process. Three-year approval period. Valve materials including issues in relation to Lead (Pb) content from 8 per cent to ≤ 0.25 per cent
   - » Assemblies are not rated with line strainers
   - » Identification information required on Assemblies
   - » Installation Methods that are approved for each type of Assembly. The orientation in which a backflow assembly can been installed is included in the list of approved backflow devices published and updated regularly by USC.
   - » Installation for access and maintenance (e.g. between 12” and 36” ‘above grade’)
   - » Installation of vented devices above flood plain
   - » Devices in parallel should be designed and installed to achieve balanced flow conditions.
5. Field Testing and Maintenance of Backflow Prevention Assemblies:
   - » Field Testing Equipment (including Recognised List of Gauges)
   - » Precautions in the Field Testing of Backflow Prevention Assemblies Appropriate equipment to carry out field testing
   - » Testing Procedures (Including common aspects e.g. position of gauge during test)
   - » Testing Procedures (Including sequence and care to prevent premature opening of relief valves)
   - » Testing of Detector Assemblies to verify correct operation of by-pass through activation of the water meter

» Test Records (including Device Identification)

» Test Results for different components including Check Valves, Differential Pressure Relief Valve, Air Inlet Valve

» Troubleshooting

» Reading manufacturer performance curves (Increasing pressure vs decreasing pressure)

» Repairs and Maintenance

» Tester Identification: a) Signature, b) License Number, c) Date of Initial Test, d) Type of Test e.g. initial / annual / post-repair / audit

» Tester Comments (e.g. test pressure fluctuations, site conditions)

» Record of Report Distribution (e.g. water authority, owner etc.)

» Retention period for test reports

» Safety Precautions (e.g. Confined spaces, Environmental concerns such as pests, sharps etc.).

(f) Cross-connection Testing

The Fellow was involved in class discussion on the importance of cross connection testing and using different testing methods:

- Reasons for Shutdown Test
- Conditions during Shutdown Test
- Participating in a Shutdown Test
- Planning for the Shutdown Test
- Inspection prior to Shutdown Test
- Test Methods (including Dye and Reduced Pressure Test)
- Remedial process when a Shutdown Test indicates a Cross-connection.
- Chlorination and Bacteriological Testing.

(g) Emergency response and assessment

The Fellow participated in class discussion with water agency employees to gain an understanding of appropriate actions in dealing with contamination of the public water supply:

- Appropriate responses
- Documenting a Declared Emergency
- Mandatory reporting when a Backflow Incident has occurred
- Records and documentation of a Backflow Incident
- Mitigation of a Backflow Incident
- Post Incident Evaluation of cause, and implementing corrective measures prevent future Incidents.

Whilst in the past water purveyors have adopted the position that, “The Solution to Pollution is Dilution”, this is bad policy and does not consider the differences between pollutants, and concentrations that have the potential to adversely affect human health.

(h) Public Relations

The Fellow studied the importance of consistent application of policy and communication in dealing with the public and media:

- The importance of Cross-connection Control and relevant literature.
- Policy when communicating with the public: Employees and contractors (e.g. authorised spokesperson to communicate with the media).

Destination 2 Outcomes

Whilst the Fellow had previous experience in all aspects of backflow prevention and cross control in Australia, the USC course provided greater insight into the various causes of backflow, different methods in carrying out risk and hazard assessment and aspects of good policy in a cross connection control program.

To successfully complete the course and final examination, it was necessary for the Fellow to study US imperial units in relation to hydraulic theory and performance of backflow prevention devices and different standards and work practices. The Australian water industry would benefit through further education of Cross Connection Control Program Managers in a course with suitable adaptations to the Australian context.

6. KNOWLEDGE TRANSFER: APPLYING THE OUTCOMES

The Knowledge gained through attending the ABPA Annual Conference in San Diego and USC Course is transferred through:

- Reviewing training competencies in the Plumbing Training Package
- Reviewing relevant Australian Standards and Codes
- Applying to Standards Australia and receiving approval for a standards project to improve AS 2845.3
- Making recommendations to relevant organisations as outlined in the following section.

