CROSS CONNECTION CONTROL

for the Plumbing and Piping Trades

PLUMBER APPRENTICESHIP PROGRAM

LEVEL 3

By Richard V. Mawle RSE

Acknowledgements & Copyright Permission

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Upgrading and refresher requirements
A Cross Connection Control refresher supplement guide may also be available.

About the author
The author has on the job experiences and been involved with the piping trades for over 35 years, including instructing as a post-secondary college-level instructor. The Author holds a Red Seal Certificate of Qualification Plumbing and trades certificate of Qualification Sprinkler-fitting and Steam Pipe Fitting. The author has also been involved curriculum development, instructing Pipe Trades including cross connection control testing and conducting building surveys at the municipal level.

Care has been exercised to address information provided is accurate at the time of publication; however, it would be appreciated that any errors or misinformation that is found be identified and corrected on a continuing basis. Suggestions for improvement are always welcome. Notify your instructor when you have any issues of concern.

Disclaimers

The materials in these Learning Guides are for use by students and instructional staff, and have been compiled from sources believed to be reliable and to represent best current opinions on these subjects. These manuals are intended to serve as a starting point for good practices and may not specify all minimum legal standards. No warranty, guarantee or representation is made by the BC Piping Trades Articulation Committee, the British Columbia Industry Training Authority or the Queen's Printer of British Columbia as to the accuracy or sufficiency of the information contained in these publications. These manuals are intended to provide basic guidelines for piping trades practices. Do not assume, therefore, that all necessary warnings and safety precautionary measures are contained in this Competency and that other or additional measures may not be required.

SAFETY ADVISORY

The current Standards and Regulation in BC can be obtained at the following website: http://www.worksafebc.com.

Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her area of work.

Industry Training Authority
January 2012

Conditions of use

This training manual is specifically designed for educational training for use only for the installation, and testing of backflow preventers in Plumbing Systems as regulated by the BC/Canadian Building/Plumbing Code in accordance with CSA B64 10 Installation and CSA test procedures. The manual may be suitable for in classroom and shop practical training for the Plumbing and Pipe Trades Certification and Apprenticeship System. The manual contains backflow prevention information complete with student objectives self-test questions at the end of each chapter. An appendix section provides additional related information. This manual is not a standalone manual. The manual works best when combined with on the job practical training assessments, technical in-school theory and practical assessments typical of an apprenticeship program in Canada.

Study skills

Each chapter starts with a list of your important objectives. Focus on these objectives as you work your way through each chapter. Once you have finished the chapter self-test questions, review the objectives. If you feel you have accomplished each chapter objective, proceed to the next chapter.

This manual "*Cross Connection Control for the Plumbing and Pipe Trades* ", is not a legally recognized cross connection manual for any purpose, it is simply an educational tool. All referenced publication used in this manual take precedence over the contents of this manual. Authorities having jurisdiction are independent of one another and can interpret and apply the National Building/Plumbing Code and local bylaws differently. It is the responsibility of the users of this manual to follow all requirements of the authority having Jurisdiction and in no case shall this manual used for any other purpose other than in-in school classroom and shop practical purposes. Consult with AHJ.

References

BC/ Canadian National Building/Plumbing Code Part 7, Plumbing Services. Adopted from the National Building Code of Canada. You should already have and use this code in the field of practice

CSA standard B64.10- and B64.10.1-Selection and installation of backflow preventers/ Maintenance and field testing of backflow preventers. It is recommended, you purchase this standard

CSA B125 standard covering plumbing fittings such as faucets and WC ball cocks

Canadian Government Program and published occupational interprovincial standards IPG

Manufactures literature, Municipal/regional bylaws, BC Safe Drinking Water Act.

Canadian/Provincial Agreement on Internal Trade Chapter 7 Labour Mobility guide lines

AWWA M-14 Introduction, Responsibilities, Plumbing Codes, Officials Health Authority etc.

AWWA/ BCWWA Canadian Cross Connection Control Manual, you will need this manual for BCWWA tester certification and water and waste industry cross connection requirements. It is a recognized manual for the implementation of Cross Connection Control Program for the water and waste industry sector tester certification.

USC Foundation for Cross Connection Control and Hydraulic research

Methodology for Setting a Cross-Connection Control Program a best practices Infra Guide © 2005 Federation of Canadian Municipalities and National Research Council.

BC Building Act 2015, Modernizing BC Building Regulatory System

BC Industry Training Authority Red Seal RSE recognition

The administrator of the Red Seal Program, the Canadian Council of Directors of Apprenticeship (CCDA),

BC Drinking Water Act: Hazard Abatement and Prevention Orders

BC Plumber program outline

All of these references play a role in the prevention of cross connection prevention. Users of this manual are obligated to confirm information provided in these linked is consistent with the intent of the referenced documents. The manual and the information contained within Itself is not a legally recognized document.

Contents

This manual is consistent with the intent of the IPG/NOA Plumber

Course outline: PLB-325 Cross Connection Control (2010) Interprovincial program guide

Learning Outcomes

- Demonstrate knowledge of cross connection control devices, their applications and operation.
- Demonstrate knowledge of the procedures used to install, maintain, repair, test and troubleshoot cross connection control devices.

Learning Objectives and Content

1. Define terminology associated with cross connection control.
2. Identify hazards and describe safe work practices pertaining to cross connection control.
3. Interpret codes and regulations pertaining to cross connection control.
   a. Training and certification requirements.
4. Interpret information pertaining to cross connection control found on drawings and specifications.
5. Identify tools and equipment relating to cross connection control and describe their applications and procedures for use.
6. Explain backflow and its causes.
7. Identify types of cross connection control devices and describe their characteristics, operation and applications.
8. Describe the procedures used to install cross connection control devices.
9. Describe the procedures used to maintain and repair cross connection control devices.
10. Describe the procedures used to test and troubleshoot cross connection control devices.

Related IPG outcomes

Demonstrate knowledge of effective communication practices.
Demonstrate knowledge of trade related documentation and its use.
Demonstrate knowledge of regulatory requirements pertaining to safety.
Demonstrate knowledge of interpreting and extracting information from drawings.
Demonstrate knowledge of piping valves, their applications and operation.
Demonstrate knowledge of the procedures used to install, maintain, repair, test and troubleshoot piping valves.
Demonstrate knowledge of water service equipment and components, their applications and operation.
Demonstrate knowledge of water treatment systems, their components, applications and operation.
Demonstrate knowledge of the procedures used to install, maintain, repair, test and troubleshoot water treatment systems.
Identify irrigation system components and describe their applications and operation includes cross connection control devices.
The CCDA Executive Committee recognizes this Interprovincial Program Guide as the national curriculum for the occupation of Plumber. With the support of Human Resources and Skills Development Canada (HRSDC), several provinces and territories have partnered to build on the ASP and the CCD A processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility. Reference is from the Interprovincial Program Guide and NOA Plumber Red Seal.

Content

Before you begin

Introduction

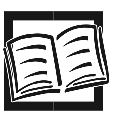
Before you start working, your way through this manual there is some background information that may help you become more familiar with the structure supporting cross connection in Canada.
Please take this time now to read the following information.

Expectations of participants

You have this manual as part of your third year of apprenticeship training program you must have completed your level 1 and level 2 training to be eligible for this level of training in cross connection control. If you pass the theory and practical portion of this third year and your fourth year training during your apprenticeship training and pass your Red Seal Interprovincial examinations, you will be issued a Red Seal Certificate of Qualification. This Red Seal endorsement entitles you to work anywhere in Canada in your trade without material additional training, experience, examinations or assessments. Refer to labour mobility guidelines 2009.

Upon successful completion and passing of this training, you should be able to:

- Install, extend, alter, renew, or repair and test backflow prevention assemblies and devices in accordance with the authority having jurisdiction and the BC/Canadian Plumbing Code consistent with the BC program outline Red Seal Program, National Occupational Analysis Plumber (NOA) and Inter-Provincial Program Guide (IPG Plumber)
- Read and interpret, follow and apply appropriate BC/Canadian Plumbing Code, CSA B64 10, B64.10 .1 Standards, regulatory authority bylaws, standard requirements and manufactures data.
- Identify and correct cross connections.
- Identify initiate and apply backflow protection measures on the job.
- Assess hazard levels and select appropriate backflow prevention.



Identify basic legal and health concerns regarding installation repair and testing for cross connection control. As you progress through the manual you will come across this **Study Task icon**. Next to the icon will be an assigned task for you to complete.

Content

Regulatory jurisdictions

In Canada, there are several levels of regulatory jurisdiction. They include federal, provincial, municipal, regional and private jurisdictions. These jurisdictions cooperate and work together supporting a multi-barrier approach against cross connections form source to tap. Typically, the provincial health authority is recognized as the primary authority for drinking water acts and regulations related to the quality of consumption of safe drinking water.

Cross connections originate in a plumbing system in particular the water distribution system inside a premise property. The drinking water system is divided into 2 main jurisdictions of authority.

1. The water purveyor's public water distribution system which begins at the source ending at the property line. The water purveyor's jurisdictional limits of authority and responsibility ends at the property line. Reference AWWA M-14
2. The water distribution system in a plumbing system downstream of the property line and begins at the property line and ending at the point of use (the tap). The Jurisdictional authorities responsible for the plumbing system typically begin at the property line and ends at the tap, point of use. Reference AWWA M-14

This manual is based on the assumption that property line separates the jurisdictional authority as identified by AWWA-M-14. These 2 jurisdictions are focused on the same goals and there may be conditional overlap of responsibilities; however, caution may be exercised, consult legal opinions, assuming the majority of cross connections originate in premises within jurisdiction 2.

The National Plumbing Code (NPC) when adopted provincially sets out the technical provisions for the design and installation of new plumbing systems. It also applies to the extension, alteration, renewal, and repair of existing plumbing systems. The current NPC includes the above activities as they apply to the objective of limiting the probability of a person exposure to illness resulting from the consumption of contaminated water in a building.

In BC the provincial Government has adopted the Canadian Plumbing Code and is the sole authority establishing Building and Plumbing Code requirements that become law. The Building and Plumbing Code establishes the minimum standards for safety, health, accessibility, fire structural protection of buildings, and protection of the building or facility from water and sewer damage. The Building/ Plumbing Code also includes requirements for energy and water efficiency.

The Building/Plumbing Code applies throughout this province, except for some Federal lands and the City of Vancouver. The City of Vancouver has its own Building Code and has additional requirements authorizing their waterworks Cross Connection program bylaws.

Refer to appendix E or reference the links in the reference document list for additional information.

All entities proposing to regulate trades workers must be consistent with the mandatory Agreement on Internal Trade (AIT) Chapter 7 Labour Mobility. Currently.

OK, let us get started, beginning with Chapter 1

Content

Chapter 1 The responsibility for cross connection control

Objectives

After completing this chapter, you should be able to:

- Define the term cross connection
- Identify three simultaneous conditions present when a cross connection occurs
- Briefly describe a cross connection control program
- Identify and describe your responsibilities and of others involved in cross connection control.
- Briefly describe the legal and health aspects including liability and risks for those involved in cross connection control.

Introduction

Define cross connection

A cross connection can be simply defined, as any actual or potential connection between a potable water distribution system and any source of contamination or pollution through which backflow may occur into our potable water distribution system.

Cross connections can occur when three conditions exist simultaneously.

1. The potable water supply piping is unprotected from a cross connection.
2. A physical or otherwise (improper air-gap) connection is made between the potable water supply piping and a contaminant source.
3. Backflow conditions are occurring caused by backpressure or back-syphonage

Describe a cross connection control program

A Cross-connection control program may be described as a process that involves in part the installation of backflow preventers to prevent the entry of non-potable substances into the public potable drinking water system from source to the point of use.

Cross connection control includes but not limited to a program of administration, education, training, record keeping, installation, and testing of assemblies. Provincial/local government regulators, water purveyors, building and plumbing code officers, inspection authorities, installer/testers, training schools/colleges and the water system users all work cooperatively to protect our drink water distribution from cross connection contamination.

Administration of programs is addressed in water purveyor bylaws and in cooperation with the Provincial/Canadian Plumbing Codes. Over time, codes have adopted requirements for health and safety objectives. The Canadian National Plumbing Code today contains enforceable requirement for installation and testing of backflow preventers during construction extension, alteration, renewal and repair of buildings. The health objective of the newer code includes the limitation of the probability that, as a result of the design or installation of the plumbing system, a person in the building or facility will be exposed to an unacceptable risk of illness due to unsanitary conditions such as the consumption of contaminated water. It is up to the local government or province to adopt the Canadian Plumbing Code or not. Local water purveyor cross connection bylaws need to ensure their bylaw fill in the gaps of provincial requirements and at the same time do not conflict with provincial codes and statutes. Currently the Canadian Building/Plumbing Code addresses the installation and testing of cross connection backflow preventers accordance with CSA standards. Intent summary. Refer to your copy of the Plumbing Code for details and online link intent division B plumbing systems, or link to 461

Cross Connection Participants:

- Ministry of health, Drinking Water Protection Act
- BC Building and Safety Standards Branch BC/Canadian Building/Plumbing Code
- Municipal and regional districts bylaws and regulators
- Plumbing officials Associations
- Government training and certification entities
- Non-government training and certification entities
- Government approved training institutions
- Non-government private training institutions
- Testers as regulated by Jurisdictional Authority requirements
- Manufacturers and representatives
- The owner of the premise, user of water
- Design engineers and private product certification bodies
- Any other

Whatever your position is in this field of cross connection controls, you must be clear about the extent of your responsibility. Consider these cross connection goals:

- Protect the public health by ensuring the water supply remains potable to the point of use.
- Reduce risk/liability of a cross connection occurring to a comfortable level at somewhere near zero.
- Other goals vary depending on the participant's responsibility in the cross connection control program.

Cross connection responsibilities

Provincial Ministry of Health responsibility (non-specific example)

Source reference: Drinking water officer guidelines

Together the Ministry of Health, the Provincial Health Services Authority, the five geographic health authorities, and the First Nations Health Authority share responsibility for ensuring appropriate health outcomes are achieved province wide.

The Minister of Health is responsible to the government and the Legislature for the overall administration of the Act and Regulation. This includes a general role in overseeing the implementation and administration of the Act by the regional health authorities.

The DWPA requires the operation, maintenance and repair of water supply systems to be completed by operators certified under the Environmental Operators Certification Program (EOCP). In instances where immediately relevant specialist knowledge is required, work can be done by individuals not certified by EOCP provided an EOCP certified operator approves their procedures.

A water supplier can be required to have a cross-connection control program if so directed by a drinking water officer, or as part of a system assessment and response plan. Drinking water officers (DWO) in the health authorities provide surveillance and monitoring of drinking water systems that may affect the public's health officer, or as part of a system assessment and response plan.

Content

Building and Plumbing codes responsibilities

The main responsibility of building/plumbing codes are to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures.

February 23, 2016 - The plumbing codebook has changed from the BC Building Code to the National Plumbing Code of Canada. (Source information program plumber)

The British Columbia/adopted Canadian Plumbing Code prescribes the requirements for the installation, extension, alteration renewal and repair of plumbing systems and parts thereof including CSA B-64 10 testing of backflow preventers at the time of installation. Typically, those persons working within the scope of the provincial Canadian Plumbing Code must have proper qualifications.

Canadian Plumbing Code requirements may be adopted and established by the authority of provincial Building Acts, Building and Plumbing Codes. (Source information Building Act)

Local governments normally administer and enforce the building/plumbing code requirements through permitting and inspection by building officials.

Responsibility Designated Trades in BC

Ministries of Jobs, Tourism and Skills Training (JTST), Advanced Education (AVED) and Education (EDUC).

The Industry Training Authority (ITA) leads and coordinates British Columbia's skilled trades system. ITA works with employers, employees, industry, labour, training providers and government to issue credentials, manage apprenticeships, set program standards, and increase opportunities in the trades. (source information ITA)

Certificates of Qualification (including those with Red Seal endorsement like Plumber) and are permanent documents with unique individual Identification numbers.

Plumber is a nationally designated trade under the Inter-Provincial Red Seal program. (Source information ITA)

ITA description: "Plumber" means a person who installs, alters or repairs any plumbing system and all work usually done by a journeyperson plumber governed by the BC Plumbing code.(AHJ) (Source information February 2016 ITA)

Approved training facilities responsibility

Accredited training institutions provide the resources for cross connection training to meet the scope description of the credential issued "Plumber"

Non-government certification responsibility

In Canada the American Water Work Associations affiliated Canadian sections provide and promote valuable support for the water and wastewater sector. industry. Among other valued activities, they provide training and certification for water and wastewater sector and its workers. In BC the BCWWA is an incorporated independent not for profit organization and remains affiliated with AWWA through joint membership structures. (Source information BCWWA)

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The water purveyor responsibility

The responsibility for the provision for the delivery of safe drinking water supplies lies with the drinking water supplier. The supplier is responsible for complying with the requirements of the Drinking Water Protection Act and Drinking Water Protection Regulation.

The water purveyors' responsibility includes but not limited to the following:

- Implementation of a cross connection program
- Adopting regulations for water supply distribution system within the limits of its jurisdictional authority.
- The water purveyor's responsibility may overlap with the responsibilities of provincial regulators; therefore, regulations within the water purveyor's bylaws must not conflict with provincial standards. (Reference AWWA manuals)

A water purveyors cross-connection program requirements shall include cooperation between all participants involved in accordance with existing provincial acts and regulations including those set out by the Plumbing Codes and municipal regional bylaw regulations as well as the current standards of the CAN/CSA B64.10-01/B64.10.1-01.

A cross-connection control program requires co-operation particularly between the municipality and its water consumers, since many of the cross-connections that exist are located on private property.

Typical components of a water purveyor cross-connection control program, but not limited to the following: (source document Infra Guide, *Methodology for Setting a Cross-Connection Control Program FCM http://www.infraguide.ca/*

- Establish financing to support the program
- Establish authority and administrative responsibility
- Conform to provincial standards and acts
- Establish a data management system
- Develop a public relations and education program
- Co-ordinate cooperative activities with local authorities, Plumbing codes
- Develop (recommend or recognize institutional private or training programs)
- Develop standard correspondence forms letters of notification etc.
- Develop requirements for a cross connection survey(inspection) and hazard assessment
- Establish inspection and testing protocols
- Develop a backflow incident response plan
- Establish enforcement strategies; and perform quality control and assurance.
- Maintain tester list and approved devices lists

A water purveyor typically adopts by laws to ensure their drinking water distribution system remains potable to the point of sale to the customer (property line). They then ensure the bylaw contains the responsibility for maintenance and annual testing of back flow is that of the premise owner or designated representative. Consult with your water purveyor. AHJ

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Ownership of backflow preventers

- In most cases, water purveyor mandates the consumer (premise owner) will retain ownership and responsibility of devices installed on private property. The owner should refer to the manufacturer's literature for testing and maintenance requirements. For cases where the municipality supplies a water meter set and a backflow preventer, the municipality will retain ownership and the consumer will rent the meter and backflow preventer. (Infra Guide)

Infra Guide definitions

- Backflow prevention device tester: a person who is registered or licensed by the regulatory authority.(Source information Infra guide)
- Cross-connection: any actual or potential connection between a potable water system and any source of pollution or contamination. .(Source information Infra guide)

Product certifying agencies responsibility

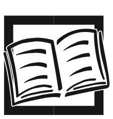
Product certification of backflow preventers is provided by several different certifying bodies include the following:

- Underwriters Laboratories (UL) Underwriters laboratories Canada (ULC)
- Canadian Standards Association (CSA)
- (NSF)International (formally the National Sanitation Foundation)
- International Association of Plumbing and Mechanical Officials (IAPMO)
- The American Society of Sanitary Engineers (ASSE)
- Factory Mutual (FM)
- Foundation for Cross-Connection Control and Hydraulic Research (USC FCCCHR)
- American Society of Plumbing Engineers (ASPE)
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

Product Certification bodies publish back flow preventer approval lists (refer to Chapter 2, definitions of an approval list).

In Canada, a backflow preventer must have at least a Canadian Standards Association stamp CSA

If you are a Canadian Certified Plumber and you are installing or testing backflow preventers, you will need to be able to read and interpret backflow preventer markings to ensure they meet those required by the authority having jurisdiction.



To see some examples of manufactures making refer to chapter 8, reading backflow Preventer name plates, certification marking and Figure 8-16—**Typical backflow preventer approvals**.

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Manufacturers responsibility

The manufacturer is responsible include but are not limited to the following examples:

- Identification markings on the assembly
- Manufactures name or trademark and identification marking include:
  - Type, Size, Model, Direction of flow, Serial number
  - Maximum rated working water pressure (MWWP)
  - Maximum rated working water temperature
- All markings shall be stamped on the valve body or a non-corrosive metal name plate securely attached to the valve body.
- Ensure that the product they produce meets the certifying body standards.
- Provide installation, maintenance, drainage, testing and repair instructions.
- General product support and specifications including approvals

The backflow preventer tester/plumber responsibility

Backflow preventer testers responsibilities include but not limited to:

- Communicate with premise owner and provide assurance of the need and purpose for testing annually and their responsibility for maintenance, testing and continued vigilance preventing cross connections on their premise.
- Notify the premise owner, fire officials and or insurance providers and obtain permission before shutting off or turning on the water
- Be registered or licensed by the local government or regional AHJ (infra guide)
- Practice your trade within the defined skill tasks of your occupation (refer to your occupational (NOC and NOA)
- Obtain liability insurance or be covered by an employer's liability insurance. (AHJ)
- Maintain your differential pressure gauge by having it recalibrated annually. Submit your annual calibration reports as required by the AHJ.
- Check with the authority having jurisdiction for additional requirements such as licensing or registration before testing a backflow preventer.
- Complete all test reports accurately, submit reports, maintain records as required by the AHJ. In some jurisdictions submission of test reports is the responsibility of the premise owner.
- Maintain your qualification skills by upgrading refresher, recertification requirements of the AHJ.
- Notify the authority having jurisdiction/water purveyor as soon as practically possible when you discover a cross connection or potential cross connection or a missing or untested backflow preventer.
- Possess a current copy of the **CSA standard B64.10-11/B64.10.1-11** Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers. or AWWA manual check with the authority having jurisdiction
- Possess a current copy of the British Columbia/Canadian Plumbing Code or any other manual or bylaw pertaining to the AHJ requirements.

Content

The owner responsibility
The owner of the premises is responsible for the following:

- The owner will ensure that cross connections do not exist or occur on the premises.
- The owner will ensure that annual testing and maintenance will be done correctly and that personnel on the premises are able to work without causing cross connections.
- The owner (customer) will have the backflow assembly tested by a qualified person as approved by the authority having jurisdiction typically within 30 days of the annual test date.
- The owner shall ensure that a test report is submitted to the AHJ typically within 30 days of the test being done. In some locations the tester will submit the reports to the AHJ.

Usually the premise is the final destination of the water system. Since the water purveyor cannot summarily access private properties, much of the responsibility to maintain the system on private property falls on the owner/occupier. If a cross connection occurs on the premises the owner will be held totally responsible for the consequences. This is stated in many bylaws.

The consulting engineer responsibility
The design engineer may be considered an expert so would be more likely to be held responsible for design faults that resulted in a cross connection. The engineer, as an expert, should have fully understood cross connection and taken the necessary precautions.

Responsibility, the buck stops here
For cross connection responsibilities, most governing entities will ensure their regulations/bylaws clearly identify cross connection requirements. It is up to the premise owner/occupier/representative and tester to follow all requirements as addressed in the appropriate bylaw or regulation. The regulatory authority (water purveyor) will not take any responsibility for the action of any others in regards to cross connection control activities inside or on a premise. When the water leaves their distribution system the premise owner and tester are responsible for cross connection prevention with in the building. You should know your responsibilities and be prepared defend the work you are responsible for. Make certain that you follow the rules.

Legal aspects and cross connections

Liability
Liability means legal responsibility for one's acts or omissions. You must have liability insurance.

Negligence
Negligence is failure to exercise the care toward others which a reasonable or prudent person would do in the same circumstances or taking action which a reasonable person would not take.

Proof of Negligence
In a negligence suit, the plaintiff has the burden of proving that the defendant did not act as a reasonable person would have acted under the circumstances. The court will instruct the jury as to the standard of conduct required of the defendant. For example, a backflow prevention tester is sued for negligence and judged according to how a reasonable tester would have acted. The plaintiff will attempt to show that the backflow protection tester violated a statute designed to prevent injury to the plaintiff. The same actions would be applied to those who have responsibilities in this cross connection field.

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An expert

An expert would be exactly what the name applies. An expert in cross connection control knows everything about cross connection and is keeping current with changes and innovations in cross connection work. When an expert makes a mistake it is much easier to establish responsibility for damages because an expert knows everything; therefore, it is easier to prove negligence. It is better never to call yourself an expert. Start off the conversation by saying "I am no expert; however, here is my opinion only".

The average Joe

It may be harder to prove negligence when an average Joe has made an honest mistake. Especially after the average Joe has first considered a plan fully and then has taken reasonable actions to implement the plan. Stop, think, carefully consider all possibilities, plan a course of action, apply your course of action diligently.

The shotgun approach

When considering a cross connection, it is highly likely that a good lawyer will take a shotgun approach when trying to establish responsibility for damages caused as a result of cross connections. The shotgun approach would pursue everybody involved in an incident. The courts of law would then decide who is responsible for what and how much they each will pay. As an installer tester you must be clear and consider where your responsibilities begin and end.

Risk

Risk is what you choose to saddle yourself with when practicing activities that vary from common practice. Good risk management requires that a person knowledgeable in the field of cross connection control takes reasonable actions to reduce their liability risk in the event of the occurrence of cross connection incidents. What you really want to do in this field of work is to reduce your risk of being held liable for any such cross connection incidents.

Reduce your risk by:

- Considering carefully every move you make and never consider your-self an expert.
- Keep active and be current with knowledge of your profession. You are obligated to do your job correctly. Perhaps error free
- You cannot deny personal knowledge of basic facts commonly known in the piping trade community.

The next time you shut down a water system practice due diligence and risk management. Take a look around and check out the building for potential back-syphonage conditions before you shut the water off. Notify the premise owners or individuals responsible and request permission before shutting off or tuning on the water supply.

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Example incident:

One plumber did not check around and ended up being the cause of a cross connection incident in the building. The incident involved the back-syphonage of glycol solution from a condensing unit back into the potable system. The whole building had to be shut down. The system had to be flushed and sampled by health authorities before being put back into operation. Nobody was injured; however, the plumber was considered to be very lucky and probably got off with only a few thousands of dollars of cost. The plumber was there to install a backflow preventer.

Note: There is no easy defense for supplying non-potable water causing injury to the user. Users of water are accustomed to clean drinking water, expecting it not only to be safe to drink but also clean and palatable. When water is not up to a recognized standard, complaints and lawsuits will soon follow, especially if injury has occurred.

This study task is optional it is just a point of interest

Complete this task: Search the internet for a published backflow preventer approval list using these search words "List of Approved Backflow prevention assemblies USC" Follow the sites direction to down load and view the list.

The list is published by, "The USC Foundation for Cross-Connection Control and Hydraulic Research". The list is over 500 hundred pages, spend only a few minutes to view the list.

Here is an exercise on backflow preventer installation orientation.

From the "list of approved backflow prevention assemblies, what letter abbreviations are used to indicate the valve installation orientation position?

Write the abbreviation next to each word here

Horizontal ______________________________

Vertical _________________________________

Up _____________________________________

Down __________________________________

Vertical with flow up _____________________

Using your BC/Canadian Plumbing Code book, look up the CSA standard of conformance for a Double Check Valve type DCVA.__________________________

Now complete Self-Test 1 and check your answers at the back of the book.

Content

Self-Test 1

Review the section objectives and then answer the following questions.

1. What is the name given to a program adopted to prevent the re-entry of non-potable water into a public water supply system?

   a. cross connection control program

   b. backflow program

   c. environmental protection program

   d. employment opportunity program

2. What provincial jurisdiction has the primary responsible for the protection of the public health?

   a. The safety services

   b. The Ministry of Health

   c. The water purveyor

   d. The *Building Code*

3. What standard does the *Building Code Part 7 Plumbing Services* regulate for the testing of backflow preventers?

   a. The *Health Act*

   b. The *Municipal Act*

   c. *CAN/CSA B64.10 -1*

   d. The *Canadian CCC* manual

4. Who has the direct responsibility to ensure that potable water is supplied to a premise?

   a. The health inspector

   b. The water purveyor

   c. The plumbing inspector

   d. The premise owner

5. A person who willfully causes a cross connection is liable for damages.

   a. True

   b. False

6. Who is responsible to ensure maintenance and testing of backflow preventers on private property is completed?

   a. plumbing inspector

   b. installer/tester

   c. water purveyor

   d. premise owner

Content

7. Regulations under the national building code are only valid in provinces that have adopted them.
   a. True
   b. False

8. When a regulation or bylaw is put in place everyone is immediately deemed to know them.
   a. True
   b. False

9. Liabilities for damages to an individual arise under what is called Common Law.
   a. True
   b. False

10. The owner of a property would be liable for any damages due to their negligence for not properly maintaining or altering their system.
    a. True
    b. False

11. The engineer's defense against liability claims is difficult because, as an expert, the engineer should have known of any hazards.
    a. True
    b. False

12. In most cases an honest error in judgment will not be considered negligence.
    a. True
    b. False

13. When it can be proven that you made no thought at all, you may be found negligent.
    a. True
    b. False

14. What term can be used an approach used by a lawyer when attaching blame to a number of individual involved in a cross connection incident?
    a. shot-gun
    b. investigation
    c. legality
    d. guilty

Check your appendix answer key

Have you accomplished your objectives of this Chapter 1? Review your Chapter 1 objectives.

If you feel you have accomplished the objectives of Chapter 1, you may wish to proceed to Chapter 2.

Content

Chapter 2 Cross connection basic terms and definitions

Objectives

After completing this chapter of the course, you will be able to:

Define common terms used in the cross connection industry. You must refer to the CSA standard B64.10, Canadian Plumbing code or Canadian AWWA Manual definitions in the field of practice.

Introduction

Definitions provide support for the information in this manual. You must be familiar with the various terms and their meanings as applied to cross connection control. You may wish to refer to this chapter while you read through the manual.

Cross connection defined

There are many books on cross connection and just as many definitions; however, simply defined, a cross connection is any actual or potential connection between a potable water system and source of contamination or pollution through which backflow may occur into the potable system.

Actual cross connection defined

An *actual* cross connection is a cross connection that currently exists. See Figure 2-1.

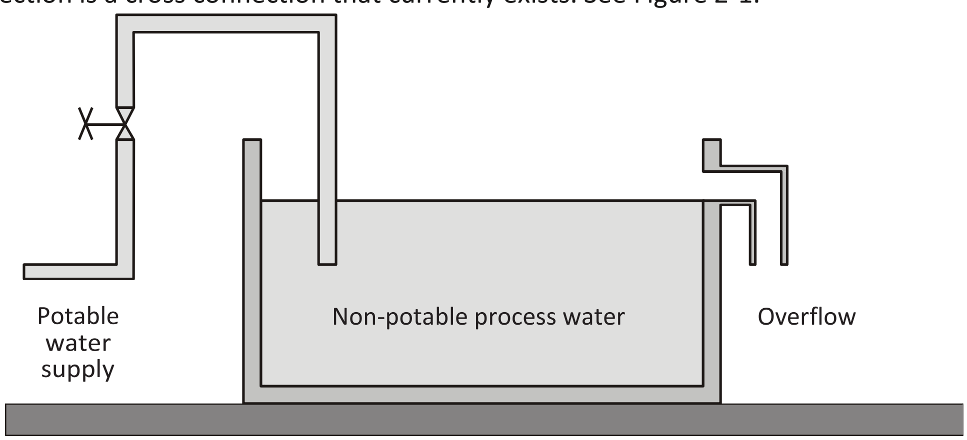


Figure 2-1- An actual cross connection example

Content

Potential cross connection

A *potential* cross connection is a cross connection that does not currently exist but may become an actual cross connection by modification or addition of a component. Potential cross connections must be treated as an actual cross connection.

Figure 2-2 shows an example of how a potential cross connection can become an actual cross connection.

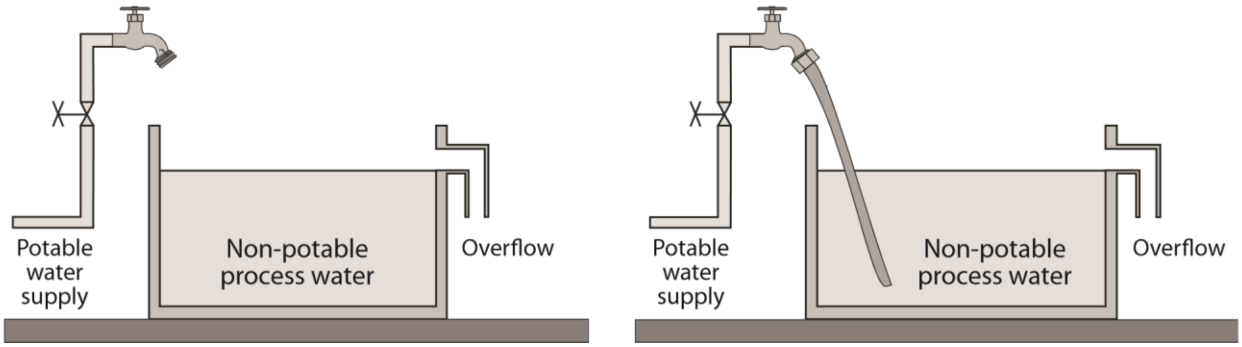


Figure 2-2—Left: A potential cross connection example.
Right: A potential cross connection has become an actual cross connection with the addition of a hose.

Air break

An air break is a term used (similar to an air gap as described below) but can refer to the unobstructed vertical distance measured from the lowest point of an indirectly connected soil or waste pipe (which may include a relief valve discharge), to the flood level rim of a drain or receptacle (floor drain etc.).

Air-gap

An air gap is the unobstructed distance from the **water supply outlet** opening to the flood level rim of the fixture or receptacle it discharges into the opening.

Approved Air-gap

This is an air gap approved by the authority and conforming to the requirements of the adopted plumbing code regulations (National Plumbing Code).

Registered Air-gap

This is an approved Air-Gap registered with the local authority and is subject to annual inspection.

Atmospheric Vacuum Breaker

Identifying an atmospheric vacuum breaker device (AVB)" in Chapter 4 for a full description.

Apparent pressure drop

This is the first observed differential pressure drop across the check valve 1 of a reduced pressure backflow preventer, and is an **observed** static pressure under no-flow conditions.

Content

Actual pressure drop
The actual recorded differential pressure drop across the first check valve of a reduced pressure backflow preventer, it is a r**ecorded** static pressure under no-flow conditions.

Approval list
A published list of approved assemblies and devices maintained by authority having jurisdiction or a product certification entity, such as the Canadian Standards Association (CSA)

Aspiration
In a piping system, aspiration is caused by high velocity flow in undersized piping. Back-syphonage backflow can occur as a result of the drop in pressure below atmospheric caused by the high velocity.

Authority
The power to give orders or make decisions: the power or right to direct or control someone or something

Authority having Jurisdiction (AHJ)
"Jurisdiction" is "the limits or territory within which authority may be exercised." To paraphrase the definitions, an AHJ would be "command within limits," where, in this case, the "limits" is the scope of what they regulate.

An example of an authority within limits: The limits of a jurisdictional authority of a water purveyor or its workers is the public drinking water distribution system from source to the property line. Reference AWWA M-14

Auxiliary water supply
This is any water supply on or available to a premise in addition to the purveyor's approved public potable water supply.

Auxiliary water supply approved
An auxiliary water supply is one that has been investigated and approved by the health authority, meets water quality regulations, and is accepted by the water purveyor.

Auxiliary water supply unapproved
An auxiliary water supply that is not approved by the health authority and the water purveyor.

Auxiliary energy source
A source of thermal energy used to provide heat other than conventional methods such as electricity oil or gas for domestic water heating or cooling. (Solar, geothermal etc.)

Content

Backflow

Backflow is a flow of fluid in the opposite direction to the normal flow direction. Backflow into a potable water system is a cross connection. Figure 2

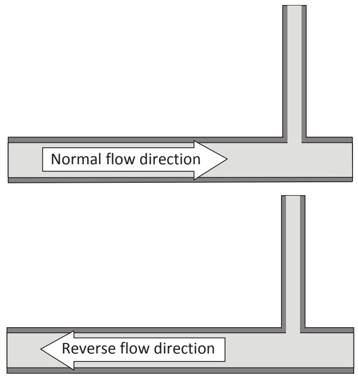


Figure 2-3-backflow

Backflow Preventer, Device or Assembly

A backflow preventer is a device or assembly used to prevent backflow into the potable water system. The terms "backflow preventer," "backflow device," and "backflow assembly" are used interchangeably in the industry. Typically, a backflow assembly comes complete with shut-offs and test valves assembled and approved in a single unit. A backflow prevention device normally comes with no shut-offs and test valves.

Back-syphonage backflow

Back-syphonage is the term used to describe backflow that is the result of a negative pressure within the potable water system. An example of back-syphonage is shown in Figure 2-4. Atmospheric pressure forces the non-potable fluid back into the drinking water supply. This back-syphonage condition occurs when the pressure in the potable water system drops below atmospheric. A water main break or closure for repairs can cause a negative pressure.

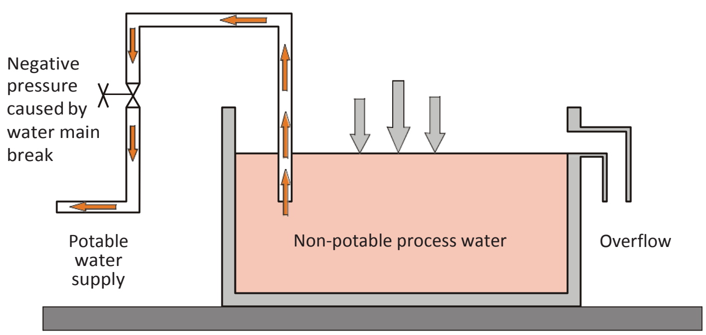


Figure 2-4- Back syphonage

Content

Backpressure backflow

Backpressure backflow is the term used to describe backflow that is the result of a pressure greater than the supply source, causing non-potable water to be forced back into the potable water system. An example of backpressure is shown in Figure 2-5. This backpressure condition occurs if the pressure from the chemical feed injector is greater than the potable water supply pressure. Backpressure also can occur from thermal expansion and elevated piping.

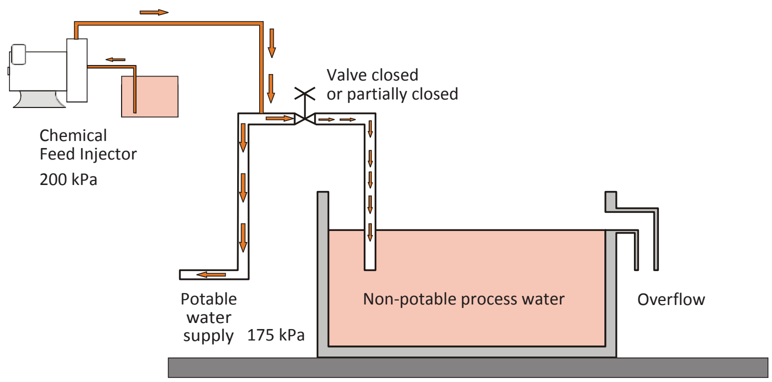


Figure 2-7-Back Pressure Example

Barometric loop

A barometric loop is a piping loop that rises to a height of 10.7 meters (35 ft.) above the run of the pipe. The piping loop will prevent back-syphonage of water up through the loop.

Black-water

This is wastewater generated in a fixture that is contaminated by urine or feces; for example, a toilet.

Buffer

A buffer is the calculated pressure difference found by subtracting the relief valve opening pressure of a reduced pressure backflow preventer from the actual pressure drop across the check valve 1 of a reduced pressure backflow preventer.

Capillary action

The action of liquid into a joint or narrow void between two adjacent surfaces.

Backflow prevention device tester

Refer to the authority having jurisdiction for their definition.

Contamination

Contamination is an impairment of the quality of the potable water which creates an actual hazard to the public health through poisoning or through the spread of diseases by sewage, industrial fluids or waste. It is also equivalent to severe or high hazard. When compared to the term "pollution" contamination is a higher hazard.

Content

Critical level

Critical level means the level of submergence at which the back-syphonage preventer ceases to prevent back-syphonage. This is a mark on a vacuum breaker that is used to determine the minimum distance above the flood level rim at which the vacuum breaker is installed. If the critical level is not marked, the bottom of the vacuum breaker is the reference point for measuring the minimum distance.

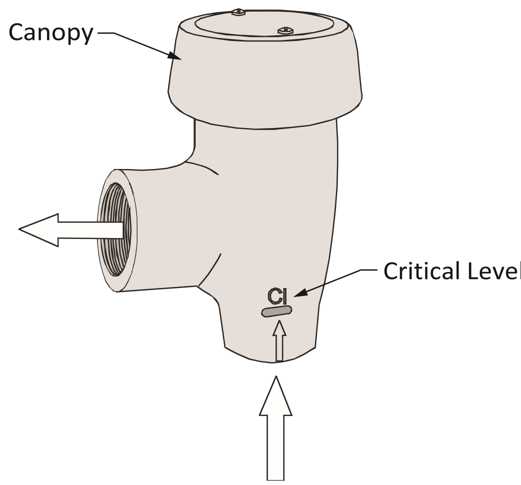


Figure 2-6—Critical level mark on an AVB

Continuous pressure

A condition present in a piping system when the water pressure remains on both sides of the back flow preventer for more than 12 hours is known as continuous pressure. Continuous water pressure can exist under flow conditions or static conditions when there is no flow through the backflow preventer.

Non-continuous pressure

A condition when the device is only subject to intermittent water pressure on both sides of the backflow preventer that do not to exceed 12 hours in a 24 hr. time period. This is known as non-continuous pressure.

Double check valve assembly

A DCVA is defined as an approved assembly consisting of two independently operating check valves, loaded to the closed position by springs or weights, and installed as a unit with, and between, two resilient seated shut-off valves and having suitable test valves for testing.

Double check detector assembly

A DCDA is defined as an approved assembly consisting of two approved double check valve assemblies, set in parallel, equipped with a meter on the bypass line to detect small amounts of water leakage or use

Effective opening

An effective opening is defined as the minimum cross-sectional area at the point of water supply discharge expressed in terms of the diameter of a circle (pipe). Where the discharge opening is not circular, the diameter of a circle of equivalent cross sectional area is used to determine the effective opening.

Content

Fixture protection isolation

Fixture protection isolation is the installation of backflow preventers at the plumbing fixture or equipment within the premise.

Enclosure

A structure constructed to house a backflow preventer above ground providing protection from freezing, clearance for maintenance and testing, prevention of tampering.

Flood level rim

Flood level rim as applied to cross connection control is defined as the top most portion of a fixture or vessel from which water can overflow. Flood level rim is not the level of an overflow opening in a fixture or equipment. Figure 2-7 below is an example of the flood level rim of a typical plumbing fixture.

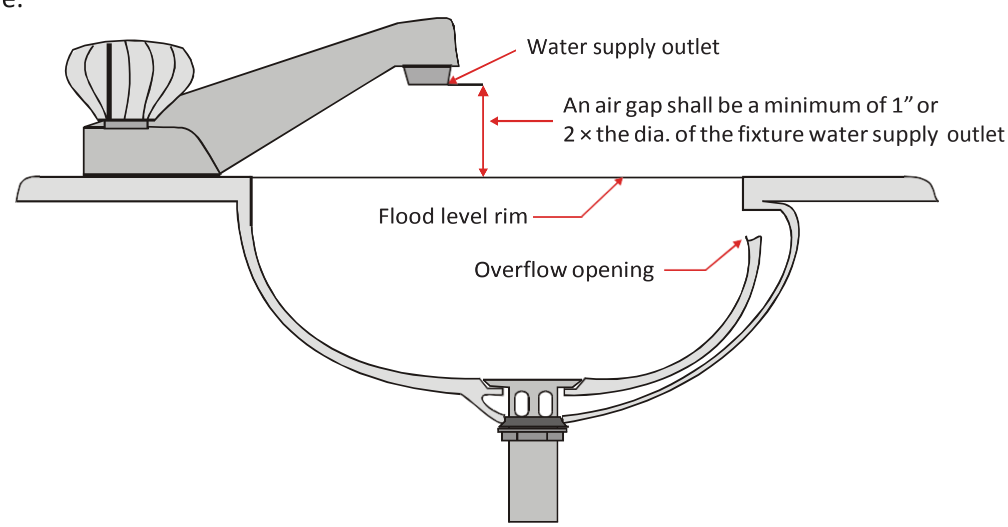


Figure 2-7 lavatory cross section

Gauge pressure

Gauge pressure is the pressure reading you observe on a typical pressure gauge. The pressure gauge reads the pressure in the system it is attached to. When it is not attached to a system the gauge reads "0" The gauge pressure does not read an absolute pressure.

Atmospheric pressure

The pressure created by the weight of the earth's atmosphere (air) which is approximately 14.73 psi) (101.3 kPa) at sea level. Atmospheric pressure varies, gets less as you go higher up from sea level and can vary with atmospheric conditions.

Absolute pressure

A pressure measured from absolute zero after atmospheric pressure is removed. Gauge pressure plus atmospheric pressure equals absolute pressure. A gauge pressure of "0" would be plus 14.73 psi (101.3 kPa) at sea level.

Content

Grey water system
An underground irrigation system (no above-ground sprinkler outlets) that uses household wastewater discharge that does not contain human/animal waste or food waste. Examples of gray water fixtures are bathtubs, showers, basins, laundry trays, and clothes washers. In some jurisdictions, this *excludes* kitchen sinks and dishwashers.

High health hazard
Any physical or toxic hazard additives which could contribute a danger to a person's health.

Hose connection vacuum breakers
Hose faucet vacuum breakers are vacuum breakers that are either incorporated into or attached onto the hose faucet (hose-bib) threads.

Health authority
An entity or official with power to give orders, make decisions, direct or control someone or something on health issues.

Heat exchanger
Heating equipment designed to transfers heat through a barrier between two physically separated fluids.

Heat transfer fluid
Heat transfer fluid is used to transport thermal energy from one location to another.

Hodge and Sterner scale
A toxicity scale that rates the lethal dose (LD) toxicity of a material, solids, liquids or gases in 6 levels from 6 (extremely toxic) to 1 (relatively harmless).

In-plant isolation/internal/individual isolation
This is defined as the practice of installing backflow prevention assemblies at the point of hazard within a premise.

Jumper connection
A short piece of piping with adapters connected which will allow a backflow preventer to be removed and replaced with the short piece of piping. Use of a jumper connection is a prohibited practice. A jumper connection is a potential cross connection.

Minor hazard,
A minor hazard means those contaminants that, at the levels found in the water, could cause aesthetic problems, but do not present a danger to health or a low probability of becoming a moderate hazard.

Moderate hazard
A substance which is a minor hazard has a low possibility of becoming a severe hazard is described as a moderate hazard. The substance would be aesthetically objectionable.

Non-potable fluid
Non-potable is defined as any fluid or other substance that is not safe for human consumption.

Content

Pathogenic
Pathogenic means a disease-causing substance.

Pollution
Pollution means an impairment of the quality of the public potable water supply that does not create a hazard to the public health but which does adversely affect the aesthetic qualities of such potable waters for domestic use. When compared to the term contamination, pollution is less hazardous.

Plumbing system
Plumbing system means a drainage system, a venting system and a water system or parts thereof.

Potable water
Potable water is defined as water that is safe for human consumption.

Premise Isolation
This is the practice of protecting the public potable water supply by installing backflow prevention assemblies at or near the point where water enters the premise.

Pressure vacuum breaker assembly (PVB)
This is an approved assembly consisting of a spring-loaded check valve loaded to the closed position, an independently operating air-inlet valve loaded to the open position and installed as a unit with and between two resilient seated shut-off valves and with suitable connections for testing. It is designed to protect against back syphonage only.

Purple pipe
Purple is the recognized standard colour adopted to identify reclaimed water systems piping only (not for other reuse water systems).

Reclaimed/Recycled
Wastewater (sewage) that has been treated to a level that allows for its reuse for a beneficial purpose but normally not for drinking water is described as reclaimed or recycled. (Some jurisdictions treat this water to a higher level where it can be pumped back into the aquifer.)

Reduced pressure backflow assembly (RP)
RP is an approved assembly consisting of two independently operating check valves, spring-loaded to the closed position. Located between the check valves is a spring-loaded differential pressure relief valve that is loaded to the open position. These components shall be installed as a unit with and between` two resilient seated shut-off valves and having four suitable test valves for testing purposes.

Reduced pressure detector assembly (RPDA)
RPDA is an approved assembly consisting of two approved reduced pressure backflow assemblies, set in parallel, equipped with a meter on the bypass line to detect small amounts of water leakage or use. This unit must be purchased as a complete assembly. The assembly may be allowed on fire line water services in place of an approved reduced pressure backflow assembly upon approval by the local water purveyor.

Content

Reuse water
This is water recycled from uses such as processing applications; for example, heat recovery manufacturing processes and such that could be reused for other applications but are not limited to typically irrigation uses. Similar to grey water definition, reuse water is considered non-potable in cross connection terms.

Residential full flow-through fire sprinkler/standpipe system
Residential full-flow fire sprinkler/standpipe system means assembly of pipes and fittings in a one or two family dwelling that conveys water from the water service pipe to the sprinkle/standpipe system's outlets and is fully integrated into the potable water system to ensure regular flow of both systems.

Residential partial flow-through fire sprinkler/standpipe system
Residential full-flow fire sprinkler/standpipe system means assembly of pipes and fittings in a one or two family dwelling that conveys water from the water service pipe to the sprinkle/standpipe system's outlets and in which flow during inactive periods of the sprinkle/standpipe system occurs only through the main header to the water closet located at the farthest point of the two systems.

Safe drinking water
Safe drinking water means water that has sufficiently low concentrations of microbiological, inorganic chemical, organic chemical, radiological or physical substances. Individuals drinking such water at normal levels of consumption will not be exposed to disease organisms or other substances that may produce harmful physiological effects

Safe drinking water regulation
The safe drinking water regulation is a provincial regulation that requires the water purveyor to provide safe drinking water to the public.

Slight drip
Means the formation and falling of drops tune of liquid; a small quantity (of liquid) falling in drops. This manual interprets a slight drip or rise in water level in or from a sight-tube as an indication that a check valve upstream of the sight-tube is not closed tight.

Stabilized Steady state reading
Means a differential pressure gauge reading that is stabilized with no indication of a continued change over a period of time as specified by the authority having jurisdiction. Fluctuation of line pressures during test procedures can be expected and may not be an indication of a fault in a check valve; however, a fluctuation in pressure continuing an overall trend downward is suspect and is not considered stabilized or steady. CSA B64.10.1 Annex A stabilize means that the gauge can be fluctuating but not descending.

Temporary water connection/service
Temporary water connection means a short term connection to the public drinking water system for the use of construction or expansion of a development or for other reasons approved by the water supplier.

Thermal expansion
Thermal expansion is the volume increase of water when it is heated. In a closed container, water cannot expand; therefore, the pressure within the container will increase due to a rise in water temperature.

Content

Toxic heat-transfer fluid
This refers to a fluid that does not have an oral LD50 of 15,000 mg/kg or greater in accordance with toxicity Class 6 ("relatively harmless") of the Hodge and Sterner scale.

Used water (systems)
Used water as defined by the water purveyor is any potable water that has passed the water meter or property line into the customer's piping system. In broad terms the water purveyor considers this used water as non-potable and does not want it to enter back into the public water supply.

Untreated water
Untreated water is any water not subject to the requirements of the Safe Drinking Water Act, and/ or water that is not under the direct control of the water purveyor (City of Guelph bylaw definition).

Water purveyor
Water purveyor means the provider or seller of the water and anyone who owns or operates a public water system.

Water System
Means a private water supply system, a water service pipe, a water distribution system or parts thereof. (This is a Building Code part 7 definition).

Water service pipe:
This is the water pipe starting at the property line and ending just inside the building.

Waterworks
Any works for the collection, production, treatment, storage, supply, transmission and distribution of water by the City, or any part of any of those works including the water service connection, but does not include plumbing to which the Building Code Act, or any amendments thereto apply. Definition Source Toronto municipal code chapter 851,

☑ Now complete Self-Test 2 and check your answers.

Content

Self-Test 2

Review the section objectives and then answer the following questions.

1. What defines a backflow of contaminated water into a potable water system?

   a. pollution

   b. cross connection

   c. backpressure

   d. back- syphonage

2. What is the provider or seller of the water called?

   a. the water purveyor

   b. the certified tester

   c. anybody involved with cross connection

   d. the premise owner

3. What defines any water supply on or available to, a premise in addition to the purveyor's approved public potable water supply?

   a. the potable water supply

   b. the certified water supply

   c. the auxiliary water supply approved

   d. the auxiliary water supply

4. What defines a piping arrangement such as a submerged inlet that currently exists and would allow backflow of contaminated water into a potable water system?

   a. potential cross connection

   b. pollution

   c. an actual cross connection

   d. backflow

5. What defines a piping arrangement that currently does not exist but may become a cross connection with the addition of a hose or by-pass?

   a. potential cross connection

   b. an actual cross connection

   c. contamination

   d. back-syphonage

Content

6. What defines the flow of fluid in a potable water system opposite to the normal direction?
   a. potential cross connection
   b. an actual cross connection
   c. reverse flow
   d. backflow

7. What type of backflow is a result of a negative pressure in a potable water system?
   a. Back-syphonage
   b. Backpressure
   c. Cross connection
   d. Potential cross connection

8. What type of backflow is a result of a pressure higher than the potable water system forcing contaminated water back into the potable water system?
   a. Back-syphonage
   b. Backpressure
   c. Pollution
   d. Cross flow

9. What is the term used to describe the top most portion of a fixture from which water can overflow?
   a. Overflow rim
   b. Top edge
   c. Rim edge
   d. Flood level rim

10. What defines water that is safe for human consumption?
    a. clean
    b. potable
    c. cold
    d. protected

11. What defines any fluid or substance that is not safe for human consumption?
    a. dirty
    b. non-potable
    c. turbid
    d. potable

Check your appendix answer key

Have you accomplished your objectives of this Chapter 2? Review your Chapter 2 objectives.

If you feel you have accomplished the objectives of Chapter 2, you may wish to proceed to Chapter 3.

Content

Chapter 3 Identifying typical cross connections

Objectives

After completing this chapter of the course, you will be able to identify:

- Typical examples of cross connections including
- Hose-bib connections
- Submerged inlets
- Injectors
- Aspirators
- Venturi effect
- Jumper connections removable pipe section
- Bypass arrangements
- Booster pump and pumps
- Enclosed pressurized vessels

Introduction

The ability of those involved in the cross connection control program to identify cross connections is the key to the elimination of existing cross connections and prevention of future cross connections.

This chapter describes and illustrates several examples of unprotected cross connections. Chapters 4 and 5 will use the same illustrations and suggest the correct backflow preventer to install.

Content

Identify hose-bib cross connections

The typical hose-bib connection found in every premise is a potential cross connection. It is a potential cross connection because the simple activity of attaching a hose to the hose-bib increases the possibility of contaminants being drawn into the potable water system. Figure 3-1 shows a typical hose-bib connection with a hose attached. The addition of the hose has created an actual cross connection. Failure of the public water system due to a water main break has created negative pressure in the system. Contaminated wading pool water is now back lowing into the public water main.

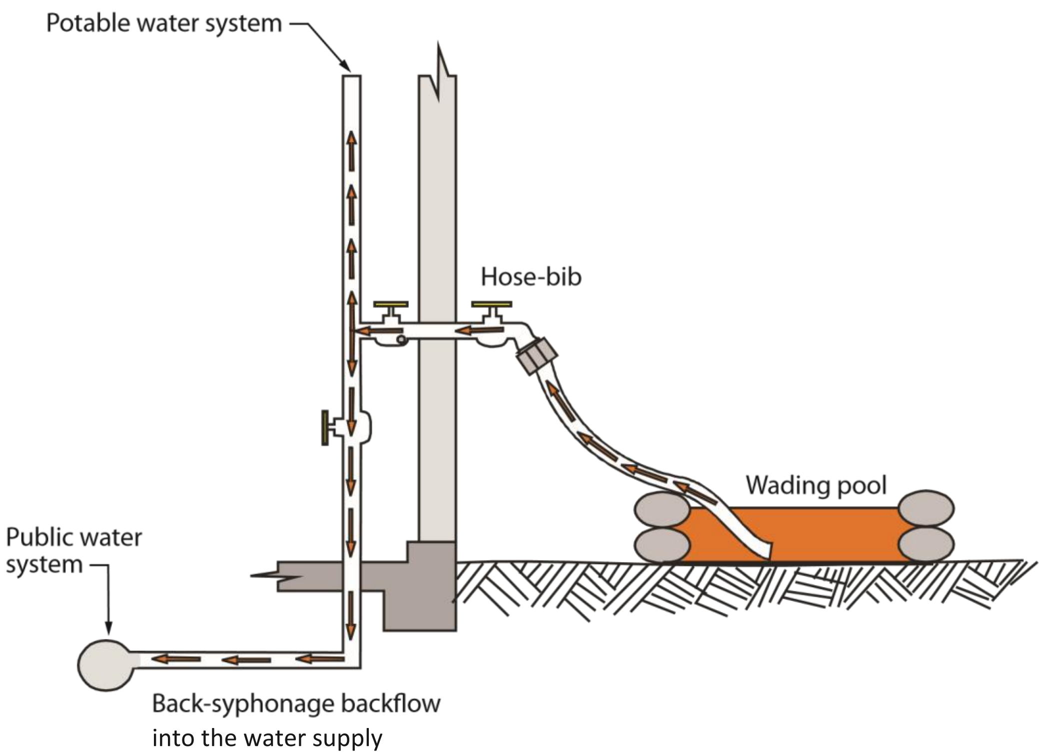


Figure 3-1—Hose-bib connection showing contaminants being drawn into the potable water system

Refer to chapter 6 for correct backflow protection needed for hose-bib connections.

Content

Identify submerged inlet cross connections

Submerged inlets are identified when a water supply inlet to a tank or similar equipment is connected below the flood level rim without an air gap. When water supplies are connected in this manner an actual cross connection is created. Figure 3-2 shows an example of a typical submerged inlet into a process water tank. This arrangement of piping is subject to back syphonage backflow.

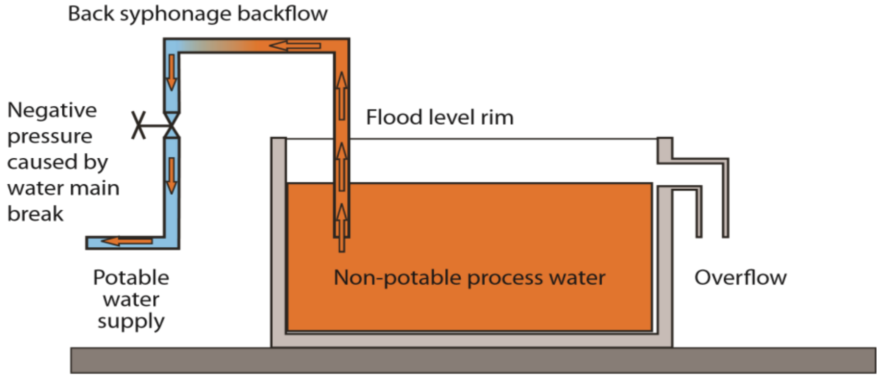


Figure 3-2—Typical submerged inlet into a process water tank

Refer to Chapter 6 for correct backflow protection.

Identifying injector pump cross connections

Injector pumps are used to inject liquids into piping systems; for example, fertilizers into irrigation systems. Usually the injector is a variation of a pump that can automatically inject products into the water supply. There is no guarantee that a substance injected into a water supply is safe for human consumption. The injector pump connection becomes a cross connection. Figure 3-3 is an example of a fertilizer injection system. The injector pump could cause fertilizer to be pumped back into the public water supply system. This would be an example of a backpressure backflow cross connection.

A few examples of where injectors may be found are in beverage machines, dental offices, medical clinics and hospitals, and the like.

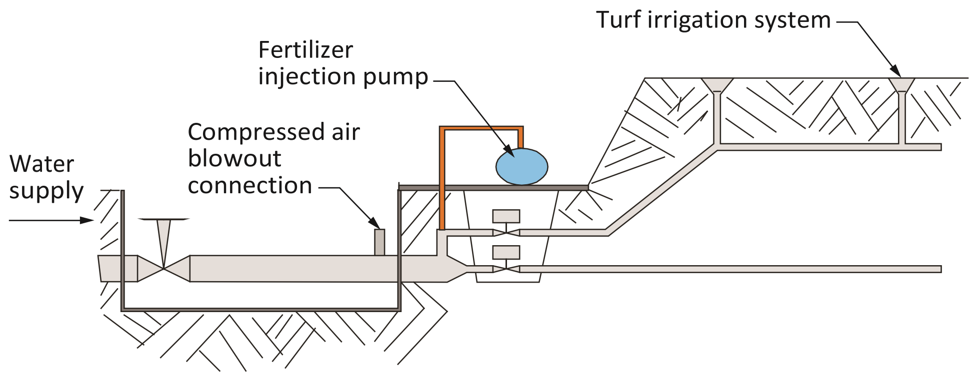


Figure 3-3—Injector pump on fertilizer injection system

Refer to Chapter 6 to see the correct backflow protection needed.

Figure 3-3 also shows the location of a blowout connection. A compressor is used to blow out water from the system, preventing freezing during the winter months. High pressure contaminated compressed air can be forced back into the public water supply through this connection. A blowout connection located upstream of the backflow preventer is a potential cross connection. Content

Identifying an aspirator/Venturi effect cross connection

An aspirator is a device that passes liquid or gas through a Venturi. The Venturi creates a negative pressure causing a substance such as fertilizers or cleaning agents to be drawn into the Venturi and missed with the flowing liquid

Figure 3-4 is an example of a water-operated garden sprayer that is being used to aspirate weed killer into the sprayer. This is a cross connection because of the possibility of weed killer being drawn back into the potable water supply; it is an example of back-syphonage backflow cross connection. Other typical examples where aspirator type equipment can be found are in dental chairs, janitor sinks and restaurant hood washes.

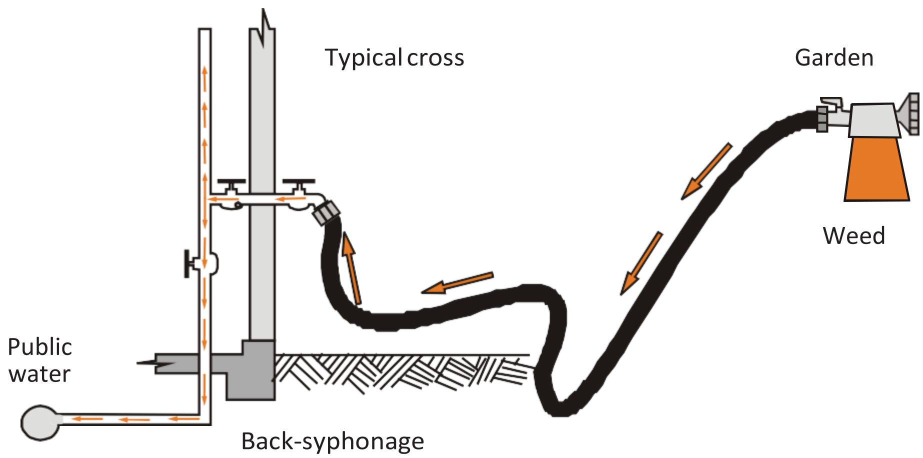


Figure 3.4 water operated garden sprayer

Refer to Chapter 6 to see the correct backflow protection needed.

Picture of weed sprayer using venture effect to draw weed killer into the high velocity water flow.

Content

Identifying Venturi effect cross connections

Venturi effect is the term used to describe a cross connection that occurs when high water withdrawals cause the pressure within a pipeline to drop to a point below atmospheric. Small branch lines and other connections could act like an aspirator. Atmospheric pressure will push any fluids connected to the branch line into the water main. Figure 3-5 shows the principle of a Venturi effect cross connection. A Venturi could be defined as a narrowing of a short section of pipe that increases the velocity and lowers the pressure of the fluid flowing in the pipe.

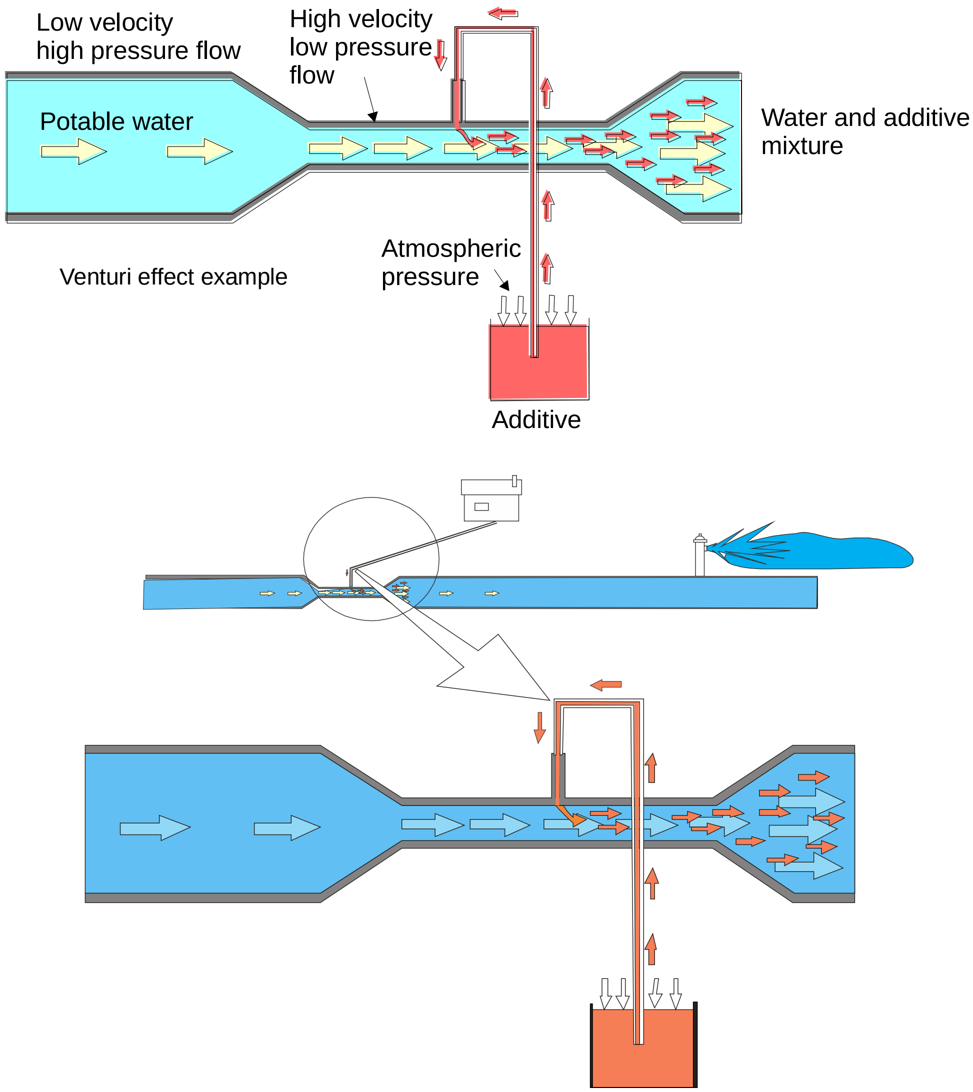


Figure 3-5- Venturi effect due to high water withdrawal at fire hydrant.
High velocity low pressure flow pressure at smaller diameter piping in a water main

Content

Identify Jumper connection cross connections

Jumper connections are a potential cross connection. The drawing below shows one example of an arrangement of piping illustrating a type of jumper connection. Jumper connections, removable sections, swivel connection or change over devices could be classified as jumper connections. This temporary service for repairs to the water main connection in the drawing below is an actual cross connection.

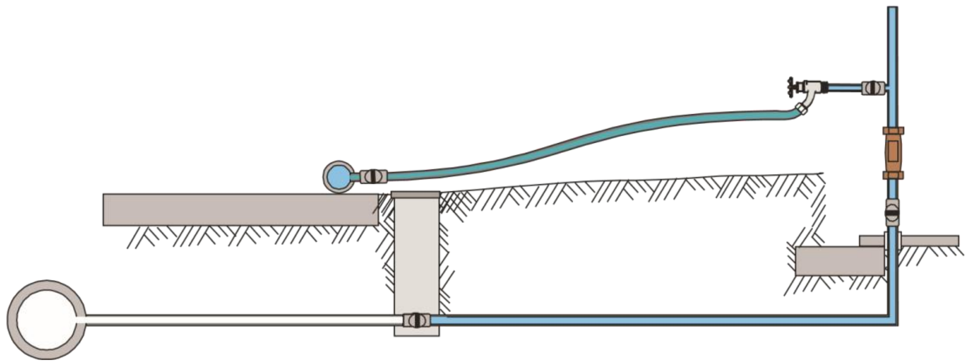


Figure 3-6—Jumper connection as temporary service for repair to a water main connection

These pictures below show a fire hydrant with proper backflow protection providing a temporary jumper service connection to premises while a water main is repaired.

Figure 3-7—Fire hydrant with proper backflow protection

Figure 3-8—Temporary service connection completed above ground at the service connection

Content

Identify bypass arrangement cross connections

Bypass arrangements are often found in commercial and some residential applications.

A simple bypass arrangement is shown in Figure 3-9; however, there is a problem.

A backflow preventer has been installed on the mainline; however, a bypass arrangement has also been installed and has bypassed the backflow preventer. Bypass piping must have the same hazard degree of backflow protection as the mainline backflow protection.

There is also no backflow protection on the hose faucet. A hose connection vacuum breaker (HCVB) is required on the hose faucet

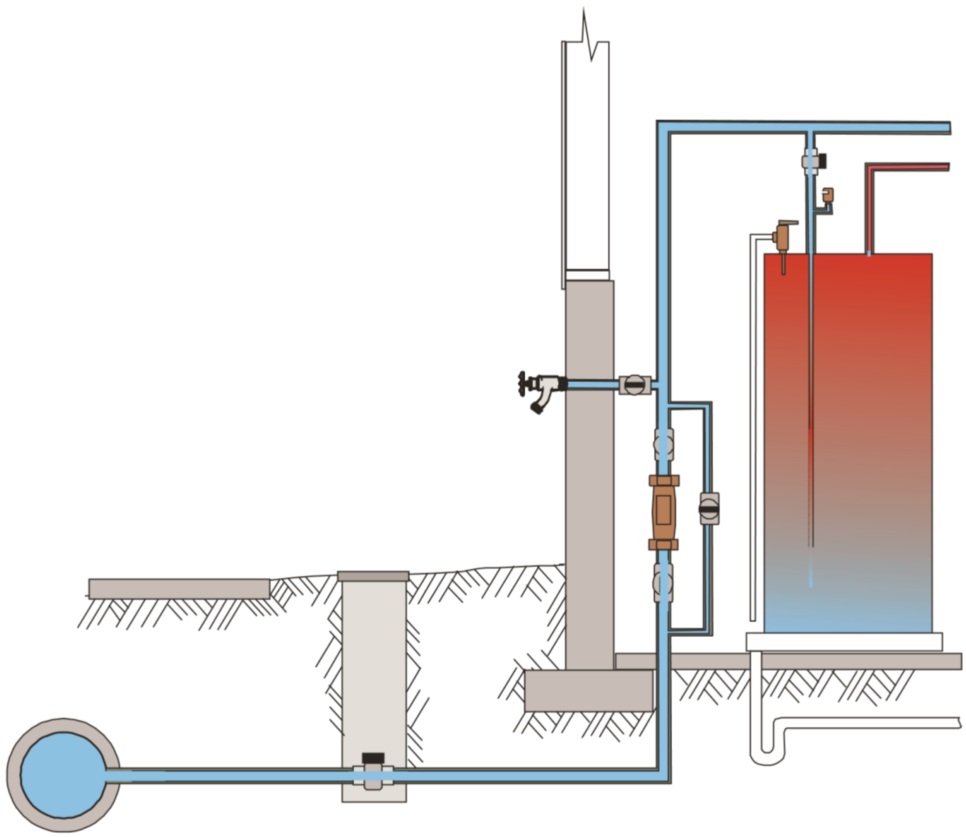


Figure 3-9—Backflow preventer installed on the mainline with bypass arrangement

Content

Identify booster pumps and pump cross connections

Figure 3-10 shows a supply line incorrectly installed to a pump suction creating a cross connection. Negative pressure is possible if the public water main is not able to keep up with the pump demand. As a result of the negative pressure at "A", a backsyphonage condition exists at sink "B", allowing the dirty sink water to be syphoned into the domestic system and being distributed to the plumbing fixture at "C". At "D", if the by-pass valve is not closed tight there is a potential for the higher boosted water pressure to be forced back into the public water system.

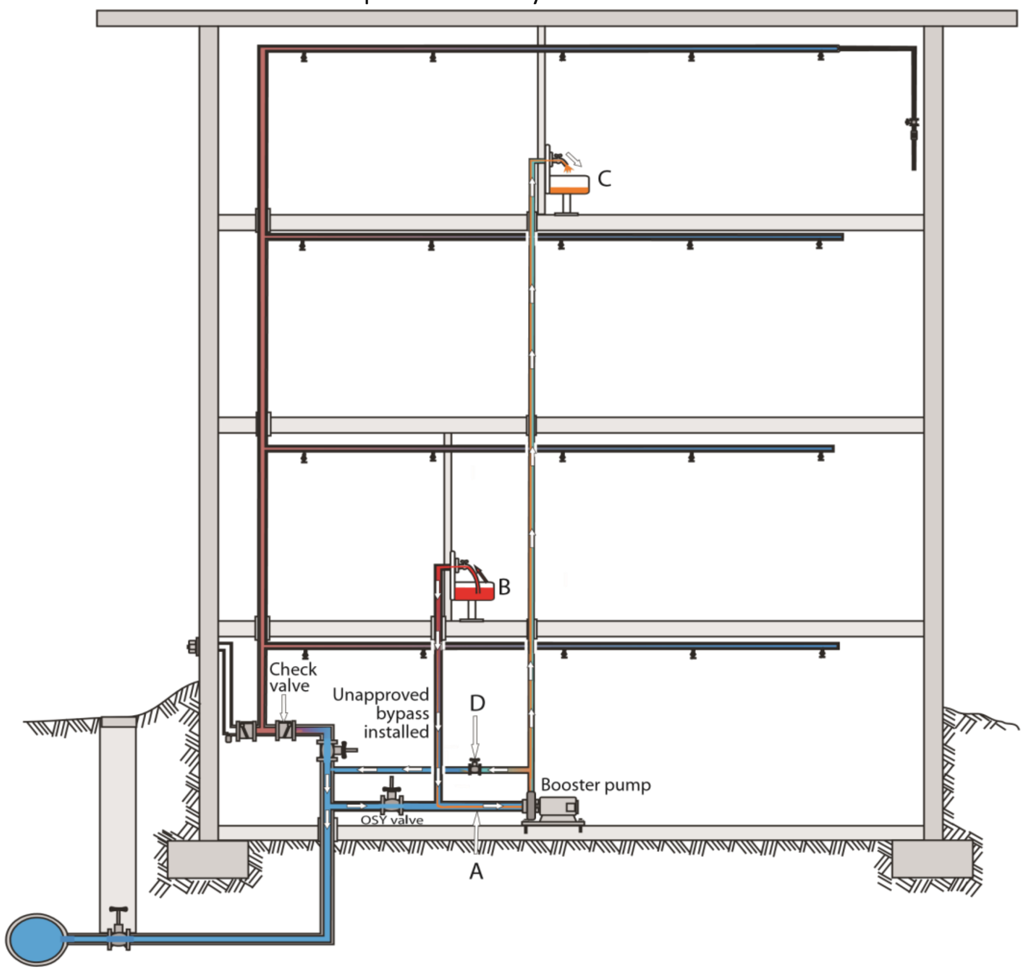


Figure 3-10—A supply line incorrectly installed to a pump suction creates a cross connection

Negative pressure caused by the pump suction at "A" can result in contamination at "B "to be drawn into the public water supply. The bypass "D" and the premise water supply lack cross connection protection.

This building in Figure 3-10 is a candidate for premise isolation with a DCVA, because of the presence of the booster pump. An RP may be required. Consult with the AHJ. Internal protection with a DCVA will also be required on the fire sprinkler system where it connects to the domestic system. A low water pressure switch may be required by the AHJ. The low pressure switch is installed on the pump suction piping. The low pressure switch will automatically shut down the booster pump if the pressure drops below to a predetermined pressure; for example, 138 kPa (20 psi).

Content

Identify pumper truck cross connections

Figure 3-111 shows a fire sprinkler system containing stagnant water (polluted). A fire pumper truck is using an auxiliary water supply during a fire. Fire pumps are capable of pressures much higher than the public water system. Unapproved possibly polluted water could be pushed back into the public water main if the unapproved single check "A" valve in Figure 3-911, below, is leaking.

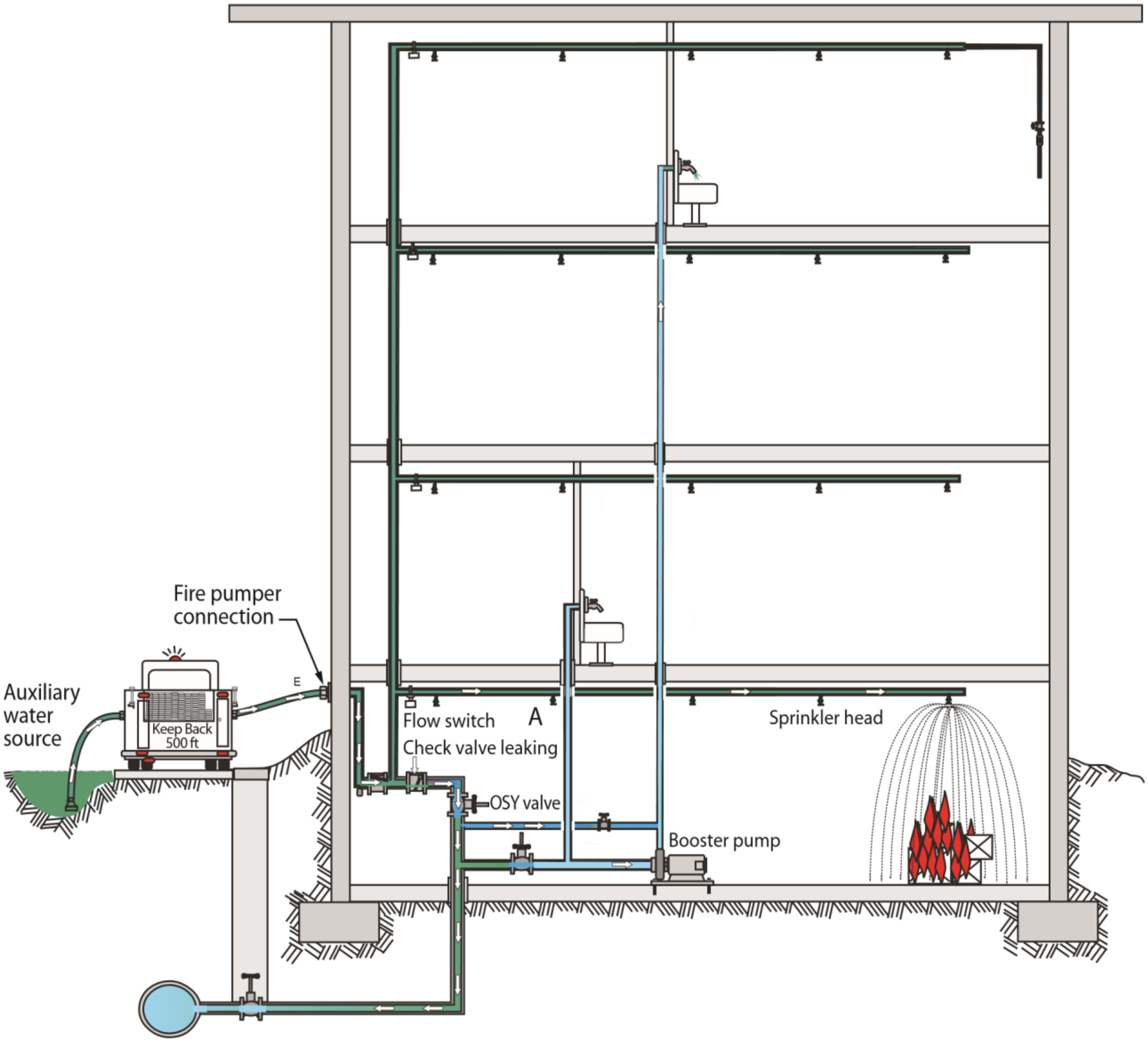


Figure 3-11—Leaking check valve creates cross connection

Refer to Chapter 6 to see the correct backflow protection needed for Figure 3-11.

This building is a candidate for RP premise isolation. Also an unapproved auxiliary water source is close by and the pumper truck is using this water source to fight the fire. This is also a cross connection.

Content

Identify pressure vessel cross connections

Pressure vessels that are connected to the potable water system can be a cross connection. An example of a pressure vessel is a heating boiler use to heat a building. Heating boilers contain water that may have treatment chemicals added to inhibit corrosion. Water pressures in heating boilers can at times be higher than the potable water system. Contaminated boiler water could backflow into the potable water system creating a back-pressure cross connection. Figure 3-10 is an example of a typical boiler feed-water connection. Backflow is occurring because the public main pressure has been reduced to a lower pressure than the boiler pressure. The single check valve "A" is leaking under a backpressure condition.

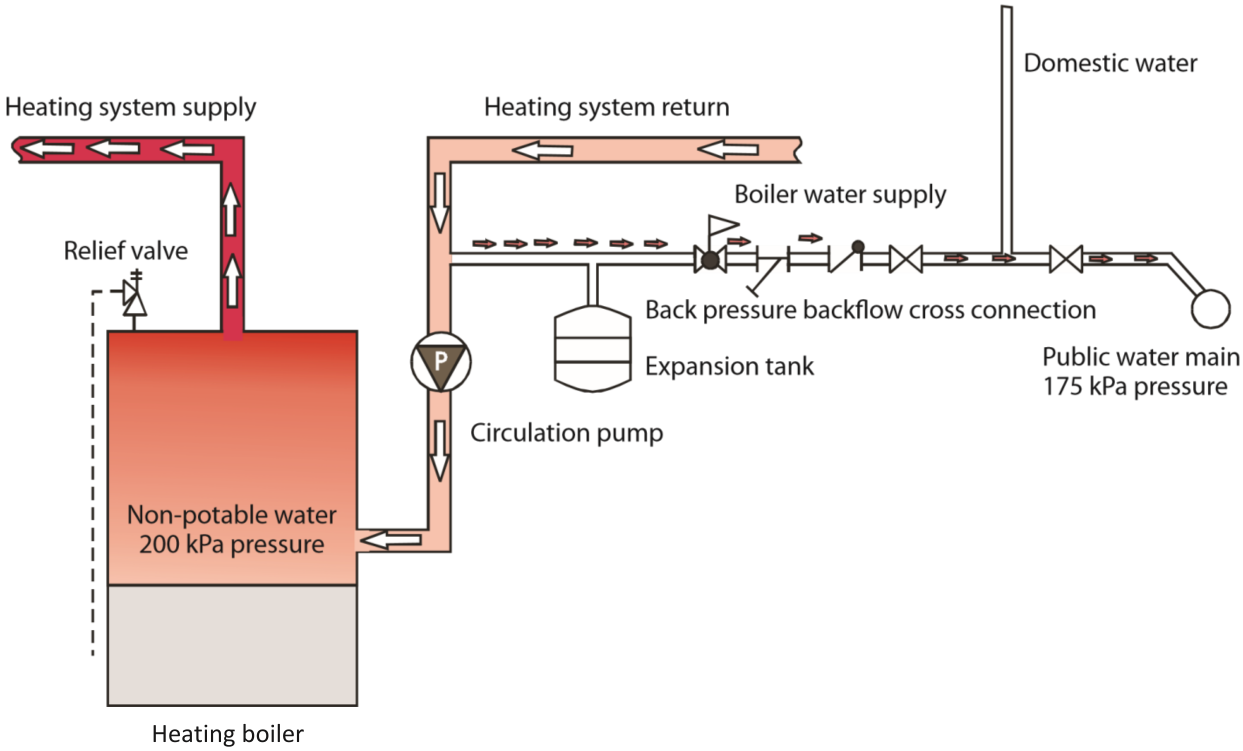


Figure 3-12—Back pressure cross connection example

Refer to Chapter 6 to see the correct backflow protection needed.

Identify capillary action cross connections

Capillary action cross connection occurs when contaminated fluids are drawn back into a small pipe opening by capillary action. This can cause the formation of a bio film in the pipe opening promoting biological growth. An example of this type of cross connection may occur in dental drills and dental syringes.

Refer to your first year science or second year trap seal loss to review capillary action.

Now complete Self-Test 3 and check your answers.

Content

Self-Test 3

Review the section objectives and then answer the following questions.

Refer to Figure 1 to answer questions 1-2.

1. What type of cross connection is shown in Figure 1?
   a. backpressure
   b. pollution
   c. an actual cross connection
   d. a potential cross connection

2. What type of backflow would occur in Figure 1?
   a. backpressure backflow
   b. back syphonage backflow
   c. pressure backflow
   d. internal backflow

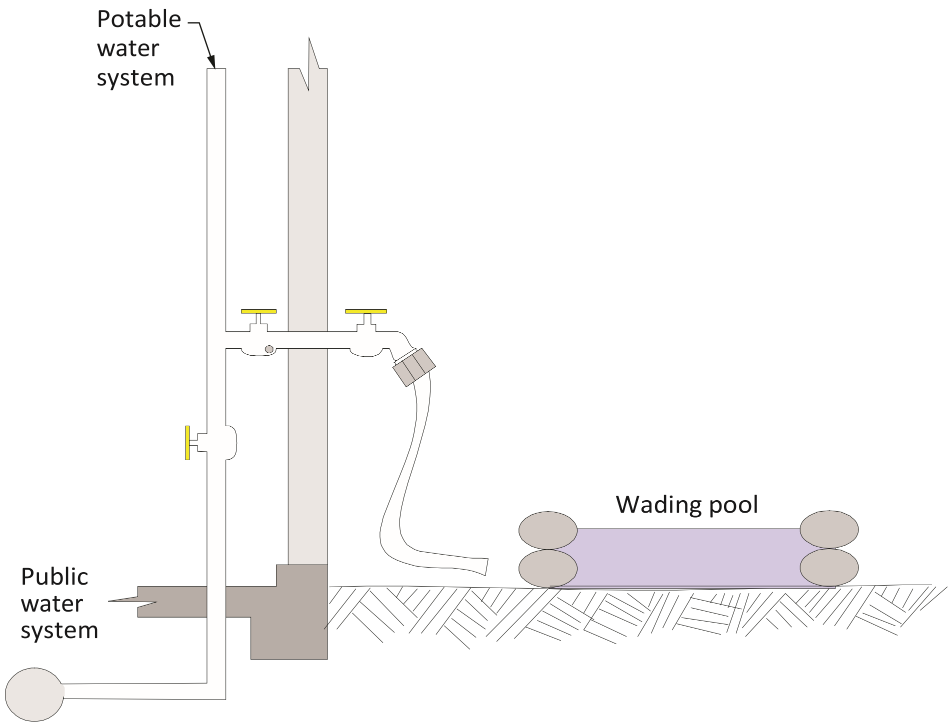


Figure 1

Content

Refer to Figure 2 to answer questions 3-4.

3. What type of cross connection is shown in Figure 2?
   a. backpressure
   b. pollution
   c. an actual cross connection
   d. a potential cross connection

4. What type of backflow would occur in Figure 2?
   a. backpressure backflow
   b. back syphonage backflow
   c. pressure backflow
   d. internal backflow

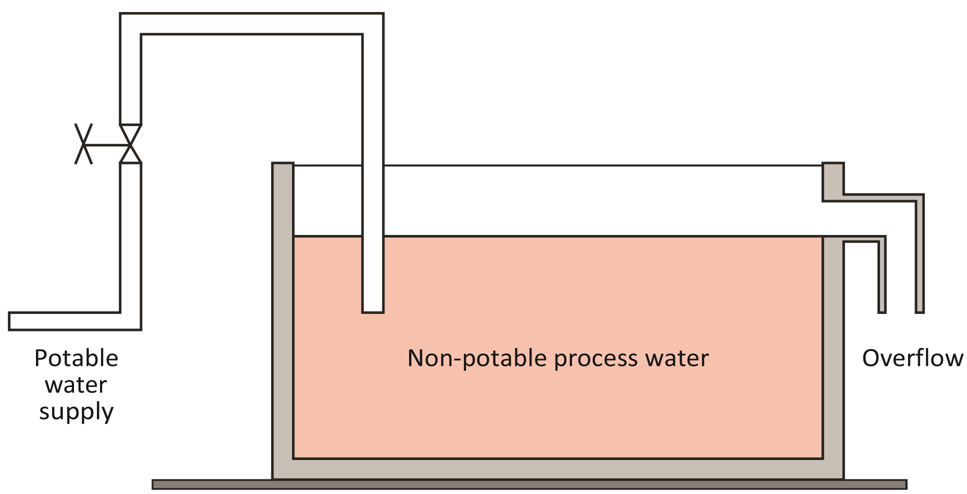


Figure 2

Content

Refer to Figure 3 to answer questions 5-7.

5. What type of cross connection is shown in Figure 3?
   a. backpressure
   b. pollution
   c. an actual cross connection
   d. a potential cross connection

6. What type of backflow would occur in Figure 3?
   a. backpressure backflow only
   b. back syphonage backflow only
   c. internal backflow
   d. backpressure backflow and back syphonage

7. How many sources of cross connections are shown in Figure 3?
   a. 1, the injector
   b. 2, the injector and sprinkler head
   c. 3, the injector, sprinkler head and blowout connection
   d. 2, the injector and the blowout connection

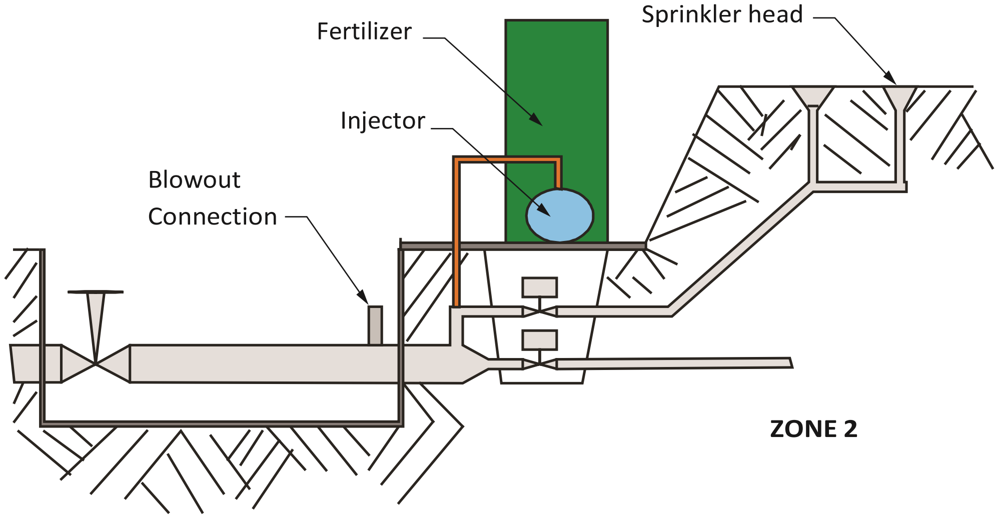


Figure 3

Content

Refer to Figure 4 to answer questions 8-9.

8. What type of cross connection is shown in Figure 4?
   a. backpressure
   b. pollution
   c. an actual cross connection
   d. a potential cross connection

9. What type of backflow would occur in Figure 4?
   a. backpressure backflow only
   b. back-syphonage backflow only
   c. internal backflow
   d. backpressure backflow and back-syphonage

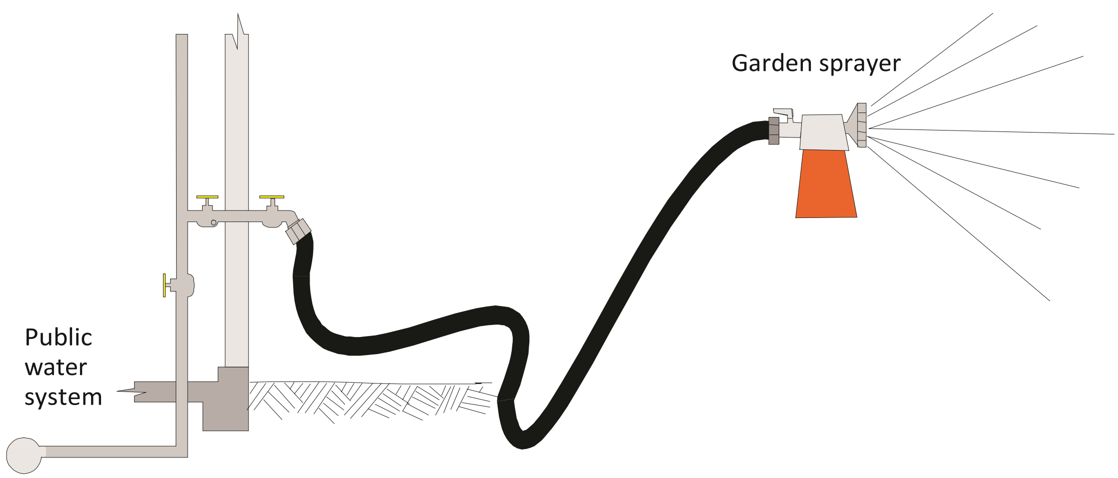


Figure 4

Content

Refer to Figure 5 to answer questions 10-11

10. What type of cross connection is shown in Figure 5?
    a. backpressure
    b. pollution
    c. an actual cross connection
    d. a potential cross connection

11. What type of backflow would occur in Figure 5?
    a. backpressure backflow only
    b. back-syphonage backflow only
    c. internal backflow
    d. backpressure backflow and back-syphonage

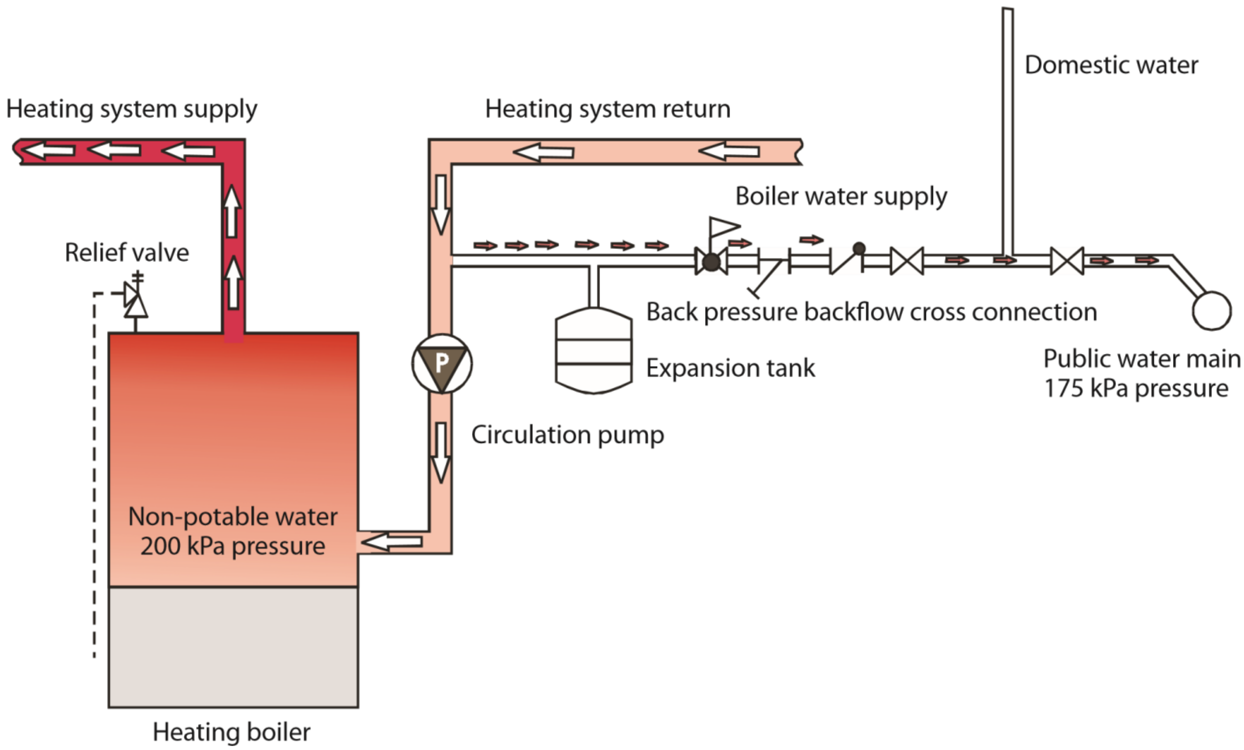


Figure 5

12. A bypass arrangement, jumper connections, removable sections, swivel connection or change over devices are considered a cross connection.
    a. true
    b. False

Content

13. A potential cross connection or an existing cross connection are treated the same.
    a. true
    b. false
14. A physical connection between a potable water system and a non-potable source can result in backflow cause by either back pressure or back syphonage.
    a. true
    b. false
15. A booster pump in a tall building could cause a back-syphonage condition in the piping system upstream of the booster pump
    a. true
    b. false
16. A break in a water main could cause back pressure downstream of the water main break.
    a. true
    b. false
17. Ship board fire pump connected to municipal system could cause a cross connection by backpressure.
    a. true
    b. False
18. A water main break could cause water head pressure from a tall building to backflow into the water main
    a. true
    b. false
19. When water is withdrawn from a potable system at a high rate; for example, a fire hydrant, the pressure in the rest of the system could fall low enough to cause back-syphonage from other premises in the water system.
    a. true
    b. false

Check your appendix answer key

Have you accomplished your objectives of this Chapter 3? Review your Chapter 3 objectives.

If you feel you have accomplished the objectives of Chapter 3, you may wish to proceed to Chapter 4.

Content

Chapter 4 Identifying backflow prevention assemblies and device

Objectives

After completing this chapter of the course, you will be able to:

- Explain the difference between a backflow prevention assembly and device • Identify the types of backflow prevention assemblies and devices including:
- Barometric loop
- Air gaps
- Reduced pressure backflow assemblies
- Reduced pressure detector assemblies
- Double check valve assemblies
- Double check detector assemblies
- Pressure vacuum breaker assemblies and spill resistant pressure vacuum breakers
- Atmospheric vacuum breakers and various backflow prevention devices

Introduction

Piping trades personnel testing backflow preventers must be able to identify the difference of a backflow preventer from other valves and piping equipment installed in piping systems. This chapter illustrates the basic backflow assemblies and devices as well as giving a brief explanation of their components and uses.

There are two basic ways to prevent contaminants or pollutants from back flowing; one is a manufactured (mechanical) backflow preventer and the other is an air gap.

Backflow prevention assemblies and backflow prevention devices

Manufactured backflow preventers can be classified into two groups:

1. backflow prevention assembly
2. backflow prevention device

NOTE: The term assembly and device are used interchangeably in some written standards; for example, the CSA standards refer to backflow preventers as devices, not assemblies. You must remember, an assembly and a device are not the same thing.

The basic differences of an assembly and a device are as follows:

- Cross connection control assemblies **must** be testable and will always have test valves and resilient seated shut-off valves.
- Cross connection control devices **may not** have test valves or shut-off valves and normally have no test procedures.
- Cross connection control devices should **not** be used in place of an approved assembly. Always consult local AHJ regulations first before installing.

One important consideration when selecting a backflow preventer is the requirements of the water purveyor and Part 7 of the *Building Code*. Also standards such as the *CSA B64.10 /B64.10.1* or local waterworks bylaws may apply. Water purveyors may also maintain an approved list of backflow preventers.

Content

Consult with the water purveyor and plumbing inspector before you select and install a backflow preventer.

Identifying a barometric loop

A barometric loop is simply a minimum 10.7 m loop of piping that is installed in a water supply to prevent back-syphonage of water into the purveyor's water supply. Barometric loops are rare; they take up a lot of room and require support. You should consult with the water purveyor before considering a barometric loop for cross connection control. The loop works because water cannot be back-siphoned more than 10.4 m vertically. A barometric loop will only protect against a backsyphonage minor hazard.

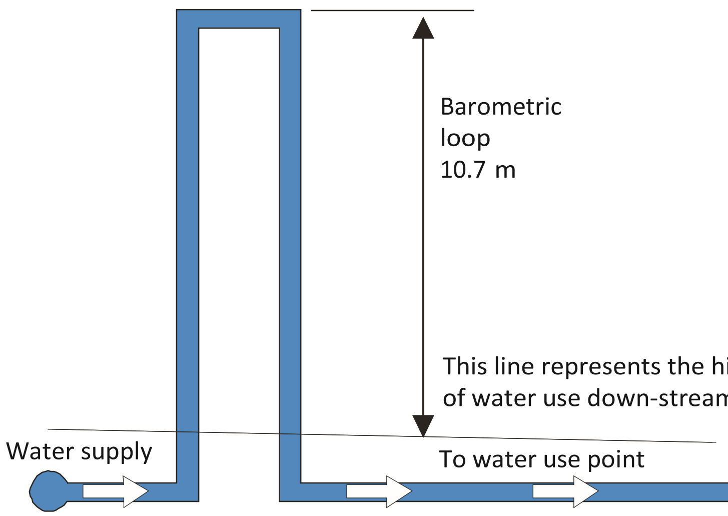


Figure 4-1— Barometric loop

Barometric loop

Content

Identifying air gaps

An air gap (AG) is the simplest form of cross connection control.

An air gap will protect against backpressure and back-syphonage in all hazards cross connections.

An air gap is the minimum measured vertical distance of free air between a water supply inlet and the flood level rim of a fixture or equipment.

Figure 4-2 shows two examples of an application of a typical air gap on a water supply to a process tank and a plumbing fixture.

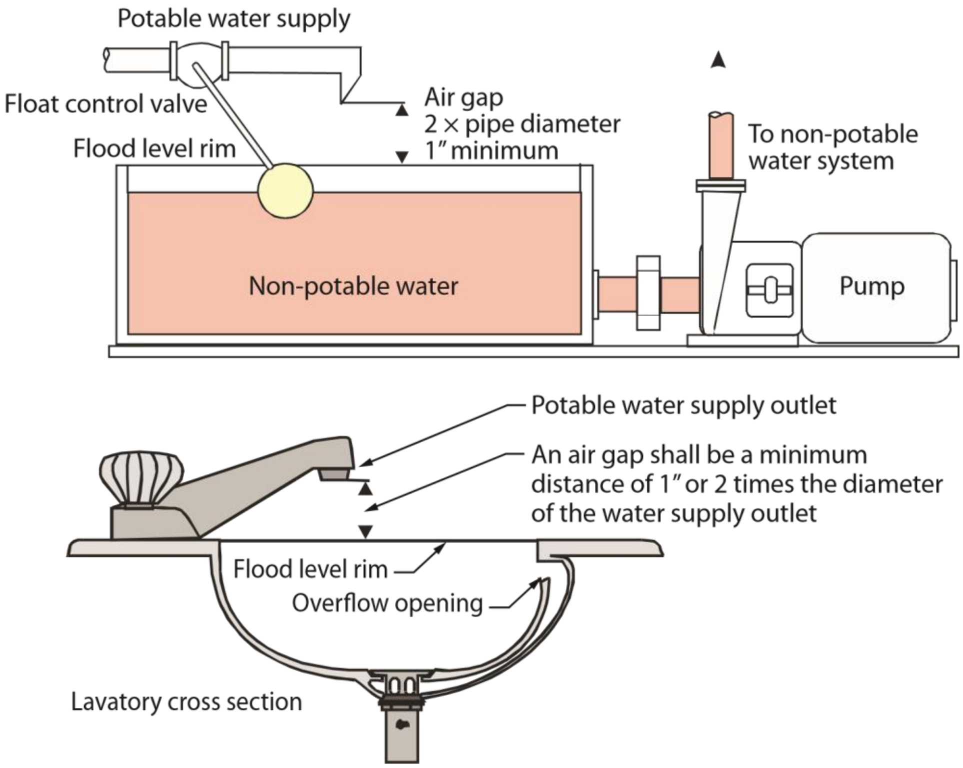


Figure 4-2—Typical air gap on a water supply on a process tank (top) and plumbing fixture (bottom)

Note: An AG, when used as a severe hazard protection, may need additional protection and possibly registered with the water purveyor as a registered air gap. This would mean it would be checked on a regular basis.

Content

Identifying reduced pressure backflow prevention assemblies (RP / RPBA)

A reduced pressure backflow prevention assembly (RP) is a mechanical backflow preventer that will prevent backpressure and back-syphonage severe health hazard cross connections. A RP is an approved assembly consisting of two independently operating check valves, spring-loaded to the closed position. Located between the check valves is a spring-loaded differential pressure relief valve that is loaded to the open position. All of the components shall be installed as a unit with and between two resilient seated shut-off valves and have four suitable test valves for testing purposes.

Figure 4-3 shows a typical RP. Not all RP’s look the same; however, one distinguishing feature is the relief valve port opening. Do not confuse the relief port on a dual check valve device with an RP.

Any backflow preventer with a relief valve port must have provisions to drain the discharge from the relief port through an air gap.

Identifying the exterior components of an RP

As well as identifying the valve itself the installer tester will be required to identify and name the basic RP parts. Figure 4-3 identifies each major exterior part of the backflow preventer. Written test procedures refer to each of these components in specific order of use during testing of the backflow preventer. The numbering order of the components is standardized to be identical to each different type of backflow assembly. The direction of numbering is from the inlet (upstream end) to the outlet side (downstream end).

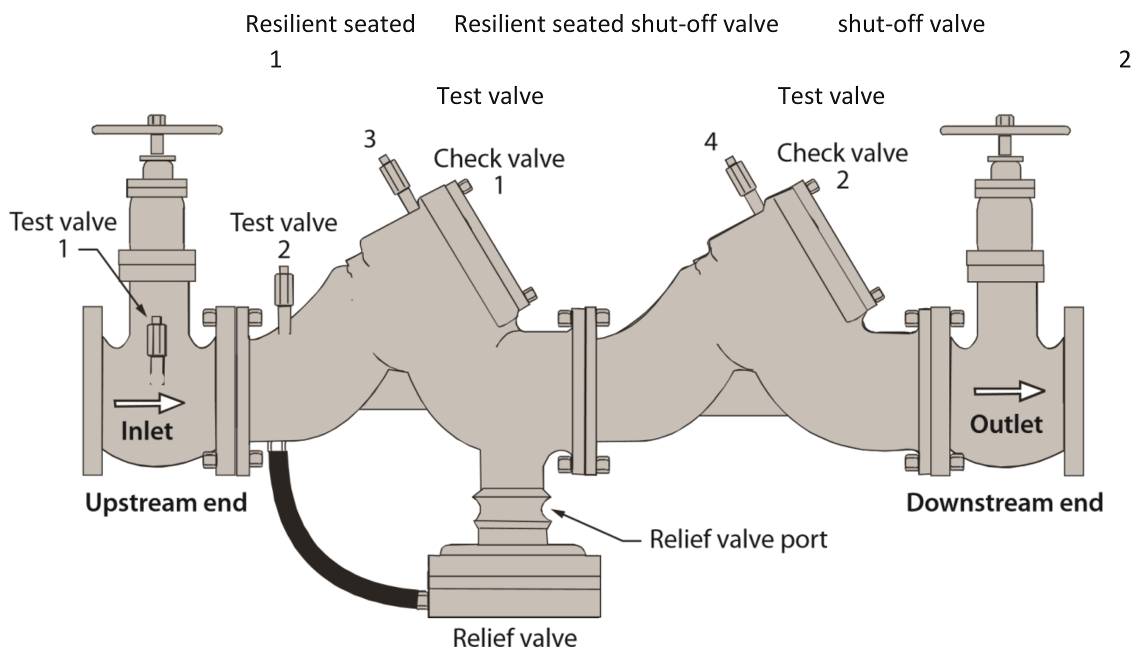


Figure 4-3—Exterior of the backflow preventer

Refer to Chapter 8 to see an illustration of internal components of a RP.

Content

Figure 4-4 shows a Reduced Pressure backflow assembly (RP)

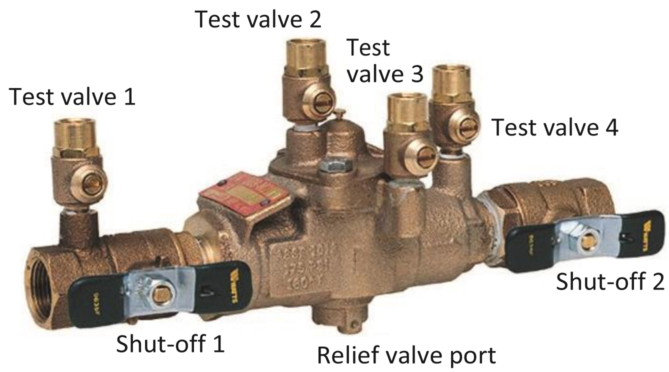


Figure 4-4—Reduced Pressure backflow assembly (RP)

Courtesy of Watts Regulator RP No. 009 QT CSA and USC approved.

Figure 4-5 shows a RP designed for use on fire hydrants and portable equipment

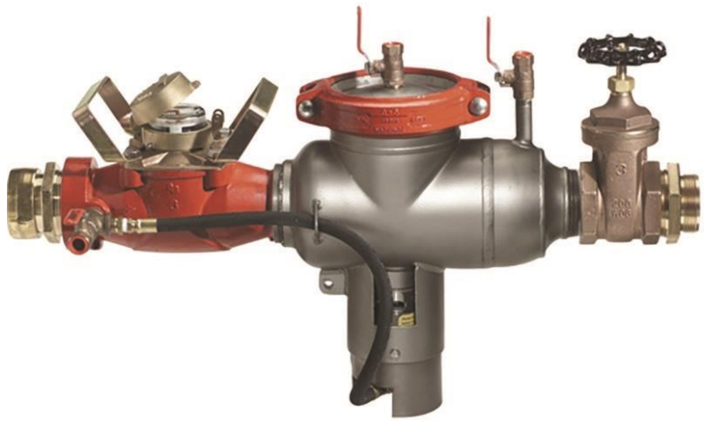


Figure 4-5—RP for fire hydrant or portable equipment

Courtesy Watts Regulator. There are no current approvals or specification available at the time of this printing.

Content

Identify a reduced pressure detector assembly (RPDA)

A reduced pressure detector assembly is a mechanical backflow preventer that will control backpressure and back-syphonage severe health hazard cross connection. A RPDA has similar construction to a RP and provides the same level of protection as the RP.

A RPDA is an approved assembly consisting of two approved reduced pressure backflow assemblies, set in parallel, equipped with a meter on the typically ¾" bypass line. The metered bypass is used to detect illegal water use, or leakage. Water purveyors may require the installation on fire sprinkler services where a large water meter is not acceptable. The RPDA metered bypass would detect theft of water from the sprinkler system. During a fire full flow would occur through the main line backflow preventer. (Refer to Figure 4-6).

A RPDA must be purchased as a complete assembly.