An outline of the findings and recommendations in this report were presented at meetings of the Backflow Prevention Association of Australia as follows:

- Victoria Chapter meeting at the offices of City West Water, Melbourne on 21 April 2016.
- National Conference at Novotel Sydney Norwest on 28 July 2016.

A further presentation is scheduled to be delivered to the Association of Hydraulic Services Consultants Australia at Rising Sun Hotel, South Melbourne on 8 February 2017.

7. RECOMMENDATIONS

Government

a) Individual state and territory government agencies responsible for regulation of on-site plumbing must support continuing education of Plumbing Inspectors through completion of:

   » Mandatory 'Backflow Prevention Testing' course which is typically delivered in three days - CPCPWT4022A - Commission and maintain backflow prevention devices (Release 1)

   » Optional completion of a Cross Connection Control Program Specialist course (to be developed as outlined in Education and Training section below).

b) Individual state and territory government agencies responsible for regulation of on-site plumbing must support continuing education of Plumbing Practitioners through development of instructional sheets providing examples of hazard assessment and implementation of measures to prevent backflow and contamination of the drinking water supply.

c) Australian Building Codes Board (ABCB) adopt a policy of retaining relevant Performance Requirements in National Construction Code Volume 3, and all Deemed to Satisfy Solutions for backflow prevention and cross connection control, including hazard assessment, within AS/NZS 3500.1. This is the optimum solution for training organizations and practitioners that overwhelmingly refer to Australian Standards for installation requirements.

Water Industry

Water suppliers should adopt a policy that all Backflow Prevention Program Managers must be trained and certified as a Cross Connection Control Program Specialist (see section on Education and Training below).

Education and Training

a) Artibus Innovation as the contact for Construction, Plumbing and Services Industry Reference Committee assigned responsibility for the Construction, Plumbing and Services Training Package, should arrange for appropriate amendments to the Training Competencies (as referenced in Appendix 1) to ensure that:

   » there is a requirement for appropriate knowledge in the hazard assessment, selection and installation of backflow prevention devices

   » where there is a requirement in critical aspects of evidence for installation of any water services, then the requirement is extended to hazard assessment, selection and installation of backflow prevention devices

   » where there is a requirement in critical aspects of evidence for design or sizing water services, then the requirement is extended to hazard assessment, selection and specification of backflow prevention devices.

b) Water Services Association of Australia (WSAA) as the peak industry body representing the urban water industry in Australia and New Zealand should adopt a policy that all Backflow Prevention Program Managers must be trained and certified as a Cross Connection Control Program Specialist.

   Whilst no such course or certification currently exists is Australia, WSAA should seek out and establish a partnership with a Registered Training Organisation (RTO) to develop and deliver a course equivalent to the University of Southern California (USC FCCCHR) Course with appropriate adaptations for:

8. RECOMMENDATIONS

» Australian / New Zealand Standards and Regulations context in relation approval of plumbing products

» Australian / New Zealand Standards and Regulations context in relation to installation of plumbing

» Australian / New Zealand Standards and Regulations context in relation to testing of backflow prevention devices

» Australian / New Zealand context in understanding hydraulic principles and theory based upon SI (International System) derived units of measurement.

Mandatory pre-requisites for the course are:

» 'White card' course which is typically delivered in one day (CPCCOHS1001A - Work safely in the construction industry (Release 1))

» 'Backflow Prevention Testing' course which is typically delivered in three days - CPCPWT4022A - Commission and maintain backflow prevention devices (Release 1).

Historically, the Water Industry through policy to protect the integrity of the mains water supplies has been the primary driver for education in backflow prevention in the plumbing industry. With further education, Water Industry Backflow Prevention Program Managers through their interactions with Licensed Backflow Testers can improve the standard of plumbing at the metered service connections.

Standards Australia

a) Australian Standards Joint Technical Committee WS-014 implement amendments to Australian Standard AS/NZS 3500.1: 2015 (attached as Appendix 2).

b) Australian Standards Committee WS-023 implement amendments to AS 2845.3: 2010 (attached as Appendices 3 & 4). Note: An application was lodged to Standards Australia by the fellow under Project Prioritisation Round 13. The Fellow received approval of the application from Standards Australia on 25 November 2016.

c) Australian Standards Committee WS-023 implement amendments to AS/NZS 2845.1: 2010 (attached as Appendix 5).

Australian Building Codes Board

A conflict exists between:

NCC 2016 Volume Three - Plumbing Code of Australia, NSW B1.2 General requirements (a) (i) (B) and NSW Figure B1.2 Typical Cooling Tower Connections

and,

AS/NZS 3500.1: 2015 Section 4.6.2.1 (a).

Where NCC Volume 3 allows an air gap or registered air gap between water supply and cooling tower basin to be in a corrosive or polluted atmosphere.

It is recommended that the relevant NSW amendment be removed from NCC 2016 Volume Three.

9. REFERENCES

Books

University of Southern California Foundation for Cross Connection Control and Hydraulic Research 2009, Manual of Cross Connection Control, 10th edition, USC, California.

Articles / Reports

ABCB, The Backflow Prevention Research Report, November 2016, released by the Australian Building Codes Board on behalf of the Commonwealth of Australia and States and Territories of Australia, Print Version 1, Release date: November 2016

Websites

University of Southern California 2016, Foundation for Cross Connection Control and Hydraulic Research, viewed 23 November 2016, http://fccchr.usc.edu/list.html.

10. ACKNOWLEDGEMENTS

The Fellow would like to thank the following individuals and organisations who generously gave their time and their expertise to assist, advise and guide him throughout the Fellowship program.

International Specialised Skills Institute (ISS Institute) – The Awarding Body

The ISS Institute exists to foster an aspirational, skilled and smart Australia by cultivating the mastery and knowledge of talented Australians through international research Fellowships.

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10. ACKNOWLEDGEMENTS

Victoria State Government Department of Education and Training Higher Education and Skills Group

The Victorian Government, through the Higher Education and Skills Group (HESG) of the Department of Education and Training, is responsible for the administration and coordination of programs for the provision of training and further education, adult education and employment services in Victoria and is a valued sponsor of the ISS Institute. Wenning thanks them for providing funding for this Fellowship.

Supporters

American Backflow Prevention Association (ABPA)

Peter McLennan, President, Backflow Prevention Association of Australia

University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCCHR)

Employer Support

Wenning Technical Services Pty Ltd

Organisations Impacted by the Fellowship

Government

- ACT Planning and Land Authority (ACTPLA)
- Artibus Innovation for the Construction, Plumbing and Services Industry Reference Committee assigned responsibility for the Construction, Plumbing and Services Training Package
- Australian Building Codes Board (ABCB)
- New South Wales Office of Fair Trading
- Northern Territory Plumbers and Drainers Licensing Board
- Queensland Plumbers and Drainers Examination and Licensing Board
- South Australia Office of Consumer and Business Affairs
- Standards Australia
- Tasmania Plumbers and Gasfitters Registration Board
- Victorian Building Authority (VBA)
- Western Australia Plumbers Licensing Board

Professional Associations

- Association of Hydraulic Services Consultants Australia (AHSCA)
- Backflow Prevention Association of Australia (BPAA)
- Water Services Association of Australia (WSAA)

Education and Training

- National Plumbing Services Training Advisory Group
- Registered Training Organisations

11. APPENDICES

1 QUALIFICATIONS AND RELEVANT COMPETENCY UNITS REQUIRING IMPROVEMENT

2 AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: AS/NZS 3500.1: 2015

3 AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: AS 2845.3: 2010

4 TEST PROCEDURE (SCDAT) 1/AUG/2016 Test method for field testing of single check detector (testable) assemblies

5 AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: AS/NZS 2845.1: 2010

11. APPENDICES

APPENDIX 1 TO FELLOWSHIP REPORT

BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL - OPPORTUNITIES FOR IMPROVEMENT IN THE AUSTRALIAN PLUMBING INDUSTRY