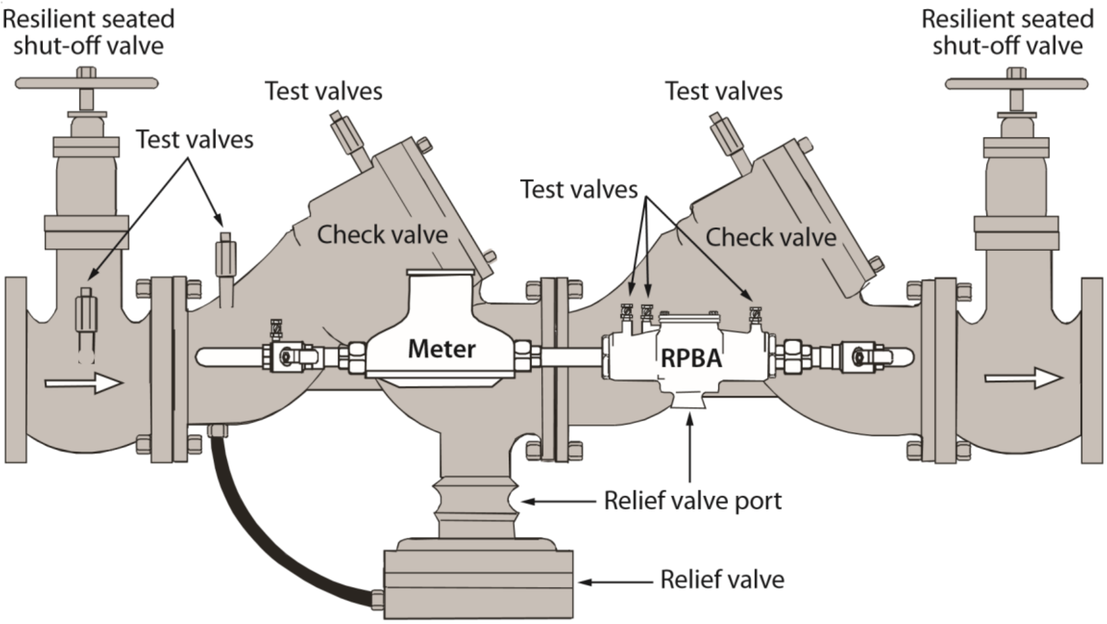


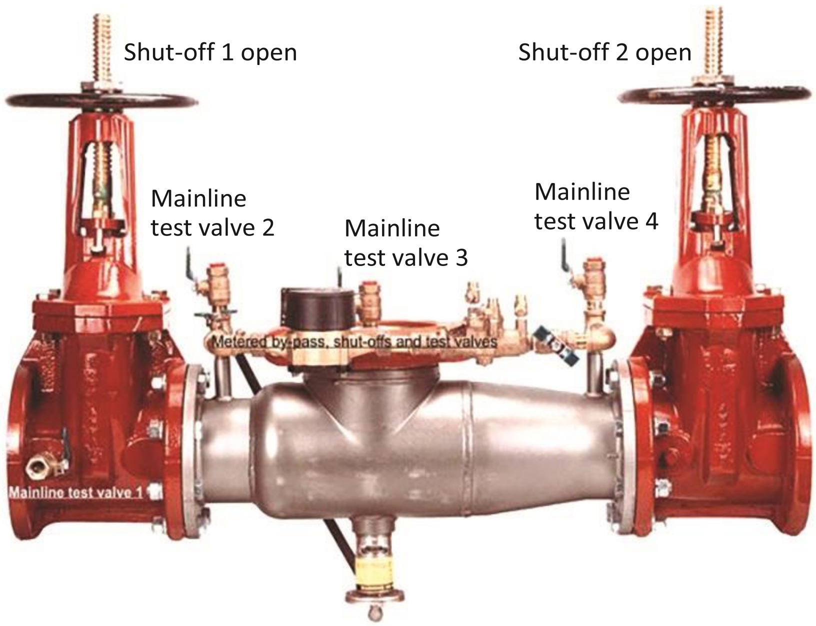
Figure 4-6—A reduced pressure detector assembly

Content

Figure 4-7 shows a RPDA

Observe the position of the valve stems. These valves are at least partially open.

Valve stem is extending up above the handle indicating the valve is partially or fully open.



Mainline test valve 3

Figure 4-7—Valve system on a RPDA

Courtesy of Watts RPDA No. 994 CSA FM and ULC.

Fire sprinkler system approved backflow Assemblies.

Backflow assemblies installed on a fire sprinkler system must be approved for this use such as:

Note:FM = Factory Mutual. ULC = Underwriters Laboratory Canada

Content

Reduced pressure backflow assembly type II (RPDA-II)

The assembly consists of a mainline RPDA II complete with two independently acting poppet type check valves with a spring loaded relief valve assembly located between the check valves. A bypass line is connected between the relief valve and the mainline check valve 2. The bypass line consists of a meter, and a single bypass check mounted between two shut-off valves, and test valves. The main line relief valve acts as a relief valve for both the mainline and bypass piping. The mainline check valve acts as the check valve 1 for both the mainline and bypass piping.

The advantage of this type II assembly is it could be lower costs and reduced pressure loses.

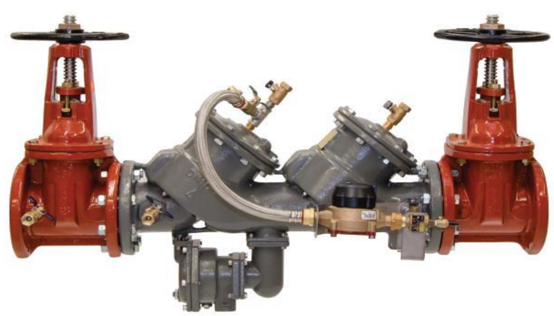


Figure 4-8—Reduced pressure backflow assembly type II
Courtesy of Febco a Watts brand RPDA type 2 single check on the bypass

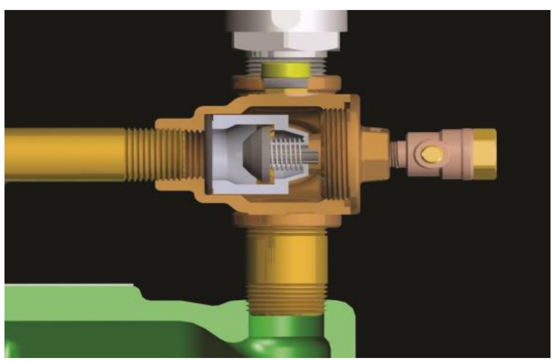


Figure 4-9—ASSE 2005 Approved bypass single check valve
Figure 4-9 courtesy of Apollo valves RPDA type II.

Note: Section 1.3.3 of ASSE 1047-2005 states:

> The bypass line shall include either, a water meter, an alarm signaling device, or both. The bypass line shall bypass either the first and second checks or the second check only. A bypass line that bypasses the first and second checks shall include an ASSE 1013 reduced pressure principle assembly. Flow rates up to and including 2.0 GPM (0.13 L/s) shall be directed through the bypass. A bypass line that bypasses the second check shall include a bypass check assembly with a shut-off valve upstream and downstream in the bypass line. The bypass line shall include two (2) test cocks, one between the upstream shut-off and the bypass check and one (1) downstream of the bypass check but before the downstream shut-off. Flow rates up to and including 2.0 GPM (0.13 L/s) shall be directed through the bypass."

Content

Identifying a double check valve assembly (DCVA)

A double check valve assembly is a mechanical backflow preventer that will control a backpressure and back-syphonage moderate hazard cross connection. A DCVA is defined as an approved assembly consisting of two independently operating check valves, loaded to the closed position by springs or weights, and installed as a unit with, and between, two resilient seated shut-off valves and having suitable test valves for testing.

Refer to Chapter 7 to see a DCVA cutaway.

Figure 4-100 shows a typical DCVA. Not all DCVAs look the same; in many cases they resemble a RP; but the DCVA will not have a relief valve opening. Do not confuse the DCVA with a dual check without relief port (DuC). A dual check valve will not be supplied with shut-offs and in many cases have no test valves. A Dual check must not be used in place of an approved DCVA.

Figure 4-10—A typical DCVA

Courtesy of Watts DCVA 719 CSA and USC approved.

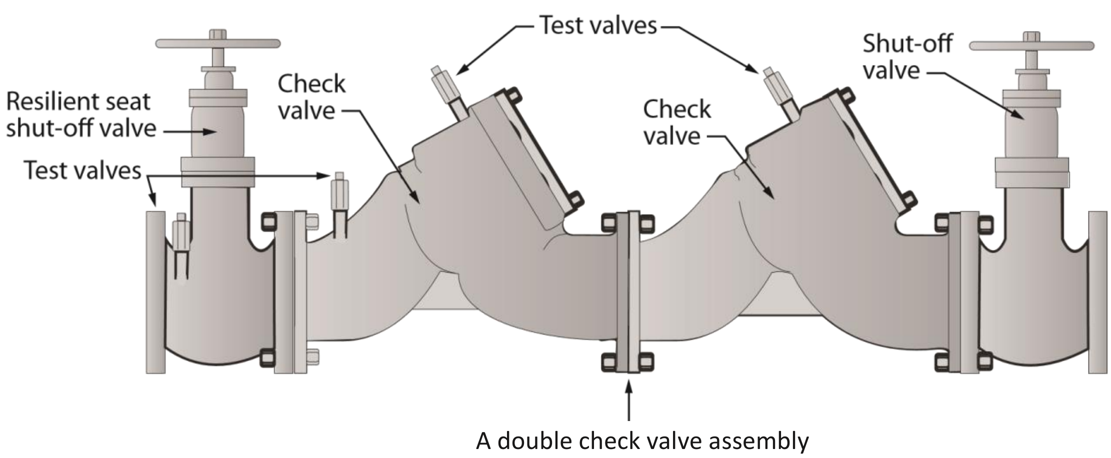


Figure 4-11—Illustration of DCVA: the assembly does not have a relief port.

Content

Identify a double check detector assembly (DCDA)

A double check detector assembly is a mechanical backflow preventer that will control backpressure and back syphonage, minor to moderate hazard cross connection. A DCDA is similar in construction to a DCVA and will be supplied complete with four test valves and two resilient seated shut-offs. The DCDA will also have a small typically ¾" bypass built into it. The bypass line will have a smaller DCVA and a water meter. The purpose of the DCDA is to detect water leakage or water use. A DCDA is defined as an approved assembly consisting of two approved double check valve assemblies, set in parallel, equipped with a meter on the bypass line to detect small amounts of water leakage or use. (Refer to Figure 4-12.)

A DCDA must be purchased as a complete assembly.

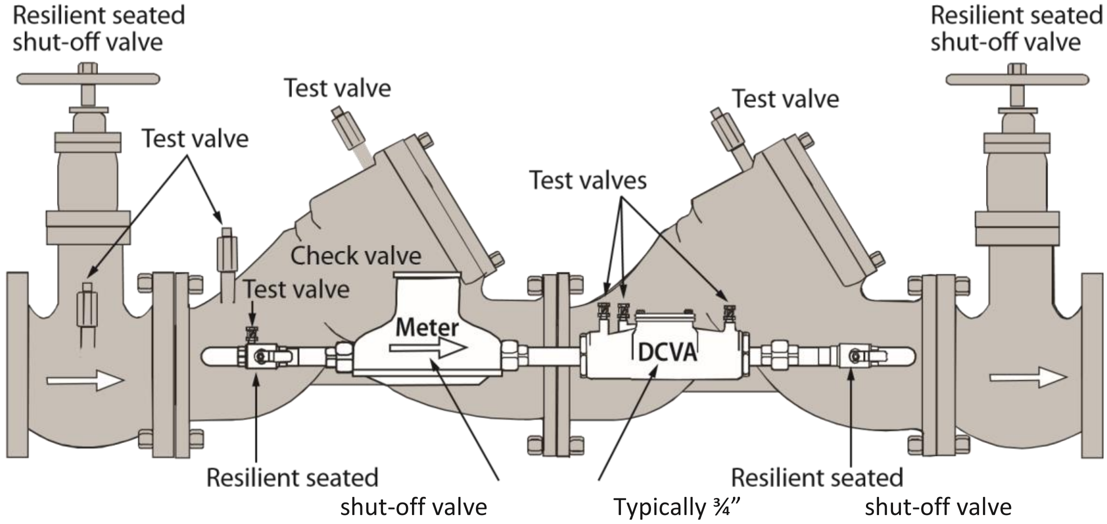


Figure 4-12—A double check detector assembly (DCDA)

Shown in Figure 4-13 are resilient seated OSY gate valves; stems are down indicating valves are closed.

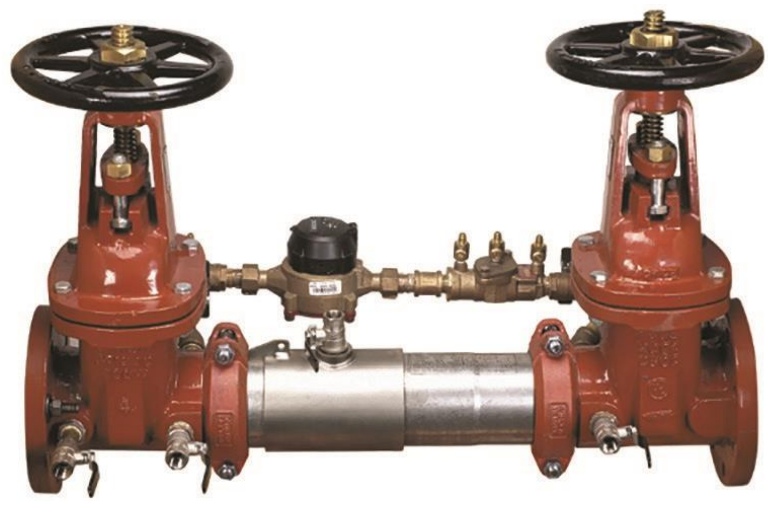


Figure 4-13—DCDA mainline assembly and metered by pass with assembly.

Courtesy of Watts 757DCDA CSA approved.

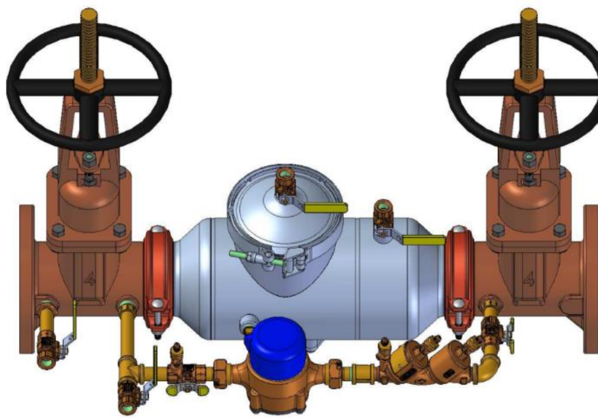
The Metered bypass is typically ¾" with a DCVA located on the bypass the same degree of protection as the mainline DCVA.

Content

DCDA

While the DCDA looks like one larger mainline DCVA and one smaller bypass DCVA the unit is design engineered so that the smaller DCVA has a lower pressure deferential than the larger mainline DCVA. These complete engineered DCDA assemblies are designed engineered so a low flow of up to three GPM, will flow through the bypass only and at higher flow the mainline line DCVA opens to provide the required system demand. These DCDA assemblies cannot be onsite constructed by the installer using typical DCVA of different sizes.

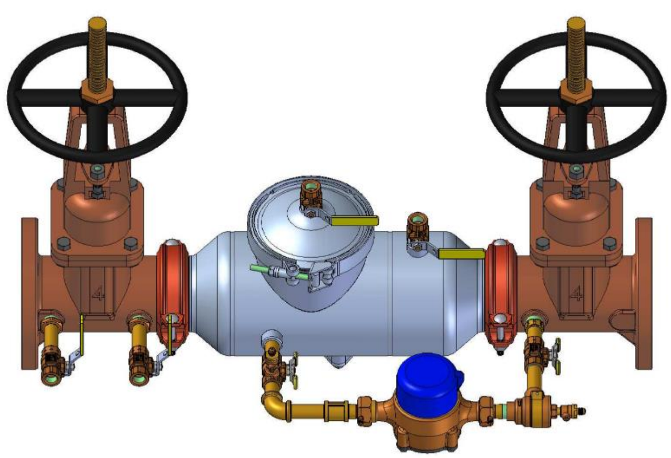
DCDA 4A Type 1 Bypass



DCDA 4A Type 1 Bypass courtesy of Apollo/Conbraco

DCDA2 4A Type 2 Bypass

The DCDA type II is a fairly new backflow assembly it consists of a mainline DCVA and a bypass with a single check and water meter shut-offs and test valves. The bypass meter detects low flows at less than 3 GPM. The DCDA type II provides the same protection as the DCDA.



DCDA 2A Type 2 Bypass courtesy of Apollo/Conbraco

Content

DCDA type II

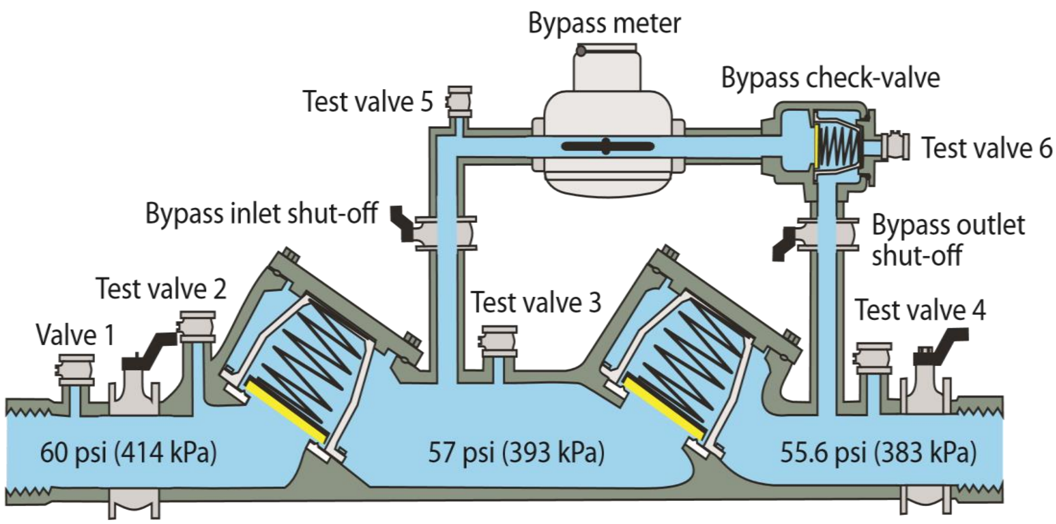


Figure 4-14—Double check detector assembly (DCDA type II)

DCDA 2A Type 2

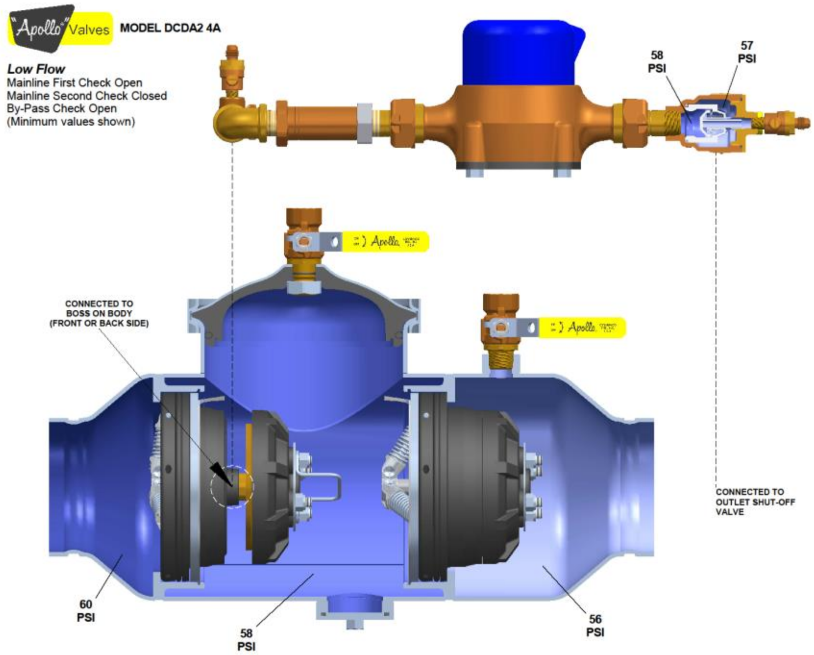


Figure 4-14 a DCDA 2A Type 2 Bypass courtesy of Apollo/Conbraco
Mainline first check valve open, mainline second check closed, By-pass check valve open

Content

DCDA 2A Type 2

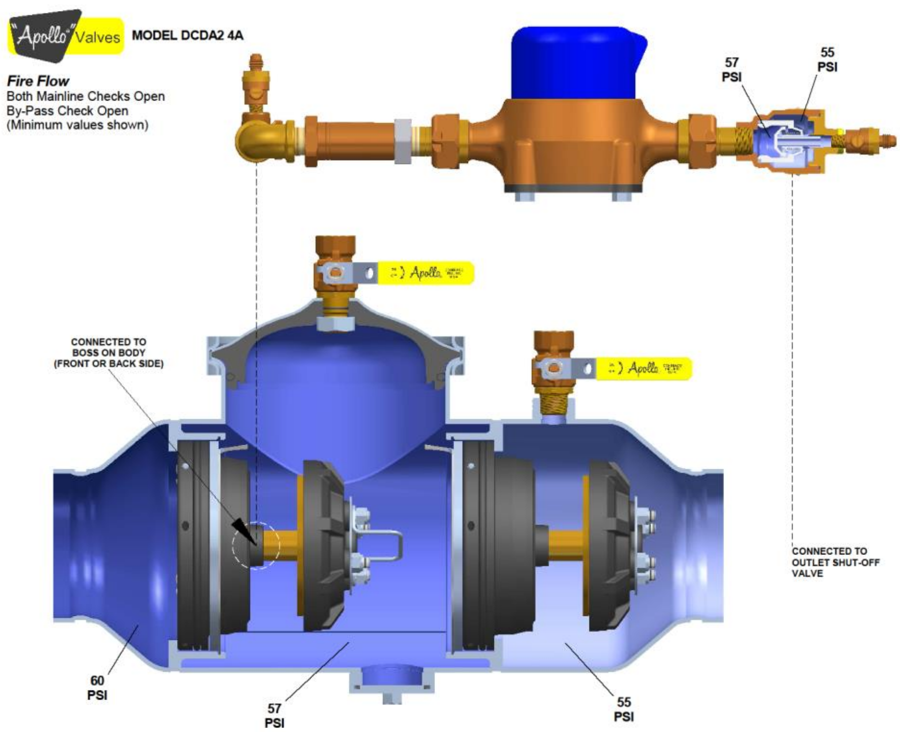


Figure 4-14 b DCDA 2A Type 2 Bypass courtesy of Apollo/Conbraco

Fire flow, both mainline check valves open By-pass check valve open

Identifying a pressure vacuum breaker assemblies (PVB)

A pressure vacuum breaker assembly is a mechanical backflow preventer that will only control back-syphonage, and in most cases minor hazard cross connections. Some purveyors may allow a PVB as protection against a severe hazard; however additional protection will be required. A PVB will be supplied complete with two test valves and two resilient seated shut-offs.

A pressure vacuum breaker is an approved assembly consisting of a spring-loaded check valve loaded to the closed position, an independently operating air-inlet valve loaded to the open position, and installed as a unit with and between two resilient seated shut-off valves and with suitable connections for testing.

Refer to Chapter 7 to see an illustration of a PVB cutaway.

Content

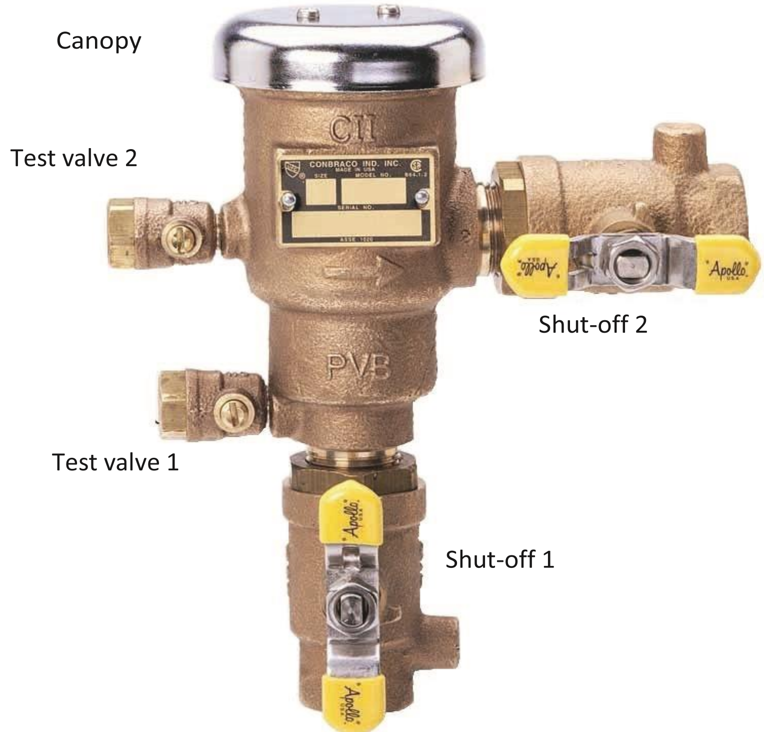


Figure 4-15—Pressure vacuum breaker assembly (PVB)

PVB Courtesy of Conbraco/Apollo valves

Content

Identifying a spill-resistant vacuum breaker (SRPVB)

Figure 4-16 shows a spill-resistant pressure vacuum breaker assembly is similar to a pressure vacuum breaker assembly. The SRPVB contains a spring loaded air-inlet valve, and internally spring loaded check valve, two resilient seated shut-off valves, one resilient seated test valve and one resilient seated air bleed (vent valve). An additional feature of the SRPVB is an internal flexible spill resistant diaphragm that allows the check valve seat and disc assembly to slide up to push the air inlet valve closed before the check valve can open; this reduces the spillage from the air-inlet valve port. The check valve is not designed to resist backpressure caused by thermal expansion.

Refer to Chapter 7 to see an illustration of a SRPVB cutaway.

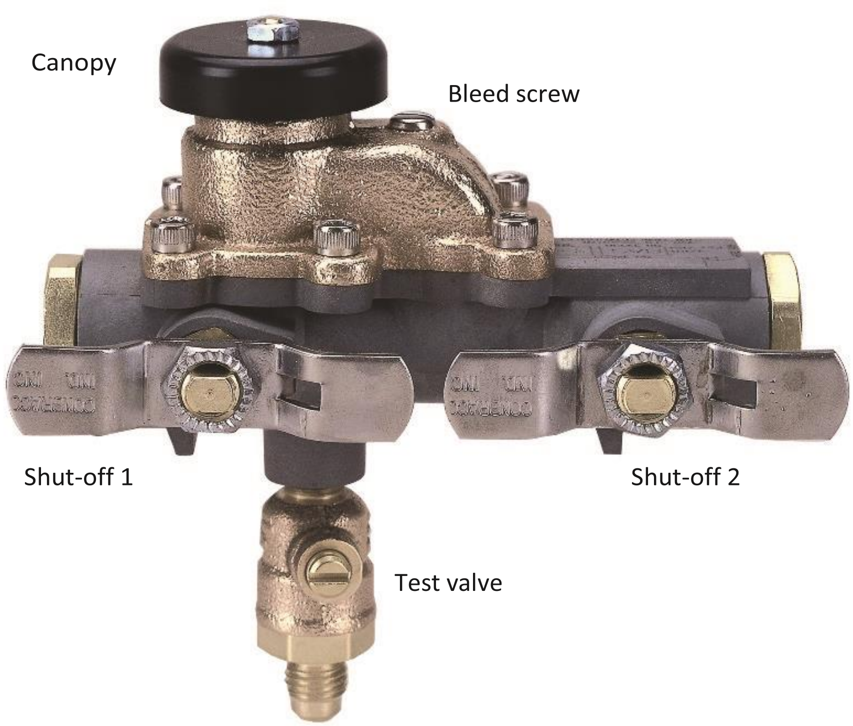


Figure 4-16—Spill-resistant pressure vacuum breaker (SRPVB)

SRPVB courtesy of Conbraco/Apollo valves, check for CSA approval.

Conbraco is now known as Apollo valves, they are one and the same.

Content

Figure 4-17 shows a SRPVB. It looks similar to a regular atmospheric vacuum breaker; however, this valve has only one test valve. The second test valve is replaced with a bleed screw. The test procedures are different than the standard PVB but the requirements of the test are very similar.

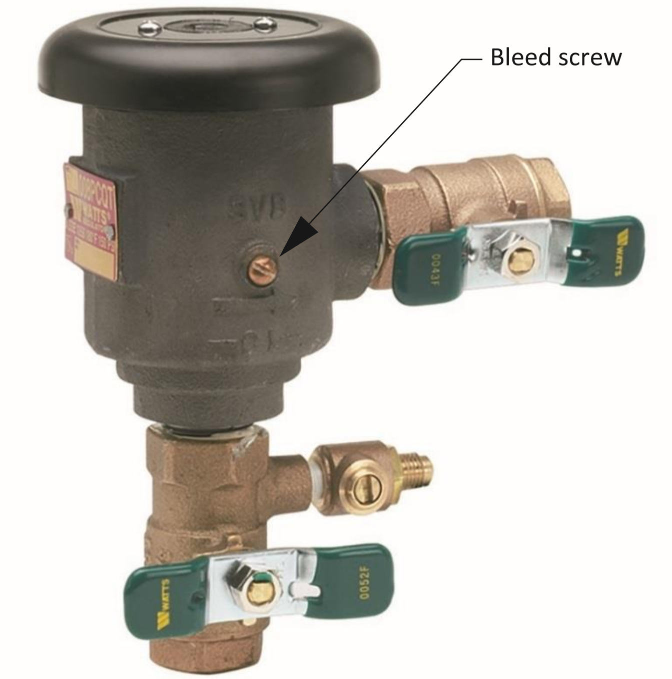


Figure 4-17— SRPVB with one test valve

Courtesy of Watts Canada. No. 008PCQT CSA and USC approved

Figure 4-18 shows a PVB. This unit is marketed as freeze resistant. It has a built in internal relief valve.

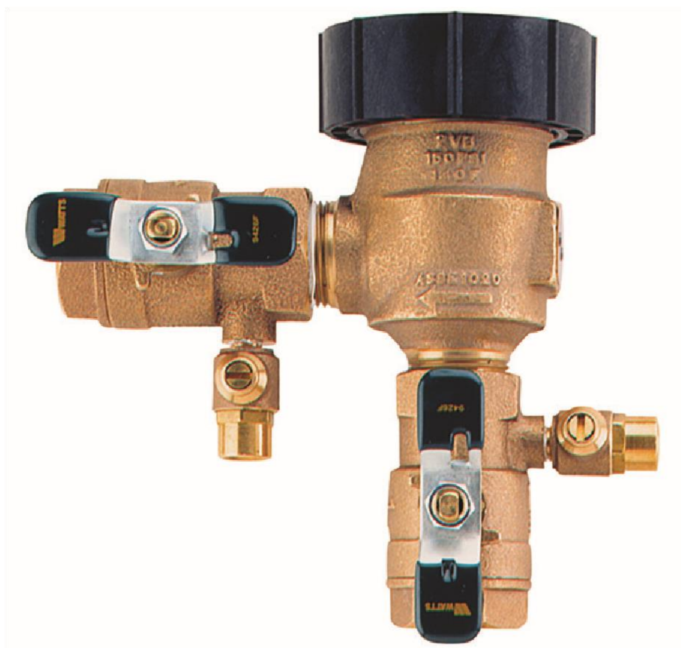


Figure 4-18—Freeze-resistant PVB

Courtesy of Watts Canada. No. 800M4FR PVB, CSA and USC approved.

Content

Identifying backflow prevention devices

Backflow prevention device is the name given to a group of backflow preventers that are not made to the same standards as backflow assemblies. Devices are normally used for minor hazard applications where the installation of a backflow assembly is not practical. Many devices are not inline testable and do not have test valves or shut-offs. Some manufacturers employ test valves and test procedures, but these procedures are not recognized officially. Exercise caution when using these devices. Ensure that the purveyor will accept the device and follow the manufacturers' recommendations.

Identifying an atmospheric vacuum breaker device (AVB)

Figure 4-19 shows examples of atmospheric vacuum breakers. An AVB is a mechanical backflow preventer that will only control back syphonage and normally minor health hazard cross connections. An AVB is a device that contains an air-inlet valve float check (poppet) and a check seat. At water pressures of zero or below, the float check drops open. This allows air to enter the device, preventing back-syphonage. Purveyors may allow an AVB as protection against a high health hazard; however additional protection may be required. An AVB does not have test valves or shut-off valves. Atmospheric vacuum breakers cannot be installed in a system where they will be subject to constant pressure. An AVB will spill water from the canopy so provision to prevent water damage will be needed.

Figure 4-19—Atmospheric vacuum breaker (AVB)

Courtesy of Watts Canada 188A anti-siphon vacuum breaker.

Content

Identifying dual check valve devices (DuC)

Figure 4-20 shows an example of a dual check valve. DuC is a backflow prevention device designed to prevent backpressure and back-syphonage for minor health hazards. They have been used on residential water services and plumbing fixtures such as shampoo basins or jetted soaker tubs with hand held showers.

They can also be used on a residential partial flow-through fire sprinkler system using potable rated piping. Check with the Authority Having Jurisdiction (AHJ).

The dual check has two independent acting soft-seated check valves loaded to the closed position.

Figure 4-20 shows an example of a DuC.

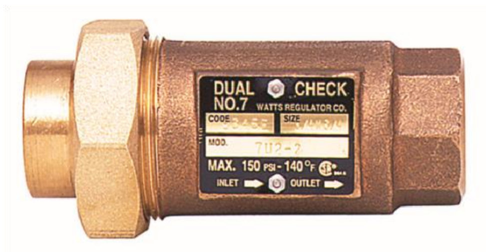


Figure 4-20—Dual check valve (DuC)

Courtesy Watts Canada No. 7 dual check.

Identifying dual check valves with atmospheric port (DCAP and DCAPC)

Dual check valves with atmospheric vent ports (DCAPs) are backflow prevention devices. They are designed to prevent backpressure and back-syphonage, and also work under continuous pressure for minor health hazards.

DCAPs have been used on residential heating systems with no chemical additives in the boiler water, Series 9D is specially made for smaller supply lines. Check with the AHJ first before installing this device; standards may conflict on the use of this device.

Figure 4-21 shows an example of a DCAP.

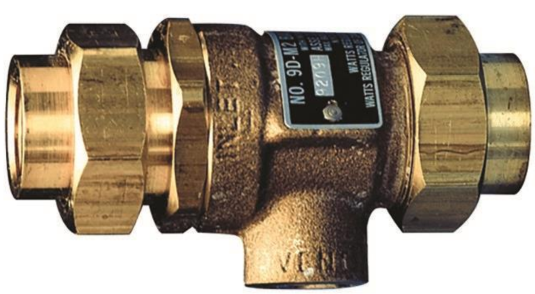


Figure 4-21—Dual check valve with atmospheric port (DCAP)

Courtesy of Watts Canada Watts 9D CSA approved.

Content

The DCAPC shown in Figure 4-22 is used as a backflow prevention device for beverage dispensing equipment water supplies. It is constructed of acetyl plastic body and nitrile/stainless components. Also shown is a plastic model of a DCAPC.

Never install these devices in-place of a backflow assembly.

Check with the AHJ first before installing these devices, standards may conflict on the use of these devices. Check for current CSA and ASSE approvals

Figure 4-22—DCAPC Plastic

Courtesy of Conbraco industries.

Figure 4-23—DCAPC Stainless
Courtesy of Watts Canada.

Identifying hose connection (bib) vacuum breakers (HCVB)

Hose connection vacuum breakers are backflow prevention devices specifically designed to be installed on hose-bib ends to prevent back syphonage backflow for minor health hazard applications. Where high health hazards exist, the HCVB must be backed up with an RP. Check with the AHJ before using this device for a high hazard.

The HCVB has a check valve loaded to the closed position and a vent port loaded to the open position. When back syphonage is present the check valve closes and the vent ports open. These devices have fasteners that will not allow the device to be easily removed. Some hose faucets come with built in vacuum breakers that if removed render the connection of a hose practically impossible.

HCVB devices shall be installed so that the atmospheric vents cannot be submerged in water.

Figure 4-24 shows an example of a HCVB

Figure 4-24—Hose connection vacuum breaker (HCVB)
Courtesy of Watts Canada 8B.

Content

Series 8B Hose Connection Vacuum Breakers permit the attachment of portable hoses to hose thread faucets and prevent the reverse flow of polluted water from entering into the potable water supply due to backsyphonage. It consists of a brass body construction (8B) or chrome finish (8BC), stainless steel working parts, a rubber diaphragm and disc, a draining stem, and a break-away set screw for tamper-resistant installations. Series 8B is ideal for inside and outside, health hazard installations requiring non-continuous pressure such as service sinks, swimming pools, photo developing tanks, laundry tubs, wash racks, dairy barns, marinas, and general outside gardening uses. Check with AHJ for local requirements

Figure 4-25—Series 8B Hose Connection Vacuum Breaker
Courtesy of Watts Canada NF8.

Series NF8 Hose Connection Vacuum Breakers are designed specifically for wall and yard hydrants to prevent the reverse flow of polluted water from entering into the potable water supply due to backsyphonage. It consists of brass body construction (NF8) or chrome finish (NF8C), stainless steel working parts, a rubber diaphragm and disc, and a draining stem. The NF8 permits manual draining for freezing conditions. Check with AHJ for local requirements.

HCVB will spit water premise owners should be aware of this.

Figure 4-26 shows a dual check hose connection dual check vacuum breaker HCDVB.

Figure 4-26—Dual check hose connection dual check vacuum breaker (HCDVB)
Courtesy of Watts Canada N9-CD.

This device is similar to the HCVB but it has a second check valve. Vented ports loaded to the open position are located between the check valves that are loaded in the closed position. In other words, if vent is open, the faucet is off, and when the vent is closed, the faucet is on. The check valves are closed when the faucet is off and open when the faucet is on. Dual Check Vacuum Breakers with Atmospheric Vent prevent back-syphonage backflow and low-head backpressure, 3m (10 ft. or less)

Content

Figure 4-27—Testable dual check vacuum breaker with atmospheric port
Courtesy of Watts Canada series N9-CD testable dual check with atmospheric port.

Field Testable Dual Check Vacuum Breakers with Atmospheric Vent prevent high-hazard backsyphonage backflow and low-head backpressure (10 ft. or less) from contaminating the potable water supply. It prevents backflow associated with hose connections when screwed directly to a sill cock, yard hydrant, or wall hydrant. It consists of a brass body construction with two independently operating rubber and stainless steel check valves, with an atmospheric vent located between them. Series N9-CD is in-line field testable, non-removable and designed for non-continuous pressure applications. It is ideal for installation in service sinks, chemical dispensers, sill cocks, and frost-proof hydrants.

Check with the authority having jurisdiction before installing.

Miscellaneous backflow prevention devices

Figure 4-28 shows an example of an AVB used for shower heads

Figure 4-28—AVB used for shower head
Courtesy of Watts Canada model S8.

Designed for use on tub and shower heads minor hazard back syphonage only Not for deck mounted applications, ASSE, UPC and IAPMO listed

Content

Dual check valve with hose connections

Dual Check Valve with Hose Connection prevent the reverse flow of polluted water from entering into the drinking water supply at individual outlets. It consists of a chrome-plated brass body construction, with two independently operating check valves, stainless steel springs, pressure plates, and brass (H7) or chrome-plated (H7C) hose connection. Series H7, H7C is designed for non-health hazard residential water system containment, continuous pressure applications, such as wash-down sinks with a hose-type device. Check with local inspection authorities for installation requirements. Suitable for close washer hose connections if required by the AHJ.

Not to be installed inside a wall or any concealed locations.

Check with the authority having jurisdiction before installing.

Figure 4.28 Dual Check with hose connections
Courtesy of watts Canada ¾ inch H7 or H7C dual check

In-Line Testable/Serviceable Dual Check Valve

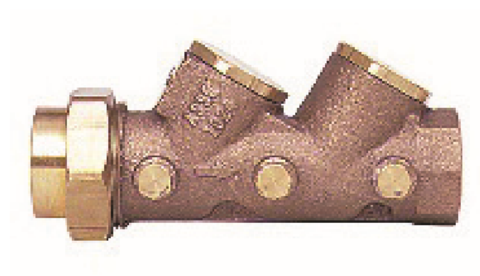


Figure 4-29—Series L7
Courtesy of Watts Canada

Series L7 In-Line Testable/Serviceable Dual Check Valves prevent the reverse flow of polluted water from entering into the drinking water supply at the service entrance or at individual outlets. It consists of a bronze body construction, with two plastic check valves with top-mounted covers, silicone discs, stainless steel springs, and three test ports for easy in-line service. Series L7 is designed for non-health hazard residential water system containment, continuous pressure applications and is installed immediately downstream of the residential water meter. Check with local inspection authorities for installation requirements. You must check for CSA approval.

Content

Identifying lab faucet dual check vacuum breaker devices (LFVB)

Lab faucet vacuum breakers are backflow prevention devices designed for installation on lab faucets to prevent back-syphonage backflow in minor health hazard applications.

When a health hazard exists, the LFVB must be backed up with an RP. Check with the AHJ before using this device for a high hazard.

Figure 4-30 shows a LFVB consisting of two mechanically independent, spring-loaded check valves and an atmospheric vent valve located between the checks. The loading of each check is accomplished by a stainless steel compression spring and is an integral part of the check assembly.

Not permitted under constant pressure or to be installed upstream of a shut off valve

Figure 4-30—NLF-9

Courtesy of Watts Canada dual check vacuum breaker for laboratory faucet.

Watts 3⁄8" (10mm) Model NLF-9/LFNLF-9 is recommended for laboratory faucets and is not suitable for continuous pressure applications. The Model N9/LFN9 series are recommended for either continuous or intermittent pressure type installations.

Dual Check Vacuum Breakers prevent the reverse flow of polluted water from entering into the potable water supply. The NLF-9 consists of a brass body construction with chrome plating, dual check valves, stainless steel working parts, and durable rubber diaphragm and discs. The NLF-9 is specifically designed for laboratory faucets where portable hoses can be attached.

Check with the authority having jurisdiction before installing.

Figure 4-31—Laboratory faucet without NFL-9 Installed

Courtesy of Zurn Wilkins.

[Content](#)

Shampoo basin backflow protection

Figure 4-32 shows a dual check valve, a Watts *3/8 inch 7(7C) or LF7* is especially recommended for shampoo sink or similar applications requiring 3⁄8" female connection for convenient attachment.

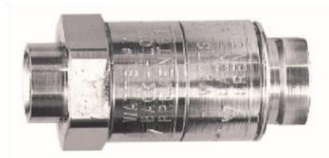


Figure 4-32—Watts 7C dual check
Courtesy of Watts Canada 7C dual check now listed as obsolete.

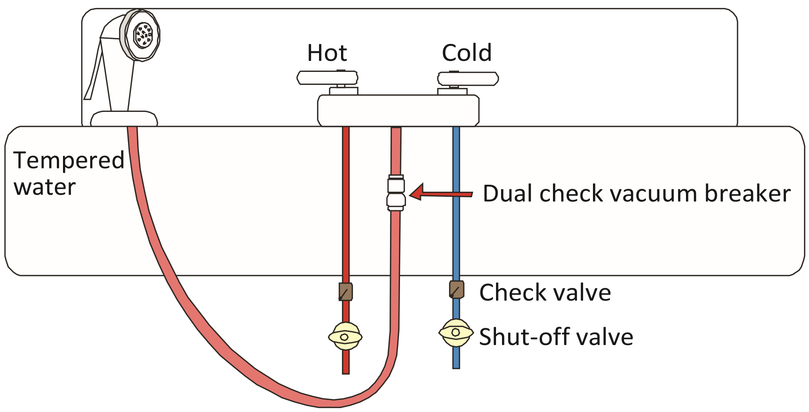


Figure 4-33—Parlor/shampoo sink

Note: Shampoo basins may require higher protection as directed by the AHJ.

Note: This figure represents a manufactures suggested use for this DuC Shampoo basins may require higher protection as directed by the AHJ.

Series 7C Dual Check Valves prevent the reverse flow of polluted water from entering into the drinking water supply at the service entrance or at individual outlets. It consists of a chrome plated brass body construction, with two independently operating check valves and stainless steel springs. Series 7C is designed for non-health hazard residential water system containment, continuous pressure applications, such as wash-down sinks with a hose-type device. Check with local inspection authorities for installation requirements.

Check with the authority having jurisdiction before installing.

Content

Air space vacuum breaker (ASVB)

Figure 4-34 and Figure 4-35 show the yellow air space vacuum breaker used on a detergent injector located on a janitor type sink. Many of these applications do not have the proper air-gap; therefore, it is important that unapproved injector connection be removed and replacement approved ASVB. You must check with the AHJ to determine the approve ASVB.

Figure 4-34—Air space vacuum breaker

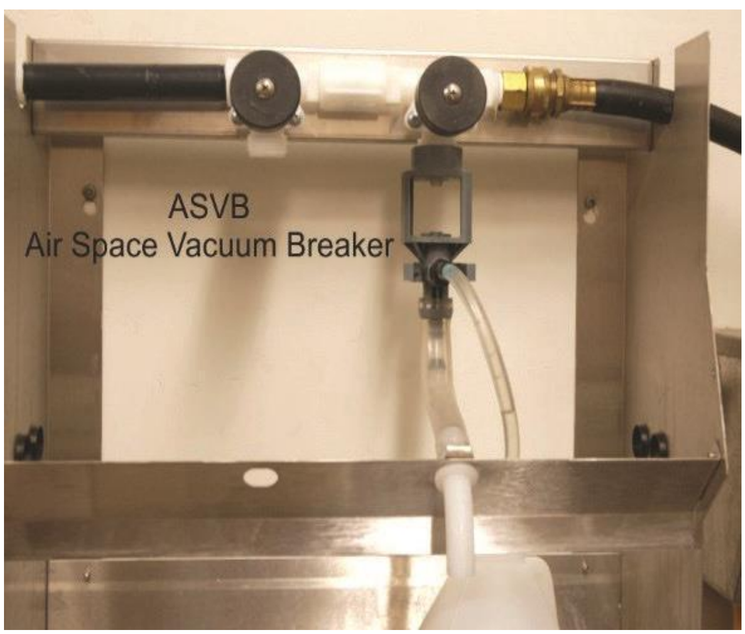


Figure 4-35—Air space vacuum breaker

☑ Now complete Self-Test 4 and check your answers.

Content

Self-Test 4

Review the section objectives and then answer the following.

Refer to Figure 1 to answer questions 1-3.

1. What is the type of backflow prevention shown in Figure 1?
   a. air break
   b. air gap
   c. inlet cross connection
   d. potential cross connection

2. What type of backflow could occur in Figure 1?
   a. Backpressure backflow
   b. Back-syphonage backflow
   c. Pressure backflow
   d. Internal backflow

3. What letter is the flood level rim of Figure 1?
   a. A
   b. B
   c. C
   d. D

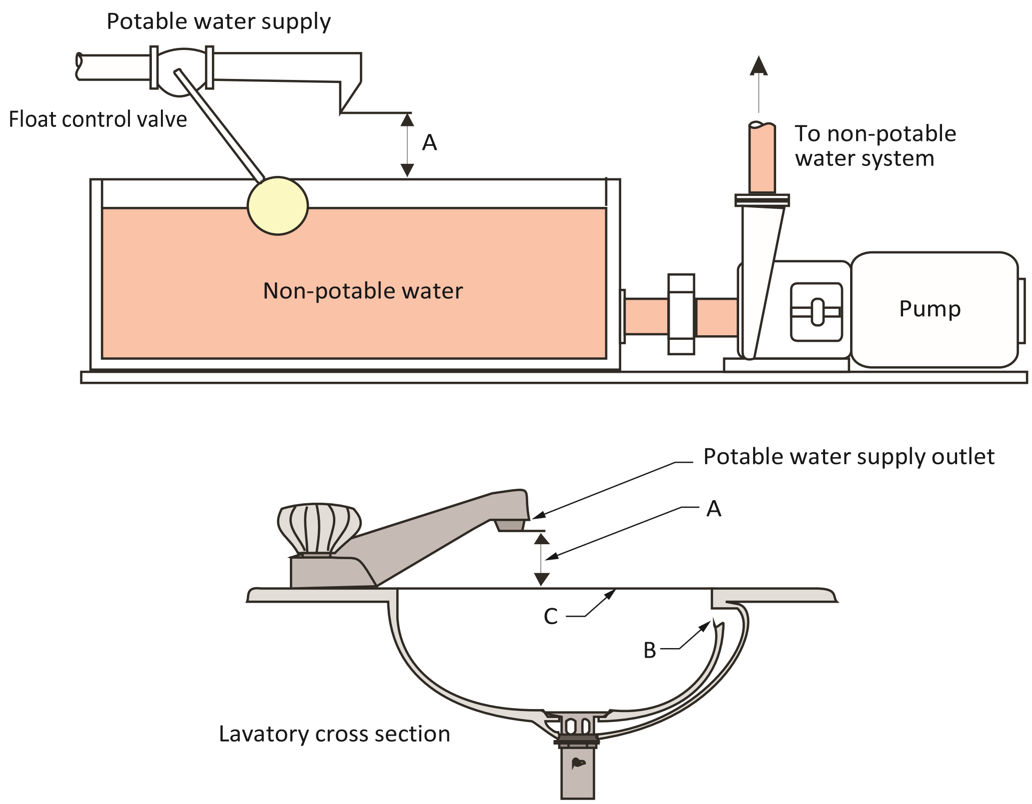


Figure 1

Content

Refer to Figure 2 to answer questions 4-6.

4. What is the type of backflow prevention shown in Figure 2?
    a. AG
    b. DCVA
    c. RP
    d. PVB

5. What type of backflow would the backflow preventer in Figure 2 stop?
    a. Backpressure backflow only
    b. Back-syphonage backflow only
    c. Pressure backflow
    d. Backpressure backflow and back-syphonage backflow

6. What maximum hazard would the backflow preventer in Figure 2 be suited for?
    a. Severe health hazard
    b. Non-health hazard
    c. minor health hazard
    d. Moderate health hazard

Figure 2 Courtesy of Watts Canada

Content

Refer to Figure 3 to answer questions 7-8.

7. What is the name given to the backflow preventer in Figure 3?
   a. AG
   b. DCVA
   c. RP
   d. PVB

8. What type of backflow would the backflow preventer in Figure 3 stop?
   a. Backpressure backflow only
   b. Back-syphonage backflow only
   c. Pressure backflow
   d. Backpressure backflow and back syphonage-backflow

Figure 3
Courtesy of Watts Canada

Content

Refer to Figure 4 to answer questions 9-10.

9. The type of backflow prevention in Figure 4 is called a(n):
   a. AVB
   b. DCVA
   c. RP
   d. PVB

10. What type of backflow would the backflow preventer in Figure 4 stop?
    a. Backpressure backflow only
    b. Back-syphonage backflow only
    c. Pressure backflow
    d. Backpressure backflow and back-syphonage backflow

Figure 4

Courtesy of Watts Canada

Content

Refer to Figure 5 to answer questions 11-12.

11. What is the name of the backflow preventer in Figure 5?
    a. AVB
    b. DCVA
    c. RP
    d. PVB

12. What type of backflow would the backflow preventer in Figure 5 stop?
    a. Backpressure backflow only
    b. Back-syphonage backflow only
    c. Pressure backflow
    d. Backpressure backflow and back-syphonage backflow

Figure 5

Courtesy of Watts Canada

Content

Refer to figures A to D to answer questions 13-16.

13. What is the name of the group of backflow preventers shown in figures A, B and C?
    a. backflow prevention devices
    b. backflow prevention assemblies
    c. check valve assemblies
    d. high hazard preventers
14. What is the name of the type of backflow preventers shown as figures A and B
    a. AVB
    b. DuC
    c. DCVA
    d. DCVP
15. What is the name of the backflow preventer shown in figure D?
    a. AVB
    b. DUC
    c. DCVA
    d. DCAPC
16. The backflow preventers shown in figures A to D may be used in-place of an approved backflow assembly.
    a. True
    b. False

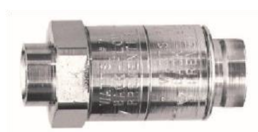


Figure A

Figure B

Figure C

Figure D

Content

Refer to Figure 6 to answer question 17.

17. What is the name of the backflow preventer in Figure 6?
    - a. AVB
    - b. DCV
    - c. LFVB
    - d. HCVB

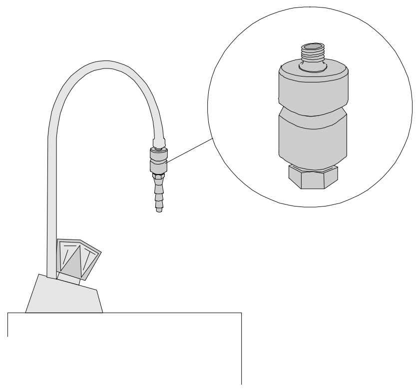


Figure 6

18. A DCAP backflow device shall be used for minor hazard only. (Orange manual section IV)
    - a. True
    - b. False

19. What is the minimum required relief valve discharge pressure of a RP?
    - a. 3.5 kPa (0.5 psid)
    - b. 6.9 kPa. (1 psid)
    - c. 13.8 kPa (2 psid)
    - d. 35 kPa (5 psid)

20. An air gap is a reliable solution for severe hazard because it cannot be easily by passed
    - a. True
    - b. False

21. What holds the relief valve of an RP closed?
    - a. spring pressure
    - b. air pressure
    - c. water pressure
    - d. water and spring pressure combined

Content

22. What minimum psid does the relief valve of an RP maintain across the first check and the zone of reduced pressure?

a. 0.5

b. 1

c. 2

d. 3

Check your appendix answer key

Have you accomplished your objectives of this Chapter 4? Review your Chapter 4 objectives.

If you feel you have accomplished the objectives of Chapter 4, you may wish to proceed to Chapter 5.

Content

Chapter 5 Identify/assess hazard designations of cross connections

Objectives

After completing this chapter of the course, you will be able to:

- Identify the classifications of health hazards in cross connections • List the factors considered when assessing a cross connection hazard.
- State and define the degrees (categories) of hazard.
- Identify the degree of hazard of common premises (for example hospitals, sewage plants).
- List the factors used to assess a cross connection, including risk and probability of occurrence.

Introduction

Before a backflow preventer can be selected and installed, a cross connection must be identified and assessed to determine the degree of hazard. A tester/installer would not normally be involved with assessing the degree of hazard of a cross connection. Usually the water purveyor would be more involved with assessment of a cross connection. The tester/installer have the best chance to identify a cross connection and identify the hazard, because they are directly involved with the piping system and components.

Classifications of Health hazards in cross connections

The health classifications as a result of cross connection contamination of the potable water system are as follows:

- Chemical hazards
- Chemicals such as cleaning agents and fertilizers can unexpectedly enter the potable water systems. Some examples where chemicals can get into the potable water system include:
- Garden aspirator sprayers for weed killer
- Irrigation system fertilizer injectors
- Detergent dispensers
- Plating plant metal cleaning/stripping tanks
- Water treatment chemicals

Physical hazards

An example of a physical hazard could be a physical injury caused by a substance such as steam, or a chemical that has found its way into a potable water system. Physical hazards include skin burns, eye damage, and if ingested internal damage.

Aesthetic hazard

An example of an aesthetic hazard would be the existence of substance in a water supply a pollutant that would not necessarily be harmful if consumed. The substance may be unpleasant by taste and smell, or could be visually unacceptable such as beverage contamination, organic matter or just dirty water.

Content

Communicable disease hazard

Contamination of a water supply from human feces can result in the spread of communicable diseases included in the following table.

The table is for reference only is not to be used for diagnosis of diseases or their source.

Identified Disease	Sources of Agent in Water Supply	General Symptoms
Amoebiasis	Sewage, non-treated drinking water	Abdominal discomfort, fatigue, weight loss, diarrhea, bloating, fever
Cryptosporidiosis	Collects on water filters and membranes that cannot be disinfected, animal manure, seasonal runoff of water.	Flu-like symptoms, watery diarrhea, loss of appetite, substantial loss of weight, bloating, increased gas, nausea
Cholera	Drinking water contaminated with the bacterium	In severe forms it is known to be one of the most rapidly fatal illnesses known
Cyclosporiasis	Sewage, non-treated drinking water	Cramps, nausea, vomiting, muscle aches, fever, fatigue
Giardiasis	Untreated water, poor disinfection, pipe breaks, leaks, groundwater contamination	Diarrhea, abdominal discomfort, bloating, and flatulence
Gastroenteritis	Manifests itself in improperly treated water	Symptoms include diarrhea, nausea, vomiting, fever, malaise, and abdominal pain
Microsporidiosis	Has been detected in groundwater, the origin of drinking water	Diarrhea and wasting in immune compromised individuals
Salmonellosis	Drinking water contaminated with the bacteria. I common as a food borne illness	Symptoms include diarrhea, fever, vomiting, and abdominal cramps
Dysentery	Water contaminated with the bacterium	Frequent passage of feces with blood and/or mucus and in some cases vomiting of blood
Poliomyelitis (Polio)	Enters water through the feces of infected individuals	90-95% of patients show no symptoms, 4-8% have minor symptoms, with delirium, headache, fever, and occasional seizures, and spastic paralysis, 1% have symptoms of non-paralytic aseptic meningitis. The rest have serious symptoms resulting in paralysis or death
SARS	Manifests itself in improperly treated water	Symptoms include fever, lethargy, gastrointestinal symptoms, cough, and sore throat
Typhoid fever	Ingestion of water contaminated with feces of an infected person	Characterized by sustained fever, profuse sweating, diarrhea
Legionnaires' disease Pontiac fever	Contaminated water: the organism thrives in warm aquatic environments.	Pontiac fever produces milder symptoms resembling acute influenza without pneumonia. Legionnaires' disease has severe symptoms such as fever, chills, pneumonia, muscle aches, occasionally diarrhea and vomiting

Table 5-1— Communicable diseases and water contamination sources

Content

Factors to consider when assessing a cross connection

- The degree of hazard
- Probability of occurrence of a cross connection will be created
- Reliability of the backflow preventer
- Assessment of the degree of risk

Degree of hazard explained

Degree of hazard is the term used to assign the health risk to an actual or potential cross connection. Assigning a degree of hazard can be difficult, especially if a substance is unknown. In a case such as this, the purveyor must assume that the hazard is high. In broad terms almost any substance other than potable water can be considered a health hazard of some degree.

Note: The higher the hazard (risk) to public health, the more stringent the backflow prevention must be.

The three degrees of hazard used by the *CSA B64-10/B64.10.1* standard are:

1. Severe hazard,
2. Moderate hazard
3. Minor hazard.

Other texts have used hazard level terms such as high hazard, moderate hazard and low hazard or health hazard, non-health hazard and severe health hazard. You may come across these other terms; however, the hazard is still the same.

Severe hazard

A severe hazard is a substance that could be introduced into a potable water system and cause a risk of death, spread of disease or illness or injury to the user of the water.

A severe hazard for; example, is pathogenic bacteria, lethal chemical and radioactive waste. A sewage treatment plant would also be an example of a severe or extreme risk health hazard.

Moderate hazard

A substance which has a low possibility of becoming a severe hazard would be a moderate hazard. The substance would be aesthetically objectionable.

Minor hazard

A minor hazard is a substance that would not cause an immediate health concern but could cause the water supply to deteriorate below acceptable drinking water standards and has a low probability of becoming a moderated hazard.

The terminology used to identify hazard level is not consistent. Depending on the program jurisdiction and the training program manual being used. Just for your information and not to be surprised when you see different words used for hazard levels, such as you read next.

High Hazard/Health Hazard

A high hazard is also defined as "contamination" and is an impairment of the quality of the potable water that creates an actual hazard to public health through poisoning or through the spread of disease by sewage, industrial fluids, chemicals, or wastewaters.

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Low Hazard/Non-Health Hazard

A low hazard is also defined as "pollution" and is an impairment of the quality of the potable water to a degree that does not create a significant hazard to the public health, but that does adversely and unreasonably affect the aesthetic quality of potable water for potable use.

Refer to Part 7 of the *BC Building/Plumbing Code*, your AHJ bylaws and *CSA B64-10/B64.10.1* current publication for detailed lists of premise hazard identification

Probability of occurrence

Probability is not an exacting term. It is used to describe a number of factors that contribute to the likelihood of a cross connection occurring in a premise. Probability factor is less important than a toxicity hazard when accessing the hazard.

Some of the probability factors are as follows:

- Probability of maintenance personnel changing or altering the piping system without the purveyor's knowledge.
- Probability that the complexity of the piping system on the premise will permit a cross connection go undetected.
- Probability that backflow preventers could be removed or bypassed.
- Probability that a potable substance in the premise water system (piping, tank or vat) could become a non-potable substance due to being changed, bacterial growth, deterioration, or reacting with the piping material.

The reliability of the backflow preventers

The reliability of a backflow preventer depends on the following factors:

- the standards to which the backflow preventer is designed
- the quality assurance to which the backflow preventer is manufactured
- the certification and testing prior to certification for use in the field
- proper installation and maintenance of the backflow preventers
- annual field testing of the backflow preventer
- Qualification of personnel field testing the backflow preventer

The higher quality backflow preventer is one that has been field-tested and certified by a recognized testing agency. This backflow preventer will provide reliable cross connection protection provided the backflow preventer can be field-tested on a regular basis. One such field testing agency is the University of California Foundation for Cross Connection and Hydraulic Research (USC FCCHR)

Backflow prevention devices may not be as reliable; however, backflow devices may provide enough protection to reduce the purveyors risk to an acceptable level. Check with the water purveyor or AHJ before installing a backflow prevention device.

Content

Assessment of risk

Installing an RP on every water service and fixture would probably reduce the risk factor to near zero. A zero risk would be ideal; however, risk assessment is not that simple. One must balance hazard risk against probability, reliability, practicality and cost factors. Ordinarily it is not the tester or the installer who must assess the risk of premise. It is the regulatory authority or water purveyor who will likely make the assessment of risk

In the assessment of risk, the purveyor will be responsible for the correct assessment. Careful consideration is needed. The goal is to avoid over assessing a hazard at a higher cost and under assessing hazard at risk of public safety. Balanced judgment is encouraged.

When assessing a hazard, the use of a published list of premises hazards has historically provided a guide for assessment. Such a list is provided by CSA B64 10. Where a hazard has not been identified on a published list then the purveyor could require the premise owner to provide proof positive as to the risk of a particular premise/substance. Where all factors have been considered and no evidence is available to assign a degree of risk, the purveyor should default to the highest risk factor.

At best, risk assessment is tricky and requires judgment and vast experience in cross connection control. A water purveyor may accept a method of cross connection protection that balances all the considerations of the risk assessment.

The water purveyor will assign a degree of hazard and determine the type of backflow protection for a premise thereby reducing the risk of cross connection to an acceptable level. The water purveyor accepts the risk and the responsibility for delivering potable water.

There are other assessment factors that are somewhat intangible these factors include:

- The numbers of and quality of trained maintenance personnel may increase a purveyor’s hazard risk assessment of a premise.
- Access to premises could be restricted. In these cases, the water purveyor has no way of knowing what is going on in the premise, the premise may be a high risk. An example of a restricted assess premise is a military base.
- Complexity of piping systems makes it harder to detect cross connections in the premise thereby increasing the assessment hazard
- The attitude of the premise owner or personnel could be negative or uncooperative. In these cases, the water purveyor will take appropriate measures to insure the public water system remains safe. The premise may be assigned a high risk category and be isolated with a backflow preventer.

Any of the above factors alone or in combination has an effect on the hazard risk assessment.

Further reducing the overall risk to the water distribution system can be accomplished by establishing a cross connection control program. Within that program the licensing of qualified trades personal will reduce the risk assessment of the entire distribution system. Canadian tradespersons, such as Plumbers, Sprinkler Fitters are trained and certified to work specifically on the various piping systems where cross connection can originate. The experience they have in installing, maintaining, repairing these systems including the testing of backflow preventers will reduce the risk to the purveyor’s system.

Content

Now complete Self-Test 5 and check your answers.

Self-Test 5

Review the section objectives and then answer the following.

1. In broad terms almost any substance other than potable water can be considered a health hazard of some degree.

   a. True

   b. False

2. A severe hazard is a substance that could be introduced into a potable water system and cause a risk of death, spread of disease or illness or injury to the user of the water.

   a. True

   b. False

3. A minor health hazard is a substance that would cause an immediate health concern and could cause the water supply to deteriorate below acceptable drinking water standards.

   a. True

   b. False

4. When assessing a premise hazard, on site surveys need not be carried out on each individual premise to determine the premise hazard.

   a. True

   b. False

5. When a substance hazard is unknown the hazard level is assumed to be high.

   a. True

   b. False

6. The probability of maintenance personnel changing or altering the piping system without the purveyor's knowledge is a factor to consider when determining a premise hazard.

   a. True

   b. False

7. The probability that the complexity of the piping system on the premise will permit a cross connection to go undetected is not a factor to consider when determining a premise hazard

   a. True

   b. False

Content

8. The probability that a substance in the premise water system (piping, tank or vat) could become a non-potable substance due to being changed through bacterial growth, deterioration, or reacting with the piping material is not factor to consider when determining a premise hazard.
   a. True
   b. False

9. Restricted access to a premise is a factor to consider when assessing a premise hazard.
   a. True
   b. False

10. The reliability of a backflow preventer is dependent on a number of factors including, annual testing, and certification of field testers, proper installation and maintenance, standards of design, quality assurance and certification before approval for use.
   a. True
   b. False

11. A risk of a premise does not normally increase with the degree of hazard.
   a. True
   b. False

12. Probability is a higher concern than toxicity when assessing hazard.
   a. True
   b. False

13. A substance which has a low possibility of becoming a severe hazard would be a moderate hazard. The substance would be aesthetically objectionable.
   a. True
   b. False

14. Which one of the following is a communicable water borne disease hazard?
   a. algae
   b. jaundice
   c. abdominal cramps
   d. cryptosporidiosis

Content

15. What is an example of a chemical hazard?
    a. algae
    b. gasoline
    c. shigellosis
    d. fertilizer injector
16. What is an example of an aesthetic hazard?
    a. bacillary
    b. amoebiasis
    c. shigellosis
    d. dirty or muddy water
17. What is an example of a physical hazard?
    a. Steam
    b. Algae
    c. Shigellosis
    d. Dysentery

Check your appendix answer key

Have you accomplished your objectives of this Chapter 5? Review your Chapter 5 objectives.

If you feel you have accomplished the objectives of Chapter 5, you may wish to proceed to Chapter 6.

Content

Chapter 6 Selecting and installing backflow preventers for specific cross connections

Objectives

After completing this chapter of the course, you will be able to:

- Identify apply the methods of application of backflow preventers.
- Explain and apply the process used to select and install a backflow preventer.
- Determine an RP relief valve discharge rate and size drainage.
- Identify and apply basic installation safety issues.
- Identify and apply additional installation considerations.
- Identify and apply the methods of freeze protection of backflow preventers.
- Identify and apply the installation requirements for each backflow preventer.
- Identify and apply the correct backflow assembly for specific cross connections.
- Identify and apply the correct backflow device for specific cross connections.

Introduction

Previous chapters in this manual have explained that backflow preventers have been designed specifically to stop backflow due to back-syphonage and others have been designed to prevent both back-pressure and back-syphonage backflow. Certain backflow preventers have been certified to protect against severe health hazards while others have been relegated to protect against moderate and minor health hazards. The backflow preventer installed must provide protection equal to the degree of risk and hazard of the premise. For example, a severe hazard and risk premise like a sewage treatment facility would require the highest degree of protection such as an air gap, as well as a reduced pressure backflow assembly.

In this Chapter you will find illustrated examples of cross connections and their recommended backflow preventers including the typical installation requirements. The examples shown generally coincide with published lists found in *CAN/CSA-B64.10, or Part 7 of the BC/Canadian Building/Plumbing Code*. There are some examples included that may have not been addressed in these publications. In cases such as this research of local bylaws and regulation in North America has been used.

Note: The process of selecting and installing backflow assemblies is generally the same; however, some differences do occur and opinions vary. In every case you should consult with the AHJ before selecting and installing a backflow preventer.

Content

Short background history information

The first cross connection and testing requirements in BC and perhaps Canada where introduced in the 1970's. The water purveyor introduced the American Water and Waste Association cross connection program requirements and test procedures. Over time AWWA programs were expanded and mandatory certification and recertification of tester was introduced in water bylaws. In the beginning the Plumbing Codes were almost silent on cross connection other than air gaps air breaks and atmospheric vacuum breakers.

Today the BC/Canadian Plumbing Code is the primary regulatory authority and is no longer silent on cross connection installation and testing of backflow preventers at the time of construction, extension, alteration, renewal or repair of plumbing systems in buildings and structures regulated by the Code.

The following requirements are part of the BC/Canadian Plumbing Code.

Division B Part 2 2.6.2 Protection from contamination

2.6.2.1 Connection of systems

(1) Except as provided in sentence (2) connections to potable water systems shall be designed and installed so that non-potable water or substances that may render the water non-potable cannot enter the system.

(2) A water treatment device or apparatus shall not be installed unless it can be demonstrated that the device or apparatus will not be introduced into the system that may endanger health.

(3) Backflow preventers shall be selected and installed, in conformance with CAN/CSA B64.10

CSA B64 10 installation of backflow preventers general application

CSA B64 10 Clause 6.1.5 Field testing at installation

The following backflow preventers and vacuum breakers shall be field tested in accordance with CSA B64.10.1 at the time of initial installation:

a. PVB devices;
b. SRPVB devices;
c. DCVA and DCVAF backflow preventers;
d. RP and RPF backflow preventers; and
e. SCVAF backflow preventers.

CAN/CSA B64. 10-clause 6.1.5 requires that backflow preventers be field tested at installation in accordance with CSA B64.10.1 at the time of installation.

Content

Refer to your copy of the BC/Canadian Plumbing Code and read the following section and appendices as referenced in the Code. You should already be familiar with this code as it was used in level 1 and 2 of your apprenticeship training.

Division B part 2 6.2.1 Protection from Contamination

Division B part section2.7. Non-Potable Water Systems

Division B Appendix A. 2.7.3.2(1) Outlets from Non-Potable Water Systems

Division B Appendix A. 2.7.4.1 Non-Potable Water System Design

Division B Appendix A 2.6 2, (3) Backflow preventers

Division B Appendix A 2.6 2. 4. (2) backflow from Fire Protection Systems

Division B Appendix A 2.6 2. 6.(1) Locations Requiring Premise Isolation

Division B Appendix A 2.6 2. 9. (2) Installation of Air Gaps

Division B Appendix A 2.6 2.10. (2) Installation of Atmospheric Vacuum Breakers.

Content

Identify and apply the methods of application of backflow preventers.

There are typically two methods of application of cross connection control:

1. Premise isolation
2. In-plant/internal isolation includes
    - Fixture isolation
    - Zone isolation
    - Area isolation

Premise isolation

Premise isolation is the installation of a backflow preventer on the water service immediately downstream of the water meter. If a water meter is not present, then place the backflow preventer immediately inside the property line or at a convenient location on the water service pipe. There must be no connections to the water service pipe upstream of the backflow preventer on the premise. Premise isolation method of application separates the customer's water system from the purveyor's supply. This method protects the purveyor's supply but does not protect the premise occupant from contamination inside the premise. Certain premises with a high health hazard require mandatory premise isolation. Refer to Table 6-1 for a partial list of such premises.

Note: Refer to CAN/CSA-B64.10-current publication for detailed application of backflow preventers. These tables are for use in this course only. Consult with the AHJ for the appropriate standard used to select premise isolation.

This table is constructed from information found in the CSA standard.

Mandatory RP Premise Isolation Examples	Degree of Hazard	Minimum Premise Isolation
Sewage treatment plants or sewage pump stations	Severe	RP and AG
Hospitals, medical/dental centers/mortuary	Severe	RP
Metal/chemical plating plants	Severe	RP
Food/beverage processing plants	Severe	RP
Piers and docks, marinas and dry docks	Severe	RP
Car washes	Severe	RP
Petroleum processing	Severe	RP
Commercial laundries	Severe	RP
Trackside facilities for trains	Severe	RP
Radioactive material processing	Severe	RP
Shopping centers	Moderate	DC
Fire sprinkler system no chemical additives	Moderate	DC
Fire sprinkler system with chemical additives	Severe	RP

Tall building over 9.4 m (30 ft.), booster pumps and elevated water storage may increase hazard levels.	Moderate	DCVA
Chemical storage facility	Severe	RP
Mandatory RP Premise Isolation Examples	Degree of Hazard	Minimum Premise Isolation
Commercial laundry	Severe	RP
Steam generation plants	Severe	RP
Restricted access premise	Severe	RP

Table 6-1— Premise isolation, hazard level and protection required

Note: When determining a premise hazard an individual assessment must be carried out. Table 6-1 alone is not sufficient to determine the hazard. Consult CSA standard Table 2 for premise isolation.

In-plant isolation

In-plant or internal isolation is the installation of backflow preventers within the premise. Protection inside the premise can be accomplished in several ways, including:

- Fixture isolation
- Zone isolation
- Area isolation

Zone and area isolation

Zone protection and area protection are often confused as to what they mean. Figure 6-1 should help define these two terms. Basically zone and area protection are trying to accomplish the same thing, that being to protect a section of a premise such as a laboratory with one backflow preventer rather than several. Zone or area isolation is better suited, but not limited to severe and moderate hazards.

The advantages of using one backflow preventer to protect several pieces of equipment are:

There may be a cost saving, especially when severe hazards and moderate hazards are involved. Only one testable backflow preventer needs to install and maintain.

There are some differences that arise when applying zone or area isolation. The differences are as follows:

Zone isolation refers to a location where fixtures to be isolated that are for non-potable use only. Piping and connected equipment downstream of the backflow preventer must have warning labels. Fixtures and equipment within the zone isolation do not require individual fixture protection.

Area isolation refers to a location where fixtures and equipment are used for both potable and non-potable use. Fixtures and equipment within the area isolation require individual fixture protection.

Content

Figure 6-1 shows the application of Zone and Area isolation.

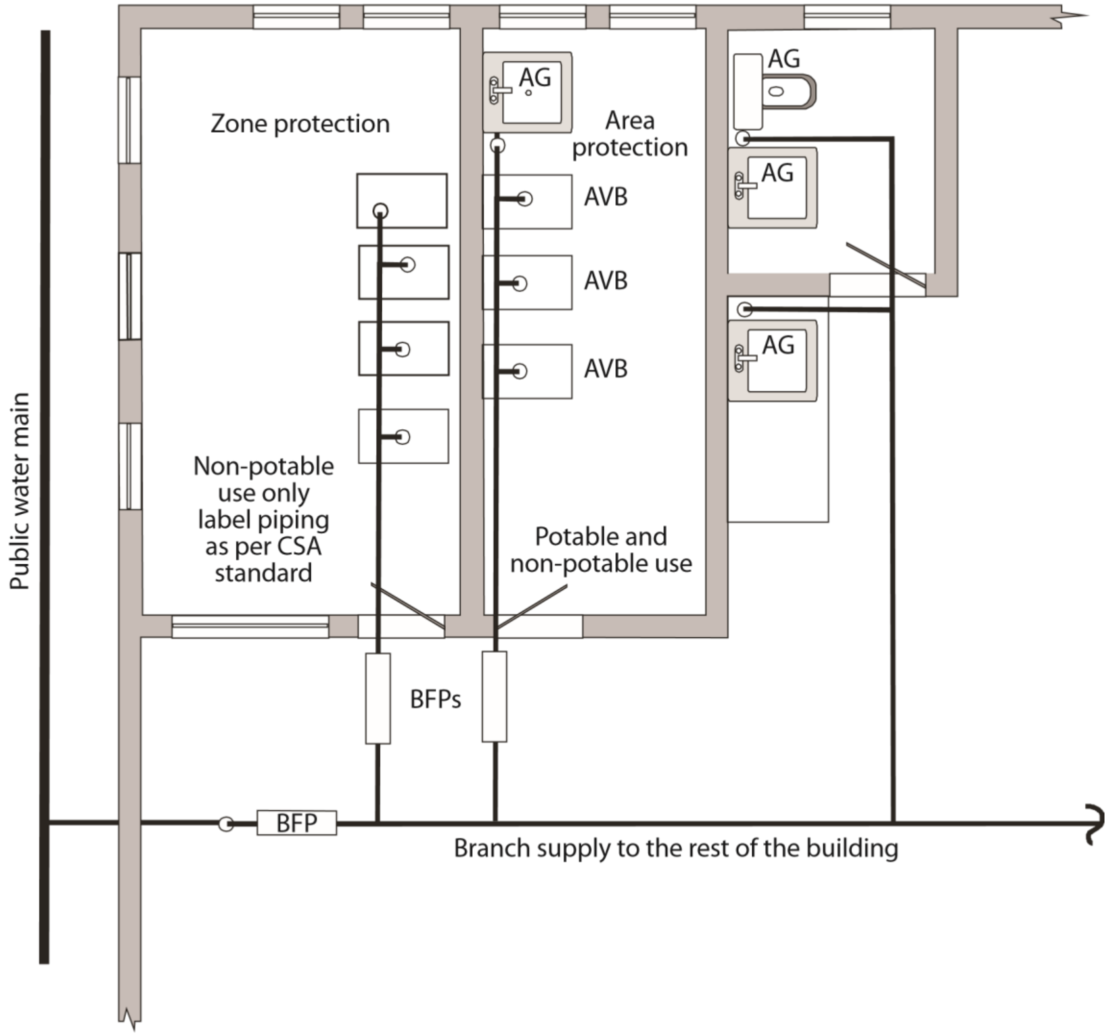

Figure 6-1—Zone and Area Isolation

Note: You should consider carefully zone and area isolation before applying this practice. Consult with the AHJ before you start. You should consider those people who may be working within the lab and the possibility of contamination of the water they may consume from a fixture within the zone.

Content

Fixture isolation

Fixture isolation is the installation of backflow preventers at the plumbing fixture or equipment within the premise. This type of protection will protect the building occupants, but may not provide full protection of the purveyor's supply. Refer to Table 6-2 for a partial list of fixture isolation examples.

Table 6-2 Fixture hazard level and protection required

Fixture isolation examples	Degree of hazard	Minimum fixture protection	Additional in plant or premise isolation
Bidets	Moderate/severe	AVB	
Hose-bib residential	Minor/moderate	AVB/HCVB	
Hose-bib industrial See note 1	Severe	AVB/HCVB	RPBA/DCVA
Ice makers	Severe	AG/RPBA	
Steam generator	Moderate	DCVA	
Vending machine	Moderate	DCAPC	
Ornamental Fountains	Moderate	DCVA/AVB/PVB	
Fire sprinkler system without additives	Moderate	DCVA	
Fire sprinkler system with additives	Severe	RPBA	
Trap primer	Severe	AG	
Lawn irrigation with chemical addition See note 2	Severe	RPBA	
Lawn irrigation with no chemical addition See note 2	Moderate	DCVA/AVB/PVB	
Domestic hot water heating boilers	Minor	DCAP	
Degreasing equipment	CSA severe	RPBA(CSA)	
Shampoo basin	Minor	AVB	
Flexible shower heads	Minor	AVB	
Gray water reuse systems, refer to local regulations	Severe	RP	
Storm water reuse systems, refer to local regulations	Severe	RP	
Water softener drain	Severe	RP	
Water softener supply	AHJ	Minor	
Swimming pools	Moderate	DCVA/AG	

Table 6-2—This table is compiled from information found in the CSA standard.

1. If a hose bib is located where it may be subject to a high hazard cross connection additional zone or premise backflow protection may be required.
   Currently there is some debate in areas of North America on the hazard of irrigation systems; there is an opinion that irrigation systems should be a high hazard. In some locations the use of a DCVA is not acceptable. A DCVA is permitted for moderate and minor hazards. Content

Residential properties and individual residents

Single family dwellings and duplex are typically assigned a minor hazard; however, these premises can contain all levels of hazard from sever to minor. Typically, in new construction cross connection issues are picked up by building inspection officials and then appropriate backflow protection is installed. After initial construction these properties are difficult to track.

Table 6-3 Residential hazard

Residential point of use hazards and appropriate back flow protection required:

Fixture or appliance	Back flow protection required
Regular bath tub with or without shower	AG
Soaker tub/jetted tub	AG
Shower not telephone extension	AG
Shower or bath with telephone shower	AVB
Lavatory	AG
Water closet tank	AG/Built in AVB at float valve
Bidet	AVB
Kitchen sink	AG
Laundry sink	AG /HCVB with hose bib end spout
Dishwasher water connection no detergent injectors	Internal AG
Dish washer with detergent injection	RP or as directed by AHJ
Dish washer Drain	AG/AB or as directed by AHJ
Clothes washer	Built in AG
Water softener t water supply	DUC or DCAP as directed by AHJ
Water softener back wash drain	AG/ Air Break AB
Water filters when not maintained promote bacteria growth refer to page	RP or as directed by AHJ
Exterior hose faucets	HCVB or as directed by AHJ assessment
Irrigation systems above or below ground	DCVA
Heating boilers no chemicals	DCAP
Heating Boiler with chemical present or future	RP
Swimming Pools with makeup water connection	AG/ DCVA
Solar heating systems with connection or potential to connect	RP or DWP or as directed by AHJ
Unauthorized illegal activities, hydroponics/chemical mixing etc.	AG /RP or as directed by AHJ

Note: Solar systems will need to be assessed and approved by the AHJ.

Content

Explain and apply the process used to select and install a backflow preventer

Prior to actually selecting the backflow preventer the cross connection must be identified and assessed to determine the degree of hazard and risk.

Identify and assess hazard designations and review the following items:

1. Determine the degree of hazard, severe health hazard, moderate and minor health hazard.
2. Determine the acceptable risk.
3. Determine the probability of occurrence.

The process of selecting a backflow preventer requires the following steps:

1. Identify and assess the cross connection.
2. Determine the type of backflow either backpressure or back-syphonage.
3. Determine installation requirements, Plumbing Code, CSA B4 10, bylaw, and manufactures requirements.
4. Select and install the backflow preventer.

The process of installing a backflow preventer should be considered the following items:

- Will the backflow preventer be subject to continuous pressure?
- Will the backflow preventer be above ground or below ground?
- Will the backflow preventer be subject to hot or cold water use? Where water temperatures will exceed the manufacturers specifications, typically 43ºC (110ºF), a backflow preventer rated for the higher temperature must be installed.
- Will the backflow preventer be subject to mechanical abuse such as freezing, physical damage, water hammer or theft? Protect the backflow preventer from freezing, theft and physical damage. Install water hammer arrestors upstream to prevent damage from excessive water hammer. Installed insulation shall not prevent proper valve operation, access for testing and maintenance.
- Will the backflow preventer provide the required flow and pressure? Size all backflow preventers according to the manufacturer’s directions using the hydraulic load of the water system.
- What are the minimum installation dimensions and clearances required for maintenance and testing?
- Will debris in the water cause fouling of the assembly? Provide a strainer on the inlet to the assembly to prevent valve failure if debris in the water is suspected. Avoid installation of strainers on fire systems.
- Will safety concerns be addressed, including confined space and elevated platforms?
- What are the applicable codes and standards applied within the jurisdiction of the installation?
- Is there a need for thermal expansion provisions?

The backflow preventer shall not interfere with the operation of thermal expansion precautions and safety devices such as diaphragm expansion tanks or thermal expansion valves (TER) as per CSA standards.

Will the backflow preventer require provisions for drainage from relief ports and is the capacity of drainage piping the correct size to handle the expected discharge?

Content

Determine a RP relief valve discharge rate and size drainage.

The table charts shown here are examples of the flow rate for 2 Watts backflow preventers. Go to the Watts web site to download and print the full table for their backflow assemblies.

Note: These curves represent catastrophic or worst case discharge rates. These curves were developed by pressurizing the outlet of the backflow preventer with the second check valve's internals removed from the body

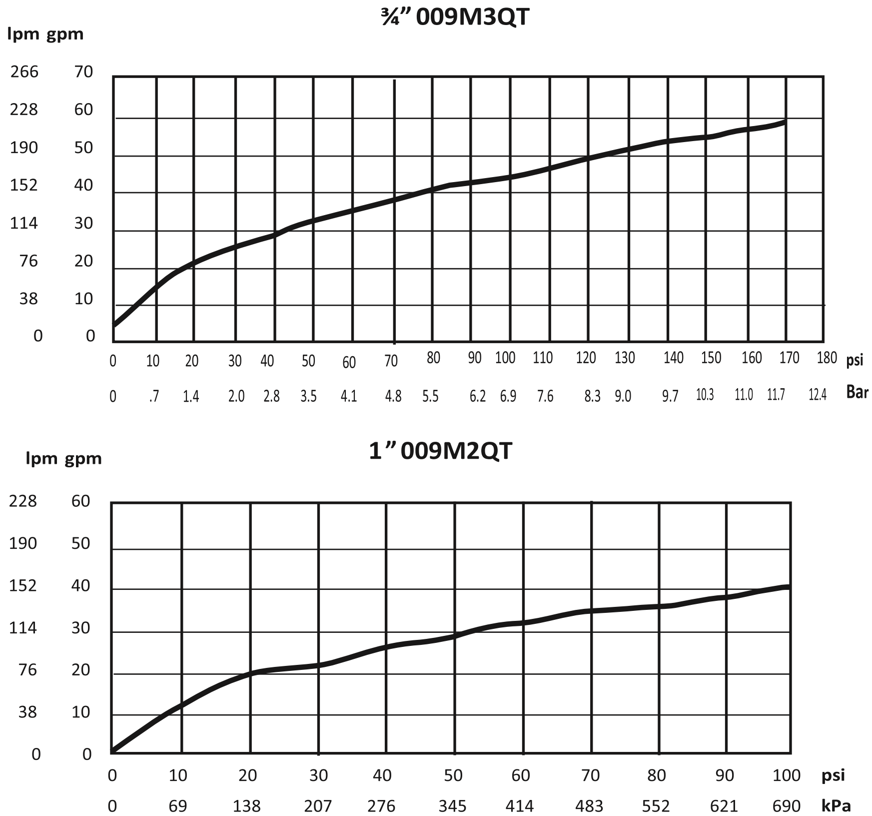

Figure 6-2—Flow rates for two backflow preventers

Using the charts determine the drain size for each assembly.

Typical Flow Rates as Sized by Floor Drain Manufacturers (Courtesy Watts Canada)		Drain size
GPM	LPM	
55	209	2
112	426	3
170	646	4
350	1330	5

Table 6-3— Flow rates by drain sizes

Consult the plumbing authority having jurisdiction to confirm the correct drain size.

Content

Who is NOT responsible for damages as a result of flooding?

Here is an example of wording from a manufacturer's specification submittal sheet regarding drainage (courtesy of Zurn-Wilkins).

Reduced Pressure Principle Backflow Preventers can and will discharge water. For indoor installations, pit or vault installations or protective enclosures, a drain needs to be provided that can handle the amount of water discharged. The chart on the previous page shows the maximum amount of water that can be discharged from the device based on the line pressure where it is installed. Rarely will a device discharge this amount of water, but if it does happen, it can cause flooding, building damage or a cross-connection that can contaminate the water supply. Therefore, a drain MUST be sized properly. WILKINS shall not be responsible for damage caused by the lack of a drain or an undersized drain.

Identify and apply basic installation safety issues

Electrical hazards

Piping systems can be an undetected path for stray electrical currents or static charges. A worker can be seriously injured when that stray current comes in contact with the worker's body. Removing a backflow assembly from a piping system could result in a fatal electrical shock to the worker. It is recommended that a worker attach a temporary jumper cable to ground the piping before removing the backflow preventer. While working on the backflow preventer do not allow water to come in contact with electrical equipment.

Confined space

Confined space can simply be an open excavation 1.2m or more in depth. Before accessing backflow preventers in confined spaces, become familiar with the confined space entry procedures. Refer to the workers' safety regulations for detailed information about confined space entry.

General safety

This course does not provide information on detailed safety procedures; however, it is important that you apply approved safe work practices at all times. When there is a danger of injury you are responsible to ensure appropriate personal safety equipment is worn and all safety procedures are followed. You should be familiar with the workers' safety regulations and specific manufacturer's safety instructions.

During installation, testing, maintenance and repair, the following partial list of safety considerations is provided:

- Lift, carry and support backflow assemblies correctly.
- Use caution when loosening check valve covers. Heavy spring tensions may be present. Manufacturers may provide spring tension retaining tools or long threaded rods or bolts to slowly remove the covers.
- Water and debris discharging from test valves may cause eye injury. Wear safety glasses.
- Confined spaces may contain deadly gases or be lacking oxygen.
- Follow the manufacturer's instructions and use the appropriate tools for the job.

Content

Stray electrical currents

Static electricity and stray electrical currents can kill. Use jumper cables to establish a ground for the piping when removing assemblies from existing installations where a possibility of electrical shock is present.

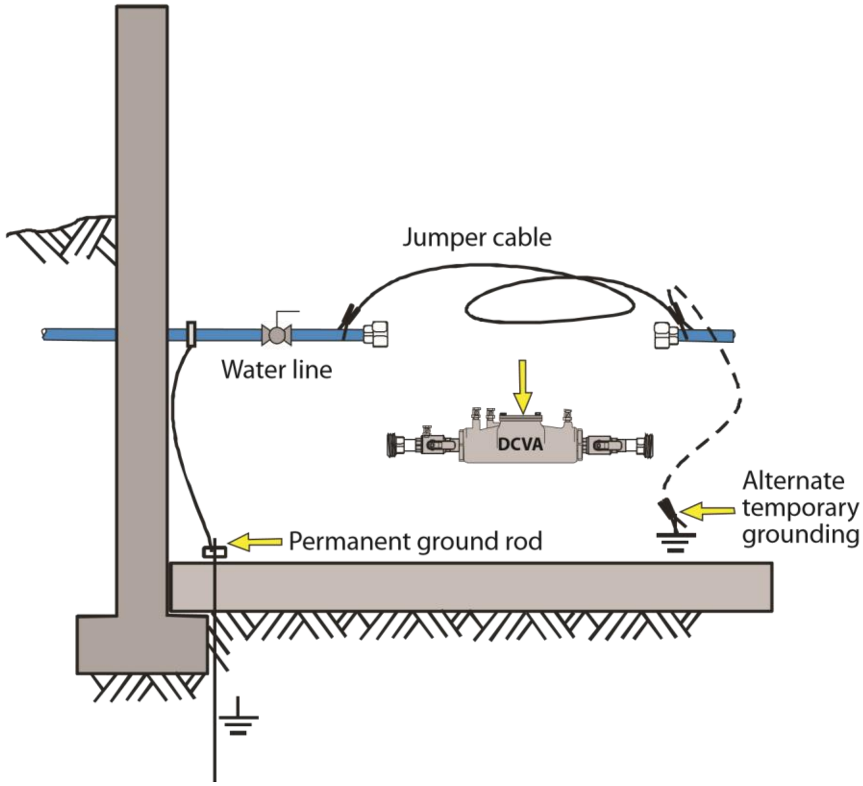

Figure 6-3—Jumper cables establish a ground when removing assemblies

Content

Above ground height limitations for backflow preventers

Backflow preventers should not normally be installed at heights that would inhibit the safe testing, maintenance and repair of the backflow preventer. CCC standards often limit the installation height to 1500mm above ground or floor level. A backflow preventer installed above this height limit would require an accessible work platform to be installed. Using a ladder to work from is not an acceptable practice.

Figure 6-4 shows an example of acceptable and unacceptable access to backflow preventers. Installing the water main at an acceptable height or building an approved work platform are acceptable practices.

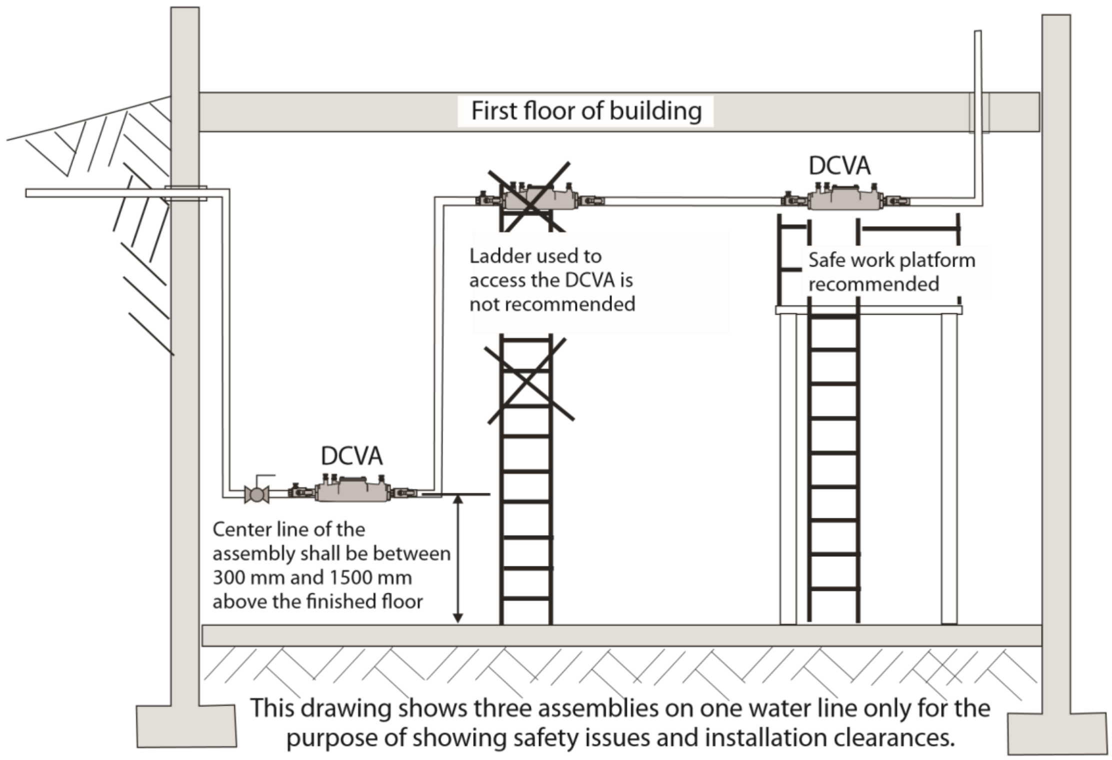

Figure 6-4—Acceptable and unacceptable access to backflow preventers

Content

Thermal Expansion

Thermal expansion is caused by the heating of a substance; for example, water. When water is heated the volume of the water expands. Heating a closed container of water will not allow the water to expand. The pressure of the water inside the container rises. At some point in time the pressure may be high enough to cause the container to rupture or a safety relief valve to discharge. A hot water storage heater is a container found in just about every habitable premise they must be equipped with temperature and pressure safety valves. Backflow preventers must not interfere with the operation of these valves. (CSA)

Figure 6-5 illustrates the difference between a closed system and an open piping system.

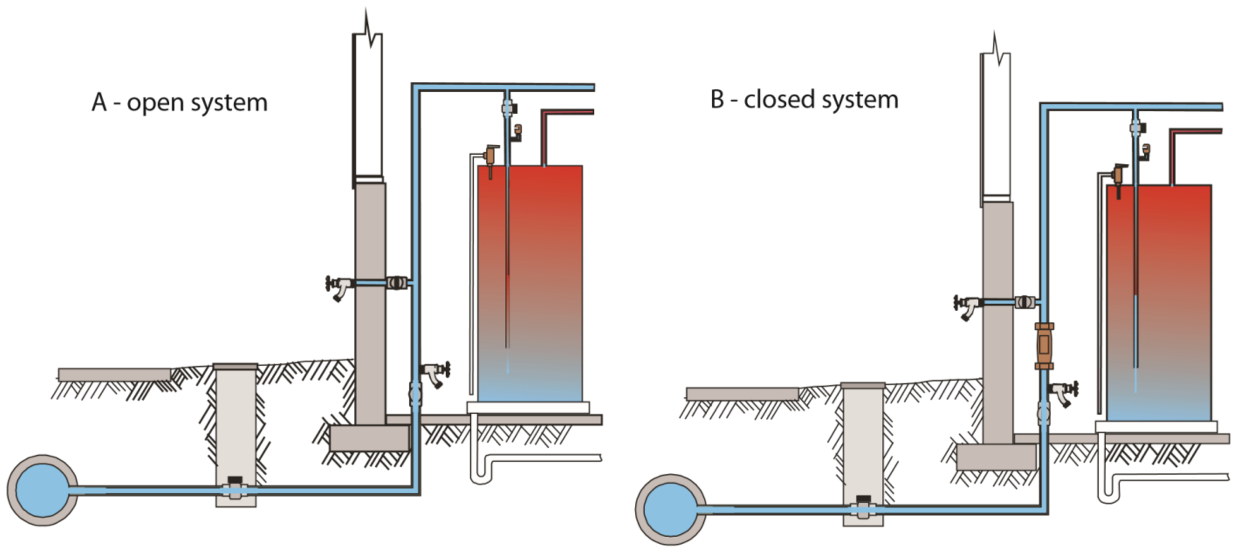

Figure 6-5—Closed and open piping systems

A: Open system

This drawing "A" is an open system. Any water pressure build-up in the premise can distribute back into the public water main.

B: Closed system

This drawing "B" is a closed system. Any water pressure build-up in the premise cannot distribute back into the public water main.

A back flow prevention valve has been installed in system "B" creating a closed system.

Why is thermal expansion in a premise a cross connection problem?

When water is heated in a water storage heater the water may expand back into the water service piping and public water main. This backflow from the premise creates a cross connection. A backflow preventer is installed to prevent this backflow. When the backflow preventer is installed another problem occurs. When water is heated in a hot water storage heater in a closed piping system the pressure in the system will rise and the relief valve may discharge. To prevent relief valve discharge due to thermal expansion thermal expansion relief is required.

Content

An example of the plumbing code requirement for thermal expansion is as follows:

1. *Protection against thermal expansion shall be required when a check valve, backflow preventer or pressure reducing valve is required on a water service.*

Thermal expansion relief tanks or thermal expansion relief valves (TER) prevent safety relief valve discharge due to thermal expansion.

Figure 6-6 and Figure 6-7 show two examples of equipment that can be installed for the purpose of thermal expansion relief.

Figure 6-6—Thermal expansion tank

Figure 6-7—Thermal Expansion Relief (TER) valves

The relief port of a TER must be piped to a safe location. The drain shall terminate at an air-break directly above a properly sized drain.

The thermal expansion tank must be appropriate size for the system and rated to handle the maximum system volume expansion and pressure that it is subjected to in use.

Content

Figure 6-9 shows thermal expansion in a water storage heater with no thermal expansion protection.

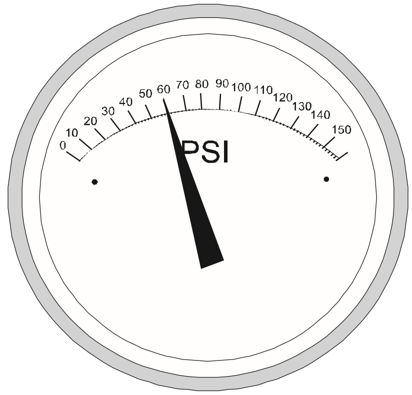

Figure 6-8—Expanded view of the system pressure gauge as shown in figure 6.9

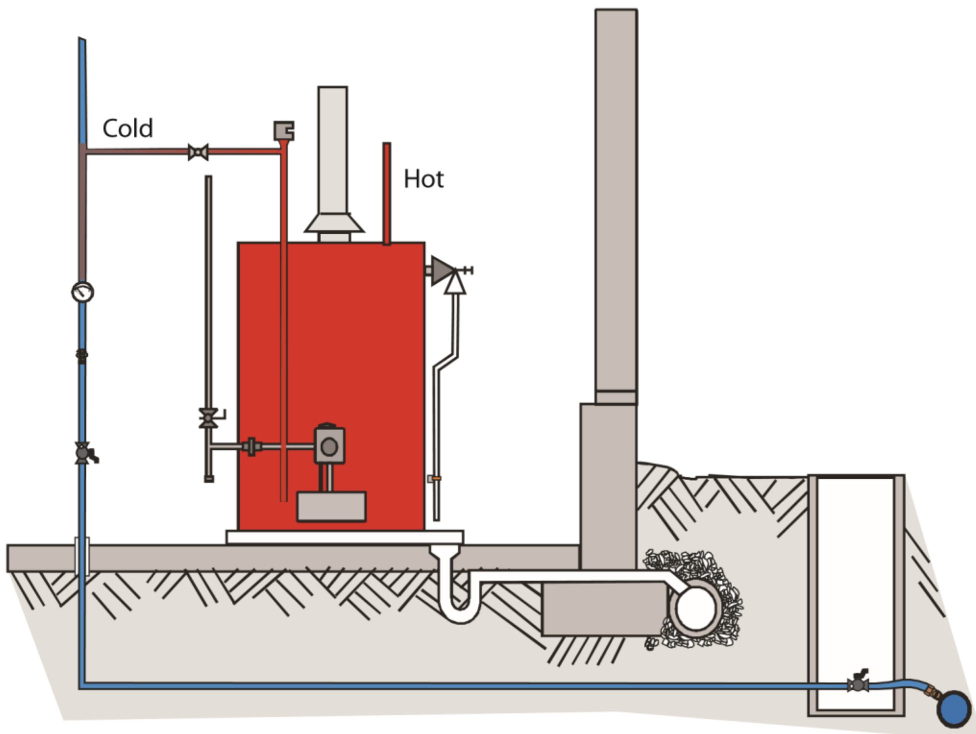

Figure 6-9—Water storage heater with no thermal expansion protection

Figure 6-9 shows hot water indicated in red has back-flowed into the cold water supply piping due to thermal expansion. This situation is pronounced when no water is being used in the premise water system. There is no place for the expansion to occur except back into the public water distribution system. The actual pressure in the premise system will not increase at this time so the safety relief valve on the hot water heater does not discharge at this time. Since thermal backpressure backflow is present a backflow preventer will be required. See Figure 6-11.

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Figure 6-11 shows a backflow preventer has been installed to prevent a cross connection. A thermal expansion tank has also been installed to satisfy the code requirement for expansion relief. This tank must be rated for the maximum operating pressure expected in the potable water system.

Note: The pressure in both diagrams, Figure 6-9 and Figure 6-11, have stayed relatively the same. Can you explain why?

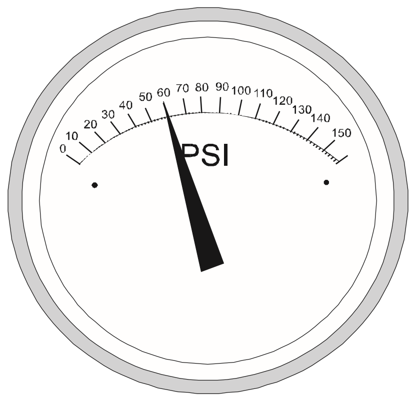

Figure 6-10—Expanded view of the system pressure gauge as shown in figure 6-11

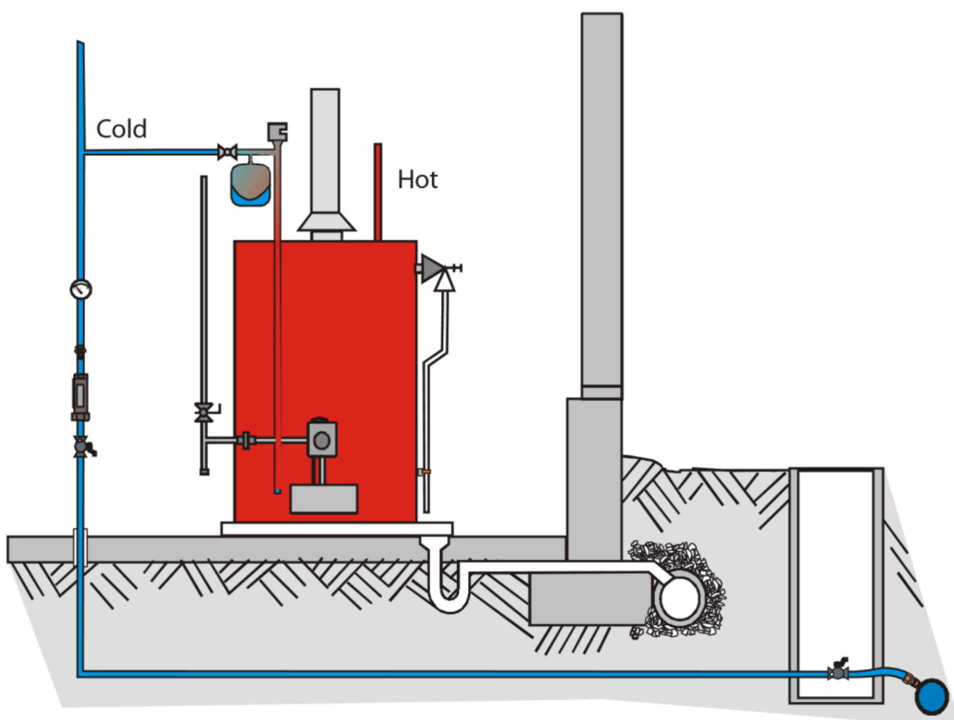

Figure 6-11—Water storage heater with thermal expansion protection

Figure 6-11 closed system with a thermal expansion tank (A) installed and a dual check valve (B) installed on the cold water downstream of the main shut-off at the left of the drawing.

The expansion tank reduces the increase in pressure caused by thermal expansion which prevents the pressure and temperature relief valve from discharging.

Content

Back flow preventer, parallel installation and bypass arrangements

Parallel installations are normally installed when uninterrupted water supply is a necessity, backflow preventers of equal flow requirements are necessary if full flow service is required. Each device shall be in operation under normal conditions.

Bypasses installed around backflow preventers for the purpose of permanent quick fill or to supply water at just a minimal flow during a repair must have the same degree of backflow protection as the mainline backflow preventer; otherwise, bypass arrangements or jumpers are prohibited.

Figure 6-12—A parallel installation

Example of a parallel installation for minimum operation and not necessarily full demand, complete with test tags and proper support. Note the vertical installation of a DCVA for the fire sprinkler system at the left side of the picture complete with chain locks on the shut-off valves.

Content

Back flow preventer protection and in-ground installation

RP installed in a semi buried pits.

If and when first approved by the AHJ; there are some requirements for semi buried pits:

- A RP cannot be installed in a below ground pit because it has a relief port that must not be subject to flooding.
- A RP **may** be installed in a semi-buried pit when first approved by the AHJ.
- Provide freeze protection.
- Provide a bore sighted daylight drain that is sized to handle the expected discharge of the relief valve; consult local plumbing code and manufacturer specifications to determine the drain size.
- The discharge opening of the daylight drain must be graded down and terminated above ground level or maximum flood level of the surrounding ground.
- The backflow preventer must be installed with an approved air gap above the drain.
- The pit or vault must be sized to allow safe access, egress, approved testing, maintenance and repair; consult safety regulations on confined space entry.
- The RP must be a minimum of 300mm above the lower ground level.

Figure 6-13 shows an example of an RP backflow preventer installed in a semi-buried pit.

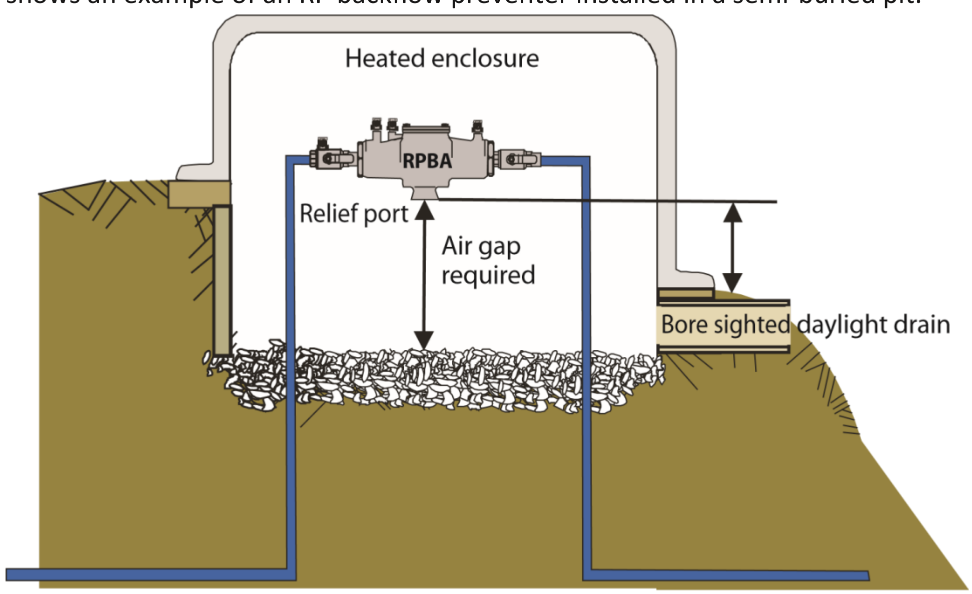

Figure 6-13—RP backflow preventer installed in a semi-buried pit.

Note: A 300 mm minimum Air-Gap clearance above ground is mandatory for installation of backflow preventers that have a relief valve port or an air-inlet valve opening.

Content

DCVA installed in a below ground pit

You may install DCVA in a dry pit not subject to flooding. Here are some suggested minimum clearances that may allow adequate room for maintenance and testing. Always check with the AHJ.

Figure 6-14 shows an example of a DCVA installed in a below ground level valve box.

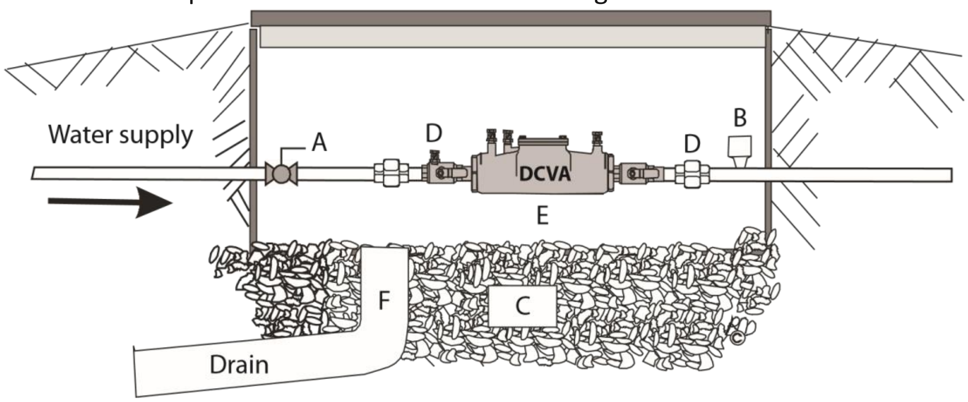

Figure 6-14—DCVA installed in a below ground level valve box.

The following apply to Figure 6-14:

- A is a resilient seated shut-off valve.
- B is an optional blowout connection.
- C equals 300 mm the minimum depth of gravel drainage.
- D is an optional union for easy removal. Before installing with unions consult with the AHJ.
- E equals 150 mm of minimum clearance under the valve.
- F is a drain pipe. Provide drainage by this method if practical.
- The minimum suggested clearance from the box end wall to valve A is 76 mm (3") The following are general below ground installation recommendations for a DCVA:
- A DCVA can be installed in a below ground pit.
- Do not install where flooding or ground water would be allowed to enter the potable water system.
- Install plugs or caps at all test ports valves. (CSA standard requirement)
- Do not install the backflow preventer below the water table.
- Do not install the valve box in a location where surface water runoff will collect. Slope the ground up to the top of the valve box.
- Do not install the in ground valve box where vehicle traffic will cause valve damage. Design the installation to support vehicle traffic where necessary.
- Valve boxes shall provide clearance to allow approved testing, maintenance; repair, removal and replacement.
- Do not install drain valves or leave open piping in a below ground valve box. Cap any open ends upstream of the backflow preventer.
- Test valves to be installed facing up or to one side.

Content

Identify and apply basic methods of freeze protection for backflow preventers

Backflow preventers installed in areas subject to freezing conditions shall be protected by an approved freeze protection method. The method of freeze protection must not create a cross connection.

The following are methods of freeze protection:

- Proper draining, insulation using heat tape and heated protective enclosures are all acceptable methods of freeze protection.
- Provide a resilient seated system shut-off and drain the service.
- Provide the manufacturers freeze protection procedures.
- Where approved by the water purveyor, remove the assembly for the winter months.
- Design system so that the backflow preventer is inside a heated structure/building. The following drain procedures are an example of procedure a manufactures procedure for freeze protection for some models of DCVAs and RPs:

- Turn off the upstream main shut-off valve that supplies water to the piping system.
- If present open any drain valves upstream and downstream of the assembly.
- Open both shut-off valves on the backflow assembly 45O (half open, half closed).
- Open all of the test valves, inlet and outlet drain valves.

- Loosen check-valve covers, leave all valves and test valves in the half open position to allow for full drainage.
- If you wish to "blow out" the system downstream of the backflow preventer, make sure the there is a drain on the downstream side of the assembly or a blowout connection and close the assembly downstream shut off 2.
- Connect the air hose to the blowout connection and blow out the downstream piping
- Leave all drain valves, assembly shut-off valves and test valves in the half open position for the duration of the winter to prevent freezing. Leaving a valve with loose covers and test valves open would only be acceptable if the assembly was in a location where no danger of flooding the assembly exists. The assembly should remain in this state until it is ready to be re-tested and put back into service and the ball valves are then fully open in service. Note: The upstream system shut-off valve must be tightly closed to prevent refilling of the system. Also, the main shut-off valve must be resilient seated to insure no leakage of water into the system. A leaking main shut-off valve upstream of the backflow preventer could refill the backflow preventer over the winter. Avoid freeze damage by repairing or replacing leaking main shut-off valves. On new installations and when replacing old valves install approved resilient seated valves only.

Note: Throughout North America climate conditions vary. In southern regions freezing is not a concern, backflow preventers are installed above ground in protective enclosures to prevent damage or theft. In northern areas freezing is a concern, some backflow preventers can be installed below ground. Installing a backflow preventer such as a DCVA below ground is permitted. An AVB, PVB, SRPVB and RP cannot be installed below ground.

Content

Ball valves freeze protection

(From Febco/Watts RP freeze protection guide lines, used with permission)

Ball valves should be drained for the winter in areas where freezing temperatures may occur. Water will become trapped between the ball and valve body if the valve is left in either the full open or full closed position. If water should freeze between the ball and valve body, damage to the ball valve will occur. After draining procedures on the backflow prevention assembly have been completed, all ball valves must be left in a half open / half closed (45 degree) position. Open the ball valve approximately 45 degrees while draining the pipeline and assembly to allow water between the ball and valve body to drain. Leave the ball valve in this position for the winter to prevent freeze damage. The valve must be closed before the system can be re-pressurized. Always open and close ball valves slowly at all times to prevent damage to the system

Freeze protection using compressed air blowout connections

Currently many existing turf irrigation systems use a compressed air blowout connection to remove trapped water. A compressed air blowout connection is a potential source of contamination. The compressed air can contain oil from the compressor and airborne contamination. Contaminated air can be forced back into the potable water system through the blowout connection. Using any compressed gas for blowing out an irrigation system upstream of the backflow preventer is not approved. Blowout connections must be installed in the correct locations. Blowout connections must only be installed downstream (outlet side) of the backflow preventer. (Refer to Figure 6-14 b.)

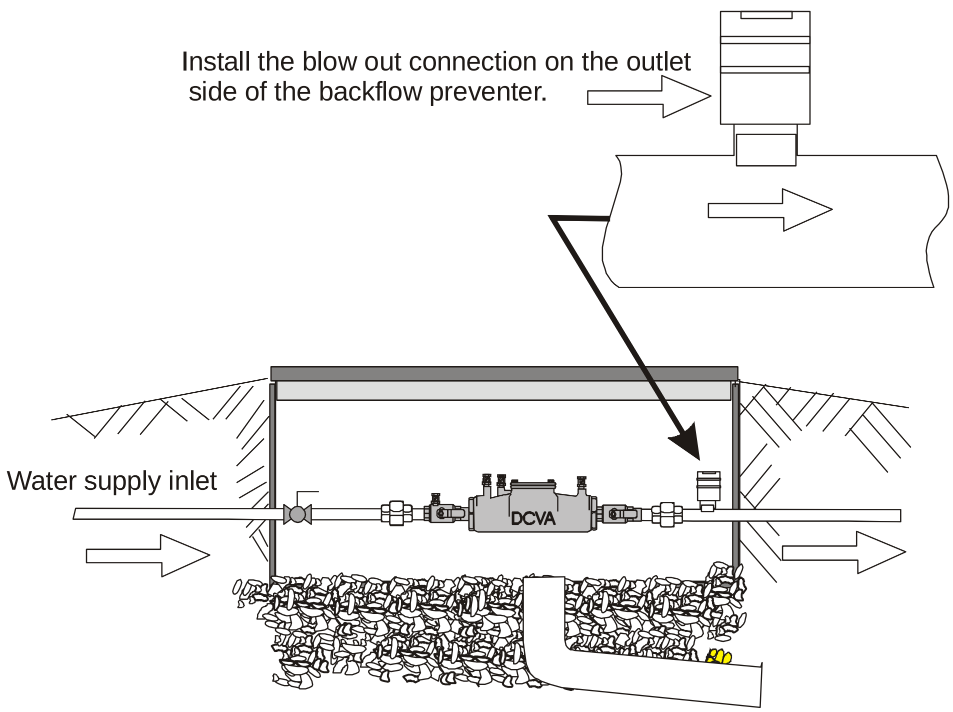

Figure 6-14-B blowout installed downstream of the DCVA

Content

Blowout connection installation restrictions:

- Blowout connections can be used with a RP or DCVA type backflow preventer.
- Blowout connections should **not** be installed with an AVB, PVB, SRPVB and any backflow preventer that is not suitable for backpressure backflow.

A blowout connection must not be installed upstream (inlet side) of the backflow preventer. This would allow contaminated air to enter the potable water system. (Refer to Figure 6-15.)

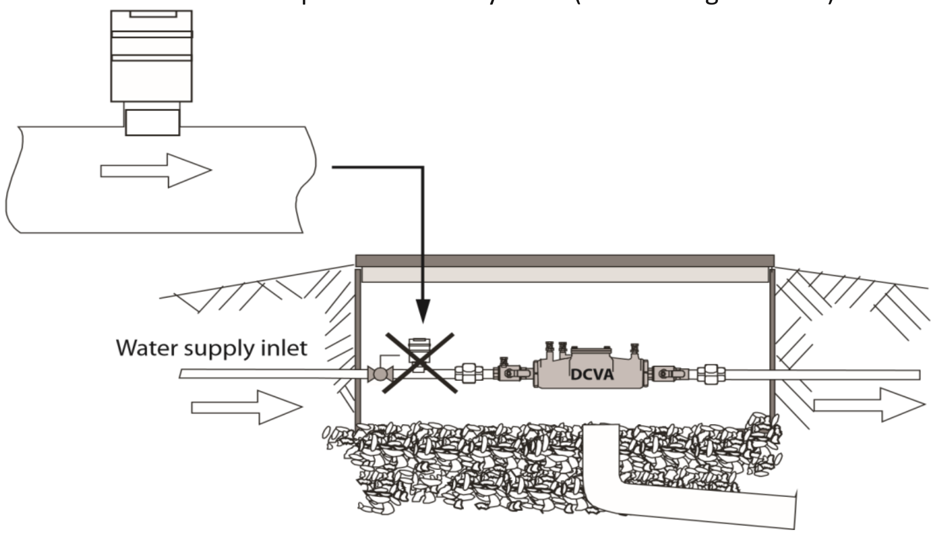

Figure 6-15—Never install a compressed air blowout connection upstream of the backflow preventer

Figure 6-16 shows that a blowout connection must **not be used** with an AVB, PVB, and SRPVB because these backflow preventers are not suitable for back pressure backflow. (Refer to Figure 6-16.)

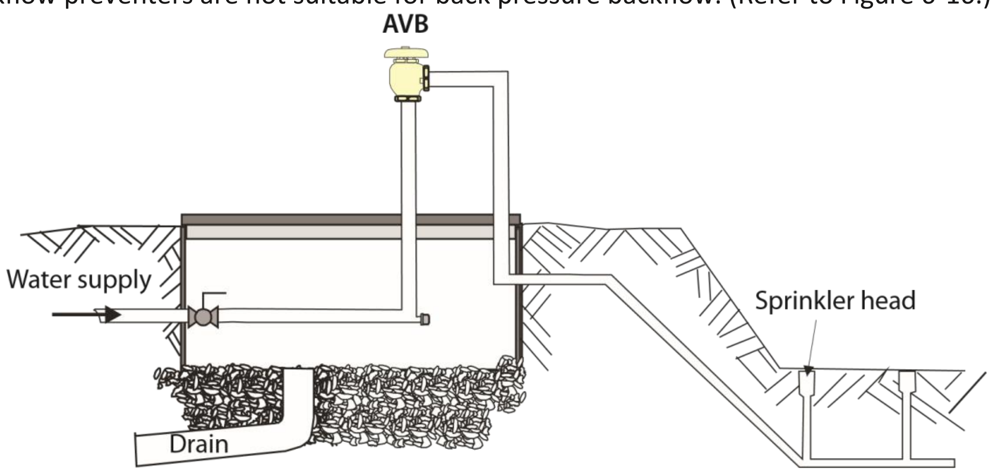

Figure 6-16—Blowout connections shall not be permitted when installed with a AVB, PVB and SRPVB

Content

Installing backflow preventers in heated enclosures to prevent freezing

Backflow preventers and piping may be installed within an onsite constructed heated enclosure or manufactured enclosure called a hot box. Insulating and or heating the backflow preventer are an acceptable method of freeze protection, provided the insulation does not prevent operation, testing and maintenance of the backflow preventer.

Figure 6-17 shows an example of a heated enclosure for a RP.

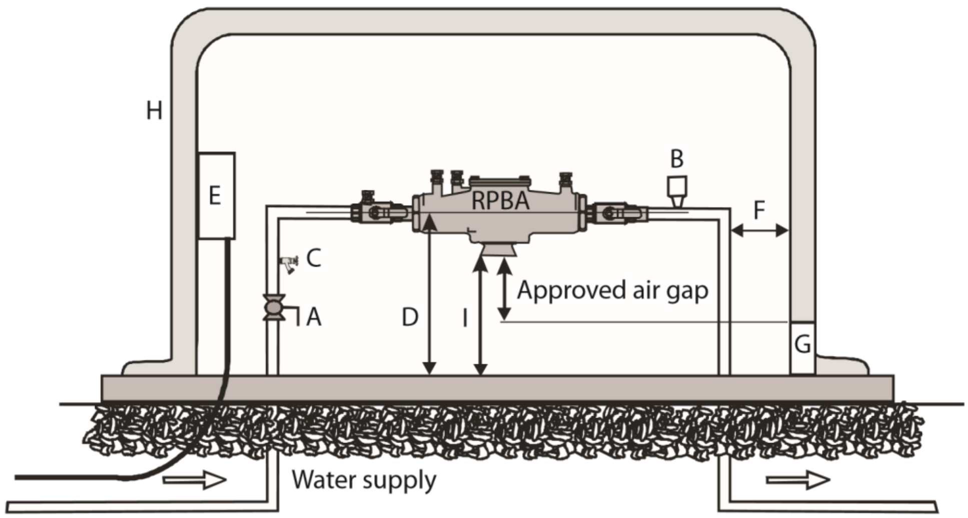

Figure 6-17—A heated enclosure for a RP

The following are installation recommendations for heated enclosures: (Refer to Figure 6-17.)

- A is a resilient seated shut-off.
- B is a blowout connection.
- C is a drain valve.
- D center-line is equal to 750mm minimum above ground level or floor, providing an approved air gap (an air gap is not required with a DCVA).
- E is a permanent CSA approved electrical connection.
- F is equal to 75mm minimum.
- 750 mm minimum in front of and 20 mm behind the backflow preventer. Allow 75 mm clearance from the underside of the valve enclosure to the top of any fully open valve stem or handle.
- 300 mm minimum above the assembly.
- G is a bore sighted daylight drain; bore sighted means that you should be able to look in one end of the drain and see the opening of the other end, not just daylight.
- I is the minimum 300 mm clearance below the relief valve.
- Support the backflow preventer as directed by the manufacturer's recommendation; do not allow larger assemblies to be supported by the piping.

Smaller enclosures may be removable for testing therefore clearances on the inside of the box can be reduced.

Content

Figure 6-18 shows a freeze protection with what is commonly called a hot box.

Figure 6-18—Freeze protection (aka hot box)

Courtesy of Watts Canada

Figure 6-18 is a series *Watts Box* backflow preventer, insulated and thermostatically heated enclosure protection with one way drains as per CSA B64 standard.

For information purposes only, here is an example table from a bylaw regarding above ground vaults with for a RP. The drain requirements are required in the jurisdiction where the bylaw applies. The housing in Figure 6-18 provides one-way drain ports.

RP Size dia.	Minimum Opening
¾"-1"	15 sq. in. (9675 sq. mm)
2"	20 sq. in (12900 sq. mm)
3"	30 sq. in (19350 sq. mm)3
4"- 6"	50 sq. in (32250 sq. mm)
8" -10"	100 sq. in (64500 sq. mm)

Table 6-4— Drain port requirements

Sizes courtesy of Orange Water and Sewer Authority.ORG Note: 1 sq. inch = 645 sq. mm

CSA requirements

Insulated enclosures (whether supplied with or without heat) shall comply with the requirements of ASSE 1060.

An enclosure complying with ASSE 1060 is an alternative to any location that would be considered a confined space.

Content

Freeze protection using low point drains

Besides blowout connections the correct placement of a low-point drain valve can be used to drain a turf irrigation system. A low-point drain valve installed downstream of the backflow preventer is acceptable. The low-point drain installed on a system using an AVB, PVB or SRPVB should not be used to attach an air compressor. These backflow preventers are not suitable for back pressure backflow. Low-point hose drains should be avoided when installed below ground upstream of the backflow preventer. Contaminated ground water can flow back into the potable water system through the open low-point drain, especially if the drain valve is left open. Cross connection standards may not permit low-point drain valves or stop and drain valves to be installed below ground up-stream of a backflow preventer. Refer to Figure 6-19 letters "B". Instead a drain valve must be installed a minimum 150 mm (6") above ground level. (Refer to Figure 6-19 letter "A".)

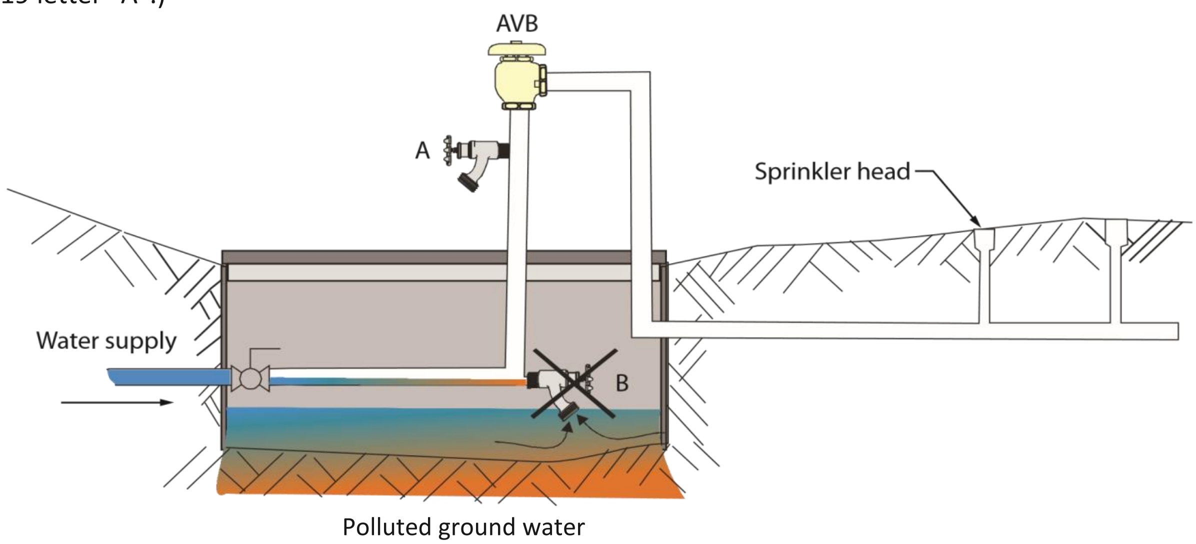

Figure 6-19—Proper placement of a low-point drain valve

As can be seen in Figure 6-19 a drain valve placed above ground will not allow drainage of the below ground piping, the possibility of freezing exists. Draining or insulation and application of heat can accomplish the freeze protection. Insulation and heating may not be practical on systems already designed and installed with no electrical power easily accessed. Installing a drain and using it to drain the system and then capping it when not in use may be acceptable to an AHJ.

Content

Figure 6-20 shows a capped pipe at letter "A" used to replace an existing hose-bib drain on an AVB irrigation system. Seek approval of the AHJ first. A well-drained gravel base is essential.

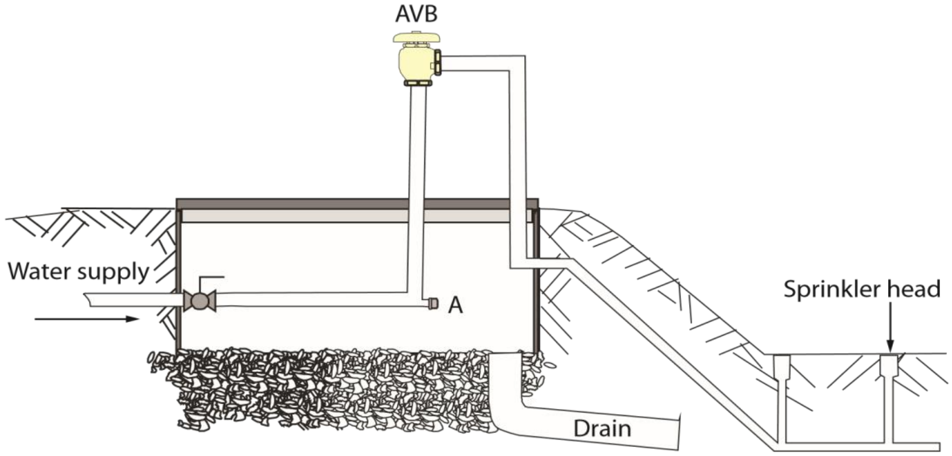

Figure 6-20—Correct and incorrect locations of drains on a PVBA system

Where first approved by the AHJ, existing installations with an underground drain valve should have the drain valve removed and replaced by a cap or plug. Refer to Figure 6-20. Proper application of capped drains may bring a lower risk of cross connection potential than the open end of a hose-bibb valve. A capped drain underground upstream of the backflow preventer is not fool proof.

Note: There remains some discussion about capped drains being a potential cross connection. Workers installing and winterizing irrigation systems must be aware of the dangers of underground drains. They must be aware of safe procedures to follow when draining the system.

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Locations of drains for AVB, PVB and SRPVB

Figure 6-21 show the correct and incorrect locations of drains for AVB, PVBA and SVBA systems.

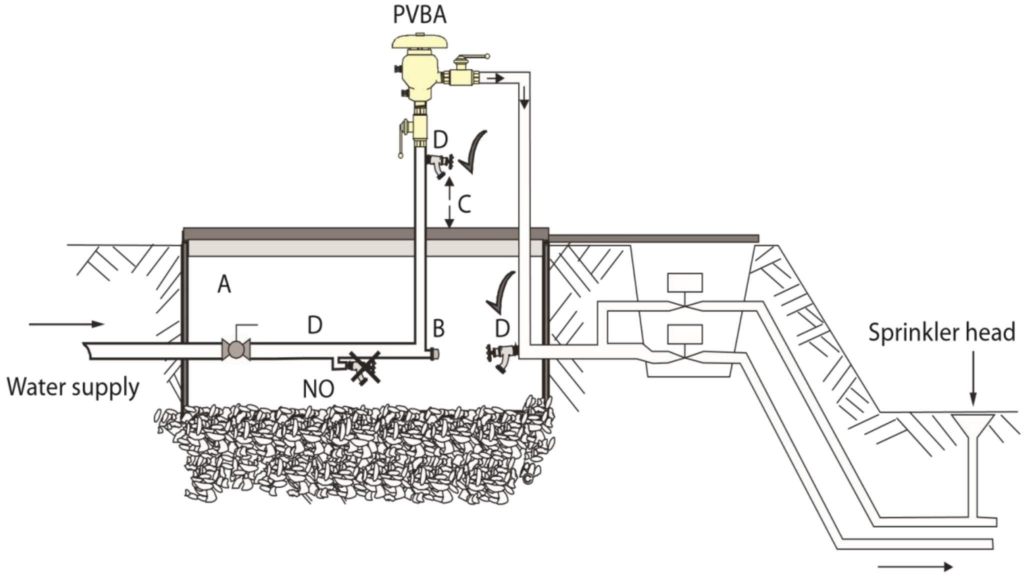

Figure 6-21—Correct and incorrect locations of drains on a PVBA system

In Figure 6-21: "A" is a resilient seated shut-off. B is an AHJ approved capped drain. C is 150 mm minimum dimension above the ground level. D is a hose-bib drain valve.

Locations of drains and blowout connections for DCVA systems

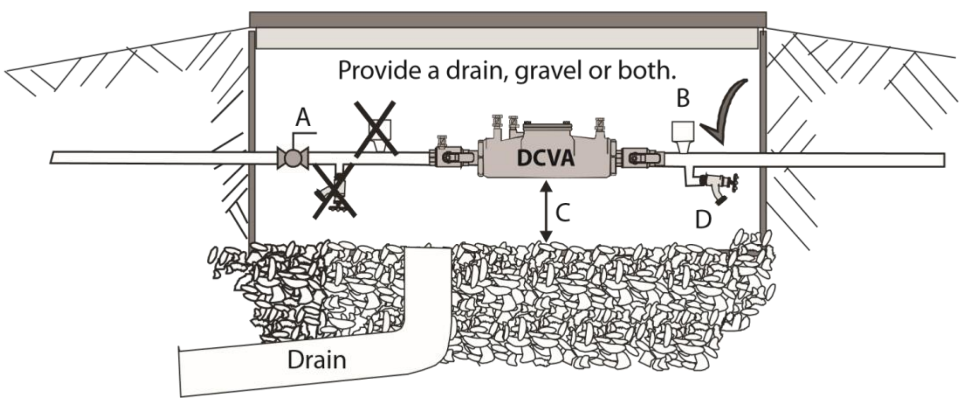

Figure 6-22—Location of drains and blow-out locations for a DCVA

Figure 6-22 shows the location of drains and blow-out locations for a DCVA

- A is a resilient seated shut-off
- B is a blowout connection
- C is 150 mm minimum dimension above the bottom of the box
- D is a hose-bib drain valve

Freeze protection options by removing the backflow preventer

An AHJ may allow the option of removal of the backflow preventer during winter to avoid freezing. Union connections will be required to make removal possible. An AHJ may not agree with the use of unions, because unions may invite the use of an illegal jumper connection. You will need to check with the AHJ first before using unions.

Content

Figure 6-23 shows a DCVA installed in a below ground box complete with union connections at letter "D". Once the DCVA has been removed the open ends must be capped. Winterize by removing the DCVA.

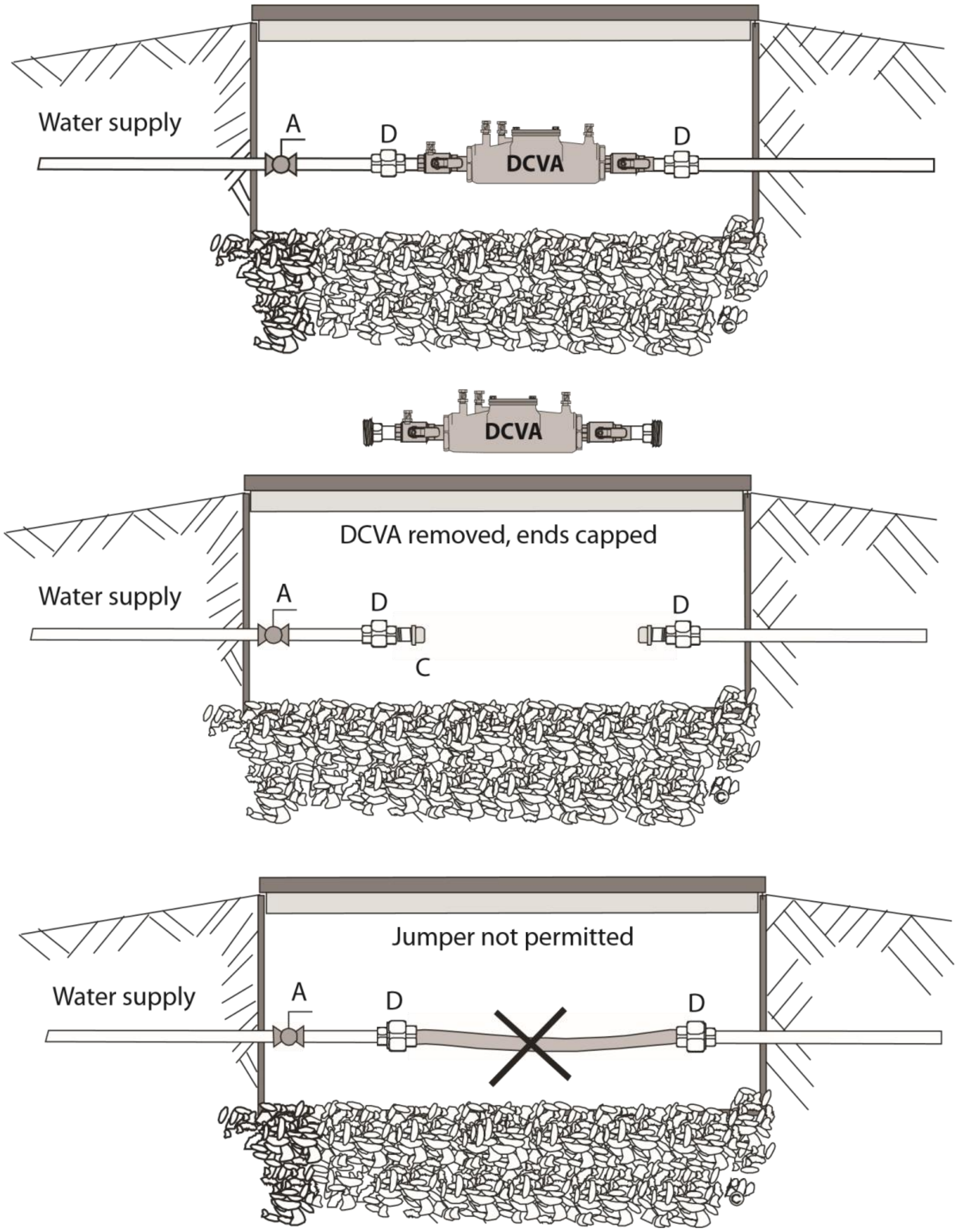

Figure 6-23—DCVA removal for winter to prevent freezing

Note: Figure 6-23 shows a jumper connection installed creating a cross connection. Jumper connections are not permitted. Some jurisdictions will not allow unions underground on irrigation services, although; the use of compression couplings and adapters are permitted and can be loosened to permit drainage. Some jurisdictions may not permit the removal of the backflow preventer.

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Removing a back flow preventer bylaws and precautions

There are existing jurisdictions with local bylaws restricting the removal of a backflow preventer.

Here is an example of a model bylaw clause as presented in the CSA standard.

No person shall remove a backflow preventer or any part thereof after it has been installed, and no owner of a building or structure in which a backflow preventer is installed shall cause or permit the removal of such a device, unless the purpose of such removal is to:

a. facilitate the repair of the device, with the device replaced immediately after the repair is carried out;
b. replace the device with another device that meets or exceeds the provisions of this bylaw or;
c. remove a device when the fixture or equipment has been taken out of service and removed.

DCVA removable freeze protection module

Figure 6-24 shows an example of a Zurn Wilkins assembly that has a black plastic removable check valve module that can be replaced with a temporary plastic orange module to prevent freezing and also serve as a blowout connection.

Figure 6-24—Assembly shown with removable check valve (black) replaced with free prevention/blowout connection (orange)

Courtesy of Zurn Wilkins model 350.

Freeze protection summary

Every precaution should be taken to avoid contamination of the potable water system while draining the system, blowing out the irrigation system or draining and removing the backflow preventer.

Recall the acceptable methods of freeze protection of backflow preventers:

- Provide a resilient seated system shut-off and drain the service.
- Provide the manufactures freeze protection procedures.
- Provide a permanent heated location.
- Where approved by the water purveyor, remove the assembly for the winter months.
- Design system so that the backflow preventer is inside a heated building.

Content

Identify and apply the installation requirements for each backflow preventer

Installation requirements for an Air Gap (AG)

Air gap requirements include the following:

- The minimum air gap dimension is 25.4mm (1") or two times the diameter of the supply outlet opening.
- An air gap provides a high degree of protection against backpressure and back-syphonage; however, it can be easily bypassed. A hose could easily be clamped to an air gap to bypass the air gap creating a cross connection.
- An air gap must not be used as the sole protection for extreme or high hazards. Additional in-plant or premise isolation may be required; for example, a sewage treatment facility requires an air gap in plant and a RP at the service connection.
- An air gap used to protect against a high hazard cross connection should be part of an annual inspection program. A registering an air gap can be applied as a method to ensure annual inspection.
- An air gap is measured from the lowest point of the water supply outlet to the flood level rim of the fixture. Do not measure the air gap from the overflow opening level.
- An air gap should not be installed in noxious environment.

Figure 6-25 shows an air gap.

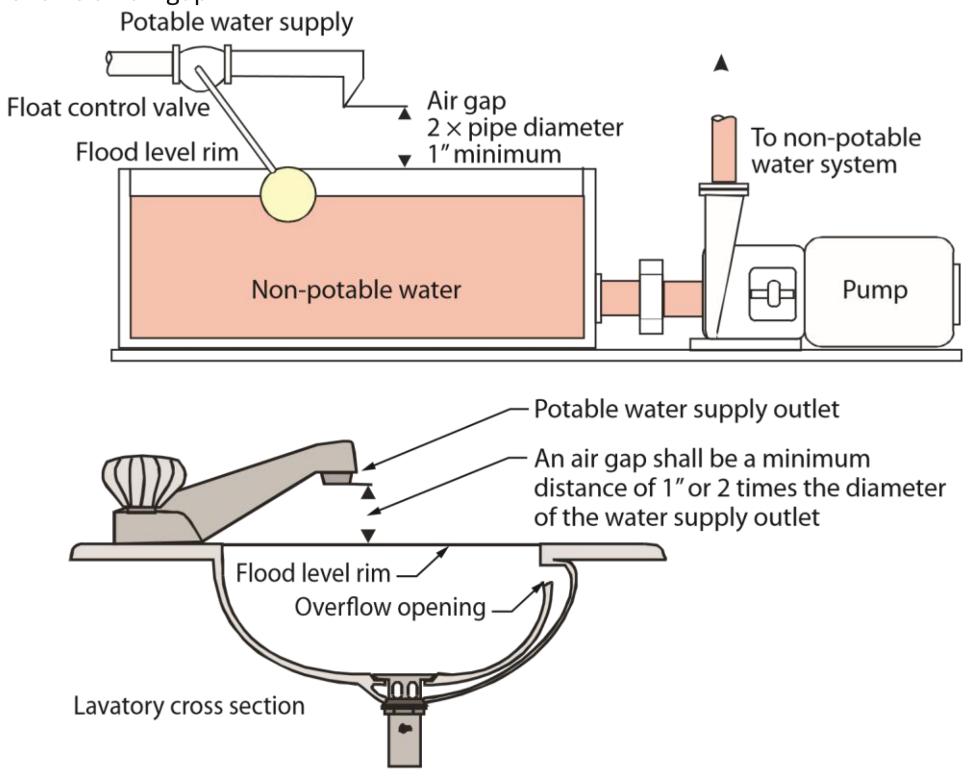

Figure 6-25—Air Gap (AG)

Content

Air gaps terminating close to vertical surfaces

Air gaps terminating close to vertical surfaces or located in pressurized buildings must be increased. The effectiveness of the air gap is reduced when it is located close to vertical surfaces of a plumbing fixture or when it is located in buildings pressurized above atmospheric pressure. At the present time there is little published information on just how much to increase an air gap in pressurized buildings. Consult the water purveyor (AHJ) for current information regarding air gaps and pressurized buildings.

Figure 6-26 shows the minimum distances from a vertical surface or similar obstruction that a standard air gap can be before it must be increased.

- If the water supply pipe air gap terminates within three pipe diameters of a vertical surface; the minimum air gap must be increased from two times the pipe diameter to 3 times the pipe diameter.
- If the water supply pipe air gap diameters terminate within four pipe of a corner vertical surface; the minimum air gap must be increased from two times the pipe diameter to 3 times the pipe diameter.

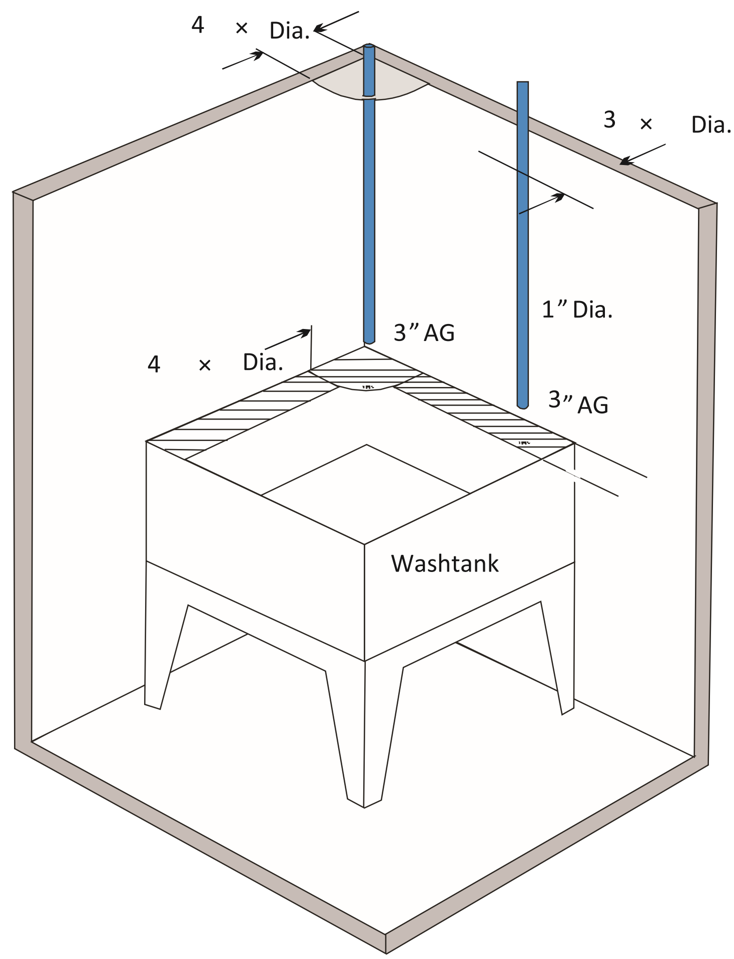

Figure 6-26—Minimum distances for standard air gap

For Figure 6-26 the air gap minimum dimensions are:

- For pipe diameters up to ½ inch the minimum air gap is 38mm (1 ½ inches)
- For pipe diameters over ½ inch up to including ¾ inch the minimum air gap is 57mm (2¼ inches).
- For 1 inch and over the standard minimum air gap becomes three times the supply pipe diameter.

Content

Indirect and direct connections, air-gaps and air-breaks

You need to consider indirect connections, direct connections and their relationship to cross connection.

Directly connected means a pipe that is physically connected in such a way so water or gas cannot escape.

Indirectly connected means a pipe that is **NOT** physically directly connected so water or gas can escape.

An air gap and an air break are both indirect connections. An air gap is the unobstructed distance from the water supply outlet opening to the flood level rim of the fixture or receptacle it discharges into. An air break is the physical separation between the lowest point of an indirectly connected soil or waste pipe and the flood level rim (FLR) of the fixture it discharges into.

Air gap and air break compared

The purpose of an air gap and air break is the same. The differences between the air-gap and the air-break are in their uses and dimensions.

Use difference:

An air-gap refers to the indirectly connected physical separation between the water supply outlet and the FLR of the fixture or equipment it supplies.

An air-break refers to the indirectly connected physical separation between a fixture drain and the waste or sewerage system it indirectly connects to.

Fixtures that must be indirectly connected are similar in function to food display, food preparation, relief valves or similar use fixtures.

Dimension difference:

The minimum vertical separation of the air-gap and the FLR is based on two times the diameter of the water supply outlet.

The minimum vertical separation of the air-break and the FLR is based on one times the diameter of the soil or waste pipe.

Examples of equipment needing an air-gap/air-break:

Booster heater for dishwashing machine: Provide an air-gap between the relief valve discharge pipe and the flood level rim of the receptacle it drains into.

Waste-cooled condenser for an ice machine or other refrigeration system equipment: Provide an air-gap between the end of the drain line and the flood level rim of the receptacle it drains into.

Drain lines for food service equipment such as salad cooler table or salad bar, ice machine or ice bin drain, soda fountain/dispenser drain, steam kettle and steam table: Provide minimum an air break. An air gap may be required if potable supply directly connected. Consult AHJ.

For condensate drain lines for refrigeration equipment, provide an air-break.

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Water softening equipment:

a. A brine tank that is filled or drained through a hose bibb is a potential cross-connection. Provide a hose connection vacuum breaker (HCVB).
b. Brine tank water supply with a gate or ball valve shall be provided with an air-gap.
c. A continuous supply directly connected to a brine tank: Provided a minimum DCAP. Consult with the AHJ. A RP may be required depending on the hazard assessment.

Drain line from a rain water tank shall not be directly connected to a drainage system: Provide an air-break.

Drains from water treatment equipment shall be provided with an air-break.

The concern of cross connection is normally with the water supply and its connections. The air break is dealing with the drainage system. As far as health protection is concerned the air-gap and air-break are both serious considerations. If the issue is cross connection of the potable water system, then the air-gap dimension will take precedence over the air-break.

Note: Often the air-gap or air-breaks are overlooked. As a qualified trade's person installing and testing backflow preventers you should be watching for these cross connection potentials.

Exceptions to indirect wastes connections

- Garbage disposal drains require a direct connection.
- Other exceptions may exist. Consult the AHJ. Air-gaps and air-breaks:
- Use an air-gap for water supply outlets directly connected
- Use an air-break for drains lines from equipment that **is not** actually directly or potentially connected to a potable water system; for example, a food display case or a relief valve drain of a heating boiler or hot water storage heater.
- If you are unsure what to use, to be certain, install an air-gap. Consult AHJ.

Note: Register the air gap with the AHJ for annual inspection if the air gap is likely to be illegally altered or there is a severe health hazard on the premise.

Measuring the air-gap at times can be controversial. You need to know exactly how the AHJ is calculating the air-gap measurements. When the water supply outlet opening is round the air-gap calculation is simple, it is two times the diameter or a minimum one inch. When the water supply outlet opening is not round you may need to calculate the area of the opening first. (Length times width.) Compare that area you calculate to that of a typical round pipe that is equivalent to or the next standard size greater to the non-round area opening. Use the equivalent pipe diameter you determined to calculate the air-gap or air-break. Another practice is to measure the largest dimension of the non-round opening and use that measurement as the diameter to calculate the air-gap.

Note: In terms of cross connection, be careful not to confuse the air-break and air-gap. The air-break minimum dimensions are one inch (25.4 mm) or one times the diameter of the indirectly connected pipe.

Content

Installation requirements for an atmospheric vacuum breaker (AVB)

Figure 6-27—AVB
Courtesy of Watts Canada

The following should be considered when selecting and installing an AVB:

- Suitable for back syphonage backflow only.
- Suitable for minor health hazard and used for high hazard only with additional use of an AG or RP. Consult with the AHJ.
- Minimum installation height of the AVB is 150 mm (Currently 25 mm is stated in *Part 7 BC Building Code*) above the flood level rim of the highest downstream piping or highest point of use open to atmosphere.
- Do not exceed the maximum 1.5m height above ground without access for maintenance.
- No shut-off valves allowed downstream of the AVB.
- Not to be subject to a constant pressure for more than 12 hours in a 24-hour period.
- Must be installed vertically.
- Size AVB according to the flow and pressure requirements of the system or at least the same size as the system piping.
- Not to be installed in any enclosed or hooded area containing toxic or poisonous gases.
- Not to be installed in a pit below ground level or in an area where it may be flooded; flooding could result in a direct cross connection through the air inlet.
- If a high health hazard is of concern, then additional protection may be required such as a reduced pressure backflow assembly. Consult with the AHJ.
- Suitable for in-plant and fixture protection.
- May be used for premise isolation for irrigation. Consult with the AHJ.
- Provide a drainage pan or a drain in areas where spillage from the canopy is a problem.
- Protect from freezing or physical damage where problem exists, of this manual.

Content

Atmospheric vacuum breaker use

An example of a submerged inlet connection

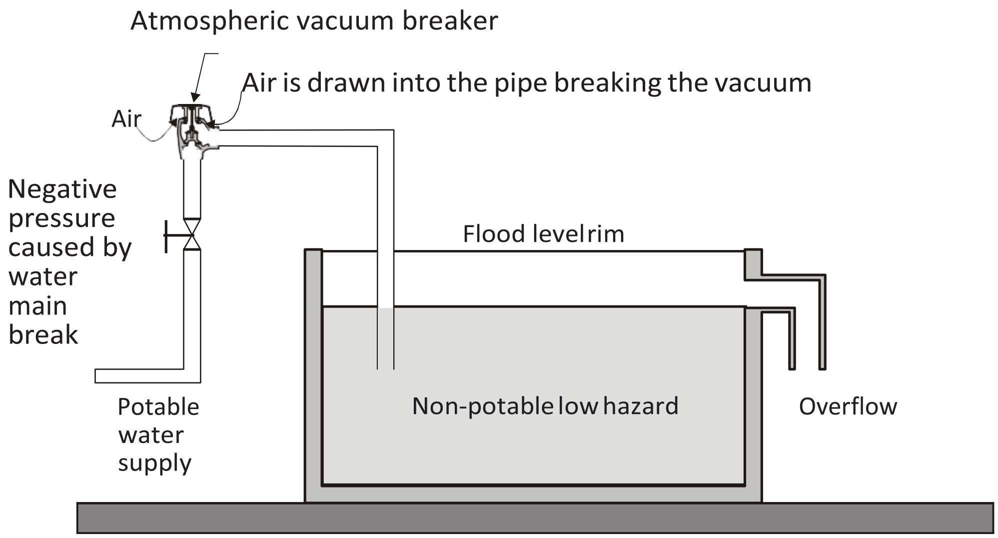

Figure 6-28—Process tank protected with an AVB installed

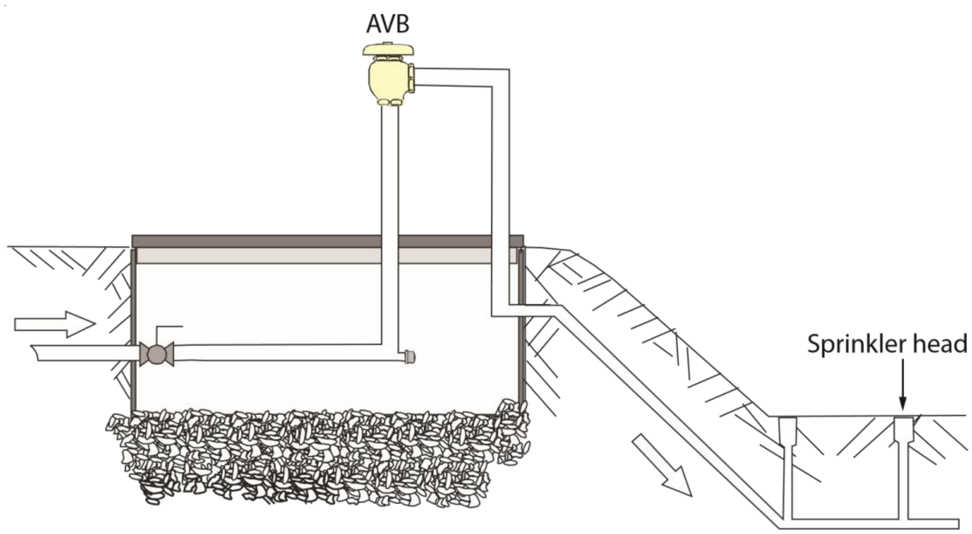

Figure 6-29—Irrigation system protected with an AVB

Note: A shut-off valve must not be installed downstream of the AVB. An AVB cannot be subject to continuous pressure for more than 12 hours in a 24-hour period. (Refer to *CSA B64-10/B64.10.1* for detailed application of AVB backflow preventers.)

Content

The following is a list of typical examples of uses for an AVB:

- irrigation systems
- bidets
- aspirators in a medical lab, as backup
- kitchen rinse hose connection (no downstream shut-off)
- kitchen equipment low hazard
- water closet flush valve
- water closet flush tank (located a minimum 25 mm above the top of the overflow tube)
- wash tanks low hazard
- autopsy and mortuary equipment, with an additional in-plant RP as backup Note: This list

is a partial list for use in this course only.

Installation requirements for a hose connection vacuum breaker (HCVB)

Figure 6-30—HCVB NFB8

Courtesy of Watts Canada

The following should be considered when selecting and installing an HCVB:

- AVB installation requirements also apply to an HCVB.
- Suitable for back syphonage backflow only.
- Suitable for minor health hazard and used for high hazard only with additional use of an AG or RP. Consult with the AHJ.
- Suitable for fixture isolation.
- Not to be used for premise isolation in any case.
- Must be permanently attached.
- Self-draining is recommended to prevent freezing.
- HCVB installed inside a heated building do not have to be self-draining

Content

HCVB use examples

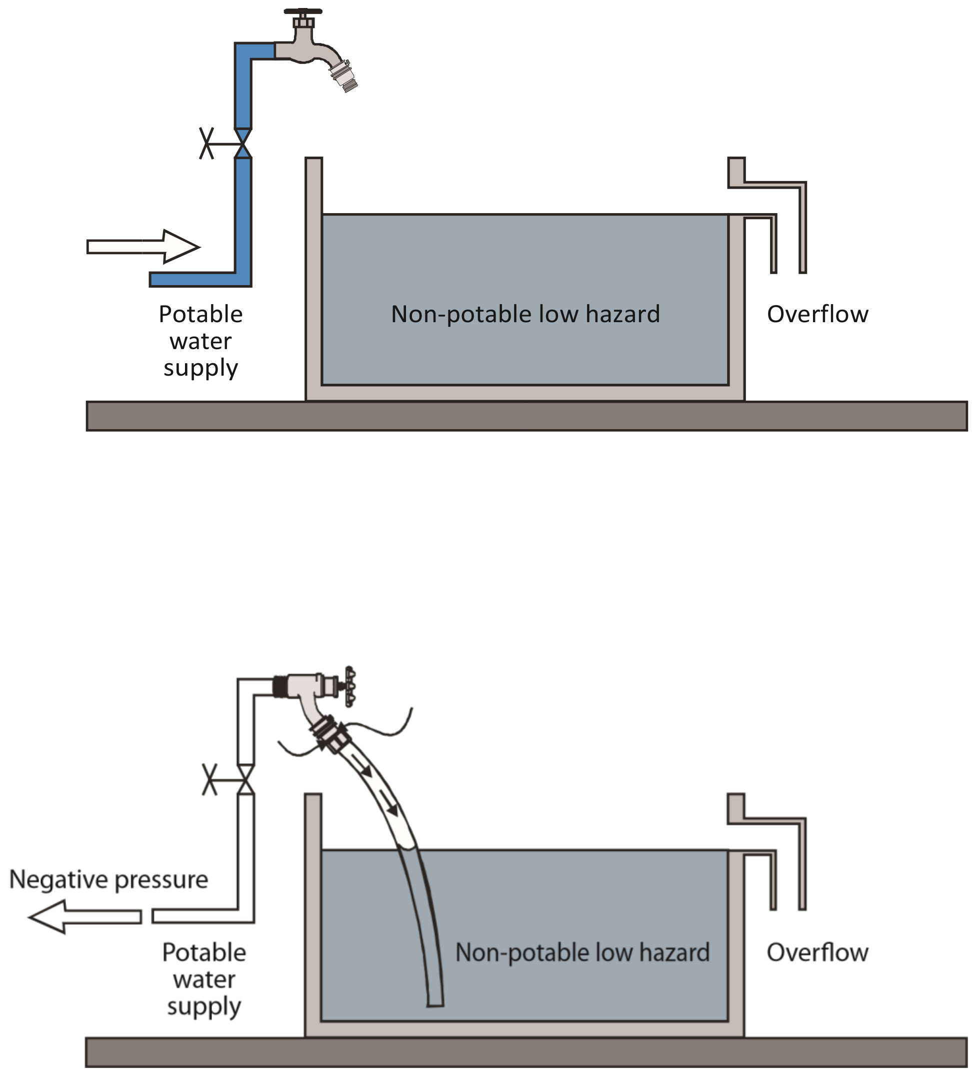

Figure 6-31—HCVB preventing backflow of non-potable water

This is an example of a HCVB being used to prevent a potential cross connection at the hose-bib. The HCVB allows air to enter the hose and relieve the negative pressure.

Content

HCVB use examples

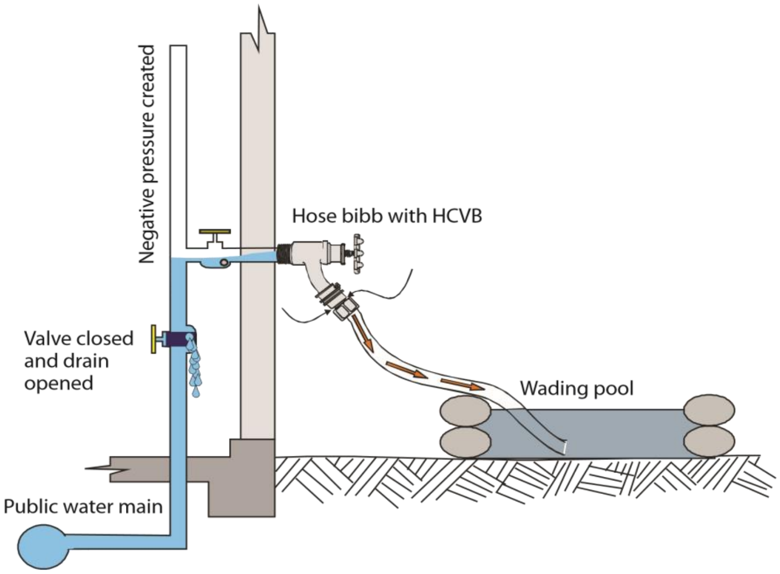

Figure 6-32—Wading pool with an HCVB installed.

The air entering through the hose connection vacuum breaker stops the pool water from being siphoned back into the house water system. The negative pressure occurred when the main shutoff valve was closed and allowing the house water system to be drained down.

Example of back-syphonage backflow prevented by installing a HCVB

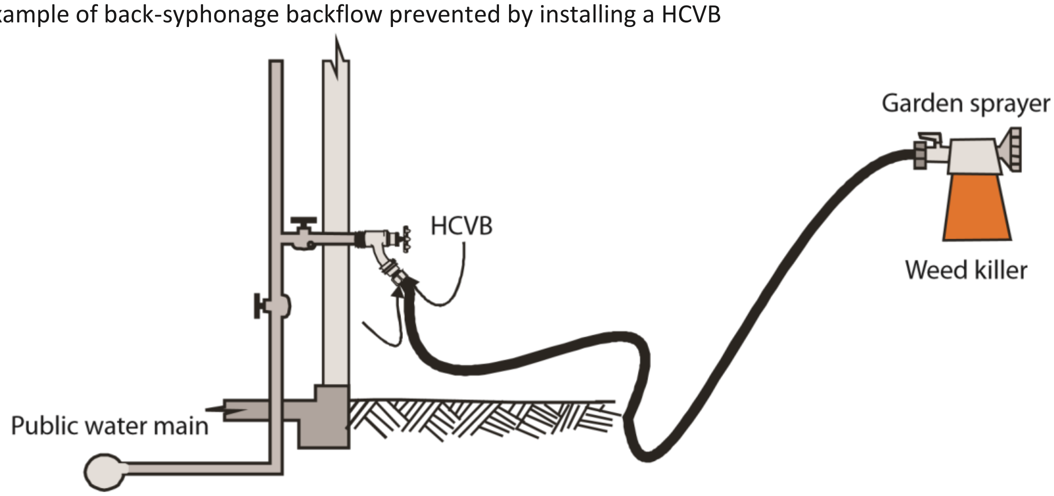

Figure 6-33—Garden hose sprayer protected with a HCVB

In Figure 6-33, although weed killers are extremely toxic, the hazard designation for a residential premise is generally low and no further protection is required. This application in an industrial application would require additional protection with an RP. Consult with the AHJ. Use of chemical aspirators should be avoided; however, the water purveyor would find this difficult to enforce in all residential applications. Note: The use of garden sprayers similar to the type shown in Figure 6-33 can contain chemicals that are a high hazard. The local purveyor may require addition protection at the water service.

Content

HCVB use examples

Simply stated a HCVB by itself should not be used for severe hazard protection.

Figure 6-34—HCVB NFB8 Courtesy of Watts Canada

Refer to *CAN/CSA-B64.10* current publications for detailed application of HCVB backflow preventers.

The following is a partial list of examples of use of a HCVB:

- residential hose faucet
- industrial hose faucet, only with additional back up with a DCVA or RP
- janitor sink
- laundry faucets
- water outlets with hose-bib ends

Content

Installation requirements for PVB and SRPVB

Figure 6-35—Pressure Vacuum Breaker (PVB)

Courtesy of Watts Canada PVB

Figure 6-36—SRPVB 008 PCQT

Courtesy of Watts Canada SRPVB

The following should be considered when selecting and installing a PVB and SRPVB.

- Back syphonage backflow only.
- Suitable for minor health hazard and used for high hazard only with additional use of an AG or RP, Consult with the AHJ.
- Suitable for continuous pressure applications.
- Size the PVB or SRPVB according to the flow and pressure requirements of the system.
- Can be installed up stream of shut-off valves.
- Minimum installation height of the PVB is 300mm flood level rim or the highest downstream piping or above the highest position of the fixture.
- Not higher than 1500mm above floor and minimum 750 in front, 300mm above and 20mm behind.
- Do not exceed the maximum height for access for maintenance.
- A PVB will require a drainage pan or a drain in areas where spillage from the canopy is a problem.
- A SRPVB will not spill water as badly as a PVB; however, it is not spill proof and spillage is still a concern.
- Protect from freezing or physical damage where a problem exists.
- Compressed air blowout connections are not permitted on systems with PVB and SRPVB backflow preventers.
- Where temperatures exceed 43°C (110°F) or as specified by the manufacturer use a hot water rated assembly.

Content

Figure 6-37 shows a turf irrigation system protected with a PVB or SRPVB.

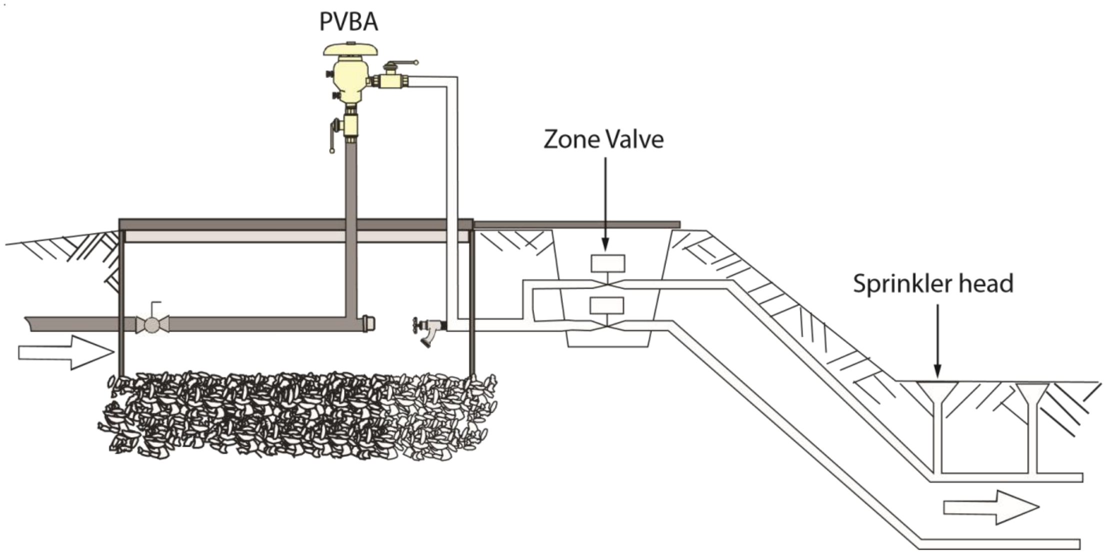

Figure 6-37—Turf irrigation system protected with a PVB

Figure 6-37 shows a PVB installed on an irrigation system with zone valves. The zone valves are downstream of the backflow preventer, resulting in the PVB being under continuous pressure. The air-inlet valve on the PVB is spring-loaded to the open position, allowing the valve to open positively after several hours of being held shut by continuous operating pressure.

(Refer to *CAN/CSA-B64.10* current publications for detailed application of backflow preventers.) Recall that

each premise must be evaluated on its own merits.

The following is a partial list of examples of use of a PVB or SRPVB:

- Irrigation system with no chemical additives.
- Bottle washing equipment backed up with an in-plant RP.

Content

Installation requirements DCVA

Figure 6-38—LF719 DCVA
Courtesy of Watts Canada (LF means Lead Free)

The following should be considered when selecting and installing a DCVA

- DCVA is suitable for back syphonage backflow and back-pressure backflow
- Non-health (minor to moderate) hazard.
- May be used for continuous pressure operation.
- May be installed in a pit if not subject to flooding and test valves capped.
- CSA states a DCVA shall not be installed in a below-ground pit unless it can be maintained in a dry condition but, then goes on to say that the test valves are to be capped when installed in a below-ground pit or vault.
- DCVA should not be installed in a below-ground pit unless adequate drainage is provided.
- The centerline height is to be between 750 mm and 1500mm above floor and 750 in front and 20mm behind.
- Must be installed in the position for which they are approved, either vertical or horizontal; consult with the water purveyor and manufacturer.
- Not to be used where chemicals are injected into the system.
- Test valves must face up or to one side.
- Where temperatures exceed 43°C (110°F), or as specified by the manufacturers use a hot water rated assembly.

Content

DCVA use examples

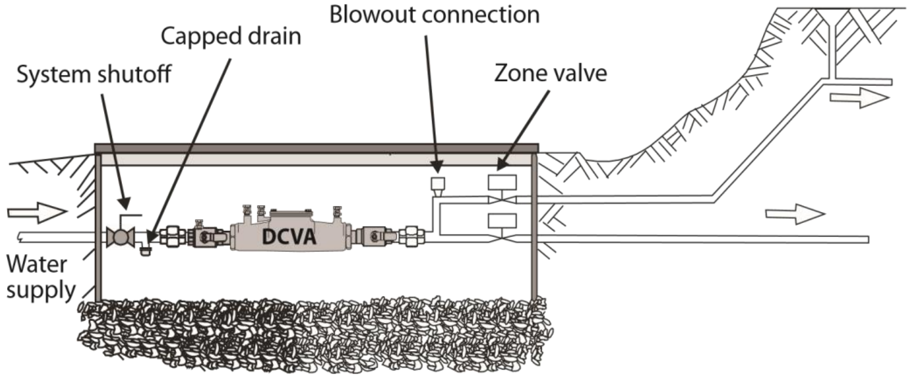

Figure 6-39—DCVA installed for irrigation installation

In Figure 6-39 a double check valve is required because the system is subject to back-pressure backflow due to the elevated sprinkler head. The irrigation sprinkler system illustrated is considered a low hazard, so a DCVA is appropriate.

Note: At the current time there is a difference of opinion about the hazard of irrigation systems and the use of a DCVA. In some jurisdictions of North America, a DCVA is not acceptable protection for irrigation systems.

The following is a partial list of typical examples of mandatory premise isolation using a DCVA or DCDA:

- tall buildings moderated hazard
- hotels
- nursing home moderate hazard
- swimming pool
- medical clinic that are non-surgical only (refer to *CAN/CSA-B64.10* current publication)
- manufacturing plants (refer to *CAN/CSA-B64.10* current publication)
- penitentiary (refer to *CAN/CSA-B64.10* current publication)

The following is a list of typical examples of in-plant or fixture isolation using a DCVA:

- fire protection systems with no chemical additives (DCVA or DCDA)
- high pressure washers with no aspirator chemical additives
- irrigation systems with no chemical additive
- private fire hydrants
- livestock drinking tanks

Note: Refer to *CAN/CSA-B64.10* current publications for detailed application of backflow preventers, recall each premise must be evaluated on its own merits.

Content

Installation requirements for an RP

Figure 6-40—LF 009 RP
Courtesy of Watts Canada

The following should be considered when selecting and installing a RP:

- RP is suitable for both back syphonage backflow and back-pressure backflow high health hazard.
- May be used for continuous pressure operation.
- Minimum installation height of the relief valve opening of the RP is 12" (300mm) above grade.
- Centre-line height between 750 mm and 1500 mm above floor, 750 in front and 20 mm behind.
- Must be provided with a correctly sized drain for the relief port and be provided with an approved air gap. Consult manufacturer's information and plumbing code requirements.
- Must not be installed in a pit below ground level.
- Must be installed in the position for which they are approved, either vertical or horizontal. Consult with the water purveyor and manufacturer.
- Any system that introduces a chemical or other potable or non-potable substance into the water supply should be considered a high hazard.
- Provide freeze protection where needed.
- Where temperatures exceed 43°C (110°F) or as specified by the manufacturer. Use a hot water rated assembly.
- Provide thermal expansion relief downstream and ensure existing pressure relief valves are operational.
- Strainer may be required. Upstream strainers used on a fire line must first be approved by the authority having jurisdiction.
- Use proper hydraulic calculations, considering available pressure, volume requirements and head loss.
- Provide adequate drainage for maximum relief valve discharge.

Content

Examples of the use of an RP

Figure 6-41 shows the use of an RP protection for a process water tank.

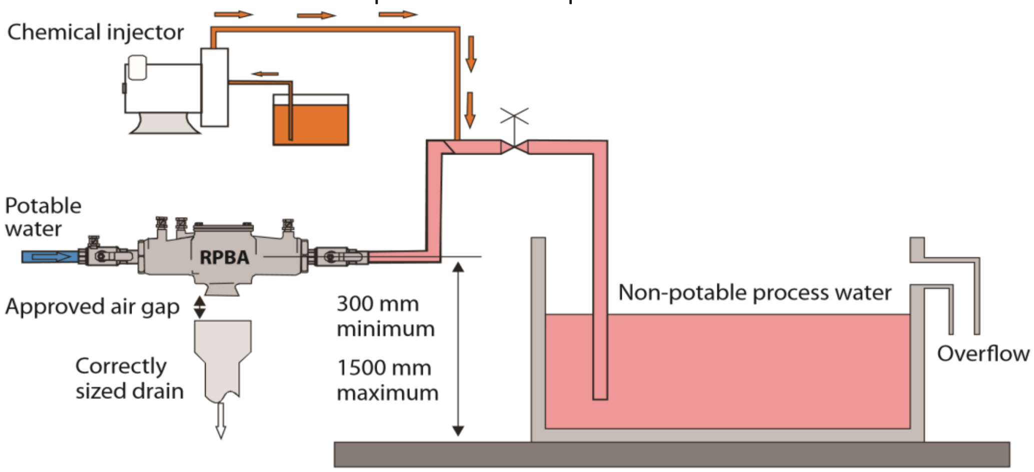

Figure 6-41—RP protection for a process water tank.

Figure 6-41 shows a RP installed on the feed-water line to a process water tank with a chemical injection system. This is a high hazard back-pressure condition. A storage tank, containing potable water to start with, would be considered a high hazard. The potable water in an open storage tank could be contaminated by bacteria growth, by debris falling into the tank, by substances being added to the tank, by leaching of metals from the container walls or by the water becoming stagnant.

The following is a partial list of typical examples of mandatory premise isolation using a RP or RPDA:

- sewage treatment plants, severe hazard (an air gap must also be installed)
- radioactive material processing, severe hazard (an air gap must also be installed)
- hospitals full treatment facility
- mortuaries
- metal plating plants
- piers, docks, marinas, dry docks, small boat marinas
- premises with restricted access
- car washes
- premises with fire sprinkler systems with antifreeze added

The following is a partial list of typical examples of fixture, in-plant isolation using a RP or RPDA:

- air conditioning systems
- aspirators in a medical lab
- autopsy tables
- bedpan washer
- oiler feed lines
- bottle washing equipment
- car washing equipment
- fertilizer injector
- film processors
- chlorine injectors
- dental equipment/cuspidors
- heat exchangers other than double wall with leak detection
- commercial hot water heating boiler
- hydrotherapy baths

Content

Note: Refer to *CAN/CSA-B64.10* current publications for detailed application of backflow preventers, recall each premise must be evaluated on its own merits.

Identify and apply the correct backflow assembly for specific cross connections.

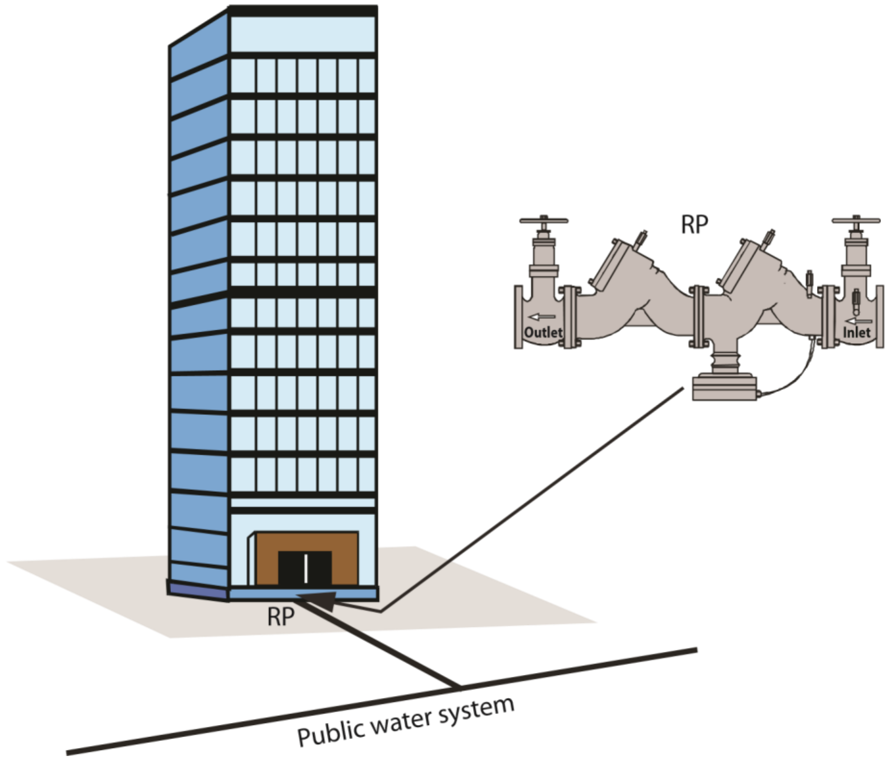

Figure 6-42—RP or RPDA protecting a tall building severe hazard

Figure 6-42 shows a tall building that has activities such as industrial use, elevated storage tanks, either open or closed, booster pumps for potable system, pneumatic pressure tank and or fire systems. Booster pumps or pneumatic tanks can create backpressure. Back-syphonage could also exist in the upper story if the public water main pressure drops below the static head pressure of the building.

Note: Avoid connecting piping to the suction side of a booster pump. In cases where this situation exists, the building is a candidate for severe hazard designation and premise isolation with an RP.

Content

DCVA use examples

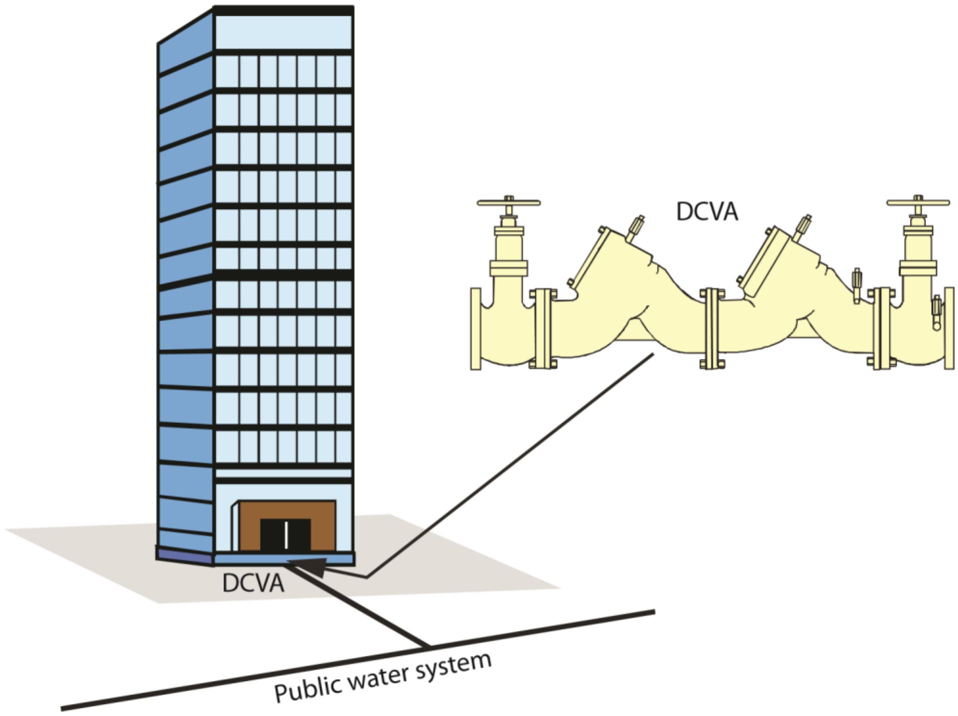

Figure 6-43—DCVA or DCDA protecting a tall building moderate hazard

Figure 6-43 shows a tall building that has activities with minor to moderated hazard levels. Activities such as offices, apartment, condominium and commercial retail would be a minor to moderate hazard.

The DCVA will prevent used water in the building from flowing back into a public water main. The head pressure caused by the weight of the water in the tall building can be greater than the public water main pressure. Backflow would occur when the public main pressure drops below the pressure of the static head pressure in the building.

Some cross connection standards classify tall buildings as any building over 9 m in height.

Note: Tall building need to be surveyed and assessed in order to determine the hazard level and the back flow may be designated differently depending on use.

Content

Trap primers

Figure 6-44 shows a trap primer, trap primers are a severe hazard, trap primers must be connected to the trap indirectly with an approved air gap.

Figure 6-45 shows a manufactured trap primer with built in air gap. This air gap would need to be at least one inch and need to be approved by the AHJ before being accepted. There are trap primers currently being used that cannot meet the minimum air gap requirement. Local AHJ often reject this type of trap primer. Existing un- approved trap primers can be easily remedied by installing an approved air gap immediately below the trap primer outlet. Consult with the AHJ.

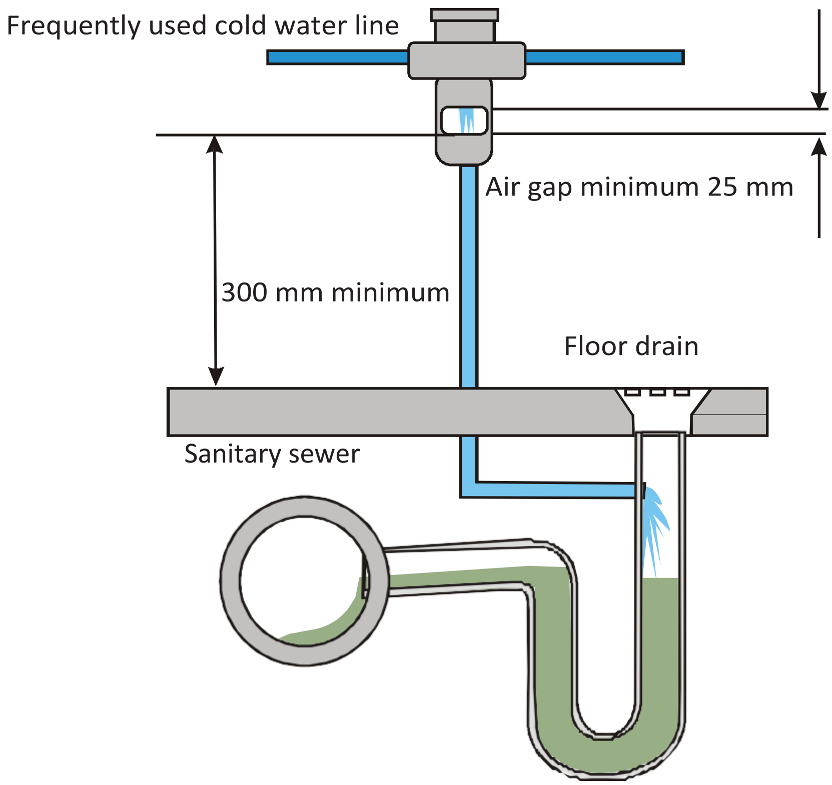

Figure 6-44—Trap primer installation measurements

Figure 6-44 shows an air-gap installed with a manufactured air gap. Trap primers are supposed to be in an accessible location for maintenance and repair.

Content

Figure 6-45 shows an existing trap primer that has **not** been approved by the AHJ. The air-gap does not conform to the air-gap minimum dimensions. When first approved by the AHJ a retrofitted approved air-gap could be installed as long as it can be assured that the air-gap is visible and not enclosed in a confined space with limited or no access.

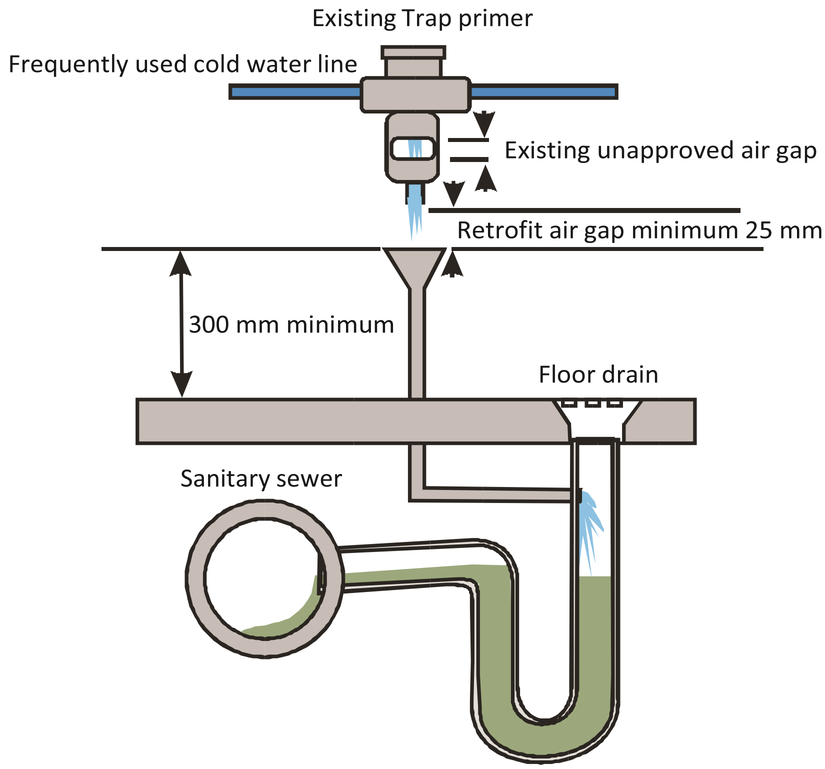

Figure 6-45—Retrofit trap primer installation only when first approved

Figure 6-46—Trap primer NOT approved AG

This picture shows an installed trap primer with a small hole used for the air-gap. This air-gap does **not** meet the requirements of an approved AG, consult with the AHJ on this one.

Content

Auxiliary water supplies protection required

The *BC Building Code Part 7 Plumbing Systems 7.6.2.5* prohibits the interconnection of a private water supply system with a public water supply system. It makes no difference whether the water supply is approved or unapproved, no interconnection is allowed.

The water purveyor may accept the connection of private water supplies to the public system. Certain provisions for backflow protection and monitoring of the water supply should be required. When accepting a connection between the public water supply and the private auxiliary supply the water purveyor would assume the risk and the liability of contravening a Code standard.

The water purveyor would consider a private water supply as non-potable because the purveyor has little control of the quality of a private water supply.

Note: Check with your local purveyor about their policy on auxiliary water supplies. DCVA protection may be allowed if the water purveyor is certain and can access and monitor and approves the auxiliary supply.

An approved auxiliary water means a supply which has been investigated and approved by the health authority, meets water quality regulations, and is accepted by the water purveyor.

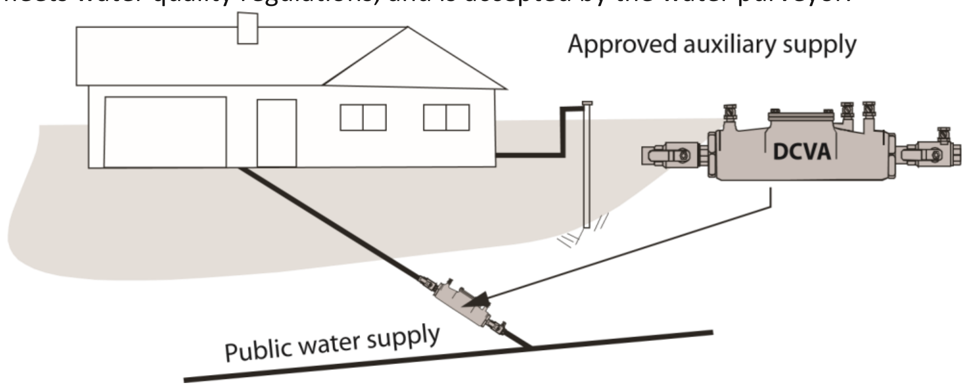

Figure 6-47—DCVA installed approved for auxiliary supply

The water purveyor may accept a lesser degree of backflow protection to isolate the premise, provided the purveyor is satisfied that the water supply is approved and will be monitored to ensure it remains that way. Even though the private water supply piping and the public water supply must not be interconnected, the chance they will be illegally connected exists. The water purveyor may require premise isolation.

Content

When an unapproved water system exists on the premise, figure 6-48, the water purveyor requires a RP to isolate the service.

Private unapproved auxiliary water supply

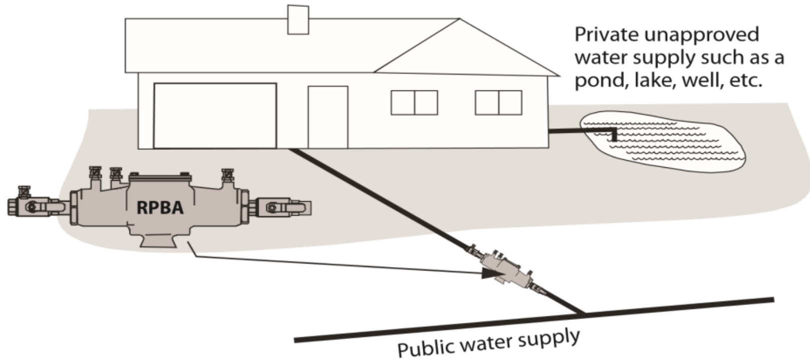

Figure 6-48—Unapproved auxiliary water RP required

Figure 6-48 shows an RP installed to protect any premise with an auxiliary water supply even if there is no direct connection. Private auxiliary supplies cannot always be monitored. It has been shown that owners of such premise will interconnect the auxiliary and the public water system together as soon as a situation to do so presents itself.

Note: Similar premises with an underground grey water irrigation system, storm water reuse, recycled, reclaimed water etc., would also be isolated with for an RP installation. Any source of water other than the public water supply can be identified as an auxiliary supply because of the probability of the auxiliary supply being connected.

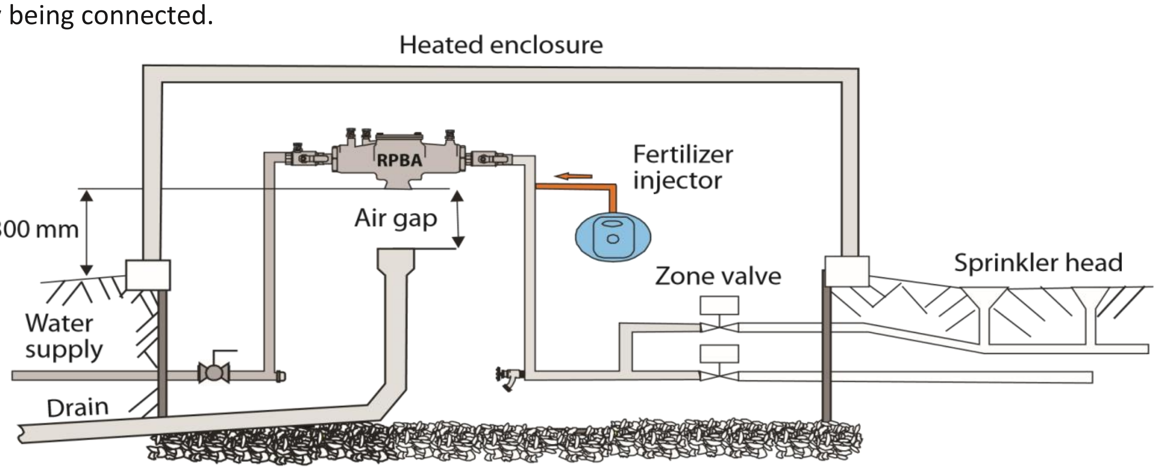

Figure 6-49—RP in a heated enclosure

Figure 6-49 shows RP protection for an irrigation system fertilizer injector, high hazard backpressure and back-syphonage cross connection.

Note: Adequate drainage must be provided for backflow preventers with relief ports. The size of the drainage piping is dependent on the rate of discharge from the individual backflow preventer. You must consult the AHJ in the location where you are installing the backflow preventer.

Content

Dock and marine repair facility

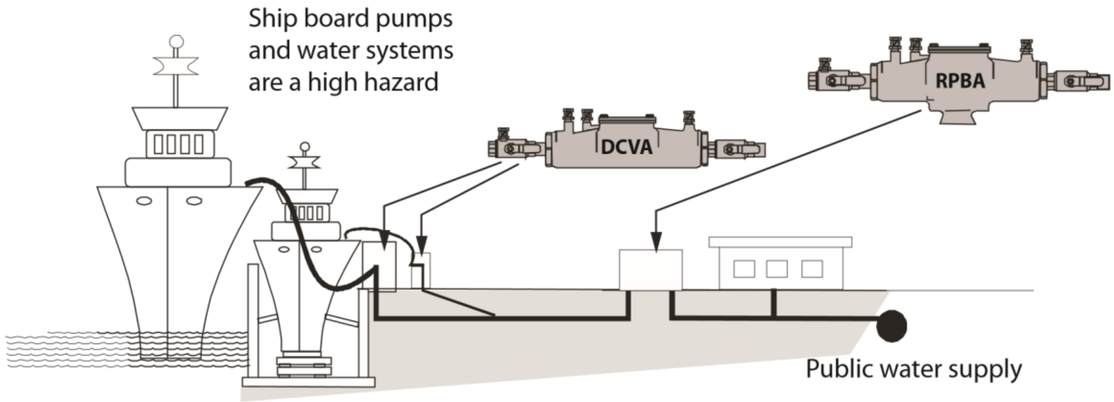

Figure 6-50—Marine repair facility RP and DCVA

Figure 6-50 shows both a RP and DCVA being used to prevent contamination of the public water supply. The hazards include shipboard piping systems, fire protection systems, wastewater treatment and disposal systems, fuel oil and hydraulic systems, and the ships' potable water system. Most large ships will contain several pumps capable of pumping pressure greater than the public water supply system. Shipboard systems can contain contamination from all over the world. Shipboard crews connect the ship systems to the shore-side systems to dispose of waste and take on fresh water supply. Connection cannot be monitored and the danger of wrong connection being made is highly probable. Water supplied to a marine facility intended for fire protection only also creates a possibility of a cross connection and will need to be isolated with a RP.

Small boat marina

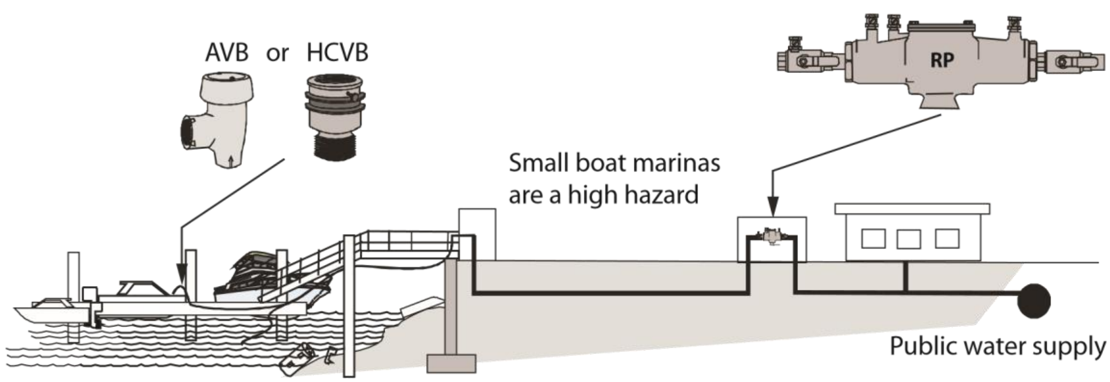

Figure 6-51—RP installed small boat marina

Figure 6-51 shows a small boat marina with an RP required at the water service and an AVB at any outlet located on the wharves and docks. There shall be no potable water supply connection to a sewage lift station located at a small boat marina.

Content

Sewage treatment facility protection

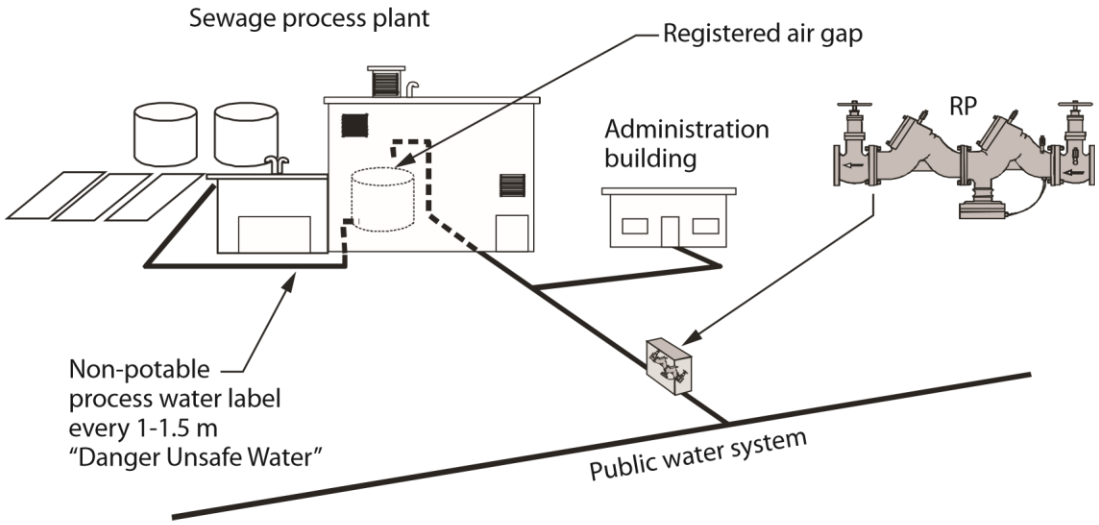

Figure 6-52—RP installed at service connection and AG within premise

Figure 6-52 shows a RP and AG used to protect a public water supply to a sewage treatment facility. A sewage treatment facility is considered a severe hazard; therefore, a reduced pressure backflow assembly and an air gap must be installed. The AG is used to separate the premise sewage process piping and equipment from the potable water system in the premise. The RP is used to isolate the entire premise from the public water supply. All non-potable water must be labeled as indicated in Figure 6-52.

Content

Municipal/Public water distribution systems

Protecting Drinking Water Pipelines with Inflow Prevention

As Val-Matic Valve and Manufacturing Corp.'s information says, "A significant risk to public health exists when a drinking water distribution system is exposed to the inflow of contaminated water or toxins at air valve locations along the drinking water pipeline. While public drinking water systems are routinely protected from contamination at the points of service with backflow prevention devices, little attention has been paid to air valve and vent inflow locations in water pipeline vaults located throughout distribution systems."

Figure 6-53—Inflow preventer valve

Courtesy Val-matic

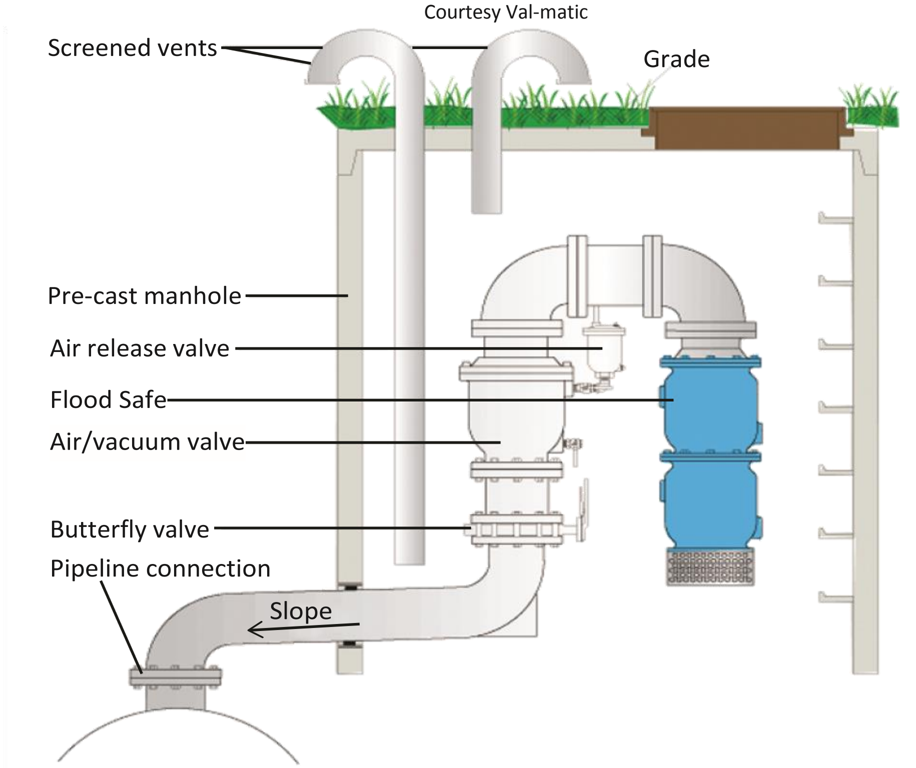

Figure 6-54—Vault piped with flood safe preventer valve

Courtesy Val-matic

Content

Here are some issues for water works:

Flushing of water mains at blow-out and fire hydrants connections could reduce pressures increasing the potential for cross connections. Blow-out connections when located below ground should be capped when not in use and extended above ground when the water main is being blown out.

Installation of an air release valve at high points in underground water mains to eliminated air in water mains is a potential cross connection. If the air release is below ground the air inlet vent should be piped to an above ground location. Consult with the AHJ for installation specifications.

A vacuum release valve is installed, typically at high points in water mains. The vacuum release allows air into the water main to prevent a vacuum occurring in the water main. A vacuum in a water main will create a back-syphonage condition. If the vacuum release is below ground the air inlet opening should be piped to an above ground location. Consult with the AHJ for installation specifications.

Stop and waste valves act as a shut off and also a drain valve. When the valve is in a closed system the drain opening allows water to drain from the downstream piping. The drain opening underground is subject to flooding and is a potential cross connection. The use of a stop and drain valve below ground should be avoided. Consult with the AHJ for installation specifications.

Fire hydrants often have drains at the bottom of the hydrant barrel. The drain prevents freezing of the barrel. This drain is open when the hydrant is off and is a potential cross connection source. Consult with the AHJ for installation specifications. There does not seem to be a solution to this issue at this time, other than providing a well-drained aggregate fill at the base of the hydrant.

New sections of water main must be tested, chlorinated, bacteria samples taken, and approved before being connected to the existing system. The minimum backflow protection used when filling and testing the new system form the existing system would be a DCVA. It is recommended to disconnect the fill pipe from the existing system if hydrostatic testing is applied to the new system. Consult with the AHJ for installation and testing specifications.

Any piping and fittings used to connect a new previously tested and passed system to the existing system shall be cleaned to remove debris and bacteria, typically chlorination. Consult with the AHJ for cleaning procedures and specifications.

Content

RP protections for sewage lift stations

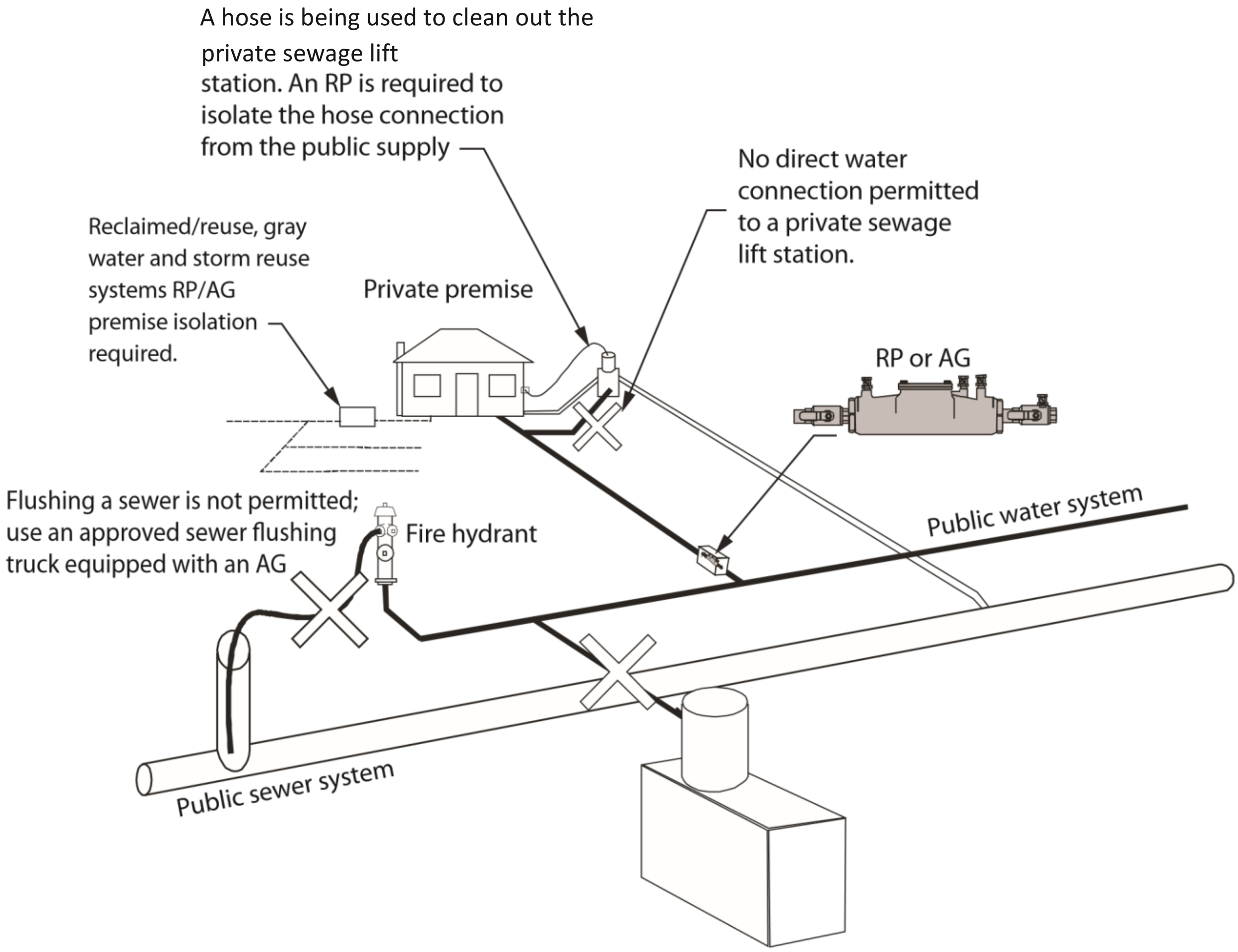

Figure 6-55—Sewage lift station do's and don'ts

Figure 6-55 shows examples of illegal use of water to flush out and clean sewage lift stations and sewer mains.

In no case will a potable water main be directly connected to a sewer system with or without backflow protection.

Flushing of a sewer main must only be completed by first filling a storage tank or truck.

The water supply to a storage tank must be supplied through an air gap. Water is pumped from the storage tank or truck to flush the sewers.

A designated hydrant equipped with an RP must be used to fill a sewage main flushing truck.

Figure 6-55 also shows an example of a grey water underground reuse system as well as a private sewage lift station. The inappropriate use of a hose connection from the private residence to either of these systems is possible so a RP or AG must be installed at the water service.

Content

Reuse or reclaimed, storm water reuse and grey water systems

Reuse (reclaimed), grey water reuse systems and storm (rain) water reuse systems are considered a high hazard, and premise isolation with an **air gap or a RP is required**. Where these systems exist, there is a possibility of the systems being interconnected with the potable system.

Where reclaimed water is derived from the effluent of sewage wastewater treatment, **no direct connection shall exist** between the potable system and the reclaimed water system.

Where potable water is used to supplement a reclaimed water system, an annually inspected air gap shall be installed to isolate the potable system from the reclaimed water system.

Reclaimed water systems

Reclaimed water refers to wastewater (sewage) that has been treated and reused for non-drinking water applications such as irrigation. Municipal controlled reclaimed water systems are common where water supply issues are a concern (not so much in Canada). The international colour standard for identifying these reclaimed water system pipes and components is purple. This purple pipe can be easily distinguished from potable drinking water system piping.

Note: Purple should not be used to identify other reuse water systems such as grey water systems or storm water reuse systems that have not been treated to reclaimed water treatment standards.

Grey water systems

Grey water systems are underground irrigation systems that use household wastewater discharge that does not contain human/animal wastes or food wastes (grey water). Examples of grey water fixtures include laundry tubs, showers, basins, bathtubs, and clothes washers.

Grey water may contain microorganisms (some likely pathogenic), dissolved salts (e.g. sodium, nitrogen, phosphates, and chloride), organics (e.g. oils, fats, milk, food, soap and detergents), or particles of dirt, lint, sand, etc. Grey water may also contain petroleum-based oils, paints, and solvents from activities that could have detrimental effects on areas irrigated with the grey water.

Grey water is often contaminated with human and animal excretions from bathing and from clothes washing.

Grey water systems are a severe hazard. Connections to the potable drinking water system are not permitted.

Grey water systems should not be used for above-ground irrigation unless specifically approved by health officials.

Storm water reuse systems

Storm water reuse systems collect and recycle storm water for irrigation purposes. These non- potable waters can contain organic or inorganic debris including fecal material such as animal droppings. Storm water should be considered non-potable. Storm water systems should not be connected to potable drinking waters systems.

Content

Rainwater collection systems

In rainwater collection systems it is not uncommon for an air-gap cross connection device to be installed. Often well or city water provides supplementary water to the rainwater collection storage tank. An air-gap is required at this supplementary supply. This prevents contamination from the tank flowing back into the potable source water supply.

Ground water systems use

Ground water may be defined as underground water that has come mainly from the seepage of surface water and is held beneath the earth's surface, often between saturated soil and rock that often supplies wells and springs. This water should not be directly connected to the potable water system.

Suggested safeguards for reclaimed water systems

Note this information is for your informational purposes only.

The major concern guiding design, construction, and operation of a reclaimed water distribution system is the prevention of cross-connections. The concern is to prevent improper use or inadvertent use of reclaimed water for a potable water supply. To protect public health from the outset a reclaimed water distribution system should be accompanied by health codes. Public health protection measures that should be addressed in the planning phase are identified below:

- Provide for the physical separation of the potable water, reclaimed water, sewer lines and appurtenances. **No direct connection** allowed to a potable water system.
- All components and appurtenances of the non-potable system should be clearly and consistently identified throughout the system.
- Identification should be through colour coding and marking. Purple for reclaimed water system only.
- The non-potable system components should be distinctly set apart from the potable system.
- Use marking methods that use unique colorings, labeling and markings.
- Non-potable piping and appurtenances should be painted an identifying colour or can be integrally stamped or marked with,
  - "CAUTION NONPOTABLE WATER – DO NOT DRINK" or
  - "CAUTION: RECLAIMED WATER – DO NOT DRINK," or
  - Non-potable piping may be wrapped in colour coded polyethylene vinyl wrap
  - Non-potable piping may be mark pipe with colored marking tape or adhesive vinyl tape.
  - When tape is used, the words
  - "CAUTION: RECLAIMED WATER – DO NOT DRINK") should be equal to the diameter of the pipe and placed longitudinally at 3 feet (0.9 meters) intervals.

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Other methods of identification and warning are: stenciled pipe with

- for pipes 2 to 3 inch (5 to 8 cm) letters on opposite sides, placed every 3 to 4 feet (0.9 to 1.2 meters)
- for pipe less than 2 inches (5 cm), lettering should be at least 5⁄8 inch (1.6 cm) at 1 foot (30 cm) intervals
- plastic marking tape (with or without metallic tracer) with lettering equal to the diameter of pipe, continuous over the length of pipe at no more than 5 foot (1.5 meter) intervals

- Vinyl adhesive tape may be placed at the top of the pipe for diameters 2.5 to 3 inches (6 to 8 cm) and along opposite sides of the pipe for diameters 6 to 16 inches (15 to 40 cm), and along both sides and on top of the pipe for diameters of 20 inches (51 cm) or greater (AWWA, 1994).
- Advisory signs and labels to be place on vaults, service boxes, or compartments that house hose bibs, along with all labels on hose bibs, valves, and outlets, to bear the words,
    - "Do Not Drink", along with equivalent international symbol
- Advisory signs for storage ponds or decorative water features bear the words
    - "Do Not Swim or drink", along with equivalent international symbol

Note: The National (BC) Plumbing Code Division B Part 2 2.7.1.1 (1) not permitted States: “A Non-Potable water system shall not be connected to a potable water system.”

All reclaimed, recycled, grey water, storm water reuse systems etc. should first be considered as non-potable.

Content

Fire sprinkler systems backflow prevention installation

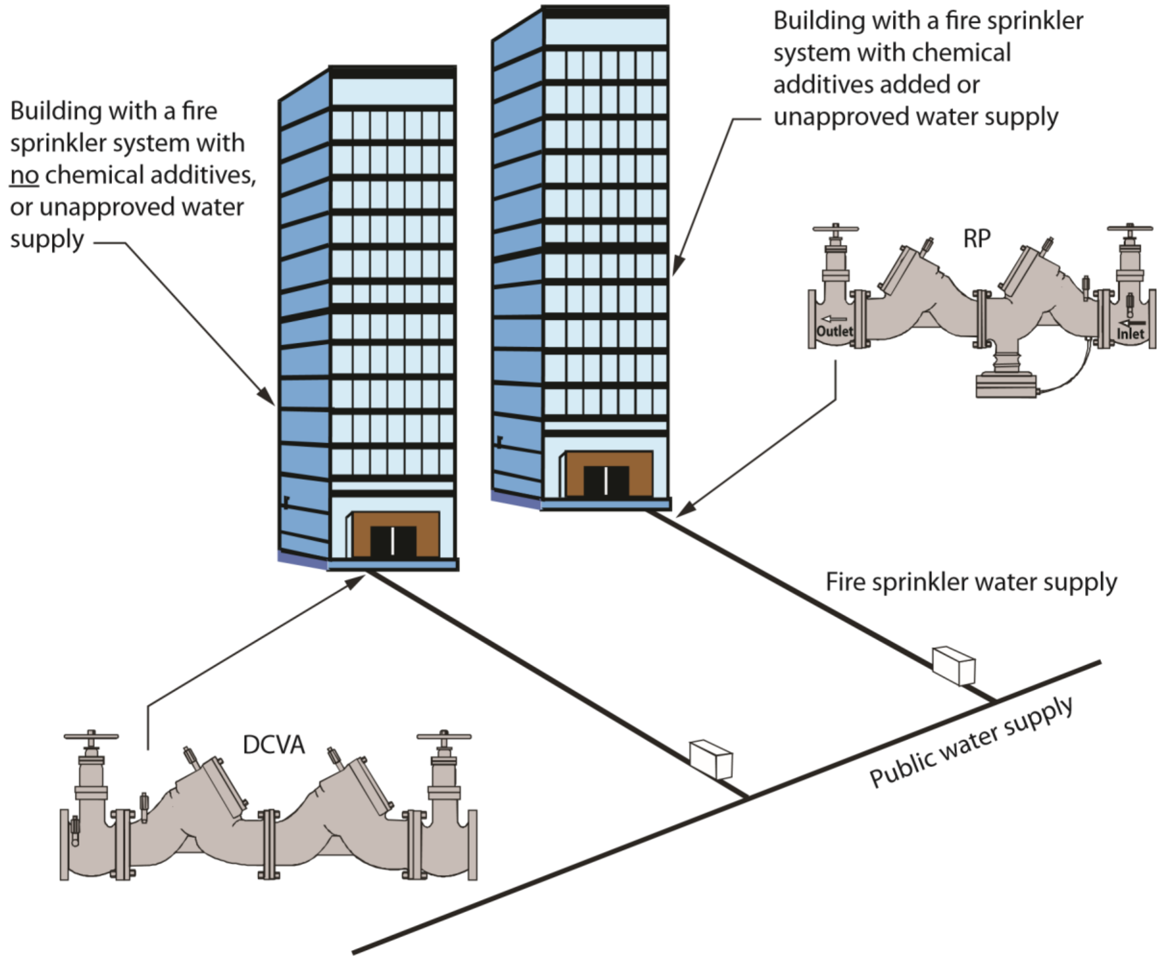


Figure 6-56—RP and DCVA installed on commercial fire sprinkler system

Figure 6-56 shows a RP and DCVA installed on other than a single family residential fire sprinkler system. A RPDA or DCDA, RPDA type II and DCDA type II may also be used.

For cross connection control purposes fire sprinkler system's degree of hazard may be categorized into the following three groups:

1. Non-residential: severe hazard fire systems with treatment chemicals, antifreeze added, tanks or reservoirs or with a fire department connection (FDC) within 518 m (1700 ft.) of an auxiliary supply. A RP or RPDA is required
2. Non-residential: moderate hazard fire systems with no treatment chemicals or antifreeze pumps, tanks or reservoirs. A DCVA or DCDA is required.
3. Single family residential fire systems with minor to moderate, no additives. DuC (consult AHJ)

Content

The following list is the hazards concerns of a fire sprinkler system:

- Growth of offensive microorganisms.
- Leaching of metals from piping materials used to construct the system
- Addition of chemicals to prevent corrosion and antifreeze solutions to prevent freezing
- Possibility of contaminated water flowing back into the potable system
- The piping material used to construct the system (potable or non-potable pipe used)
- The possibility of auxiliary water supplies being connected to the fire protection system
- Microbiologically Influenced Corrosion (MIC)

MIC is the term used for corrosion influenced by microbes in the water. The primary concern is that the influence of these microbes is often an extremely accelerated rate of corrosion. Additives added to a fire sprinkler system to treat MIC will likely require the use of an RP. You will need to consult with the AHJ. There are different opinions on this subject and the value of additives.

Here are some installation considerations for a backflow preventer for a fire sprinkler system:

- Do not use strainers on fire sprinkler line unless approved by insurance underwriters.
- Be aware of the proximity of auxiliary supplies, especially with in 518 m (1700 ft) of a Fire department connection (FDC).
- Size the backflow preventer to the hydraulic demand of the fire sprinkler system.
- The Fire department connection shall be installed downstream of the backflow preventer.
- A fire department connection with an available unapproved auxiliary supply is high hazard. A RP or RPDA is required.

Refer to your copy of the Canadian or Provincial Plumbing Code section 7.6 potable water systems, sub section backflow from fire protection systems.

Content

Fire sprinkler system back flow requirements

Note: The following requirements are referenced from the BC Plumbing Code Format and wording may not be exact; therefore, application in the field should be referred to the appropriate standard and authority having jurisdiction (AHJ).

Auxiliary water supplies (fire sprinkler system)

The auxiliary water supply of a fire sprinkler system may include water from another purveyor's public water supply or any natural source, such as a well, lake, spring, river, stream, harbor, and/or used waters or industrial fluids. Where an auxiliary supply is available an RP may be required.

A**n RP, when required on the potable water service pipe will also require an RP on the separate fire service.**

Where a RP backflow preventer is required on the potable water service pipe for a premise that also has a class 3, 4, 5 or 6 separate fire service connection, an RP must also be installed on the separate fire service. The RP must conform to *CSA B64-10/B64.10.*

Residential fire sprinkler systems

Residential fire sprinkler systems that use piping and fittings that are approved for potable use may not be a cross connection hazard. Single family residential sprinkler systems can be designed and installed using approved potable water piping. These residential fire protection systems are designed in such a way to allow water to circulate throughout the entire system. The circulation of water prevents stagnant water from occurring. These residential fire sprinkler systems are referred to as full flow-through systems and they may not require backflow protection.

Residential full flow through systems

Residential full flow through fire sprinkler system means an assembly of pipe and fittings that conveys water from the water service pipe to the fire sprinkler outlets. The system is fully integrated into the potable water system to ensure a regular flow of water through all parts of both systems.

Protection required:

A backflow preventer shall not be required in residential full flow through systems, in which the pipe and fittings are constructed of potable water system materials.

Residential partial flow through fire sprinkler system

Residential partial flow through a fire sprinkler system means an assembly of pipe and fittings that conveys water from the water service pipe to the fire sprinkler outlet. Flow only occurs through the main header to a water closet located at the farthest point of the system during non-functioning periods of the fire system.

Protection required:

Residential partial flow through fire sprinkler systems in which the pipe and fittings are constructed of potable water system materials shall be protected by a dual check valve for fire systems (DuC) backflow preventer conforming to *CSA B64-6.1, Backflow Preventers, And Dual Check Valve Type for Fire Systems.*

Content

Selection table for Backflow Preventers on Fire Sprinkler and Standpipe Systems Table 6-5 is an example only and is to be used for educational use only. Consult the current AHJ for the appropriate regulations.

Type of Backflow Preventer Recommended	When Potable Water System Materials are Used		When Non-Potable Potable Water System Materials are Used	
	Minor Hazard Residential Partial Flow Through System	**Minor Hazard** Class 1 System	**Moderate Hazard** Class 1, 2 or 3 systems Class 6 system supplied by public water supply only	**Severe Hazard** Class 6 system Class 4 and 5 systems with antifreeze or other additives
DuC	P	NP	NP	NP
SCVA	P	P	NP	NP
DCVA	P	P	P	NP
RP	P	P	P	P

P = permitted NP = not permitted

Table 6-5— Fire sprinkler protection required (from BC Plumbing Code Division B Appendix A)

Here is national Fire protection association (NFPA) regulations related to cross connection. Consult with AHJ and current NFPA regulations.

Fire Protection Systems General Conditions:

- Antifreeze solutions must be water solutions of pure glycerin (C.P. or U.S.P., 96.5% grade) or propylene glycol conforming to of NFPA-13, current Edition. These are best described as food grade chemicals.
- Antifreeze solutions must be tested to verify compliance with above conditions. Any other antifreeze solution is **not** permitted and must be replaced.
- Expansion chambers shall be of an appropriate size to compensate for thermal expansion of antifreeze solution.
- An adequate amount of piping before or after the location of any backflow prevention device shall be increased in size to compensate for the pressure loss created by the device being installed. The flows are to be in accordance with NFPA-13 for the appropriate hazard classification in the area downstream of the backflow prevention device.

Content

Backflow preventer approved for fire sprinkler use

The National Fire Protection Association (NFPA) regulates fire protection systems.

NFPA requires that backflow preventers and related equipment must be Underwriters Laboratory (UL) approved for use in a fire sprinkler system. An approved backflow preventer installed in a fire sprinkler system must bear a UL (ULC Underwriters Canada) label. Backflow preventers approved for fire sprinkler systems are designed to provide maximum flow with the lowest possible pressure loss.

Figure 6-57—Fire sprinkler system class 1 no chemical additives

DCVA installed with indicating shut–off valves with tamper switches. If you operate these valves you are sure to cause an emergency alarm.

Note: When testing this assembly, you must also notify fire officials before shutting any fire system valves off and comply with any requirements requested by the fire officials.

Content

Identify and apply the correct backflow device for specific cross connections

Backflow prevention devices are backflow preventers used to protect against minor hazard cross connections. They shall not be used as a substitute for a testable backflow assembly. In certain applications, a backflow device can be used in a high hazard situation if it is backed up with an appropriate assembly.

Review backflow prevention devices in this manual.

The following should be considered when selecting and installing a HCVB, AVB and DuC-VB devices:

- Refer to Chapter 4 for more considerations for AVB, HCVB and dual check vacuum breaker
- In all cases consult with the local water purveyor and manufacturer's directions before using a backflow prevention device
- Suitable for back syphonage backflow only
- Suitable for minor health hazard and is used for high hazard only with additional RP protection. Consult with the AHJ.
- Suitable for in-plant fixture isolation.
- Not to be used for premise isolation in any case.

Dual Check (DuC) Vacuum Breakers prevent the reverse flow of polluted water from entering into the potable water supply. It consists of a Lead Free (LF) brass body construction with an atmospheric vent, and NPT female inlet and outlet connections. Series LFN9 and LFN9C are designed for non-health hazard, continuous pressure. (C = chrome plated)

Figure 6-58—LFN9

Courtesy of Watts dual check vacuum breaker

These devices are not intended for installation where emergency or temporary water discharge can cause water damage because they are not designed to be spillage free under all service conditions. For this reason and for maintenance accessibility, these devices must not be installed inside a wall or any concealed location. This device should be installed at the furthermost downstream end of the supply pipe or fixture where temporary spillage due to critical flow pressure conditions can be discharged harmlessly. Also, the backflow preventer will operate most satisfactorily when located as far downstream as possible, because any backpressure is minimized applications Refer to *CAN/CSA-B64.10* current publications for detailed application of backflow preventers.

Recall each premise must be evaluated on its own merits.