QUALIFICATIONS AND RELEVANT COMPETENCY UNITS REQUIRING IMPROVEMENT

CPC32413 Certificate III in Plumbing

Core units	
Water stream	
CPCPFS3031A	Fabricate and install fire hydrant and hose reel systems
CPCPWT3020A	Connect and install storage tanks to a domestic water supply
CPCPWT3021A	Set out and install water services
CPCPWT3022A	Install and adjust water service controls and devices
CPCPWT3023A	Install and commission water heating systems
CPCPWT3026A	Fit off and commission heated and cold water services
CPCPWT3027A	Connect irrigation systems from drinking water supply
Mechanical services stream	
CPCPMS3033A	Install small bore heating systems
Elective units	
Water stream	
CPCPFS3037A	Install domestic and residential life safety sprinkler systems
CPCPIG2021A	Design domestic urban irrigation systems
CPCPIG3021A	Set out, install and commission irrigation systems
CPCPMS3033A	Install small bore heating systems
CPCPMS3040A	Install and maintain evaporative air cooling systems
CPCPWT3024A	Install and maintain domestic water treatment equipment
CPCPWT3028A	Install water services
CPCPWT3029A	Install water pipe systems
CPCPWT3030A	Install home fire sprinkler systems
Mechanical services stream	
CPCPMS3040A	Install and maintain evaporative air cooling systems

CPC32513 Certificate III in Plumbing (Mechanical services)

Core units	
Mechanical services stream	
CPCPMS3033A	Install small bore heating systems
CPCPFS3031A	Fabricate and install fire hydrant and hose reel systems

CPCPWT3020A	Connect and install storage tanks to a domestic water supply
CPCPWT3021A	Set out and install water services
CPCPWT3022A	Install and adjust water service controls and devices
CPCPWT3023A	Install and commission water heating systems
CPCPWT3026A	Fit off and commission heated and cold water services
CPCPWT3027A	Connect irrigation systems from drinking water supply
Elective units	
Mechanical services stream	
CPCPMS3040A	Install and maintain evaporative air cooling systems
CPCPFS3037A	Install domestic and residential life safety sprinkler systems
CPCPIG2021A	Design domestic urban irrigation systems
CPCPIG3021A	Set out, install and commission irrigation systems
CPCPMS3033A	Install small bore heating systems
CPCPMS3040A	Install and maintain evaporative air cooling systems
CPCPWT3024A	Install and maintain domestic water treatment equipment
CPCPWT3028A	Install water services
CPCPWT3029A	Install water pipe systems
CPCPWT3030A	Install home fire sprinkler systems
Gas services stream	
CPCPMS3033A	Install small bore heating systems

CPC40912 Certificate IV in Plumbing and Services

Core units	
Plumbing and services – Operations stream	
CPCPWT4011B	Design and size heated and cold water services and systems
Plumbing and services – Hydraulic services design stream	
CPCPWT4011B	Design and size heated and cold water services and systems
Elective units	
Fire services stream	
CPCPFS4024A	Design residential and domestic fire sprinkler systems
Air conditioning and mechanical services stream	
CPCPMS4011B	Design, size and lay out heating and cooling systems
CPCPWT4011B	Design and size heated and cold water services and systems
CPCPWT4022A	Commission and maintain backflow prevention devices
Plumbing and services – Management stream	
CPCPFS4024A	Design residential and domestic fire sprinkler systems
CPCPMS4011B	Design, size and lay out heating and cooling systems

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CPCPWT4011B	Design and size heated and cold water services and systems
CPCPWT4022A	Commission and maintain backflow prevention devices
Plumbing and services – Operations stream	
CPCPFS4024A	Design residential and domestic fire sprinkler systems
CPCPMS4011B	Design, size and lay out heating and cooling systems
CPCPWT4022A	Commission and maintain backflow prevention devices
Plumbing and services – Hydraulic services design stream	
CPCPFS4024A	Design residential and domestic fire sprinkler systems

CPC50412 Diploma of Plumbing and Services

Group A Fire services: core	
CPCPFS5010A	Design fire-compliant hydraulic services
CPCPFS5011A	Design fire sprinkler systems
CPCPFS5012A	Design fire hydrant and hose reel systems
Group B Plumbing and services management: core	
CPCPCM5011A	Design complex cold water systems
CPCPCM5013A	Design complex (non-solar) heated water systems
Group C Air conditioning and mechanical services: core	
CPCPMS5013A	Design hydronic heating and cooling systems
Elective units	
Group D General electives	
CPCPPS5023A	Design solar water heating systems
CPCPPS5025A	Design grey water re-use systems
CPCPPS5027A	Design irrigation systems