Content

The following is a partial list of examples of uses of HCVB, AVB, and DuC-VB:

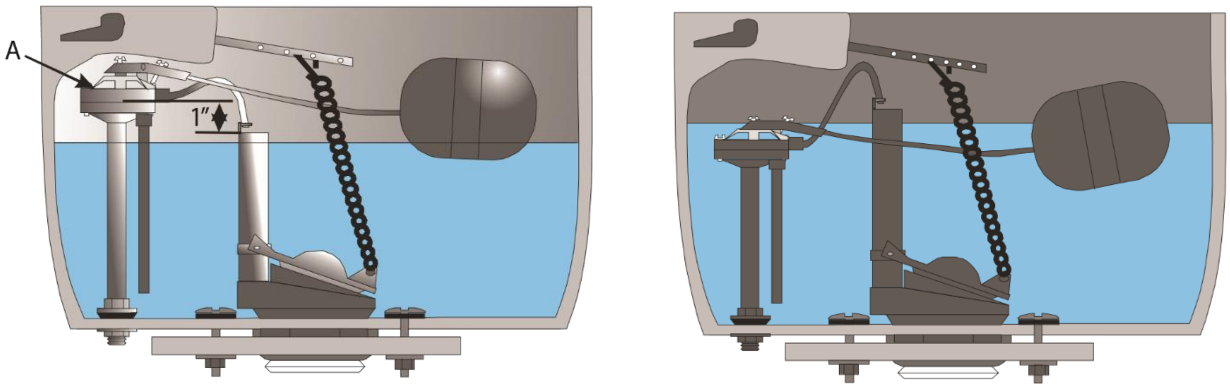
- laboratory bench equipment AVB, LFVB high hazard backed up with RPBA
- laboratory bench equipment AVB, LFVB minor hazard
- bidet AVB
- aspirator non-toxic AVB, LFVB serrated faucet AVB, LFVB

The following is a partial list of examples of use of a DuC:

- residential water services minor hazard
- residential fire sprinkler systems minor hazard
- jetted bathtubs with telephone shower mounted in the tub deck

AVB for water closet tanks

Figure 6-59 shows how to eliminate the risk of reverse flow in toilet tanks, anti-siphon ball valve "A". The ball valve should be installed with a minimum 25mm (1 inch) air gap above the overflow tube.



Correct installation Incorrect installation

Figure 6-59—AVB installation in flush toilet. Correct shown on left; Incorrect on right.

Figure 6-60—Governor 80 Ball Cock and Thermal Expansion Relief Valve

Courtesy Watts Canada Governor 80.

Series Governor 80 Ball Cock and Thermal Expansion Relief Valves are triple-function devices: a toilet tank ball cock, an anti-siphon backflow preventer and a thermal expansion pressure relief valve. The Governor 80 limits the domestic water system’s preset static pressure, protects the temperature and pressure relief valve on the water heater, reduces the requirement for a thermal expansion tank or an auxiliary relief valve and prevents backflow from water closets. The relief valve is set at 80 psi.

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Back flow protection for residential service connections DuC

Figure 6-61 shows a dual check valve (DuC) installed on a minor hazard residential water service, typically ¾". The dual check shown is sometimes referred to as an angle dual meter check. DuC backflow preventers are available in other patterns and sizes. (Refer to Chapter 4.)

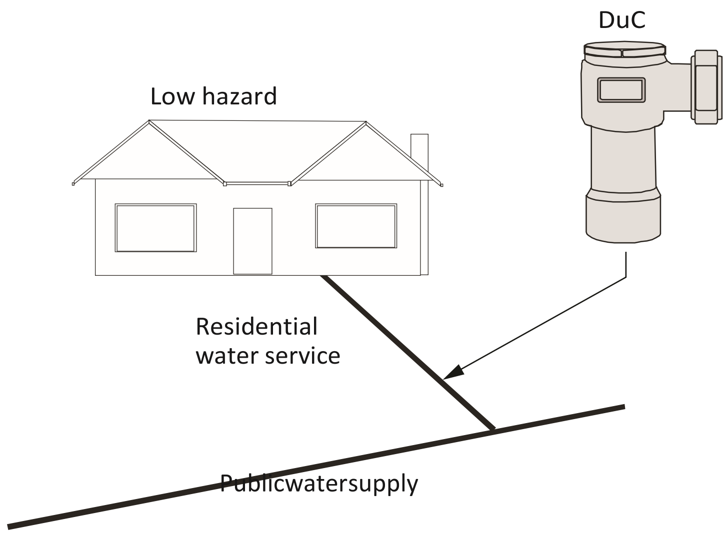

Figure 6-61—DuC installed on a minor hazard residential water service

Note: Refer to *CAN/CSA-B64.10* current publications for detailed application of backflow preventers.

In all cases consult the water purveyor before installing a backflow device.

Installation practices include for a DuC:

- Except for fire sprinkler system a strainer up stream may be useful.
- As with any back pressure backflow preventers, provisions for thermal expansion and or water hammer may be required.
- As with most backflow devices they do not have nationally recognized standardized test procedures; however, some AHJ may require manufactures test procedures be used if available.
- Should be installed with union connections and adequate space for maintenance and testing.

Figure 6-62—DuC

Courtesy of Watts Canada

Content

Vending machine back flow protection

The hazards of vending machines

Soft drink dispensers (post-mix carbonators) use carbonated water mixed under pressure with syrup and water to provide soft drinks beverages. Many, water pipes are made of copper. When carbonated water comes into contact with copper, it chemically dissolves the copper. This copper-carbonate solution has been proven to be a risk to the digestive system. Ingestion of water containing concentrations of copper and carbonic acid can result in vomiting and nausea, with generally no long-term effects. Also various syrups are mixed with the carbonated water; these syrups must not be allowed to enter back into the potable system.

The following illustration indicates the minimum requirements for carbonated beverage machines; a water purveyor may require protection with a stainless steel RP.

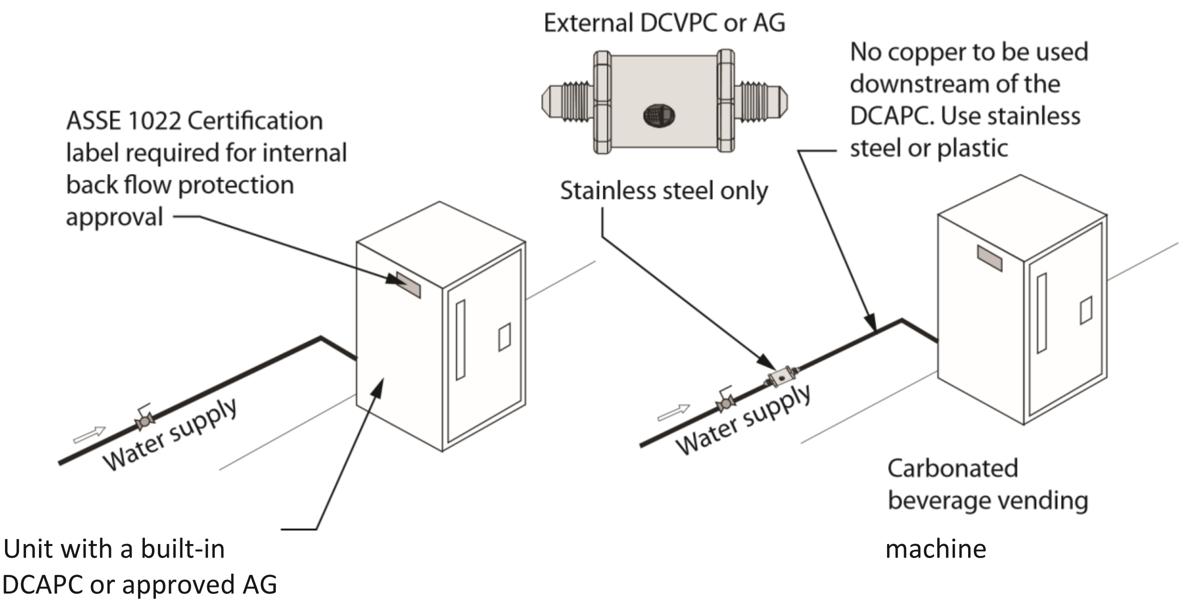

Figure 6-63—Carbonated vending machine installed with DCAPC minimum requirements

Figure 6-63 shows a dual check valve with vent port (DCAPC) installed carbonated vending machine. The letter "C" stands for carbonated water use)

CAN/CSA B64.10-07 allows a DCAPC for vending machines with carbonators.

New vending machines may be manufactured with integral AG or DCAPC. The dispenser shall bear the label of an approved testing agency, certifying and attesting that such equipment has been tested and inspected and meets the requirements of the approved applicable (*ASSE 1022*) standard. Carbonated vending machines without internal protection shall have an AG or approved DCAPC installed on the water supply to the vending machine.

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Currently several backflow preventers have been certified to the requirements of ASSE Standard 1022. Some approved backflow prevention devices are listed below:

- ABCO (Anderson Brass Company) model AB-1.
- Watts Regulator model SD-3.
- Conbraco model 4C-100 series CBBP.

There is often controversy over backflow protection for these carbonated vending machines. Before you proceed to install any backflow preventer for vending machine consult the AHJ.

Post mix and pre mixed vending machines

Post mix vending machine means a vending machine that mixes the ingredient at the machine.

Premix vending machine means a vending machine that distributes the beverage from pre mixed packages.

Vending machine backflow protection

The following is a list of suggested backflow protection requirements for vending machine:

- To prevent leaching of toxic materials caused by possible interaction of carbonated water, piping and contact-surfaces, post-mix, soft drink vending machines which are directly connected to the external water supply system must be equipped with appropriate backflow protection. An Stainless steel (SS) RP is required or a brass RP with a DCAPC downstream of the RP. (Consult the AHJ)
- Install the backflow preventer immediately upstream from the carbonator, with no copper tubing or other potentially toxic tubing or contact surfaces in or downstream from the backflow preventer.
- A filter screen of not less than 100 mesh per 25mm (one inch) must be installed in the water line immediately upstream of the backflow preventer in a location which permits servicing or replacement.
- In all vending machines in which carbon dioxide is used, all food-contact surfaces from the backflow preventer, will be of such material as to preclude the production of toxic substances which might result from interaction with carbon dioxide or carbonated water.
- Provide adequate drainage for the backflow preventer relief port.

Content

DCAPC protection carbonated beverage system

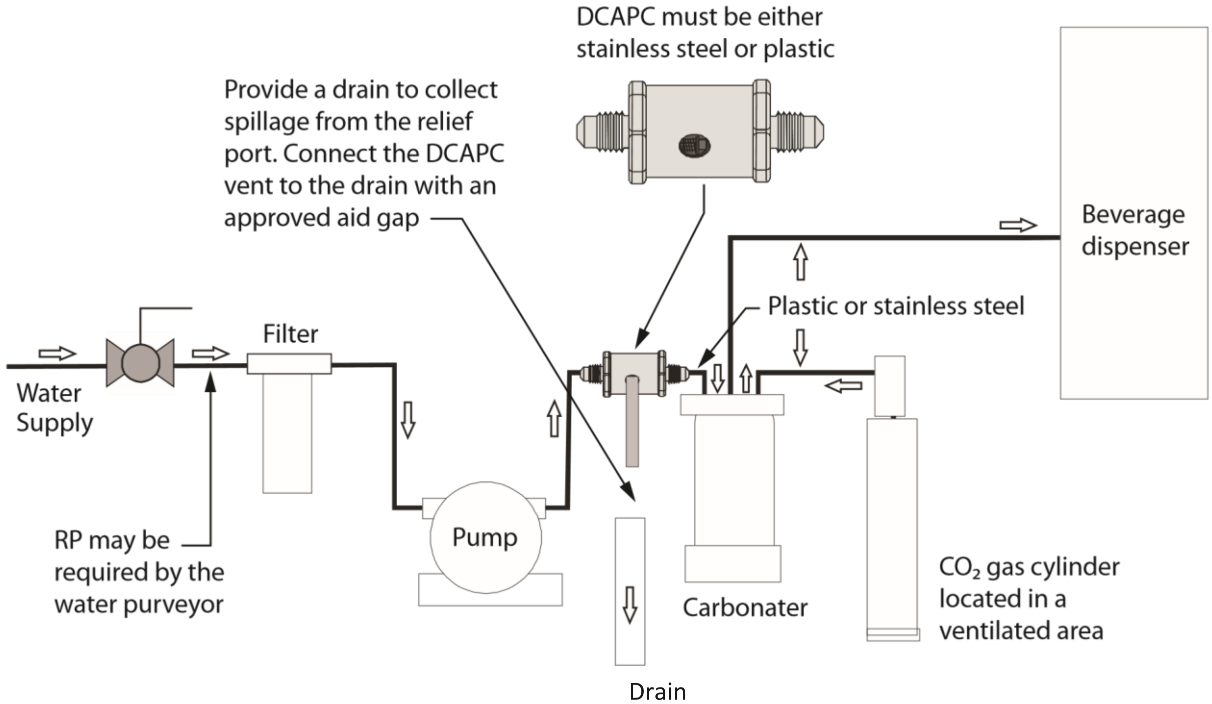

Figure 6-64—DCAPC protection carbonated beverage system

Figure 6-64 shows a carbonated beverage piping system protected with a stainless steel DCAPC.

The current placement of the DCAPC in Figure 6-64 will prevent carbon dioxide gas and carbonic acid from getting back to the pump and possibly causing corrosion of the pump components. If the DCAPC is moved to the inlet of the filter, all components downstream of the DCAPC must made of a material that is not affected by carbon dioxide gas, stainless steel, plastic, no copper is allowed.

Note: Consult the water purveyor and manufacturer for the approved use and correct location of the DCAPC prior to installing the system. Many AHJ require a stainless steel RP for carbonated vending machines. A brass RP may be acceptable if a stainless DCAPC is also installed between the carbonated system and the RP.

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Beverage dispensers

Here are few examples of back flow protection for beverage dispensers.

Figure 6-65—Beverage dispenser with DuC

Picture shows hot beverage dispensers, minor to moderate hazard

With DuC's installed, first approved by the AHJ. A DCAP could also be used; however, drainage through an air gap would also be required.

Figure 6-66—Beverage dispenser before installation of DuC

Content

Backflow protection for hydronic heating systems

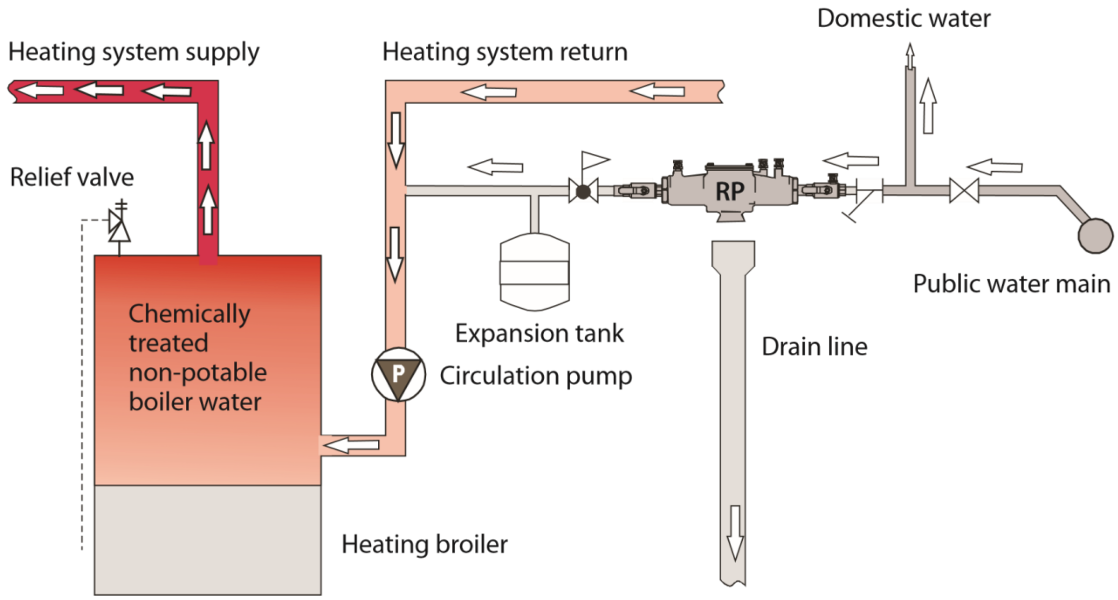

Figure 6-67—RP installed on a commercial heating system

Figure 6-67 shows a RP used to protect the public water supply from contamination of a heating boiler with chemical additives. Pressure vessels including boilers that are connected to the public water main can be minor to moderate or high hazard. Heating boilers are considered a high hazard when water treatment chemicals have been added. A RP would be the required.

Some boilers do not have chemicals added; in such cases they are a moderate hazard and a DCVA would be appropriate protection.

CAN/CSA-B64.10 current publication allows a dual check valve with an atmospheric port to be used on a heating system. The system must use potable rated components and no chemicals or means to add chemicals. Consult your AHJ

Note: The possibility that an owner or maintenance personnel could add chemicals to a boiler at a later date without knowledge of the water purveyor may cause some water purveyors to require RP protection. Consult your AHJ.

Content

Protection for residential heating boiler with no additives

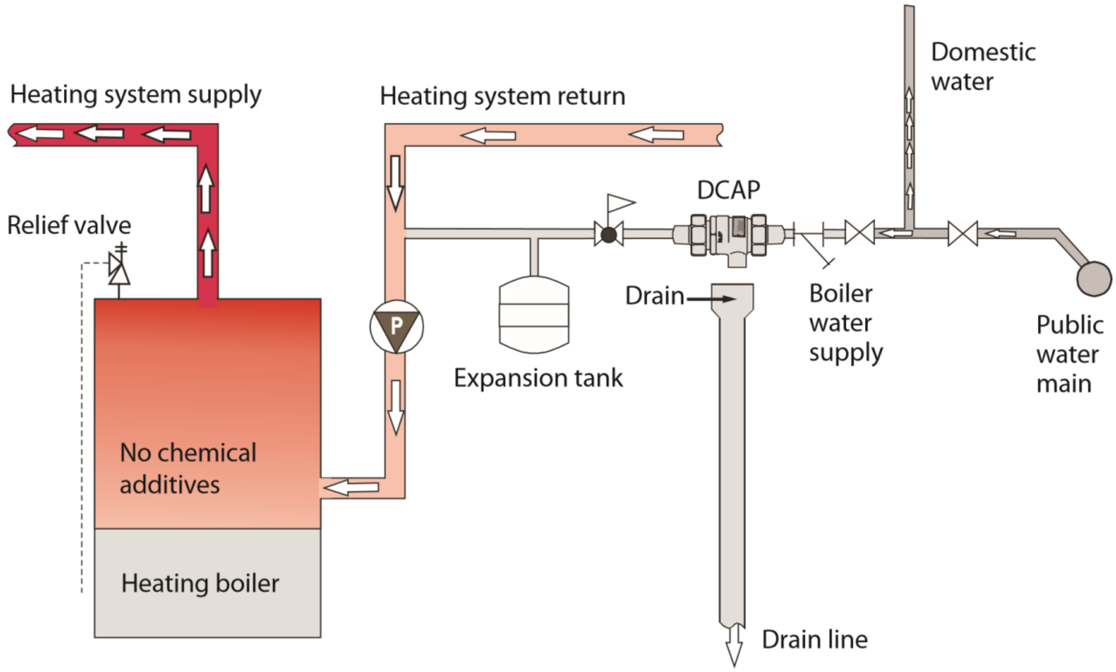

Figure 6-68—DCAP installed on residential heating boiler

Figure 6-68 shows a DCAP installed on a residential heating system. The components of the system are potable water rated; for example, copper or plastic materials. The system has no chemical additive. This system hazard level is minor. Backpressure is a concern. A water purveyor **may** allow the use of a DCAP in this circumstance.

The following is a partial list of examples for possible use of a DCAP:

- beverage machines moderate hazard (non-carbonated)
- humidifier minor to moderate hazard
- residential heating system with no chemicals added
- piping supplying a hose-bib, rated as a moderate hazard
- pressure washer with no aspirator minor hazard
- steam table minor to moderate hazard

Note: When a DCAP is used for individual fixture isolation of moderate hazard or high hazard, they may need additional protection. Consult with the AHJ. A DCAP is not approved for commercial heating systems. Refer to *CAN/CSA-B64.10* current additions for detailed application of backflow preventers.

Content

Heat exchangers and solar systems

Note: The following information on heat exchangers and solar systems should be confirmed with your AHJ. This information is intended to help you in making valued decisions in the field. The hazard level of heat changers is a hot topic so you really need to consult with the AHJ.

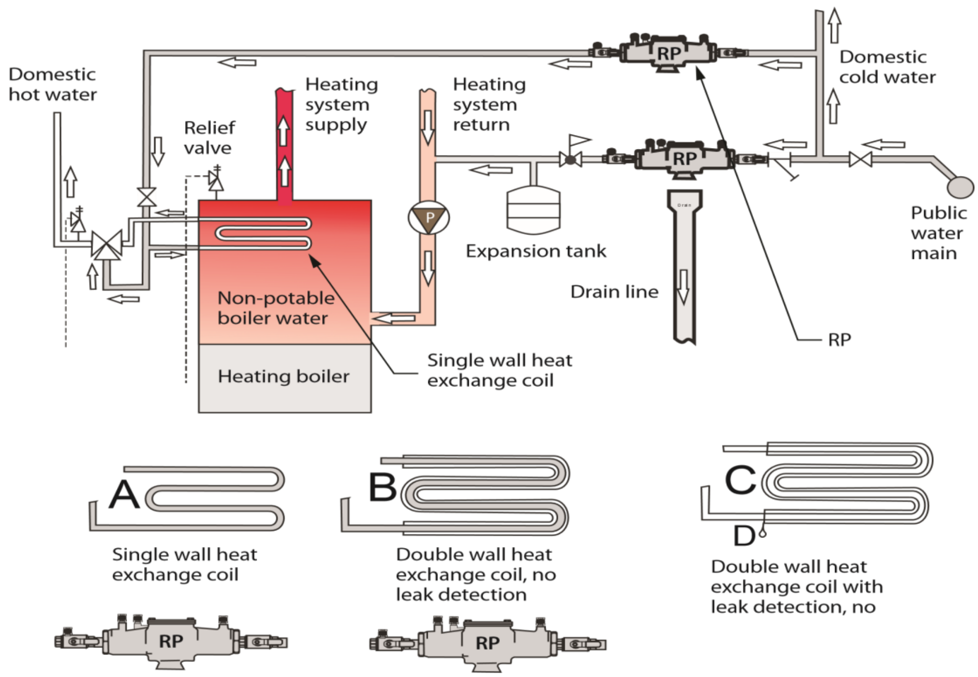

Figure 6-69—Heat exchangers and backflow protection required

Recall the CSA definition of a heat exchanger is a device or an assembly that transfers heat between two physically separated fluids.

The problem with heat exchangers is that failure of the heat exchanger wall will allow the boiler water (the heating medium) to contaminate the potable water system. The contamination will occur on the domestic hot water side downstream of the heat exchanger even when the RP in figure 6-69 is present and operating.

The double wall with leak detection requires no further back flow protection or testing. Any failure of the wall of the heat exchanger allows non-potable water to flow to open air. There is no contamination of the domestic water supply either upstream or downstream of the heat exchanger.

There are opinions that the double wall leak detection heat exchanger is inefficient so are not readily accepted by some; however, proper sizing of the heat exchanger can solve this issue and provide very good cross connection protection at the same time.

Cross connection back flow can occur through the heat exchanger walls from the heat transfer fluid side to the potable water systems side whenever the fluid pressure is higher than the potable water supply. Annex "F" of CSA B64-10 suggests that heat exchangers have means to automatically maintain the heat transfer fluid lower than the potable water supply pressure.

Any hydronic heating system connected to the potable water system shall have the appropriate back syphonage or back pressure protection installed on the connection.

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Heat exchanger consideration

Before considering using lower levels of protection other than the installation of an RP or DWP for a heat exchanger, you may need to consider the flowing:

A leak in single wall heat exchangers wall used for domestic hot water use could result in the higher pressure potable water flowing through exchanger wall and into the non-potable boiler water. At first glance the result would appear to be no backflow of non-potable boiler water fluid back flowing into the domestic potable system. You may jump to a conclusion that this example is not a cross connection problem, no backflow protection required. Perhaps you would reconsider your conclusion and consider back flow protection is required when any back flow of a heat transfer fluid is possible.

- Opening and closing of valves during maintenance and repair may result in the domestic water system pressure to drop lower than that of the heat transfer fluid in the exchanger. A leak in the exchanger wall would result in back flow of heat transfer fluid into the potable water system.
- If the water main is shut down or under heavy use this can cause a lowering of the supply pressure to less than the boiler water pressure. Backflow of heat transfer fluid into the potable water system will occur.
- The boiler water feed line pressure reducing valve set higher than the potable water supply pressure.
- A potable heat exchange fluid medium can degrade over time.
- The heating mediums tend dissolve metal components of the system.
- An existing potable rated heated medium can be easily replaced with a non-potable heated medium.
- Maintenance workers performing repairs or alterations to the system without AHJ knowledge.

Note: all of the above scenarios are reduced or eliminated by the use of a double wall heat exchanger with leak detection. Double wall heat exchangers with leak detection do not require any further backflow protection.

Flat plate heat exchangers

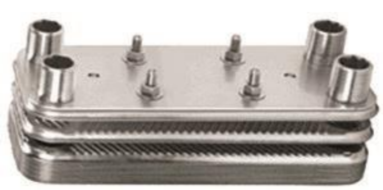

Figure 6-70—Flat plate heat exchanger

Courtesy SEC heat exchanger PEI Canada

Flat plate manufacturers have available a double wall, vented brazed plate heat exchangers. These exchangers meet local plumbing codes. The manufacturer states that their flat plate exchanger advantages are being highly compact and ideal for new construction. The flat plate exchanger is an alternative to shell and tube heat exchangers. Their flat plate double wall heat exchanger with leak path provides protection of the potable water supply from boiler water and other non-potable fluids.

Recall the CSA definition of a heat transfer fluid is a fluid that is used to transport thermal energy from one location to another.

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CSA Standards: Backflow from hydronic heating systems summary

You should have in your possession the CSA standards as referenced by the CPC

Hydronic heating systems connected to the potable water distribution system must have cross connection protection against back pressure or backsiphonage. Those hydronic heating systems with heat exchangers for domestic hot water purposes need to follow CSA procedures or those of the Authority Having Jurisdiction.

Typical examples of back flow prevention requirement (CSA reference)

Residential hydronic heating systems constructed with material approved for potable water use and no chemical additive or no provisions to add chemical additives.

- Use a CSA approved DCAP or
- Use a CSA approved DCVA

Residential hydronic or any other premise heating systems not constructed with material approved for potable water use and no chemical additive or no provisions to add chemical additives.

- Use a CSA approved DCVA or
- Use a CSA approved RP

Any residential premise containing a hydronic heating system containing chemicals or provisions to add chemicals.

- Use a RP approved by CSA

All other premises (other than residential) with outlets to provide supply make up water to heat transfer unit fluids in all other heating systems shall protect against backpressure or backsiphonage bac flow

- use a CSA approved RP

Note: Check with The AHJ for use of a Double wall with leak protection back flow prevention

CSA Standards: Heat exchanger and fluid requirements summary

You should have in your possession the CSA standards as reference by the BC/CPC and AHJ local requirements.

Heat exchanger transfer units and transfer fluids

Using CSA Hodge and Sterner scale, heat transfer fluids that are potable or relatively harmless the heat exchanger can be:

- a single wall type or
- Double wall with visible leak detection

Double wall with visible leak detection exchanger are to be used with all other heat transfer units.

Any potable make-up water connections to heat exchanger fluid piping loops must be protected against backpressure or backsyphonage by the installation of a backflow preventer as per CSA “backflow from hydronic heating systems”

All other premises facilities with outlets to provide supply make up water to heat transfer unit fluids in all other heating systems shall protect against backpressure or backsiphonage backflow with an RP as per CSA series standards.

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Solar heating basic piping system

Solar package systems heat exchangers shall comply with CSA series standards

Solar heating of domestic hot water has become a popular energy saving addition to a domestic water system. These solar piping systems can be simple but are more often complex. The following information is dealing with the cross connection concerns that solar systems bring to the domestic potable water system.

The issue with these solar systems is when they require connections to the potable water system and contain heat exchangers and or use heat transfer fluids. These fluids can be a hazard so proper backflow prevention is required. Do it yourselfers and installers often do this work without building and plumbing permits. Alterations and connections to the potable water supply system can be made without knowledge of the AHJ. Plumbing permits are normally required for alteration of plumbing system the AHJ becomes aware of the installation determines the degree of hazard and prescribes appropriate backflow protection.

When a solar system is connected to the potable water system the potential for contamination of the domestic cold water system is increased. The AHJ can require the installation of appropriate back flow protection such as RP or a double wall heat exchanger with leak detection for severe hazards.

When a solar system is not initially connected to the potable water system the probability that the solar system will be connected to the potable water system at a later date without proper backflow protection and without AHJ knowledge is a concern.

Heat transfer fluids may deteriorate over time. A minor hazard transfer fluid could become a moderate or high hazard. The backflow prevention used at initial installation may no longer be appropriate. Maintenance of the system should ensure that heat transfer fluids are evaluated and replaced if they are not up to standards of their original hazard designation.
Replacing of a heat transfer fluid by the system owner operator can increase the risk if the wrong heat transfer fluid is used with a higher hazard designation

The double wall with leak detection exchanger is the best protection to avoid both upstream and downstream contamination. In some jurisdictions a double wall heat exchanger may be accepted; this does not protect the downstream consumers of the domestic hots water system. Consult with the AHJ, who may then be responsible for the increased risk associated heat transfer fluids.

The degree of hazard for solar systems can vary depending on:

- The type of system either a passive solar system, flow through system or active solar system.
- The type of heat exchanger used.
- The type of heat transfer fluid used.

Passive solar is a system that uses no external mechanical power to move the collected solar heat.

Flow-through system (once-through) uses all potable water rated piping and components do not use heat transfer mediums; instead they circulate the potable water through the solar collectors.

Active solar system uses a mechanical device, such as pump or fan run by electricity to transport air or water between a solar collector and the interior of a building for heating or cooling.

Content

Once through flow through

Figure 6-71 represents a once-through (flow-through) solar domestic water system example. It is not recommended for areas subject to freezing. These once through systems may not require a backflow preventer. (Figure 6-71 is not to be used for design purposes.)

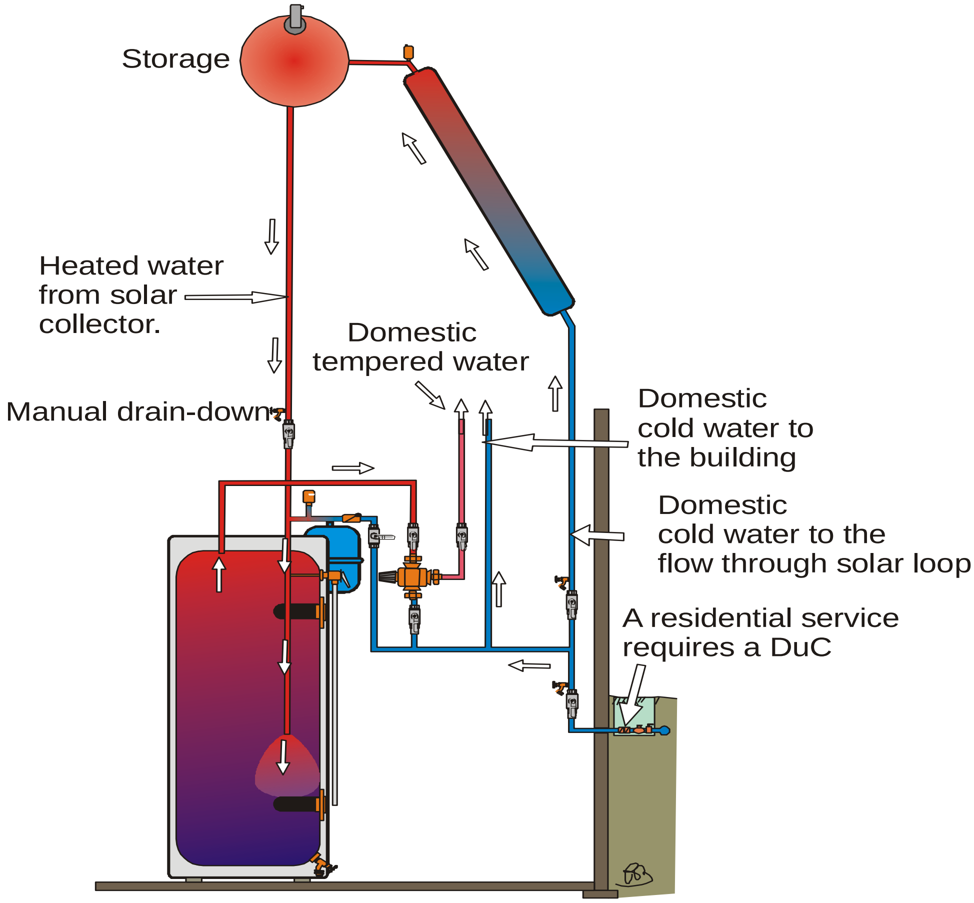


Figure 6-71—Basic flow through/once through solar system

Here is some information regarding liquid to liquid heat transfer systems as summarized from CSA B64-10 as referenced in the body of BC/CPC

Heat exchanger identification markings

Markings must be, permanent, legible, visible after installation acceptable to the AH, in metric units, and French and English.

Piping shall be clearly marked so that the difference between potable piping and transfer fluid is clear.

Markings on heat exchangers shall include the manufactures name and registered trade mark and location, the model name or number or both, serial number, maximum working pressure, and recommended rate of flow for the heat transfer fluid and the potable water

System transfer fluid should be should be specified and indicate a warning about substituting other fluids.

Single wall heat exchanger used on potable water systems must have a warning label stating DO NOT ADD TOXIC CHEMICALS, ADDITIVES, OR ETHANOL ANITFREEZE TO HEAT THE TRANSFER FLUID. and equivalent French wording.

Content

Active solar system

Figure 6-72 represents a simple residential single tank active solar system. A double wall heat exchanger with leak detection is used. Use of a double wall heat exchanger with leak detection reduces the possibility of contamination of the potable cold and hot systems.

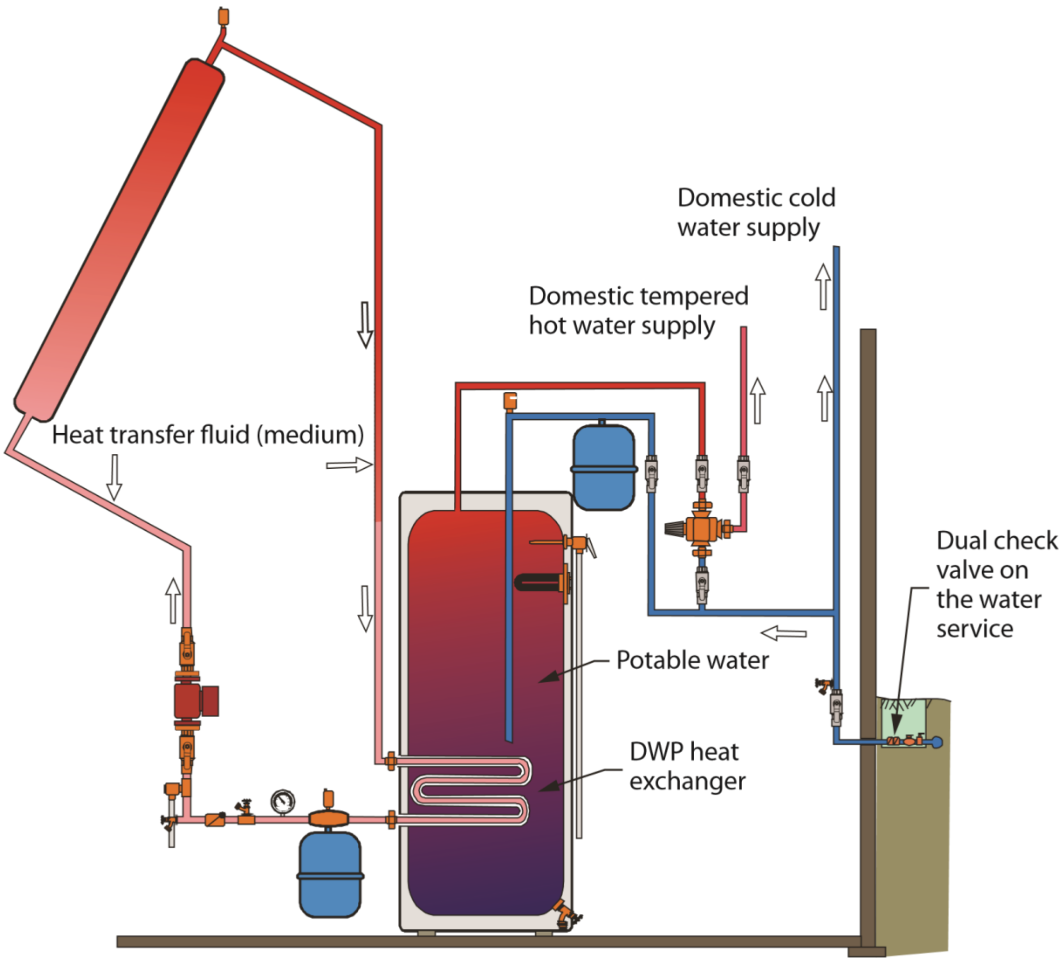


Figure 6-72—Active solar system DWP heat exchanger

Note: Figure 6-72 uses a DWP, so no further back flow protection or annual testing costs are needed. This DWP exchanger is the end of the story. There is very little possibility of the domestic cold and hot water system becoming contaminated with heat transfer medium.

Heat transfer mediums:

Heat transfer medium means the fluid used to collect the heat from the solar collector and distribute it to the heat exchanger. Heat transfer medium's hazard levels have been classified in some jurisdictions. The three levels of hazard used are severe, moderate and minor.

Content

Rating the toxicity level of heat transfer mediums

A non-toxic medium would need to be confirmed using a toxicity scale. An example of a toxicity scale is the Hodge and Sterner scale.

Note: To view an example of the Hodge Sterner scale, refer to the appendix. The AHJ not the assembly installer/tester, would need to confirm the toxicity of a heat transfer medium and then assess a hazard level and the appropriate backflow protection.

Heating medium hazard heat exchanger and type of protection:

Heating Medium	Heat Exchanger	Protection Required
Minor hazard	SW, DW and DWP	No protection required
Moderate hazard	SW	DCVA required
Moderate hazard	DW and DWP	No protection required
Severe hazard	SW and DW	RP protection required
Severe hazard	DWP	No protection required

Table 6-7—Heat exchanger type, hazard and protection required

This table is an example not to be used in the field. Consult with the AHJ and CSA B64-10 references Note: Always consult with the AHJ

Heat Exchanger Non-specific	Moderate to Severe
Hot water systems (all types – direct heating of water supply)	Minor
Solar energy units	Severe
Solar hot water systems (residential – no chemicals added)	Minor to Moderate
Solar hot water systems (residential – non-toxic heat transfer fluid	Minor to Moderate
Solar hot water systems (commercial – single wall heat exchangers)	Moderate to Severe
Solar hot water systems (all types – double walled heat exchangers)	Minor
Solar hot water systems (residential – toxic heat transfer fluid)	Severe
Here are a few examples of hazard level for similar equipment CSA	
Steam table	Moderate
Steam table	Minor
Steam cleaner	Moderate
Steam generator	Moderate
Steam boiler	Severe
Still	Minor

Table 6-8—Heat exchanger example hazard classifications

This table is an example not to be used in the field. Consult with the AHJ and CSA B64-10 references Note: Always consult with the AHJ

Content

Issues to consider when selecting a heat exchanger:

- Use of a heat transfer medium either potable or non-toxic does not take into account the possibility of degradation of the transfer medium over time due to continued heating and cooling and general contamination from system components, adsorption of metals.
- Also the danger of transfer mediums being changed is a concern especially when the AHJ may have no continued access to check systems once they are installed.
- Labeling of piping will help; however, the risk of degradation of the heated medium or 100% prevention of a potable heated medium from being changed to non-potable remains.
- Many jurisdictions consider any heat transfer medium as non-potable; therefore, accepting only double wall heat exchangers with leak detection or an RP. A simple solution to complex problem is double wall heat exchanger with leak detection.
- Unqualified sources have indicated that the double wall heat exchangers with leak detection are within 7% efficiency of a single wall exchanger. The cost is marginally higher and they often take up less space. They also eliminate the need for backflow prevention and the additional cost of annual maintenance of the backflow preventer

Reference information:
From the Oregon State plumbing and health regulation, this is not a Canadian standard; however, it demonstrates the concern for unqualified persons working on the plumbing system including solar systems connections to the plumbing system.

447.065 Solar heating and cooling systems. RF10.

(1) Notwithstanding ORS 447.020, a person may not engage in the trade of installing solar heating and cooling systems unless the person possesses either a license as a journeyman plumber issued under ORS chapter 693 or a solar heating and cooling system installer license issued by the State Plumbing Board under ORS 693.111.

(2) A license issued under ORS 693.111 does not authorize a person to connect a solar heating and cooling system to a potable water source. The connection of a solar heating and cooling system to a potable water source must be made only by a journeyman plumber licensed under ORS chapter 693.

Content

Miscellaneous hazard protection applications

Purveyor monitored water tanker trucks

Optional permanent mounted air gapped fill pipe or RP

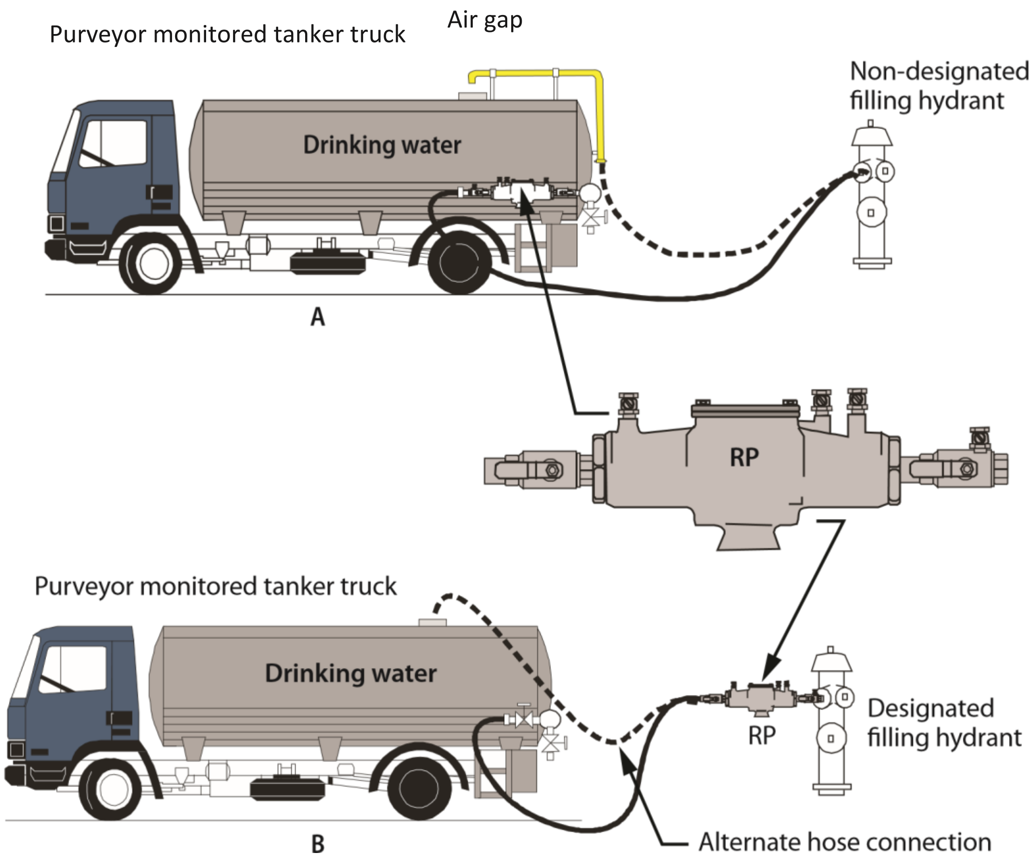


Figure 6-73—Connection to designated and non-designated hydrant

Figure 6-73 "A" shows a purveyor monitored potable water tanker-trucks filling at a non-designated hydrant. This truck may be inadvertently filling using a contaminated fill hose or air gap piping. These contaminants can enter the public system. The purveyor accepts this risk in this case

Figure 6-73 "B" shows a purveyor monitored potable water tanker-trucks filling at a designated hydrant. The designated hydrant is a hydrant identified and monitored by the water purveyor.

Potable water truck "A" with a truck permanently mounted AG or RP provides adequate protection when filling at a non-designated hydrant.

Potable water truck "B" provides the best protection, in this case no matter what the condition of the tanker truck piping, hose or water, the potable water supply is protected.

Establishing designated fill hydrants and monitoring the tank truck usage are ways that a water purveyor can reduce the risk of contamination of the water supply. These water filling stations should include a method to allow any hose or piping attached to drain automatically when disconnected.

Protection recommended on a water filling station: RP Note: *CAN/CSA-B64.10* current publication recommends that a DCVA or AG be used for tanker trucks that are only used for transporting potable water.

Content

Tanker trucks for sewer flushing, street cleaning or agricultural spray equipment.

Tanker trucks that are intended to carry toxic non-potable substances must have a permanently installed air gap located on the truck. Many water purveyors would not allow any tanker truck with toxic materials to directly connect to a potable water system. This type of cleaning or spray equipment that requires filling a tank for mixing chemicals, flushing sewers, cleaning street etc., are potential cross connections. These types of water use should be protected by the use of a permanently truck or trailer mounted air gap. In addition, the water purveyor may assign a designated hydrant to fill this equipment only with an RP similar to those used to fill drinking water tanker trucks.

Some cross connection standards consider portable spray cleaning trucks and equipment as a moderate hazard. Caution must be used since it is difficult to monitor how this equipment is maintained or used. A double check valve assembly may be acceptable to some AHJ only for portable spray cleaning equipment, never for sewer cleaning. Consult with the local water purveyor for the method of backflow protection for water tanker trucks in your area.

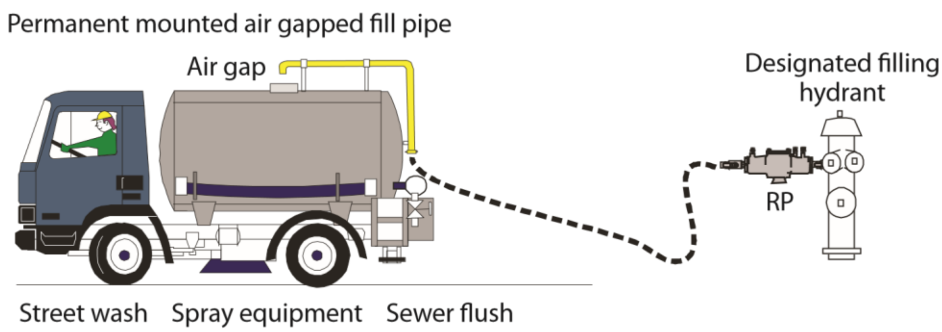


Figure 6-74—Tanker trucks non potable use

Figure 6-74 shows a tanker truck used either for sewer flushing, street cleaning, or agricultural spray equipment.

Figure 6-75—Picture showing truck mounted RP and AG at filler

Note: In this picture the RP is permanently mounted on the truck. The fire hose will connect to the designated filling hydrant. The water purveyor has accepted this installation. The water purveyor has assumed the fire hose will not ever be contaminated.

Content

Water-operated ejectors

Water-operated ejectors are used to evacuate waste water from collection sumps.

Figure 6-76—Water connected ejector not allowed

Figure 6-76 shows an example of a water-operated ejector. Potable water is being used to operate the Venturi. Non potable fluid is being drawn from the sump and discharged at the discharge of the ejector. The fluid in a sump would typically be groundwater, surface water and possible sewage effluent. The hazard level of the water-operated sump ejector is severe. Despite the apparent use of the AVB in this example there should be no connection between a potable water line and this type of ejector allowed.

Older style water operated sump ejectors usually located in the sump. The ejector would be partially or fully submerged much of the time. When finding these water operated ejector pumps they should be removed. Check with the local AHJ for appropriate backflow protection.

The flowing for your information are some requirements extracted from codes and health regulations.

BC/Canadian Plumbing code excerpt:

Division B.2.7 non-potable water systems

2.7.1.1 Not permitted

(1) A non-potable water system shall not be connected to a potable water system.

Here is an example of an excerpt taken from the Oregon State plumbing and heath regulation.

Waste water and sewage from plumbing fixtures

(4) The use or installation of water-operated sump pumps or sewage ejectors, if connected to the potable water supply, is prohibited.

Note: The use of an RP for these ejectors may not be adequate in some jurisdictions. Consult the AHJ. Note: The CSA standard rates sewage pumps and sewage ejectors as a severe hazard.

Content

Temporary service connections during construction

During construction at new building sites water may be provided from the public water system at the property line. The water connection to the construction sites is considered a temporary water connection. The temporary connection to the premise would need to be assessed for the hazard level and appropriate backflow protection installed.

Cement mortar batching plant.

Cement batching plant can contain cement, additives and aggregate being mixed with water. The backflow protection required is an RP. Mobile plants require the same protection; however, testing of the RP would occur after each move.

Water softeners and water treatment

Backflow water from a water treatment device such as water softener could contain particles of the softening media, or regeneration including salts and potassium permanganate. Proper maintenance is required otherwise bacteria build up in the softener media. Backflow from the softener is possible allowing media sands, salt brine, or other treatment material, and bacteria back into the drinking water supply. The hazard from water treatment equipment is normally minor; however, when this equipment is not maintained the hazard level can be moderate to severe.

Back-flow protection required:

- For residential application install DuC on the water supply for minor hazard and an indirect connection by means of an air-break for back wash drains.
- For commercial application a DCVA on the water supply and an indirect connection and an air-break for backwash drains. RP if treatment additives are used chlorine, soda ash, etc. Note: Each Installation will need to be evaluated on its own merits. Consult the AHJ before selecting the appropriate backflow preventer.

Water Filters

What cross connection hazard can water filters cause? After all, you install the filter to remove any number of pollutants from the drinking water. Just like the water softener the hazard level is normally minor; however, when not kept clean with regular maintenance a water filter can turn into something completely different. The owner of water filtering equipment must maintain the filters and equipment frequently. It is very difficult to enforce maintenance therefore a water purveyor cannot depend on maintenance being completed on a water filter of any type.

Water filters do not disinfect drinking water; however, they do remove certain chemicals and particles and improve the taste, odor and appearance of the water. Water filters that are not maintained properly might release filtered contaminates back into the water. Organic matter can build up in the filter cartridge and cause bacterial growth. Experience as shown that bacteria levels can increase dramatically over normal unfiltered water.

Content

The hazard assigned to a water filter

Headline "Tourist Killed by Hotel Water" In December of 2009 a European tourist staying in a luxury Miami hotel died as a result of Legionnaires Disease and two other prior guests had fallen ill with the same serious form of Pneumonia, according to the Miami Herald. The hotel was closed by the authorities and an investigation revealed that the hotel had installed "a powerful water filter" to remove chlorine from the city supplied water, but the system had also encouraged bacterial growth. The hotel had opened less than one year previous and is had to be closed while the water system was inspected and disinfected. (Source article courtesy of the IAPMO Drinking Water and Backflow Prevention magazine)

Water filter backflow protection required:

- Residential applications a DuC would be okay for a minor hazard; consult the AHJ.
- Commercial applications should have a DCVA installed, an RP if additives are used. Note: Water filters can be a serious problem if not maintained properly.

Water cooled equipment:

Ice making machines, refrigeration, air conditioning, cooling towers and compressors equipment are often, but not always, water cooled and connected to the public water supply. The hazard level varies from minor to severe so assessment of each application will be needed. Consult the AHJ.

Backflow protection required:

- Residential applications may use a DUC or DCAP for minor hazards. Consult the AHJ.
- Commercial application will depend on assessment. RP installed for severe hazard. Consult the AHJ.

Steam Cleaning Units:

Before a steam cleaning unit can be connected to a potable water piping system a Reduced Pressure Backflow Assembly (RP) must be installed on the potable water piping connection to the steam cleaning unit. Consult the AHJ.

Backflow protection required

- CSA B64 10 Steam cleaning hazard
  - Steam cleaner Moderate
  - Steam generator Moderate
- Consult with the AHJ to determine the type of backflow preventer required.

Dental offices

Dental equipment connected to the potable water system must be isolated from the potable water supply by the installation of a back flow preventer. The backflow preventer should be installed upstream of the dental equipment system.

Dental offices may operate without a direct connection to the potable water system in such cases no back flow protection is required for the dental equipment use. Premise isolation may still be required such as a double check valve assembly for commercial buildings.

Dental equipment connected to the potable water system will needed protection at the point of connection, CSA classifies dental equipment a minor hazard; confirm the type of back flow preventer required by consulting the authority having jurisdiction in all cases.

Content

Reverse osmosis systems

Osmosis is the process of water passing through a semi permeable membrane in order to balance the concentration of contaminants on each side of the membrane. A semi permeable membrane is a barrier that will pass some substances like clean water, but not other substances such as salts and minerals.

Contaminants such as lead, chromium, VOC's and arsenic are undetectable to the taste. Additionally, over time if you do not replace the filter elements, other bad tastes and odors will be apparent in your drinking water.

Maintenance

It is important to change out filter elements at the recommended intervals as indicated in the manufacturer's operation manuals.

Figure 6-77—Residential Reverse osmosis system
Courtesy Watts Canada

Caution: Do not use where water is microbiologically unsafe or with water of unknown quality without adequate disinfection before or after the unit. System must be maintained according to manufacturer's instructions. Note: Booster pump required if inlet pressure is below 40 psi.

Backflow protection reverse osmosis

The installation of a backflow preventer on the water supply to reverse osmosis system.

CSA B64 10 reverse osmosis hazard classification:

- Reverse osmosis equipment, Minor
- Reverse osmosis equipment with backwashing, Moderate
- Reverse osmosis equipment with chemical cleaning, Severe

Consult with the AHJ to determine the type of backflow preventer required.

Content

Dishwashers

Domestic dishwashers

Backflow protection for a domestic dishwasher is handled differently depending on the AHJ. Figure 6-78 shows a method of piping using a manufactured air gap that could be applied.

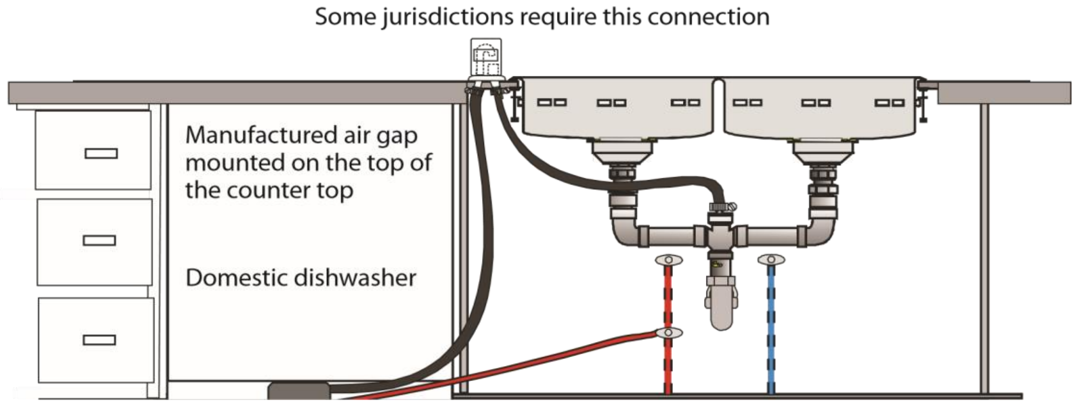


Figure 6-78—Residential dishwasher with air-gap fitting at counter level (ASVB)

Note: This air gap is shielded and may not meet the exacting definition of an ASVB air-gap in the eyes of some AHJ; therefore, consult with the AHJ before using this method.

Figure 6-79—Air gap device Courtesy of Moen

Backflow protection for a domestic dishwasher is handled differently depending on the AHJ. Figure 6-80 shows another method of piping using a manufactured air-gap that could be applied.

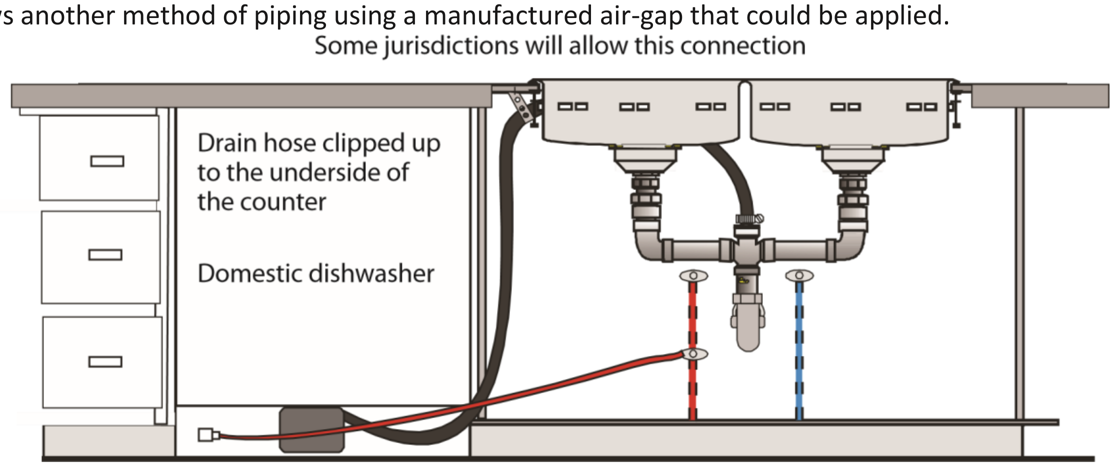


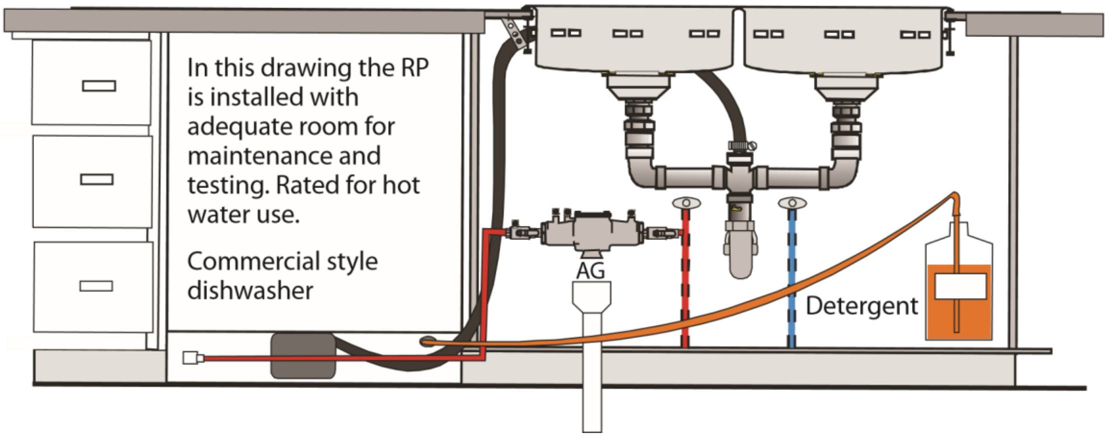
Figure 6-80—Residential dishwasher no air-gap AHJ approved

Content

Commercial dishwasher under counter style

Backflow protection required for a small commercial dishwasher typically used in small kitchens in meeting halls or similar use. They often will include automatic detergent addition; this increases the hazard level too high; therefore, requiring a RP to be installed. Consult the AHJ.

Meeting hall small commercial style under counter dishwasher with detergent additives



Adequate size drain as per plumbing code

Figure 6-81—Under counter dishwasher with detergent RP required

Commercial restaurant style dishwasher/glass washer

In a typical restaurant, backflow preventers are most frequently found in ice-makers, coffee machines, soda machines, dishwashers, sinks. Restaurant owners are responsible for maintaining each backflow preventer

Commercial dishwashers often have detergent dispensers connected to the incoming water supply to the dishwasher or glass washers A backflow preventer will be required on this detergent dispenser water supply.

Figure 6-82 is a picture of a commercial kitchen dishwasher with black detergent dispensers. Notice the AVB Backflow protection this may be acceptable for the AHJ; however, you must confirm with the AHJ.

Figure 6-82—Commercial kitchen dishwasher with detergent dispensers attached to incoming water supply

Content

Commercial Dish washer hot water booster

Figure 6-83—Booster heater for a commercial dishwasher

Courtesy of Allied engineering.

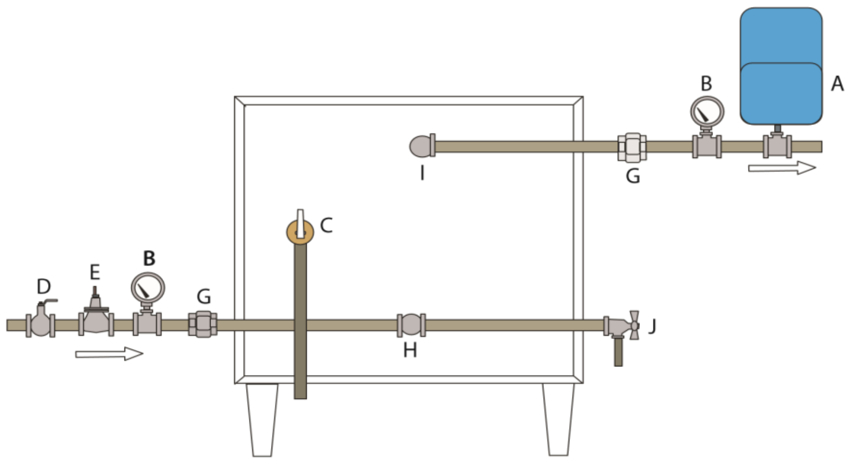


Figure 6-84—Booster heater piping diagram

The booster heater is installed as close to the dishwasher as possible.

- "A" is an expansion chamber or arrestor which helps to prevent water hammer caused by solenoid valve on the dishwasher
- "B" is a Temperature and Pressure Indicating Gauge: This gauge indicates the temperature and pressure and is useful when determining incoming water temperature or adjusting the pressure reducing
- "E" is a pressure reducing valve should be installed set to the manufactures instructions with a built-in by-pass.
- "C" is a Temperature and Pressure Relief Valve: The relief valve protects the tank from becoming overheated and/or over-pressurized.
- "G" are dielectric couplings and should be used in connecting dissimilar metals, such as galvanized to copper, to prevent electrolysis.

Booster heater concerns

A check valve or pressure reducing valve without internal bypass should not be installed in the supply line to the booster heater. Thermal expansion may cause the relief valve to discharge. Thermal expansion control is required. All shut-off valves must be gate or ball valves, not globe valves.
High 365 ^{O} C (180 ^{O} F) temperature water back-flowing from the booster heater into the domestic water system could be an issue at nearby hot water fixture outlets. Backflow protection may be required by the AHJ.

CSA B64.10 lists the hazard level for a commercial dishwasher as moderate.

Content

Dish washer back flow protection required:

- Typically, the AHJ may be requiring an installation of an RP for a commercial dishwasher. Check with the AHJ for correct backflow protection required and location to be installed on the piping system.
- Any backflow preventer installed on a hot water pipe must be hot water rated.
- it is important that provisions for water expansion are provided.

Residential properties and individual residents

Single family dwellings and duplex are typically assigned a minor hazard; however, these premises can contain all levels of hazard from sever to minor. Typically, in new construction cross connection issues are picked up by building inspection officials and then appropriate backflow protection is installed. After initial construction these properties are difficult to track.

Residential point of use hazards and appropriate back flow protection required:

Fixture or Appliance	Back Flow Protection Required
Regular bath tub with or without shower	AG
Soaker tub/jetted tub	AG
Shower not telephone extension	AG
Shower or bath with telephone shower	AVB
Lavatory	AG
Water closet tank	AG/Built in AVB at float valve
Bidet	AVB
Kitchen sink	AG
Laundry sink	AG /HCVB with hose bib end spout
Dishwasher water connection no detergent injectors	Internal AG
Dish washer with detergent injection	RP or as directed by AHJ
Dish washer Drain	AG/AB or as directed by AHJ
Clothes washer	Built in AG
Water softener water supply	DUC or DCAP as directed by AHJ
Water softener back wash drain	AG/ Air Break AB
Water filters when not maintained promote bacteria growth	RP or as directed by AHJ
Exterior hose faucets	HCVB or as directed by AHJ assessment
Irrigation systems above or below ground	DCVA
Heating boilers no chemicals	DCAP
Heating Boiler with chemical present or future	RP
Swimming Pools with makeup water connection	AG/ DCVA
Solar heating systems with connection or potential connect	RP or DWP or as directed by AHJ
Unauthorized illegal activities, hydroponics/chemical mixing etc.	AG /RP or as directed by AHJ

Table 6-9—Residential hazard

Note: Solar systems will need to be assessed and approved by the AHJ. Content

Now complete Self-Test 6 and check your answers.

Self-Test 6

Review the section objectives and then answer the following questions.

1. Which of the following choices best describes installation of a backflow preventer on a water service to protect the purveyor water supply but not the building occupants?

    a. Premise isolation

    b. In-plant isolation

    c. Fixture isolation

    d. Premise protection

2. What is the backflow preventer required for premise isolation of a sewage treatment plant?

    a. RP

    b. RP and AG

    c. DCVA and AG

    d. PVB

3. What is the backflow preventer required for premise isolation of a food processing plant?

    a. RP

    b. RP and AG

    c. DCVA

    d. PVB

4. What is the protection required for a fire sprinkler system without additives?

    a. RP

    b. RP and AG

    c. DCVA

    d. PVB

5. What is the protection required for a turf irrigation system with chemical additives?

    a. RP

    b. RP and AG

    c. DCVA

    d. PVB

6. What method of isolation will provide the best protection to each building occupant?

    a. In-plant isolation

    b. Premise isolation

    c. Service protection

    d. Fixture isolation

Content

7. What would the first basic step in the process of selecting a backflow preventer be?
   a. Install the backflow preventer
   b. Determine the installation requirements
   c. Determine the type of backflow
   d. Test the backflow preventer

8. Theft of a backflow preventer is not considered when installing a backflow preventer.
   a. True
   b. False

9. Two considerations when selecting the size of a backflow preventer are the manufacturer specification and the hydraulic load of the piping system.
   a. True
   b. False

10. The water temperature and pressure of the piping system are not considered when selecting a backflow preventer.
    a. True
    b. False

11. A RP can be installed in a pit below ground level.
    a. True
    b. False

12. What is the minimum vertical air gap dimension?
    a. 25.4 mm (1")
    b. 50 mm (2")
    c. 75 mm (3")
    d. 100 mm (4")

13. What is the minimum vertical height of an AVB above the flood level rim of a fixture?
    a. 50 mm
    b. 100 mm
    c. 150 mm
    d. 300 mm

14. What is the maximum number of hours that constant water pressure can be applied to an AVB?
    a. 2
    b. 4
    c. 6
    d. 12

Content

15. Which one of the following is not an approved installation requirement of an AVB?
    a. Must be installed vertically.
    b. May be used for premise isolation of low hazard turf irrigation systems.
    c. May be installed below ground.
    d. Must not to be installed upstream of a shut-off valve.
16. The minimum type of backflow preventer required to prevent cross connection in Figure 1 would be a(n)?
    a. DCVA
    b. AVB
    c. RP
    d. HCVB

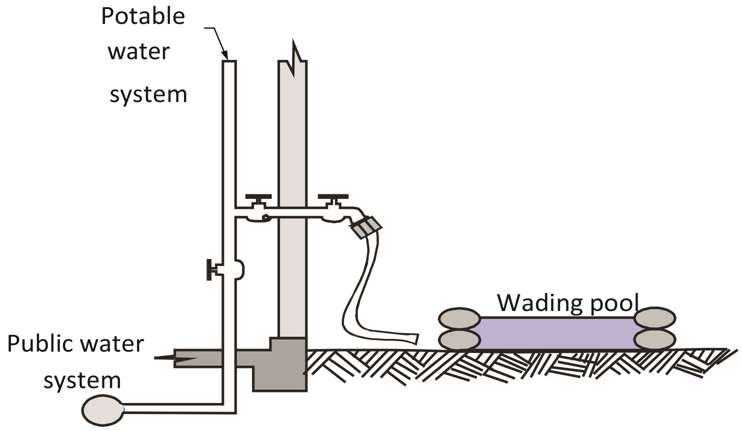


Figure 1

17. The minimum type of backflow preventer required to prevent cross connection in Figure 2 would be a(n)?
    a. DCVA
    b. AVB
    c. PVB
    d. HCVB

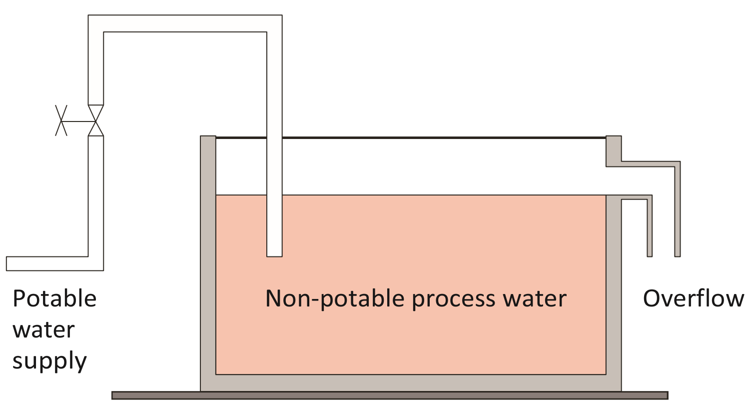


Figure 2

Content

18. What would the minimum type of backflow preventer required to prevent cross connection in Figure 3?
    a. DCVA
    b. PVB
    c. RP
    d. HCVB

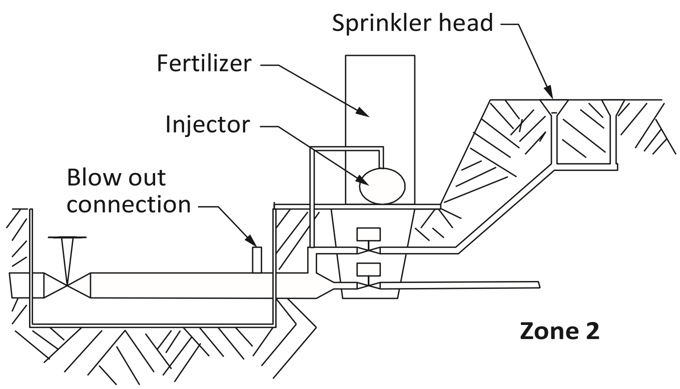


Figure 3

19. What would be the minimum backflow preventer required for Figure 4?
    a. DCVA
    b. PVB
    c. RP
    d. HCVB

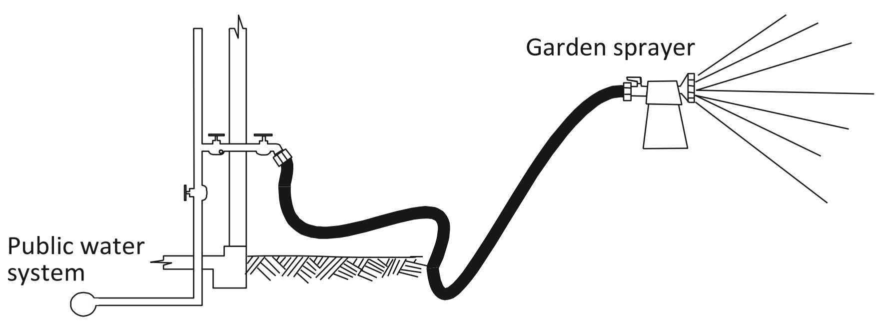


Figure 4

Content

20. What would be the minimum backflow preventer required in Figure 5? (The tank contains water with chemical additives.)

    a. DCVA

    b. PVB

    c. RP

    d. HCVB

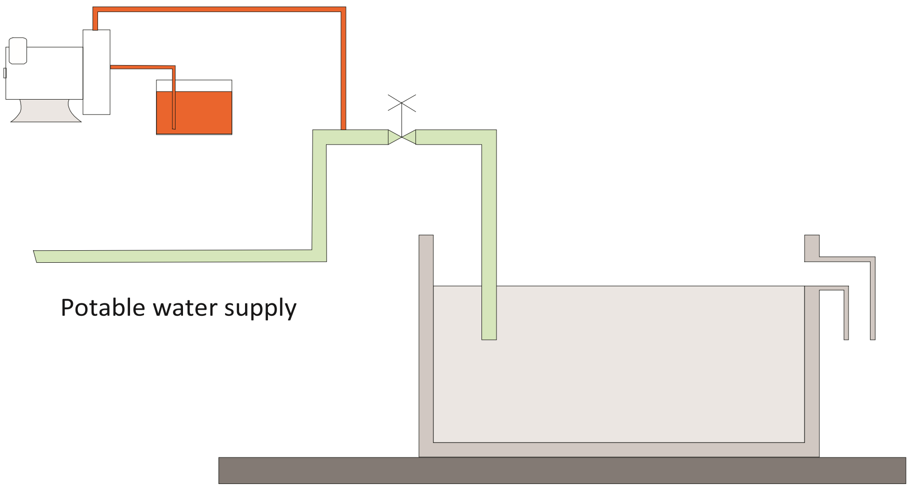


Figure 5

21. Provided you can reroute the piping in the valve box to allow an above ground installation, what would be the minimum type of backflow preventer required in Figure 6?

    a. AVB

    b. DCV

    c. RP

    d. PVB

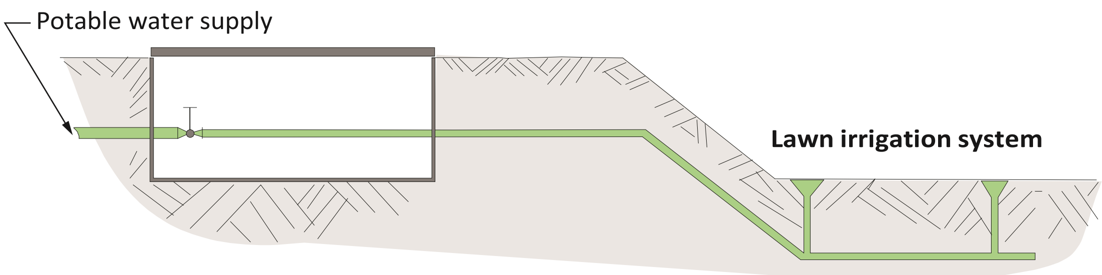


Figure 6

Content

22. Provided you can reroute the piping in the valve box to allow an above ground installation, what would the minimum backflow preventer required in Figure 7?
    a. AVB
    b. DCVA
    c. RP
    d. PVB

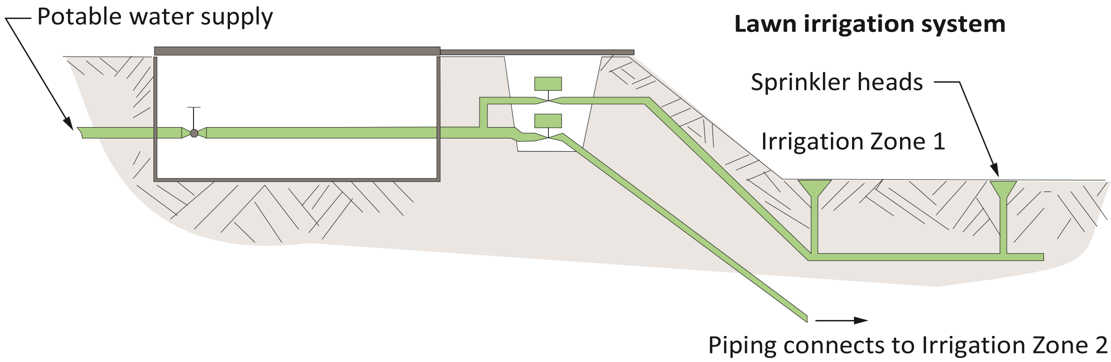


Figure 7

23. Without changing the piping location, what would be the minimum backflow preventer required in Figure 8?
    a. AVB
    b. DCVA
    c. RP
    d. PVB

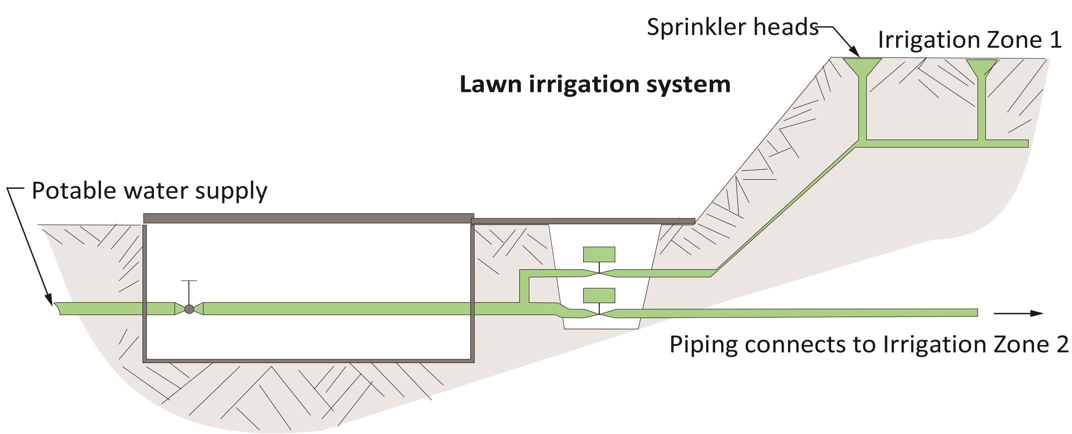


Figure 8

Content

24. What is the minimum backflow preventer required in Figure 9? (There are chemical additives in the heating boiler.)
    a. AVB
    b. DCVA
    c. RP
    d. PVB

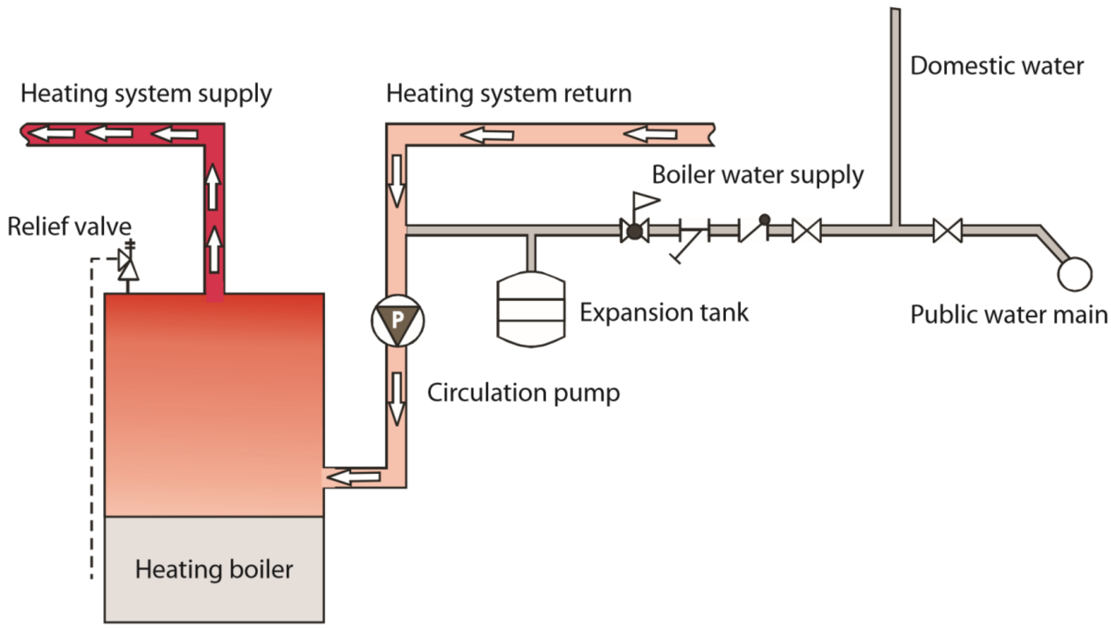


Figure 9

25. Which one of the following backflow preventers should not be subject to continuous back pressure?
    a. AVB
    b. DUC
    c. DCVA
    d. RP

26. What device should be installed to prevent fouling of a backflow preventer check valves?
    a. Air chamber
    b. Soft seated check valve
    c. Resilient seated shut-off valve
    d. Strainer

27. An extension ladder is an acceptable safe access to a backflow preventer.
    a. True
    b. False

Content

28. What minimum type of backflow protection would a bidet require?
    a. AVB
    b. PVB
    c. DCVA
    d. DuC

29. What type of backflow preventer must not be used for premise isolation?
    a. DCVA
    b. RP
    c. HCVB
    d. PVB

30. A drain valve located upstream of a backflow preventer located on an irrigation system would be installed at what minimum distance above ground level?
    a. 50 mm
    b. 150 mm
    c. 200 mm
    d. 1 m

31. Compressed air can be used to blowout the water from an irrigation system that is protected with a PVB.
    a. True
    b. False

32. Which one of the following is completed if a backflow preventer is to be removed to protect it from freezing?
    a. The open ends of piping are left open to allow continued drainage.
    b. The backflow preventer is replaced with a jumper connection.
    c. The system shut-off is left partially open.
    d. The open ends are capped watertight.

33. When replacing non-resilient seated valves, install approved resilient seated valves.
    a. True
    b. False

34. What is the minimum clearance below the center-line of an RP?
    a. 100 mm
    b. 200 mm
    c. 300 mm
    d. 750 mm

Content

35. Except for smaller assemblies located in removable enclosures what is the minimum clearance in front of a backflow preventer installed in an enclosure?
   a. 100 mm
   b. 200 mm
   c. 300 mm
   d. 750 mm
36. When first approved by the AHJ, what requirements must a daylight drain have when installed in a semi-buried pit housing a back flow preventer?
   a. One size larger than the relief valve opening
   b. Two sizes larger than the relief valve opening
   c. Bore sighted
   d. Installed with a check valve to prevent flooding of the pit
37. Which one of the following statements applies to the discharge opening of a daylight drain located in a semi-buried pit? When first approved by the AHJ
   a. Terminate below ground.
   b. Have a screen installed.
   c. Be terminated in a sump.
   d. Be above ground and the maximum flood level.
38. DCVA test valves located in a below ground box must face up only.
   a. True
   b. False
39. What is the minimum clearance below a DCVA placed in a below ground box?
   a. 150 mm
   b. 200 mm
   c. 300mm
   d. 600 mm
40. What is the maximum recommended height above ground or floor level to install a backflow preventer before a safe work platform is required?
   a. 300 mm
   b. 600 mm
   c. 1500 mm
   d. 2032 mm
41. A DCVA will protect against a back-syphonage and backpressure cross connection.
   a. True
   b. False

Content

42. Which of the following statements is **not** true of a DCVA installation?
    a. Not to be used where chemicals are injected.
    b. May be used for continuous flow conditions.
    c. May be used for minor health or moderate health hazard.
    d. Do not cap the test valves when installed below ground.
43. A DCVA **must not** be installed in a pit below ground level.
    a. True
    b. False
44. What type of backflow can tall buildings be a source of?
    a. Backpressure only
    b. Back-syphonage only
    c. Both backpressure and back-syphonage
    d. Extreme hazard cross connections only
45. What word defines water that has passed through the water meter or property line from the purveyor's system to the customer's system?
    a. Polluted water
    b. Used water
    c. Contaminated water
    d. Dirty water
46. A premise with an approved private water supply acceptable to the water purveyor may be protected with premise isolation using a DCVA.
    a. True
    b. False
47. The *BC Building Code Part 7 Plumbing Systems* will allow interconnection of an approved private water supply and a public water system.
    a. True
    b. False
48. A private water supply that is unmonitored or unapproved is considered a high hazard.
    a. True
    b. False
49. What is the minimum cross connection protection for a fire protection system with no chemical additives added?
    a. PVB
    b. DCVA
    c. RP
    d. RPDA

Content

50. What is the minimum protection for an unapproved water supply?
    a. DCVA
    b. RP
    c. PVB
    d. AVB
51. What is the minimum premise protection for gray water, sewage effluent reuse systems or storm water reuse systems?
    a. PVB
    b. DCVA
    c. AG or RP
    d. AVB
52. What is the minimum protection at a premise where reclaimed sewage effluent is supplemented with potable water?
    a. RP
    b. Annually inspected AG
    c. DCVA
    d. AG
53. It is an acceptable practice to directly connect the potable water main to a sewer main for flushing purposes if a RP is installed on the outlet from the potable system. This is not a Canadian manual regulation question.
    a. True
    b. False
54. What is the minimum protection for a commercial heating boiler with chemical additives?
    a. PVB
    b. AG
    c. DCAP
    d. RP
55. What is the minimum protection for fire sprinkler systems with no chemical additives?
    a. RP
    b. DCVA
    c. Single soft seated alarm check
    d. AG
56. A fire department connection shall be connected upstream of the backflow preventer.
    a. True
    b. False

Content

57. A single seated alarm check valve is an approved backflow preventer. No test valves and no shut offs on the valve.
    a. True
    b. False
58. What cannot be installed with a backflow preventer without approval of insurance underwriters or the authority having jurisdiction?
    a. Strainer
    b. Ball valve (ULC approved)
    c. DCAF
    d. RPF
59. What is the minimum protection for a double wall heat exchanger with leak detection?
    a. RP
    b. DCVA
    c. No protection
    d. AG
60. A heat exchanger with an IAPMO approval label is generally double wall with leak detection. This is not a Canadian manual regulation question.
    a. True
    b. False
61. What is the minimum protection for water tanker trucks?
    a. PVB
    b. Permanently mounted AG
    c. AVB
    d. DuC
62. A gray water system contains waste water from a water closet.
    a. True
    b. False
63. What type of heat exchanger will require no additional backflow protection?
    a. Single wall
    b. Double wall
    c. Double wall with leak protection
    d. Potable water exchanger

Content

64. Gray water systems can be used for above-ground sprinkler system irrigation. This is not a Canadian manual regulation question.
    a. True
    b. False
65. Some large backflow assemblies have heavy check valve springs held in place with cover plates. When removing the cover-plate you should use long threaded bolts or rods.
    a. True
    b. False
66. Piping downstream of a DCAPC must be copper and or brass.
    a. True
    b. False
67. DCAPC are designed for continuous pressure use.
    a. True
    b. False
68. DCAPC are designed to prevent backflow of carbon dioxide gas.
    a. True
    b. False
69. A DCAPC should be installed in concealed unventilated spaces.
    a. True
    b. False
70. What should be installed for installations requiring 24 hr un-interrupted service?
    a. Filters
    b. Air gaps
    c. pressure relief valves
    d. parallel service arrangement
71. The SCVAF consists of an assembly consisting of one internally loaded check valve and two tightly closing resilient seated shut off and test valves.
    a. True
    b. False
72. The SCVAF can be used for any minor hazard cross connection.
    a. True
    b. False

Content

73. The SCVAF is installed in the horizontal position unless by recommended by the manufacturer or approved of the AHJ.
    a. True
    b. False

74. The SCVAF shall not be installed in a pit unless adequate drainage is provided to keep the pit dry.
    a. True
    b. False

75. The SCVAF must be protected from freezing and a temperature exceeding.
    a. 32°C
    b. 34°C
    c. 40°C
    d. 43°C

76. A bypass arrangement around a backflow assembly will require the same degree of protection as the mainline assembly?
    a. True
    b. False

77. What type of backflow assembly is required for a temporary water service to a building site when no connection to the new system is present?
    a. AVB
    b. PVB
    c. DCVA
    d. RP

78. What type of backflow assembly is required for a temporary water service to a building site when a connection to the new system is present?
    a. AVB
    b. PVB
    c. DCVA
    d. The assembly that is commensurate with the premise hazard.

79. What backflow protection is required with a minor hazard heat transfer medium used with an SW, DW, or DWP heat exchanger?
    a. DCVA
    b. No protection required.
    c. RP
    d. AVB

Content

80. When a SW heat exchanger with a moderate hazard heat transfer medium is used, what minimum backflow preventer will be needed?
    a. DCVA
    b. RP
    c. DUC
    d. AVB

81. What backflow preventer will be required with a moderate hazard heat transfer medium when used with DW or DWP heat exchanger?
    a. DCVA
    b. RP
    c. AVB
    d. None

82. What backflow preventer will be required with a severe hazard heat transfer medium when used with a DWP heat exchanger?
    a. DCVA
    b. RP
    c. AVB
    d. None

83. What back flow preventer will be required with a severe hazard heat transfer medium when used with SW or DW heat exchanger?
    a. DCVA
    b. RP
    c. AVB
    d. None

84. A water filling station will have a RP installed on the premise.
    a. True
    b. False

85. A water filling station will have a method to allow the attached hose to drain automatically when disconnected from the tanker truck.
    a. True
    b. False

Content

86. What minimum backflow preventer is used to isolate the premise for a moderate hazard metal manufacturing plant?

a. DCVA

b. RP

c. AVB

d. PVB

87. What backflow preventer is used to isolate the premise of a tall building with a booster pump and take-off on the suction side of the booster pump?

a. DCVA

b. RP

c. PVB

d. AVB

88. What minimum protection is required for metal plating plants?

a. DCVA

b. RP

c. PVB

d. AVB

89. What minimum protection is required for a paper products plant?

a. DCVA

b. RP

c. PVB

d. AVB

90. What minimum backflow protection is required for a residential full flow through fire sprinkler system with potable piping, no additives?

a. DCVAFF

b. DuC

c. RPF

d. None

91. With potable piping and no additives, what minimum backflow protection is required for a residential partial flow through fire sprinkler system?

a. DCVAF

b. DuC

c. RPF

d. DCAP

Content

92. What minimum backflow protection is required for a Class one fire sprinkler system with potable piping?
    a. DCVAF
    b. SCVAF
    c. RPF
    d. DuC

93. What minimum backflow protection is required for a Class one fire sprinkler system with non-potable piping and no additives?
    a. DCVAF
    b. SCVAF
    c. RPF
    d. None

94. What minimum backflow protection is required for a Class two fire sprinkler system with non-potable piping and no additives?)
    a. DCVAF
    b. SCVAF
    c. RPF
    d. RP

95. What minimum backflow protection is required for a Class one, two, three fire sprinkler system with non-potable piping and antifreeze?
    a. DCVAF
    b. SCVAF
    c. RPF
    d. None

96. What type of fire sprinkler system is a combined industrial system supplied only from the public system with or without gravity tanks or pump suction tanks?
    a. Class 2
    b. Class 3
    c. Class 5
    d. Class 6

97. What type of fire sprinkler system is supplied from the public system with access to an auxiliary system within 518 meters (1700 ft)?
    a. Class 3
    b. Class 4
    c. Class 5
    d. Class 6

Content

98. A ¾" dia. water supply that terminates above the flood level rim of a fixture is located within 3 diameters of a vertical surface. What is the minimum air gap allowed?

a. 38 mm (1½")

b. 50 mm (2")

c. 57 mm (2¼")

d. 75 mm (3")

99. A 1" dia. water supply pipe terminates above the flood level rim of a fixture within 4 diameters of a corner at two vertical surfaces. What is the minimum air gap required?

a. 38 mm (1½")

b. 50 mm (2")

c. 57 mm (2¼")

d. 75 mm (3")

Content

100. Fill in the missing hazard designation and minimum protection required.

Fixture Isolation Examples	Degree of Hazard	Minimum Fixture Protection	Additional in-Plant or Premise Isolation
Bidets			
Hose-bibb residential			
Hose-bibb industrial			
Ice makers			
Steam generator			
Vending machine			
Ornamental Fountains			
Fire sprinkler system without additives			
Fire sprinkler system with additives			
Trap primer			
Lawn irrigation with chemical addition			
Lawn irrigation with no chemical addition			
Domestic hot water heating boilers			
Degreasing equipment			
Shampoo basin			
Flexible shower heads			
Swimming pools			

Content

101. Fill in the degree of hazard for each premise

Premises Identification	Degree of Hazard
Sewage treatment plants or sewage pump stations	
Hospitals, medical/dental centers	
Metal plating plants	
Food processing plants	
Piers and docks, marinas and dry docks	
Car washes	
Restricted access premise	
Shopping centers	
Mobile home parks	
Fire sprinkler systems with no chemical additives	
Fire sprinkler systems with chemical additives	
Storage facilities	
Commercial laundry	
Dental clinics	
Steam plant	
Tall buildings over 9.4m (30ft)	

Check your appendix answer key

Have you accomplished your objectives of this Chapter 6? Review your Chapter 6 objectives.

If you feel you have accomplished the objectives of Chapter 6, you may wish to proceed to Chapter 7

Content

Chapter 7 Components and sequence of operation of backflow preventers

Chapter objectives

After completing this chapter of the course, you will be able to:

- Explain the purpose of testing backflow assemblies.
- State when backflow preventers are tested.
- Identify and name the main components of backflow assemblies.
- Describe the sequence of operation of each assembly.

Introduction

Chapter 7 introduces you to the basic construction of each backflow assembly, its basic components and sequence of operation. It is imperative to fully understand the correct sequence of operation of each assembly before you attempt to test and troubleshoot the assemblies. After completing this chapter, you will learn to test each backflow assembly in Chapter 8.

Identifying and naming components (parts) of backflow assemblies

The following information is generic in nature and not specific to any individual backflow preventer. Illustrations have been simplified to show only the basic components of backflow assemblies.

The **illustrations are not engineered** to show the exact construction details required of a particular backflow assembly. Published standards that contain design and material specification include the American Water Works Association standards (AWWA), CSA, ASSE and USC FCCCHR standards. For more information on these associations visit their web sites:

- USC FCCHR: http://www.usc.edu/dept/fccchr/
- AWWA: http://www.awwa.org/
- ASSE: http://www.asse.org/
- CSA: http://www.csa.ca/

Note: The water pressures indicated in the illustrations are for purpose of demonstration only. Actual system pressures on the job will vary depending on the water purveyor's system and the design characteristics of the backflow assembly.

Content

RP components

Figure 7-1 shows the components of a RP

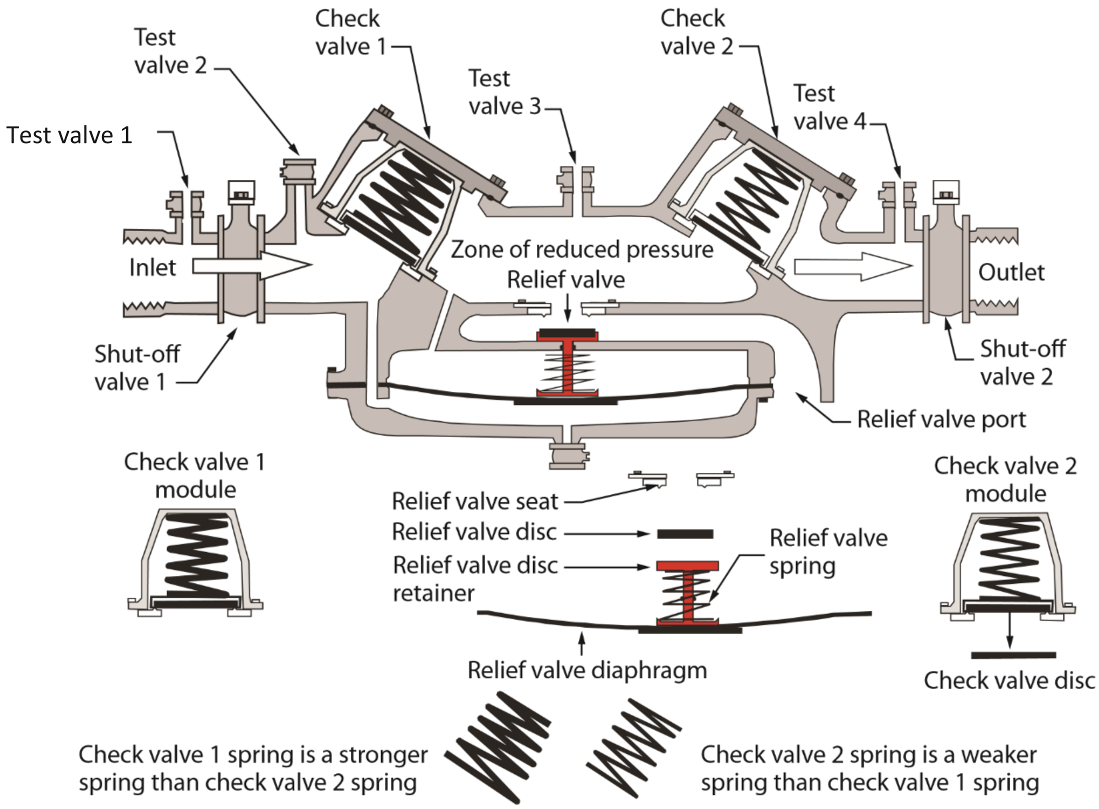


Figure 7-1—RP components

For Figure 7-1 you will need to be able to identify and memorize the name of each component.

The test procedures you will be learning refer to each of these parts using the names given in this illustration. If you cannot identify the parts you will not be able to interpret the test procedures.

Notice that the test valves, shut-off valves and the check valves are numbered in the direction of flow from the inlet to the outlet numbers (1, 2, 3 etc.) This method of numbering is standard with all backflow prevention assemblies. Also the names of the components are standardized. Consistency in identification of valve parts reduces confusion and the possibility of error.

Facts about the components of the RP

- The shut-off valves must be resilient seated full port ball valves or resilient seated wedge gate valves. Typically, sizes 2 inch and under are full port ball valves.
- The test valves must be resilient seated, typically ball type valves.
- The check valve 1 spring is stronger than the check valve 2 spring.
- Typical pressure drop across the check valve 1 is approximately 5-15 psid (35-103 kPa).
- Typical pressure drop across the check valve 2 is approximately 1-5 psid (7-35 kPa). The check valve and relief valve discs are resilient seated (soft seated).

Refer to Chapter 6 of this manual for installation requirements. Content

- The check valves are loaded to the closed position.
- The relief valve is loaded to the open position.
- Typical relief valve spring loading is between 2-5 psi (14-35 kPa).

Figure 7-2 shows the parts and names of an RP.

When testing and repairing valves you must identify these components correctly.

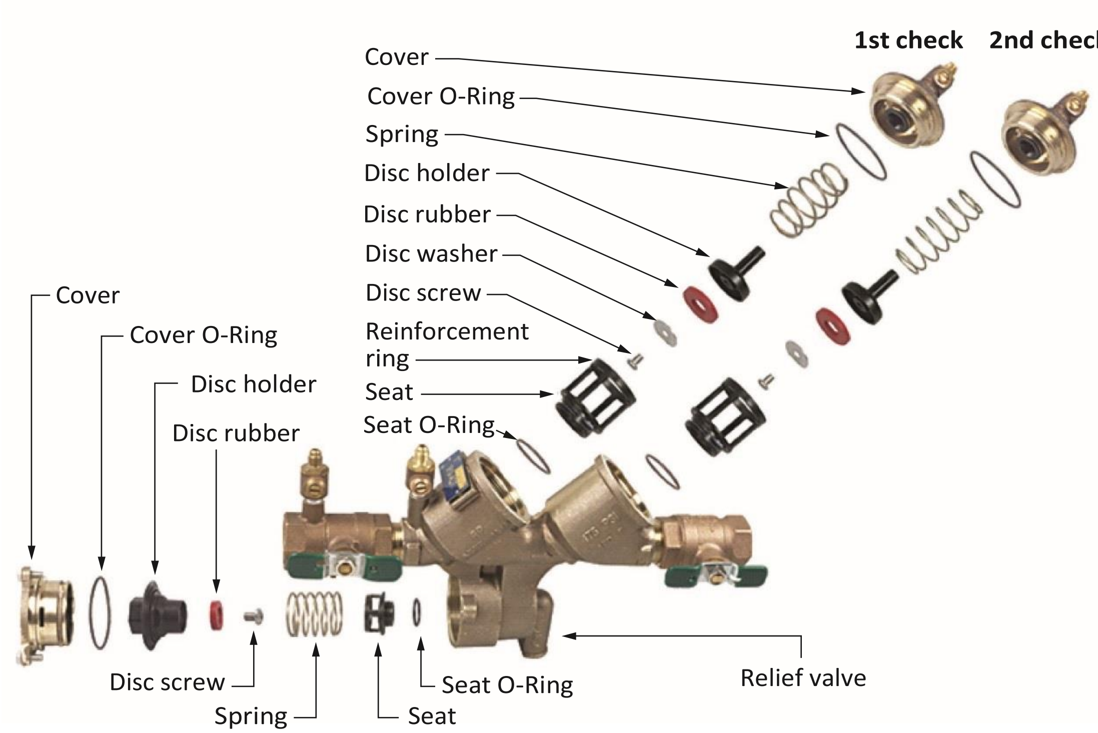


Figure 7-2—

Manufacturer's component list

Courtesy of Watts Canada

Content

Sequences of operation

Figure 7-3 shows an RP before installation.

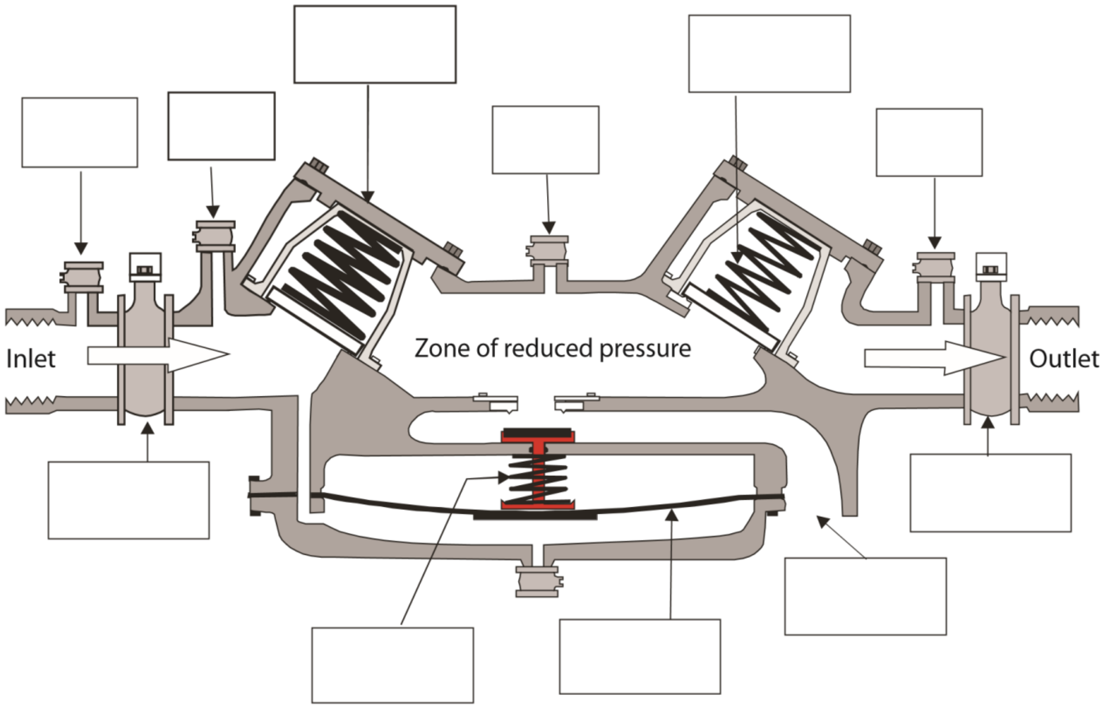


Figure 7-3—Identify RP components

On Figure 7-3, fill in the blank boxes with the correct names of the components. When you have finished, see Figure 7-1 in the section "RP components" to check your work.

Figure 7-3 shows that both check valves are spring-loaded to the closed position and the relief valve is spring-loaded to the open position. Line pressure is required on the inlet side of the assembly to close the relief valve. Refer to Figure 7-5 to see a relief valve being held closed by line pressure.

Before installing an RP or any backflow assembly, flush the supply lines to remove debris.

It is recommended to install strainers on the inlet pipe to prevent debris from fouling of check valves.

Note: Study the following series of illustrations showing the position of the check valves, the operation of the relief valves and typical pressures and pressure drops through the valve. It is important to be familiar with the operation of the assemblies and associated components. Trace the direction of flow and path of water through the valves.

Content

Figure 7-4 shows the RP with water pressure on and flow through the assembly.

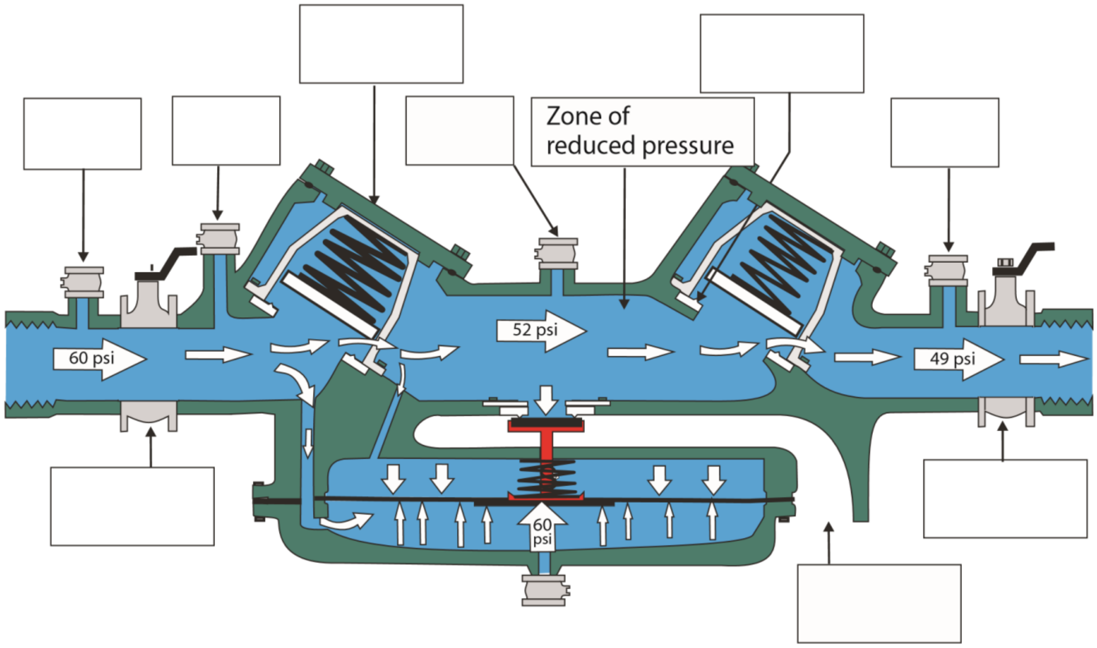


Figure 7-4—RP water flow and identify components

First you should fill in the blank boxes in Figure 7-4 with the correct names of the components. Refer to Figure 7-1 for the correct names.

RP sequence of operation during normal flow

For the purpose of simple explanation, the term pressure is used to describe the force used to open and close the relief valve. Force and pressure is not technically the same thing.

Referring again to Figure 7-4 notice that the water enters the RP inlet at a pressure of 413 kPa (60 psi). As the water flows into the assembly a portion of the water flows down through a passage ending under the diaphragm, pushing it up, compressing spring "S" and closing the relief valve "R". Back at the inlet the remainder of the water flows through the number one check valve.

As the water flows through the check valve one the pressure drops to 359 kPa (52 psi). The pressure drop is a result of the spring tension and friction of the moving parts of check valve one. Water flows into the zone of reduced pressure. The pressure in the zone 359 kPa (52 psi) pushes down on the relief valve diaphragm, trying to force it down. The relief valve "R" remains closed because the higher closing pressure 413 kPa (60 psi) is pushing up from below the diaphragm. The zone pressure pushing down on the relief valve diaphragm is assisted by the spring pressure "S "which is also trying to force the relief valve open by pushing down on the relief valve diaphragm. The zone pressure plus the spring pressure do not add up to more than 413 kPa (60 psi) so the relief valve remains closed.

Water continues to flow through the zone of reduced pressure and out through check valve two. The pressure drops to 338 kPa (49 psi) as the water passes through the check valve. The water exits the assembly through shut-off two. The total loss of pressure loss through the valve is 76 kPa (60 psi minus 49 psi =11 psi).

Content

Figure 7-5 shows an RP with a backpressure backflow condition.

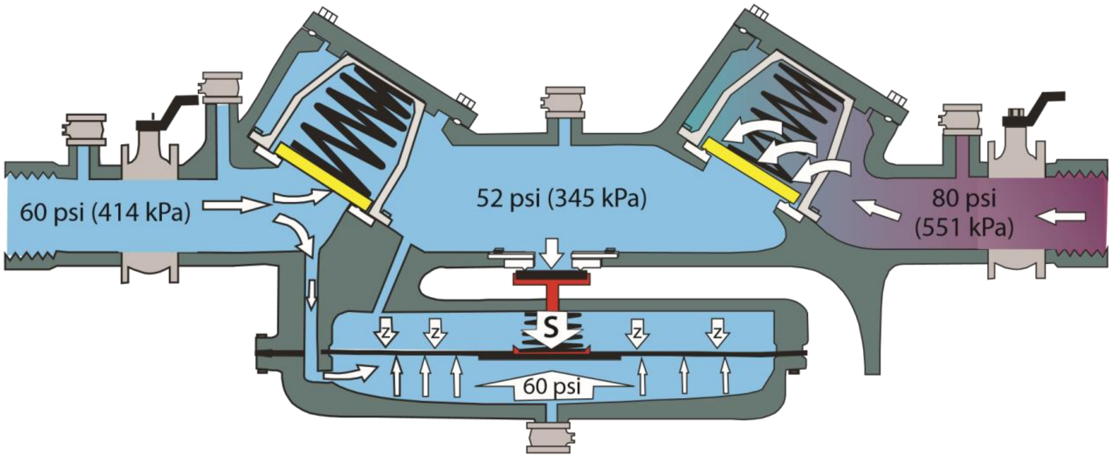


Figure 7-5—RP with backflow condition

RP sequence of operation during backflow

The RP check valve two is preventing contaminated water from back flowing and contaminating the potable water supply. Both check valves are closed and the relief valve remains closed. The valve is functioning correctly preventing any possible contamination of the potable water system upstream of the RP.

Content

Figure 7-6 shows a RP with backflow and a leaking check valve 2

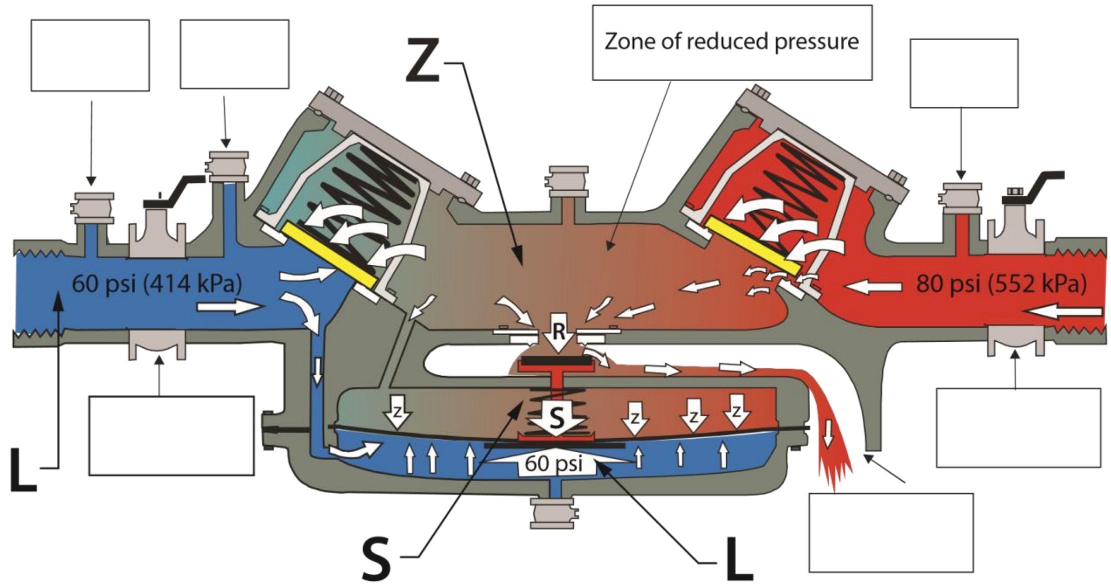


Figure 7-6—Leaking check valve 2

First you should fill in the blank boxes in Figure 7-6 with the correct names of the components. Refer to Figure 7-1 for the correct names.

Pressures (rather than force) are used in Figure 7-6 to simplify the explanation of the principle of operation of the relief valve. Relief valve spring pressures vary from assembly to assembly and friction due to resistance of moving parts all affect the actual pressure inside an assembly.

RP sequence of operation during backflow conditions and leaking check valve 2

Figure 7-6 shows that check valve 2 is leaking water back into the zone "Z" and is causes the pressure in the zone to increase. When the pressure in the zone increases to 393 kPa (57 psi) the force pushing down on the relief valve diaphragm would be 393 kPa (57 psi). Combined with the assistance of the relief valve spring "S" 21 kPa (3 psi), the total force trying to push the relief valve open would be would be 414 kPa (60.5 psi). The downward force of 414 kPa (60.5 psi) "Z" plus "S" is greater than the line force "L" 413 kPa (60 psi) that is pushing up so the relief valve will begin to open. The relief valve will continue to open until it is relieving the same amount of water that is back flowing past check valve two.

The open relief valve allows the non-potable water leaking through the check valve to discharge to an air gapped drain. The check valve one has remained closed, which prevents the non-potable water form flowing back into the potable system.