CPC50612 Diploma of Hydraulic Services Design

Core units	
CPCPCM5011A	Design complex cold water systems
CPCPCM5013A	Design complex (non-solar) heated water systems
CPCPFS4024A	Design residential and domestic fire sprinkler systems
CPCPPS5023A	Design solar water heating systems
CPCPPS5025A	Design grey water re-use systems
CPCPWT4011B	Design and size heated and cold water services and systems
CPCSFS5007A	Create detailed designs for hydrant and hose reel systems
Elective units	
CPCPFS5011A	Design fire sprinkler systems

CPCPMS5013A	Design hydronic heating and cooling systems
CPCPPS5027A	Design irrigation systems

AHC21116 Certificate II in Irrigation

Group B Electives	
NWPIRR013	Construct and install irrigation delivery and stormwater drainage assets

CPC20912 Certificate II in Urban Irrigation

Core units	
CPCPFS2021A	Connect static storage tanks for fixed fire protection systems
CPCPIG2021A	Design domestic urban irrigation systems
CPCPIG3021A	Set out, install and commission irrigation systems
Elective units	
CPCPWT3027A	Connect irrigation systems from drinking water supply
CPCPWT3028A	Install water services
CPCPWT3029A	Install water pipe systems

AHC32416 Certificate III in Irrigation

Group A Electives	
AHCIRG331	Install pressurised irrigation systems
Group B Electives	
CPCPIG2021A	Design domestic urban irrigation systems
CPCPWT3027A	Connect irrigation systems from drinking water supply *
CPCPCM2043A	Carry out WHS requirements

AHC41116 Certificate IV in Irrigation

Group A Electives	
AHCIRG431	Supervise irrigation system installation

AHC51616 Diploma of Irrigation Management

Core units	
AHCIRG501	Audit irrigation systems

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AHCIRG503	Design irrigation, drainage and water treatment systems

CPC32813 Certificate III in Fire Protection

Core units	
CPCPFS2021A	Connect static storage tanks for fixed fire protection systems
CPCPFS3030A	Design pre-calculated fire sprinkler systems
CPCPFS3031A	Fabricate and install fire hydrant and hose reel systems
CPCPFS3037A	Install domestic and residential life safety sprinkler systems
CPCPWT3028A	Install water services
Elective units	
CPCPWT3029A	Install water pipe systems
CPCPWT3030A	Install home fire sprinkler systems

CPC50509 Diploma of Fire Systems Design

Core units	
CPCSFS5002A	Research and interpret detailed fire systems design project requirements
Group A Water-based systems elective units	
CPCSFS5006A	Create detailed designs for fire sprinkler systems
CPCSFS5007A	Create detailed designs for hydrant and hose reel systems
CPCSFS5009A	Create detailed designs for fire systems' water supplies

APPENDIX 2 TO FELLOWSHIP REPORT

BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL - OPPORTUNITIES FOR IMPROVEMENT IN THE AUSTRALIAN PLUMBING INDUSTRY

AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: AS/NZS 3500.1: 2015

ITEM	CLAUSE	DESCRIPTION
SECTION 4 CROSS CONNECTION CONTROL AND BACKFLOW PREVENTION		
1	4.2.3	The section should be reworded such that the space between the partition walls is drained in such a way that the outlet cannot be plugged or capped and the discharge is external and readily visible.
2	4.2.4 (d)	The words, “other than used for containment” should be removed.
3	4.2.5	The NOTE should be reworded such that where cross connections cannot be immediately rectified, they are reported to the relevant Government Department of Health in Australia.
4	4.3	The section on Cross Connection Hazard Ratings should refer to authoratitive advice / or text such as MSDS to assist in determining the hazard rating. The method for hazard rating assessment requires clarity and streamlining for practitioners.
5	4.4.1	Figure 4.4.1 should be redrawn to relocate the hose tap within 18 metres of zone protection, and to indicate hazard levels for all devices in the drawing. Solid and broken lines should also be redrawn to clearly define boundaries of properties.
6	4.4.1	An additional NOTE should be provided that backflow prevention devices in series should be avoided to minimise pressure losses.
7	4.5	Table 4.4.1 should be amended to remove Single check valve non-testable as it is not a backflow device and cannot conform to AS/NZS 2845.1: 2010
8	4.5	Table 4.4.1 should be amended such that *Backflow Prevention Devices shall be fitted with Isolating valves where required to meet the acceptance test criteria specified in AS/NZS 2845.3
9	4.6.2.1 (f)	A definition is required for in-line devices
10	4.6.2.2	A specification is required for Accessibility. For example 1 metre maximum above ground level or platform. For example 300 mm minimum side and top clearance. For example, 100 mm minimum clearance for the attachment of hoses for the performance of the applicable test procedure.
11	4.6.3.1	Should also refer to compliance with 4.6.2
12	4.6.3.2 (a)	Table 4.6.3.2 should refer to Appendix H which should be Normative
13	4.6.3.2 (i) (iv)	Should only be used in fire services as containment protection
SECTION 5 INSTALLATION OF COLD WATER SERVICES		
14	5.3.2 (e)	At each testable backflow prevention device. Isolating valves must be resilient seated.

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SECTION 6 FIRE SERVICES		
15	6.3	Addition to NOTES: Backflow prevention assemblies in fire services must not incorporate line strainers
SECTION 7 IRRIGATION AND LAWN WATERING SYSTEMS		
16	7.2 (b)	The dimension 450 mm in Figure 7.2(B) (iii) needs to be clarified somewhere in the text
SECTION 12 INSTALLATION OF WATER SUPPLY TO SPECIFIED FIXTURES		
17	12.2.2	The dimension 25 mm air gap needs to be referenced to points of measurement
APPENDIX G TYPES OF BACKFLOW PREVENTION		
18	Table G1	Coils and jackets in heat exchangers requires review to specify the hazard ratings for single wall and double wall heat exchangers (A proposal to Standards Australia has been lodged to amend AS 3498----2009)
19	Table G1	The note at the base of the table should state that *Any backflow device for a cooling tower must be located outside the cooling tower and not in a corrosive or polluted atmosphere.

APPENDIX 3 TO FELLOWSHIP REPORT

BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL - OPPORTUNITIES FOR IMPROVEMENT IN THE AUSTRALIAN PLUMBING INDUSTRY

AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: AS 2845.3: 2010

ITEM	CLAUSE	DESCRIPTION
SECTION 2 FIELD TESTING AND MAINTENANCE		
1	2.3 (c)	A review is required to determine whether the upstream isolating valve is required to be watertight as this does not affect the integrity of the test results.
2	2.3 (d)	A review is required to determine whether the upstream isolating valve is required to be watertight as this does not affect the integrity of the test results.
3	2.3 (e)	A review is required to determine whether the upstream isolating valve is required to be watertight as this does not affect the integrity of the test results.
4	2.3 (f)	A review is required to determine whether the upstream isolating valve is required to be watertight as this does not affect the integrity of the test results.
APPENDICES		
5		A complete review of all Appendices is required with particular scrutiny on the testing procedures for mechanical backflow prevention devices.
		The procedures have drawing errors, and for numerous reasons throughout the standard, are not technically accurate. For example, Figures F1, G1, H1 and I1: Quarter turn butterfly valves and line strainers are not permitted in fire services.
		The procedure at Appendix H for testable single check valves should incorporate a diagnosis / measurement of maximum pressure loss, as manufacturers are fitting detector check valves springs and valves that produce an excessive pressure loss.
		Test procedures should include “call to action” prompts for the user to “Observe”, “Record”, “Calculate” etc (See example re-written procedure: Report Appendix 4 which, in addition, removes the need for a superfluous test tap in the by-pass assembly)
6	Appendix C3	A review of the procedure is necessary to ensure sequence is appropriate in relation to cleaning line strainer
7	Appendix D3	A review of the procedure is necessary to ensure sequence is appropriate in relation to cleaning line strainer
8	Appendix E3	A review of the procedure is necessary to ensure sequence is appropriate in relation to cleaning line strainer
9	Appendix F3	A review of the procedure is necessary to ensure sequence is appropriate in relation to cleaning line strainer
10	Appendix G3	A review of the procedure is necessary to ensure sequence is appropriate in relation to cleaning line strainer