Content

Figure 7-7 shows the RP with a leaking check valve 1.

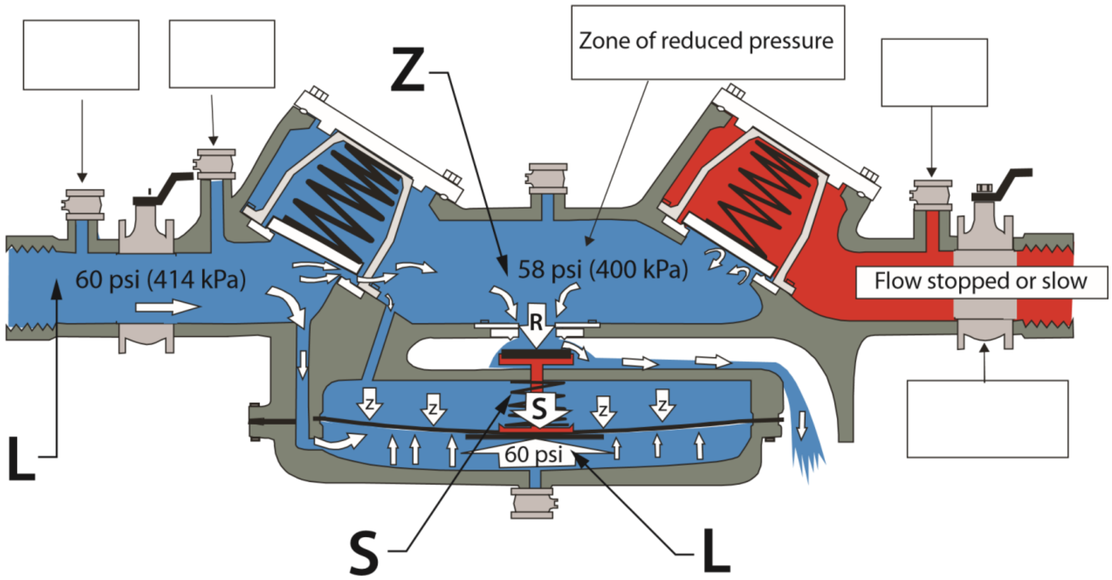


Figure 7-7-Leaking check valve 1

First you should fill in the blank boxes in Figure 7-7 with the correct names of the components. Refer to Figure 7-1 for the correct names.

RP sequence of operation with a leaking check valve one.

Figure 7-7 shows a symptom of spillage at the relief valve port. The spillage of the relief port under this condition typically occurs when the flow of water at the outlet is low or stopped. The illustration shows the check valve one is leaking into the reduced pressure zone. The pressure in the zone has increased and the relief valve is discharging.

A leaking check valve one is often caused by fouling of the check valve seat caused by debris in the water supply. Flush out the lines before installation and install a strainer if necessary.

Never flush a backflow preventer before testing. Flushing the assembly before testing will result in inaccurate test results.

Content

Figure 7-8 shows the RP with a back-syphonage condition

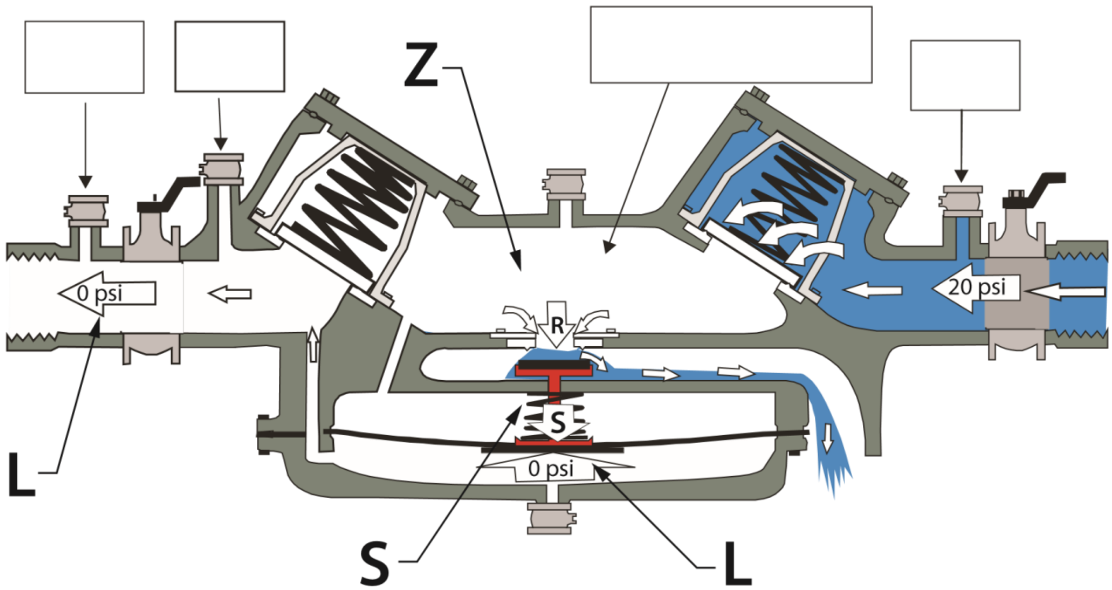


Figure 7-8—Back syphonage condition

First you should fill in the blank boxes in figure 7-8 with the correct names of the components. Refer to Figure 7-1 for the correct names.

RP sequence of operation during back syphonage

In Figure 7-8 the water supply has been interrupted and the pressure at letter "L" on the inlet to the assembly has fallen to zero. As the water pressure on the inlet to the assembly begins to drop, the pressure holding the relief valve closed will also drop. When the pressure on the inlet side drops to within a minimum 13.8 kPa (2 psid) above the zone pressure the relief valve will open causing the zone to drain. The check valve two will stop backflow into the zone from the outlet side of the assembly.

The relief valve opens on the same principle of operation as it did with a leaking check valve one and two.

The last sequence of illustrations on the RP have shown that it can be concluded that the RP protects against backpressure and back-syphonage cross connections.

Content

Figure 7-9 shows the RP with nuisance spillage of the relief port.

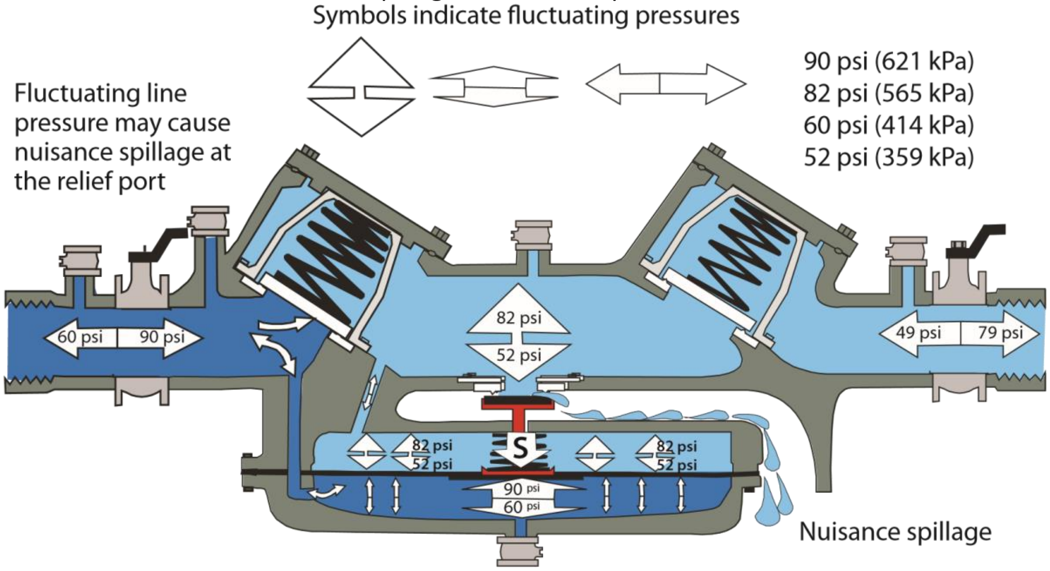


Figure 7-9—RP nuisance spillage

RP sequence of operation with nuisance spillage

Figure 7-9 shows a fluctuating line pressure at the inlet to the RP from a high of 620 kPa (90 psi) to a low of 414 kPa (60 psi). Nuisance spillage of the relief valve occurs each time the line pressure surges and then drops back to the original line pressure. Each surge in pressure boosts the zone pressure to 565 kPa (82 psi) after the initial high surge of pressure 620 kPa (90 psid) the line pressure upstream of the number one check valve will drop back to 414 kPa (60 psi). If the 565 kPa (82 psi) in the zone cannot be dissipated downstream at the same rate and time as the inlet pressure falls back to 414 kPa (60 psi) the relief valve will open (spit). Occasionally the 565 kPa (82 psi) in the zone is briefly captured, especially if the pressure cannot dissipate through the assembly outlet. At this brief moment when the pressure in the zone approaches the inlet line pressure, the relief valve will immediately open and reduce the pressure in the zone to at least 13.8 kPa (2 psid) below the inlet line pressure. The relief valve will then close. Recall that the zone pressure will not get within 13.8 kPa (2 psid) of the inlet because the relief valve will open.

Repeated fluctuation of the inlet line pressure will cause the relief valve to spit or discharge with each fluctuation. This nuisance discharge can be avoided by the installation of a soft seated check valve on the inlet or water hammer arrestors upstream of the assembly if the discharge is caused by excessive water hammer.

Content

Figure 7-10 shows the RP with a soft seated check valve installed up steam of the RP.

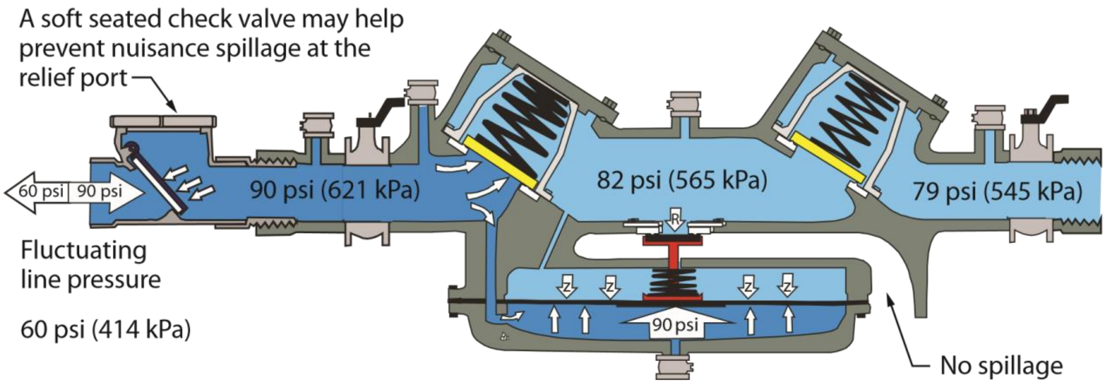


Figure 7-10—RP with soft seated located check upstream

Figure 7-10 shows a check valve installed to prevent nuisance spillage caused by fluctuations in the line pressure. The check valve works by capturing the excess line pressure at the inlet to the RP. The captured line pressure remains on the relief valve diaphragm thus stopping the relief valve from opening while the high pressure remains in the reduced pressure zone. Eventually the captured high pressure at the inlet of the RP and the zone of reduced pressure is dissipated downstream through normal use. Meanwhile there has been no nuisance spillage.

The installation of a soft seated check valve may not stop the nuisance spillage. The installation of water hammer arrestors on the inlet side of the assembly may reduce fluctuations caused by water hammer to acceptable limits.

This completes the information on the components and sequence of operation of a RP.

RPDA type II sequence of operation

The basic sequence of operation of this is valve is the same as a RP. The following information just deals with the flow through the assembly under no flow and flow conditions.

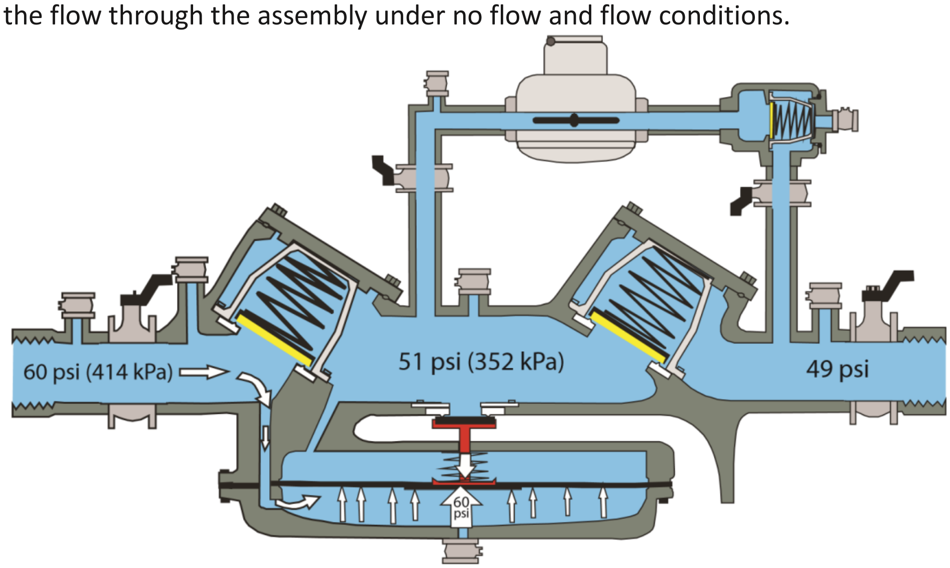


Figure 7-11—RPDA type II no flow

Content

Figure 7-11 shows the static no flow position, all check valves closed and relief valve closed.

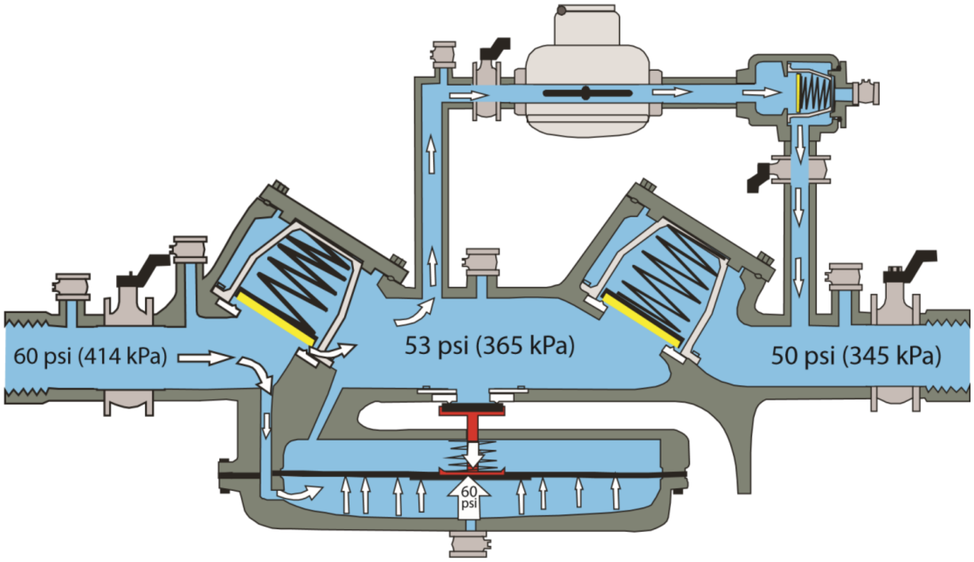


Figure 7-12—RPDA bypass flow only is detecting theft or leaks

Figure 7-12 shows the RPDA type II bypass check valve open, detecting leaks or theft of water as it passes through the bypass meter and single check. Minimum flows under 2 GPM (0.126 l/sec) will flow through the meter while the mainline RP check valve 2 is closed.

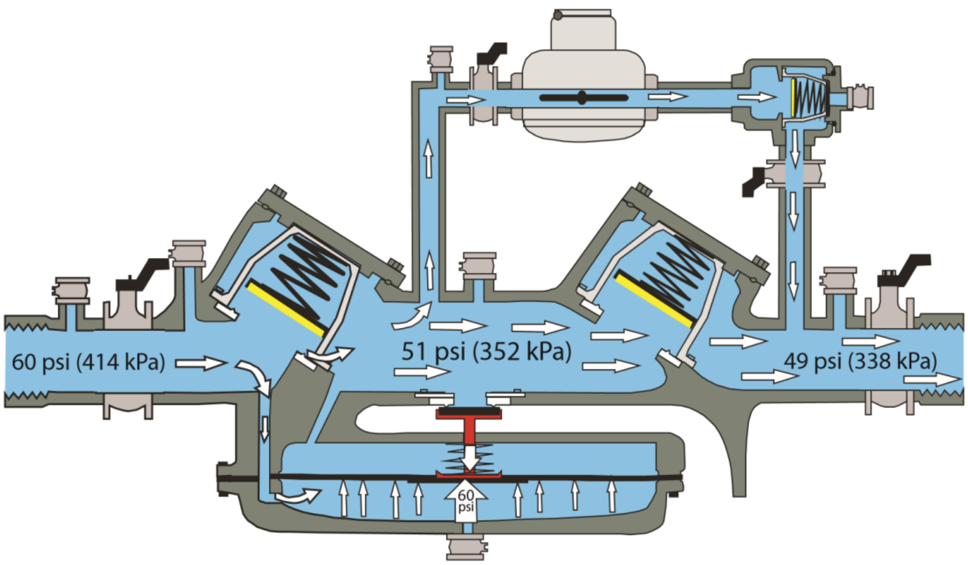


Figure 7-13—RPDA type II full flow condition

Figure 7-13 shows the RPDA type II mainline check valve opens as the flow increases in the event of a fire.

Note: All other sequences of operation are the same as a normal RP. The RPDA type II assembly provides the same degree of protection as the RP.

Content

DCVA components and their names

Figure 7-14 shows the double check valve assembly components.

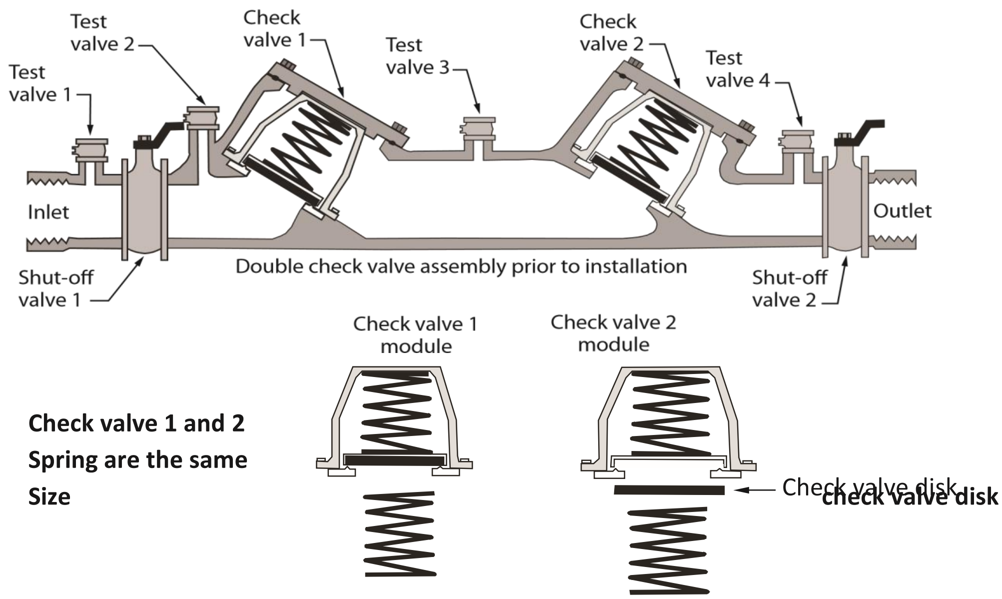


Figure 7-14—DCVA Identify parts

For Figure 7-14 you will need to be able to identify and memorize the name of each component.

The test procedures you will be learning refer to each of these parts using the names given in this illustration. If you cannot identify the parts you will not be able to interpret the test procedures.

Notice that the test valves, shut-off valves and the check valves are numbered in the direction of flow from the inlet to the outlet numbers (1, 2, 3 etc.) This method of numbering is standard with all backflow prevention assemblies. Also the names of the components are standardized. Consistency in part identification reduces confusion and the possibility of error.

The valve body of the DCVA in Figure 7-14 is similar in shape to the RP, except that there is no relief valve. The DCVA contains two internally loaded check valves in a single body.

Facts about the components of the DCVA:

- The strengths (size) of the check valve 1 and check valve 2 are the same.
- The check valves are spring-loaded to the closed position, so they will provide positive closure.
- The check valve discs are resilient seated, soft seated.
- The check valves are designed to close against a minimum of 6.9 kPa (1 psid) in the direction of flow.
- The shut-off valves must be resilient seated full port ball valves or resilient seated wedge gate valves. Typically, sizes 2" and under are full port ball valves.
- Refer to Chapter 6 for installation requirements.

Content

Figure 7-15 shows a DCVA with normal flow and backflow

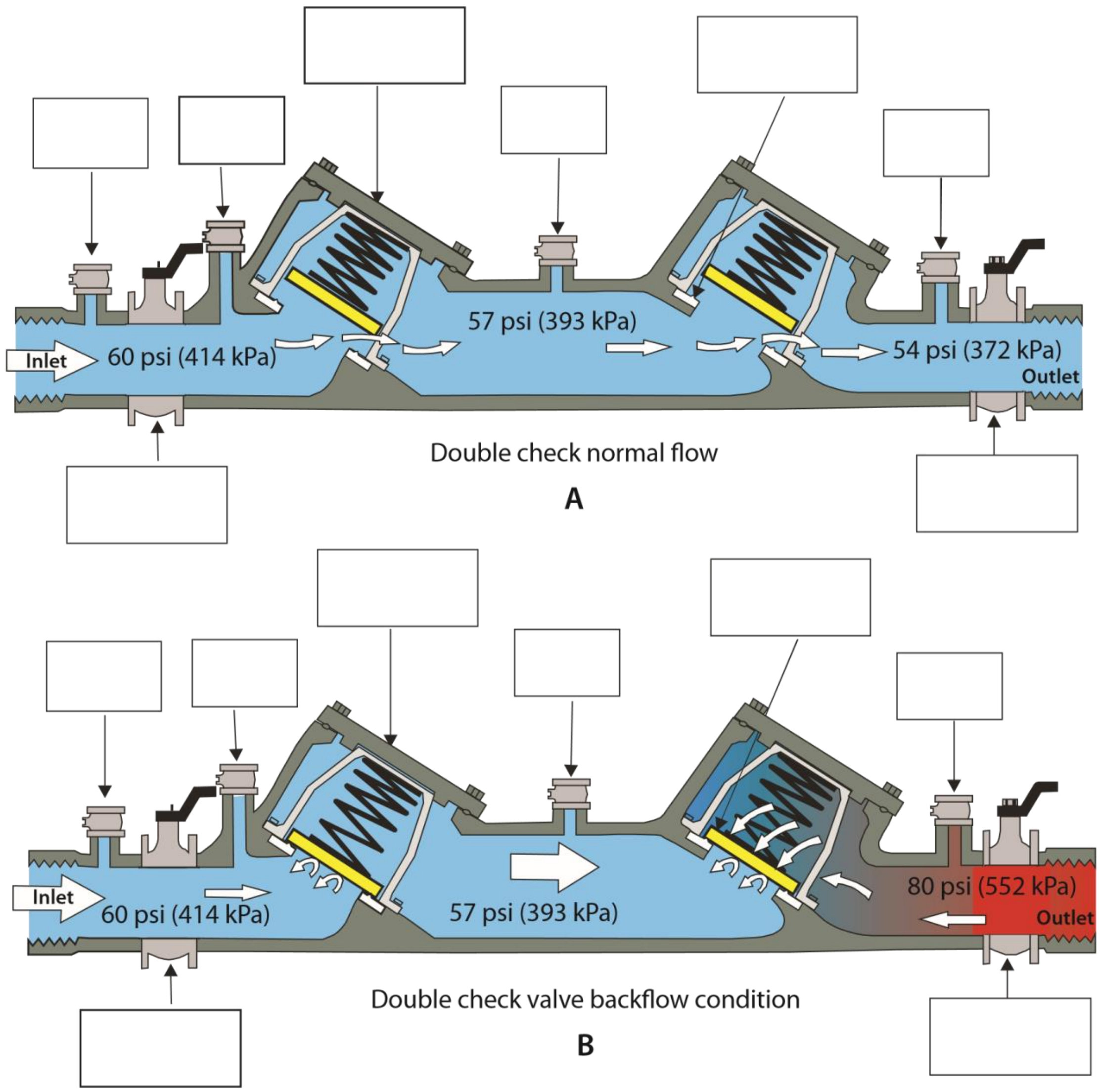


Figure 7-15—DCVA identify the parts

First you should fill in the blank boxes in Figure 7-15 with the correct names of the components. Figure 7-14 of this manual for the correct names.

DCVA sequence of operation during normal flow

Figure 7-15 "A" shows the water passes flow through the DCVA the total pressure drop through this DCVA is not as high as the total pressure drop through a RP. Refer to Figure 7-1 to see the pressure drop through a RP. Compare the difference in design and operation.

DCVA sequence of operation during backflow

In Figure 7-15 "B" you will notice that backflow is present and the 1 and 2 check valves are closed tight, stopping pollution of the potable water supply on the inlet side of the DCVA. The DCVA is functioning as designed.

Content

Figure 7-16 shows the DCVA with leaking check valves

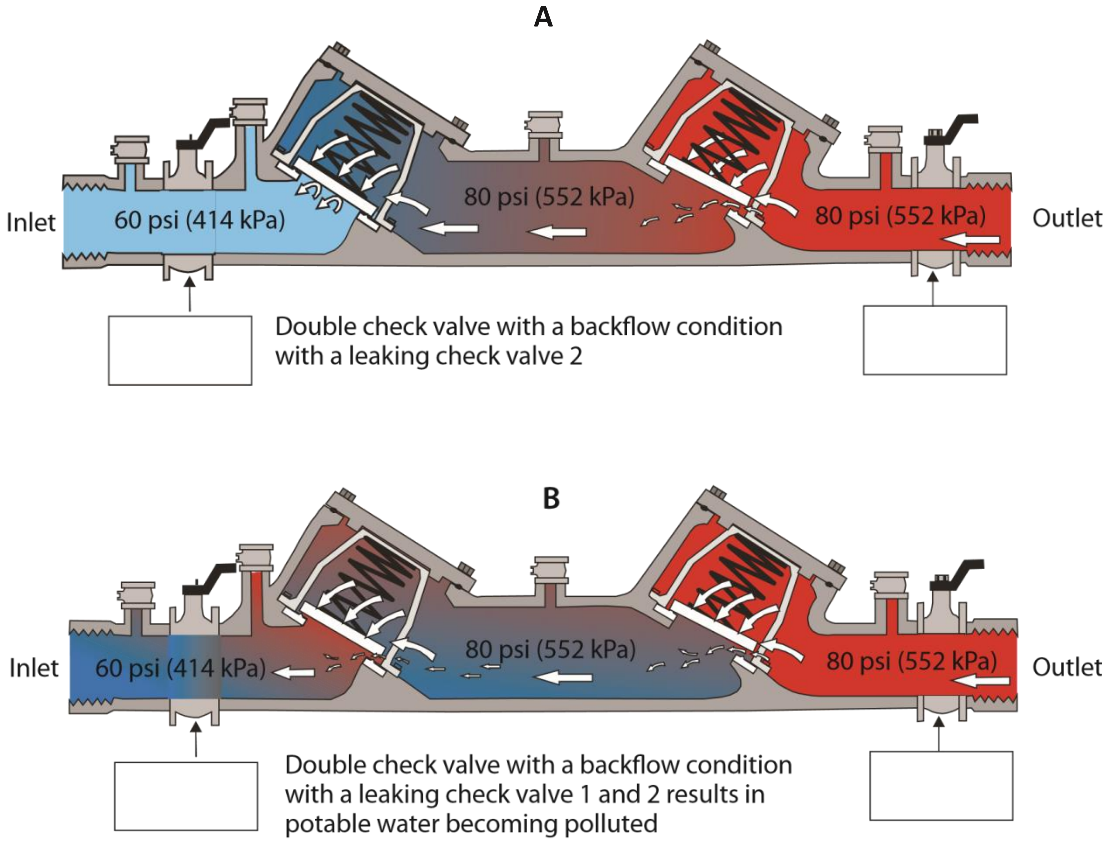


Figure 7-16—DCVA backflow conditions

First you should fill in the blank boxes in Figure 7-16 with the correct names of the components. Refer to Figure 7-14 of this manual for the correct names.

DCVA sequence of operation during a leaking check valve two, letter A
With a leaking check valve 2; no pollution of the potable inlet water supply is occurring because the check valve 1 is closed tight.

DCVA sequence of operation during a leaking check vale 1 and check valve 2, letter B
With a leaking check valves 1 and 2 pollution of the potable inlet water supply is occurring. The amount of pollution; however, is small and the pollution is a minor hazard.

Back syphonage backflow caused by a water supply interruption would also be prevented by the DCVA. In fact, both check valves will close positively when there is still a 6.9 kPa (1 psi) positive pressure in the DCVA.

This completes the information on the components and sequence of operation of a DCVA.

Refer to Chapter 8 in this manual for information on test procedures.

Content

DCDA type II sequence of operation

The basic sequence of operation of this is valve is the same as a DCVA or DCDA. The following information just deals with the flow through the assembly under no flow and flow conditions.

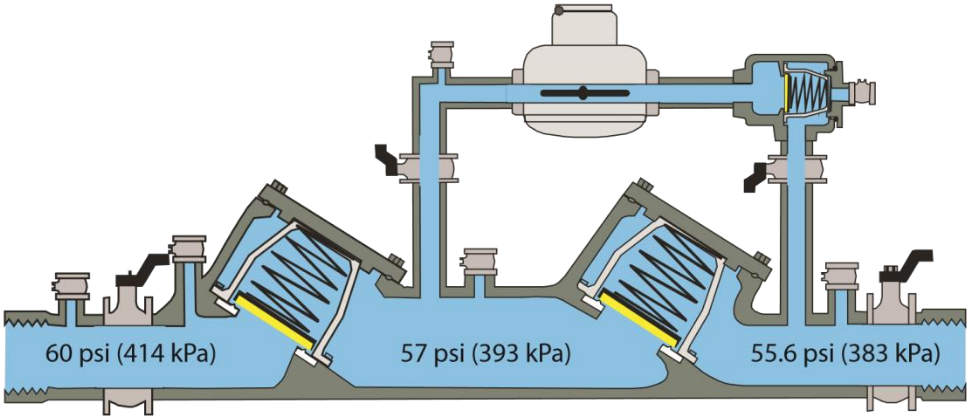


Figure 7-17—DCDA type II static no flow condition

Figure 7-17 shows the DCDA type II in a static no-flow position, all check valves closed.

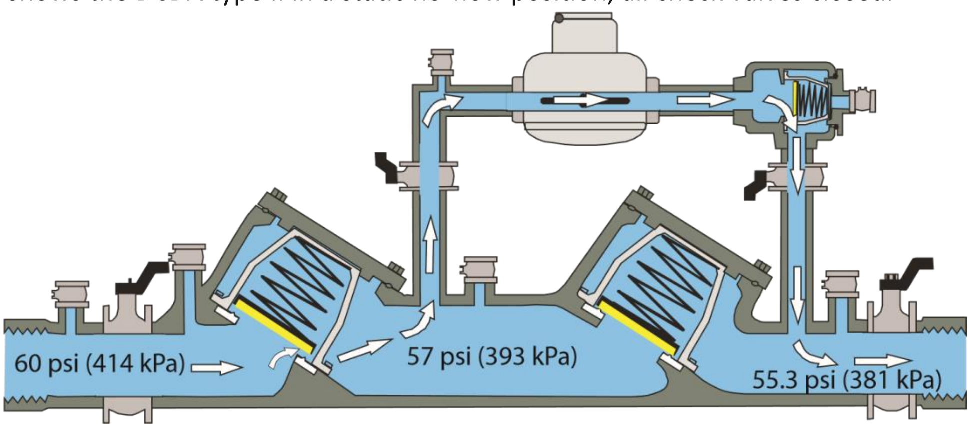


Figure 7-18—DCDA flow through bypass detecting theft or leaks

Figure 7-18 shows the DCDA type II bypass check valve open, detecting leaks or theft of water as it passes through the bypass meter and single check. Minimum flows under 2 GPM (0.126 l/sec) will flow through the meter while the mainline DCVA check valve 2 is closed.

Content

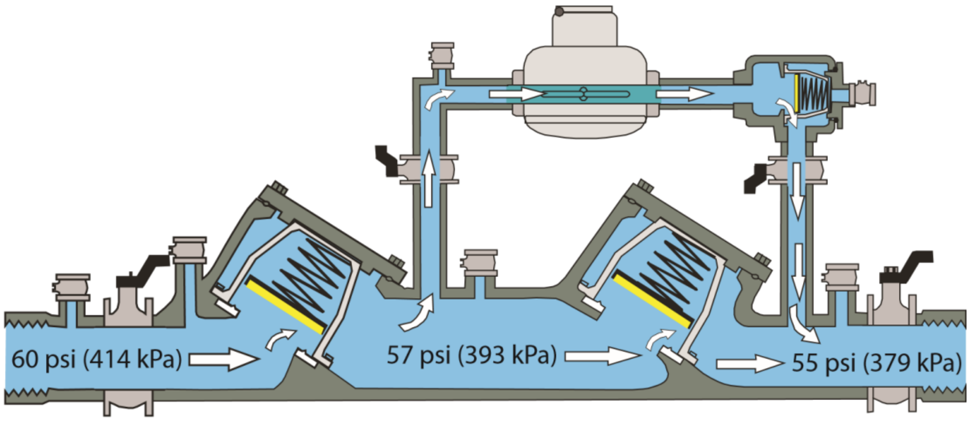


Figure 7-19—Flow condition during in a fire

Figure 7-19 shows the DCDA type II mainline check valve open as the flow increases in the event of a fire.

Note: All other sequences of operation are the same as a normal DCVA. The DCDA type II assembly provides the same degree of protection as the DCVA.

Note: Actual pressure readings inside the valve will vary depending on the manufactures design characteristics. All pressures in the illustrations are for educational use only.

Content

PVB components

Figure 7-20 shows a pressure vacuum breaker assembly and components.

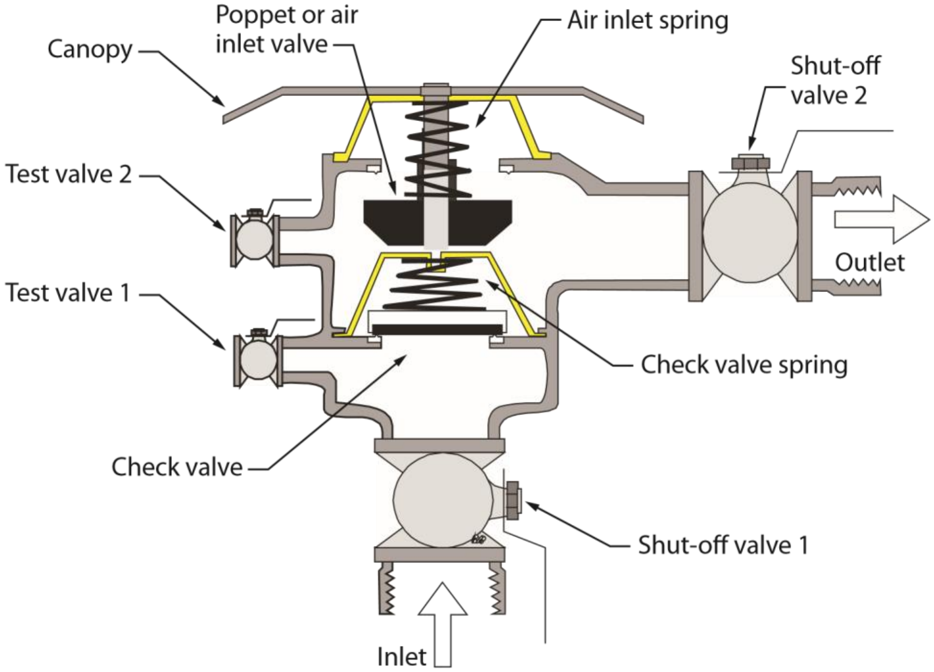


Figure 7-20—PVB identify the components

For Figure 7-20 you will need to be able to identify and memorize the name of each component.

The test procedures you will be learning refer to each of these parts using the names given in this illustration. If you cannot identify the parts you will not be able to interpret the test procedures.

Notice that there are only two test-valves, one spring-loaded check valve and one poppet/air-inlet valve. The shut-off valves and test valves are numbered in the direction of flow from the inlet to the outlet. This method of numbering is standard with all backflow prevention assemblies. Also the names of the components are standardized. Consistency in part identification reduces confusion and the possibility of error.

Facts about the components of the PVB:

- The check valve is spring-loaded to the closed position so it will provide positive closure. The check valve will close against a minimum of 6.9 kPa (1 psid) of positive pressure in the direction of flow from inlet to outlet.
- The air-inlet valve is spring loaded to the open position, it provides positive opening when the minimum pressure in the valve is at or above 6.9 kPa (1 psid).
- The canopy can be removed for testing and maintenance.
- The shut-off valves must be resilient seated full port ball valves or resilient seated wedge gate valves. Typically sizes 2" and under are full port ball valves.
- Refer to Chapter 6 of this manual for installation requirements.

Content

Figure 7-21 shows a PVB with normal flow conditions.

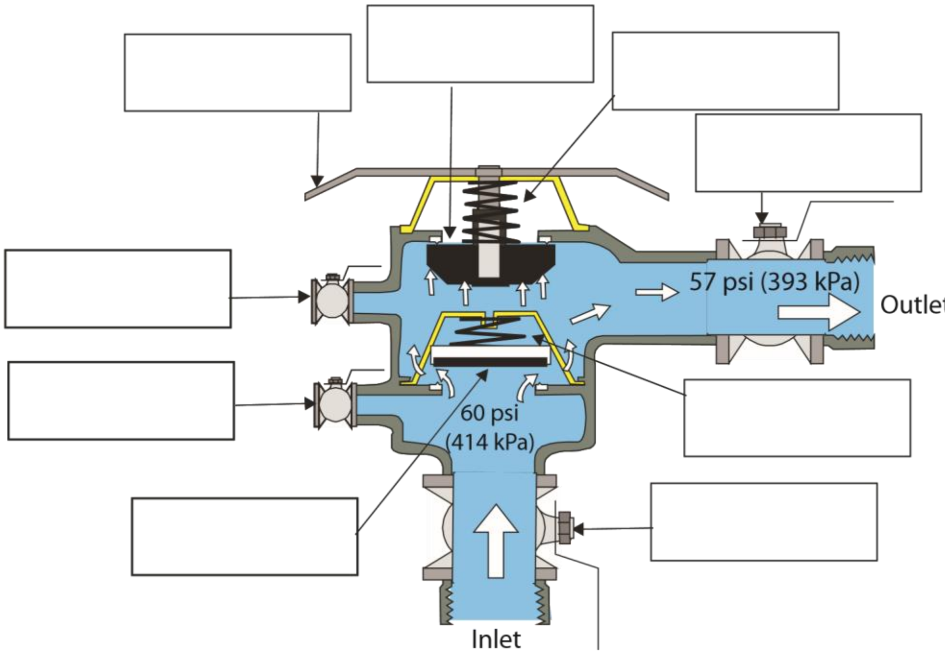


Figure 7-21—Identify the components practice

First you should fill in the blank boxes in Figure 7-21 with the correct names of the components. Refer to Figure 7-20 of this manual for the correct names.

PVB sequence of operation during normal flow

Figure 7-21 shows the flow of water from the inlet to the outlet of the PVB. As the water passes through the PVB the water pressure closes the air-inlet valve and forces open the check valve. The PVB air-inlet valve will spill water when the pressure in the PVB is not strong enough to close the air-inlet valve. Spillage usually occurs when water first enters the valve as the shut-off one is opened. The PVB should be provided with a drainage pan under it to prevent water damage.

Recall that the PVB is only designed to prevent a cross connection caused by back-syphonage backflow. It is not approved to prevent backflow due to backpressure.

Content

Figure 7-22 shows the PVB with a back-syphonage condition due to interrupted water supply.

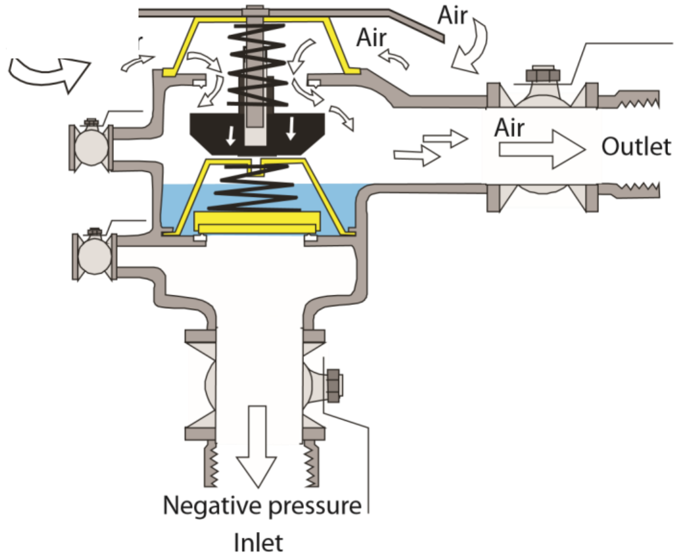


Figure 7-22—PVB Identify components

PVB sequence of operation during back-syphonage

Figure 7-22 shows the water supply pressure has dropped to a point where it has about to create a negative pressure at the supply inlet. The check valve has closed and the air-inlet valve has opened. The open air-inlet valve allows air to rush in, preventing a negative pressure from occurring in the piping downstream of the check valve. Polluted water cannot be pulled back into the potable water supply inlet piping. Also the check valve has closed tight preventing any polluted water above the check valve from entering the potable water supply inlet piping. The spring on the air inlet valve will open when there is 6.9 kPa (1 psid) or more positive pressure left in the PVB. The valve is functioning as it is designed to do.

Figure 7-22 shows that after the air-inlet valve opened, it continued to open until it came to rest on the bracket above the check valve. This inlet valve must be fully open to provide entry of sufficient air to relieve any vacuum created in the downstream piping (outlet piping).

Content

SRPVB sequence of operation and components

Figure 7-23 shows the SRPVB components

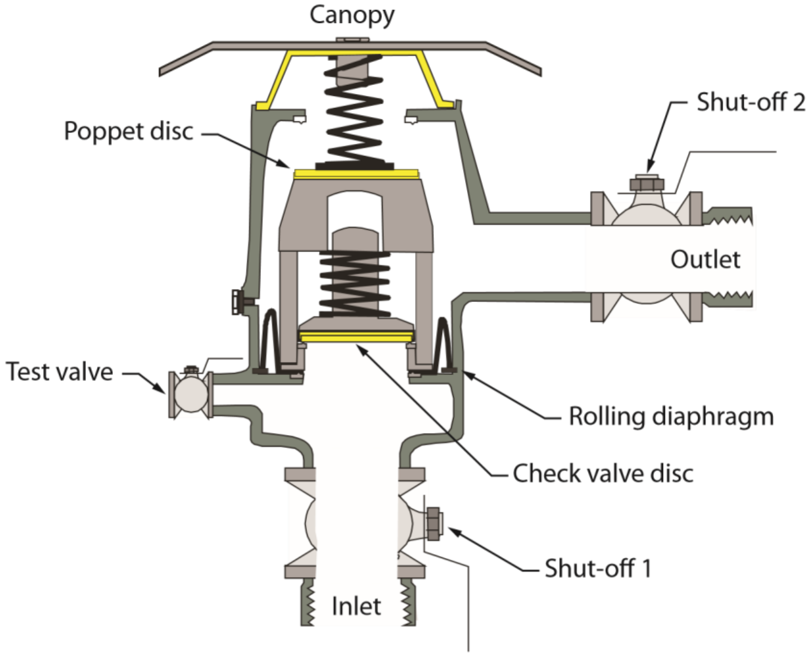


Figure 7-23—SRPVB identify components

For Figure 7-23 you will need to be able to identify and memorize the name of each component. For Figure 7-23 the test procedures you will be learning refer to each of these parts using the names given in this illustration. If you cannot identify the parts you will not be able to interpret the test procedures.

Notice that there is one test-valve and one bleed/screw (vent valve), one spring-loaded check valve and one poppet/air-inlet valve. This SRPVB employs a rolling diaphragm to assist the spill resistant feature. The shut-off valves and test valves are numbered in the direction of flow from the inlet to the outlet. This method of numbering is standard with all backflow prevention assemblies. Also the names of the components are standardized. Consistency in part identification reduces confusion and the possibility of error.

Facts about the components of the SRPVB:

- Essentially the SRPVB serves the same purpose as the PVB with the additional feature of being spill resistant; being careful not to use the word spill proof. The check valve is spring loaded to the closed position so it will provide positive closure. The check valve will close against a minimum of 6.9 kPa (1 psid) of positive pressure in the direction of flow is from inlet to outlet.
- The air-inlet valve is spring loaded to the open position, it provides positive opening when the minimum pressure in the valve is at or above 6.9 kPa (1 psid).
- The canopy can be removed for testing and maintenance.
- The shut-off valves must be resilient seated full port ball valves or resilient seated wedge gate valves. Typically sizes 2" and under are full port ball valves.

Content

Figure 7-24 shows the component's position when water is beginning to flow through the valve. Notice the air-inlet valve (poppet disc) is closed before water has entered the valve body above the check valve. (This is the spill resistant feature.)

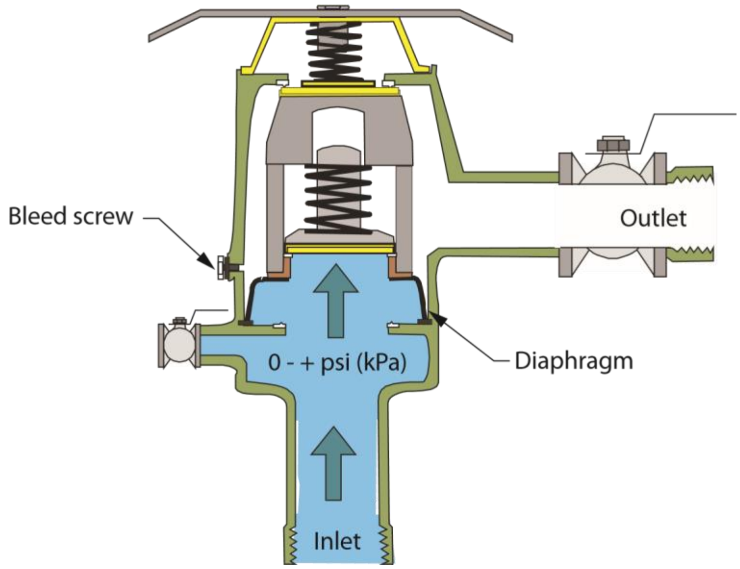


Figure 7-24—Water starting to flow

Figure 7-25 shows the SRPVB with full water flow.

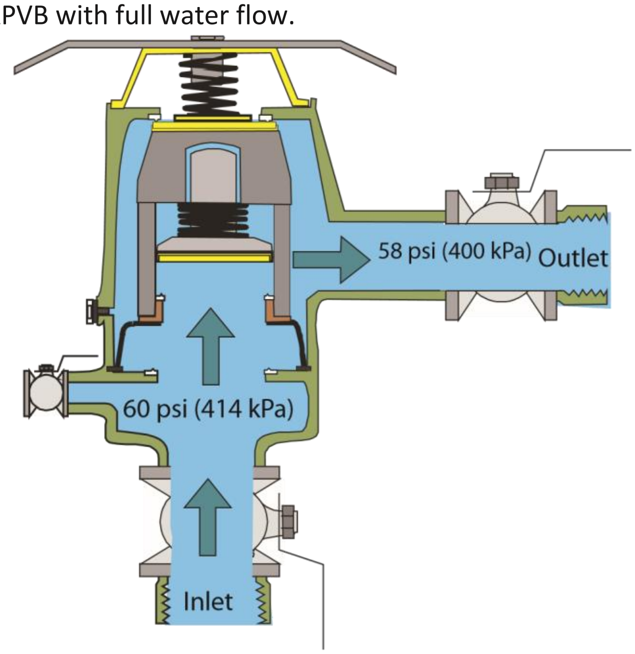


Figure 7-25—SRPVB full flow condition

Content

Figure 7-26 shows the SRPVB under a back-syphonage condition. The air-inlet valve has just opened at a positive pressure at or above 6.895 kPa (1 psid). There is still a little pressure left below the check valve rolling diaphragm. The check valve is closed.

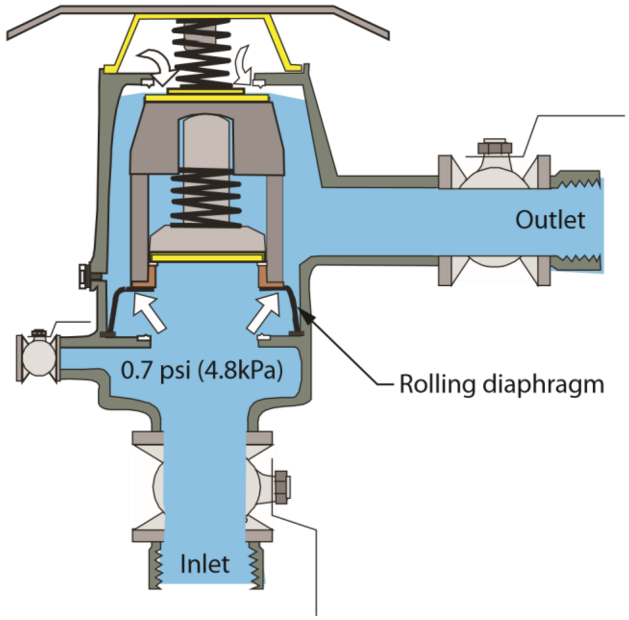


Figure 7-26—SRPVB back syphonage condition air-inlet just opening

Figure 7-27 shows the SRPVB with a negative pressure (back-syphonage) at the inlet.

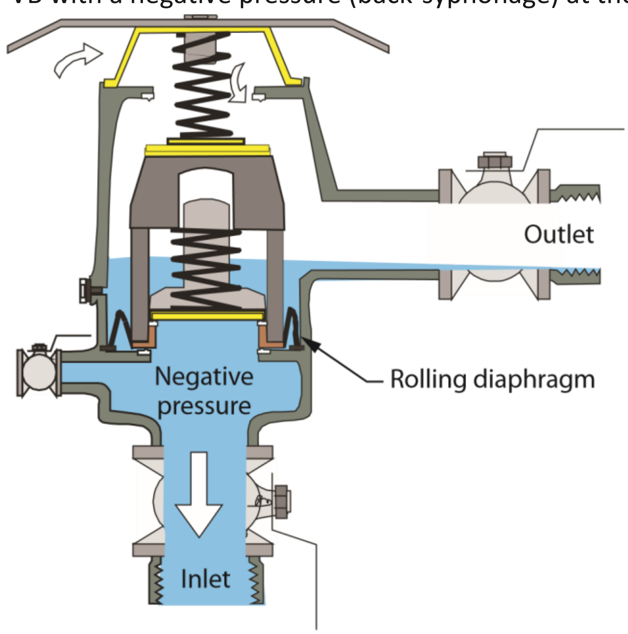


Figure 7-27—SRPVB air-inlet fully open

Figure 7-27 shows the air inlet/poppet completely open, check valve closed and the rolling diaphragm has fully seated. The SRPVB has protected against back-syphonage backflow.

Content

Note: The SRVBA shown in the previous illustrations uses a rolled diaphragm design rather than a flat design as is the case with the RP relief valves shown in previous illustrations. A rolling diaphragm is domed shaped or molded. Rolled diaphragms provide easier movement, low friction and better sensitivity.

Not all manufacturers use springs to provide the opening force at the PVB/SRPVB-inlet valve. Some air-inlet valves appear to be designed with the actual sealing disc applying the opening force rather than a spring. You may be wondering, what happened to the spring?

This completes the information on the components and sequence of operation of backflow assemblies.

Now complete Self-Test 7 and check your answers.

Content

Self-Test 7

Review the section objectives and then answer the following questions.

1. What backflow assembly has one test valve and one bleed screw/vent valve?
   a. SRPVB
   b. RP
   c. DCV
   d. PVB
2. What back flow preventer allows the air-inlet valve to close before the check valve opens?
   a. PVBA
   b. DCV
   c. SRPVB
   d. RPF
3. Which of the following is a component of an RP?
   a. Dump valve
   b. Relief valve
   c. Metal seated check valve
   d. Strainer
4. What backflow assembly is designed to discharge water when backflow, backpressure and a leaking check valve condition exists?
   a. SRPVB
   b. PVB
   c. DCV
   d. RP
5. What is done with an existing shut-off valve that is not resilient seated?
   a. Removed and replaced with a resilient seated valve
   b. Remain in service if it allows for proper testing
   c. Remain in service if it is leaking but only allows testing every other year
   d. Be re-used after removal but only as a shut-off two valve on an assembly
6. What is the correct order of numbering of test valve from inlet to outlet of a backflow assembly?
   a. 1, 2, 3, 4
   b. 2, 3, 4, 1
   c. 4, 3, 2, 1
   d. 1, 2, 3

Content

7. What is a characteristic of the check valve one on an RP?
   a. Spring-loaded to the open position
   b. Not spring-loaded
   c. Spring-loaded to the closed position
   d. Is metal to metal seated

8. What must the minimum differential of the zone of reduced pressure not be in an RP?
   a. 3 psid (21 kPa) of the outlet pressure
   b. 2 psid (13.8 kPa) of the outlet pressure
   c. 1 psid (6.9 kPa) of the inlet pressure
   d. 2 psid (13.8 kPa) of the inlet pressure

9. What is a characteristic of the test valves used on backflow assemblies?
   a. larger than ¾"
   b. smaller than 1⁄8"
   c. resilient seated gate valves
   d. resilient seated ball valves

10. What is a characteristic of the check valve 2 spring on an RP?
    a. is the same size as the check valve 1
    b. can be replaced with a spring from another make and model of the same size
    c. is not as strong as the check 1 valve spring
    d. can be used to replace the check valve 1 spring

11. What holds the relief valve on an RP closed?
    a. supply line pressure
    b. spring pressure
    c. stopper discs
    d. zone of reduced pressure

12. What is a characteristic of the relief valve on a RP?
    a. spring-loaded to the open position
    b. relieves on a temperature rise
    c. spring-loaded to the closed position
    d. activated as the pressure in the zone of reduced pressure drops

Content

13. What would you do before installing a backflow assembly?
    a. test the assembly
    b. flush the supply lines
    c. remove and clean the test valves
    d. flush the assembly

14. What is characteristic of the resilient seated ball valves used as backflow assembly shut-offs?
    a. over 2" in size
    b. reduced port
    c. full port
    d. reduced port under 2" in size

15. What will a symptom be of a leaking check valve 2 on the RP when backflow is occurring?
    a. the check 1 valve will open
    b. contamination of the potable water supply
    c. the relief valve closes
    d. the relief valve discharges

16. What would be the symptom of a leaking check valve 1 on the RP?
    a. relief valve discharge
    b. relief valve no discharge
    c. check valve 2 leaks
    d. the shut-off 1 valve leaks

17. What is a 3rd requirement of the RP test?
    a. check 2 shall close tight in the reverse direction of flow
    b. check 1 shall close tight in the reverse direction of flow
    c. relief valve shall open at or above 2 psid
    d. check valve 1 shall close tight in the direction of flow

18. What is the cause of nuisance spillage?
    a. low pressure
    b. high pressure
    c. fluctuation in supply pressure
    d. leaking check valve 2

Content

19. What may a soft seated check valve installed upstream of the RP prevent?
    a. water hammer
    b. nuisance spillage
    c. cavitation
    d. leaking check valves

20. DCVA check valve 1 and 2 springs are the same strength.
    a. True
    b. False

21. DCVA check valves are loaded to the open position.
    a. True
    b. False

22. DCVA check valves are resilient seated.
    a. True
    b. False

23. A PVB has three check valves.
    a. True
    b. False

24. The air-inlet valve of a PVB is loaded to the closed position.
    a. True
    b. False

25. What minimum pressure must the air-inlet valve of a PVB open at or above?
    a. 6.9 kPa (1 psid)
    b. 13.8 kPa (2 psid)
    c. 21 kPa (3 psid)
    d. 50 kPa. (7 psid)

26. The air-inlet valve of a PVB must open fully.
    a. True
    b. False

Content

27. What is the minimum psid across the check valve of a PVB?
    a. 6.9 kPa (1 psid)
    b. 13.8 kPa (2 psid)
    c. 21 kPa (3 psid)
    d. 50 kPa. (7 psid)

28. A PVB will protect against backpressure cross connections.
    a. True
    b. False

Check your appendix answer key

Have you accomplished your objectives of this chapter? Review your Chapter 7 objectives.

If you feel you have accomplished the objectives of Chapter 6, you may wish to proceed to Chapter 7.

Content

Chapter 8 Test Procedures for Backfow Preventers

Objectives

After completing this chapter of the course, you will be able to:

- State the purposes of testing back flow preventers.
- State the frequency of testing backflow preventers.
- State the requirements for testing and repairing older backflow assemblies.
- Identify the types of differential pressure gauges and name the basic parts.
- Identify and name the test gauge accessories.
- Reading backflow preventer name plates and certification logos
- Read and interpret differential pressure gauge readings.
- State the frequency of test gauge calibration and who calibrates the gauges.
- State the test requirements of each backflow assembly.
- Demonstrate from memory the ability to test each assembly using a pressure differential gauge.
- Accurately record test results using purveyor approved test report forms
- Explain the test procedure for a DCVA using a sight tube.
- Apply safety practices in this manual.

Introduction

There are several different test procedures used in North America and in Canada currently the test procedures required are B64.10.1 test procedures as stated in CSA B64.10 and is adopted and enforceable in the Canadian Plumbing Code (CPC). Local Government and privately owned water works water distribution systems typically are using AWWA cross connection guidelines and test procedures. The water works by-laws are enforced and are normally applicable only within the jurisdictional limits of the AHJ establishing the bylaw. If you are testing backflow preventers, you need to be familiar with the appropriate AHJ test procedures and practices required.

The test procedures used in this manual are for a three-valve or 5-valve differential pressure gauges. The manual cross section Illustrations of each test procedure step will to help you visualize what is going in the device at each step. You will first learn to test correctly functioning assemblies. Learning the basic steps correctly first will simplify troubleshooting. Troubleshooting test procedures are included in Chapter 9 of this manual.

Notes: The illustrated test procedures in this manual are generic test procedures and are for educational use only. You must refer to the test procedures adopted by the local water purveyor while testing on the job. The BC/Canadian Plumbing Code requires testers to follow CSA test procedures. (Reference CSA 64-10

Content

Testing Backflow preventers

Purpose of testing backflow preventers

Backflow preventers/assemblies are designed, manufactured, installed and to protect the water supply from contamination because of backflow of non-potable substances. These installed assemblies are only as good as their ability to maintain correct working conditions. Use of testing procedures will ensure these assemblies **remain** in safe working conditions.

Testers are required to follow the specific test steps exactly as stated in the procedures.
The reason for these exacting test procedures is to ensure consistent and reliable test reports. Testing and test reports are critical for the water purveyor and the cross connection program. The test results are the only way a water purveyor can monitor and accumulate records of each assembly in the purveyor's system. Eventually a history of each assembly is established. The purveyor can use the assembly history to identify assemblies that are not performing up to acceptable standards. The continued testing and record keeping ensures that the water supply continues to be protected from cross connections.

Frequency of testing backflow assemblies

Backflow assemblies must be tested on a continuing basis. The frequency of testing is:

- at initial installation
- annually
- after maintenance and repair
- after relocation
- as often as required by the water purveyor to ensure safe operation
- after changes or repairs upstream of the backflow preventer

Testing and repairs of older assemblies

Presently existing backflow preventers that do not meet current requirements may stay in operation provided the following requirements are met:

- The backflow preventer must still function to prevent contamination of the public potable water supply to the satisfaction of the water purveyor.
- Testing must meet the requirements of the current standards acceptable to Authority Having Jurisdiction.
- Shut-off valves that are not resilient seated ball or wedge gate type may remain in service only as long as the assembly can be tested. A valve should be replaced if it will not allow approved testing.

Actions taken if the assembly fails

If an approved backflow preventer fails the annual test, the tester shall immediately notify the customer, that they need to have the assembly repaired or replaced if necessary.

If the defective backflow preventer, cannot be immediately repaired or replaced, the tester shall immediately notify the customer and the cross connection control officer of this result. The repair or replacement of the defective backflow preventer along with the subsequent testing and notification of the cross connection control officer by the tester shall be completed within a required time limit/calendar days of the date of the failed test.

Content

Testing equipment

Figure 8-1 shows a three valve differential pressure gauge and the names of the components.

Three valve differential pressure gauge

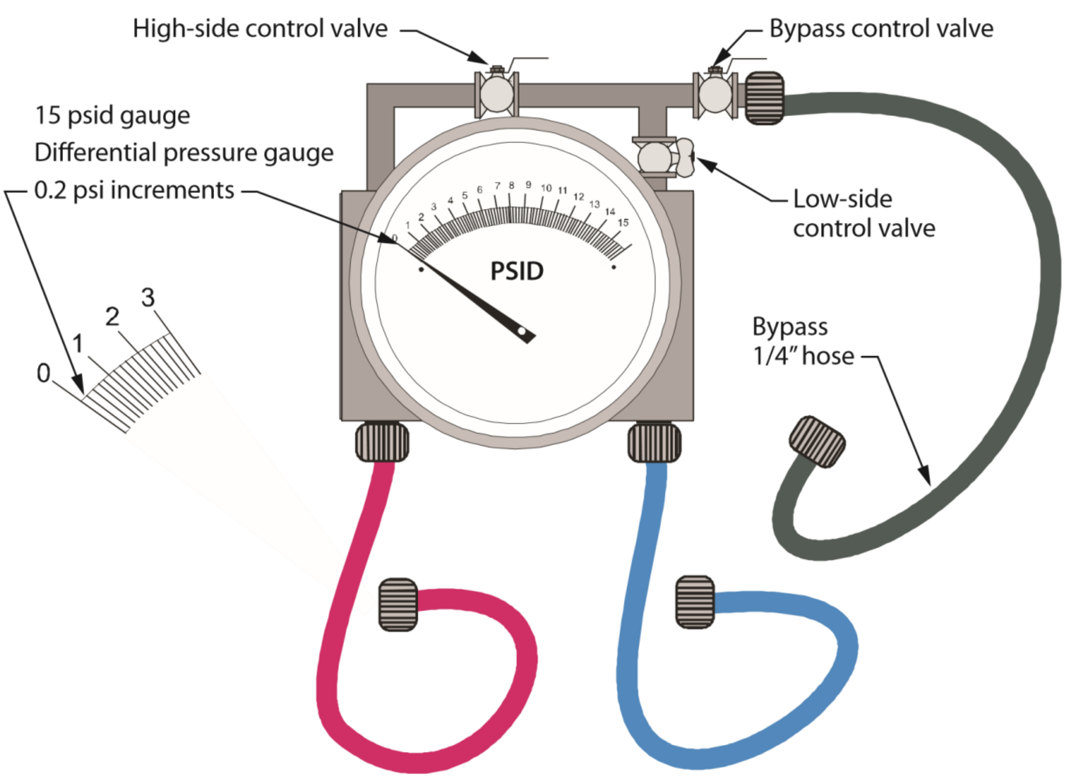


Figure 8-1—Three valve differential pressure gauge components

Figure 8-1 shows a three valve differential gauge. You must memorize the names of the components, the pressure range of the face plate, and the increments of the face plate. The component names are used to describe the test procedures so it is important to identify the correct components of the gauge.

Typically control valves are ¼" needle type valves. Do not use excessive force when operating the control valves as the seats can be damaged.

The hose connections are typically ¼" high-pressure hose with 45° SAE flare connections.

Gauges typically come with brass ¼" flare by male iron pipe adapters and bushings ¼" by ¼, ½", and ¾". Test valves on assemblies are typically ¼" to ¾" in diameter.

Drain the gauge and store in a protected, heated area.

The recommended size diameter of a differential gauge is 4.5" with major increments of 1 psid and minor increments of 0.2 psid

There are other gauges including five-valve gauges, two-valve gauges, and digital electronic differential gauges. There are test procedures specifically written for each type of gauge depending on the assembly being tested. For this course you will be using a five-valve differential pressure gauge or a three-valve differential gauge Content

Five valve differential gauge parts

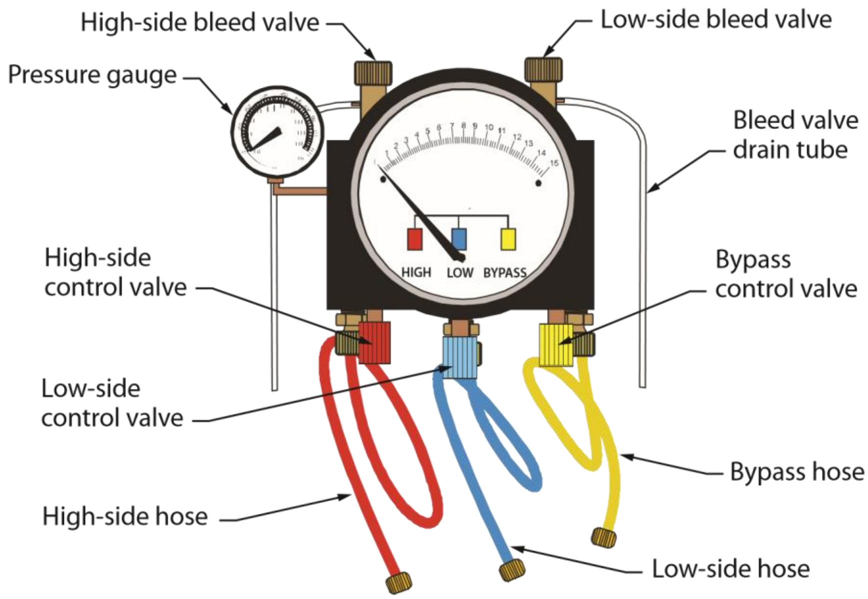


Figure 8-2—5 valve differential pressure gauge components

You should be able to name and identify and operate these gauge components figure 8-2

Figure 8-3—Example test kit, hoses and adapters

Courtesy Watts regulator TK 99 E

Content

 Content

Figure 8-4 shows the back side of a five-valve gauge and its bleed valves and bleed valve drain tubes

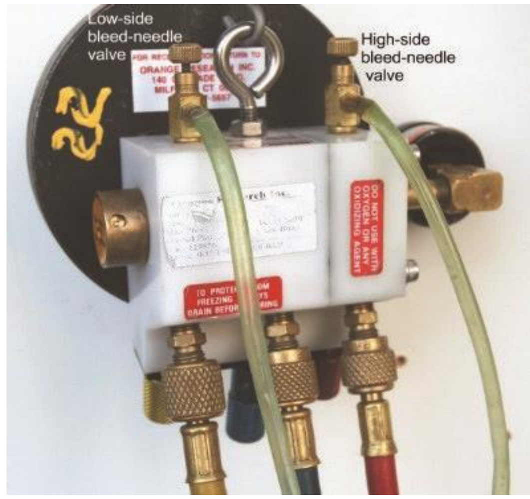


Figure 8-4—Differential gauge back view

Figure 8-5—Shows a complete five-valve test kit

Courtesy of Conbraco Industries.

Figure 8-5 includes bushings, adapters and plasticized test procedures.

The procedures that come with test kits may not be acceptable to the AHJ; therefore, you are advised to consult the AHJ before using these procedures in the field.

Adapters and bushings will be required to adapt your gauge hoses to the various sizes used for the test valves. Typically, you will need reducing bushings from ½" by ¼" size up to ¾" by ¼"size. A ¼" male iron pipe by female iron pipe 90°-degree street elbow is useful. Three of four ¼" flare adapters are handy to have.

Content

Digital readout differential pressure gauge

Another type of differential pressure gauge is the digital readout. These gauges are used by some cross connection control testing companies; they provide printouts of the test procedures and monitor differential pressures continuously. They are generally more expensive to acquire and must be handled with greater care than a conventional analogue differential pressure gauge. Figure 8-6 shows a digital print out test gauge with serial port, and a computer cable, software for downloading and storing test results to a PC system.

Figure 8-6—Digital readout differential pressure gauge

Figure 8-7—Digital differential gauges

Courtesy of Watts Regulator

Content

Content

Reading and interpreting the differential pressure gauge readings

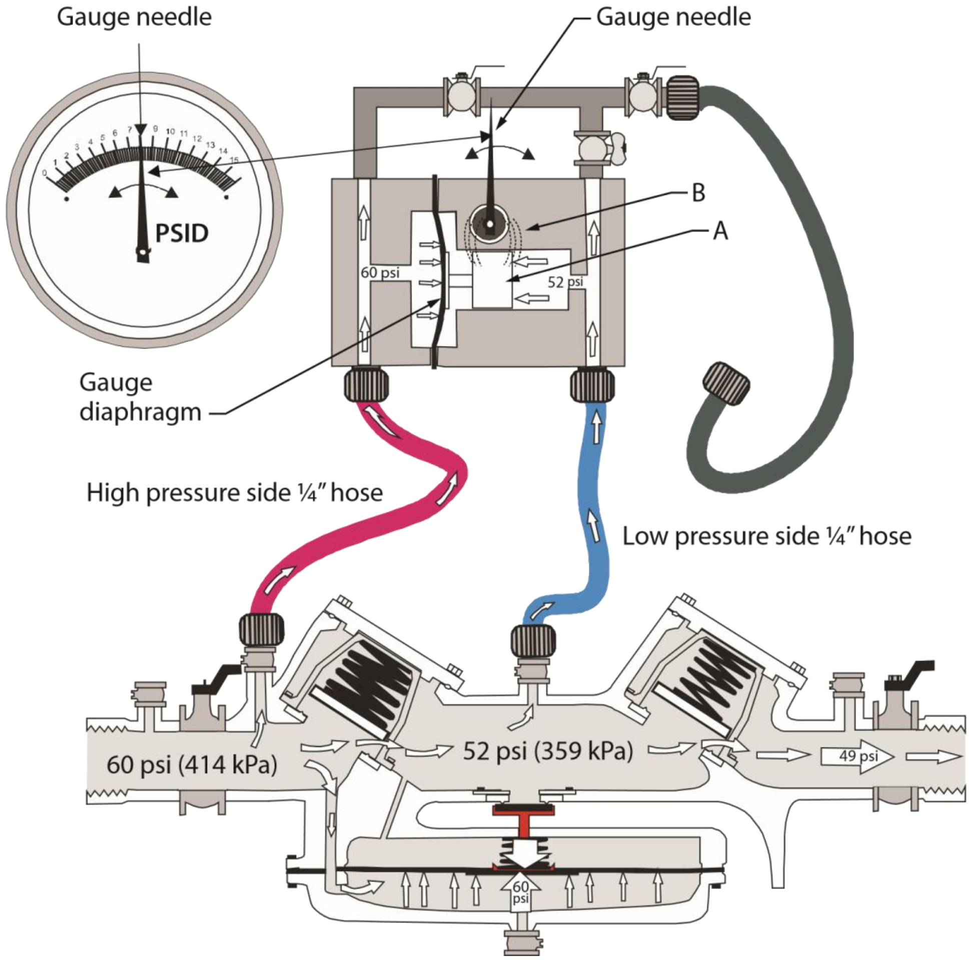


Figure 8-8—Gauge on a reduced pressure back flow assembly

Figure 8-8 simulates the inside of a three valve differential pressure gauge

The gauge shown above is currently connected to a reduced pressure back flow assembly. The high-side hose is connected to test valve 2 and the low-side hose is connected to test valve 3. Inside the valve body the pressure at test valve 2 and test valve 3 pushes in opposite directions against the gauge diaphragm. At letter "A" is a magnetized cylinder attached to the diaphragm. At letter "B" is a separated magnet-sensitive cylinder attached to the gauge needle in an isolated sealed chamber. Any movement in the diaphragm cylinder is reflected by a corresponding calibrated movement of the gauge needle. The units of measure are pounds per square inch differential (psid). The reading on this gauge is 8 psid. (60 psi – 52 psi = 8 psid).

It is important to remember that the main dial on the differential pressure gauge reads the difference in pressure between the high and low-side hose connections, not the actual pressures.

Content

The following illustration Figure-8-9 represents the pathways for water to flow within a differential pressure gauge. Manufacturers actual gauge pathways will be configured differently; however, the functions of the valves will be the same or similar.

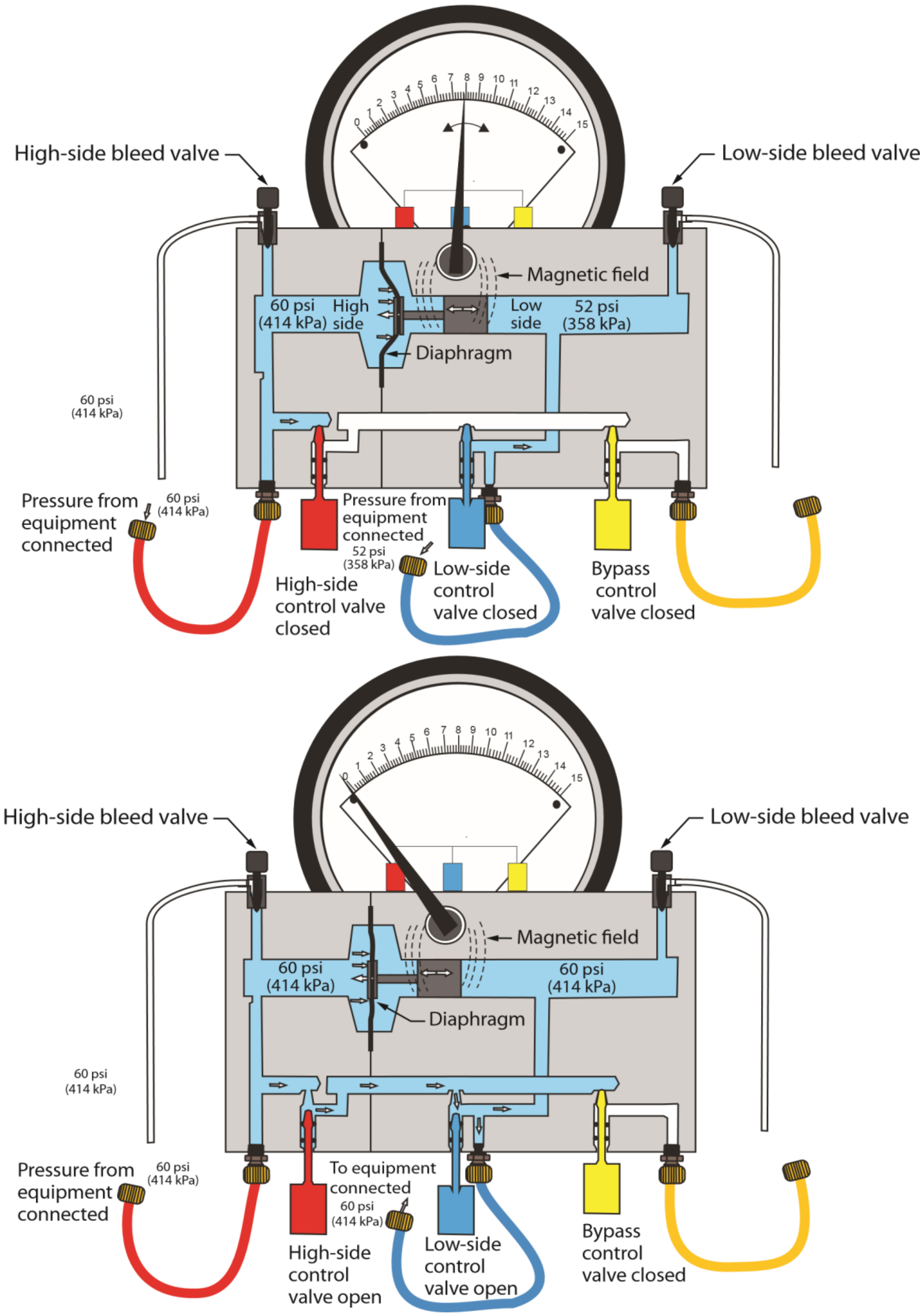


Figure 8-9—Pathways for water to flow within a differential pressure gauge

Content

Calibration for test equipment

Differential pressure gauges and similar test equipment must be maintained in good working condition. Needle valves, hoses, fittings and the gauge itself shall be maintained drip tight. Leaky fittings on the gauge will cause false readings. The gauge must read zero when not pressurized. To ensure gauge accuracy the gauge must be calibrated annually. The accuracy must **not** be out by greater than plus or minus 0.02 psid. The AHJ will typically require proof of calibration by a certified instrument company. Proof of calibration may be required with your annual certification renewal. A leak test of your test equipment should be completed by applying test pressure according to the manufactures maximum working pressure for a set minimum period of time.

The types of test equipment that may be used for calibrating a differential pressure gauge include the following:

- calibration using a no fault mercury manometer
- calibrating using water column method
- calibrating using a standard calibration gauge

All of these calibrating methods compare the pressure recording on the testing equipment to the differential pressure gauge reading at the time of calibration. If the differential gauge reading is within a limit of margin of error established by the AHJ it is certified for another year. If the reading is out of range for margin of error the differential gauge may need to be sent to a gauge manufacturer or a designated calibration company.

Note:

- Details of methods of calibration of your test gauge can be found in many cross connection control manuals.
- Calibrating your own test gauge may not be acceptable to the local AHJ.
- Calibrating of your test gauge will likely need to be done by an approved instrument calibration company.
- You may need to check with the AHJ for a list of approved instrument calibration companies. Appendix C—Manufacturers and Contacts.
- An instrument company doing calibration must insure that their methods of calibration and that their test equipment is calibrated to a recognized standard.
- A recognized standard is published by National Institute of Standards and Technology. (NIST)

Content

Testing accessories

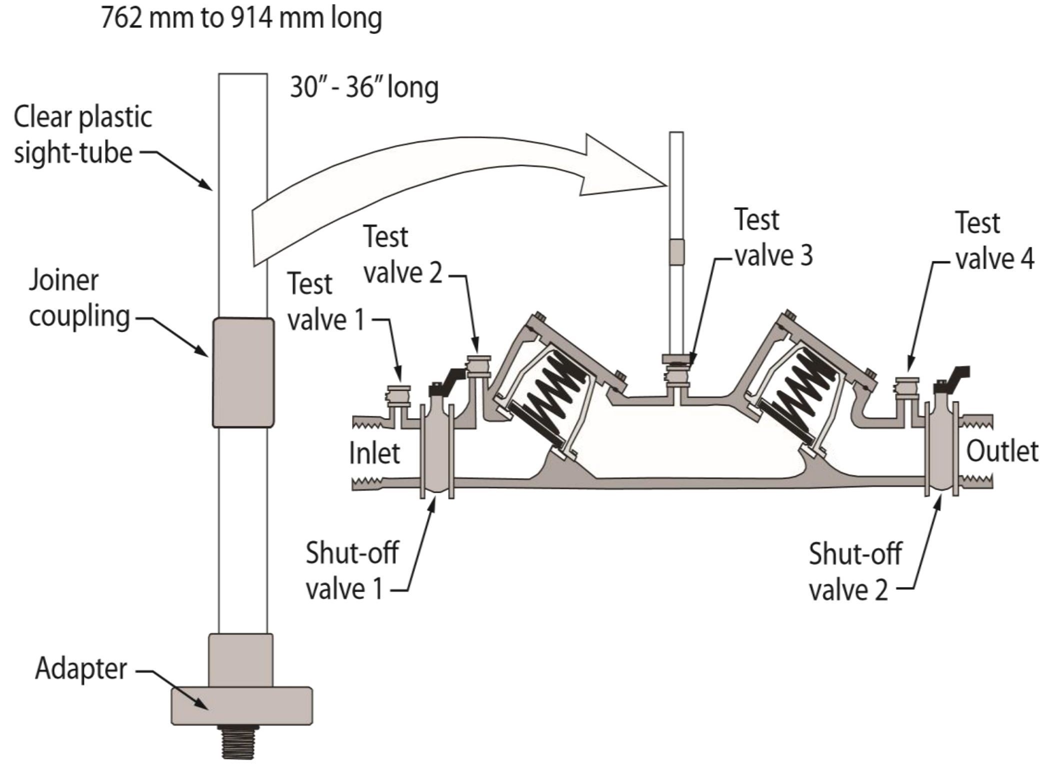


Figure 8-10—Using a sight-tube for alternate test of a DVCA

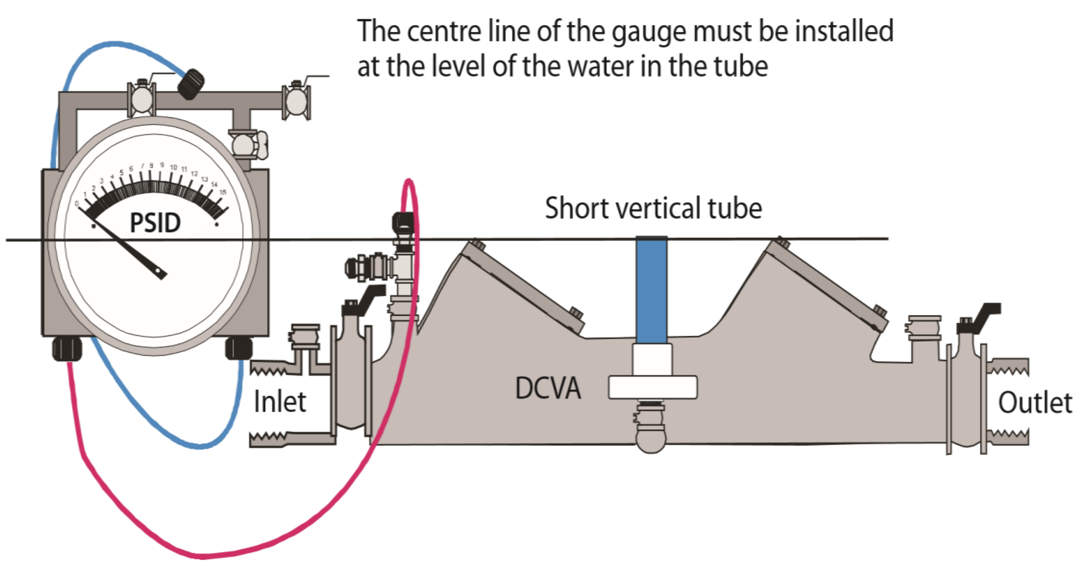


Figure 8-11—Using a short vertical tube when testing a DCVA

Figure 8-11- shows a short vertical tube installed when testing with a differential pressure gauge. The short vertical tube is used to accommodate assemblies with test valves below the center line.

Content

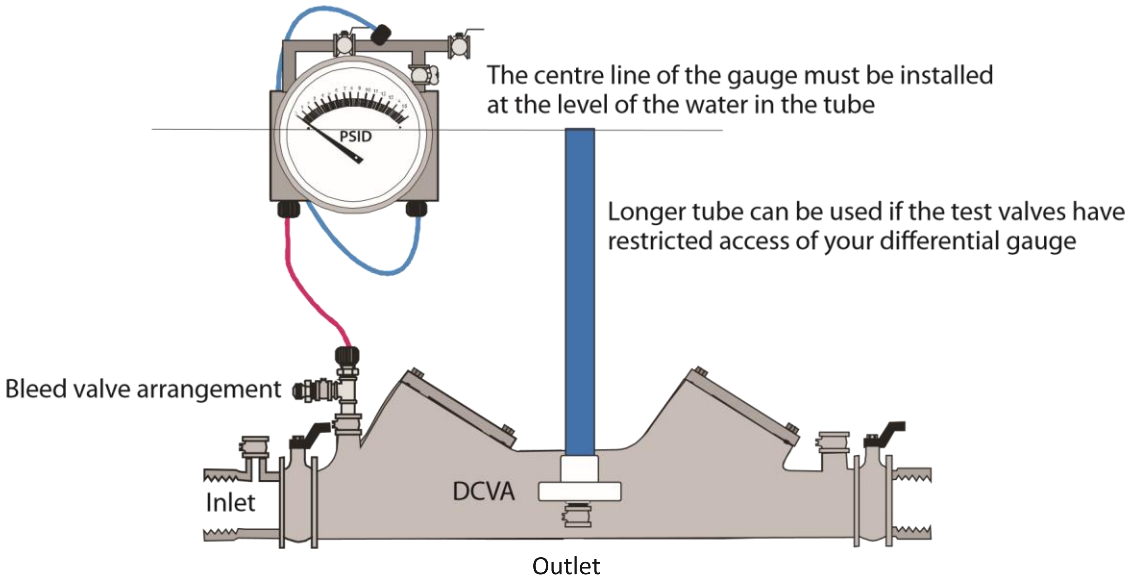


Figure 8-12—Using a sight-tube with a 5 valve differential gauge

Figure 8-12 shows the use of a long sight-tube with an assembly that has limited access for the gauge. As long as the gauge is held at the level of the water in the tube an accurate reading can be obtained. Also shown is a bleed valve arrangement. The bleed valve arrangement is installed when troubleshooting a leaking shut-off valve.

Note: Often you will come across a DCVA installed in a below-ground valve-box. Often the installer has given no consideration for testing. A long vertical tube and a spare gauge hose will come in handy for positioning your gauge for testing. (See Figure 8-13.)

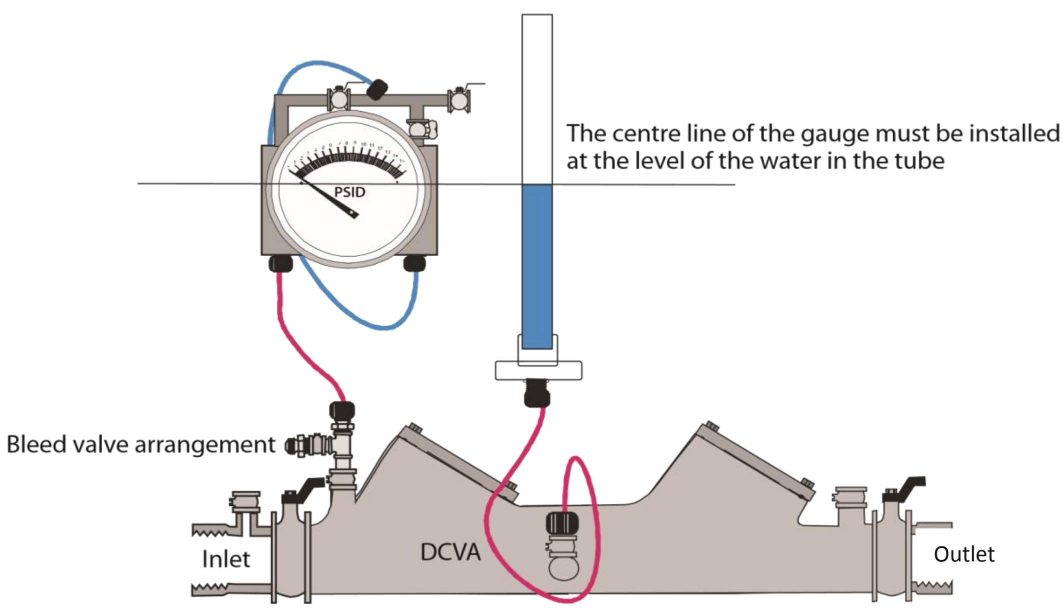


Figure 8-13—A vertical tube and a spare gauge hose used for testing a DCVA installed in a below-ground valve-box

Content

Figure 8-14—Using a bleed valve arrangement

Courtesy of Mid-West Instruments

Figure 8-14 shows a bleed-valve arrangement being used to compensate for a leaking shut-off 1 on a PVB.

Note: Since leaking shut-off valves are common, it is recommended that the bleed-off assembly be used every time the test procedure is completed, this will eliminate the need for disconnecting, and reconnecting and then bleeding the test gauge if a shut-off is found to leak. Refer to Chapter 9 for information about troubleshooting DCVA test procedures.

Drop cloths and drying cloths

When testing assemblies, fittings and components used during the testing procedure can be easily dropped into a drain or on to the ground. Careful use of a drop cloth can avoid unexpected losses of miscellaneous parts. Water spillage, intentional or as a surprise-is inevitable; use drying cloths to constantly mop up water on or around the assembly. Too much water lying around makes it harder to detect leaks or problems.

You can also use a flexible surgical hose or similar, and a clean container to capture any water from test valves and bleed valves. Especially when the backflow preventer is locate where you need to keep the surrounding area dry.

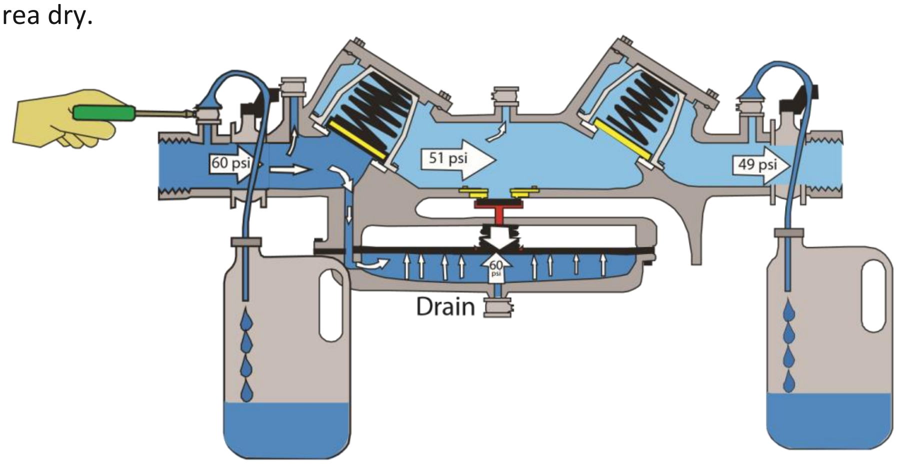


Figure 8-15—Using containers to avoid water spillage optional

Content

Pressure gauges

Standard pressure gauge:

- A standard pressure gauge is required to read the line pressure at the time of testing a backflow assembly.
- Dial size is not regulated; however, a gauge that is capable of reading pressure of the system is required.
- Typically test valve 1 or 2 is an ideal connection point for the pressure gauge.
- The line pressure is recorded on the test report form.
- Some differential pressure gauges have line pressure gauges attached and therefore a separate pressure gauge may not be required.

A pressure gauge assembly can be built on the job site. Use components similar to a bleed valve assembly with swivel flare connections and a bleed valve for easy installation and air removal. The addition of a spare test gauge hose could make installation easier and the gauge easier to read when testing at underground valve boxes etc.

Reading backflow preventer name plates, certification marking and logos

Identification and approval markings on backflow assemblies can be difficult to locate and identify. As a backflow preventer tester you must be able to interpret the markings on a backflow preventer. In Canada the marking CSA stands for Canadian Standards Association. A CSA certification marking means a product has been tested and meets applicable standards for safety and/or performance, including the applicable standards written or administered. A CSA marking must be on all plumbing products, including backflow preventers.

Other approvals may be present. You will need to consult the local AHJ to confirm required approvals. As well as approval markings, there will be the make and model numbers, size and serial numbers, and possibly manufacturing codes. It is critical that the backflow preventer tester identifies and records all the required information correctly on the test report form.

Here are some typical names of associations and approval agencies, complete with abbreviations:

- Building Officials and Code Administrators (BOCA)
- American National Standards Institute (ANSI)
- Underwriters Laboratories (UL)
- Underwriters Laboratories Canada (ULC)
- Canadian Standards Association (CSA)
- (NSF) International (or formally the National Sanitation Foundation)
- International Association of Plumbing and Mechanical Officials (IAPMO)
- The American Backflow Prevention Association (ABPA)
- The American Society of Sanitary Engineers (ASSE)

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- Factory Mutual (FM)
- Foundation for Cross-Connection Control and Hydraulic Research (USC FCCCHR)
- American Society of Plumbing Engineers (ASPE)
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

Figure 8-16 shows some examples of marking logos/stamps you can find on backflow preventers.

Uniform Plumbing Code, American Society Stationary Engineers, Canadian Standards Association, Underwriters Laboratories

Figure 8-16—**Typical backflow preventer approvals**

Note: These logos are provided courtesy of the respective approval agency/associations. They are not to be reproduced in any format for any use other than as an example in this manual.

Field-test report form

The field test report form is a critical component of the test procedure. The report form will be the basis for accurate record keeping for backflow assemblies.

Test report forms have not been standardized. A water purveyor may choose to use a generic form or may modify the form for specific needs. A report form may have separate sections for recording test results for a RP, RPDA, DCVA, DCDA, PVB and SRPVB; only one of these sections is completed for the assembly being tested. Use only one assembly per test report form. A report form will also contain a retest and repair information section. This section must be filled out when repairs are made. The repair information will provide the water purveyor with the critical performance evaluation of an assembly. This will help a purveyor to decide whether an assembly will remain on their approval list.

The information to be recorded on the test report will include but not be limited to the following:

- Assembly location address and area in the building etc.
- Manufacturer, make, model and serial number
- Initial test results, repairs/maintenance performed, and retest results
- Tester name and certification number
- Date and time of test
- Signature of tester and owner/representative
- All data collected for components tested.

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Submission of report forms

Test result forms are submitted to the appropriate authority having jurisdiction according to their individual directions. As a tester you will need to consult with the AHJ in your location to determine the specific instruction for the processing of their forms.

Typically copies of a test report would be submitted to the AHJ within 30 days of the issuance of the notification for testing. (Refer to local ordinances.)

All or some of these listed participants will have copies of these reports depending on the local AHJ specifications:

- Water purveyor or administrative authority
- Municipality
- Owner of the premise
- Tester

Record keeping

Completed report forms shall remain on file for as long as the AHJ requests. Maintaining accurate records can reduce liability risks.

Penalty for incorrect recording:

- The report forms must be filled out correctly.
- Check the test form to ensure all required information has been accurately recorded.
- Deliberate falsifying of a report form could result in tester licensing or registration being revoked by the AHJ.

A tester should not improvise the approved test procedures. A tester who decides to improvise will accept the risk of a liability claim. Follow the test steps as they are written.

Content

Here is an example of test report form. Note: Not to be used in the field.

BACKFLOW PREVENTION ASSEMBLY TEST AND MAINTENANCE REPORT

New Installation : ☐ Annual Test: ☐

Account Name: ______________________ Mail to: ______________________
Service Address: ______________________ ______________________
Location of Device: ______________________ ______________________
______________________ ______________________
____

Type of Service: Domestic: ☐ Fire: ☐ Irrig: ☐ Mechanical: ☐ Other: __________ ☐
Type of Device: DC: ☐ RP: ☐ RPDA: ☐ DCDA: ☐ PVB ☐ SVB ☐

MANUFACTURER	MODEL	SIZE	SERIAL NUMBER

	Reduced Pressure Principle Assembly (RP)			
	Double Check Valve Assembly			
INITIAL TEST	Check Valve 1	Check Valve 2	Relief Valve	PVB / SVB
Apparent Reading ______	______ PSID Leaked ☐	______ PSID Closed Tight ☐ Leaked ☐	Opened at ______ PSID Did Not Open ☐	Air Inlet Opened at ______ PSID Did Not Open ☐
REPAIRS	Cleaned ☐ Replaced: Disc ☐ Spring ☐ Guide ☐ Pin Retainer ☐ Hinge Pin ☐ Seat ☐ Diaphragm ☐ Other ☐ ______	Cleaned ☐ Replaced: Disc ☐ Spring ☐ Guide ☐ Pin Retainer ☐ Hinge Pin ☐ Seat ☐ Diaphragm ☐ Other ☐ ______	Cleaned ☐ Cleaned Sensing Line ☐ Replaced: Disc: Upper ☐ Lower ☐ Spring ☐ Diaphragm: Large: Upper ☐ Lower ☐ Small ☐ Seat: Upper ☐ Lower ☐ Spacer: Lower ☐ Other ☐ ______	Check Valve Held at ______ PSID Leaked ☐ Cleaned ☐ Replaced: Air Inlet: Disc ☐ Check Disc ☐ Air Inlet: Spring ☐ Check Spring ☐ Other ☐ ______
FINAL TEST				
Apparent Reading ______	______ PSID Leaked ☐	______ PSID Closed Tight ☐ Leaked ☐	Opened at ______ PSID	Air Inlet ______ PSID Check Valve ______ PSID

Comments: ____
____

Initial Test By: ______________ Company: ______________ Test Date: ______
Pass: ☐ Fail: ☐ Tester #: ______ Gauge #: ______

Note: The test report form in the jurisdiction you work may be different. Consult with the AHJ

Content

Example only of a test report form for Type II detector assemblies

This report form illustrated is an example only showing the addition of a place for the RPDA type II and the DCDA type II Of course water purveyors will need to adjust their current forms to provide space for the Type II valves. You may be required to fill out a separated reform for the bypass RPDA/ RPDA Type II or DCDA/DCDA Type II.

Address:						
Mailing address:						
Location of device:						
Manufacturer:						
		Size of device				
Model number:		Type of device	RP ❑	DCVA ❑	DCDA TYPE II ❑	PVB ❑
Serial number mainline:			RPDA ❑	DCDA ❑	RPDA TYPE II ❑	
Serial number bypass:						
MA INLI NE	**No. 1 Check valve** Leaked ❑ Closed tight ❑ CV ________ psid		**No. 2 check valve** Leaked ❑ Closed tight ❑ CV ________ psid		**Relief valve** RP/ RPDA only Opened at ________ psid Did not open ❑	**Pressure vacuum breaker** Air-inlet valve opened at ________ psid Did not open ❑ Opened fully ❑ CV ________ psid CV Leaked ❑
BYP ASS DC DA RP DA	**No. 1 Check valve** Leaked ❑ Closed tight ❑ CV ________ psid		**No. 2 check valve** Leaked ❑ Closed tight ❑ CV ________ psid		**Relief valve** RPDA only Opened at ________ psid Did not open ❑	
BYP ASS DC DA TYP EII RP DA TYP EII	**No. 1 Check valve** Leaked ❑ Closed tight ❑ CV ________ psid					
Comments:						
Date:	Time:	Tester Cert No.:				
Gauge Ser. No.:		Signature:				
Gauge Model No:		Name (Print):				
Gauge Manufacturer:				Passed ❑		
Gauge calibration date:				Failed ❑		
Company Name:				Phone No.		
On this day I certify that the data in this report is accurate as tested using the current approved test procedures						

Content

Before you start the test procedures here are some topics to read through.

Brief introduction

The illustrate procedures in this manual are intended to help you:

- To visually see the inside components of the assembly you are testing.
- Observe the pressure readings shown in each portion of the valve at the time of the test.
- Trace the direction of flow easily.
- While practicing the test procedures you can quickly look at the illustration to check the position of the hose connections and which valves are opened and closed.
- When looking at the illustrations, think of the purpose of each step you are doing and why you are doing the step.
- Think about the operation of each component and what is happening inside the assembly as you complete each step of the test procedure.
- Fully understand how the assembly and each of its components function as a unit. The test procedures and troubleshooting of the assembly will make more sense and increase your confidence.
- The illustrated test procedures in this manual are generic test procedures and are for educational use only until such time as approved by the local authority having jurisdictions for use in the field.
- In the field you must follow the prescribed, approved, certified written procedure that the local licensing or registration AHJ is enforcing "CSA B64 10.1"
- These procedures must be practiced until you can demonstrate the test procedures correctly and in entirety.

Your responsibilities

There are going to be times when you will be thinking that you can save some time by doing things just a little bit differently than the prescribed procedures. **Don't**.

Remind yourself of your responsibility, risks and liability. It is much easier for a good lawyer to defend you if you use a prescribed certified procedure rather than something you have altered. You may be finding yourself listening to your lawyer and the plaintiff's lawyer arguing over whether the prescribed procedures or your procedures are the same or not the same. Time is money here and a couple of months later the judge comes up with the decision. Maybe you win, maybe not, either way it is going to cost you

Does it really matter if you miss taking a reading at the correct time or open and close a valve at the wrong time? Yes, sometimes it does and sometimes it does not. If you think for one minute that a good lawyer quoting an approved procedure is going to lose the case, then think again.

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Your guarantee of the test procedure

When you test a backflow assembly, the data you record is only current at the time you tested the assembly. Data recorded at the time of test may indicate a backflow assembly has passed; however, this does not mean that the assembly will work the next day or any day after. Make sure your customer understands this. Flushing test valves

Flushing test valves

During this RP test procedure, you will be directed to flush the test valves and open test valves at a specific time and, a specific order. You will also be directed to observe and record information at specific times and orders.

The relief valve on the RP is sensitive to fluctuations in line pressure variations. You will need to establish the flow through the assembly before bleeding the test valves so as not to cause the relief valve to open accidently. When water is flowing in the assembly it is less likely the relief valve will operate as a result of opening and closing test valves. Pressure cannot easily accumulate in the zone of reduced pressure when water is flowing.

Never flush an assembly before starting the test. Test results will be incorrect. You may flush an assembly to facilitate repairs after a test fails

What do the terms apparent pressure drop and actual pressure drop mean?

Apparent pressure drop is defined as the first observed differential pressure drop across the check valve one of a reduced pressure backflow preventer. It is the **observed** static pressure under no flow conditions after you have closed shut off number 2 to begin the test procedure of a reduced pressure backflow assembly. The observed apparent static pressure-drop across check valve number one serves as a guide to remind you to establish the actual pressure drop during certain stages of the test procedures.

Actual pressure drop is the recorded differential pressure drop across the check valve one of a reduced pressure backflow preventer. It is a **recorded** static pressure drop under no flow conditions, and is used to calculate the buffer.

It is important that you **observe** the apparent static pressure drop when the procedures tell you. You should not be recording the apparent static pressure drop. You must record the actual pressure drop when the test procedure directs you to do so.

The observed apparent pressure-drop across check valve one is only recorded as the actual static pressure drop after you have confirmed that the check valve 2 has held tight. The apparent and actual pressure drop recorded should be close to the same. Remember to observe (not record) the apparent pressure drop across check right after closing the shut-off 2, near the beginning of the test procedure.

Content

Overview of some preliminary tasks

- Prior to beginning the actual test, the following procedures should be completed:
- Contact the premise owner/representative and arrange date and time of test
- Ensure owner notifies fire protection authorities about any water shut downs that will interrupt the water supply of a fire sprinkler system.
- If possible, consult manufacturer's information and ensure that repair parts are readily available.
- Check the test equipment for current calibration certification.
- Check the test equipment for obvious damage.

Be prepared to apply safe work practices including:

- Confined space entry of this manual)
- Elevated work platforms, ladders and scaffold
- Personal protective equipment, safety glasses, visible vest, hard hat safety footwear
- Electrical hazard of this manual)
- Manufacturer's safety instructions
- Safe use of tools

Testing the RP

Okay, it is time to start. First you need know what the RP test requirements are.

To begin a backflow preventer test procedure, begin as follows:

- **Notify**/request permission of the owner/representative that the water will be shut-off. Never shut off the water until the owner has confirmed that it is OK to shut the water off. Confirm with the owner that the fire authority has been notified of the purpose, time of shutdown and expected length of time of the shutdown.
- **Identify** that the assembly being tested is the correct assembly by verifying the serial numbers with previous test reports.
- **Inspect** the assembly for obvious sign of damage and identify the components including the test valves and shut-off valves. Ensure all components are present and check the air gap at the relief port. Note the direction of water flow.
- **Observe** the assembly area for indications of water spillage or leakage, especially from the relief port. Spillage from the relief port could be a symptom of an intermittent relief valve discharge. A prudent tester will observe the piping system and equipment around the valve and be aware of piping changes or equipment uses that may alter the appropriateness of the backflow preventer currently installed.

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Basic equipment required for testing

Before you start the test procedures you will need to gather a few tools and equipment. See Figure 8-17.

- Differential pressure gauge
- Adjustable wrench
- ¼ inch flare adapters, & bushings
- Drop cloth
- Drying cloth
- Eye protection
- Teflon tape
- Screw driver
- Pressure gauge minimum size
- suitable to record maximum line
- pressures of the system 0-60*

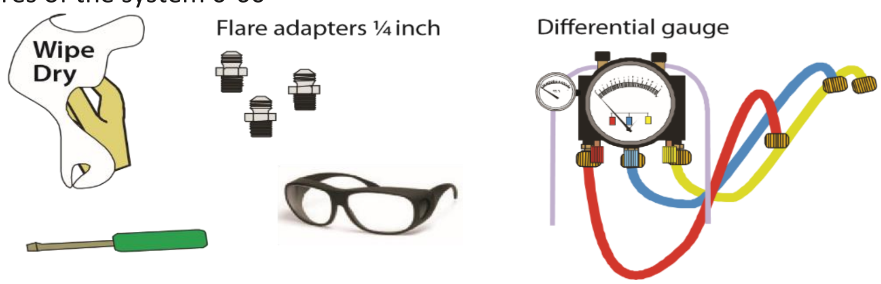

Figure 8-17—Tools required

Note: *The pressure gauge may not be required if the AHJ has approved the use of the differential gauge with a self-contained pressure gauge.

You will be recording various pressure measurements, if not clearly written the readings can be misinterpreted. To avoid this when recording pressures such as .8 psid write the number this way 0.8 psid to avoid the number being mistaken for 8 psid.

During the test procedures it is recommended that you wear eye protection. The position of test valves may be such that water discharging could be directed directly at you. Water discharge can be unexpected and sudden. Often as a result of a test valve discharge from a valve that has been left open unintentionally.

Figure 8-18 shows the drying symbol used in these procedures. The symbol reminds you to keep things dry. Drying the valve will help slow you down during the examination process and give you a chance to gather your thoughts. Water dripping could be a sign of leaking connections or the relief valve opening.

Figure 8-18—Keep things dry

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You can also use a flexible surgical hose or similar, and a clean container to capture any water from test valves and bleed valves. Especially when the backflow preventer is located where you need to keep the surrounding area dry.

RP test requirements

You are completing this test procedure to check the RP to determine if the following requirements:

- The relief valve shall open at or above 2 psid.
- The check valve 2 shall be closed tight at a steady pressure for two minutes' minimum against all pressures in reverse direction.
- Record the actual pressure drop across the check valve 1.
- The check valve 1 shall be closed tight at a steady pressure for two minutes' minimum in the direction of flow.
- Calculate and record the buffer. The buffer must be a minimum 3 psid or more.
- Record the line pressure at time of test.
- Check that the relief valve air gap is approved.

RP pretest preparation steps

Prior to starting the RP test procedure complete the pretest procedures as follows:

1. Notify/request permission of the owner before the water will be shut-off.
2. Identify the RP, record make, model, serial number and size.
3. **Inspect** and identify the RP test valves and shut-off valves, check the air gap and record if it passed or failed. Check clearance dimensions allow testing.
4. Observe for obvious leakage. Check surrounding area and piping for CCC issues, changes in piping and usage; for example, bypass piping.
5. Mount the differential pressure gauge at a position close to the valve and at approximately the valve level. Position of the gauge is not critical to your gauge readings when testing an RP. Gauge position is critical when testing a DCVA or PVB.

Notifying and requesting permission to shut off or turn on water

It turns out that notifying the owner that the water is about to be turned on or shut off may not be enough to avoid conflicts. Actually getting a response in the form of a directive from the owner leaves no doubt who approved the turning off or on the water. A signature may remove all doubt of who is responsible for damages as a result of inadvertently turning off or on a water supply.

You may find it worthwhile to explain to the owner the possibilities of back-syphonage occurring while the premise water is shut off. An owner should advise the premise occupants not to use the water during the testing procedures. This would be an appropriate precaution against backsyphonage occurring.

We start by flushing the test valves. If you remove any test valve caps, be sure to keep track of them by putting them in a safe place.

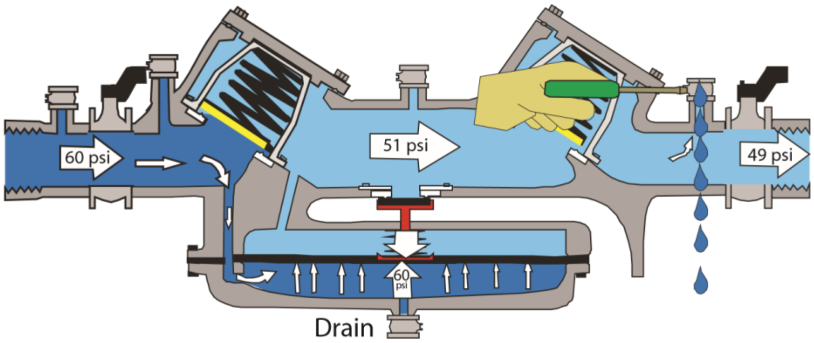
These procedures must be practiced until you can demonstrate the test procedures correctly and in entirety.

Content

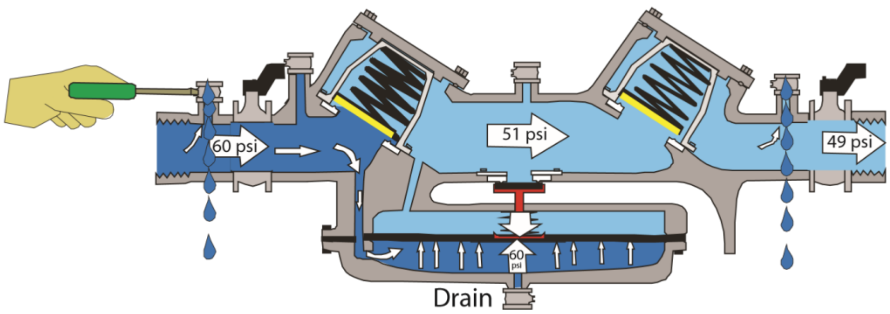
Flushing the RP test valves

When flushing the test valves and bleeding the differential pressure gauge you must follow the steps correctly. You must establish flow through the assembly to avoid inadvertently causing the relief valve to discharge before you are ready to record the opening point.

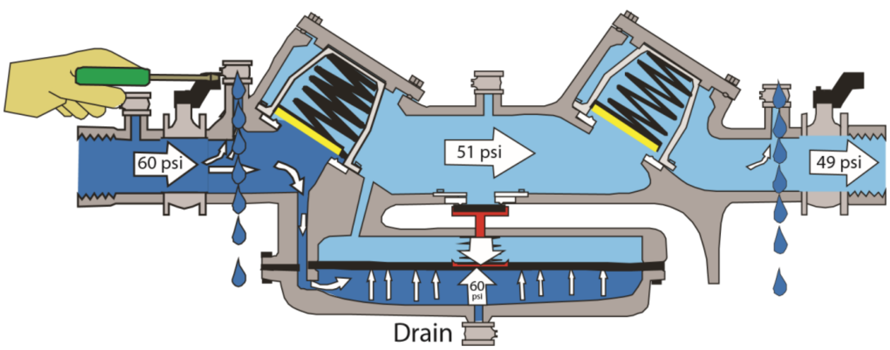
1. Slowly open test valve 4. Leave it running to avoid relief valve discharge. Wear safety glasses when testing.



2. Slowly open and close test valve 1.

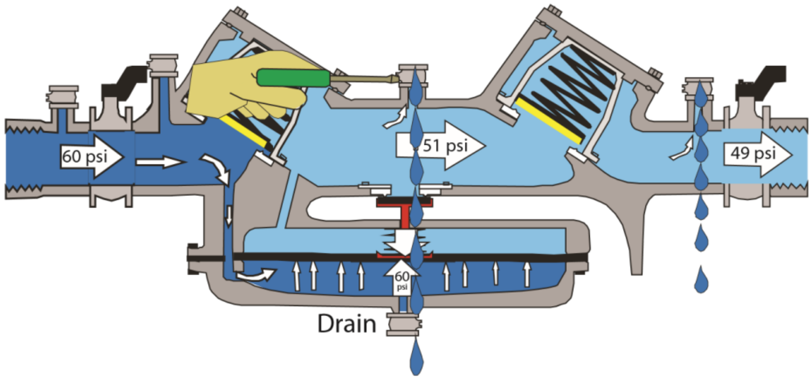


3. Slowly open and close test valve 2.

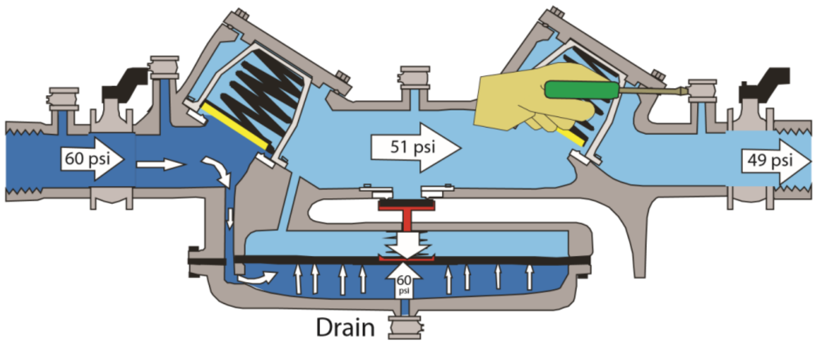


Content

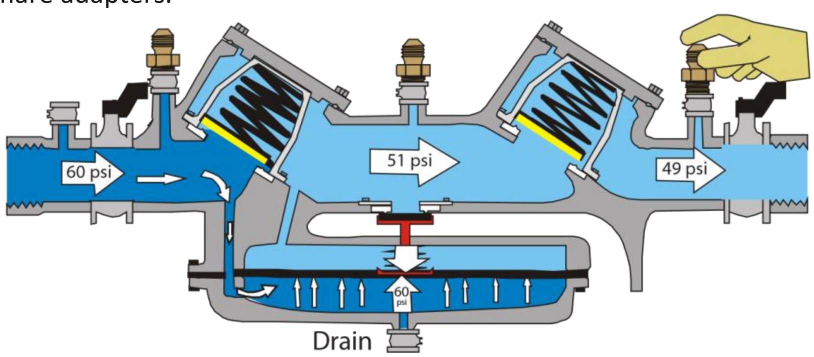
4. Slowly open and close test valve 3. Wear safety glasses when testing.



5. Slowly close test valve 4



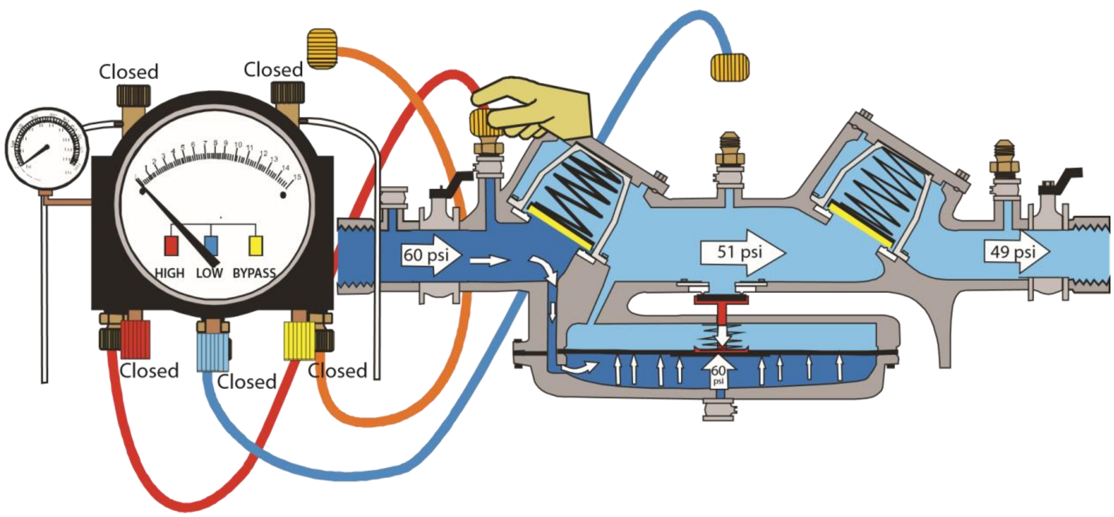
6. Install ¼ inch flare adapters.



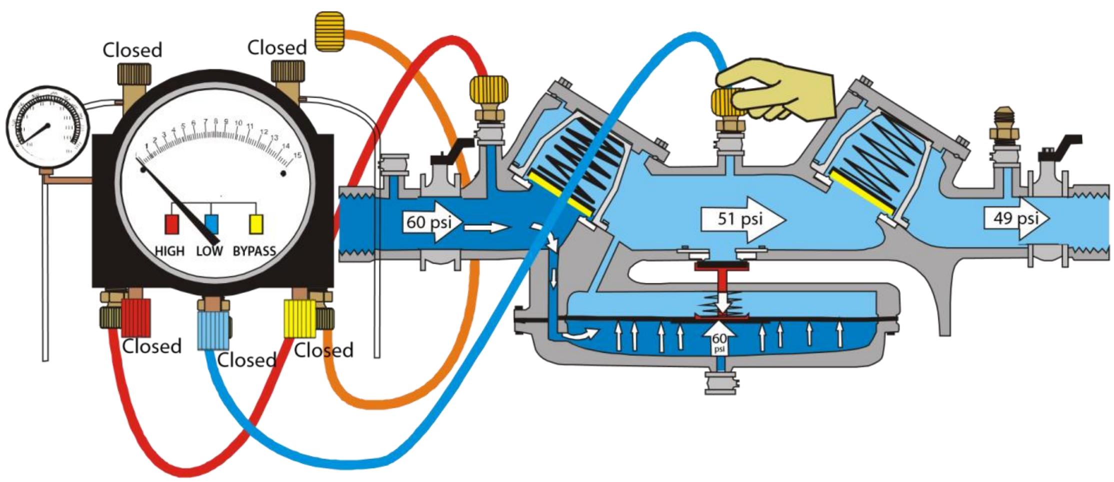
Content

Connecting RP test equipment

1. Connect the high-side hose to test valve 2.



2. Connect the low-side hose to test valve 3.

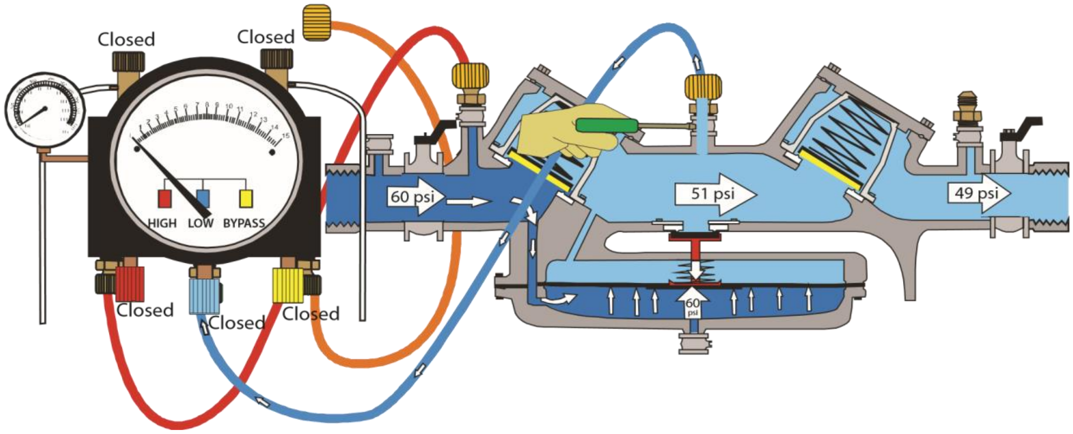


Note: You are going to find assemblies that have test valves with adapters already an integral part of the test valve. You will also come across assemblies with test valves that have integral mechanism which automatically open the test valve when you attach the hose. This could be an issue, because you could cause the relief valve to discharge prematurely if you connect to the test valve number two first. When connecting and bleeding the gauge with an assembly having self-opening test valves you must connect the low-side hose to test valve number three first. Then you must open the low-side bleed needle valve on the gauge and leave it running before you connect the high side hose to test valve number two. Connect to and bleed the high-side hose and gauge at test valve number two after you have established flow while water is continuing to run from the low-side bleed needle. To finish bleeding close the high side needle first then the low-side.

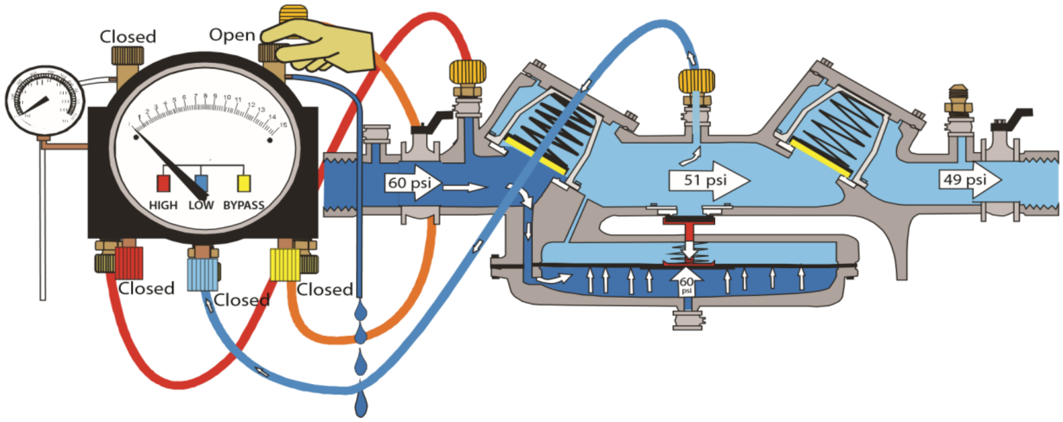
Content

Bleeding the RP test equipment

1. Slowly open test valve 3.

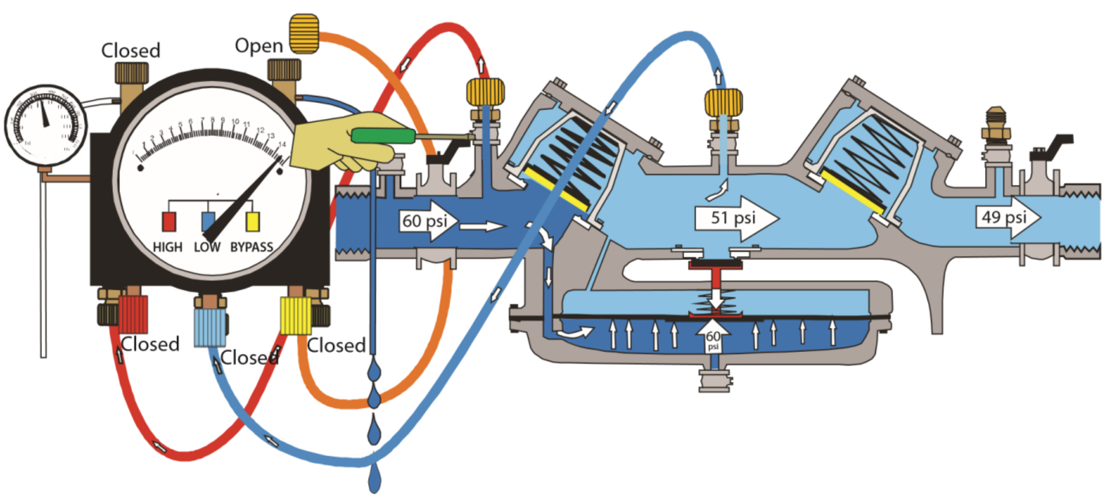


2. Slowly open the low-side bleed needle valve to bleed air from the gauge and hose. Leave it running.



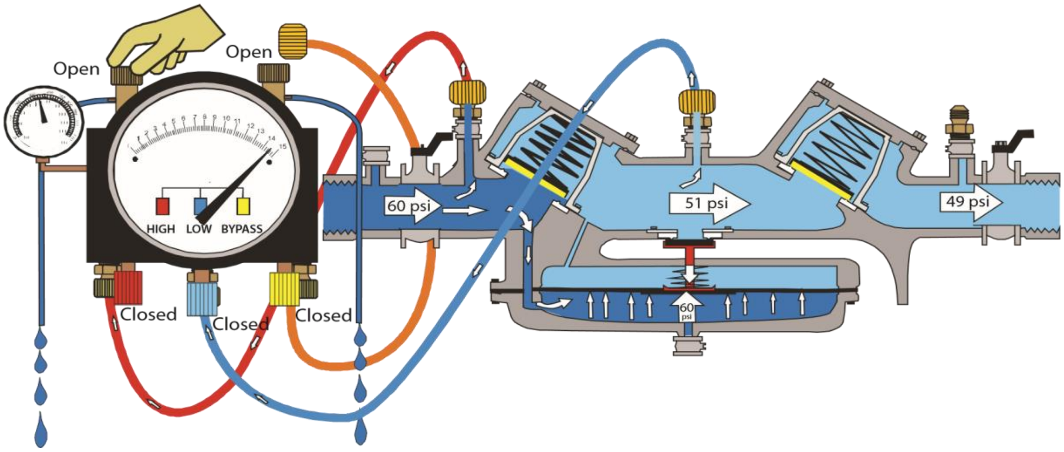
Note: The reason for bleeding the zone of reduced pressure first and leaving it running is to reduce the risk of the relief valve opening before you are ready to test it.

3. Slowly open test valve 2.

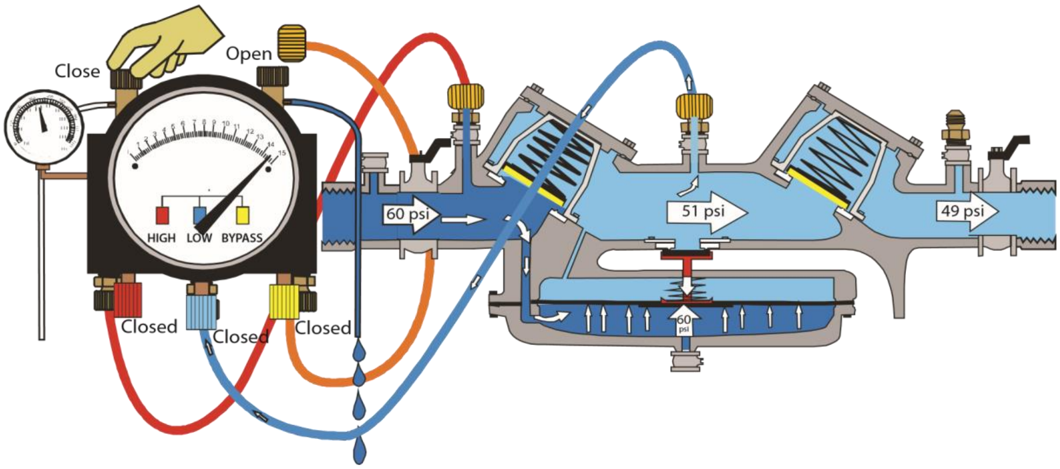


Content

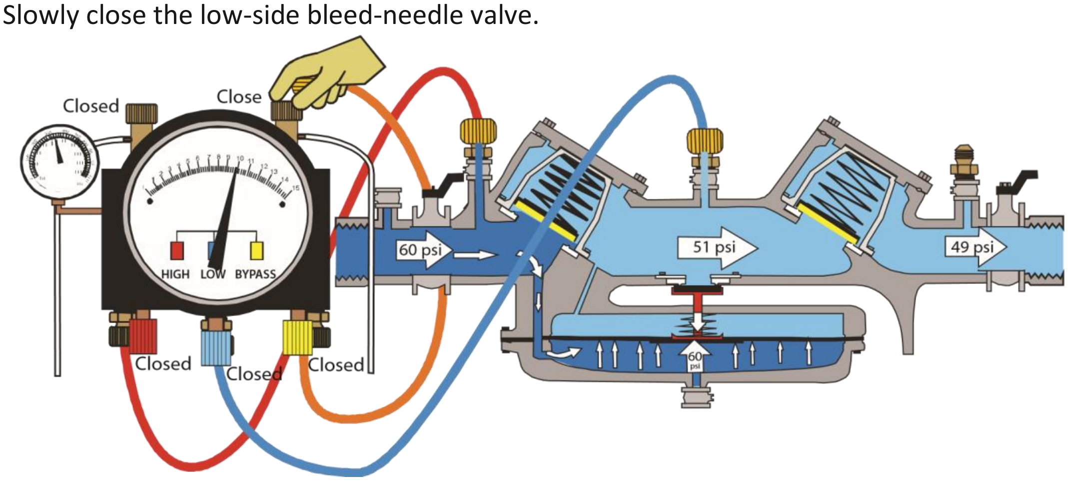
4. Slowly open the high-side bleed needle valve to bleed the air from the gauge and hoses. Bleed until all the air has been bled from the gauge and hose.



5. After the gauge reaches the upper end of the scale, slowly close the high-side bleed-needle valve.



6. Slowly close the low-side bleed-needle valve.

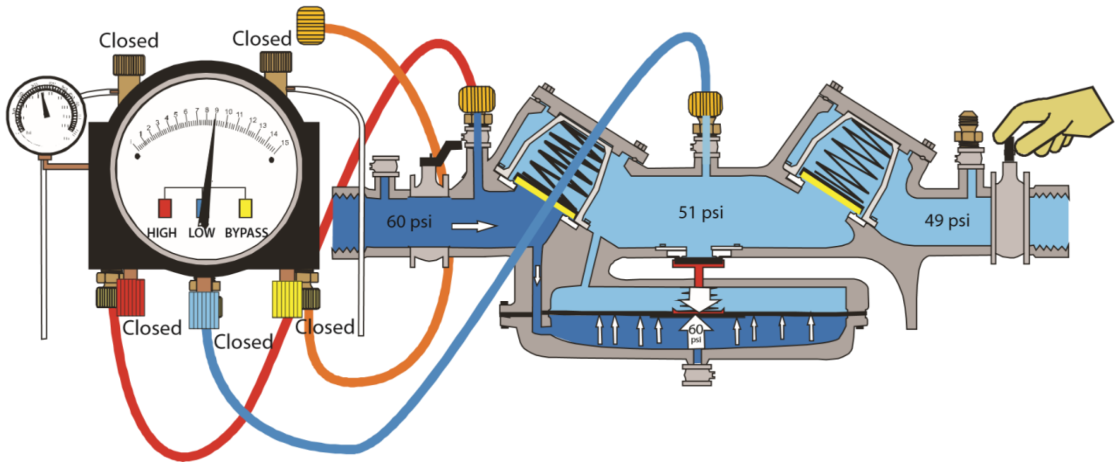


Note: Study each illustration, trace the flow, observe the pressures, think about what you are trying to accomplish with each step.

[Content]

Closing the RP shut off valve for testing

Slowly close shut-off 2 only.



Observe the apparent static pressure drop across check valve 1, in this case 9 psid.

Do not record this apparent observed static pressure drop as the actual static pressure drop for check valve 1 or the static line pressure of the assembly on the AHJ test report form. Just mentally note or write on a piece of paper for now. You will be recording the actual static pressure drop across check-valve 1 and the static line pressure on the report form later in the test procedures. The actual static pressure drop recorded for check valve 1 is used to calculate the buffer. This noted apparent pressure drop may be used later for troubleshooting purposes. Chapter 9

The RP is now ready to test.

Notes:

- For the remainder of the test the gauge will be registering the psid across check valve 1.
- When closing the shut-off 2 the relief valve may discharge. If the psid drops and the relief valve discharges, the check valve 1 may be leaking. Refer to the troubleshooting in Chapter 9.
- If the shut-off 2 is leaking, water would still be flowing through the valve so the pressure would be a flow pressure. The actual pressure drop must be a static pressure reading. You will not know if the shut-off 2 is leaking until you perform the test requirement for the check valve 2.
- Study each illustration, trace the flow and observe the pressures. Think about what you are trying to accomplish. Do you know what is happening inside the valve with each step? If you don’t you should.

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If you are using a three-valve gauge here are the steps to bleed it. Refer to Figure 8-19.

1. Slowly open the gauge bypass valve.
2. Slowly open test valve 3.
3. Slowly, open the low-side control valve, to bleed all the air. Leave it running.
4. Slowly open test valve 2
5. Slowly open the high-side control valve to bleed all the air.
6. Slowly close the high-side control valve.
7. Slowly close the low-side control valve.
8. Slowly close the bypass control valve.
9. Finally close the shut-off 2.

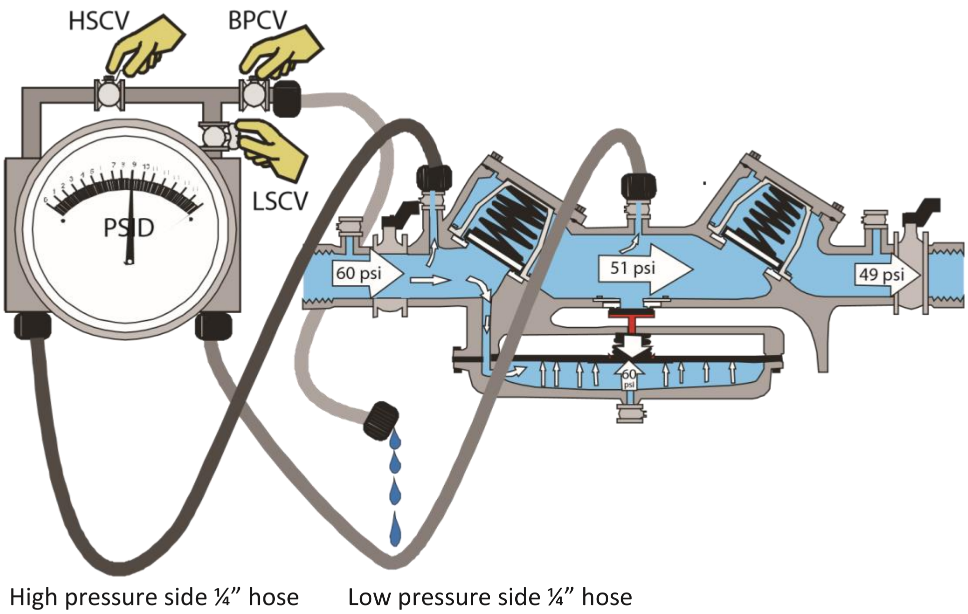

Figure 8-19—Bleeding the gauge and hose with the 3 valve gauge

Note: When connecting and bleeding the two, three or five valve gauge with an assembly having self-opening test valves you must:

- Connect the low-side hose to test valve number three first.
- Then you must open the low-side bleed needle valve on the gauge and leave it running before you connect the high side hose to test valve number two.
- Then connect and bleed the high-side hose and gauge at test valve number two after you have established flow and while water is continuing to run from the low-side bleed needle valve.
- To finish bleeding close the high side needle first then the low-side.

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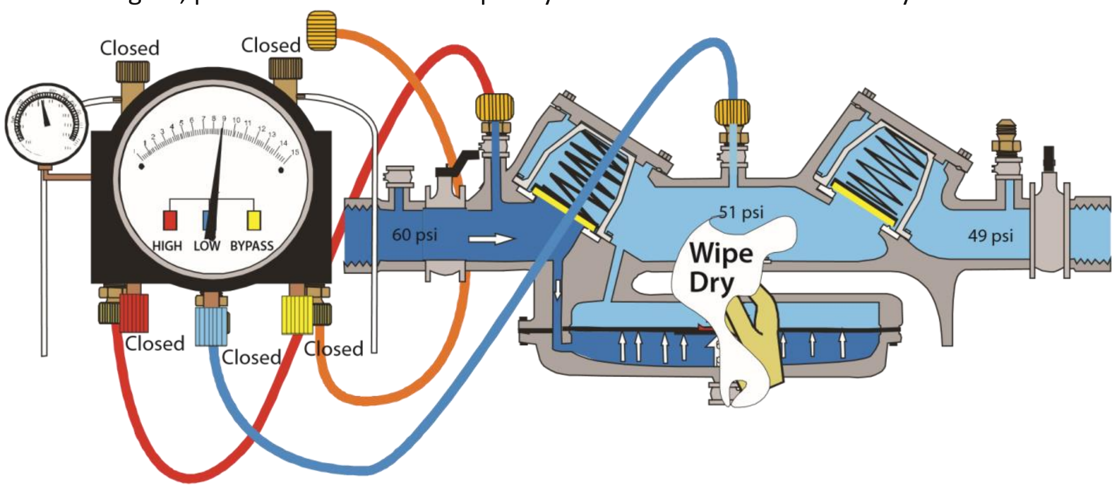
Testing the RP relief valve requirement

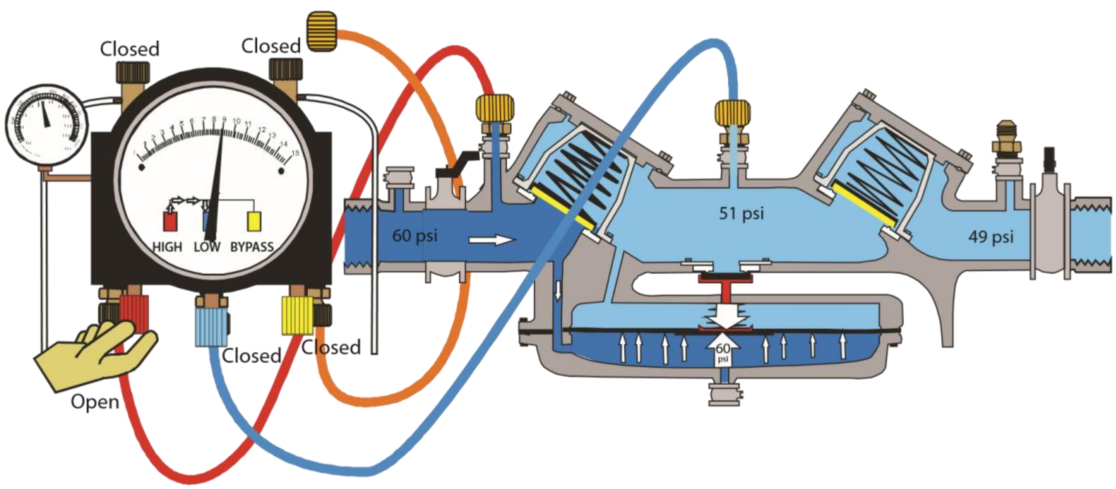
The relief valve shall open at or above 2 psid.

You are testing the relief valve first because its correct operation is needed to validate the remaining tests.

1. Before moving on, pause a moment and wipe dry the valve. Think about what you are about to test.



2. Slowly open the high-side control valve.



Note: By opening the high-side control valve, water flows from the high-side chamber of the gauge into an internal manifold passage. Higher pressure water is directed to the closed low-side control valve and the closed bypass control valve through the passage.

The red, blue and yellow rectangles drawn on the gauge face illustrate the manifold passage and the external control valves at the bottom of the gauge body. These valves when opened in the correct sequence will let high-side water flow into the blue (low-side) or yellow bypass hose respectively.

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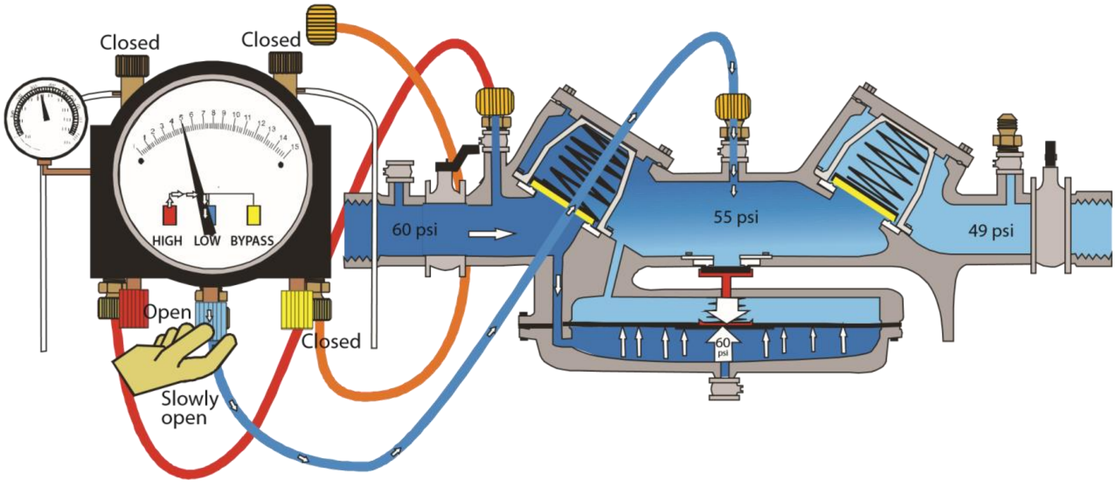
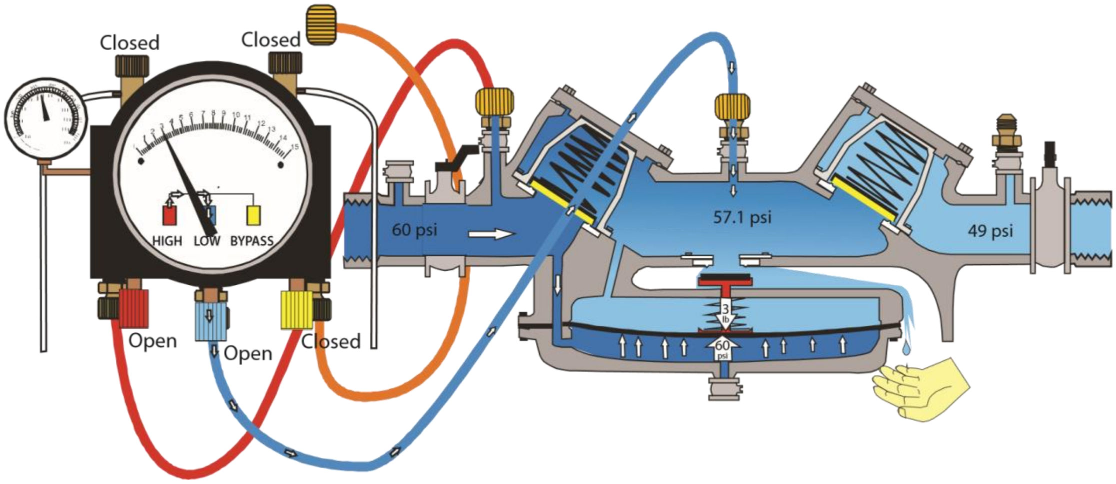
3. Slowly open the low-side control valve not more than ¼ turn. Observe the gauge needle and allow the gauge needle to drop slowly.



If the low side control valve has to be opened more than ¼ turn and the gauge needle fails to continue to drop, you may have forgotten to close the shut-off 2 or it could be a leaking. Check the shut-off 2 to confirm closed tight. Refer to troubleshooting in Chapter 9.

4. Continue to observe the gauge needle as it slowly drops. Place your hand under the relief port. Be ready to observe the relief valve opening pressure differential. Feel the water droplets on your hand.



Record the psid at which the relief valve opened.

The relief valve will be recorded as passed if it opens at or above 2 psid.

If the relief valve opens at less than 2 psid or fails to open, record that the relief valve has failed.

Note: You must stop and record the results of each requirement test as soon as you complete them while they are fresh in your mind. It should be recognized that the relief valve fails if it opens at less than 2 psid. The relief valve can also fail if it does not open. Failing to open should be recorded as this provides a correct assessment and accurate information for the purveyor records. The backflow prevention of the assembly when the relief does not open is compromised more so than when it did open but at a low a psid difference.

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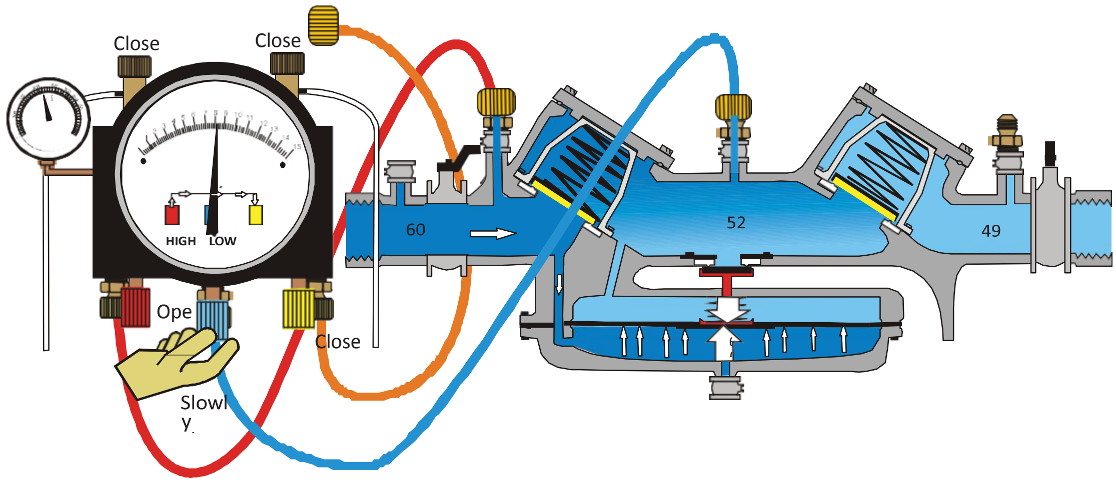
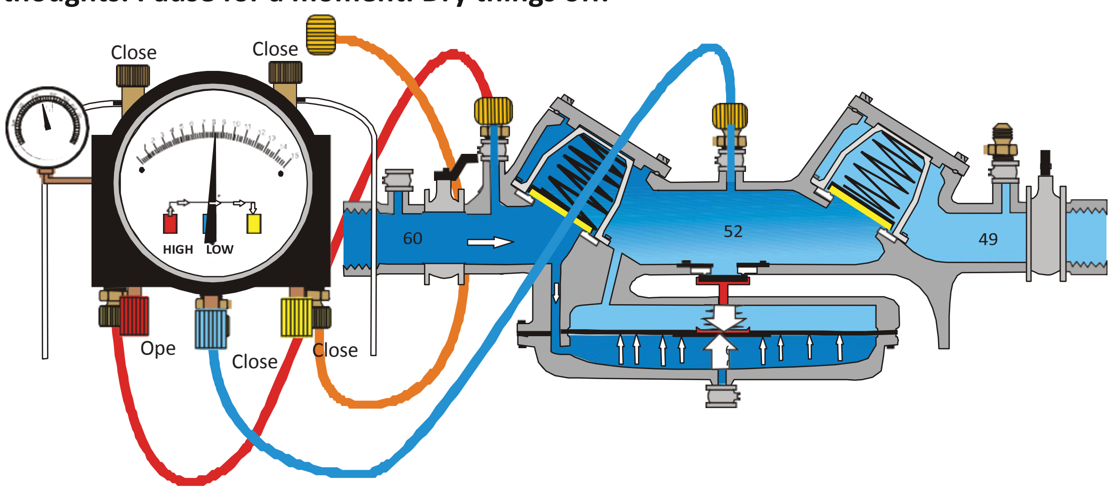
Finishing the RP relief valve test procedures

1. Slowly open the low-side control valve



2. Gather your thoughts. Pause for a moment. Dry things off.



Can you explain why the psid is not at the apparent pressure drop that you observed earlier in the test procedure? Perhaps you forgot to note the apparent pressure drop.

Ask yourself. What is the second requirement of the RP? The answer should be: The check valve 2 shall be closed tight at a steady pressure for two minutes' minimum against all pressures in the reverse direction.

Note: You will need to re-establish the psid across the check valve 1; however, not at this moment.

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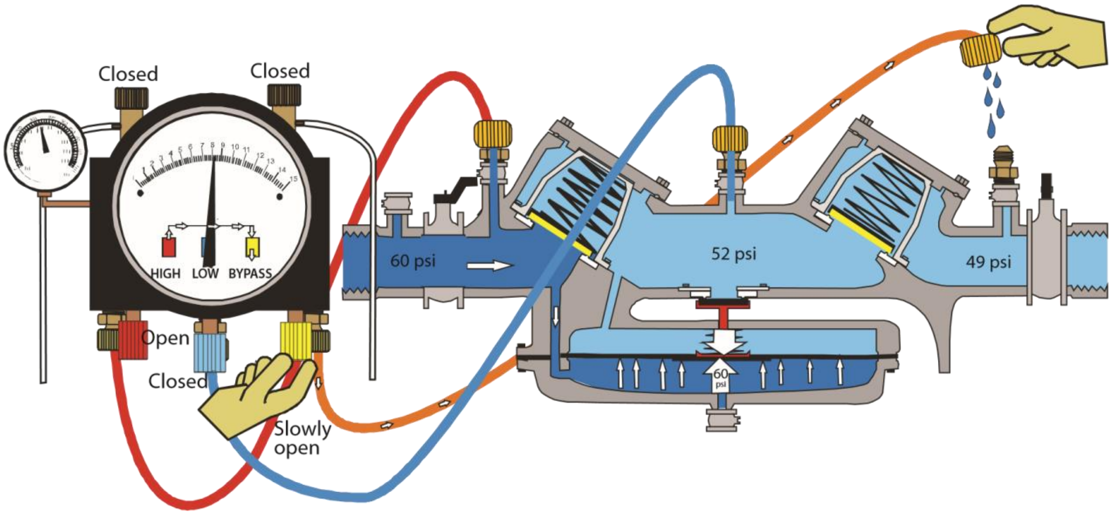
RP check valve 2 test requirement

Check valve 2 shall close tight and hold a steady psid for two minutes.

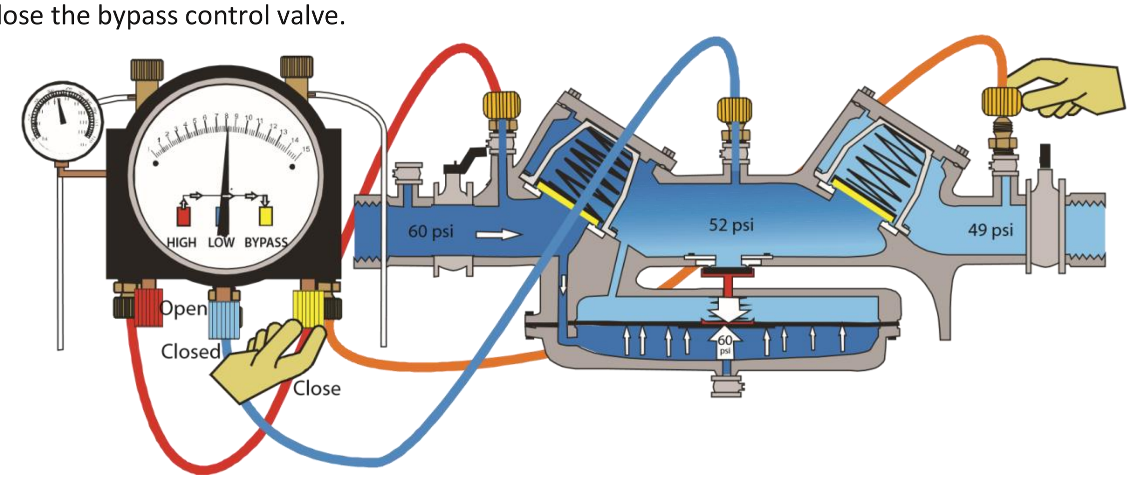
Preparing to test the RP check valve 2

1. Slowly open the bypass control valve and bleed the bypass hose.



2. Slowly close the bypass control valve as you connect the bypass hose to test valve 4.

Note: Closing the bypass valve is often missed. Make sure you see the water stop running from the end of the bypass hose just as you connect to the test valve 4. If you stop the water you will have remembered to close the bypass control valve.



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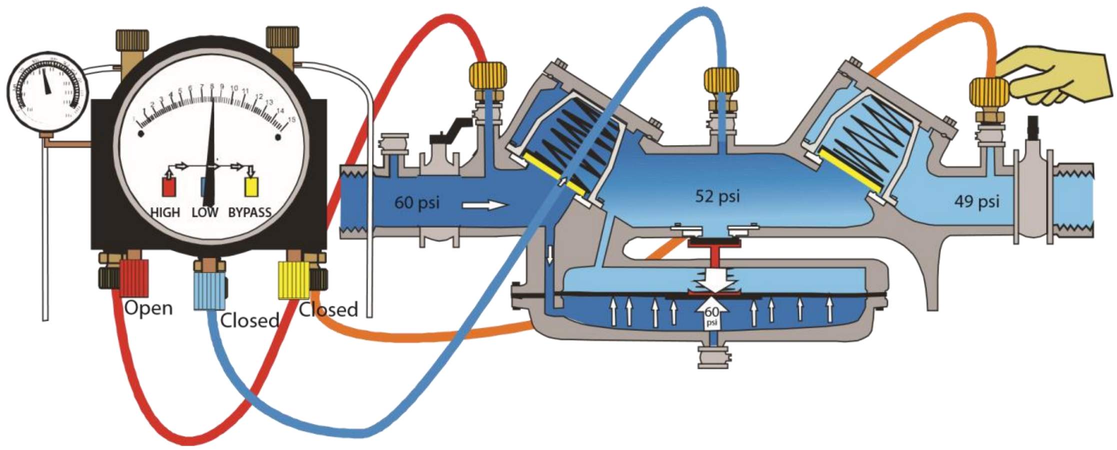
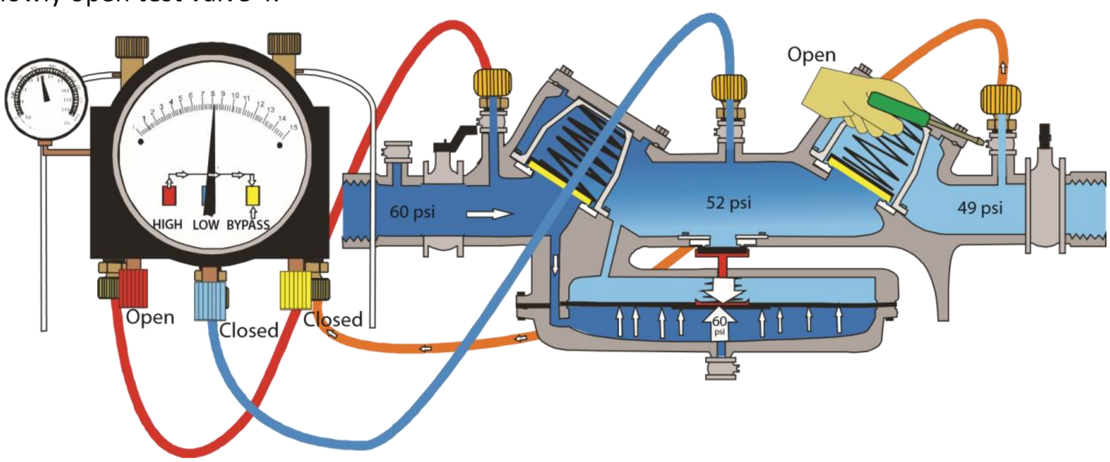
3. Tighten the hose up to test valve 4.



Did you close the bypass? The answer should be yes.

4. Slowly open test valve 4.



Note: When you open test valve 4 water flows back through the bypass hose to the closed bypass control valve at the test gauge. If you do not close the bypass before you open the test valve 4, you will allow the 60 psi (413.7 kPa) from the high-side to back pressure the check valve 2 before you are ready. You will not recognize your mistake. Disc compression will happen and you will not even notice it. Make sure you bypass hose is closed before opening test valve 4.

Proceed to the next step to re-establish the apparent pressure drop across check valve 1.

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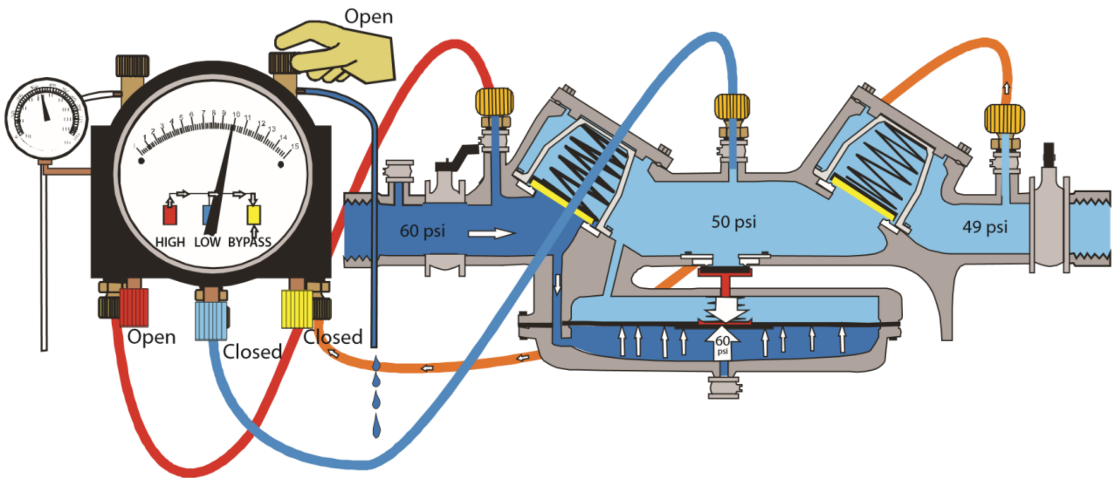
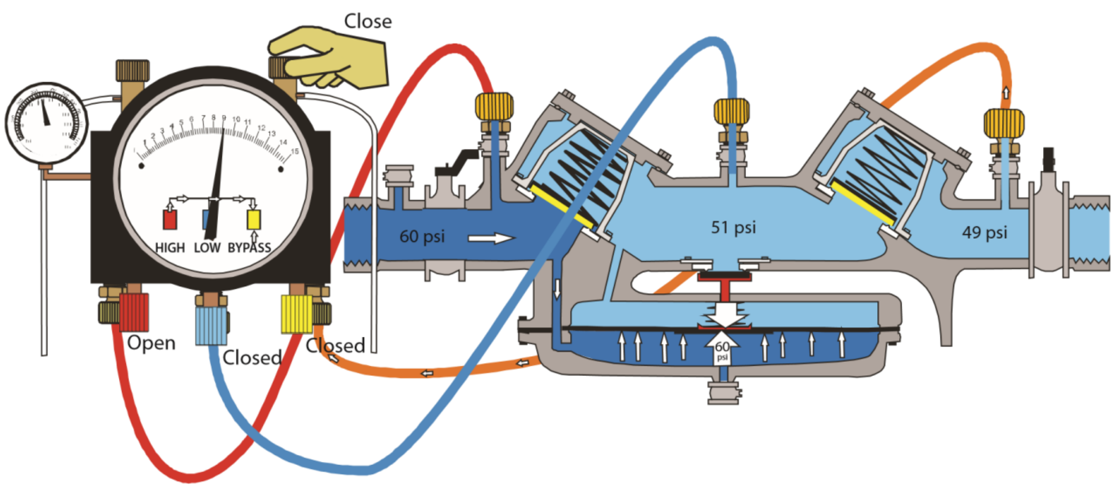
5. Re-establish the apparent psid in the zone of reduced pressure by opening the low-side bleed-needle valve. Observe the gauge and when the gauge needle reaches at or above the previously observed apparent pressure you will then proceed to the next step.



6. Slowly close the low-side bleed-needle valve.



Note: You have just re-established the apparent psid across check valve 1 and you will be able to clearly observe the disc compression when you apply backpressure to the check valve 2 in the next step.

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When using a three-valve gauge, re-establish the apparent psid by (refer to Figure 8-20):

- Bleeding water pressure from the zone of reduced pressure, by loosening the low-side hose nut at test valve 3.
- Tighten the nut when the gauge apparent psid reaches a pressure above the original apparent pressure drop.

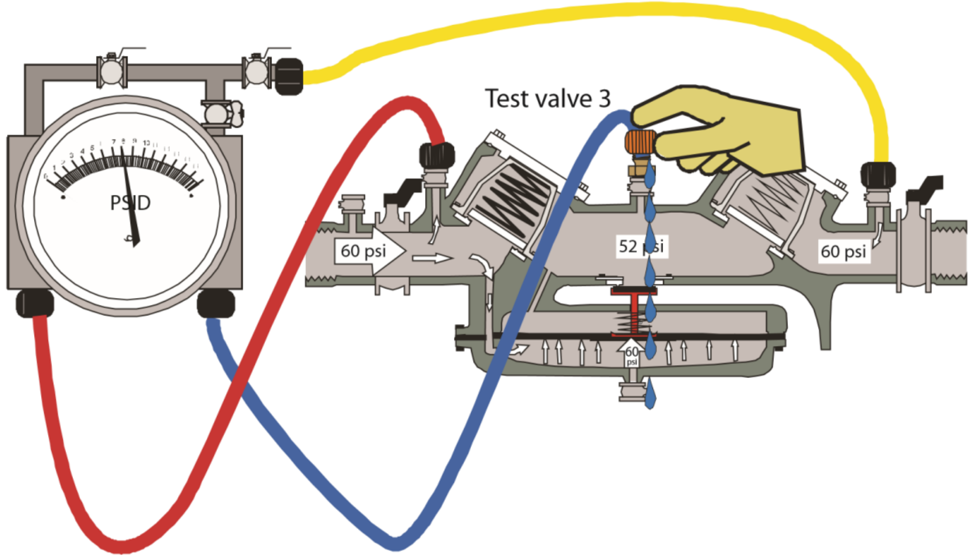

Figure 8-20—Re-establish pressure differential with a 3 valve gauge bleed

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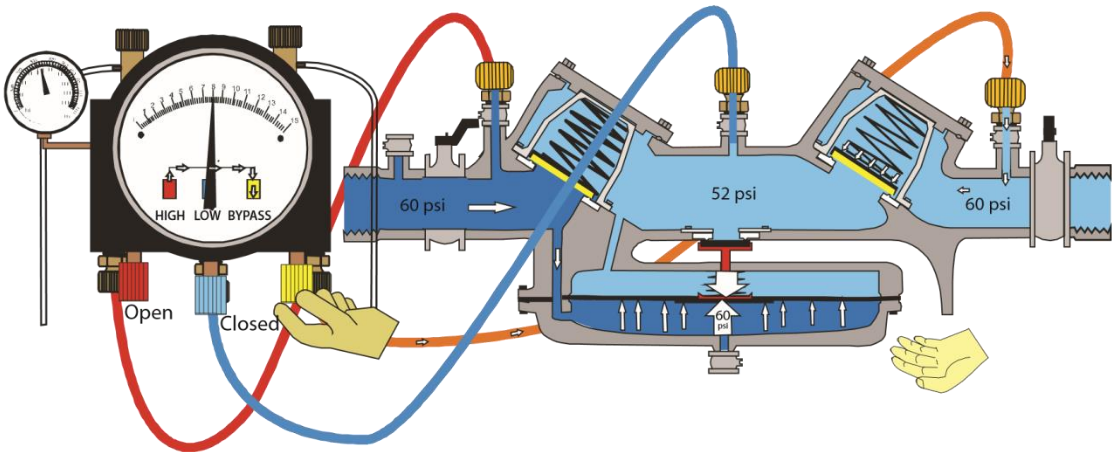
Can you remember what requirement you are testing for now? The requirement is:

The check valve 2 shall close tight at a steady pressure for two-minutes minimum against pressures in reverse direction.

Testing steps of the RP check valve 2

1. Slowly open the bypass hose.

Watch the gauge needle for a small drop in the differential pressure caused by disc compression. If you do not see disc compression you most likely have not re-established the apparent pressure or you did not open test valve 4. Start this procedure over.



Observe the gauge and relief valve port. Wait until the gauge remains steady for a minimum of two minutes.

- Confirm there is no discharge from the relief valve.
- The check valve 2 shall be recorded as passed (closed tight).

Study each illustration, trace the flow, observe the pressures, think about what you are trying to accomplish with each step.

- Keep the assembly dry to identify relief valve discharge easier or locate leaks in connections.
- The test valve 2, test valve 3, test valve 4, high-side control valve, and bypass control valve all remain open for the rest of the test procedures, except for when you record the line pressure.
- The low-side control valve shall remain closed for the rest of the procedures.

Note: The psid continues to drop to the relief valve opening psid. This could be caused by excessive disc compression, not a leaking check valve. Some assemblies may have excessive disc compression. This excessive disc compression will cause the gauge needle to fall to the relief valve trip point before the disc compression has completed. To ensure the relief valve has not tripped due to disc compression, open the low-side, bleed needle valve to relieve the disc compression. Close the low-side bleed needle valve and continue to observe the gauge needle. When the gauge needle steadies and the relief valve has not opened, the check valve is holding tight.

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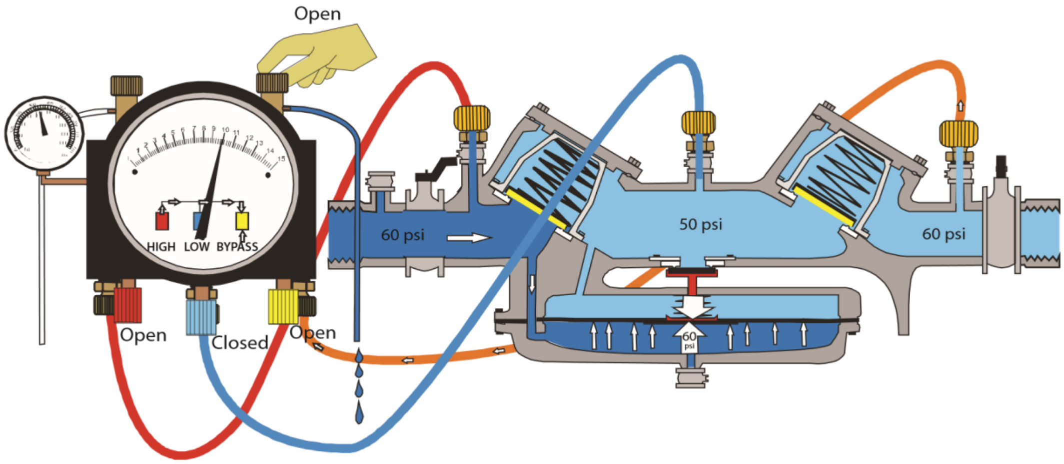
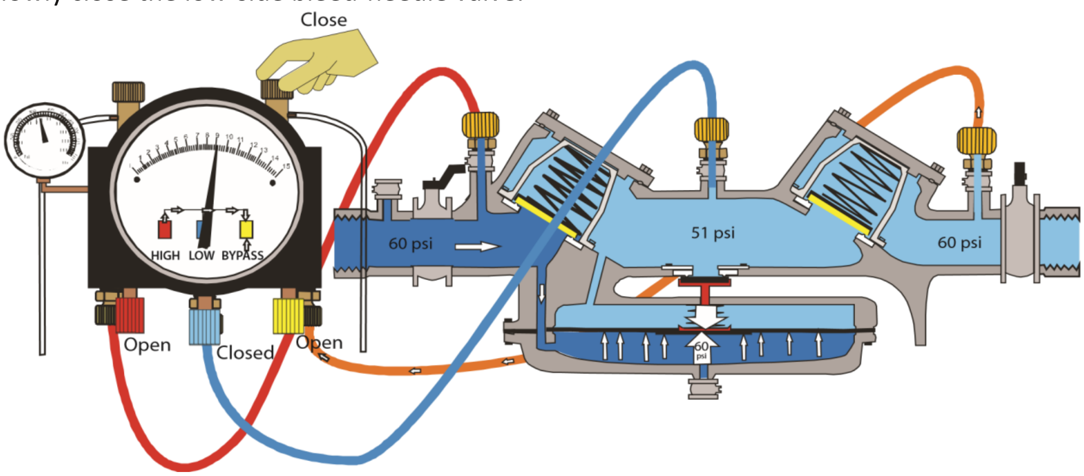
These next three requirements are easily missed, so concentrate, because after bleeding the gauge you have little to do except observe and record. You may feel you have to open or close a valve or do something and you would be wrong.

1. Re-establish the apparent psid in the zone of reduced pressure by opening the low-side bleed-needle valve. Observe the gauge and when the gauge needle reaches at or above the previously observed apparent pressure, proceed to the next step.



2. Slowly close the low-side bleed-needle valve.



Note: Now the gauge should be reading the apparent static pressure drop noted earlier. The gauge is ready to begin the next RP test requirement. The next step does not require you to touch any more valves.

In the next step you will be completing the following tasks:

- Record the actual pressure drop across check valve 1.
- Record that the check valve 1 is closed tight.
- Calculate and record the buffer.

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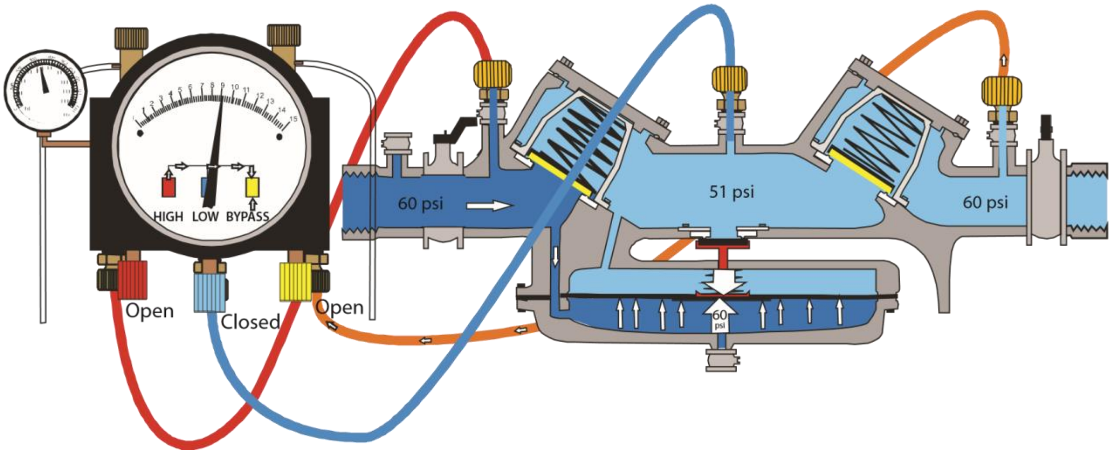
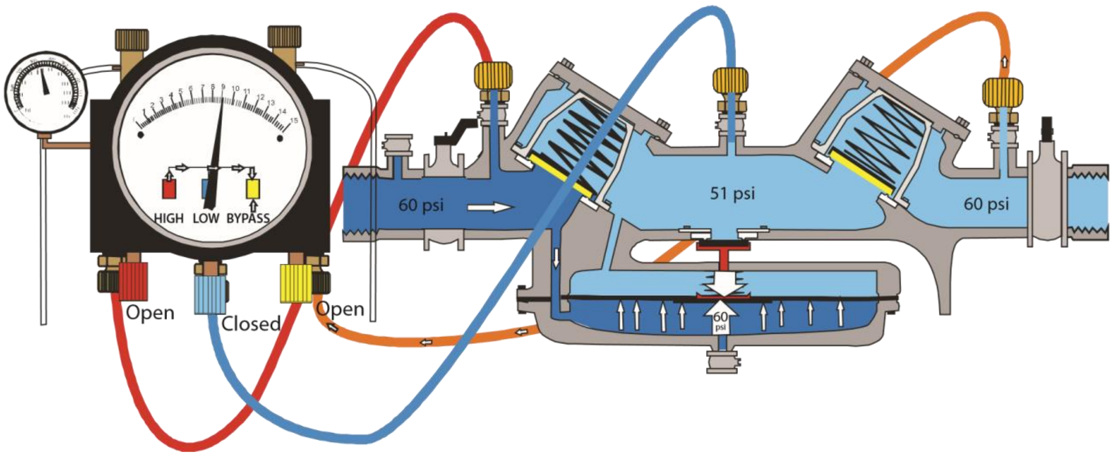
3. Observe the pressure drop across check valve 1. This pressure must hold steady for a minimum of two minutes. Wait for the gauge needle to steady. Time the steady state for a minimum of two minutes. If the gauge needle has held steady, the observed psid reading can be recorded as the actual static pressure drop across check valve 1.



4. Record the actual psid



Just how long do you wait for a steady state gauge reading?

Note: The reading must stay steady for a minimum of two minutes. How long are you going to wait for the gauge to reach a steady state? A gauge reading, in real life may be jumping all over the place as system pressures fluctuate. The best case would be the gauge to reach a steady state quickly and then stay steady for a minimum of two minutes. If the gauge is not holding steady you may have to determine if the component is failing or if the reading is unsteady due to fluctuating system pressures. You can expect the gauge reading to continue to drop and the relief valve to eventually open and drip at the relief valve port if the check valve one is leaking.

The bottom line is; you need to get an accurate reading. Practice good risk management. You have to be sure a check valve is not leaking. Accepting anything less than not leaking is simply bad practice.

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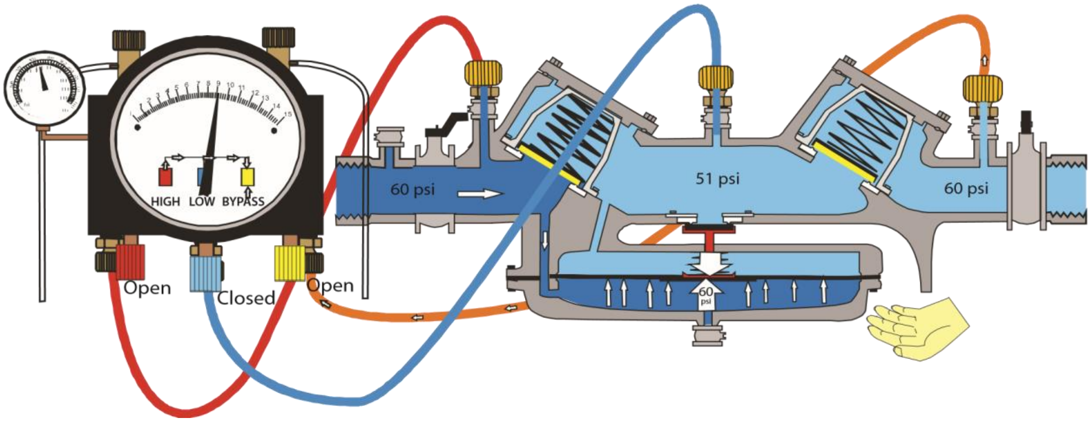
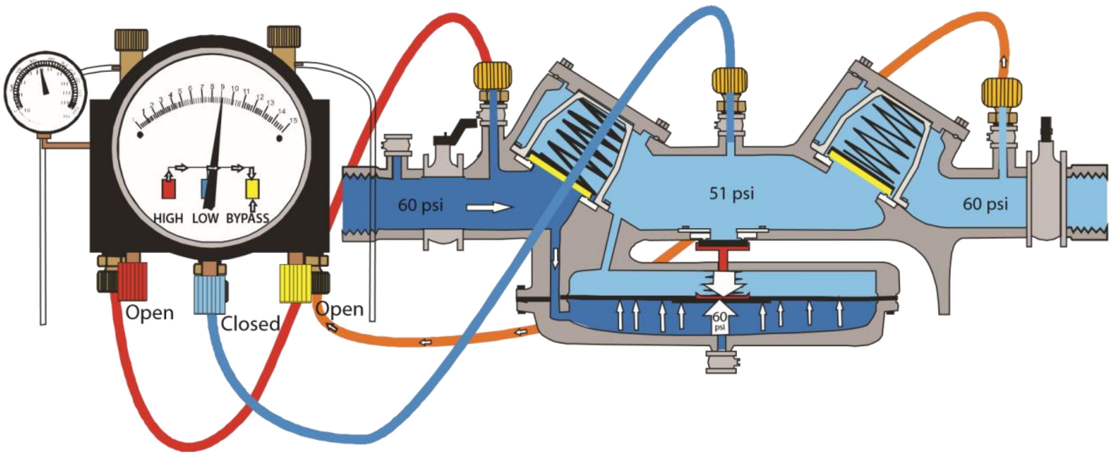
5. Once you have recorded the actual psid across the check valve 1, you need to confirm and record that the check valve 1 is not leaking. While you have been waiting two minutes you are also checking the check valve 1 for holding tight. If the gauge has held steady and there has been no discharge from the relief valve, check valve 1 shall be recorded as closed tight.



6. You now need to calculate and record the buffer.



Notes:

How to you calculate the buffer?

- Calculate the buffer by subtracting the relief valve opening psid from the recorded actual differential pressure across check valve one.
- Record the buffer.
- What is the purpose of the buffer?
- A minimum buffer of three psid will help in reducing nuisance spillage of the relief valve during minor pressure fluctuations in the supply line pressure. A buffer of less than three psid will increase the potential of nuisance spillage. A low buffer does not indicate a faulty or leaking check valve one.
- Ask yourself did you use the actual pressure differential pressure recorded to calculate the buffer or did you mistakenly use the pressure without re-establishing the actual pressure drop. You must use the reestablished actual pressure psid.
- Some new published test procedures (USC-FCCCHR manual 10th edition) have eliminated the requirement of the three psid buffer and have simply required that the actual pressure drop across check valve 1 needs to be a minimum of five psid.

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Prepare to record the line pressure

At the time of printing of this manual in Canada the current CSA test procedures require that the line pressure be taken with an appropriate pressure gauge located at test valve 1. If you are required to take the line pressure at test valve 1 you will need to use the following procedure:

1. Close all the test valves.
2. Remove your differential pressure gauge.
3. Reconnect the differential gauge high-side hose to test valve 1.
4. Open test valve one to recharge the gauge.
5. Bleed the air from the gauge by opening and then closing the high-side bleed-needle valve.
6. Observe and record the line pressure.

If you are using a separate pressure gauge assembly to acquire the static pressure use the following procedure:

1. Close all test valves.
2. Remove your differential pressure gauge.
3. Install the pressure gauge assembly with bleed-valve on test valve 1.
4. Open test valve 1 to charge the gauge.
5. Bleed the air from the gauge and hose by opening and closing the bleed-assembly valve.
6. Observe and record the line pressure.
7. For certification purposes and practical application in the field consult the AHJ to confirm the desired location to observe and record the static line pressure.

Note: It may make little difference taking the line pressure at either test valve 1 or 2 using the differential pressure gauge or a separate pressure gauge; however, CSA procedures require the static line pressure to be obtained from test-valve 1. In any case consult the AHJ.

Content

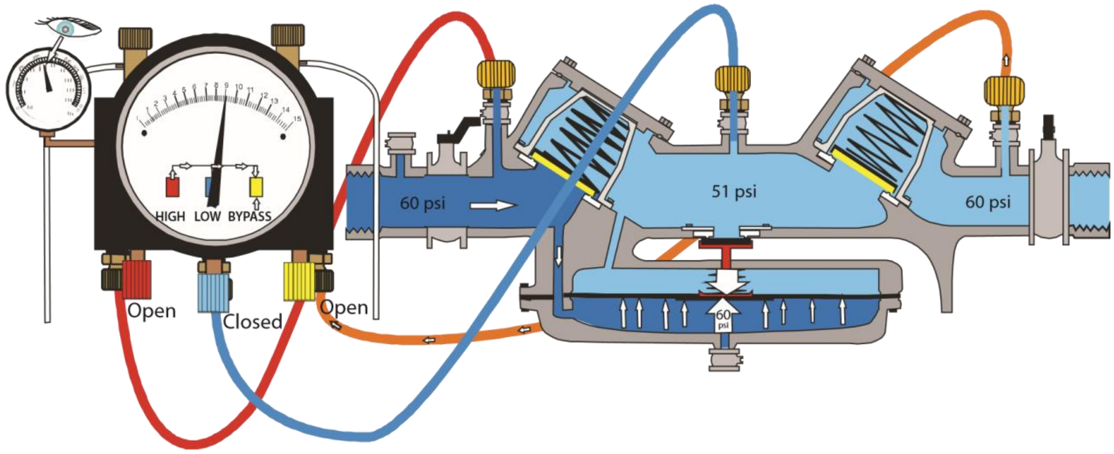
Requirement to obtain and record the RP static line Pressure

Requirement

Observe and record the static water pressure at the time of the test.

For the purpose of this publication you can take the line pressure with the differential gauge at its current location at test valve 2.

1. Observe and record the line pressure, in this case 414 kPa (60 psi).

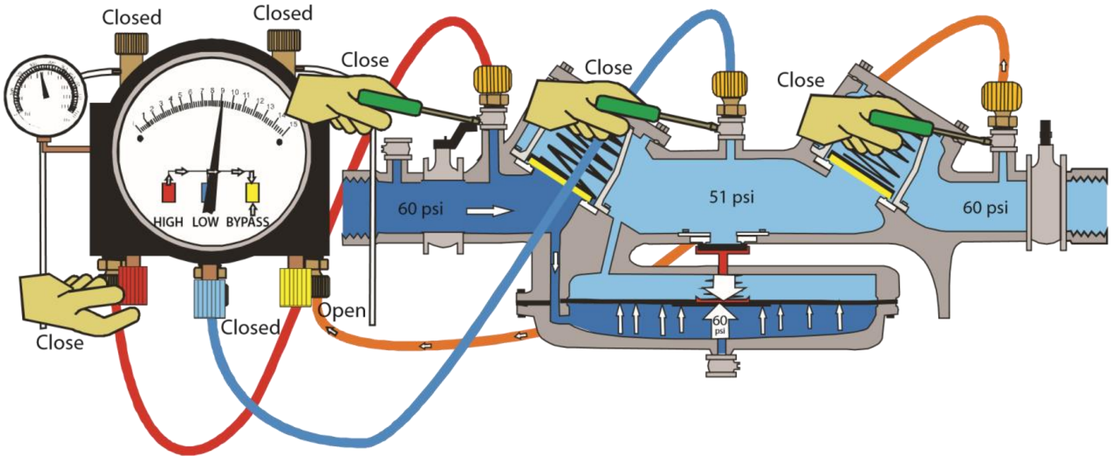


You have completed the test requirements for the RP. It is now time to remove your test equipment, get the water back on, and complete the paper work.

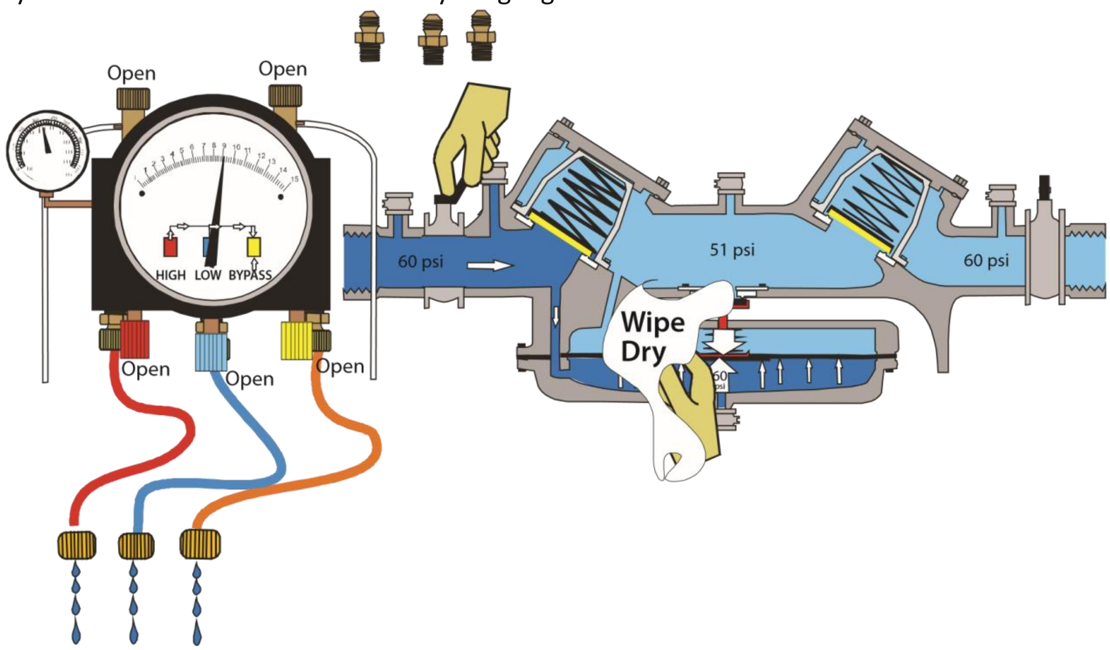
Content

Completing final tasks and returning the RP to service

1. Close all test-valves and close the high-side control valve.



2. Disconnect the gauge and remove any adapters. Check that shut-off 1 is fully open. Check for leaks. Dry the valve off. Remember to drain your gauge.

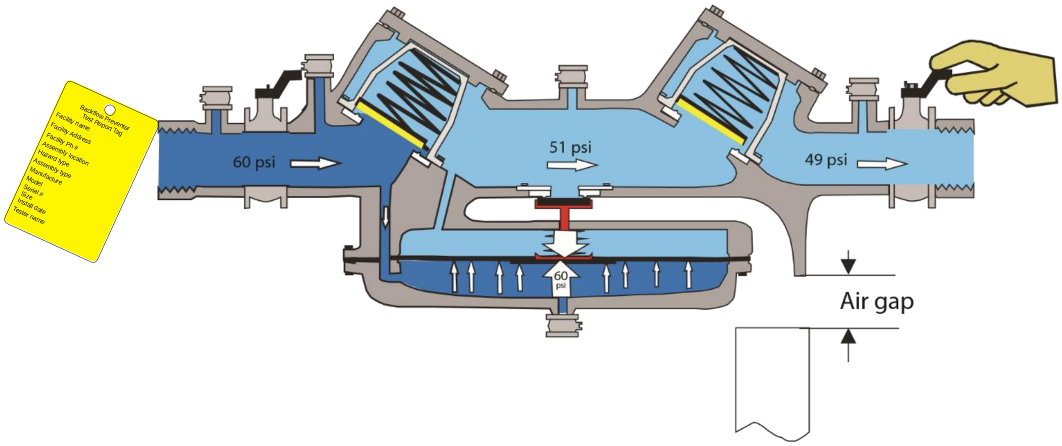


Content

Turn the RP water back on and check the air-gap.

3. Seek permission to turn the water back on and then slowly open shut-off 2.

Slowly open shut-off 2



Final clean up and recording

- Remember to check and record the air gap is not less than the minimum 1" or 2 × the diameter of the relief valve opening. If the port is odd-shaped, then use the largest dimension to calculate the air-gap to be safe.
- It is also important to check the capacity of the drain itself. It should be large enough to handle the intended flow. Check with AHJ for code and bylaw regulations. You may also need to refer to the manufacturer specification to determine the expected flow rate of the relief valve opening.
- Complete test forms and have owner/representative sign, then send copies, one to each appropriate authority.
- Fill out a test tag and attach it to the assembly.

Note: Since the water has been shut off for testing, the possibility of cross connection occurring in the system is increased. Notify the owner/representative and seek permission that the water will be turned on. Turn the water on as soon as possible.

Remember to remove your adapters. It could be embarrassing to have to come back later to retrieve what you have left behind.

A word of Caution

The differential pressure gauge is very sensitive to pressure fluctuations in the water system. Once that gauge is connected to the system it monitors the pressure differential across the check valve 1 continually or until you take it off-line. Water pressure fluctuations from within the system can disrupt the differential pressure readings on the gauge when you are testing. This can prevent you from completing a procedure correctly. If the fluctuation occurs, you can re-establish the apparent pressure drop by opening the low-side bleed-valve on the gauge. Repeat any steps that were disrupted. It is your responsibility to ensure that you have completed the test procedure correctly

Content

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Test procedures for a RPDA using a five-valve differential pressure gauge

RPDA preliminary steps and test requirements are the same as that required for a normal RP.

Existing RPDA requirements:

- The mainline relief and bypass relief valve shall open at or above 2 psid (13.8 kPa).
- The mainline check valve 2 and the bypass check valve 2 shall be closed tight at a steady pressure for two-minutes minimum against all pressures in reverse direction.
- Record the actual psid across the mainline and the bypass check valve 1. The same as the RP.
- Calculate and record the buffer of the mainline and bypass assemblies. The buffer must be a minimum 3 psid (21 kPa)
- Record the line pressure at time of test (typically at the mainline test valve 1 or 2).
- Check that the mainline and bypass relief valve air gap is approved.
- Additional requirements and or duties other than the actual backflow assembly test procedures:

Note: These additional requirements may or may not be required by the AHJ in your location. Consult the local AHJ to confirm these additional requirements.

Verify that the bypass meter will record low flows; for example, under 2 GPM (26.4 l/sec.)

Record the meter reading before starting the test and after completing the test.

Remember when dealing with fire sprinkler systems the appropriate fire authority and any insurance concerns must also be contacted before shutting the system off. You should be prepared provide at least the reason and the duration of the shut-down.

Figure 8-21—Double Check Detector Assembly

Note: Recoding the meter readings and water usage during the test is important information for the water purveyor. The water purveyor needs to be able to distinguish between water leaks or theft and the water you use during testing. The purveyor does not want to be trying to track down a leak or theft of water when the real water use issue was a result of your testing of the backflow assembly.

Content

Water meter maintenance is usually handled by the utility provider (water purveyor); therefore, you will need to consult with the purveyor in regards to the data wanted as a result of your testing.

From a fire official point of view water meters and backflow preventers add additional restriction of flow and pressure losses to the system. From the water purveyor point of view, the fire system is a cross connection hazard and water leakage or theft are concerns. RPDA, DCDA and RPDA type II, DCDA Type II backflow assemblies may be a reasonable compromise. The ability of the bypass meter to register low flows would not reduce the effectiveness of the mainline RPDA to protect against backflow flow; however, the water purveyor may need you to collect this data for their records.

When testing a RPDA or an RPDA type II, an issue can arise when you find an assembly with the mainline test valve 4 is located on the bypass piping. An additional requirement to ensure the bypass is not blocked may be required. (Refer to Chapter 9 troubleshooting.)

If you are going to be reading a water meter it might be to your advantage to be able to read one.

Reading a water meter basics

Water meter dials are not all the same; however, they are relatively easy to interpret once you know how. Water meters typically measure flow in cubic meters, cubic feet or gallons.

Here is some basic information on small positive displacement water meter reading:

- First open the dial cover and determine from the dial if the measuring units are in GPM, Cubic ft. or Cubic meters.
- Read the odometer dial numbers from the direction left to right, writing each number down as you read.
- If the sweep hand (gauge needle) is between numbers, use the lower number.

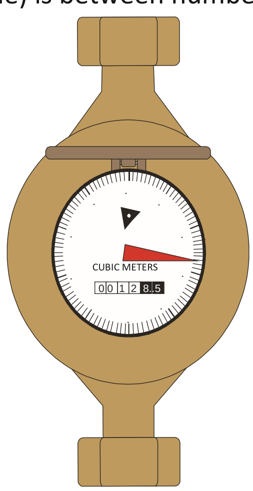


Figure 8-22—Water meter dial showing triangle low flow indicator

The small black triangle in this drawing is a low-flow indicator. The triangle spins as any small amount of water passes through the. You can observe this indicator to indicate there is flow through the RBDA bypass. The triangle is also used to detect leaks.

Content

Figure 8-23—Picture of a typical residential positive displacement water meter-

Reading the water meter

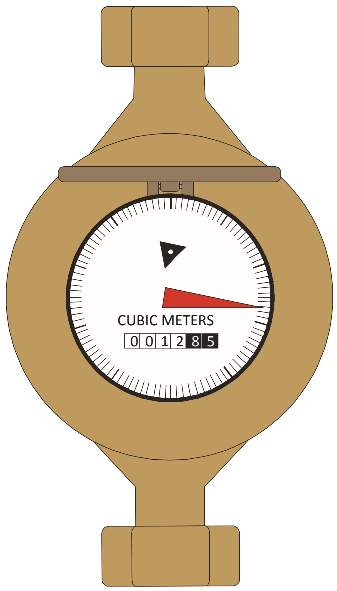


Figure 8-24—Reading the meter dial

Figure 8-24 shows the numbered dial face is divided into 10ths and 100ths.

0	0	1	2	8	5

Figure 8-24 shows the odometer on this meter does not read to the decimal of a cubic meter it just reads whole meters. For example, to record this meter reading, starting from the left as 001285.28 (one thousand two hundred and eighty-five point two eight cubic meters. The 0.28 of a meter is read from the actual dial not the odometer.

Some meters will show decimal parts of a meter on the odometer, in this case a mark will show where the decimal is in .10ths or 100ths

0	0	1	2	8	5
					▲

Note: Not all water purveyors record the water meter readings the same way. It may depend on their particular billing system. You may find more than a few digital remote reading meters also.

- One cubic meter (m^3) equals one thousand litres.

  One cubic ft. = 6.24 imp gal and 7.48 US gal.

Content

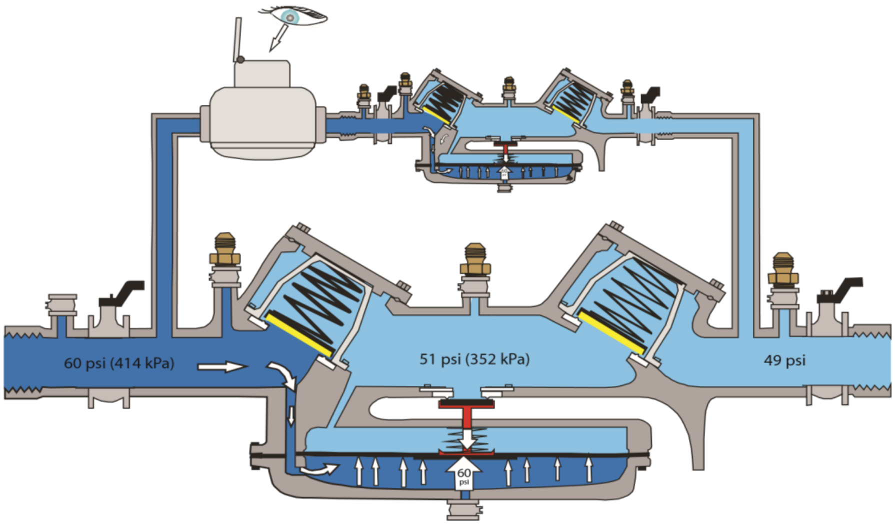
RPDA test procedures

(Reference USC foundation for Cross Connection Control and Hydraulic Research test procedures. Check with appropriate AHJ)

These test procedures are included in the manual as **information only** currently these procedures have not been recognized; therefore, would need to be adopted by the regulatory authority and then with permission from USC.

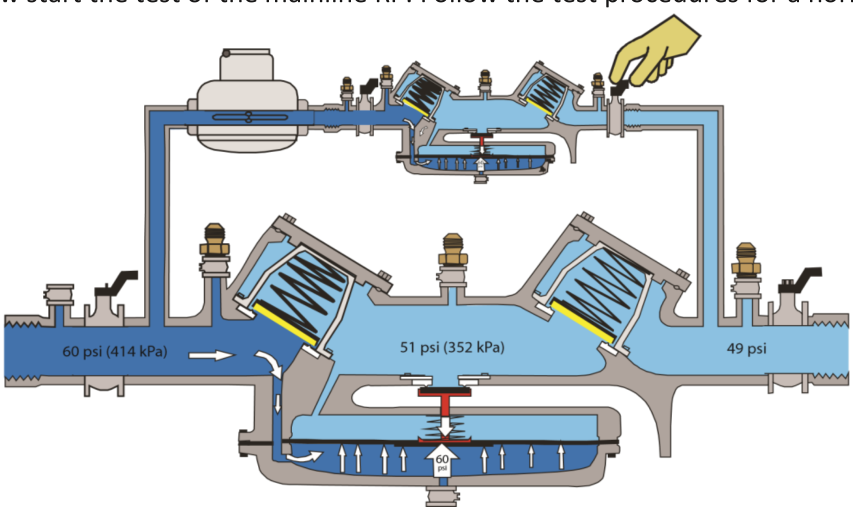
These test illustrations only show the additional steps used when testing a RPDA. The majority of the test procedures are identical to the normal RP.

1. The first step is to complete all preliminary procedures the same as when testing an RP backflow assembly. (Notify, identify, inspect and observe)
2. Observe and note the meter reading before starting the test procedures



3. Close the bypass shut-off valve 2.

You can now start the test of the mainline RP. Follow the test procedures for a normal RP



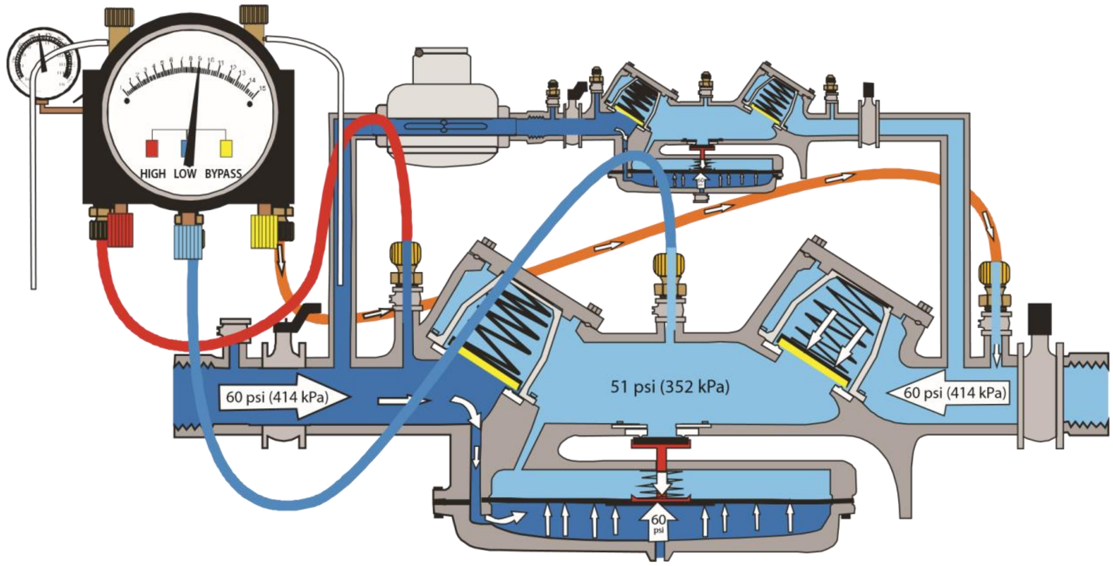
Note: The RPDA test requirements are similar to the regular RP assembly. It is assumed that you have mastered the regular RP procedures before attempting the RPDA procedures.

Content

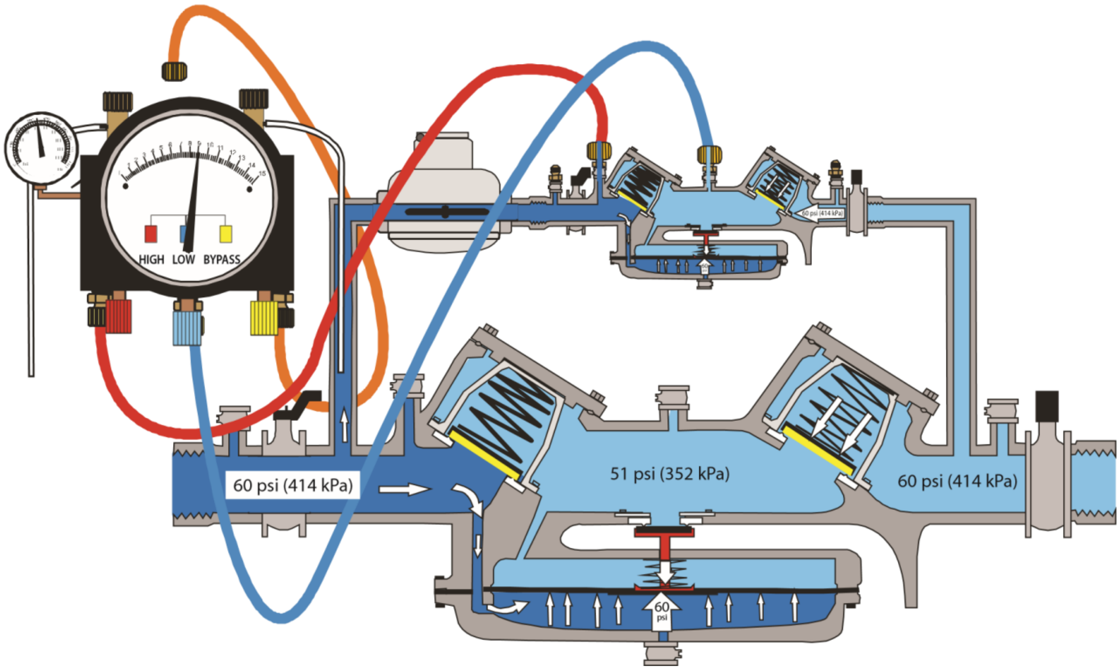
The following illustration indicates the positions of the gauge and hoses after completing the regular test of the mainline RP.

4. You have just completed the test procedures of the mainline RPDA.

Close all your test valves and remove the differential pressure gauge leaving both the mainline and the bypass shut-off valves closed. You can now proceed to test the bypass RP.



5. Reconnect your differential gauge to the bypass RP. Remember to bleed the test valves and gauge. Proceed with the bypass RP test using the same procedures as a regular RP.

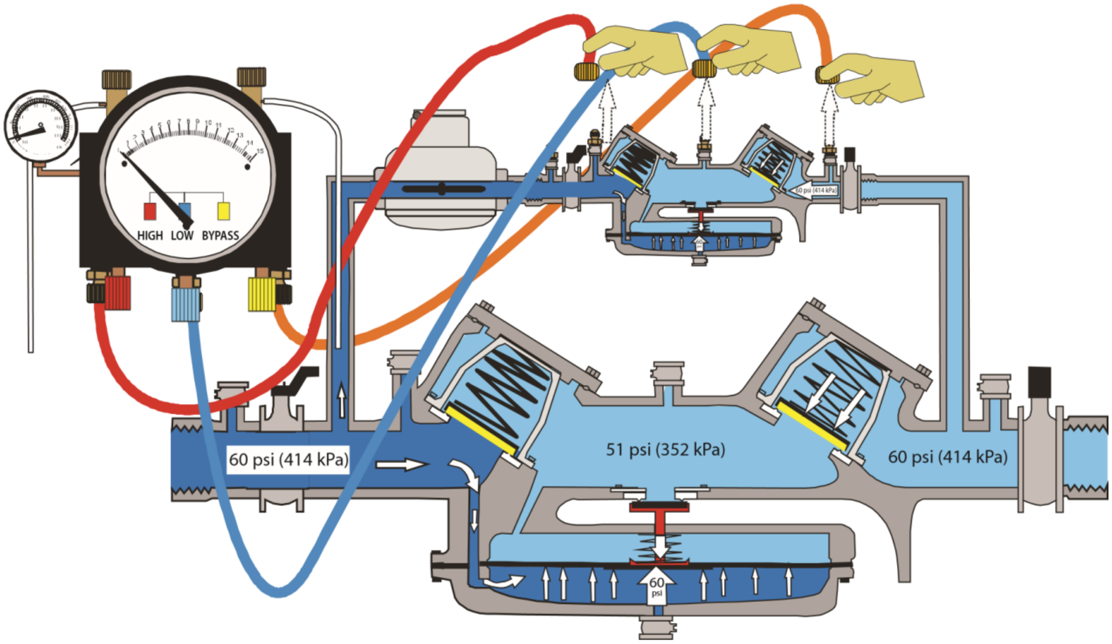


Note: Since the RPDA bypass test requirements are similar to a regular RP assembly it is assumed that you have mastered the regular RP procedures before attempting the RPDA bypass procedures.

Once you have completed the bypass RP test and are now ready to remove your equipment.

Content

6. Close your test valves and remove the test equipment.

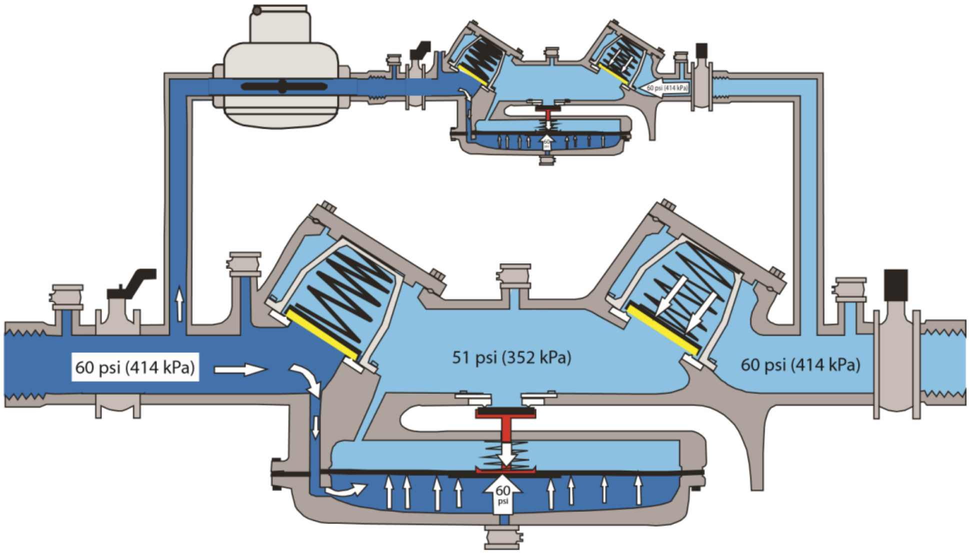


After completing the test procedures, you will need to complete additional requirements.

Additional requirements for the RPDA:

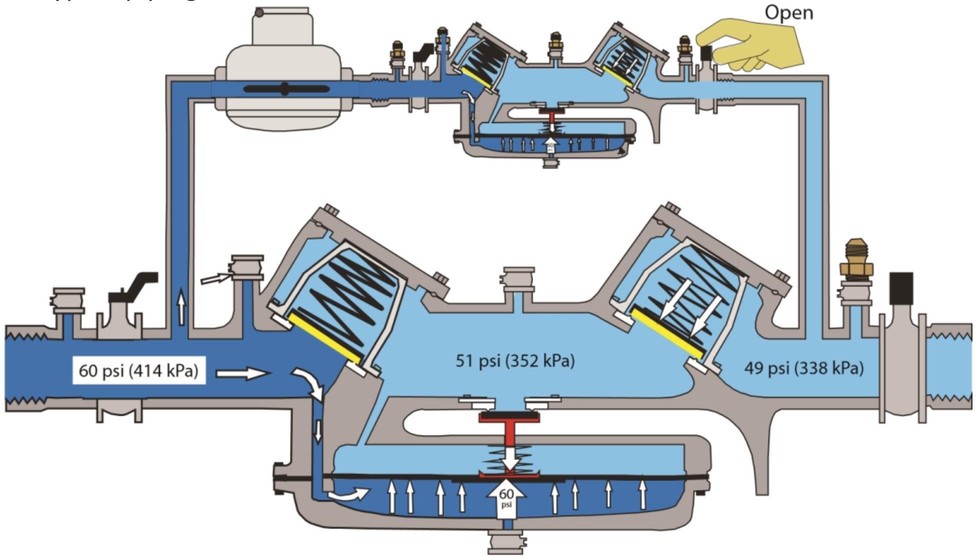
- The metered bypass must detect low flows of water under 2 GPM minimum.
- If the mainline test valve 4 is located on the bypass piping you will need to confirm that the bypass piping is not blocked. (Refer to Chapter 9.)

1. After you have removed all your equipment. Proceed to the next step.

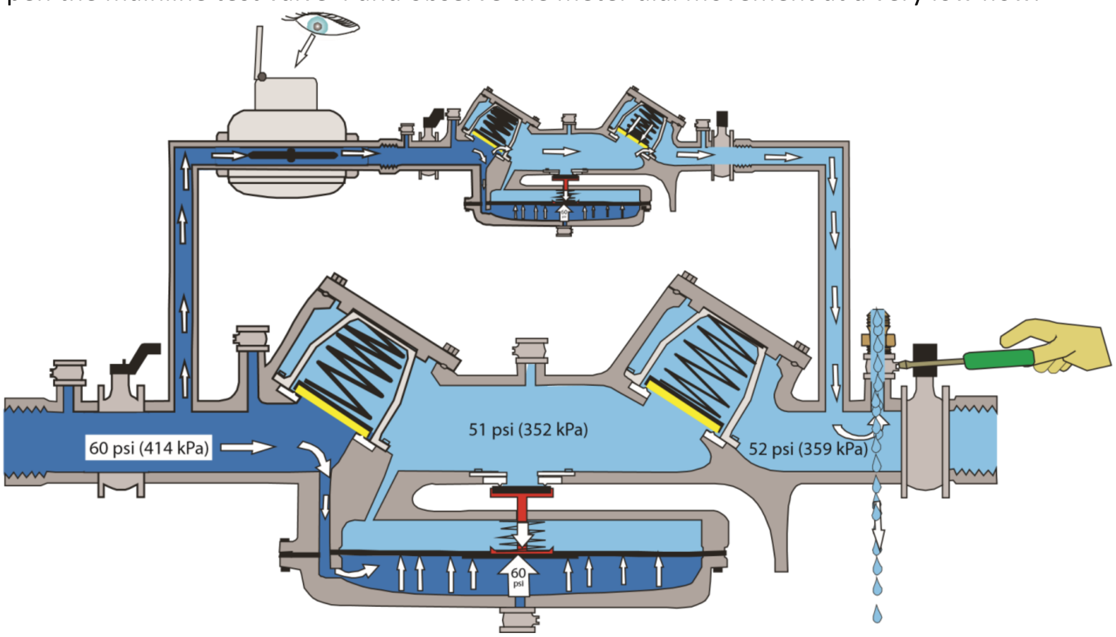


Content

2. Open the bypass piping shut-off 2.



3. Open the mainline test valve 4 and observe the meter dial movement at a very low flow.



Note: The bypass RP is design engineered to detect leaks or water theft under low flow situations. You need to watch the meter dial triangle as you begin to open the test valve. The rotating triangle on the meter dial should move the instant you have water running at the test valve. The movement of the meter and water running from the test valve also confirms that the bypass is not blocked by scale buildup or debris. If the meter is faulty and needs repair, usually the water utility will look after repairs.

You need to turn the water on and then observe and record the water meter reading.

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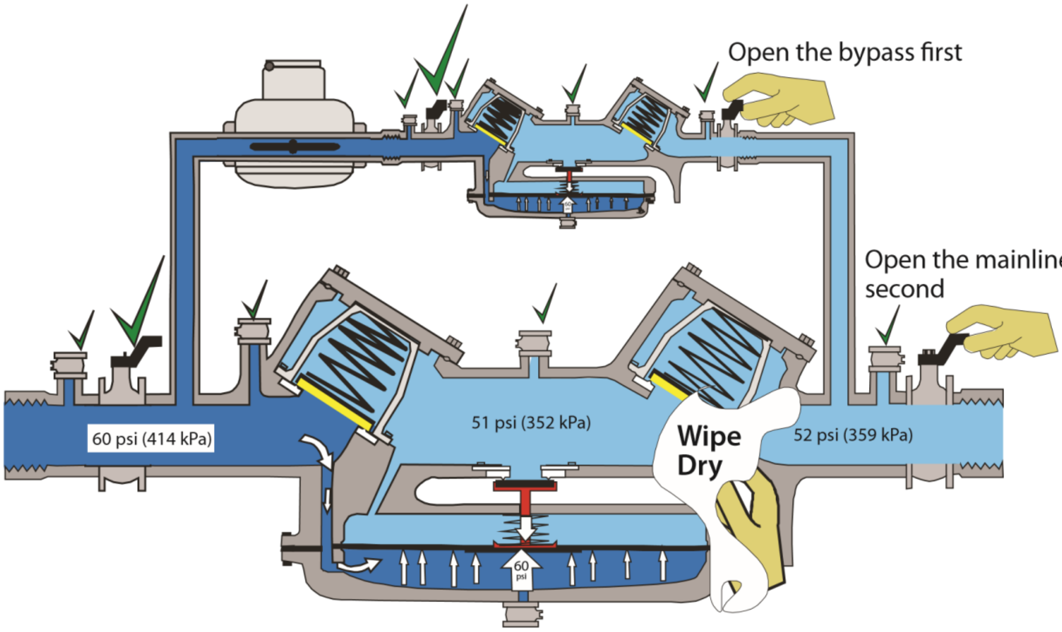
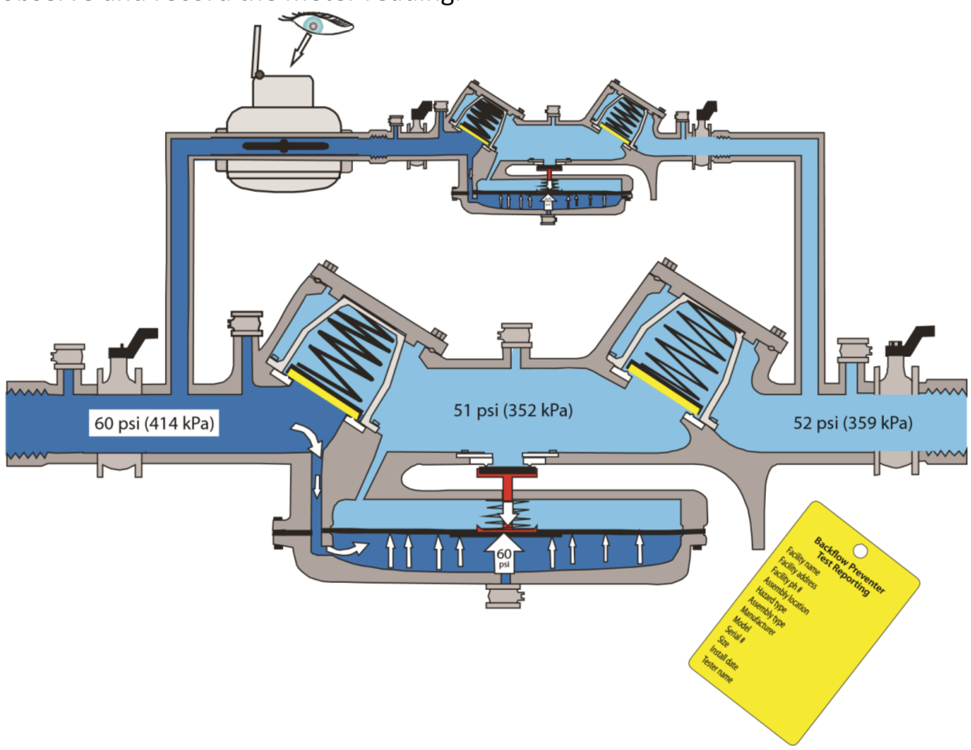
4. Notify and seek permission and then slowly fully open the bypass shut-off and then slowly fully open the mainline shut-off valve. Check that all test valves are completely closed.



Note: Did you remember to take the static line pressure? If not obtain the static water pressure now before the final reading of the water meter.

5. Finally observe and record the meter reading.



Note: Follow the standard cleanup procedures you follow for testing the regular RP backflow preventer. Check for leaks and insure that the assembly test tag is attached.

Content

Test procedures for a RPDA type II using a five-valve differential pressure gauge

(Reference USC foundation for Cross Connection Control and Hydraulic Research test procedures. Check with appropriate AHJ)

These test procedures are included in the manual as information only currently these procedures have not been recognized; therefore, would need to be adopted by the regulatory authority and then with permission from USC.

RPDA type II preliminary steps and test requirements are the same as that required for a RPDA with the exception of the bypass which contains a single check valve that must meet the requirement of a DCVA check valve.

The RPDA type II test requirements

The mainline RP must meet the requirements for a RP.

The bypass single check valve must meet the requirements of a DCVA check valve. The single bypass single check shall hold a steady state minimum psid at or above 1 psid for two minutes.

RPDA type II additional requirements

Additional requirements and or duties other than the actual backflow assembly test procedures:

Note: These additional requirements may or may not be required by the AHJ in your location. Consult the local AHJ to confirm these additional requirements.

- Verify that the bypass meter will record low flows; for example, under 2 GPM (26.4 l/sec.)
- Record the meter reading before starting the test and after completing the test.
- Remember when dealing with fire sprinkler systems the appropriate fire authority and any insurance concerns must also be contacted before shutting the system off. You should be prepared provide at least the reason and the duration of the shut-down.

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RPDA Type II test procedures

You start the testing the RPDA type II by completing the test of the mainline RP following all the procedures of a RP. Figure 8-25 shows the RP mainline test has been completed. The gauge has been moved and positioned to test the bypass single check valve. The test procedure for a DCVA check valve has been applied to the bypass single check valve. The single check valve has held at or above 1 psid steady for a minimum of two minutes and no water is running from the sight tube. Figure 8-25 starts at recording the results.

1. Observe the psid holds steady at or above 1 psid for a minimum of 2 minutes and the sight-tube is not discharging water. Record the single check valve psid and record it as passed.

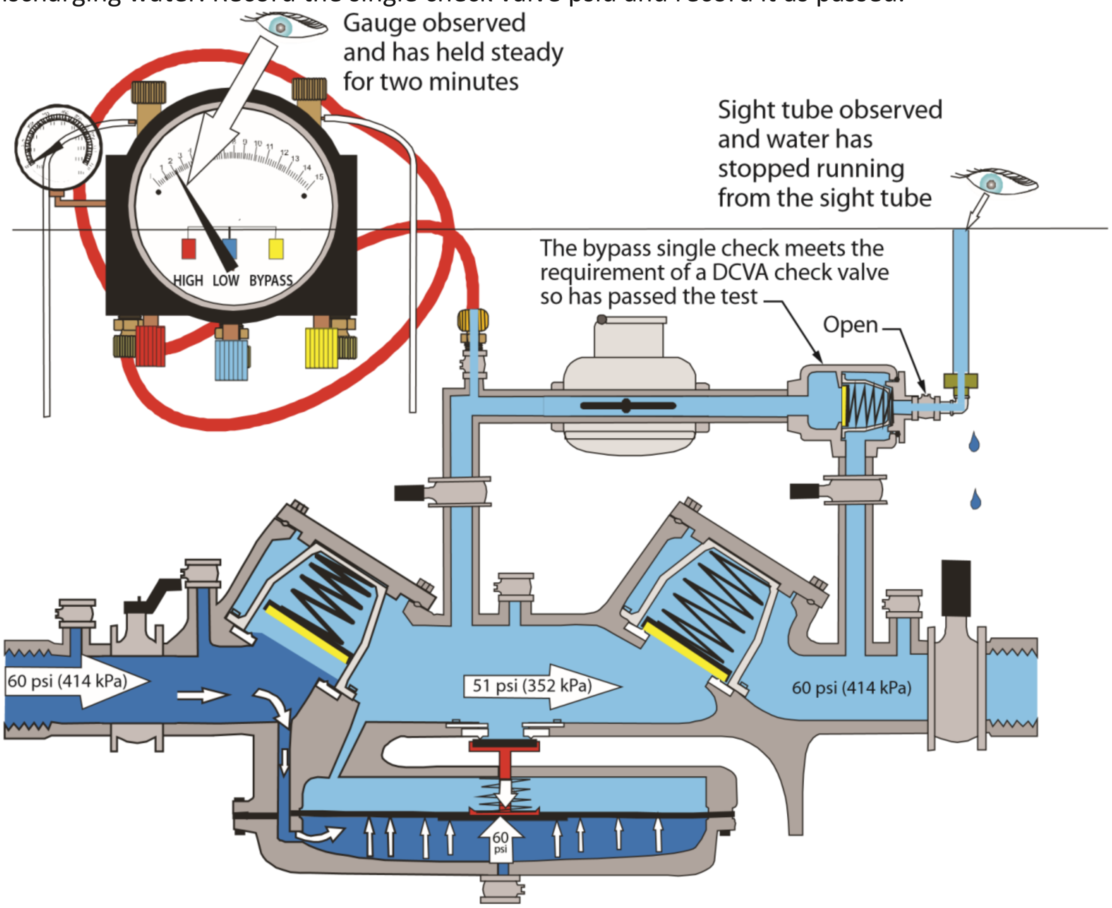
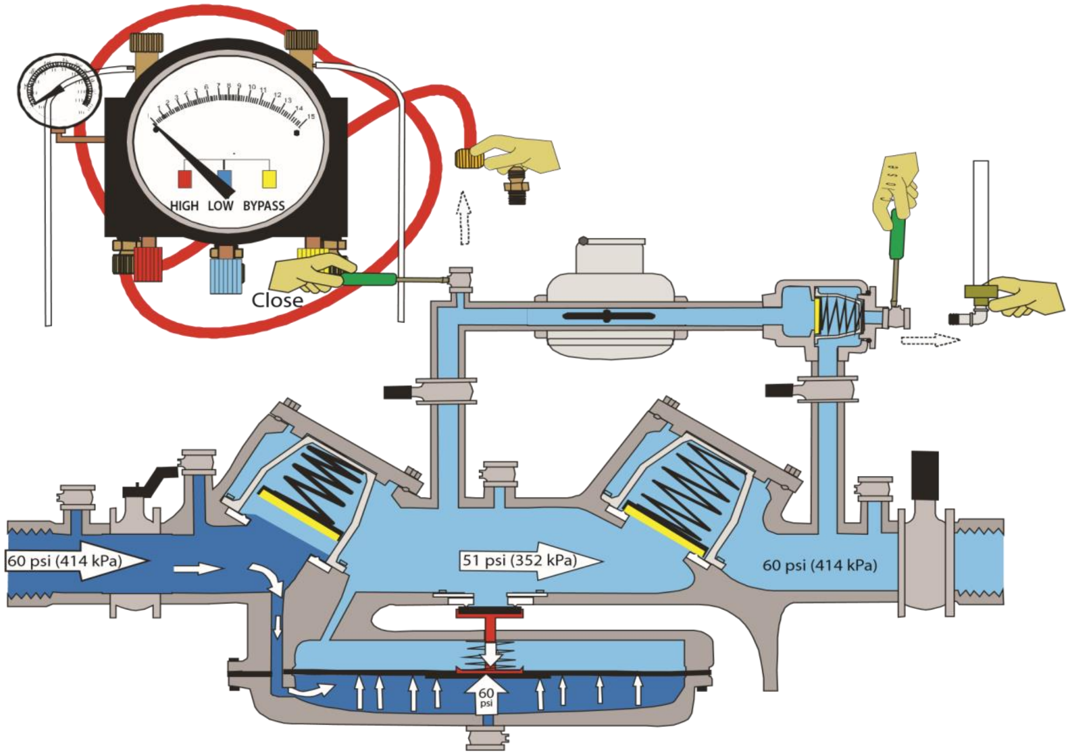


Figure 8-25—Observing the meter reading

Content

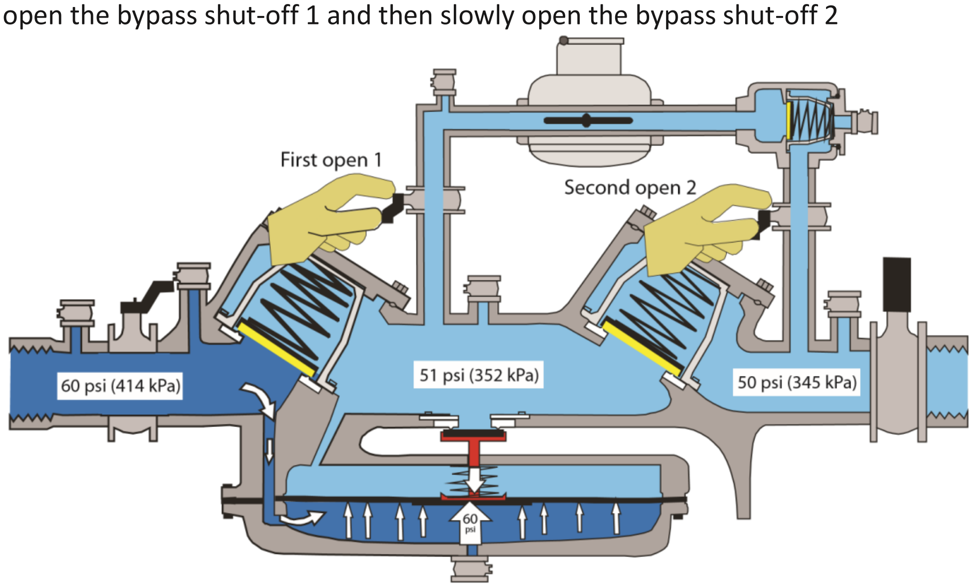
2. Remove all equipment.



Check the operation of the water meter.

Requirement: The bypass meter will detect low flows under two GPM

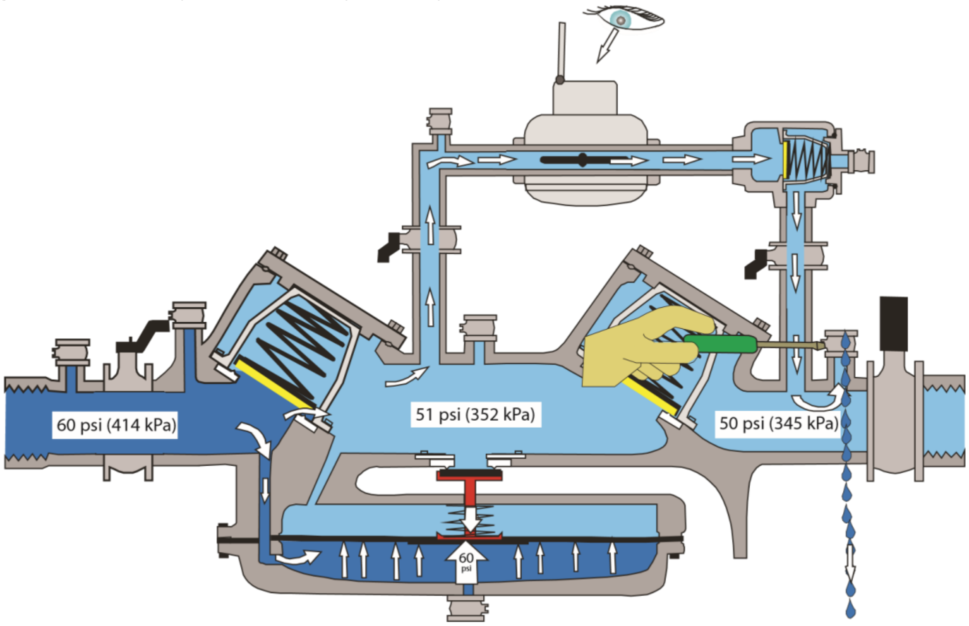
1. Slowly open the bypass shut-off 1 and then slowly open the bypass shut-off 2



Content

2. Slowly open the mainline test valve 4 and initiate low flow through the bypass meter.

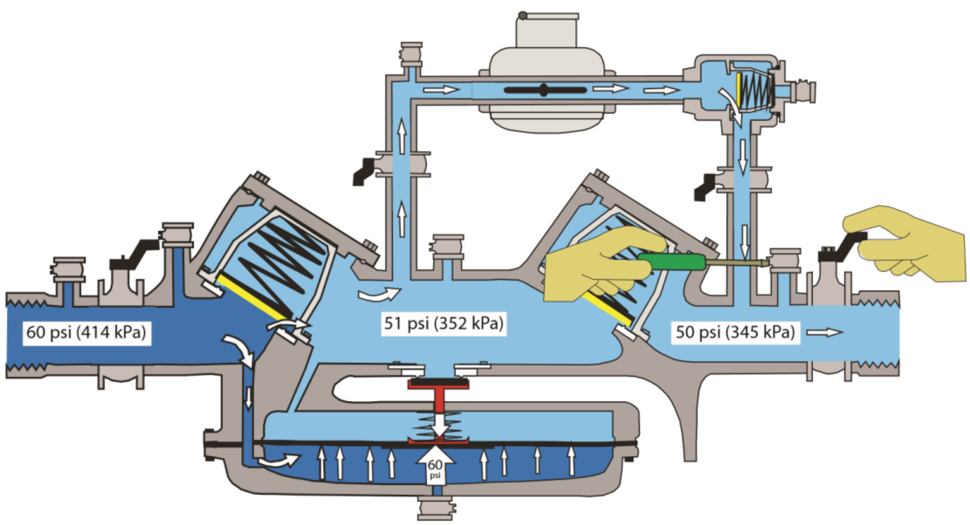
3. Observe the meter dial. Movement of the dial indicates flow through the meter. Record the meter is working on the test report when required by the AHJ.