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APPENDIX 4 TO FELLOWSHIP REPORT

TEST PROCEDURE (SCDAT) 1/AUG/2016

Test method for field testing of single check detector (testable) assemblies

PROCEDURE

(1) Test preparation:

a) Check and, if necessary, open upstream isolating valve

b) Ensure by-pass inlet valve is open, and close by-pass outlet valve

c) Close downstream isolating valve

d) In sequence, open and close test taps (1) and (2) to flush out any impurities

e) Ensure test kit valve (A) is open, (B) is closed and (C) is open.

(2) To test the upstream and downstream isolating valves:

a) Connect the high-pressure hose to test tap (2).

b) Slowly open test tap (2) and vent water through the vent hose, then close test kit valve (C).

NOTE: The differential gauge will indicate a high reading.

c) Close upstream isolating valve

d) Slowly open test kit valve (B) and vent water through low pressure hose to drop the gauge reading to centre of the dial.

e) Close test kit valve (B).

f) **Observe** the differential gauge for change.

If the pressure on the gauge is rising, either the upstream isolating valve or downstream isolating valve is leaking. To determine which valve is leaking, open test tap (1). If there is a continuous discharge of water from test tap (1), the upstream isolating valve is leaking. If there is no continuous discharge, the downstream isolating valve is leaking.

If the pressure on the gauge is dropping (approaching zero), the downstream isolating valve is leaking.

Faulty isolating valves must be repaired or replaced, and the test must be repeated. Leakage invalidates the test results. **Record result**

RESULT:	UPSTREAM ISOLATING VALVE LEAKING	YES / NO
	DOWNSTREAM ISOLATING VALVE LEAKING	YES / NO

g) Close test tap (2).

h) Close test kit valve (A) and open test kit valve (C).

i) Remove high-pressure hose from test tap (2).

j) Open upstream isolating valve

(3) To test the main non-return valve:

a) Connect-

» the high-pressure hose of the test kit to test tap (1); and

» the low-pressure hose of the test kit to test tap (2).

b) Slowly open test taps (1) and (2).

c) Open test kit valve (A) and bleed water through the vent hose.

d) Close test kit valve (A).

e) Slowly open test kit needle valve (B) and bleed water through the vent hose to eliminate air from the system.

f) Slowly close test kit needle valve (B) and **Observe and Record** the reading on the differential pressure gauge.

GAUGE READING:_____

If a reading below 17 kPa is indicated, the non-return valve shall be deemed to be faulty. The non-return valve shall be repaired or replaced, and the test shall be repeated.

(4) To test the by-pass dual check valve assembly:

a) Slowly open by-pass outlet valve.

b) Open test kit valve (A) and bleed water through the vent hose.

c) Close test kit valve (A).

d) Slowly open test kit needle valve (B) and bleed water through the vent hose to eliminate air from the system.

e) Slowly close test kit needle valve (B) and **Observe and Record** the reading on the differential pressure gauge.

GAUGE READING:_____

If a reading below 7 kPa is indicated, the by-pass dual check valve shall be deemed to be faulty. The valve shall be repaired or replaced, and the test shall be repeated.

The reading of the pressure differential of the main single check valve [reading in Step (3) (f)] shall at least 10 kPa higher than the reading of the pressure differential of the by-pass assembly [reading in Step (4) (e)].

11. APPENDICES

Calculate Pressure Differential

CALCULATION:

MAIN CHECK VALVE DIFFERENTIAL minus BY-PASS ASSEMBLY DIFFERENTIAL

_____ (must be at least 10 kPa)

If the pressure differential across the main single check valve is not at least 10 kPa higher than the pressure differential across the by-pass assembly, the cause shall be diagnosed and rectified, and the test shall be repeated.

(f) Close test taps (1) and (2), open test kit valves (A) and (B), disconnect the test kit pressure hoses and open the downstream isolating valve. This restores the device assembly to operating condition.

UPON COMPLETION ALL ISOLATION VALVES MUST BE LOCKED IN THE OPEN POSITION

APPENDIX 5 TO FELLOWSHIP REPORT

BACKFLOW PREVENTION AND CROSS CONNECTION CONTROL - OPPORTUNITIES FOR IMPROVEMENT IN THE AUSTRALIAN PLUMBING INDUSTRY

AUSTRALIAN STANDARD REQUIRING IMPROVEMENT: ASNZS 2845.1: 2010

ITEM	CLAUSE	DESCRIPTION
SECTION 1 SCOPE AND GENERAL		
1	1.1	Removal of reference to PN 10, PN 12 and PN 16
2	1.7	Removal of reference to PN 10, PN 12 and PN 16. Allowable operating pressures to be prescribed by the manufacturer.
SECTION 2 MATERIALS		
3	2.1	Removal of option to use alternative materials
4	2.2	Remove 2.2 to 2.11. ASTM A276 does not allow 304 Stainless Steel as it results in pitting in poor water quality areas.
		Springs and circlips should be permitted if they meet the requirements of AS/NZS 4020
		Stainless steel should be permitted as a cast component
SECTION 3 COMMON DESIGN AND PERFORMANCE REQUIREMENTS		
5	3.5.3	Internal thread complying with AS ISO 7.1 or an SAE thread suitable for the connection of test equipment
		Delete Table 3.1
ALL SECTIONS FOR BACKFLOW DEVICES		
6		Delete all references to Hazard Ratings as the application of Hazard Ratings to backflow devices and particular situations is within AS/NZS 3500.1
SECTION 11 DOUBLE CHECK DETECTOR ASSEMBLY (DCDA)		
7	11.4.2	Rewrite based on relevance to flow rates
SECTION 12 MANUFACTURER'S DATA		
8	20.1	add (d) Orientation eg. Horizontal, Vertical upward flow, Vertical downward flow
SECTION 13 REDUCED PRESSURE DETECTOR ASSEMBLY (RPDA)		
9	13.4.2	Rewrite based on relevance to flow rates
SECTION 14 SPILL RESISTANT PRESSURE VACUUM BREAKER (SPVB)		
10	14.2	Remove, "Application is limited to installations of mains pressure flushing devices".
SECTION 18 SINGLE CHECK DETECTOR ASSEMBLY (TESTABLE) (SCDAT)		
11	18.3.4	Consider rewriting to allow the use of single check valve
	18.4.2	Rewrite based on relevance to flow rates
SECTION 19 MARKING AND PACKAGING		

11. APPENDICES

12	19.1.1	Consider adding requirement for Watermark
APPENDIX A MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS STANDARD		
13	Table A1	Remove section on material properties except reference to clause 3.2 Effect on water
14	Table A3	Remove section on material properties except reference to clause 3.2 Effect on water
15	Table A5	Remove section on material properties except reference to clause 3.2 Effect on water
16	Table A7	Remove section on material properties except reference to clause 3.2 Effect on water
17	Table A9	Remove section on material properties except reference to clause 3.2 Effect on water
18	Table A11	Remove section on material properties except reference to clause 3.2 Effect on water
19	Table A13	Remove section on material properties except reference to clause 3.2 Effect on water
20	Table A15	Remove section on material properties except reference to clause 3.2 Effect on water
21	Table A17	Remove section on material properties except reference to clause 3.2 Effect on water
22	Table A19	Remove section on material properties except reference to clause 3.2 Effect on water
23	Table A21	Remove section on material properties except reference to clause 3.2 Effect on water
24	Table A23	Remove section on material properties except reference to clause 3.2 Effect on water
25	Table A25	Remove section on material properties except reference to clause 3.2 Effect on water
26	Table A27	Remove section on material properties except reference to clause 3.2 Effect on water
27	Table A29	Remove section on material properties except reference to clause 3.2 Effect on water