Note: Leave the mainline shut-off closed until after completing the test procedures on the bypass RP assembly.

4. Close test valve 4, notify and seek permission and then slowly open the mainline shut-off valve.

Observe the water meter, calculate the water use during the test and record the results when required by the AHJ.



5. Check that both of the shut-off valves are open and the test valves are closed tight.

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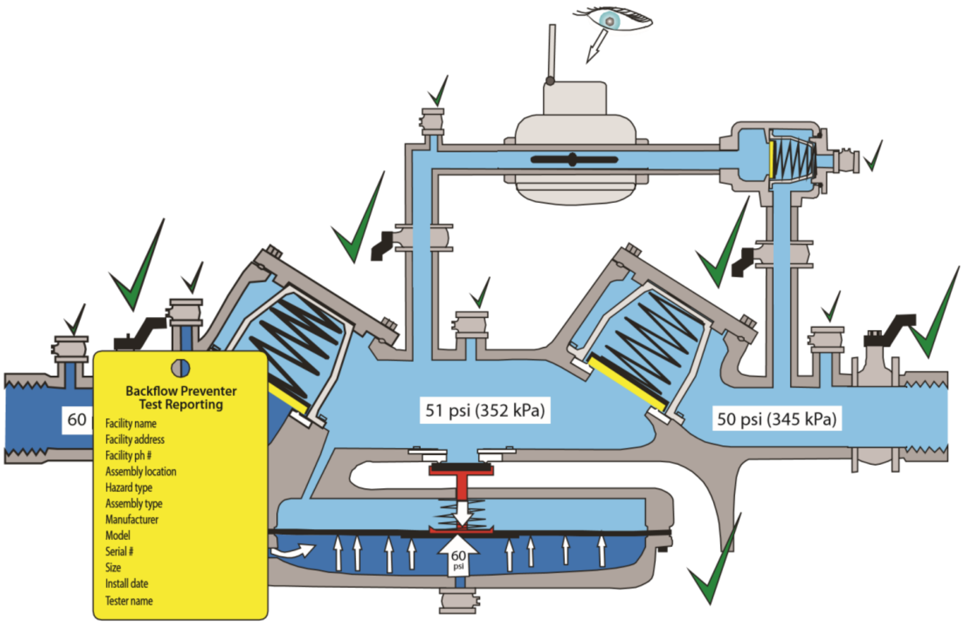
6. Observe the meter dial for movement and confirm that there is no flow.
7. Observe and record the meter reading



Note: Failing to record the meter reading does not mean the assembly has failed and or unable to perform its intended function as a backflow assembly. It is more a courtesy to the water purveyor. The purveyor may reject your test form if it has not been filled out correctly.

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Test procedures for a DCVA using a three-valve or a five-valve differential pressure gauge

These procedures must be practiced until you can demonstrate the test procedures correctly and in entirety.

DCVA test requirements

You are completing this test procedure to check the DCVA to determine if the following requirements are met:

- The static pressure-drop across check valve 1 shall be at least 6.9 kPa (1 psid) and hold steady for a minimum of two minutes.
- The static pressure-drop across check valve 2 shall be at least 6.9 kPa (1 psid) and hold steady for a minimum of two minutes.
- Record the line pressure at the time of test.

Basic practices:

- Do not flush the assembly prior to starting the test procedure.
- As a general rule open or close any valves slowly.
- Recall the internal components of the valve and the sequence of operation of the DCVA as you complete the test.

Flushing the test valves:

During this test procedure you will be bleeding the test valves and positioning the pressure differential gauge at a correct height. Both shut-off valves will be closed during this test. Only the differential pressure gauge high-side hose will be connected to the DVCA. The low-side hose and bypass hose are not used and must be coiled up at the level of the differential gauge. Alternatively, both these hoses can be removed from the gauge when approved by the AHJ. Note: A high-side hose dangling down between the gauge and PVB does not affect the reading.

DCVA Pretest preparations steps

Prior to starting the test procedure, you must complete the pretest procedure:

1. Notify and seek permission of the owner before the water will be shut-off.
2. Identify the DCVA; record make, model, serial number and size.
3. Inspect the DCVA; test valves and shut-off valves; for example, look for damaged or missing components and the like.
4. Observe for obvious leakage and any apparent cross connections in the surrounding piping; for example, bypass piping.

Content

Figure 8-26 shows some equipment you will need:

- Drop cloth
- Adjustable wrench
- Blade screw driver
- Teflon tape
- Drying cloth
- Eye protection
- Screw driver
- Differential gauge
- Pressure gauge minimum size suitable to record maximum line pressures of the system

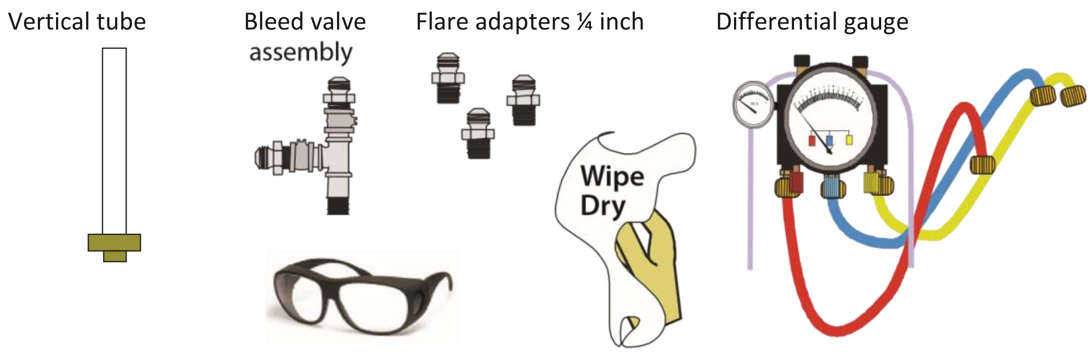
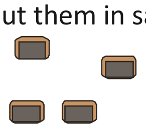


Figure 8-26—Required equipment for DCVA test procedure

DCVA test procedures.

When we have completed the pre-test procedures we can begin the test procedures.

Remove caps or plugs from test valves and put them in safe place.



Test valve caps removed

[Content](#)

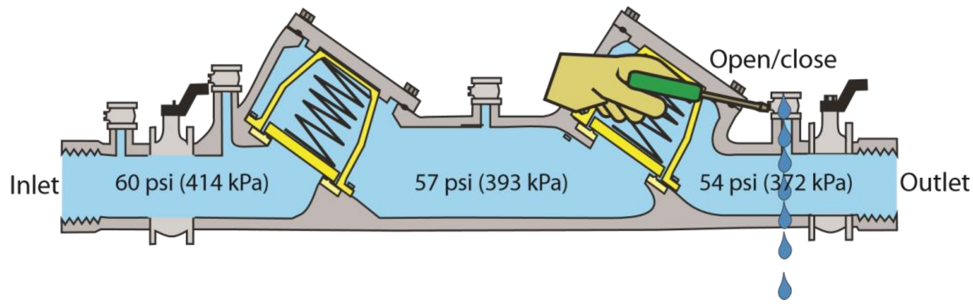
DCVA continued

- Prior to connecting the gauge, the test valves must be flushed out.
- Wear safety glasses when conducting the test procedures.

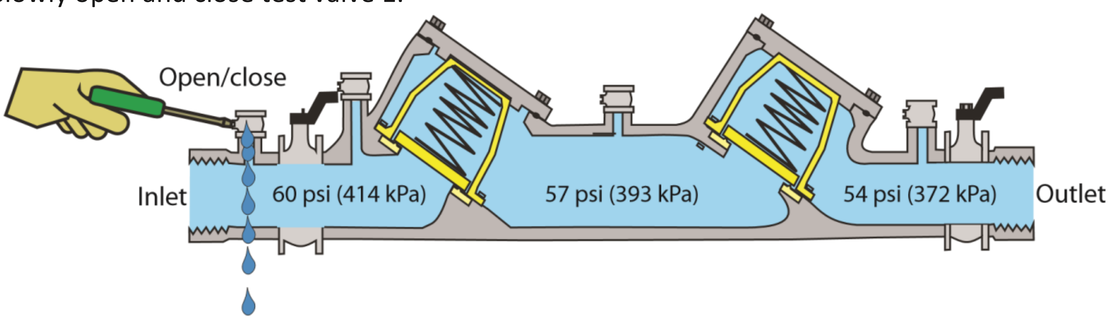
For this test and any other assembly, the test valves must be flushed. For the purpose of consistency, we will use the same flushing procedures as we used for the RP, except you do not have to leave the test valve 4 running.

DCVA pretest preparation flushing the test valves

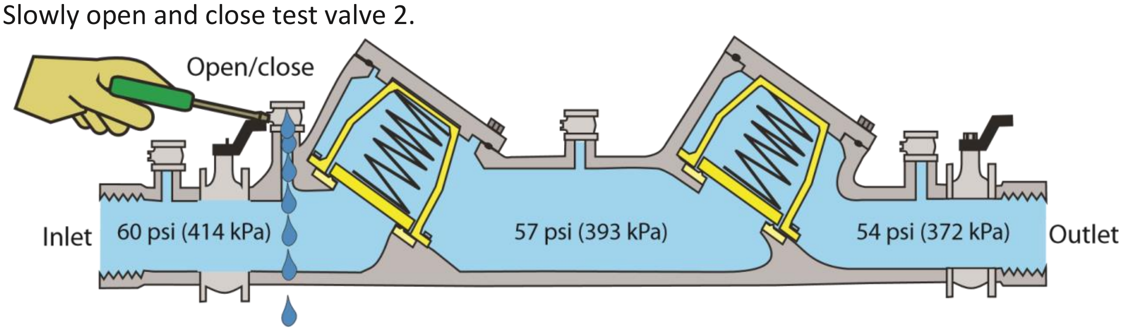
1. Slowly open test valve 4 and then close it



2. Slowly open and close test valve 1.



3. Slowly open and close test valve 2.



Note: Study each illustration, trace the flow, and observe the pressures in the illustration. Ask yourself, what are you doing?

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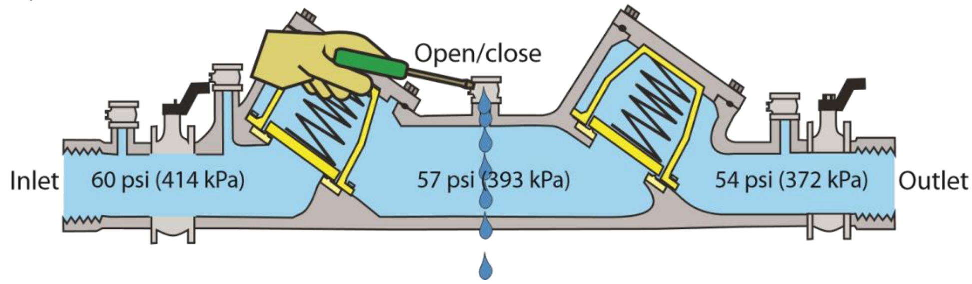
4. Slowly open and close test valve 3.



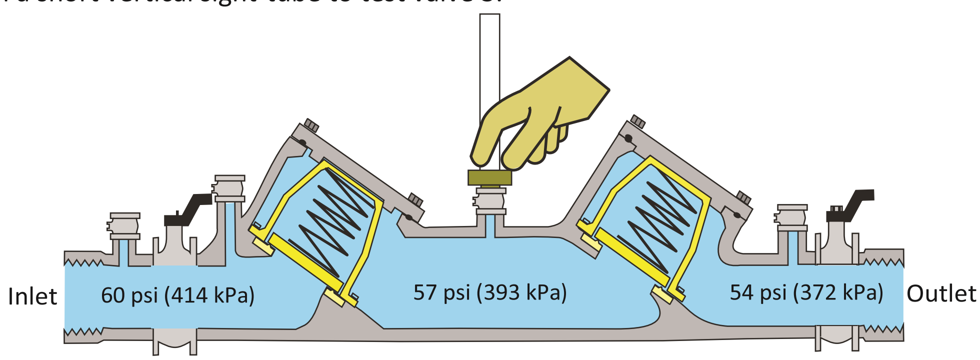
Note: The test valves have now been flushed out and are ready to connect the differential pressure gauge.

We will also be installing a vertical sight-tube and the bleed-valve assembly before we can attach the gauge.

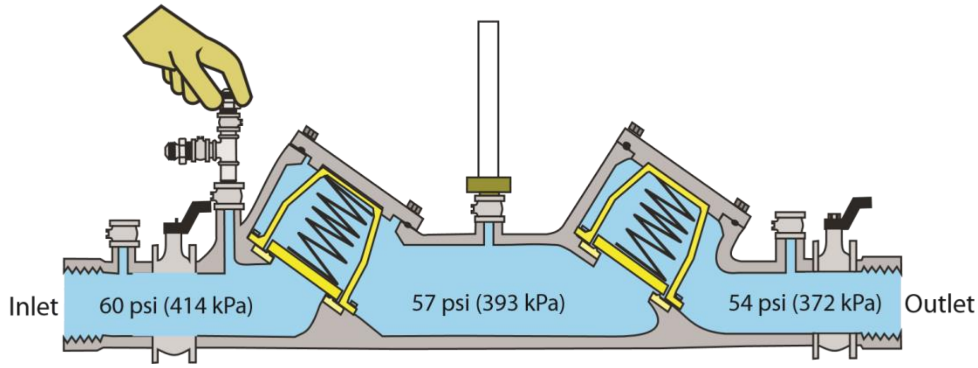
The gauge should be held at the same height of the test valve downstream of the check valve being tested, except when a site-tube is used at the level of the water in the sight-tube. You will need to make sure you hold the gauge at the correct height when you are taking the gauge readings.

DCVA preparations

5. Attach a short vertical sight-tube to test valve 3.



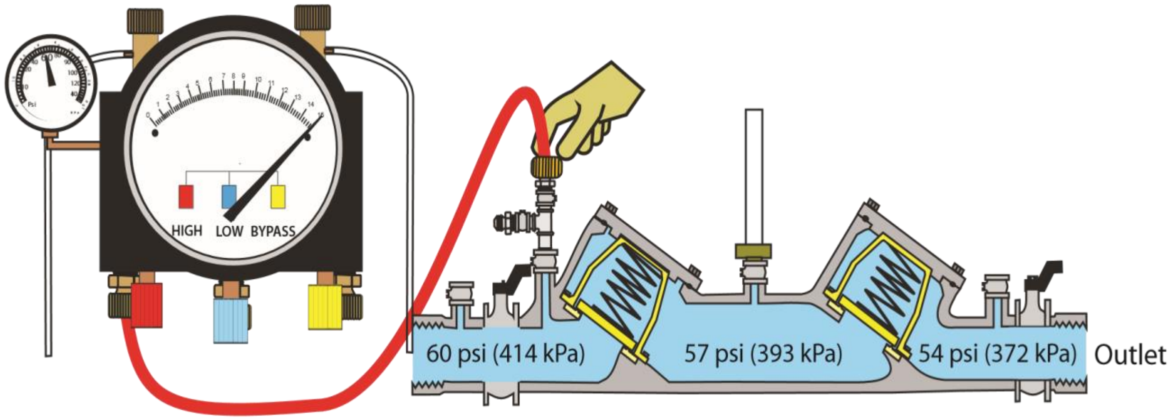
6. Attach a bleed-valve arrangement to test valve 2.



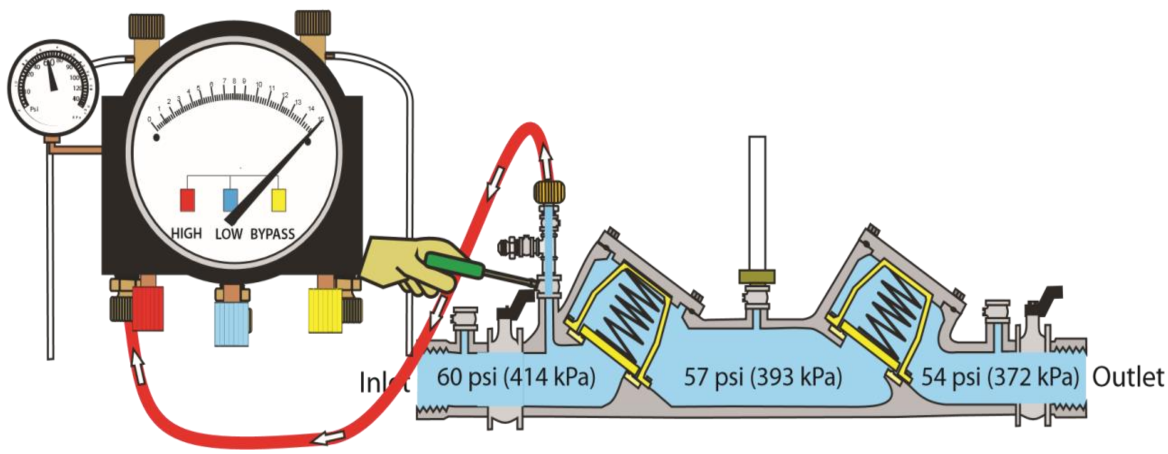
Both the sight-tube and the bleed-valve assembly are not a mandatory part of the test procedures; however, it is a common practice by some to install both of these for the test. If troubleshooting is needed, then the bleed-valve assembly is already installed and ready for use. The site-tube will also help you clearly see any water movement at the test valve; especially when testing in-ground valve boxes.

Content

7. Attach the high-side hose to the test valve 2 bleed-valve arrangement; notice the gauge is at the height of the expected water level in the sight-tube.



8. Slowly open the test valve 2. (Notice that the gauge has pressurized.)



Note: If other hoses are attached to your gauge, coil up the hoses so they are at the same level as the gauge/DCVA. This will avoid incorrect readings caused by the pressure head in the unused hoses. (Removing unused hoses may be acceptable AHJ)

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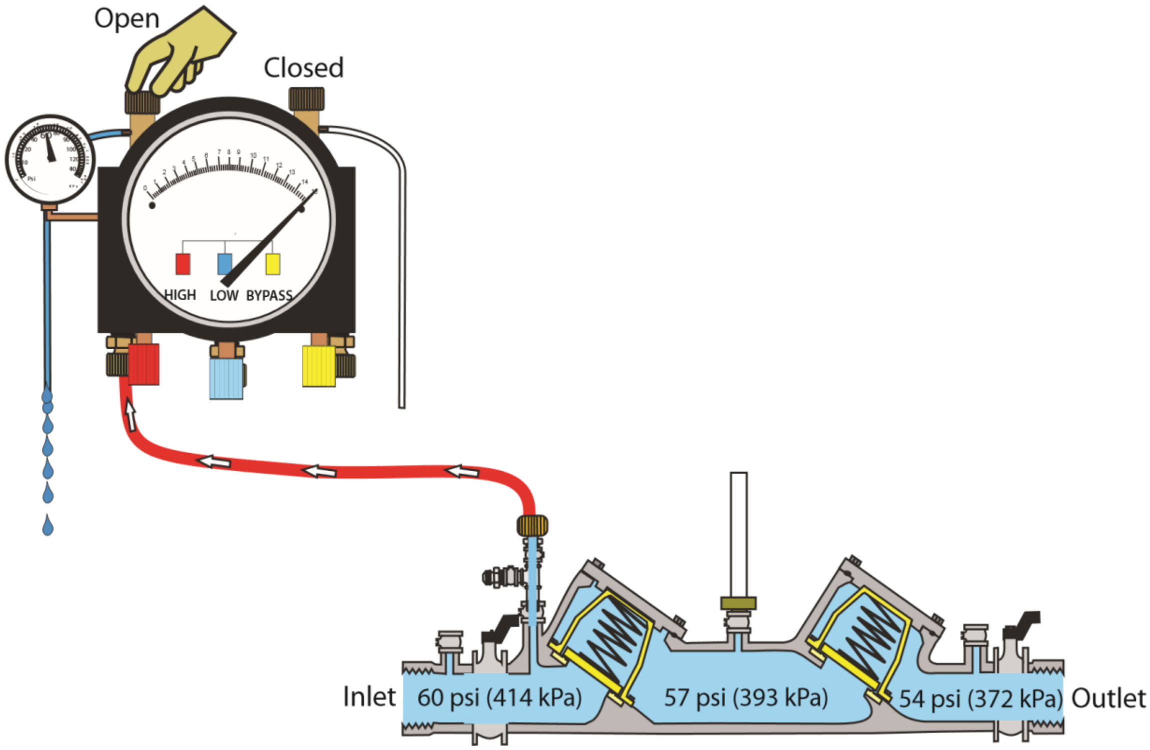
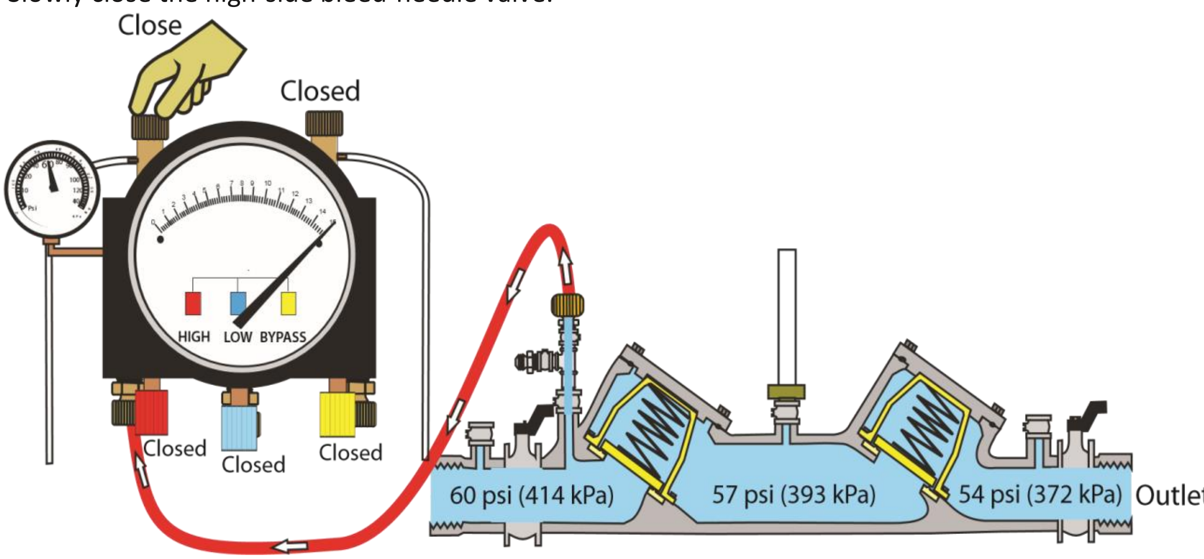
9. Slowly open the high side-bleed needle-valve to bleed air from the gauge.

You can elevate the gauge when bleeding to assist in eliminating air from the hoses.



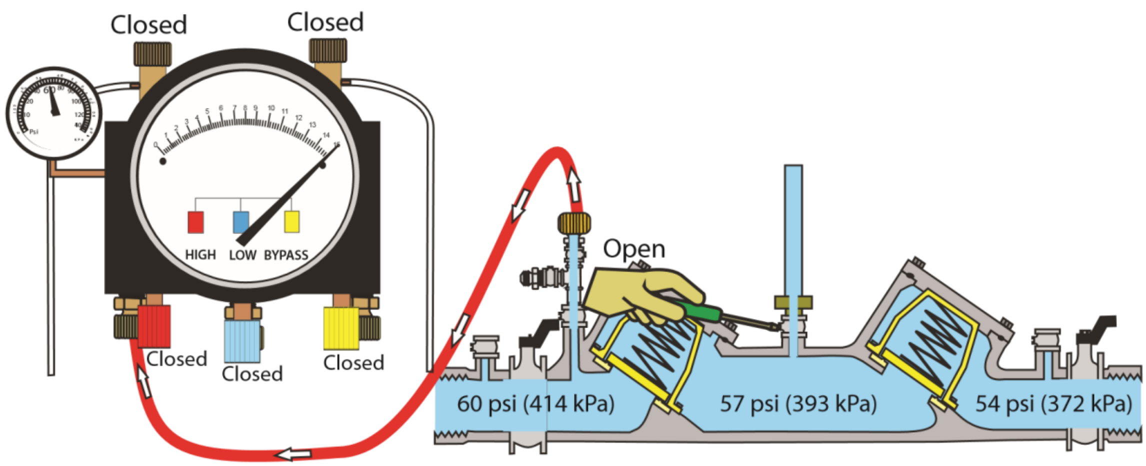
10. Slowly close the high-side bleed-needle valve.



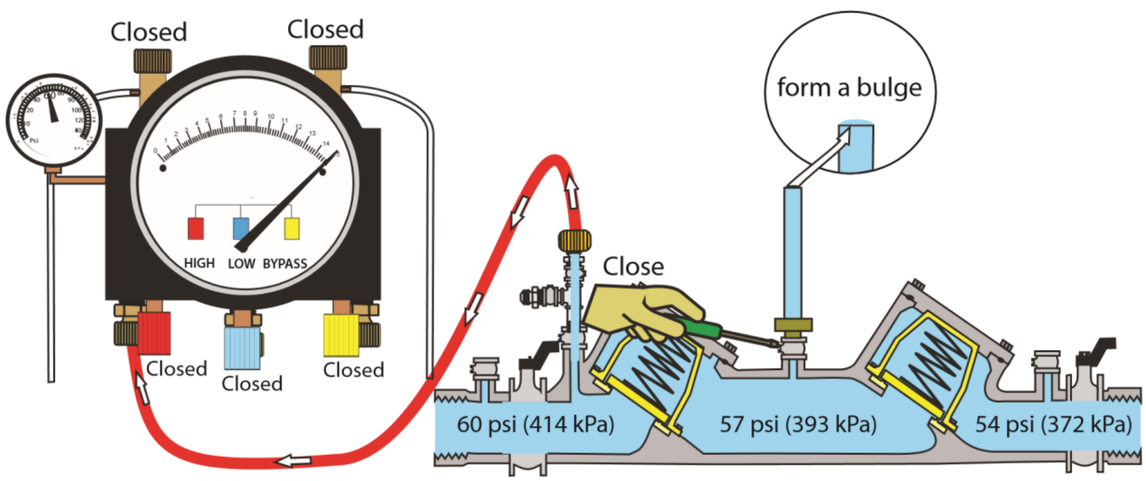
Note: At this point in the procedure we should notice that the gauge is reading the difference between the pressure in the assembly and the atmospheric pressure around the outside of the assembly.

Content

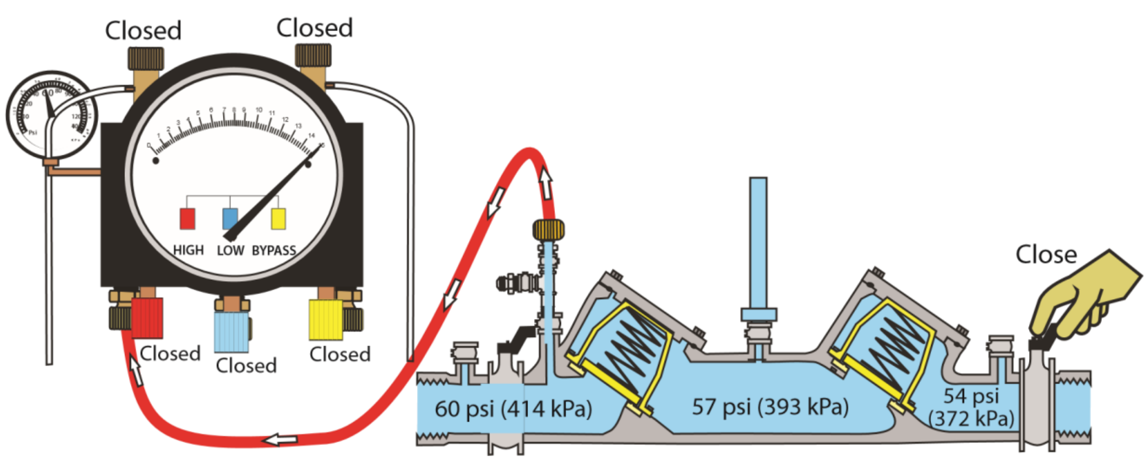
11. Open test valve 3 and fill the sight-tube with water.



12. Close the test valve 3 when the sight-tube is full.



13. Slowly close the shut-off valve 2.

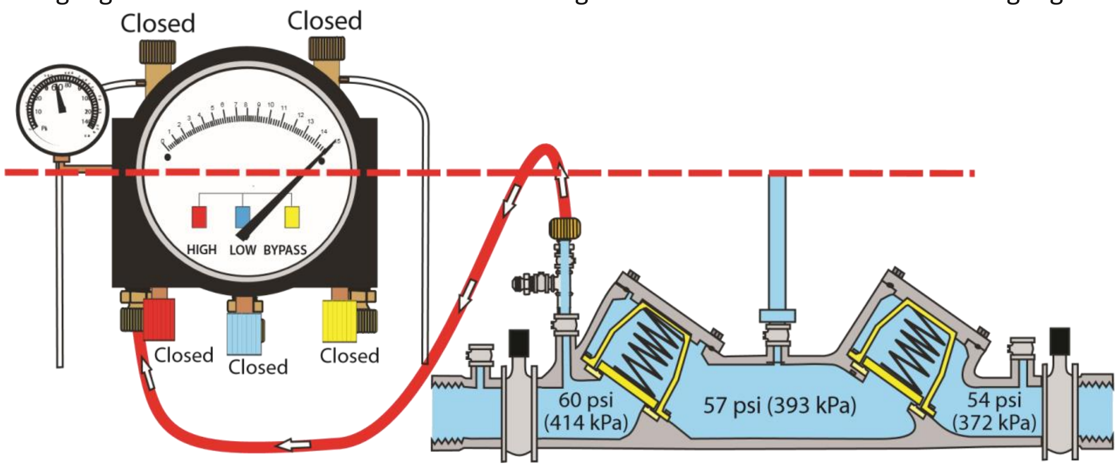


Content

14. Slowly close the shut-off valve 1.

Check that your gauge is at the level of the water in the short sight tube.

Note: As you observe the gauge reading make sure you check to confirm that you have the differential pressure gauge at the elevation of the water in the sight-tube within the diameter of the gauge diameter.



You are now ready to actually do the test requirement of the check valve 1.

Content

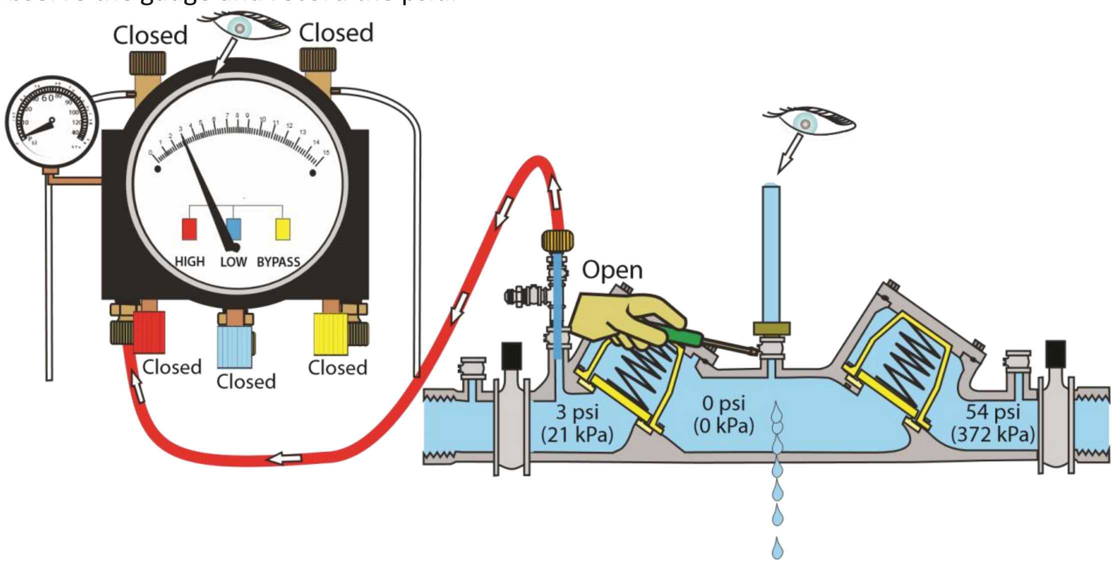
DCVA requirement one

The check valve 1 shall hold steady for minimum of two minutes at a pressure of 1 psid (6.9 kPa) or higher in the direction of flow.

1. Slowly open the test valve 3.

Water will run from the sight-tube and then it should stop completely. Observe that the water stops flowing. Wait until the gauge reading stabilizes and a steady pressure is attained

2. Begin the minimum two minutes' steady state reading and no water discharges from the sight-tube. Observe the gauge and record the psid.



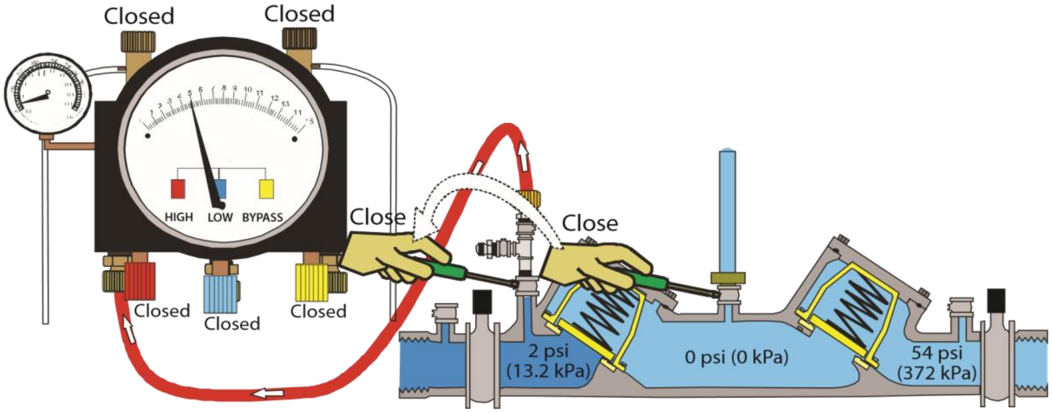
When a Minimum 2-minute steady stated pressure is achieved at or above 1 psid and no water is discharging from the test valve 3 this indicates check valve 1 is closed tight.

3. Record that check valve 1 has closed tight.
   - If the psid stops at less than 1 psid, record the pressure and indicate check valve 1 has failed.
   - If water continues to run from test valve 3, refer to troubleshooting Chapter 9.
   - The psid recorded indicates the relative strength of check valve 1 spring

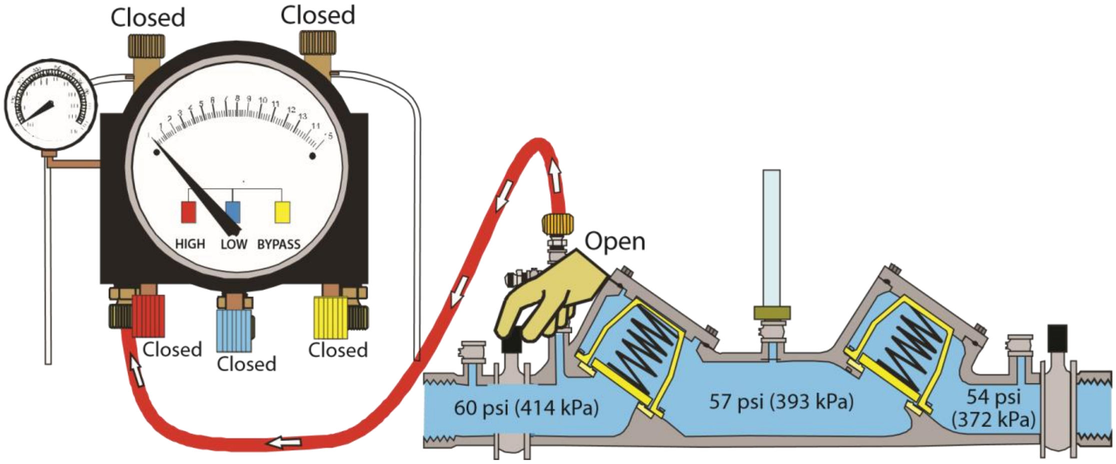
Content

DCVA preparing to complete the requirement for check valve 2

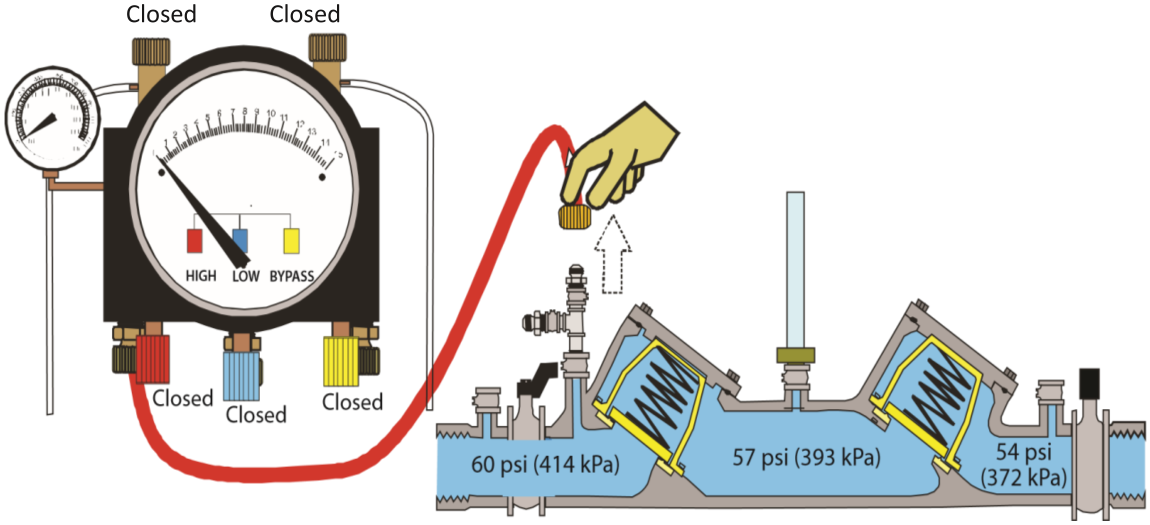
1. Close test valve 3 and test valve 2



2. Slowly open shut-off 1 to recharge the valve.

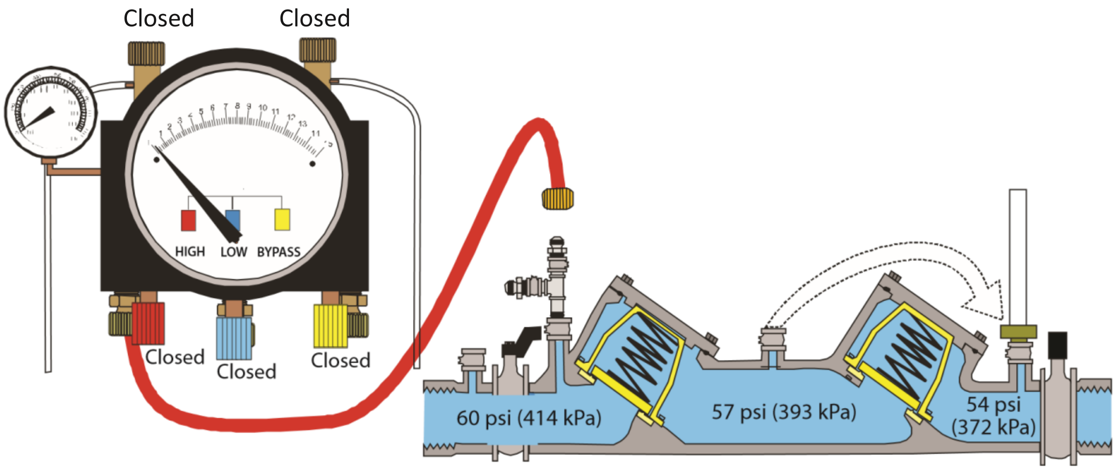


3. Remove the high-side hose from the bleed-valve assembly.

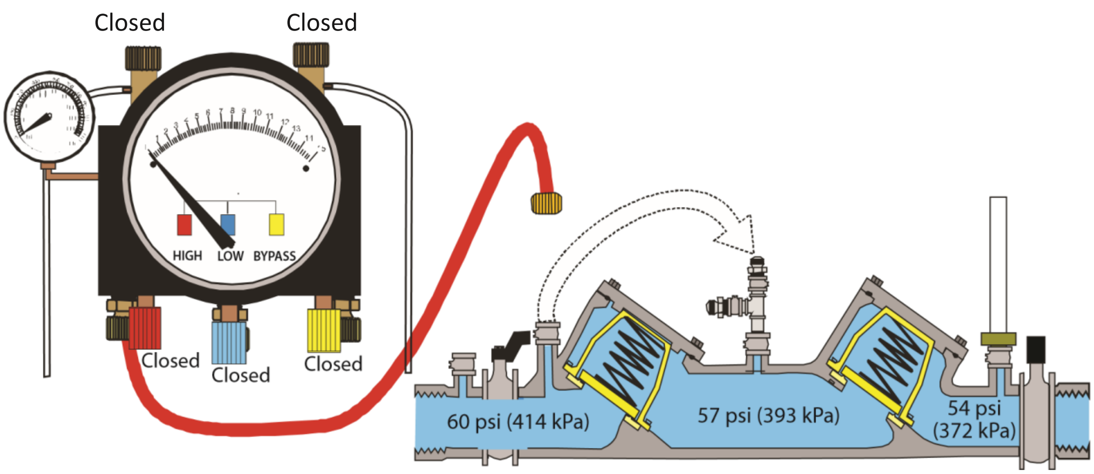


Content

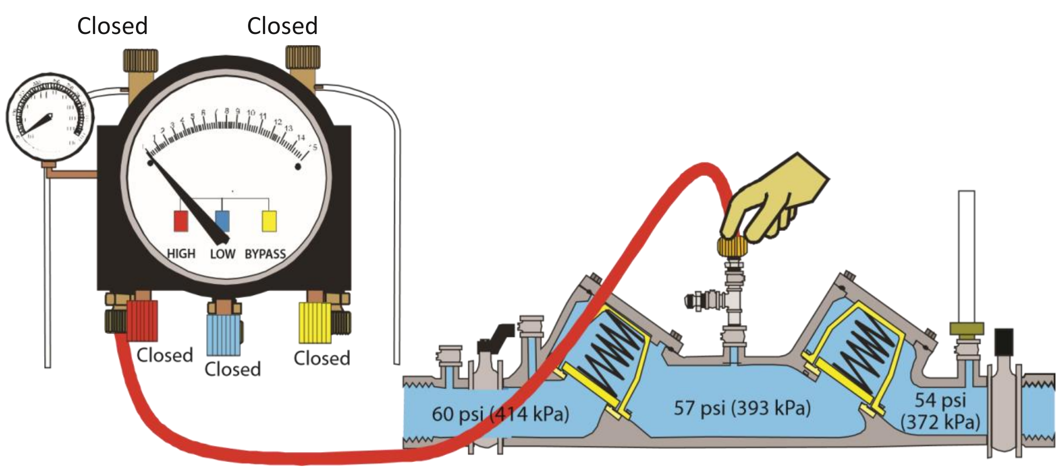
4. Move the sight-tube from test valve 3 to test valve 4



5. Move the bleed-valve assembly from test valve 2 to test valve 3.

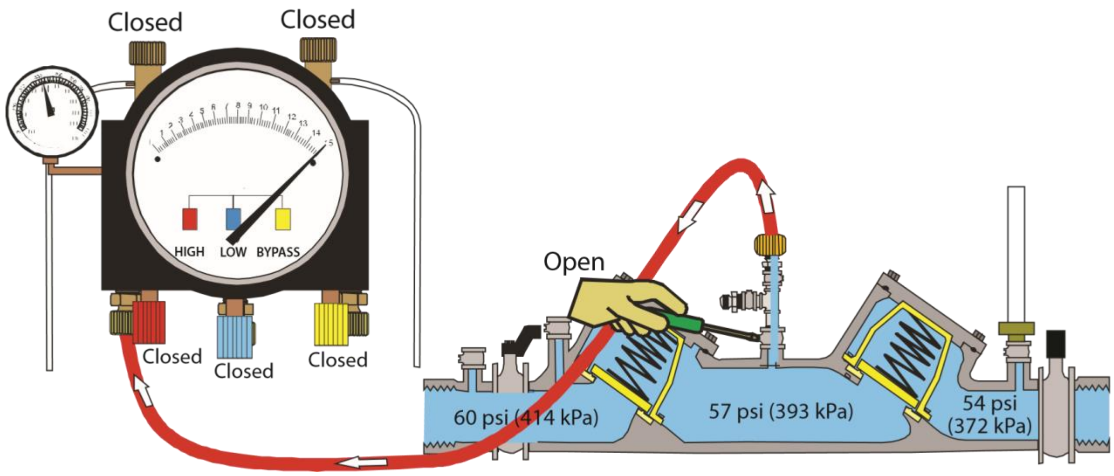


6. Reconnect the high-side hose to the bleed-valve assembly at test valve 3

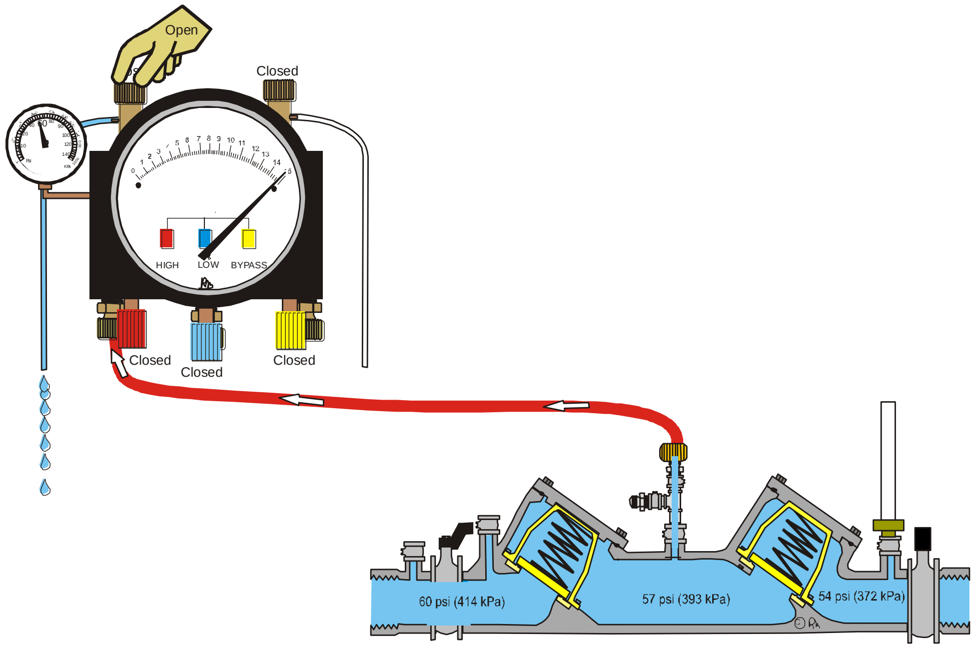


Content

7. Slowly open test valve 3 to recharge the gauge.

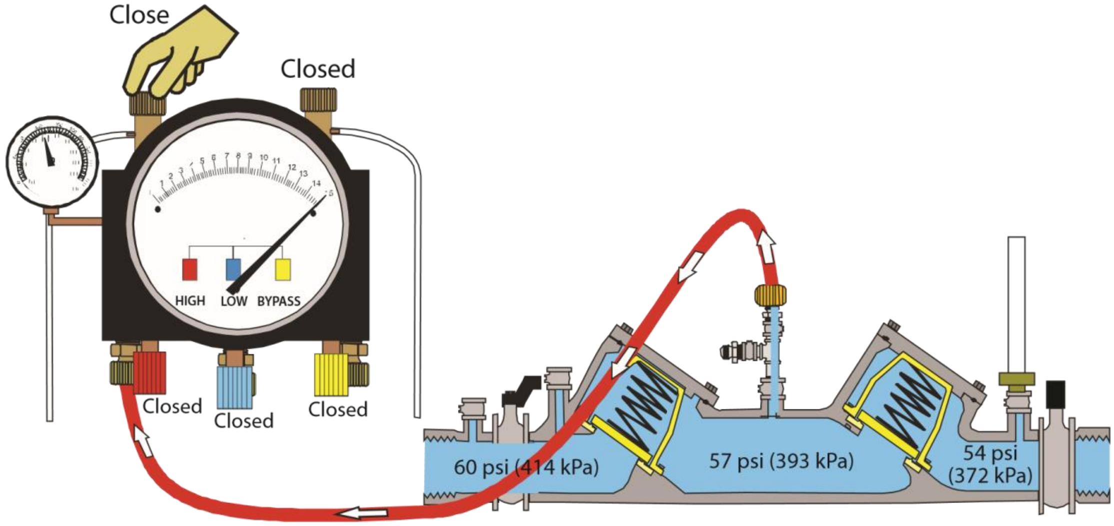


8. Open the high-side bleed-needle valve and bleed the air from the gauge and the hose. Hold the gauge above the assembly to allow the air to bleed from the hose easily.



Content

9. Close the high-side bleed-needle valve.



Note: When using a three valve gauge to bleed the zone use the following steps (refer to Figure 8-27):

- Slowly open the high-side control valve H.
- Open the low-side control valve and bleed all air from the gauge L.
- Close the high-side control valve H.
- Close low-side control valve L
- The bypass control valve remains closed.

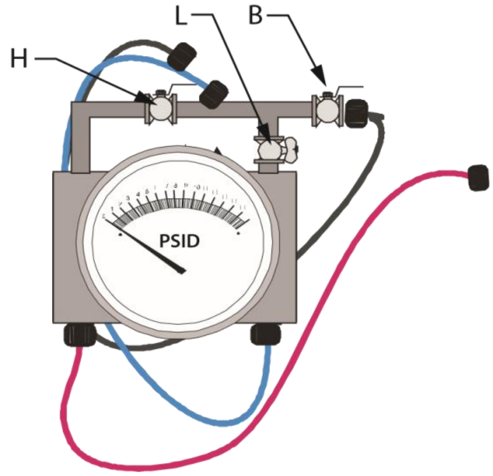
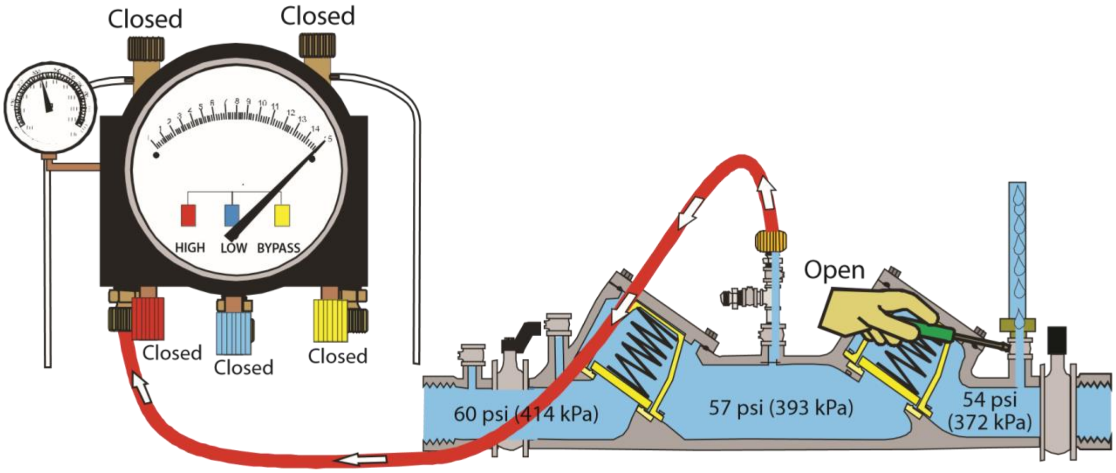


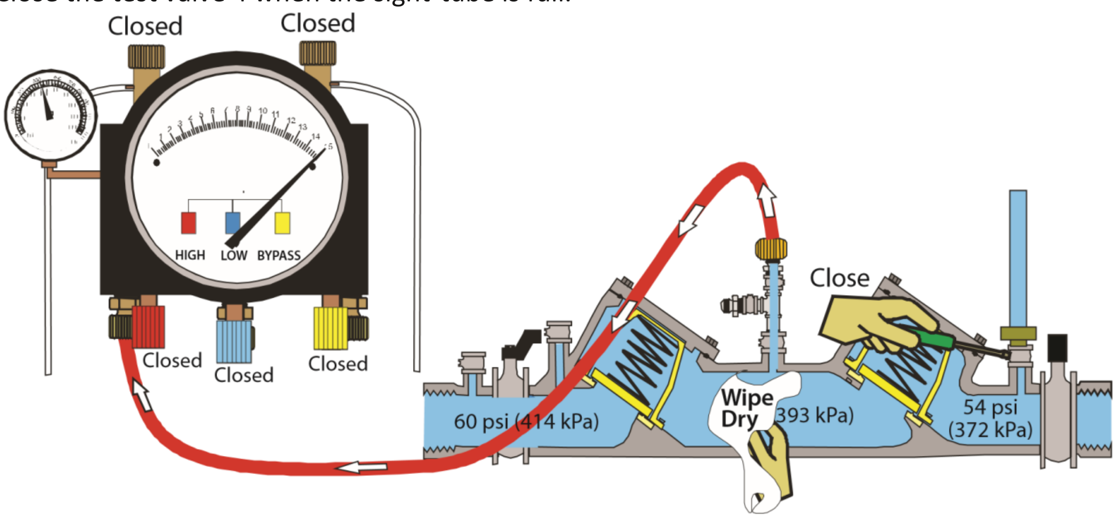
Figure 8-27 Bleed gauge using 3 valve gauge

Content

10. Slowly open the test valve 4 and fill the sight tube.

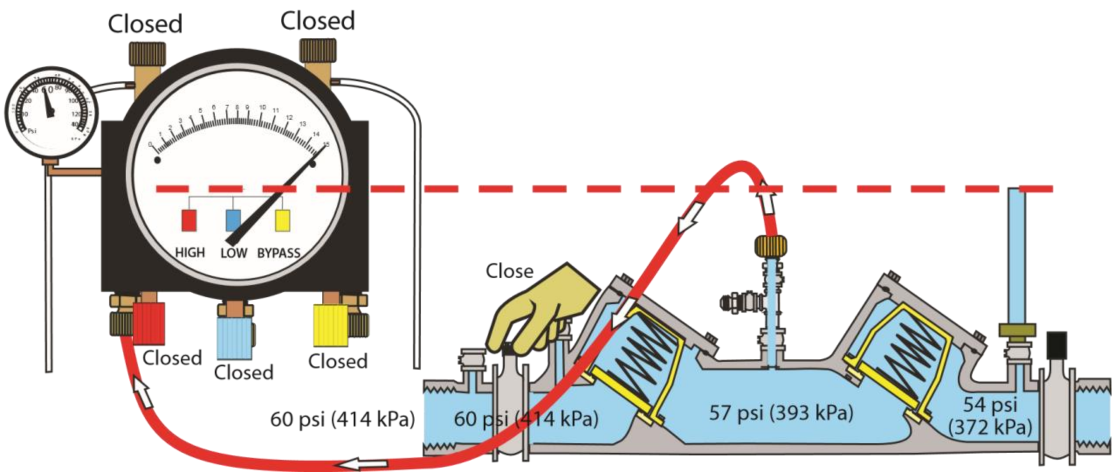


11. Close the test valve 4 when the sight-tube is full.



12. Slowly close the shut-off 1 valve to isolate the assembly.

Check to ensure gauge is at the height of the water level in the sight-tube.



You are now ready to actually do the test requirement of the check valve 2.

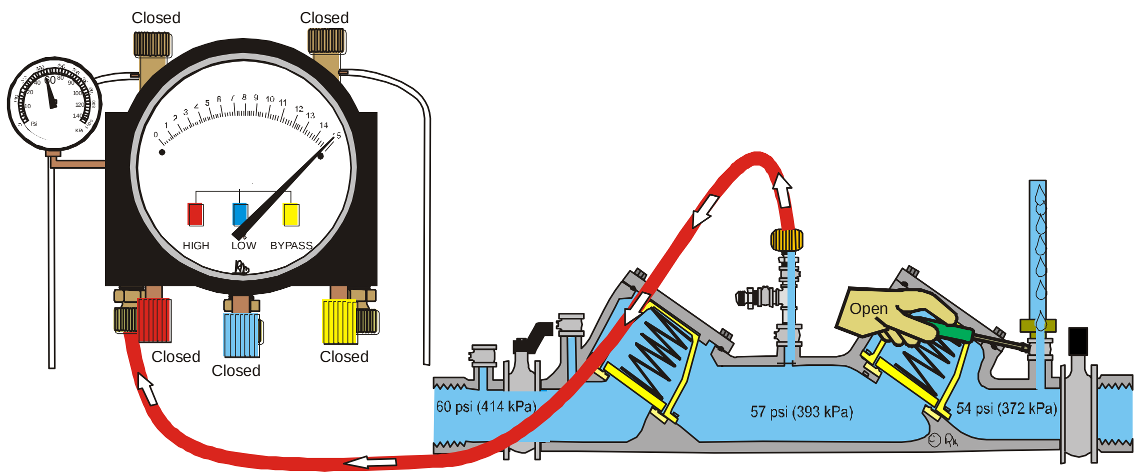
Content

DCVA test requirement 2

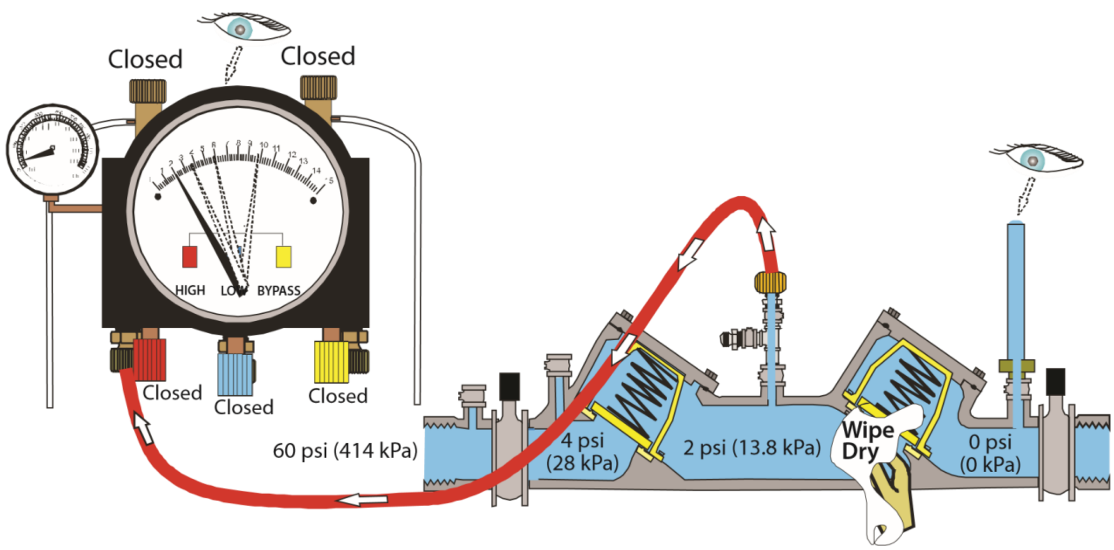
The check valve 2 shall hold steady for minimum of two minutes at a pressure of 1 psid (6.9 kPa) or higher in the direction of flow.

During this test, test valve 4 will be opened slowly and water pressure will be relieved from downstream of check valve 2.

1. Slowly open the test valve 4.



2. Wait for the water to stop running from the sight-tube at test valve. Observe the gauge reading stays steady for two minutes. Record the psid.



Note: A steady pressure at or above 1 psid and no water discharging from the test valve 4 indicates the check valve 2 is closed tight. Record check valve 2 as closed tight and passed.

If the psid is less than 1 psid, record the pressure and indicate the check valve 2 has failed.

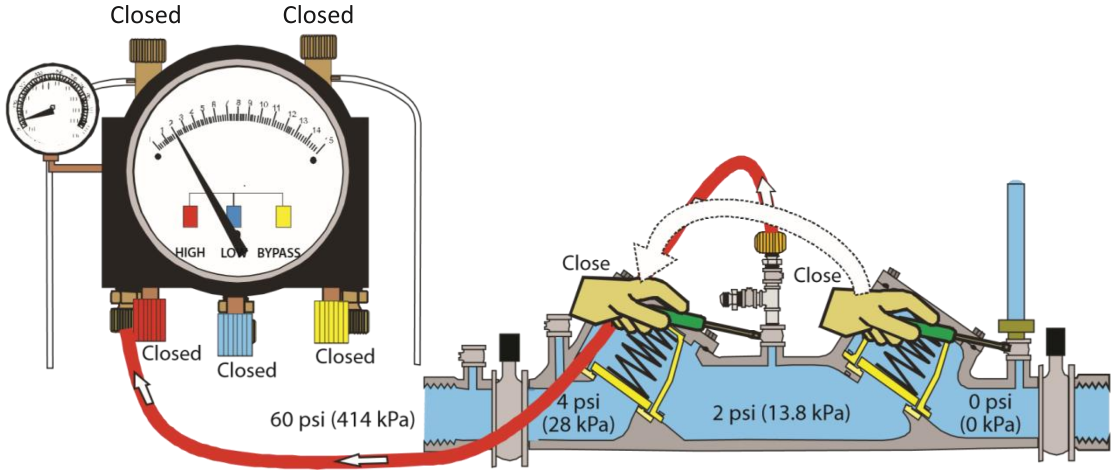
If water continues to run from the test valve 4, refer to troubleshooting DCVA Chapter 9.

As you observe the gauge reading make sure you check to confirm that you have the differential pressure gauge at the elevation of the water in the vertical sight-tube and within the diameter of the gauge face.

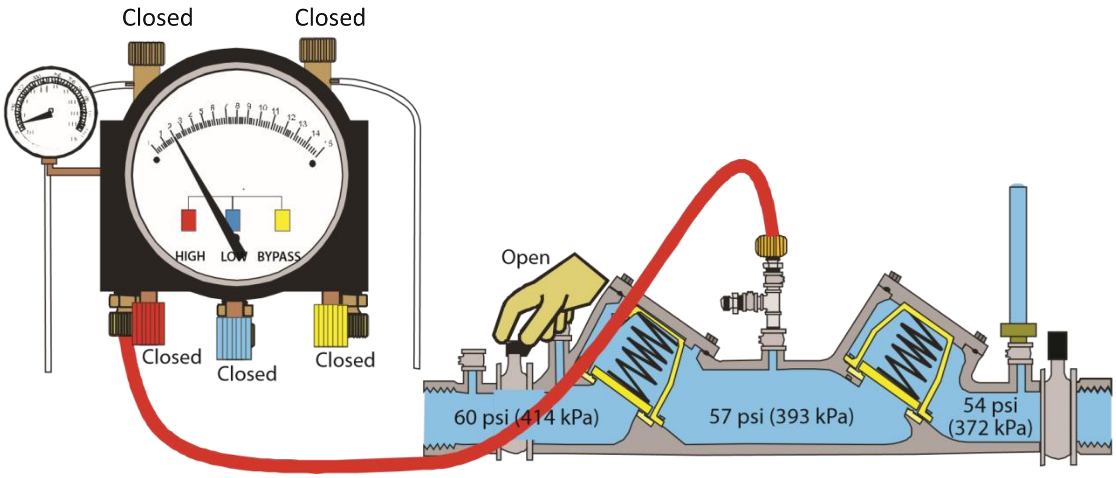
Content

DCVA preparing to record the line pressure

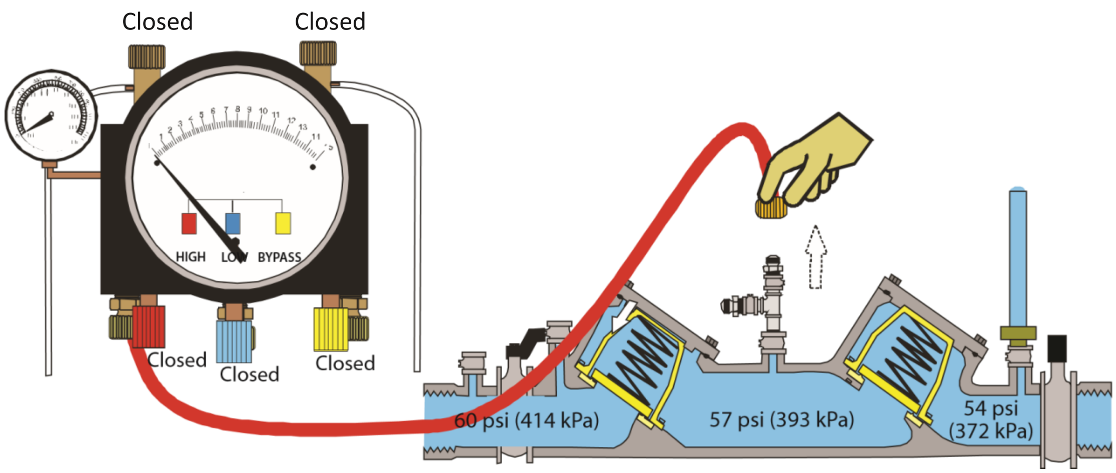
1. Slowly close test valve 4 then test valve 3.



2. Slowly open shut-off 1 to recharge the assembly

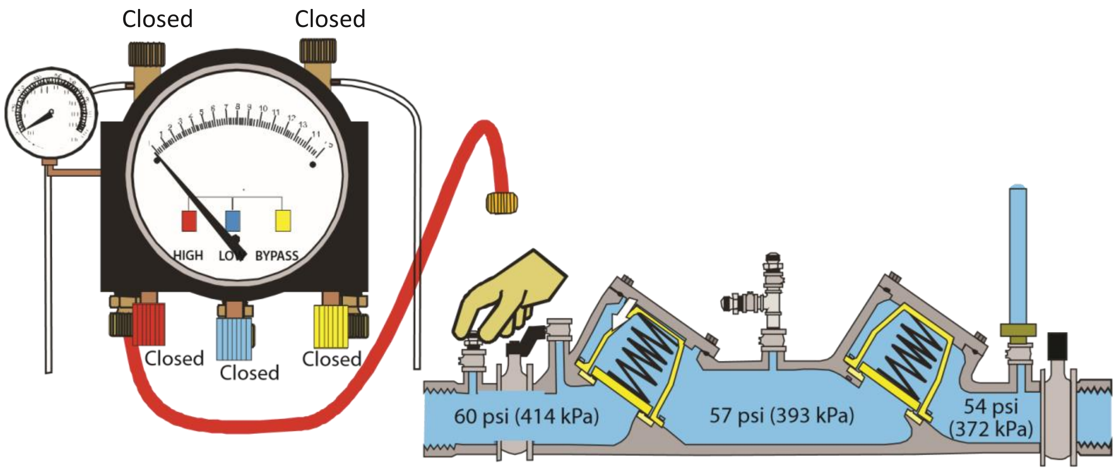


3. Remove the high-side hose from the bleed-valve assembly at test valve 3.

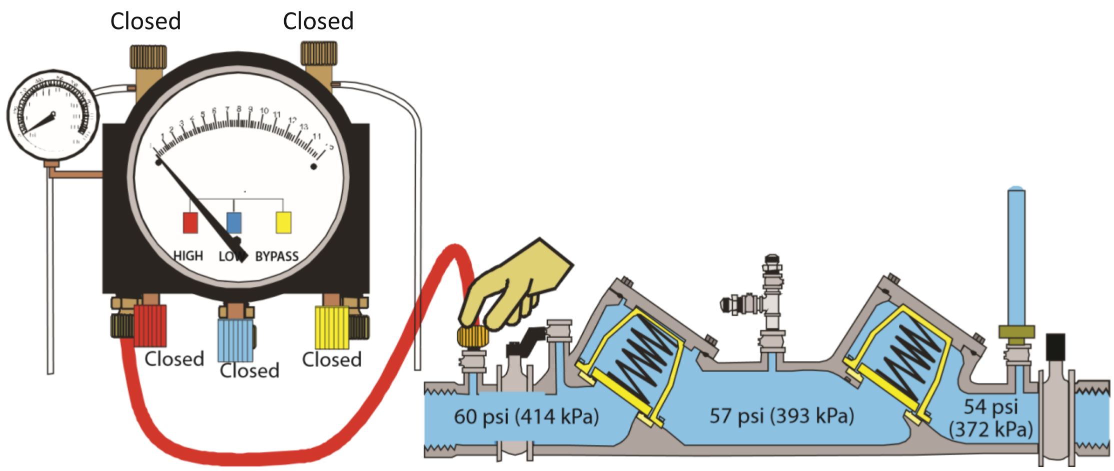


Content

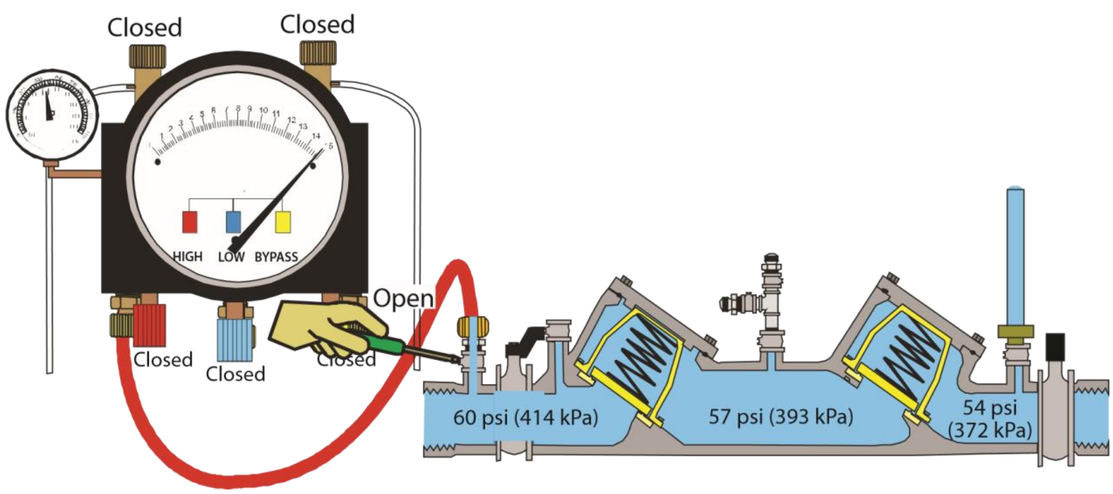
4. Install an adapter at test valve 1.



5. Connect the high-side hose to test valve 1.

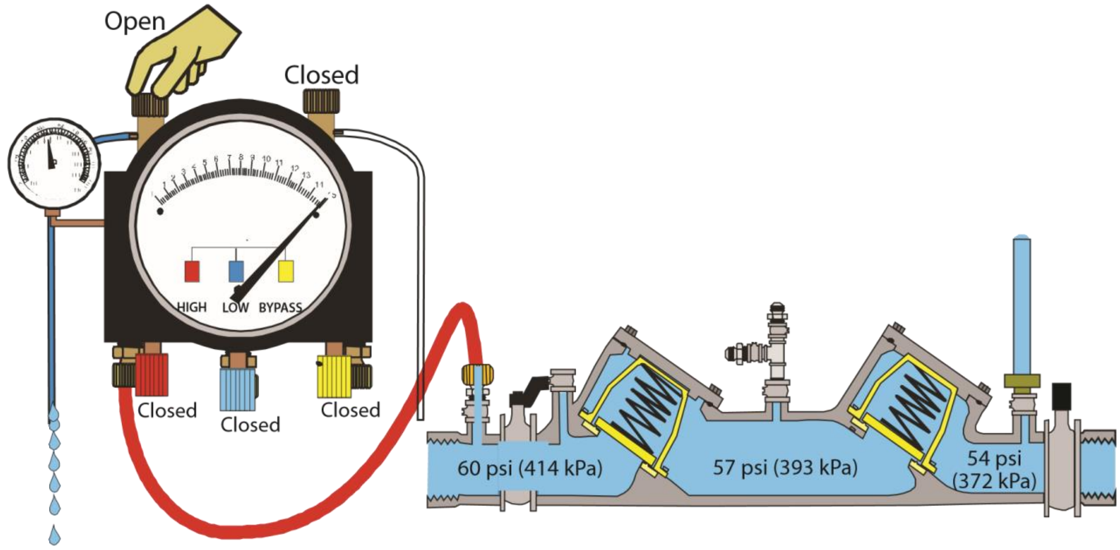


6. Slowly open test valve 1.

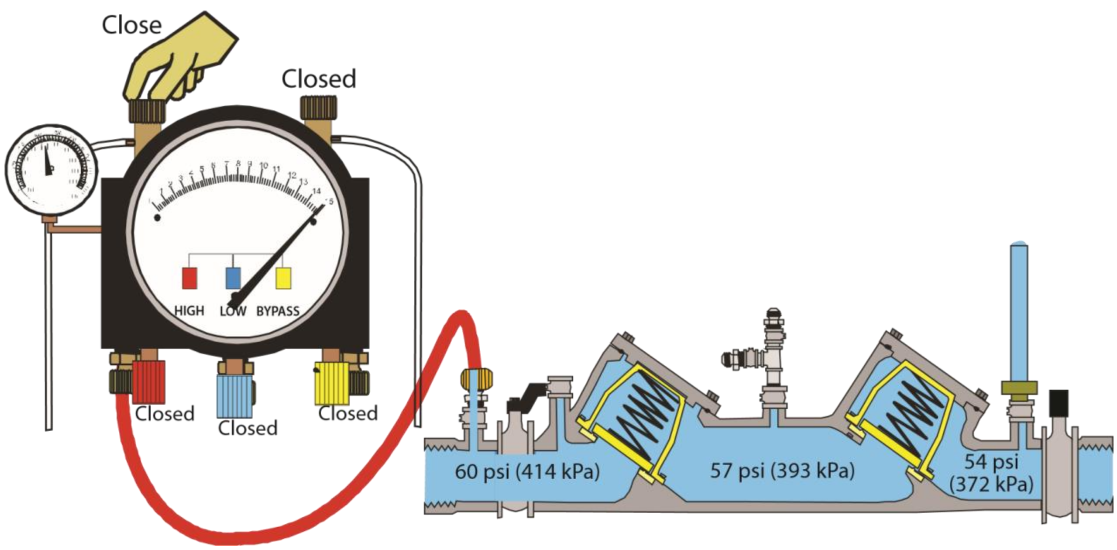


Content

7. Slowly open the high-side bleed-needle valve to bleed the air from the gauge or the bleed-valve on the pressure gauge assembly.



8. Close the high-side bleed-needle valve. If you are using a pressure gauge assembly close the bleed-valve.



Content

Note: When using a three valve gauge to bleed the zone use the following steps (refer to Figure 8-28):

- Slowly open the high-side control valve H.
- Open the low-side control valve and bleed all air from the gauge L.
- Close the high-side control valve H.
- Close low-side control valve L
- The bypass control valve remains closed.

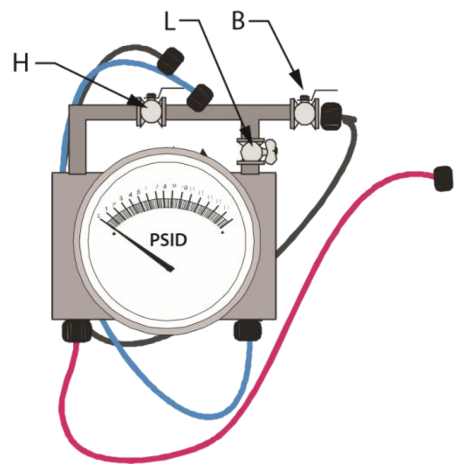


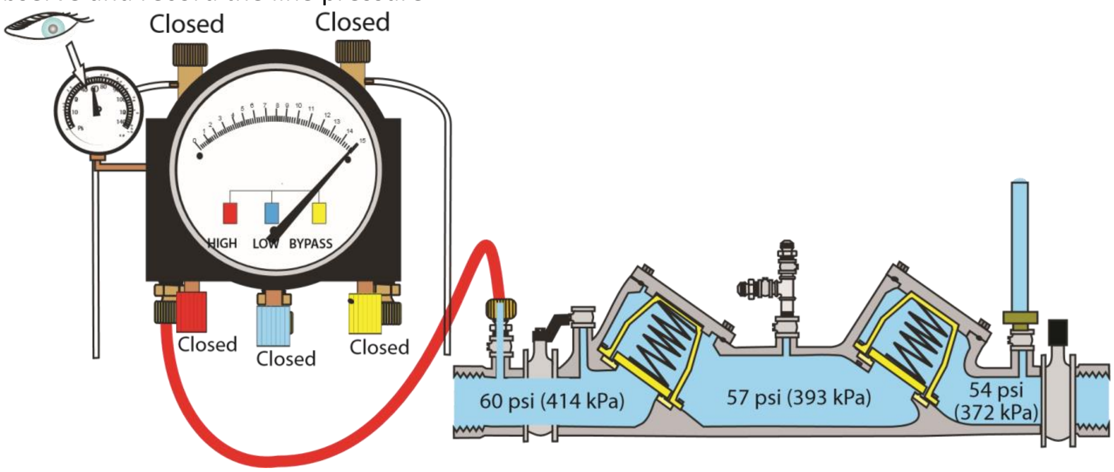
Figure 8-28- Bleed gauge using 3 valve gauge

Content

DCVA requirement static line pressure

The next requirement of the DCVA is to observe and record the line pressure.

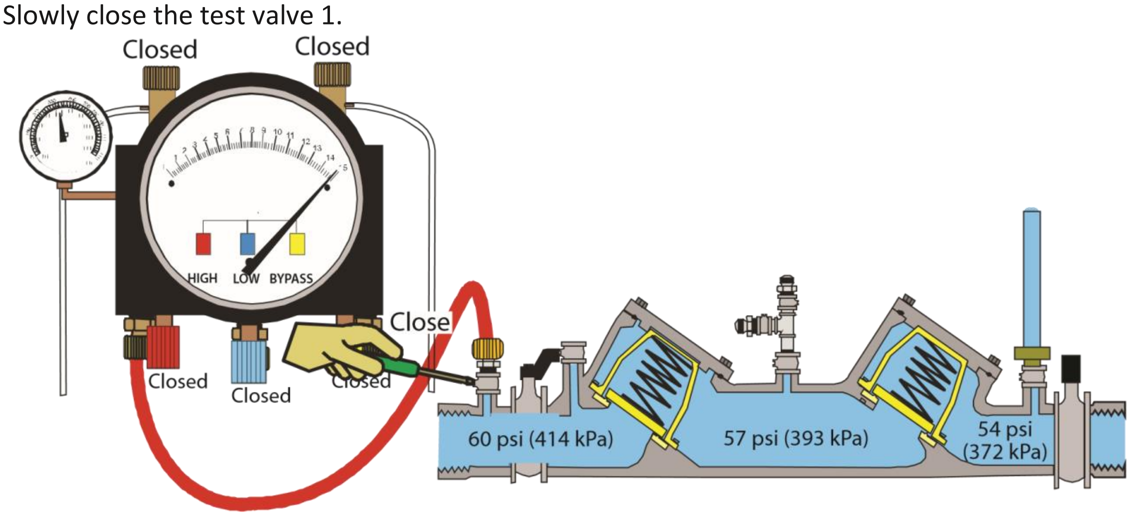
1. Observe and record the line pressure



Note: When the line pressure is recorded on the test form it shall be recorded as passed; if the pressure is not recorded the test shall be recorded as failed. Once the pressure is recorded the final requirement for the test has been completed.

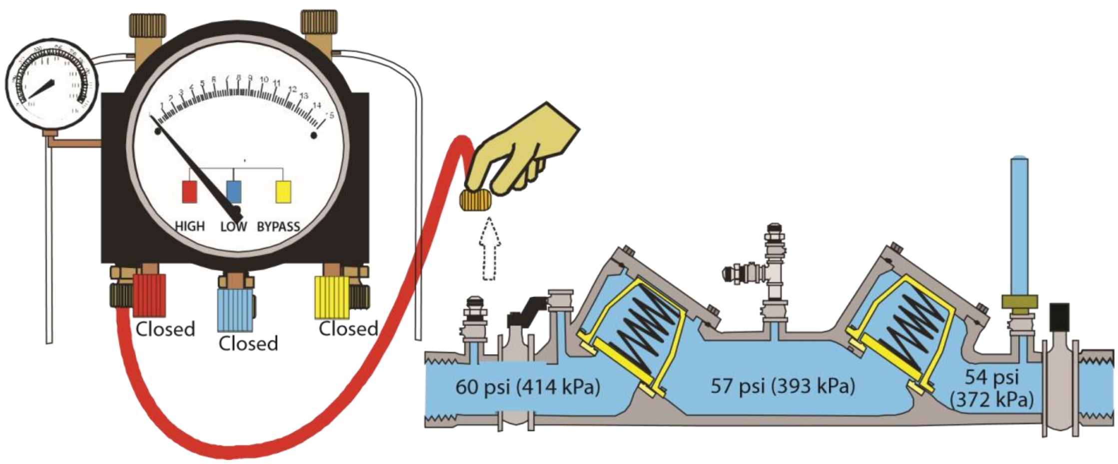
DCVA final cleanup:

1. Slowly close the test valve 1.



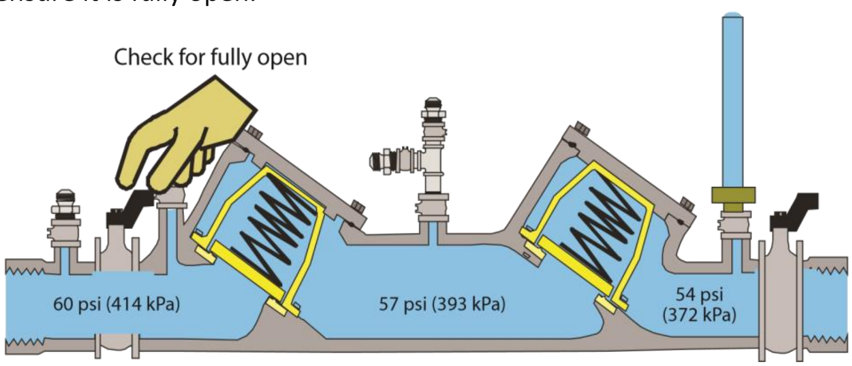
Content

2. Remove the gauge from test valve 1

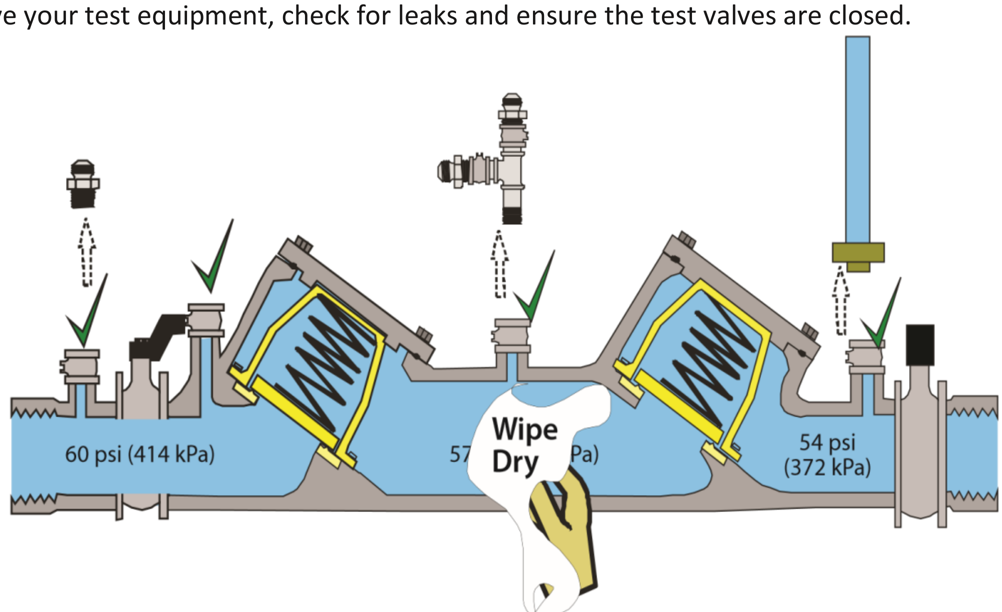


Returning the DCVA to service

3. Check shut-off 1 to ensure it is fully open.

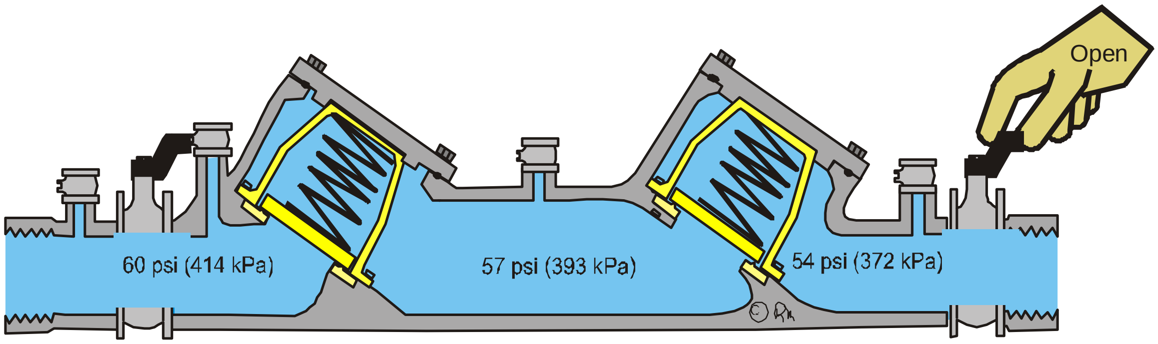


4. Remove your test equipment, check for leaks and ensure the test valves are closed.



Content

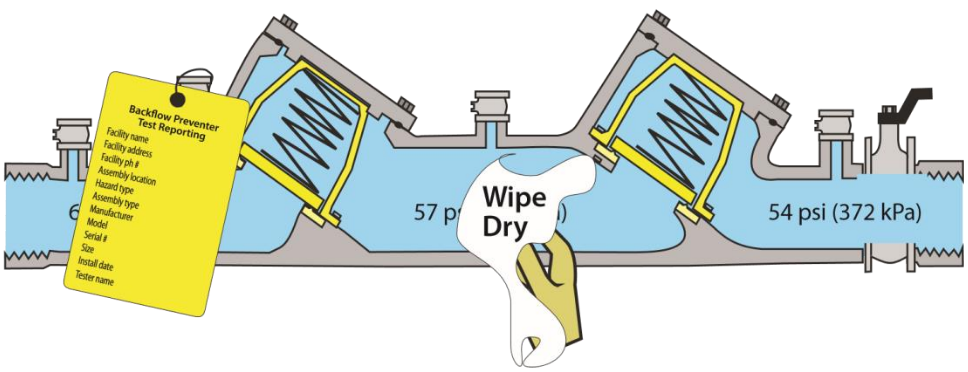
5. Request permission to turn the water back on. Turn on the water on by slowly opening shut-off 2 to avoid downstream damage.



Note: Since the water has been shut off for testing, the possibility of cross connection occurring in the system is increased. Notify/ request permission of the owner/representative and as soon as possible and then slowly turn the water on.

1. After the water is back on complete the following tasks:
2. Remove all test equipment.
3. Re-install caps when required.
4. Check for leaks.

5. Fill out and attach the test card



Complete test forms and have the owner/representative sign, and send copies one to each appropriate authority.

Note: Remember to remove your adapters, bleed-valve arrangement and vertical sight-tube. It could be embarrassing to have to come back later to retrieve items you have left behind.

Content

Remember to drain your gauge (see Figure 8-29).

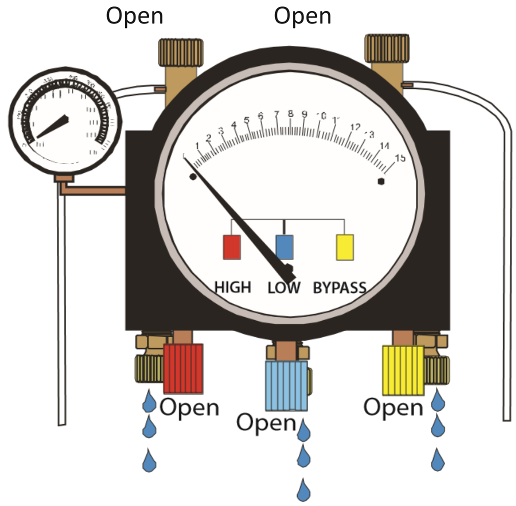


Figure 8-29—Remove hoses and drain gauge

Content

Test procedures for a DCDA using a Five-valve differential pressure gauge

DCDA preliminary steps and test requirements are the same as that required for a normal DCVA.

Existing DCDA requirements:

- The mainline check valves and the bypass check valves shall hold a steady a psid of at or above 1 psid in the direction of flow for a minimum of two minutes.
- Record the line pressure at time of test. (typically at the mainline test valve 1 or 2)
- Additional requirements and or duties other than the actual backflow assembly test procedures:
- These additional requirements shown below may or may not be required by the AHJ in your location. Consult the local AHJ to confirm these additional requirements.
- Verify that the bypass meter will record low flows; for example, under 2 GPM (26.4l/sec.)
- Record the meter reading before starting the test and after completing the test.
- Remember when dealing with fire sprinkler systems the appropriate fire authority including insurance issues that may need to be resolved before shutting the water off. You should be prepared provide at least the reason and the duration of the shutdown.

Note: These following test procedures do not include troubleshooting procedures. (Refer to Chapter 9 troubleshooting.)

Content

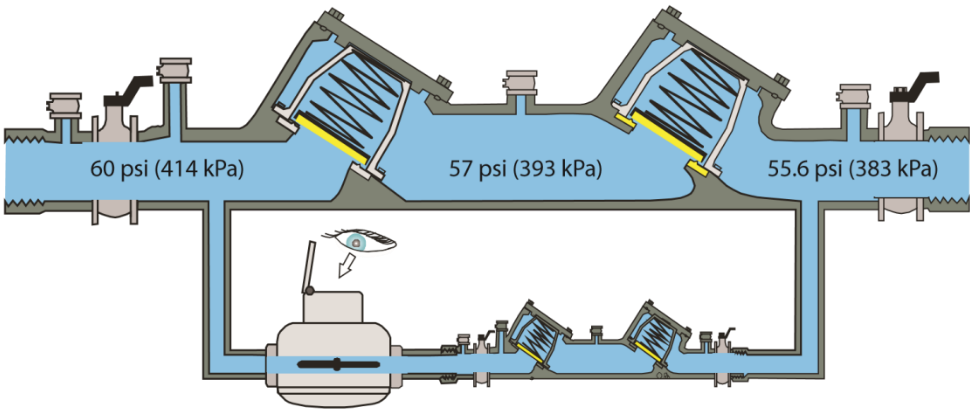
DCDA test procedures

(Reference USC foundation for Cross Connection Control and Hydraulic Research test procedures. Check with appropriate AHJ)

These test procedures are included in the manual as **information only** currently these procedures have not been recognized; therefore, would need to be adopted by the regulatory authority and then with permission from USC.

These test procedure illustrations only show the additional steps used when testing a DCVA. The majority of the test procedures are identical to the normal DCVA.

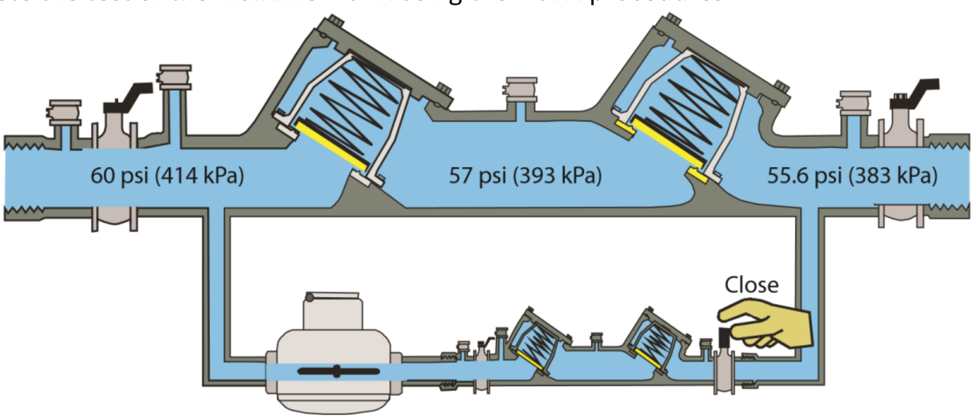
1. The first step is to complete all preliminary procedures the same as when testing a DCVA backflow assembly. (Notify, identify, inspect and observe)
2. Observe and record the meter reading



Note: some published test procedures of the DCDA start by testing the bypass DCVA first. Apollo valves DCVA and DCDA series 4S and 4SG models List the mainline first, followed by the bypass. USCFCCCHR, list the bypass test procedures first then the mainline assembly.

For the purpose of this manual, keep consistent with the RPDA test order by testing the mainline first. After observing and recording the meter reading you can complete the test of the mainline DCVA following the same procedures of a DCVA.

3. Close the bypass shut-off 2.
4. Complete the test of the mainline DCVA using the DCVA procedures

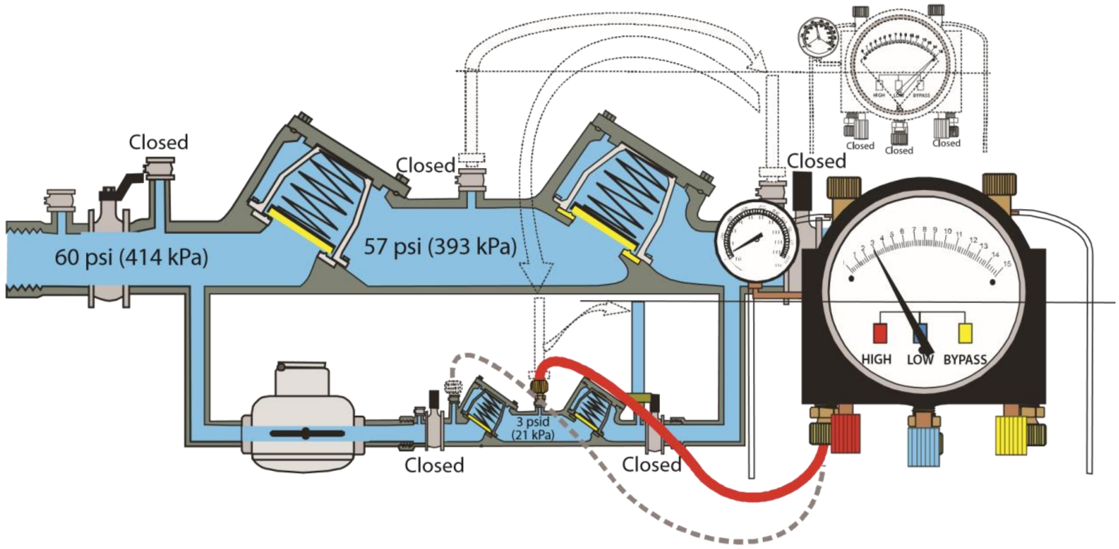


Content

Testing the bypass DCVA

Once you have completed the mainline test procedure and have just complete the test procedure for the bypass DCVA. The broken lines show the sequence of positions of the procedure steps leading up to the completion of the bypass DCVA test procedure. You need to remove your equipment and then confirm that the bypass meter is working. You have closed the mainline shutoff 1 to test the mainline DCVA and re-opened it to complete the test of the bypass DCVA.

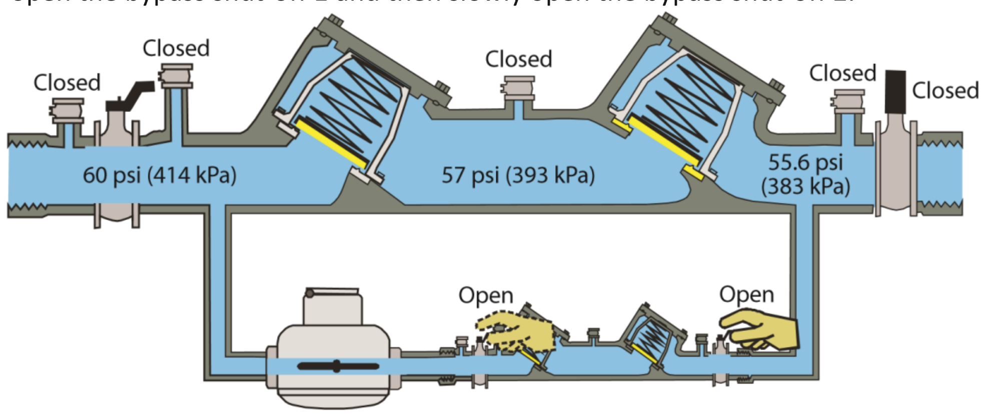
Complete the procedure for the bypass check valve 2. Record the bypass check valve 2 results, passed if the bypass check valve 2 held at or above 1psid and has held steady for 2 minutes.



The broken line shows where the equipment has been removed from previous steps

The ghost gauge position above the current gauge position indicates gauge position for mainline test.

1. After removing the test equipment. Close all open test valves, and remove your test equipment. Slowly open the bypass shut-off 1 and then slowly open the bypass shut-off 2.

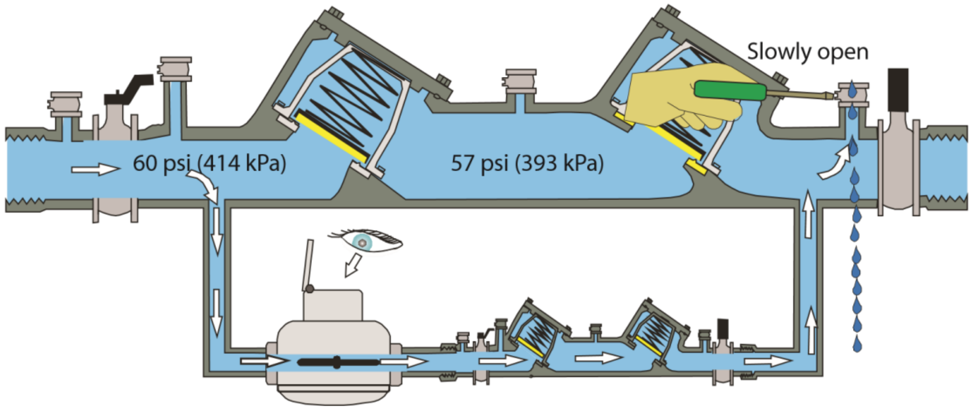


Note: you are now ready to confirm that the bypass meter is operating.

Content

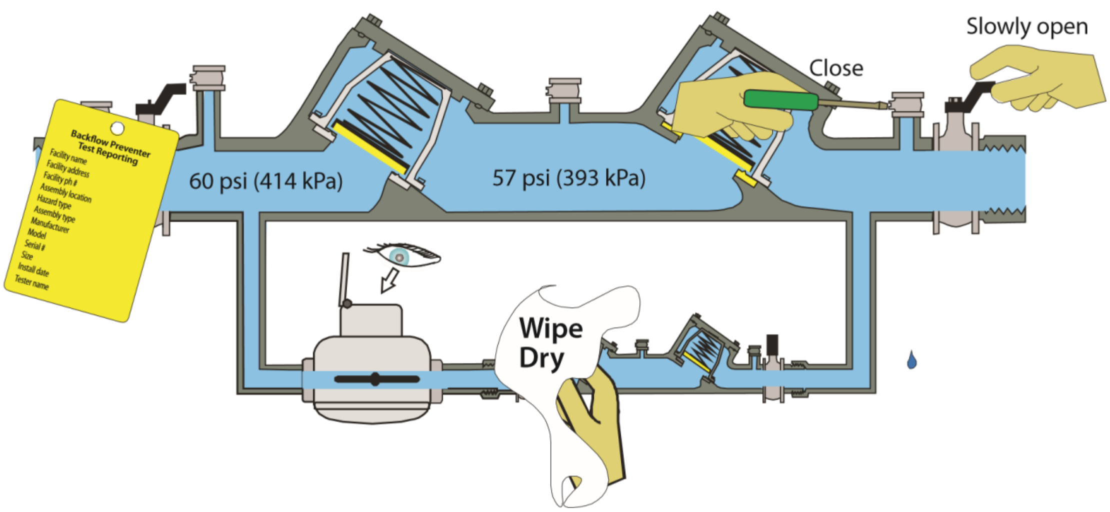
Requirement: Confirm the DCDA bypass meter operation

1. Slowly open the mainline test valve 4 and observe the meter triangle indicator at the same time. If the triangle meter is moving this indicates it is operating as designed record the meter as operating and then record the meter reading.



You have completed the test procedures of the DCDA. You need to get the water back on, check for leaks, and make sure all shut-off valves are fully open.

- Notify and seek permission turn the water on.
- Close test valve 4 and then slowly open the mainline shut-off.
- Observe and record this final meter reading.
- Re-install test valve caps when required.
- Check for leaks.
- Fill out and attach the test card.
- Complete final documentation and distribute as directed by the AHJ.



Content

Testing a pressure vacuum breaker assembly using a three or five-valve differential gauge (CSA)

These procedures must be practiced until you can demonstrate the test procedures correctly and in entirety.

PVB test requirements

You are completing this test procedure to check the PVB to determine if the following requirements are met:

- The air-inlet valve shall open when the pressure in the valve body is not less than 1 psid (6.9 kPa).
- The air-inlet valve shall be fully open when the valve body is completely drained. A fully open air-inlet valve will ensure full volume of air into the piping system breaking any possible negative pressure in the system.
- The check valve shall hold a static pressure drop tight not less than 1 psid in direction of flow.
- Record the line pressure at the time of test.
- This test procedure will be completed using a three-or five-valve differential pressure gauge.
- Do not flush the assembly prior to starting the test procedure.

Flushing the test valves, position of gauge:

During this test procedure you will be bleeding the test valves and positioning the pressure differential gauge at a correct height. Only the differential pressure gauge high-side hose will be connected to the PVB. The low-side hose and bypass hose are not used and must be coiled up at the level of the differential gauge. Alternatively, both these hoses can be removed from the gauge when approved by the AHJ. Note: A high-side hose looping down between the gauge and the PVB connection does not affect the reading.

A PVB is subject to spillage.

To avoid spillage and excessive water hammer when opening shut-off 1 make sure shut-off 2 is closed, then open shut-off 1 slowly at first and then when water appears at the air-inlet valve opening, open it quickly. This motion is intended to seat the air-inlet valve very quickly with the minimum of water hammer and water spillage. As a general rule, open or close any valves slowly, to prevent water hammer.

Recall the internal components of the valve and the sequence of operation of the PVB as you complete the test procedure.

Content

Figure 8-30 shows some equipment you will need:

- Drop cloth
- Adjustable wrench
- Blade screw driver
- Teflon tape
- Drying cloth
- Eye protection
- Screw driver
- Differential gauge

Vertical tube Bleed-valve Flare adapters ¼ inch Differential gauge

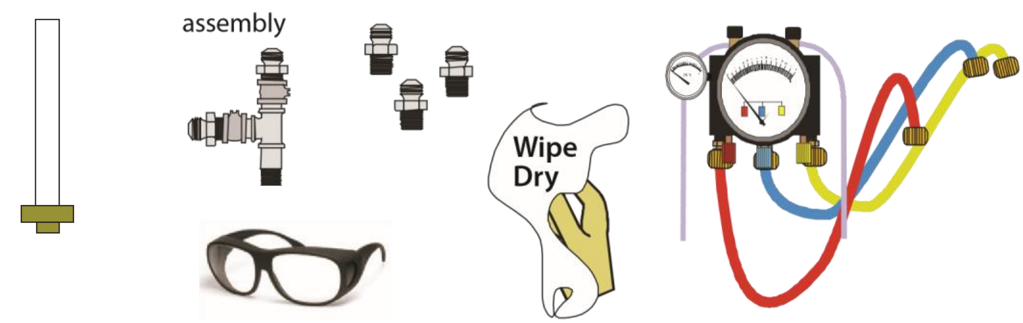


Figure 8-30—Required equipment for the PVB test procedure

Pressure gauge minimum size suitable to record maximum line pressures of the system.

The use of the bleed-valve assembly is recommended. You will save time if you run into a troubleshooting issue when testing.

PVB Pretest preparations steps

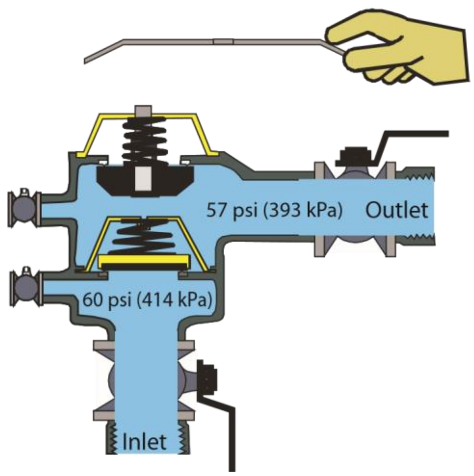
- Notify/request permission of the owner before the water will be shut-off.
- Identify the PVB, record make, model, serial number and size.
- Inspect and identify the PVB test valves and shut-off valves; for example, damaged or missing components.
- Observe for obvious leakage and any apparent cross connections in the surrounding piping; for example, bypass piping.

Content

Starting the test procedure

The gauge must be positioned at the elevation of the AVB for this test procedure

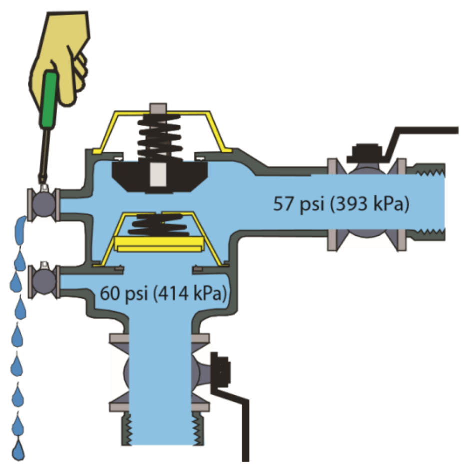
1. Remove the canopy. Examine the air inlet and remove any debris. Do not physically alter the air inlet or its components during the examination. Physically altering the valve, itself may affect true results of your test.



Before attaching the test gauge, the test valves must be flushed. For consistency, you will use the same procedures as we used for the RP, except you do not have to leave the test valves running. Start with test valve 2 first.

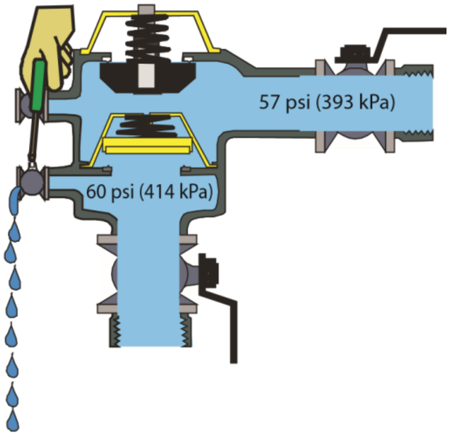
Flushing the test valves:

2. Slowly open the test valve 2 and then close it.



Content

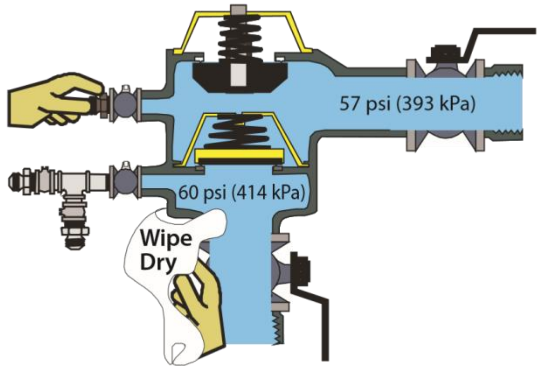
3. Slowly open the test valve 1 and then close it.



This completes flushing the test valves.

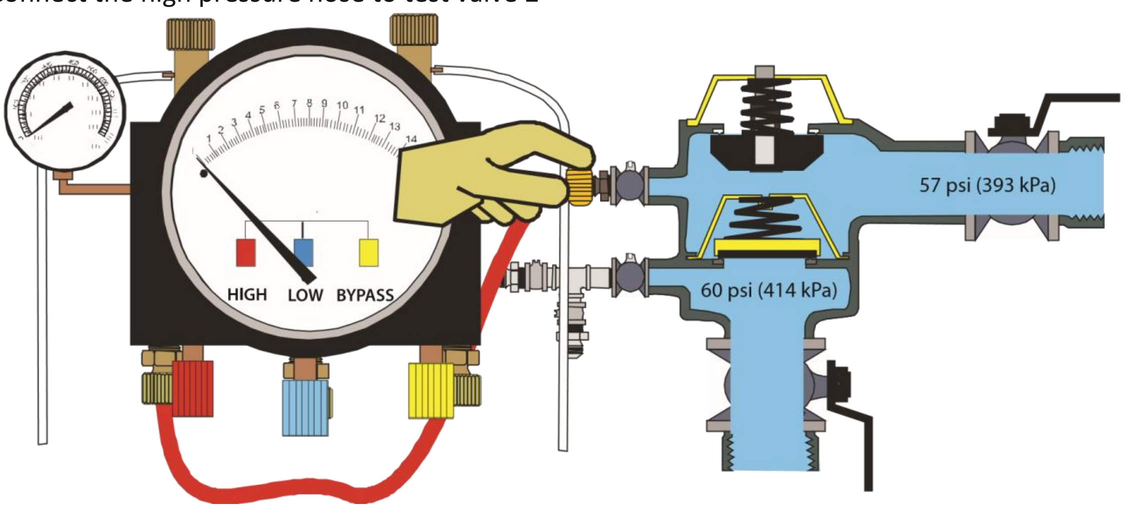
Test procedure shows the use of an optional bleed-valve assembly.

4. Install an adapter at test valve 2 and a bleed-valve assembly at test valve 1.



Install the gauge.

5. Connect the high pressure hose to test valve 2

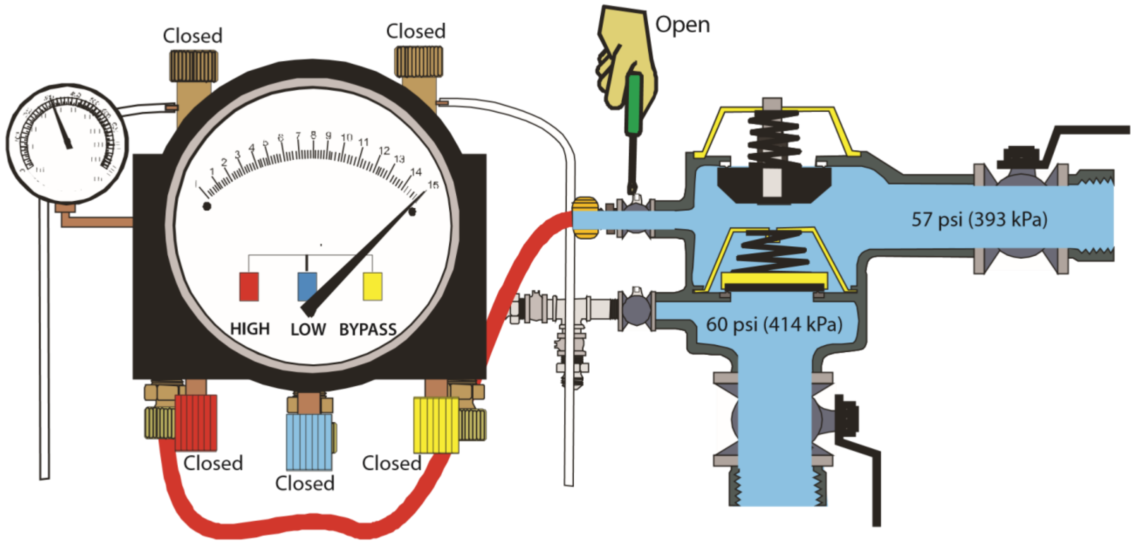


Note: The bleed-valve assembly is used when troubleshooting. A tester may use the bleed-valve assembly just in case a problem occurs.

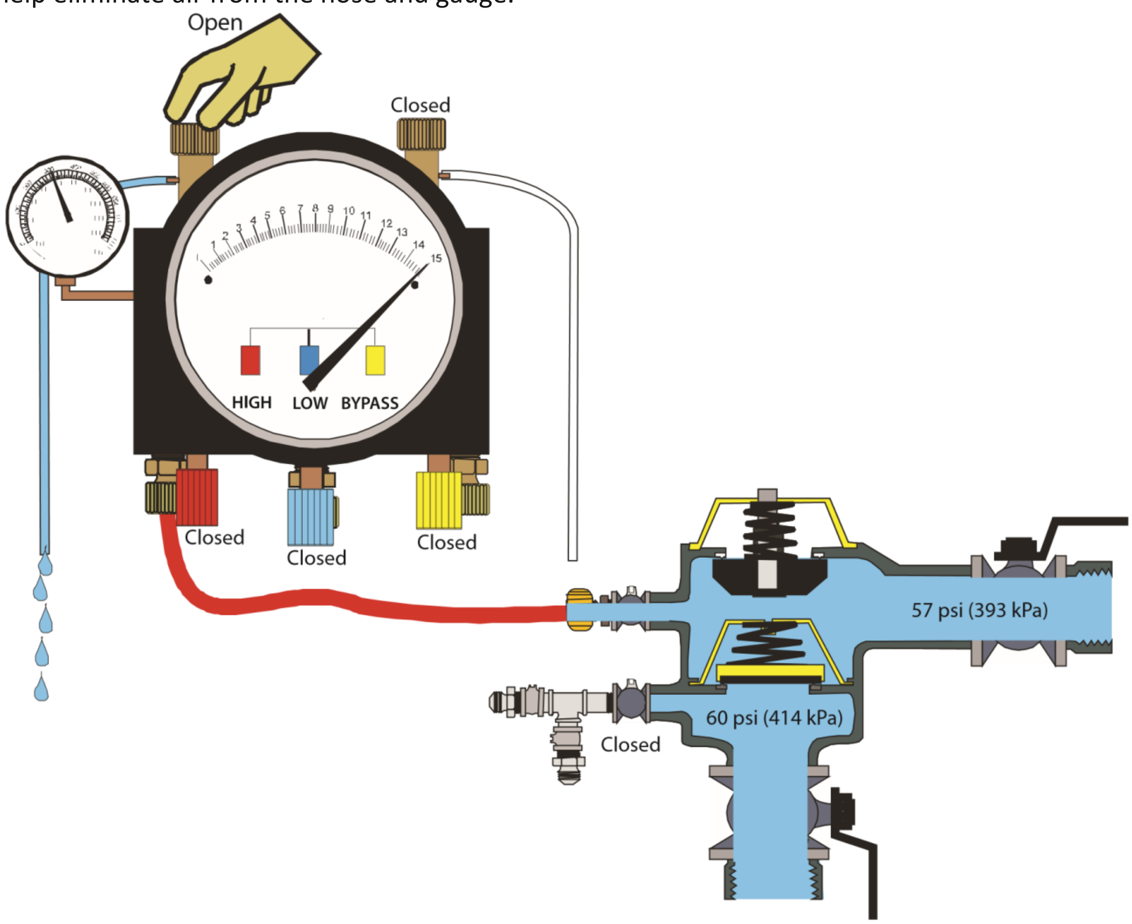
Content

Charging and bleeding air from the hose and the differential gauge.

1. Slowly open test valve 2.



2. Slowly open the high-side bleed needle valve to bleed air from the gauge. Hold the gauge elevated to help eliminate air from the hose and gauge.



Content

Note: When using a three valve gauge to bleed use the following steps (refer to Figure 8-31):

- Slowly open the high-side control valve H.
- Open the low-side control valve and bleed all air from the gauge L.
- Close the high-side control valve H.
- Close low-side control valve L • The bypass control valve remains closed.

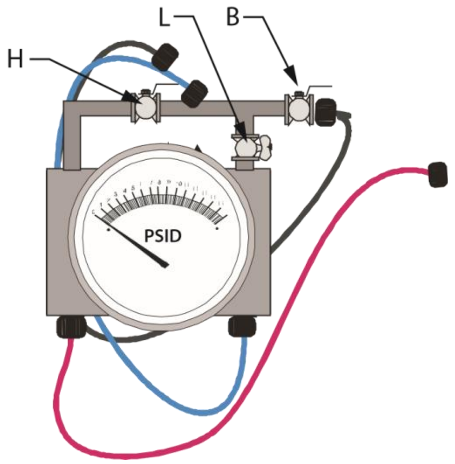
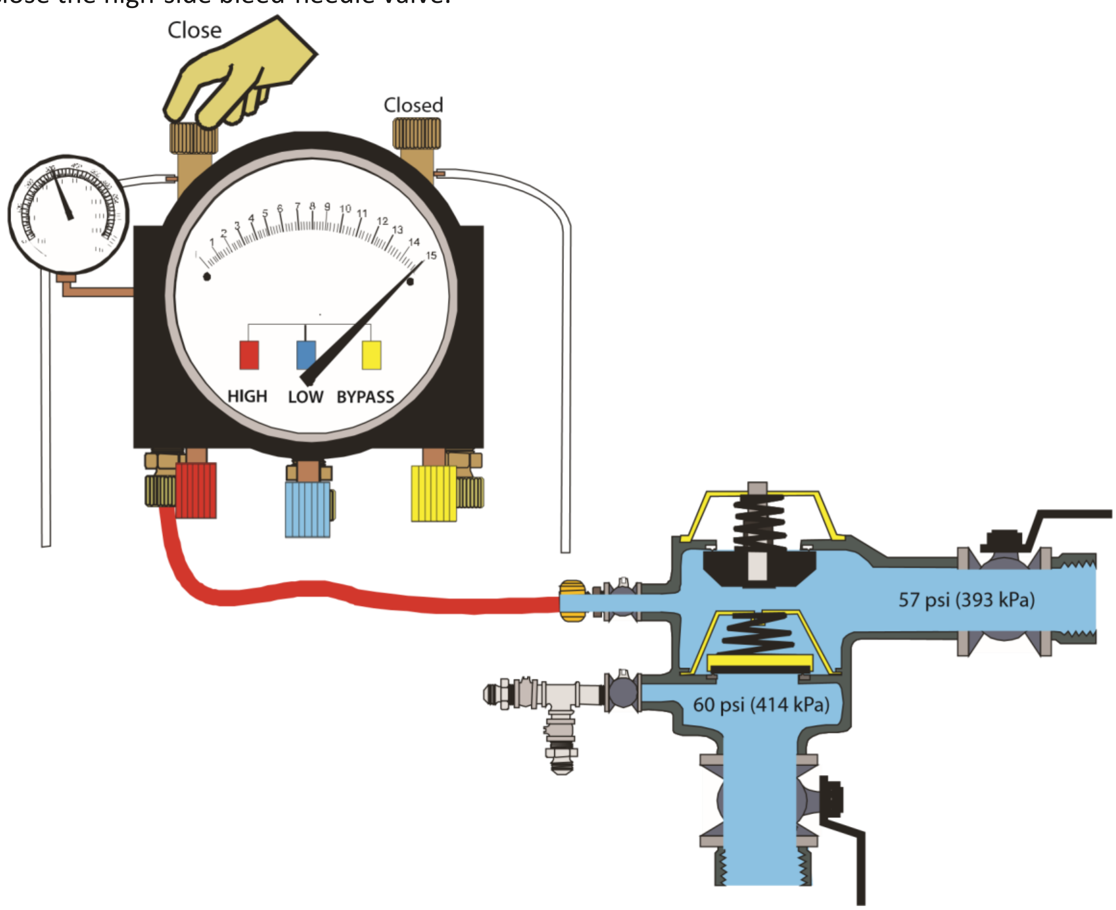


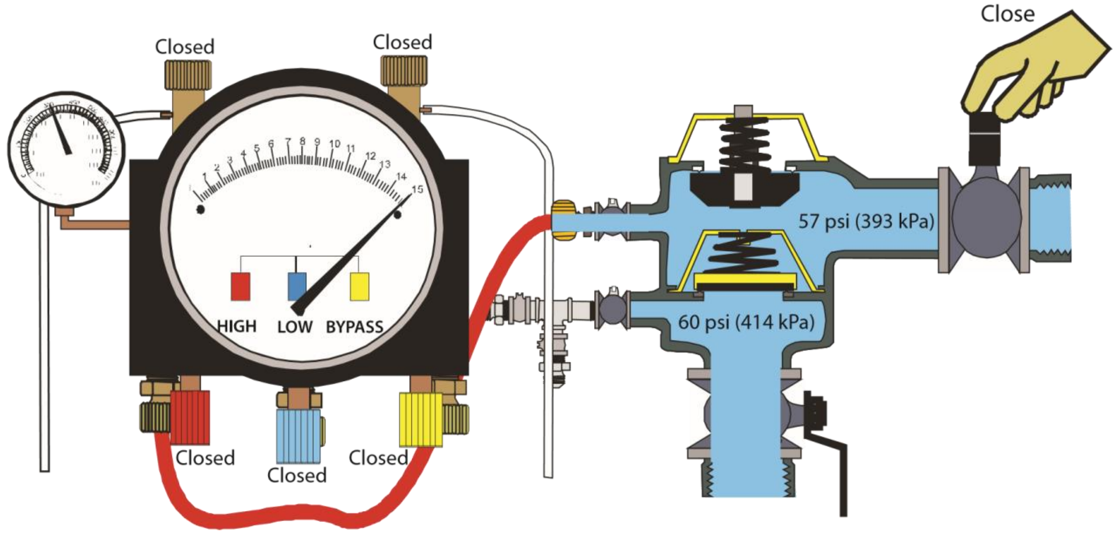
Figure 8-31—Bleeding the gauge with a 3 valve gauge

3. Close the high-side bleed-needle valve.



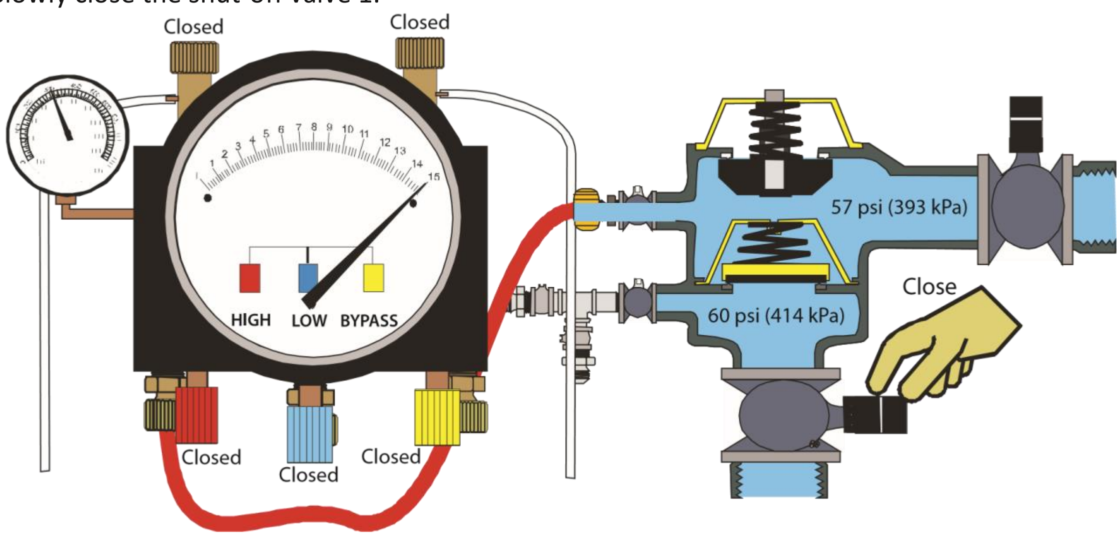
Content

4. Slowly close the shut-off 2.



TIP: before you close shut-off 1 consider watching the gauge to see if it starts to drop when shutoff 1 is closed, watch for the opening psid. If you note the opening psid now it will assist when troubleshooting a leaking shut-off 2, refer to trouble shooting chapter 9, PVB leaking shutoff 2.

5. Slowly close the shut-off valve 1.



Note: If other hoses are attached to your gauge, coil up the hoses so they are at the same level as the PVB. This will avoid incorrect readings caused by the pressure head in the unused hoses. (Removing unused is acceptable.)

The PVB is now ready to start the first requirement test procedure.

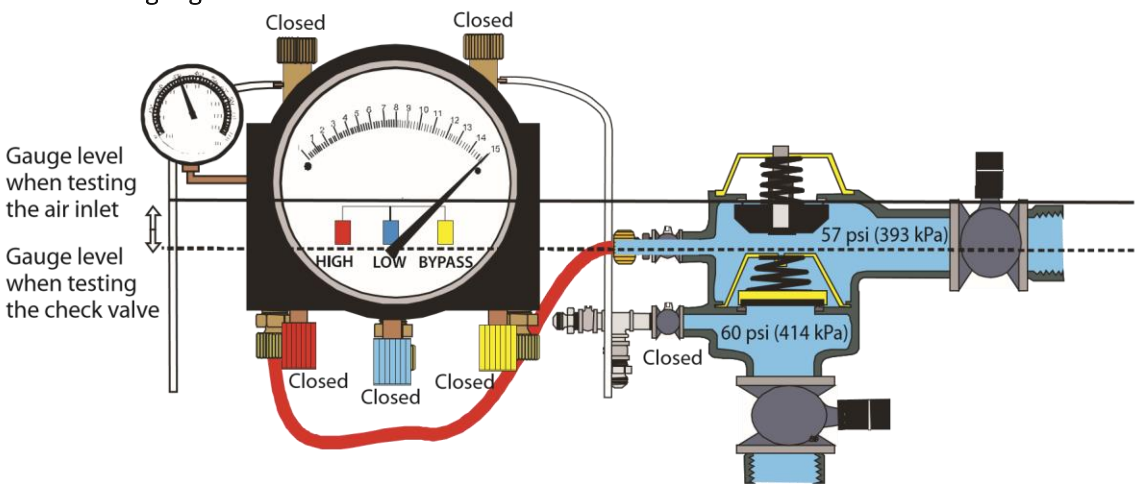
Content

PVB test one requirements

- The air-inlet valve shall open when the pressure in the valve body is not less than 1 psid (6.9 kPa).
- The air-inlet valve shall be fully open when the valve body is completely drained.

Begin the test for the air-inlet valve opening at or above 1 psid.

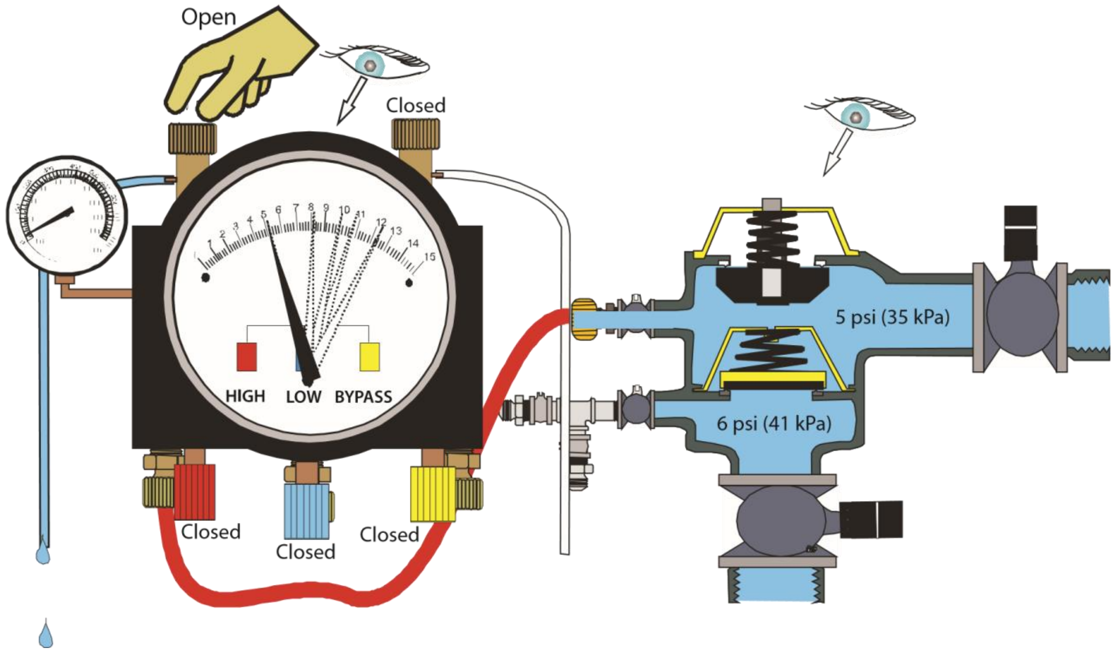
1. Position the gauge at the correct location



Note: You have to be aware of the gauge height in relationship to the level of the water above the component you are testing. In this example test valve 2 is below the air-inlet valve, you may want to adjust the gauge height to the water level at the air inlet. The slight move in this example above may seem redundant. On a small valve, height differences amount to less than the 0.2 psid (1.38 kPa) increments on the gauge dial face. On a large valve the differences in elevation would need to be around 5 inches (130 mm) to register clearly on the gauge. (Five inches is equal to about 1.8 psid (12.3 kPa). On the job it is not always easy to see the actual water level inside of a valve so a rule of thumb may be to keep you gauge height and water level within the diameter of the gauge face itself. Some published test procedures are very specific about gauge levels. Presently in Canada the gauge is to be held at the level of the assembly. For this manual you need to be more specific and stay within the gauge diameter.

Content

2. Slowly open the high-side bleed-needle valve, not more than ¼ turn. Observe the gauge and the air-inlet valve closely



Note: At first you will not see any movement in the differential gauge reading until the pressure in the valve drops below 15 psi. The highest reading on the differential gauge is 15 psid.

Note: Figure 8-32 shows when using a three valve gauge to test the PVB you will need to use the following steps.

- Open the high-side valve H.
- Open the low-side control valve L very slowly; so that it drops the psid very slowly.

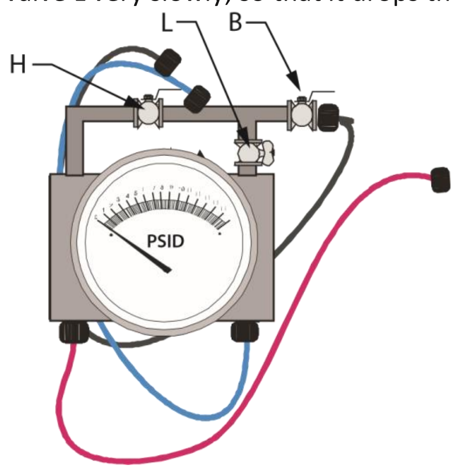
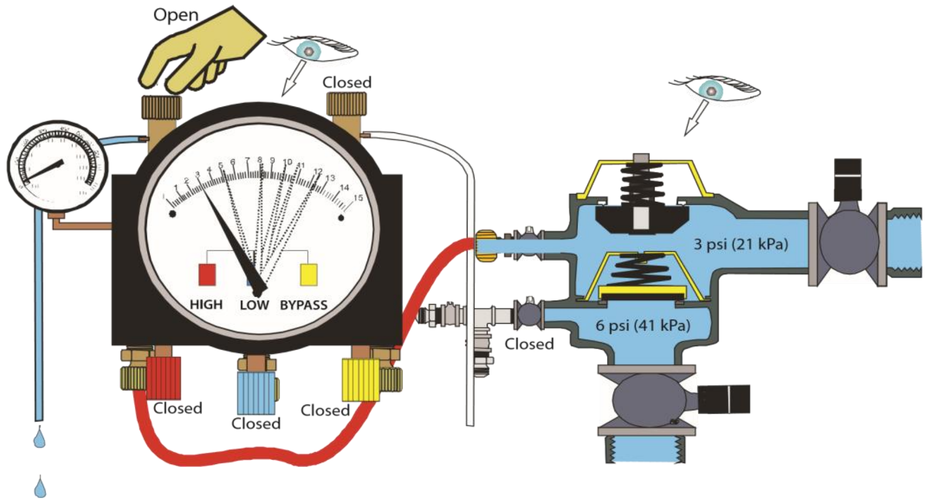


Figure 8-32—Using a three valve gauge to test the PVB

Content

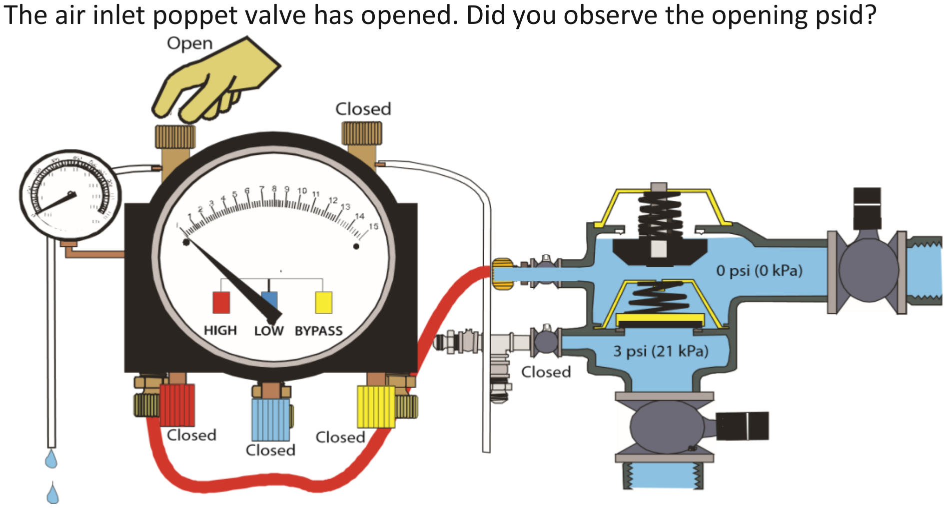
Watch carefully. The air-inlet valve must open at or above 1 psid.

3. Observe the gauge as the pressure continues to drop. Count down the readings.



Note: Do not allow it to drop too fast. You are watching the gauge and listening for the air-inlet valve to open. At that precise moment when the poppet opens, the gauge reading must be taken. Immediately the air-inlet valve pops open the gauge needle will drop to zero. If you miss the reading your test result is void. You will need to recharge the valve and start again. Needless to say, your next reading may not be as accurate as if you had done it correctly to start with.

4. The air inlet poppet valve has opened. Did you observe the opening psid?



Three psid was the opening point of the air-inlet valve. This is reading at or above the requirement of 1 psid.

Record the psid on the report at the correct location. This air-inlet valve has passed.

Note: Try counting down the gauge readings to yourself as the needle pressure drops. It will keep you focused and help you remember the reading. The speed of the drop picks up as you reach the opening psid. The spring is beginning to move the poppet to the open position. You must wait until the valve opens.

Content

Second requirement of the PVB:

Wait for the air-inlet valve to open fully.

1. Open up the high-side bleed-needle valve fully to help drain the valve quicker.

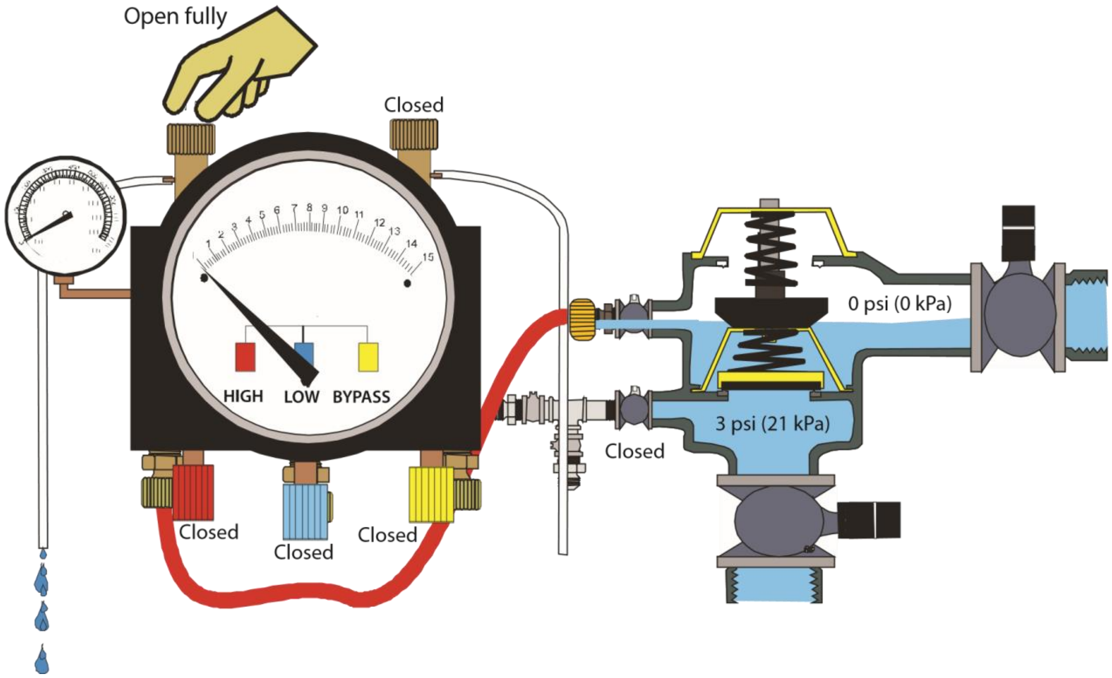


Figure 8-33 shows when using a three-valve gauge use the following steps:

- The high-side control valve is already open.
- Open the low-side control valve fully.
- Wait patiently for the valve body to drain.
- When the low pressure hose stops discharging this indicates that the valve body has drained completely.

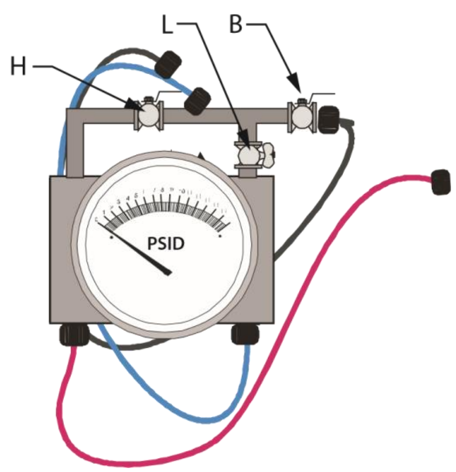
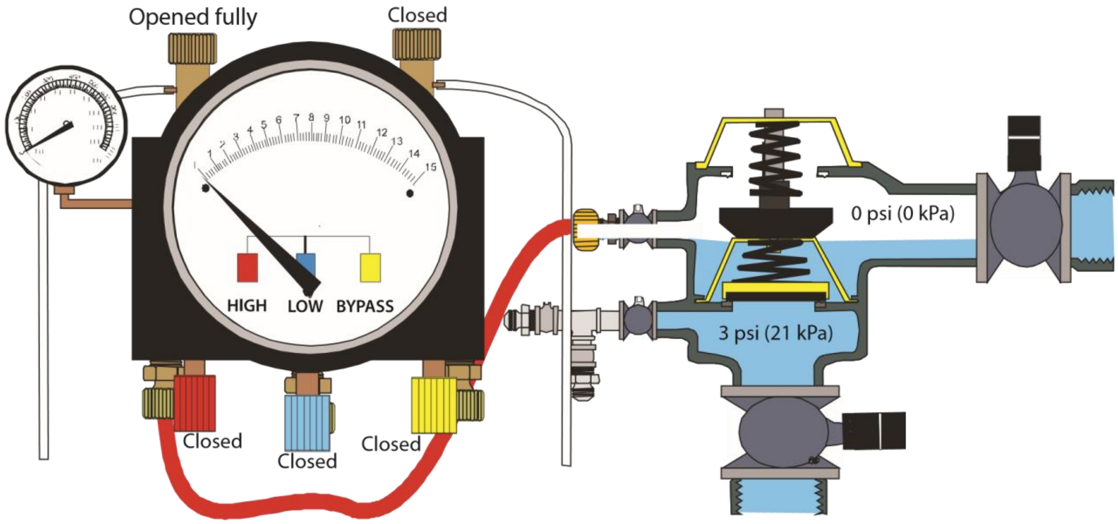


Figure 8-33—Bleeding the gauge with a 3 valve gauge

Content

2. Wait until the water has stopped draining from the valve body.



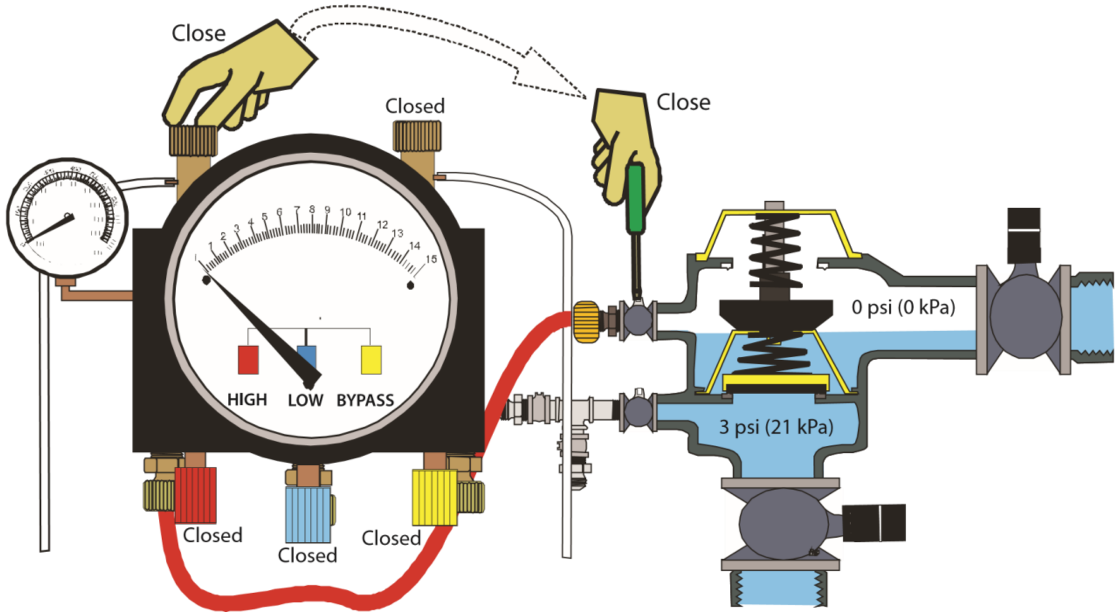
Record that the air-inlet valve is either fully opened and passed or failed if not fully open.

Note: When the body of the valve is completely drained you can now check the valve by looking down into the air-inlet valve opening to confirm the air-inlet valve is fully open. A flashlight may be helpful and you may touch the poppet to determine it is fully open.

There may be a concern about sticking something into the air-inlet valve that could be contaminating the public water supply. Certainly you need to confirm fully open, if the only way to do this is by inserting a clean utensil, this may be acceptable. A screwdriver that has been used for poking around in a drain pipe would not be clean.

Preparing the PVB for the next requirement, the check valve:

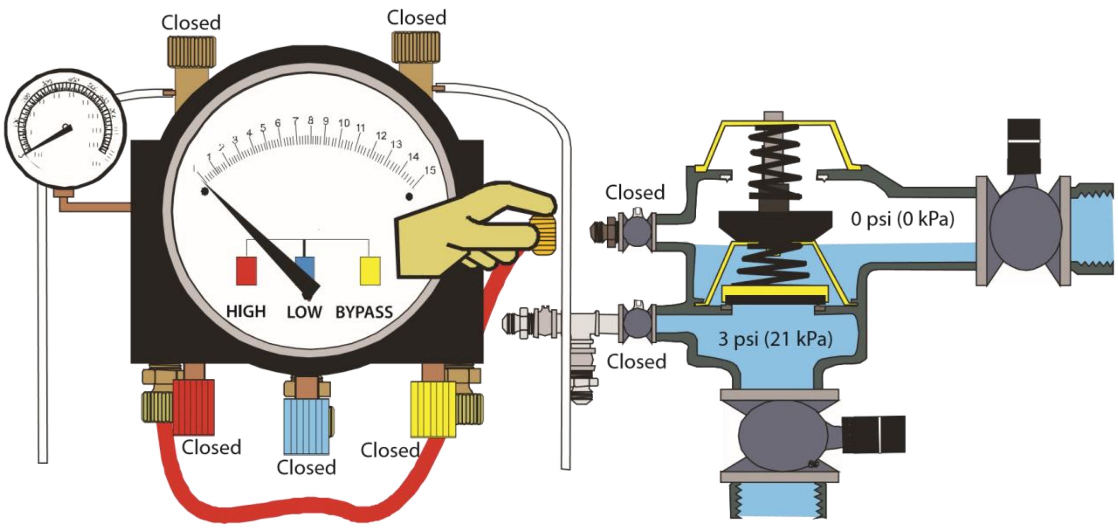
3. Close the high-side bleed-needle valve. Close test valve 2



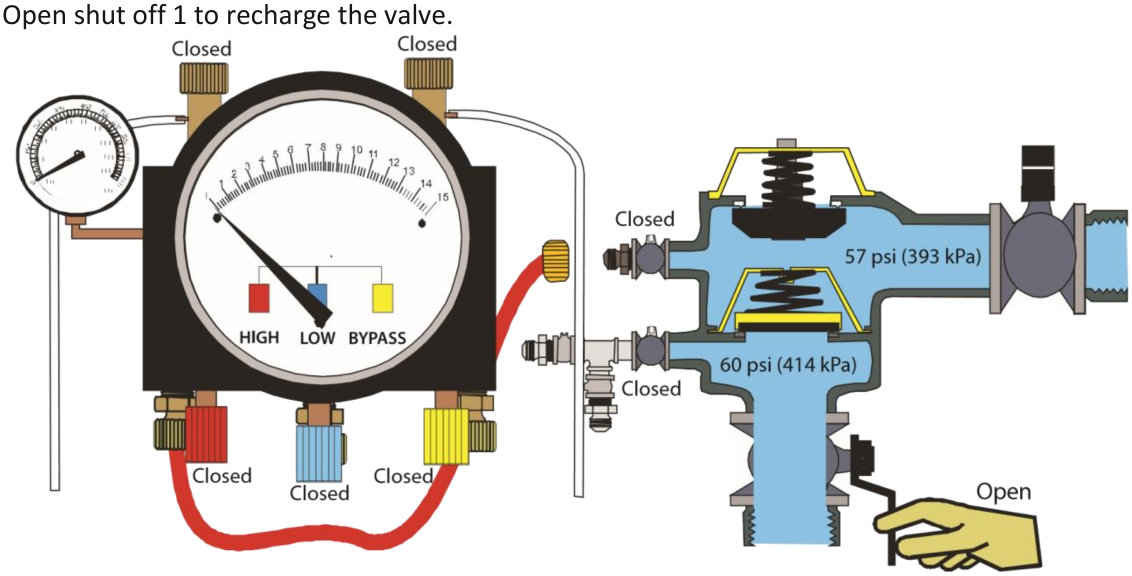
Content

4. Remove the differential pressure gauge from test valve 2.

Note: The first two requirements of the PVB are complete. Now you need to get ready for the next requirement.



5. Open shut off 1 to recharge the valve.



Note: When opening the shut-off 1, open the valve just enough until water just begins to appear at the air-inlet valve opening, at that moment, give the valve a quick turn to open it further and quickly seat the air-inlet valve. This will help limit water spillage and water hammer.

Ok, you are now ready to start requirement three of the PVB.

Content

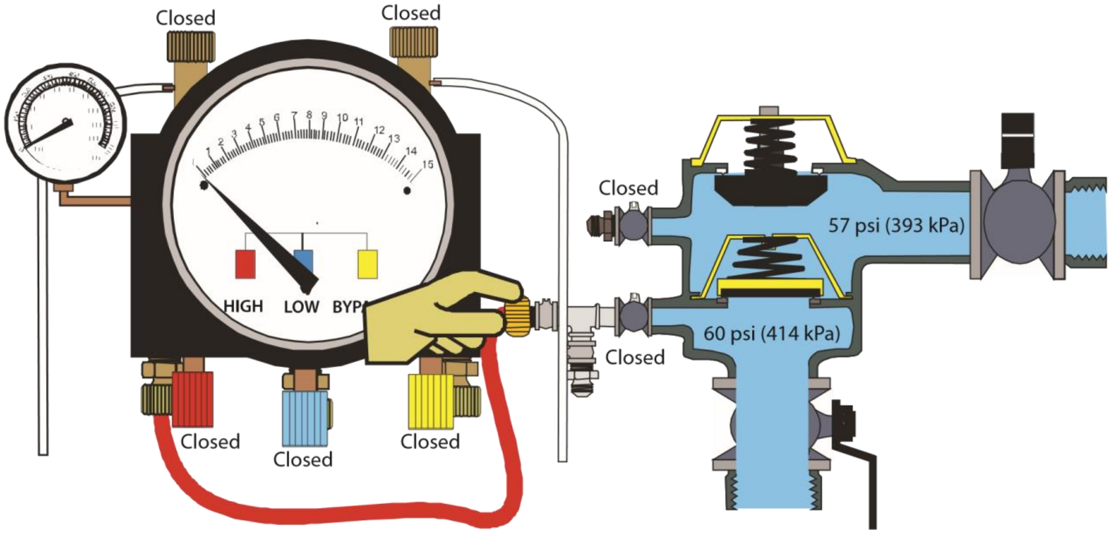
PVB set-up procedure for the check valve 1 test

Requirement:

The check-valve shall hold a steady static pressure drop of not less than 1 psid in direction of flow for a minimum of two minutes.

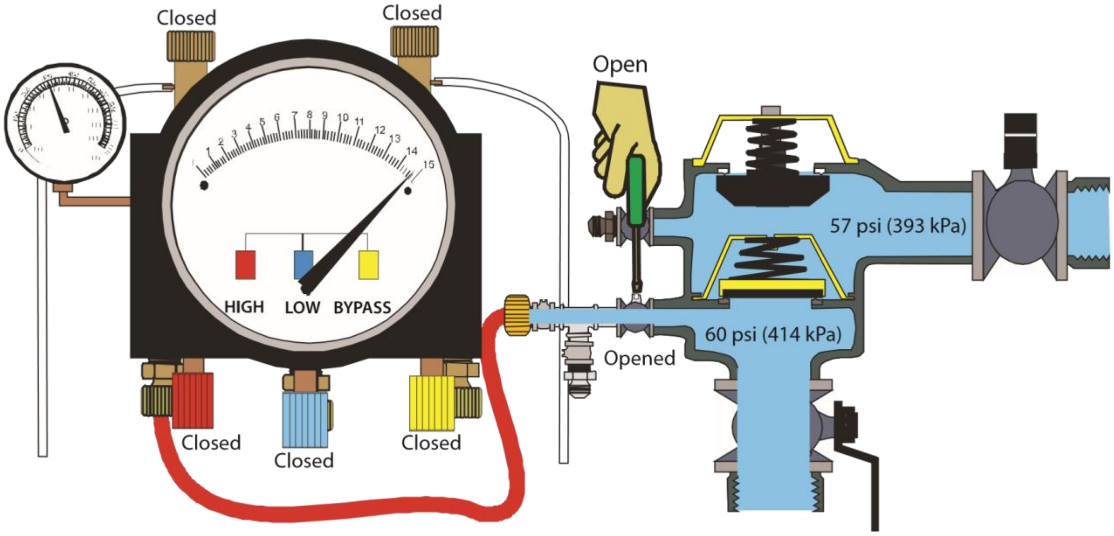
Reinstall the gauge:

1. Connect the high-side hose to the test valve 1 bleed-valve assembly



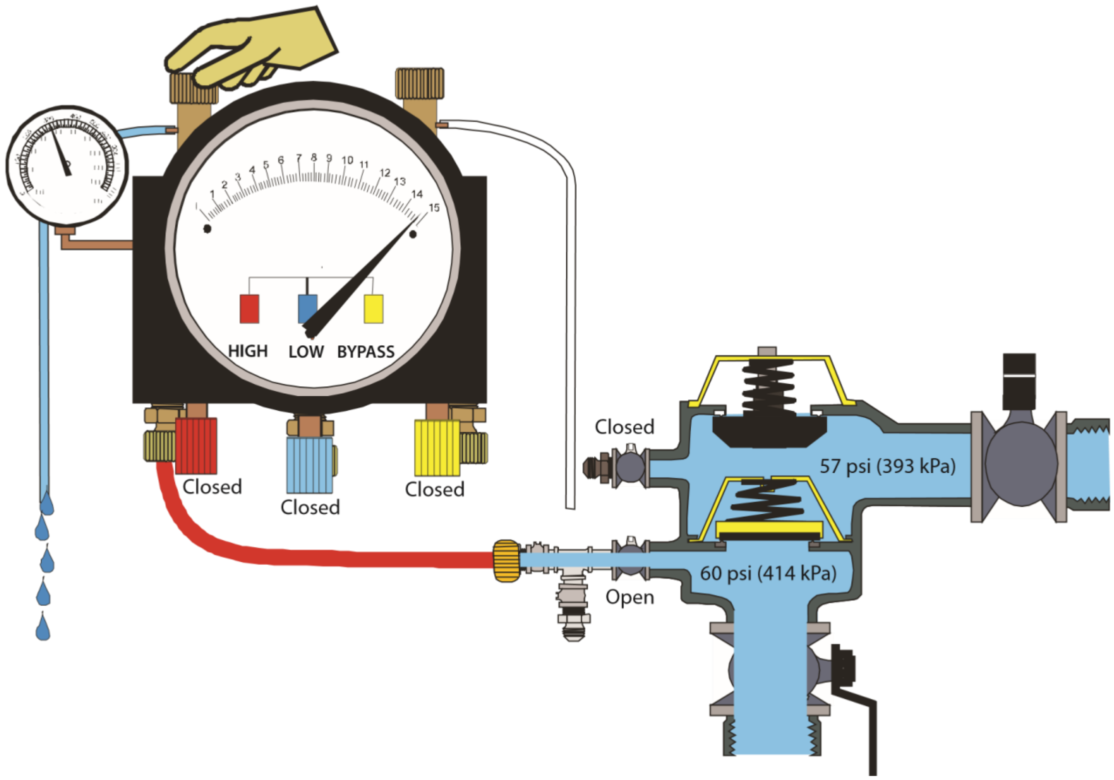
Recharge the gauge.

2. Slowly open test valve 1 to recharge the gauge.



Content

3. Slowly open the high-side bleed-needle valve to bleed air from the gauge.



Note: Raise the gauge up higher than the PVB when bleeding to help remove air from the hose.

Figure 8-34 shows when using a three valve gauge, bleed the air from the gauge by:

- Open the high-side control valve H.
- Open the low-side control valve L. (the Bypass control valve remains closed)
- Close the low-side control valve L.
- The high-side control valve is left open.

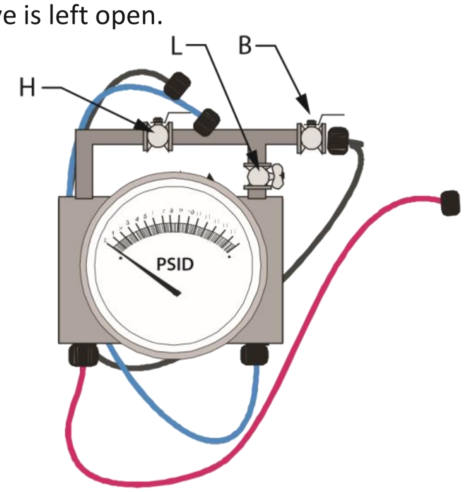
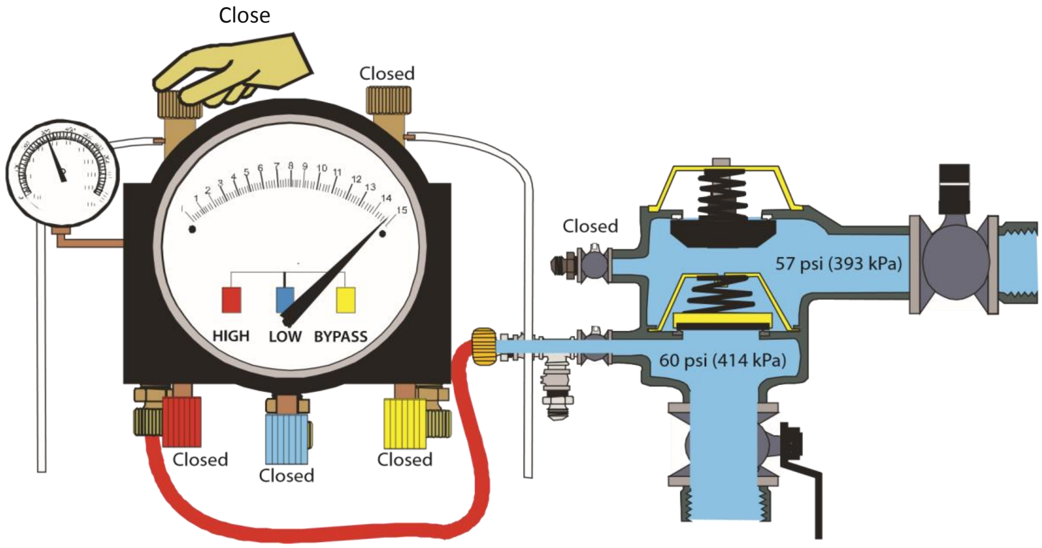


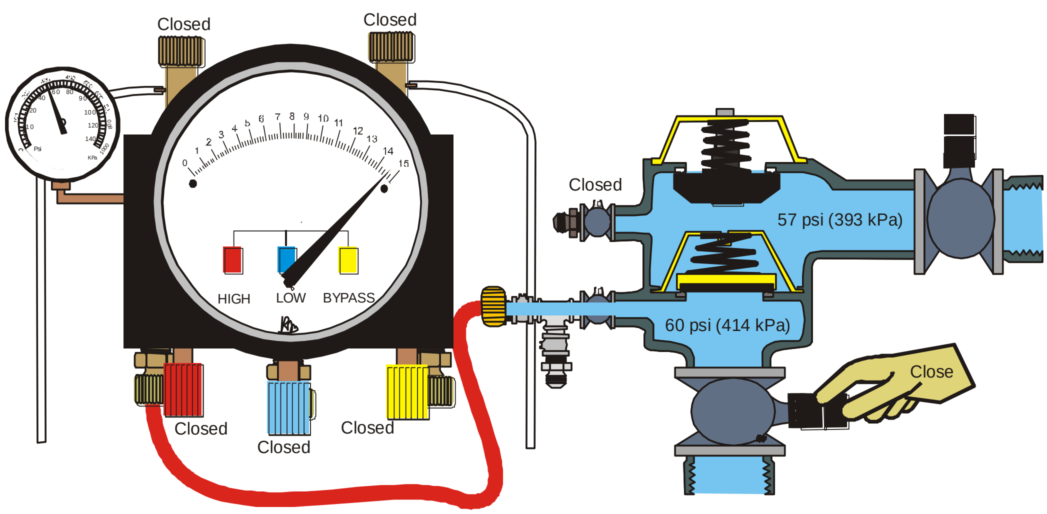
Figure 8-34—Bleeding the gauge using a 3 valve gauge

Content

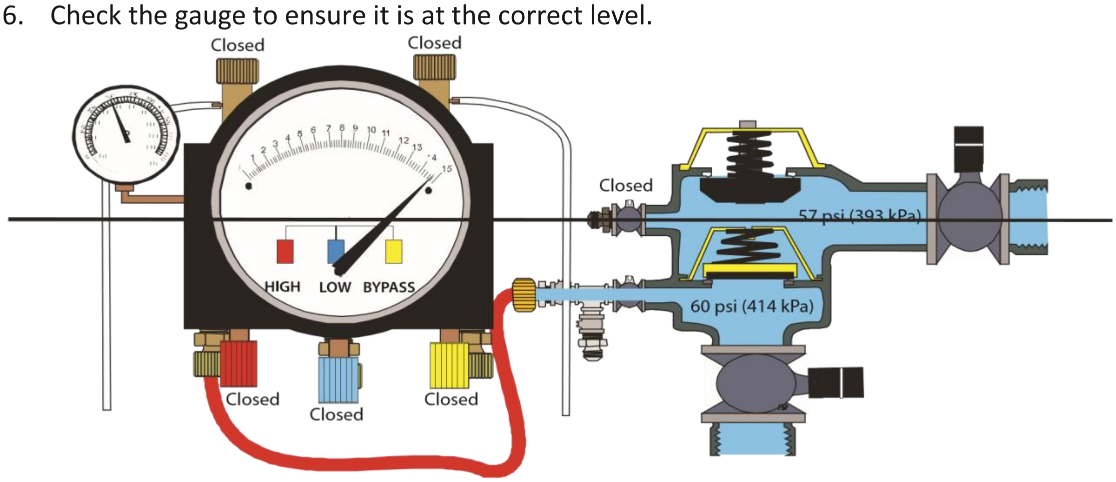
4. Close the high-side bleed-needle valve



5. Slowly close shut-off 1.



6. Check the gauge to ensure it is at the correct level.



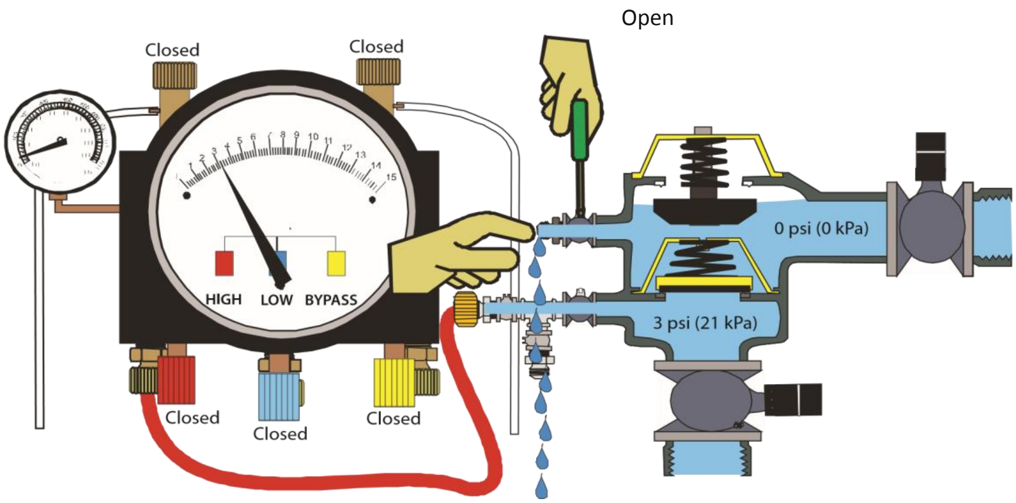
You are now ready to begin the test for the third requirement of the PVB.

Content

Begin the 3rd test requirement of the PVB

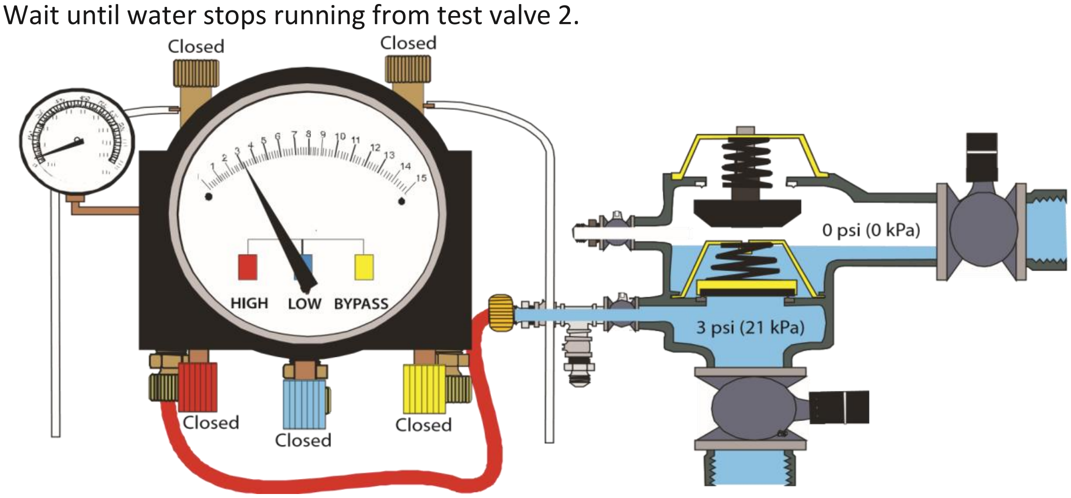
Requirement
The third requirement of the PVB is the check valve shall hold tight for a minimum of two minutes at or above 1 psid.

1. Slowly open the test valve 2



Note: You can promote capillary action by touching your finger to the test valve 2 outlet, this will help the valve body to drain quickly. If water continues to run from test valve 2. If water continues to run from test valve 2, refer to Troubleshooting PVB test procedures in Chapter 9.

2. Wait until water stops running from test valve 2.



- Observe the gauge and after the PVB has completely drained:
- Observe the gauge for minimum of two minutes at a steady state.
- The pressure must be at or above 1 psid for the check valve to pass this requirement.
- If not at or above 1 psid then record the check valve as failed as failed.
- Record the gauge pressure in the correct location on the report form; in this case, 3 psid.
- Allow the valve body to completely drain.

Note: Remember as you observe the gauge reading to make sure you check to confirm that you have the differential pressure gauge at the elevation of the assembly.

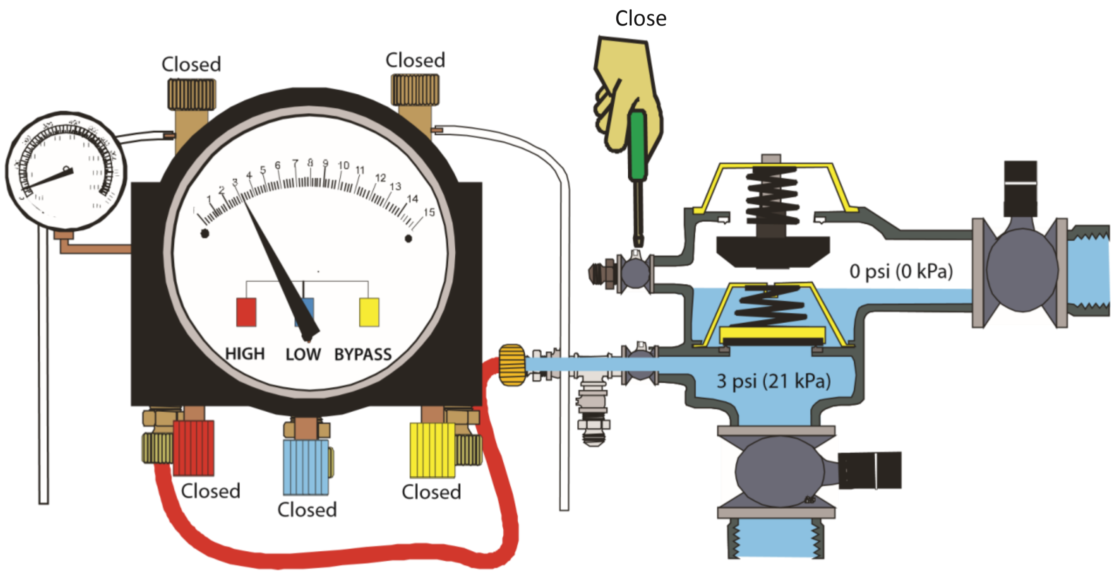
Content

Prepare for the final requirement of the PVB:

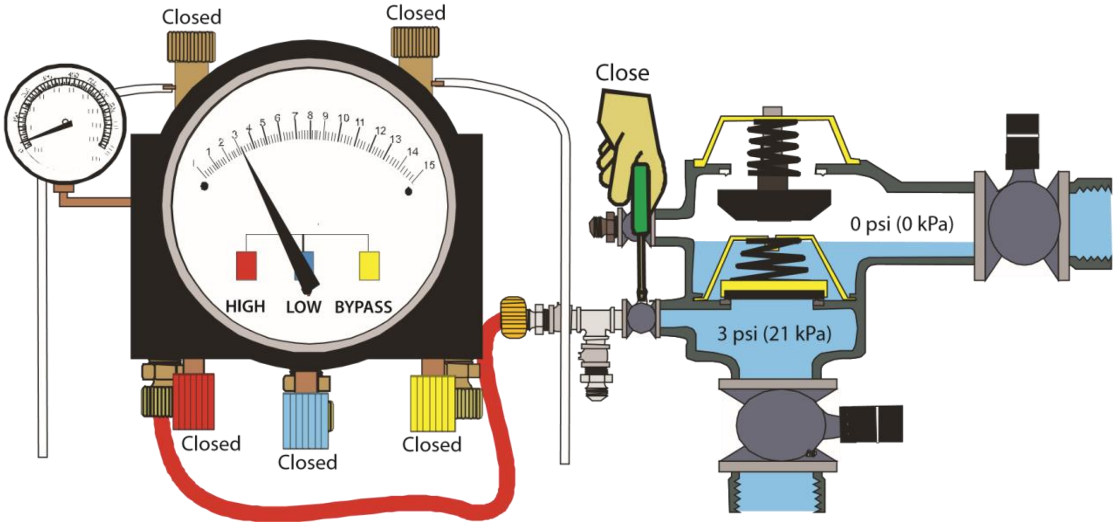
Requirement
Obtain the line pressure

Using a three or five-valve gauge with pressure gauge to obtain the line pressure.

1. Close test valve 2.



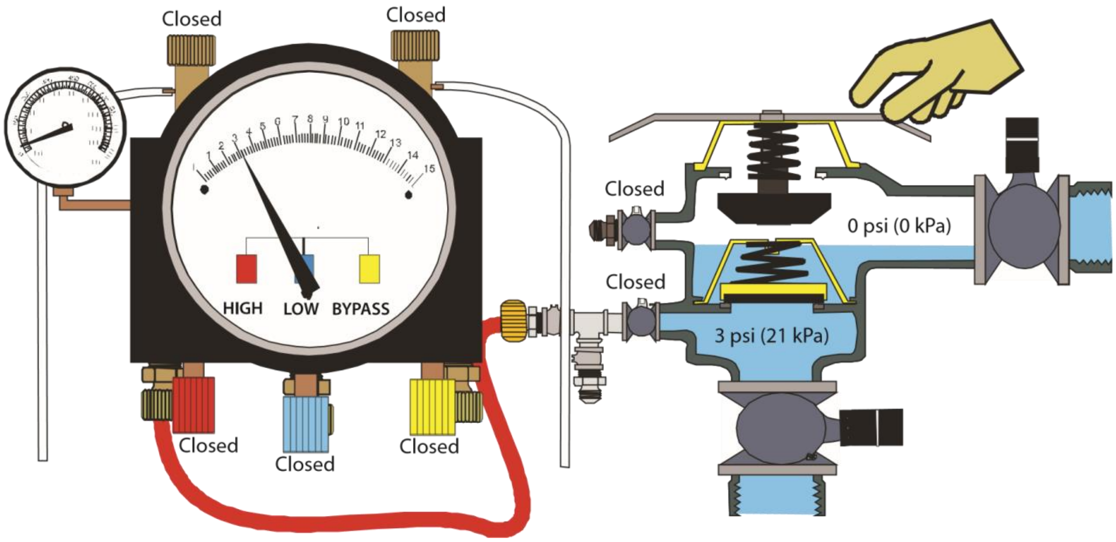
2. Close test valve 1 to reduce damage to your gauge prior to recharging the differential pressure gauge.



Note: If you are using a normal pressure gauge you will need to connect the gauge to test valve 1. You will need to bleed air from the gauge by opening and closing a bleed-valve on the gauge assembly. Then you can record the line pressure. Since you are using the differential gauge and the gauge has already been bled of air earlier in the test procedures, you will not have to re-bleed the gauge.

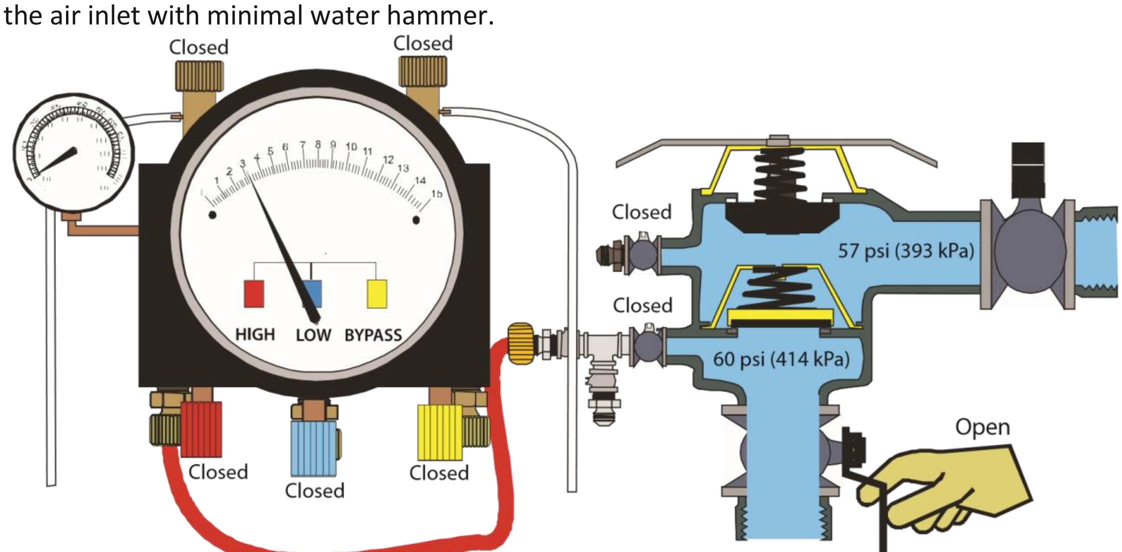
Content

3. Reinstall the canopy.



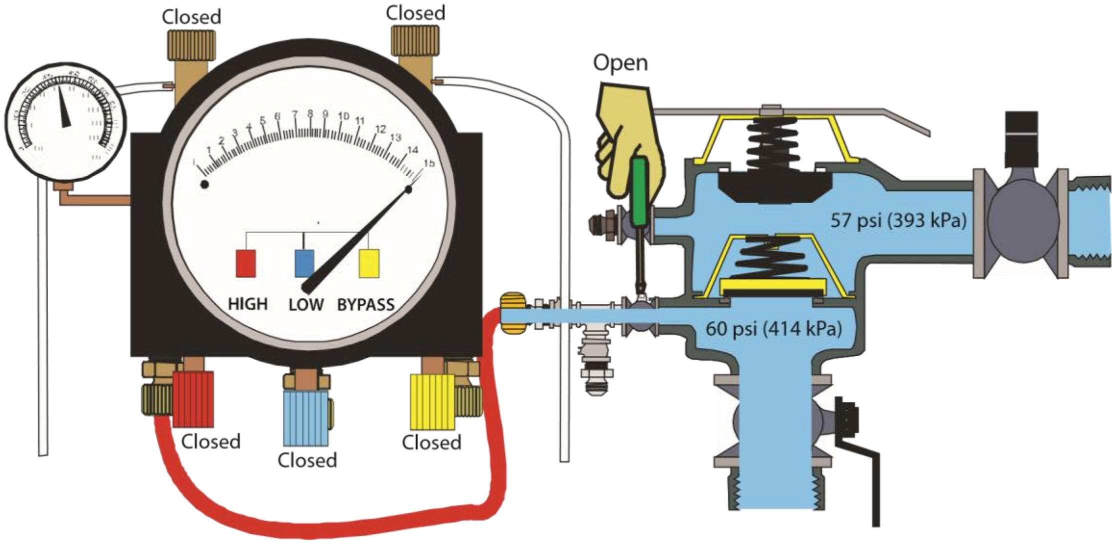
4. Recharge the PVB.

At first open shut-off 1 slowly, when water appears at the air inlet, sharply open the valve. This may help seat the air inlet with minimal water hammer.

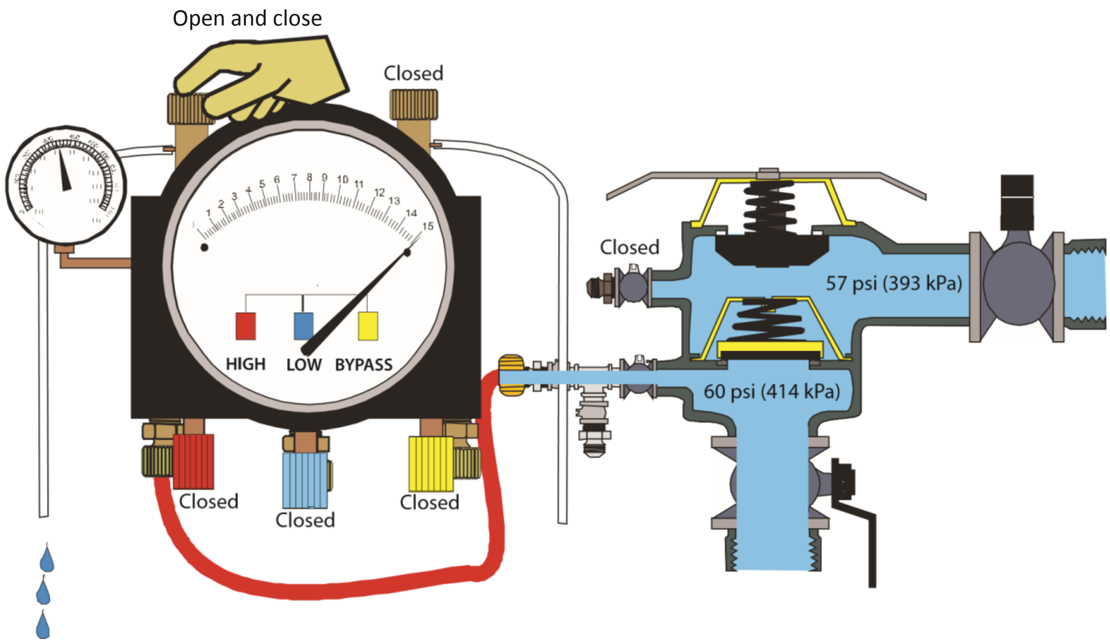


Content

5. Open test valve 1 to recharge the gauge



6. Since the gauge was not drained, you may not need to bleed the gauge, however, you may still wish to bleed the gauge by opening and closing the high-side bleed-needle valve.



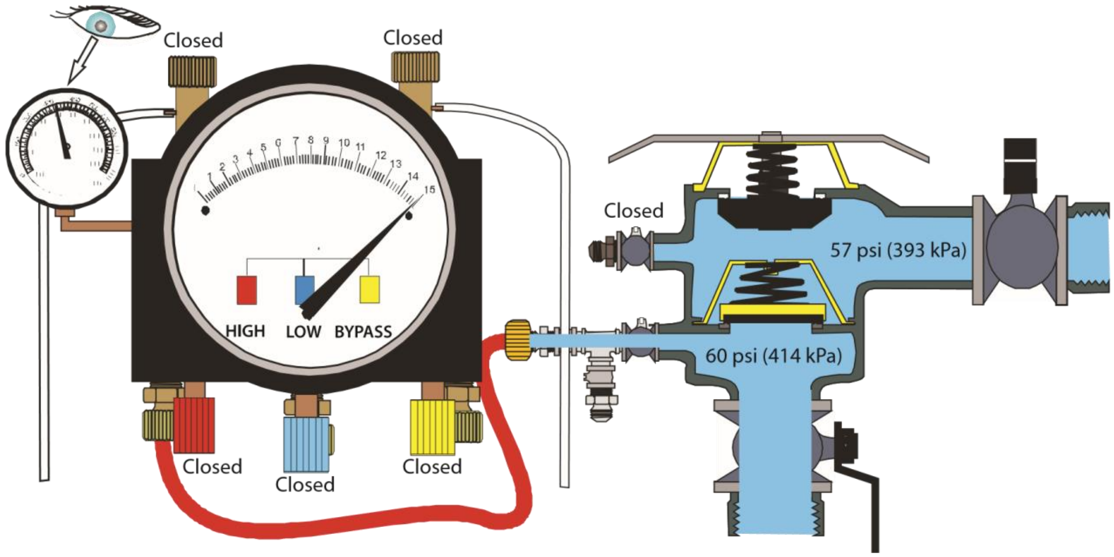
Note: If you are using a normal pressure gauge you will need to remove the differential pressure gauge and then connect the pressure gauge to test valve 1. You will need to bleed air from the gauge by opening and closing a bleed valve on the gauge assembly. Then you can record the line pressure. Since you are using the differential gauge and the gauge has already been bled of air earlier in the test procedures, you will not have to re-bleed the gauge.

Content

Begin the 4th requirement of the PVB

Requirement
Record the line pressure reading of the PVB.

1. Observe and record the line pressure at the correct location on the test report form.



If the pressure is recorded, then the test requirement is recorded as passed.

If the pressure is not recorded on the report form, the test requirement is recorded as failed.

In this case the line pressure is 60 psi (414 kPa)

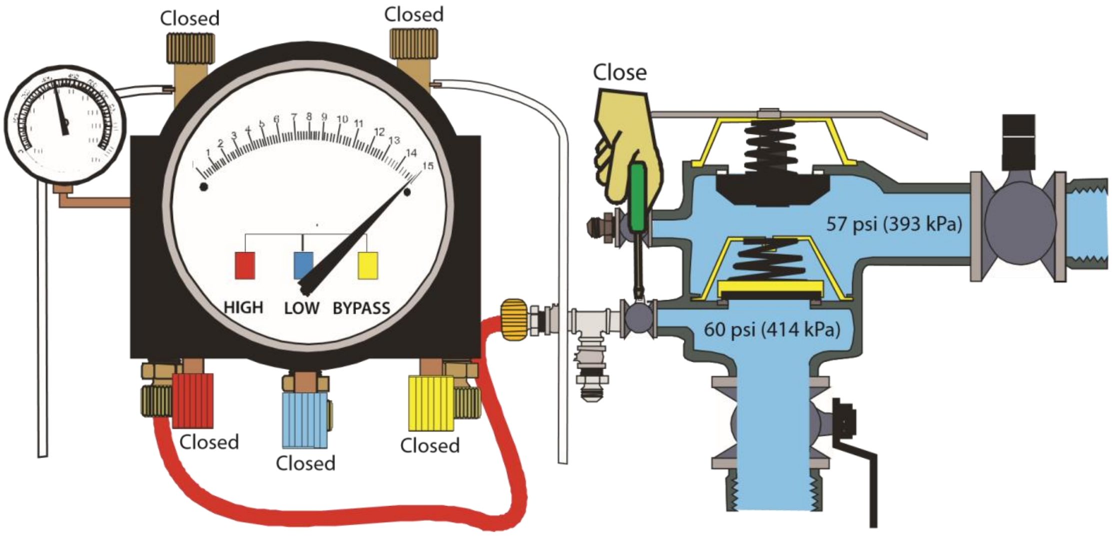
Note: All test requirements for this valve have now been recorded. You can now put the valve back in service by following the correct procedure as described on the next page.

Content

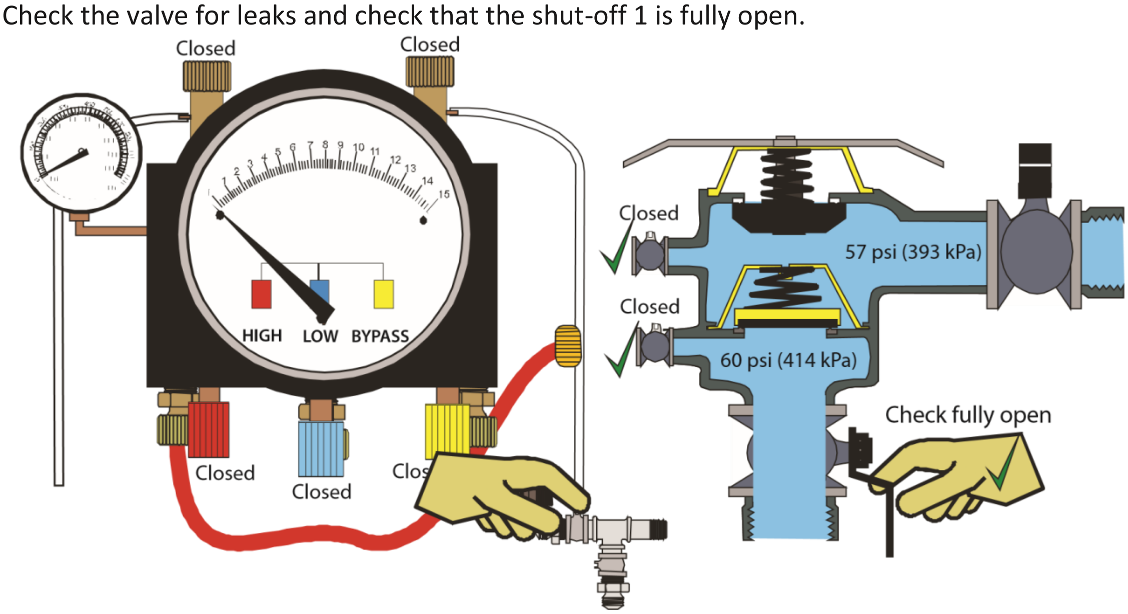
Completing the test of the PVB

Turning the water back on and removing equipment

1. Close the test valve 1.



2. Remove the test gauge, remove the adapters
3. Check the valve for leaks and check that the shut-off 1 is fully open.

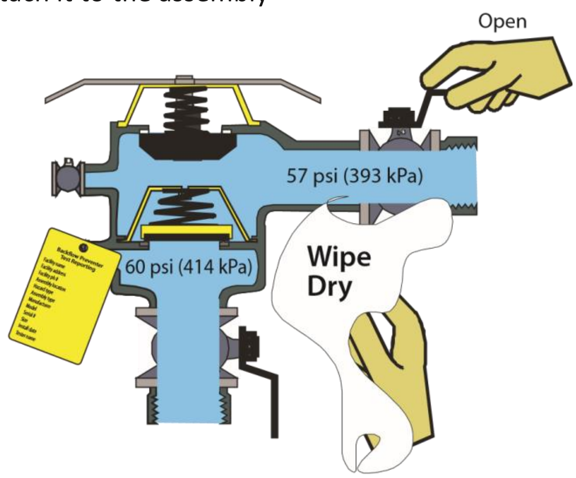


Note: Remember to drain your gauge before storage.

Notify and request permission of the authority in charge or owner that the water is about to be turned on.

Content

4. Slowly open shut-off valve 2.
5. Fill out a test tag and attach it to the assembly



Complete test forms and have the owner/representative sign, then send copies one to each appropriate authority.

Since the water has been shut off for testing, the possibility of cross connection occurring in the system is increased. Notify the owner/representative and seek permission to turn on the water on as soon as possible.

Remember to remove your adapters. It can be embarrassing to have to come back later to retrieve items you have left behind.

Check for leaks, and that all test valves are closed, and the shut-off valves are fully open. Dry the valve off.

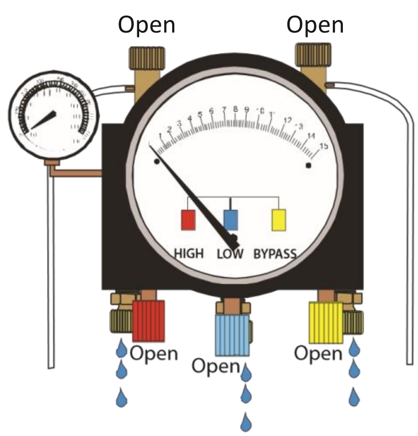


Figure 8-35—Drain your gauge before storage

Content

Testing a Spill-resistant pressure vacuum breaker assembly using a three or five-valve differential gauge (CSA)

The procedures must be practiced until you can demonstrate the test procedures correctly and from memory.

Equipment required

Figure 8-36 shows some equipment used.

- Differential pressure gauge
- Adjustable wrench
- ¼ in. flare adapters, & bushings
- Drop cloth
- Teflon tape
- Eye protection
- Screw driver

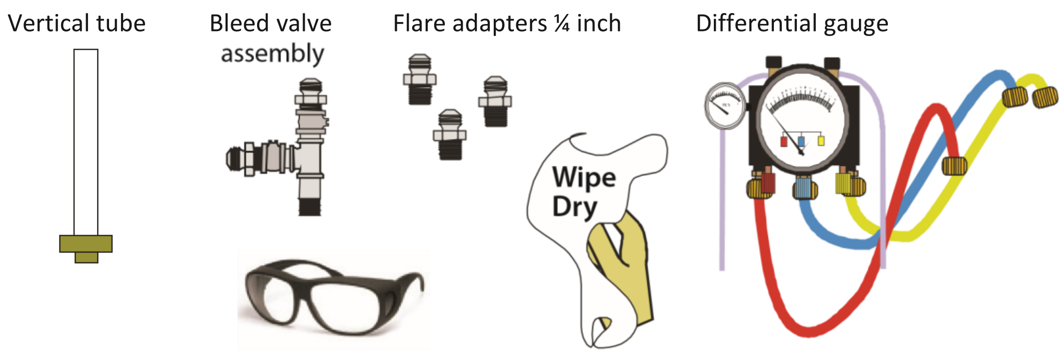


Figure 8-36—Test tools

Pressure gauge minimum size suitable to record maximum line pressures of the system

Content

SRPVB test requirements

You are completing this test procedure to check the SRPVB to determine if the following requirements are met:

- The check valve shall hold steady for minimum 2 minutes at a static pressure drop of not less than 1 psid (6.895kPa) in the direction of flow.
- The air-inlet valve shall open when the pressure in the valve body is at or above 1 psid (6.895 kPa).
- The air-inlet valve shall be fully open when the valve body is completely drained.
- Record the line pressure at the time of the test.

Do not flush the assembly prior to starting the test procedure.

During this test procedure you will be bleeding the test valves and positioning the pressure differential gauge at a correct height. Only the differential pressure gauge high-side hose will be connected to the SRPVB. The low-side hose and bypass hose are not used and must be coiled up at the level of the differential gauge. Alternatively, both these hoses can be removed from the gauge.

Note: A high-side hose looping down between the gauge and SRPVB connection does not affect the reading.

To avoid spillage with a spill resistant vacuum breaker open shut-off 1 slowly. The air inlet will close without spillage. As a general rule, open or close any valves slowly, to prevent water hammer.

Recall the internal components of the valve and the sequence of operation of the SRPVB as you complete the test procedure.

Content

SRPVB and PVB differences in the test procedure

There is only one test-valve. You will only be connecting your gauge high-side hose to test-valve one.

The bleed-screw/vent valve will serve to bleed water from the valve during the test procedures. The differential gauge is not connected to this bleed vent screw.

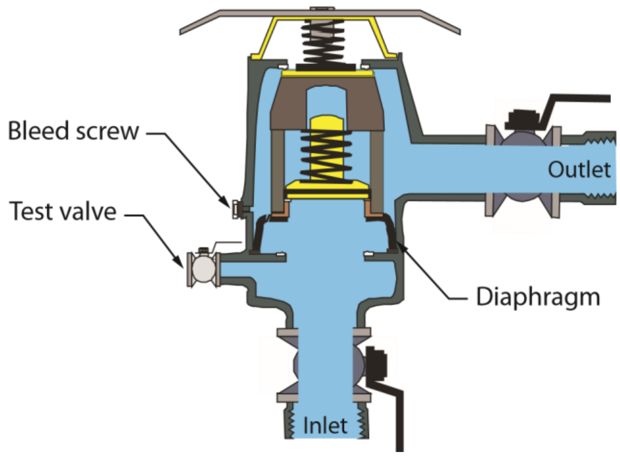


Figure 8-37—Spill Resistant Vacuum Breaker (SRPVB)

Testing procedure options when testing a SRPVB Using a five valve gauge

1. Testing the air-inlet valve:

You will be opening the bleed screw (vent valve) first and then the high-side bleed-needle valve at the same time. It is important to open both these valves slowly. Be sure you are also watching for the air-inlet opening PSID at the same time. The air-inlet could open when you are opening the bleed vent valve and if you were not watching you will not be able to establish an accurate opening PSID of the air-inlet valve.

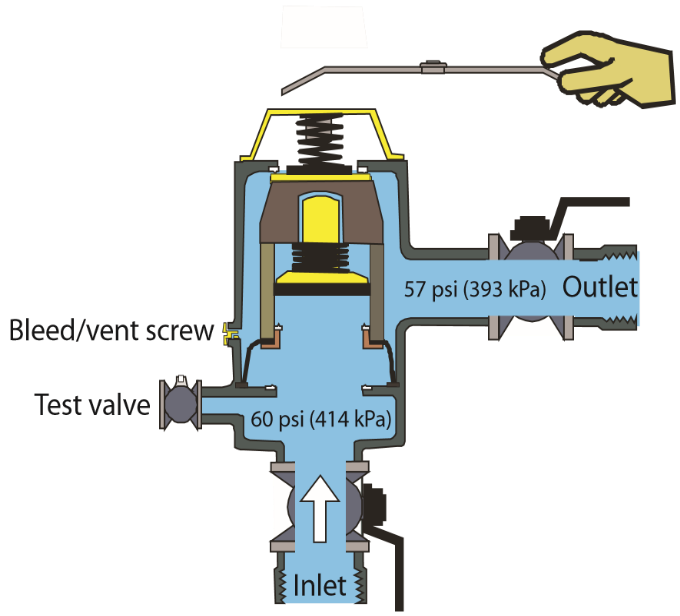
SRPVB Pretest preparations steps:

- Notify and request permission of the owner before the water will be shut-off.
- Identify the SRPVB, record make, model, serial number and size.
- Inspect and identify the SRPVB test valves and shut-off valves; for example, damaged or missing components.
- Observe for obvious leakage and any apparent cross connections in the surrounding piping; for example, bypass piping.

Content

Starting the test procedure for the Spill Resistant Vacuum Breaker (SRPVB)

1. Remove the canopy. Examine the air inlet and remove any debris but do not physically alter the air-inlet valve or its components during the examination. Physically altering the valve, itself may affect true results of your test.



Note: This SRPVB drawing and others used for these procedures are depictions for educational purposes. The terms vent valve and bleed screw are both used to describe the same valve.

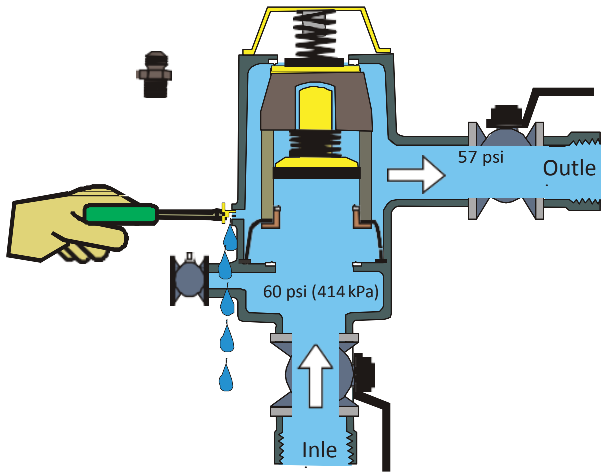
Flushing the test valves and bleed-screw:

When flushing the bleed-screw and test valve you do not have to follow a specific order; however, for this procedure we will use the same consistent flushing procedures as with the RP, DCVA and PVB, for the purpose of this publication. (Recall bleed procedures for the RP are important.)

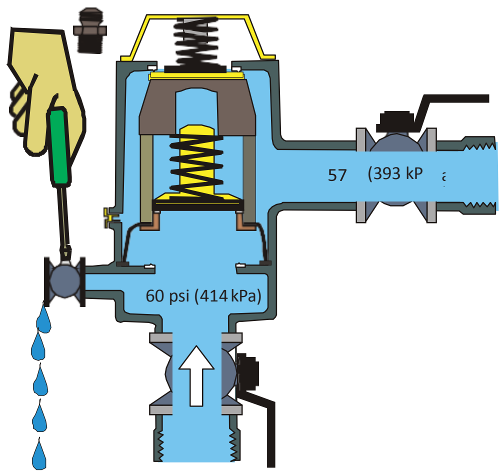
Do you have your safety glasses on?

Content

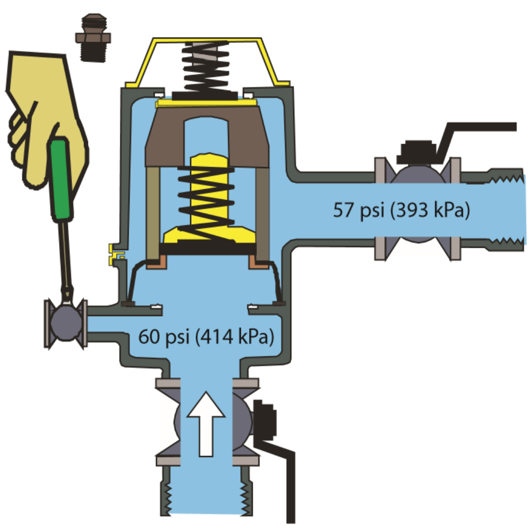
2. Open and close the bleed screw/vent valve to remove debris.



3. Open the test-valve to remove debris.

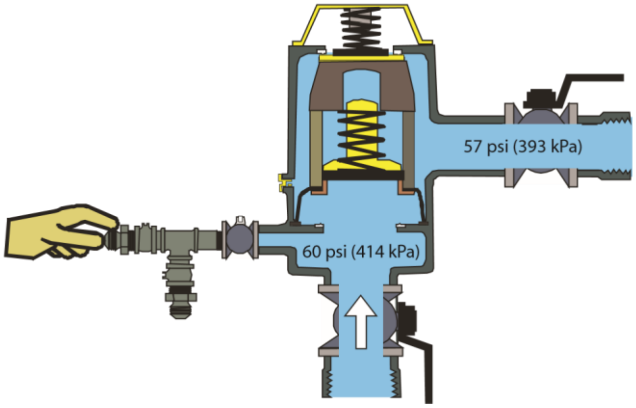


4. Close the test-valve

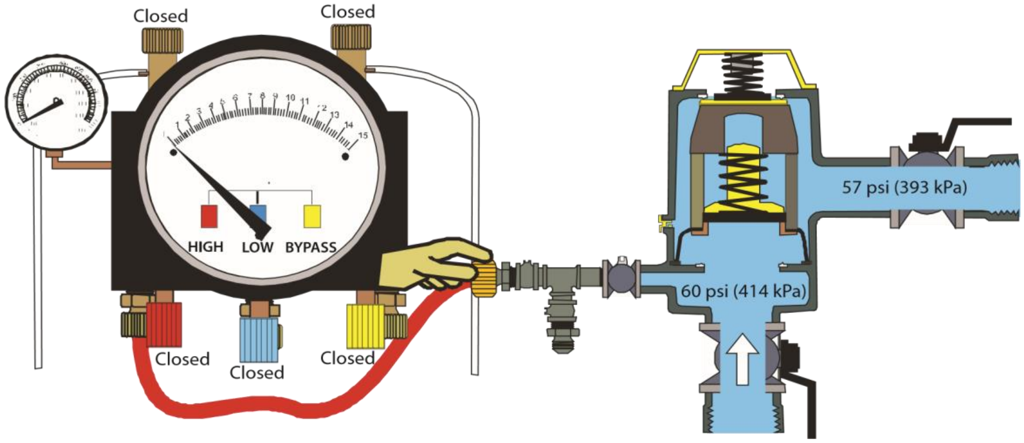


Content

5. Install the bleed-valve assembly to the test-valve.



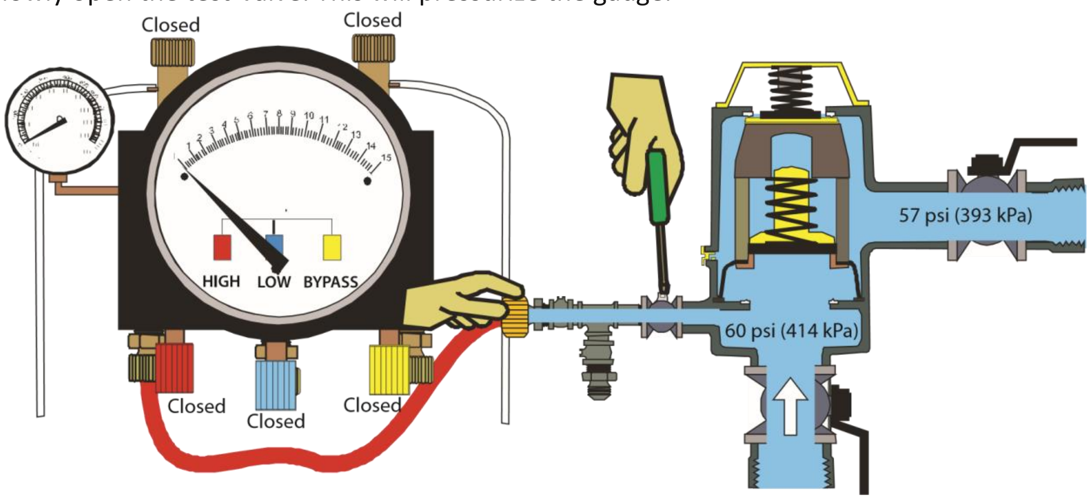
6. Connect the high-side hose to the test-valve bleed valve assembly.



Note: Remember to wrap hose at the same height as the assembly or remove unused hoses.

You now need to flush the gauge and hose.

7. Slowly open the test-valve. This will pressurize the gauge.



Content

Figure 8-38 below, shows bleeding air when using a three-valve gauge.

- Open the high-side control valve H.
- Open the low-side control valve L.
- The bypass control valve remains closed.
- Close the low-side control valve L.
- The high-side control valve is left open.

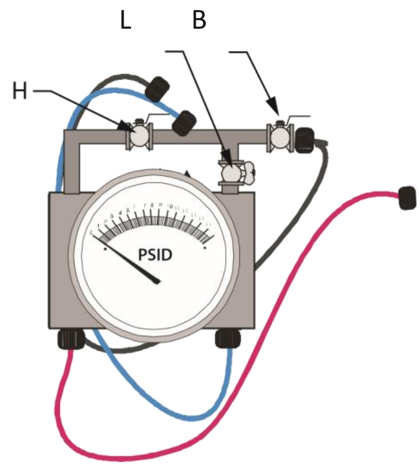
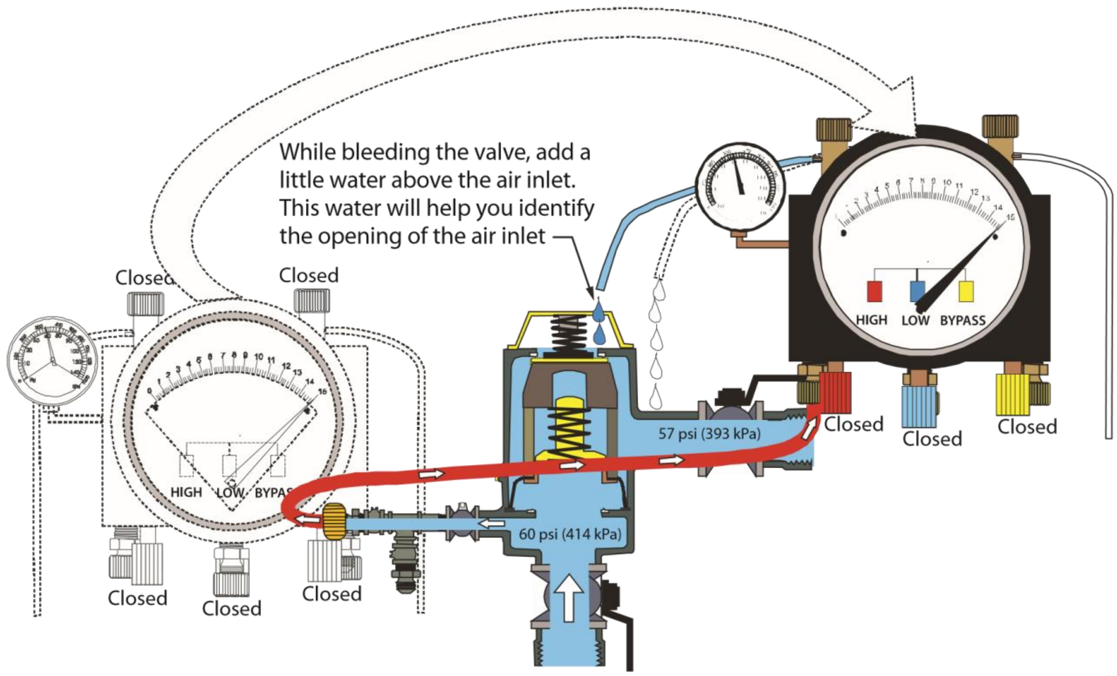


Figure 8-38—Bleeding the gauge with a 3 valve gauge

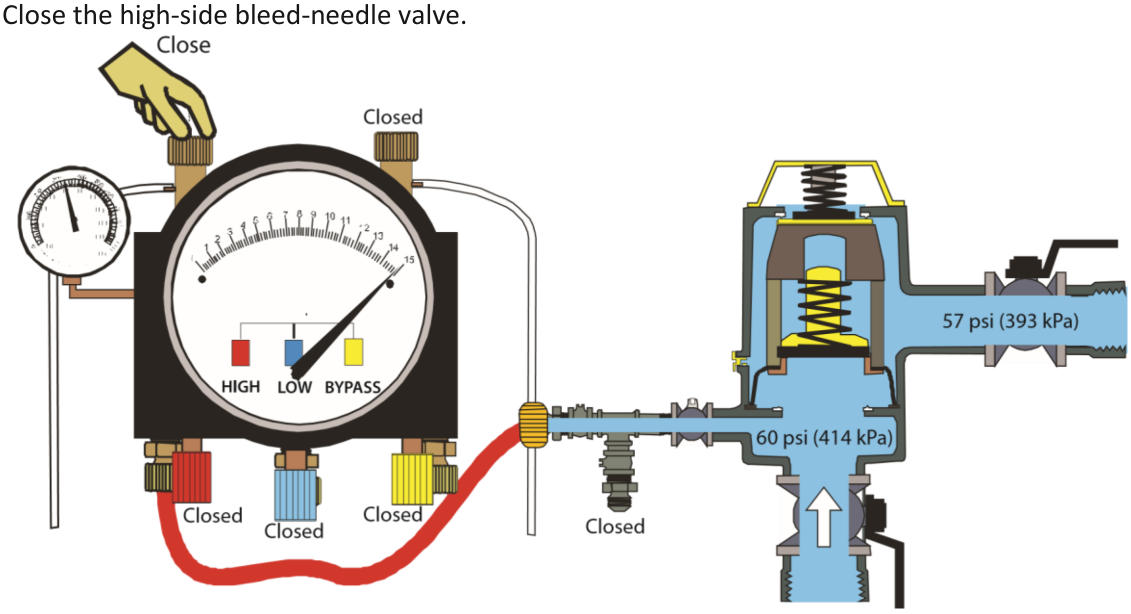
Content

8. Slowly open the high-side bleed-needle valve and bleed air from the gauge and hose. Elevate the gauge to assist air from the hose and gauge.



Note: You may fill the area above the air-inlet valve with water. This will allow you to see clearly when the air-inlet valve opens. The water level above the air-inlet valve will drop and run into the valve body as the air-inlet valve opens. Use the high-side bleed valve drain tube of the gauge to supply the water above the air-inlet valve.

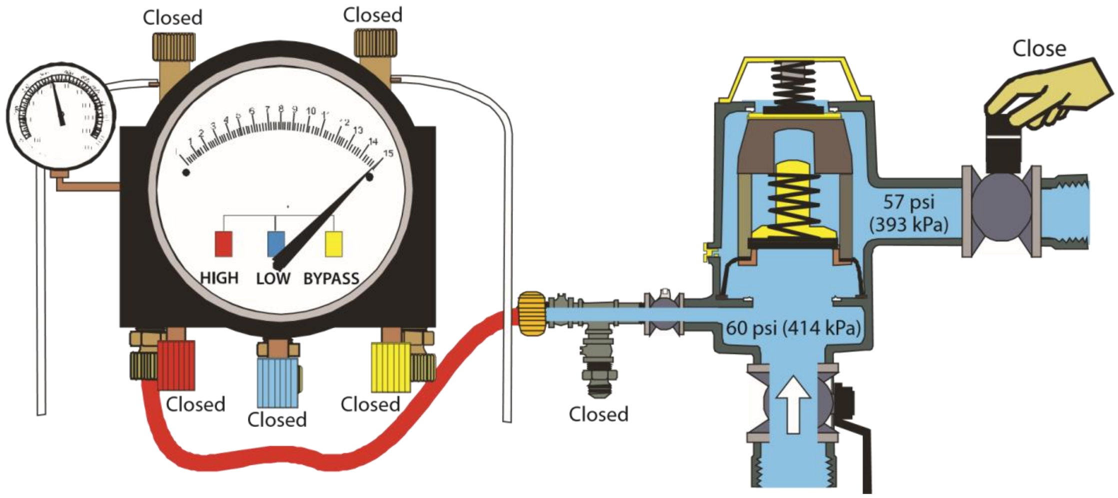
9. Close the high-side bleed-needle valve.



Note: When bleeding the gauge, make sure you wait until all trapped air is removed from the gauge.

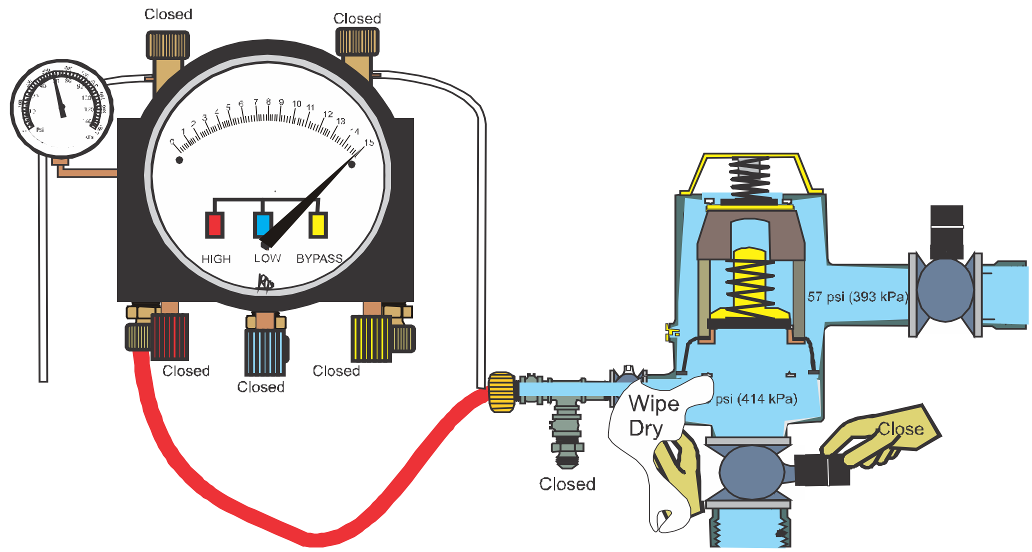
Content

10. First slowly close the shut-off valve 2.



Remember, closing and opening valves slowly is a good practice.

11. Close shut-off 1. For this example, the test gauge should be at the same level as the vent valve.



The valve is now ready for the first test.

Check your gauge and connections for leaks, wipe the valve dry

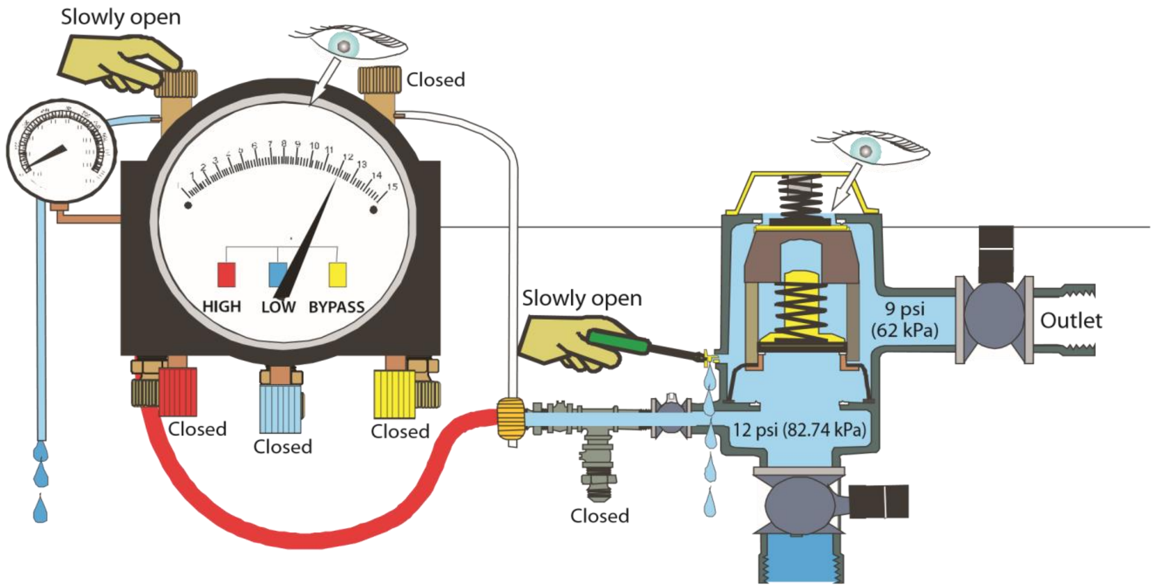
Notice that the diaphragm is pushed up by the line pressure and the check valve is closed by the spring. The water is shut off and the flow has stopped. Since pressure is caught under the diaphragm it remains up so it is holding the air-inlet valve closed at the same time.

Content

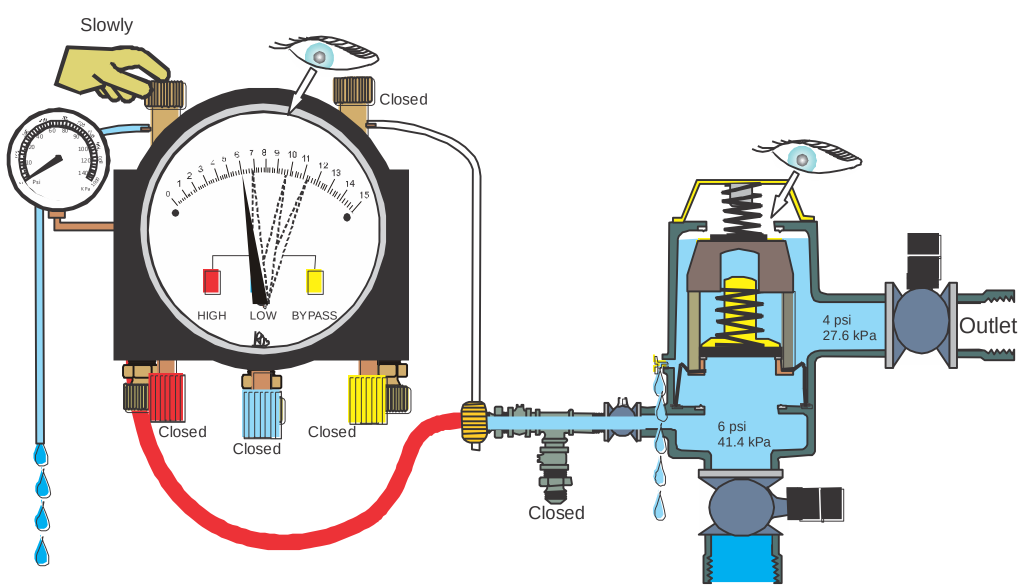
Requirement of the SRPVB (CSA standard)

- The air-inlet valve shall open when the pressure in the valve body is at or above 1 psid (6.895 kPa).
- The air-inlet valve shall be fully open when the valve body is drained.

1. Slowly open the bleed vent screw and the high-side bleed- needle valve slowly. Observe the gauge readings and the water level resting above the air inlet. Be prepared to record the psid if and when the air-inlet valve opens? The test gauge must be at the same level as the vent valve.



2. Observe the gauge reading and the water level above the air inlet. When the water drops into the air-inlet opening this indicates the air-inlet has opened. Observe and record the air-inlet opening psid. If the psid is at or above 1 psid, record as passed. If the air-inlet valve opens at less than 1 psid, then record as failed. If the air-inlet valve does not open, record failed to open.



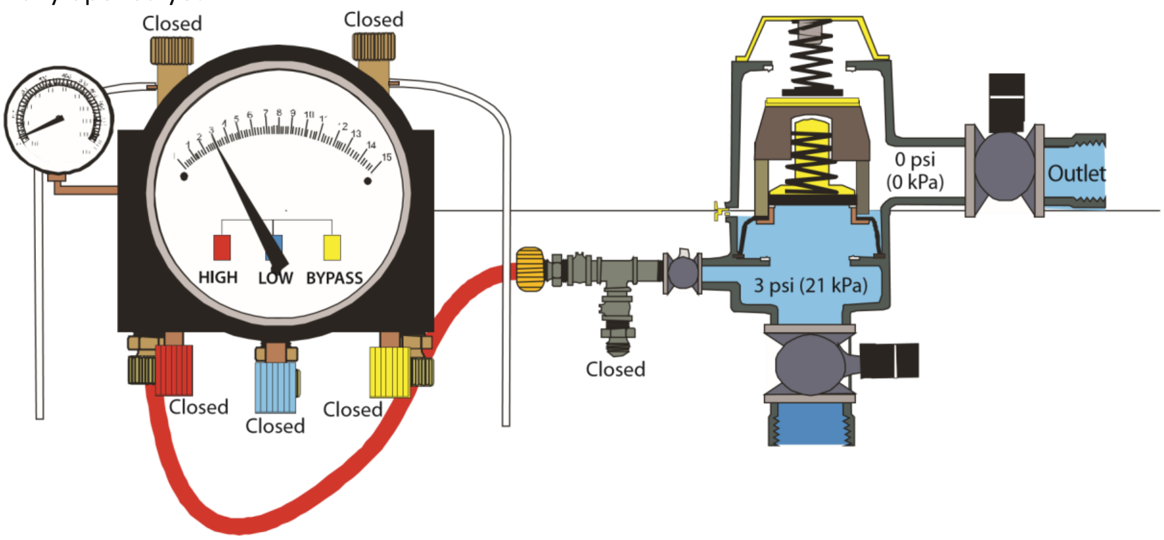
The air inlet has just opened in this diagram. Now you need to wait for the poppet to fully open.

Content

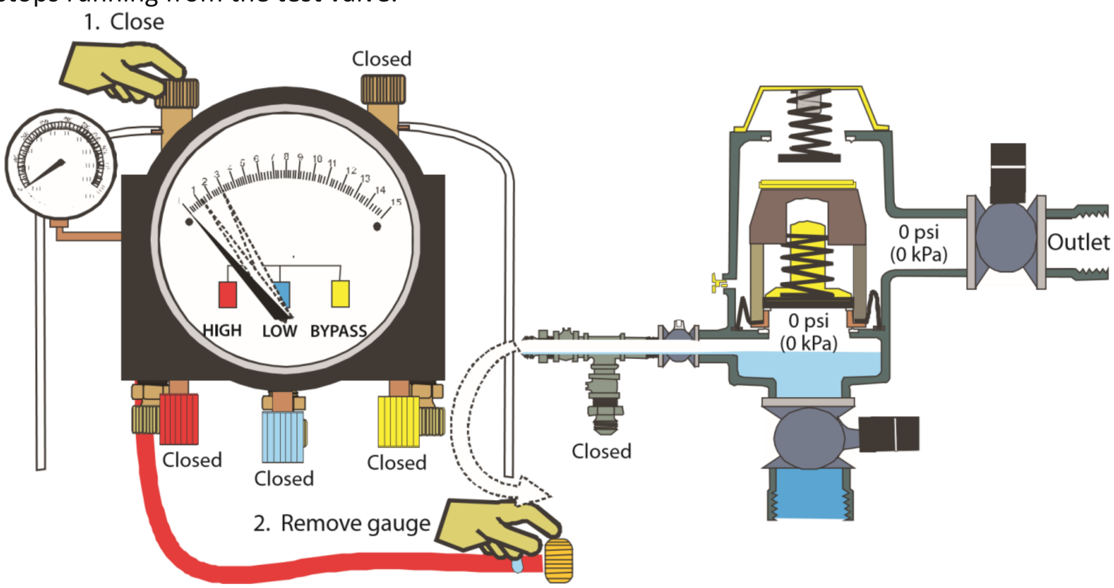
SRPVB air-inlet valve continued

Requirement
The air-inlet valve shall be fully open when the valve body is drained.

1. When the water stops draining there may be water still in the valve body. The air-inlet may not be fully opened yet



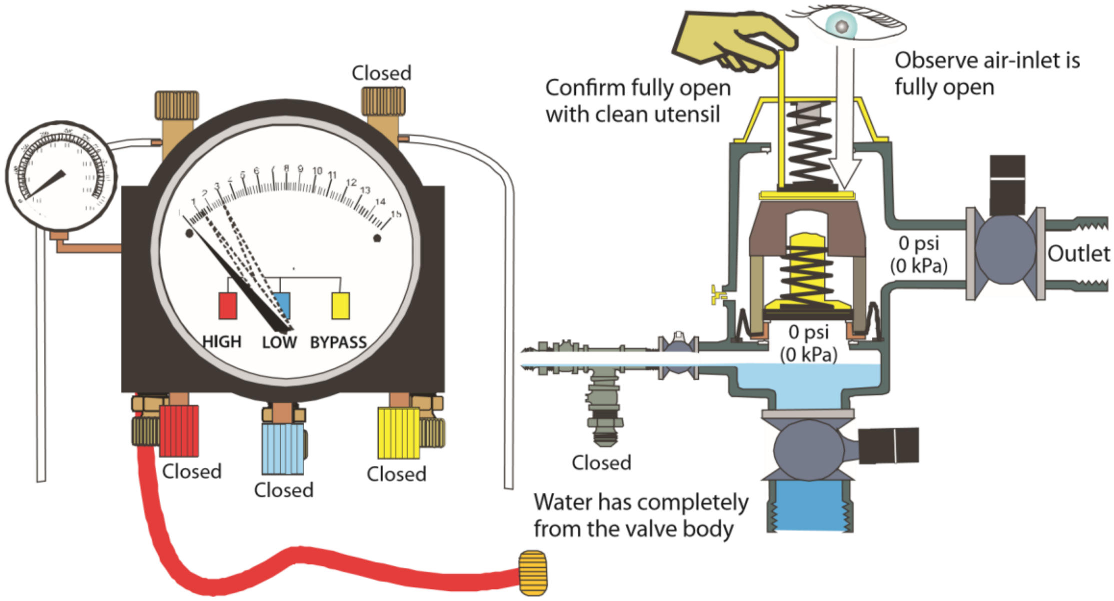
2. Remove the high-side hose from the test valve and allow the valve body to drain. Wait until the water stops running from the test valve.



Note: removing the high–side hose to assist in draining the valve body is not mentioned in the CSA standard procedures. If you do this, you should check with the authority having jurisdiction first if you decide it is necessary.

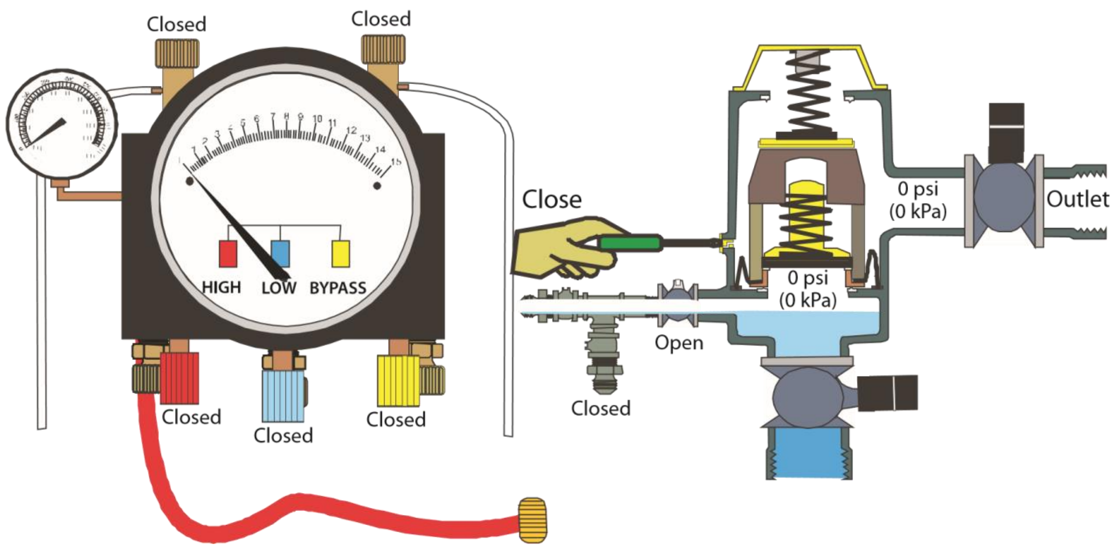
Content

3. Confirm that the air-inlet valve is fully open. Record the air-inlet valve is fully open and record as passed. If the air-inlet valve did not open fully record the air inlet as failed.



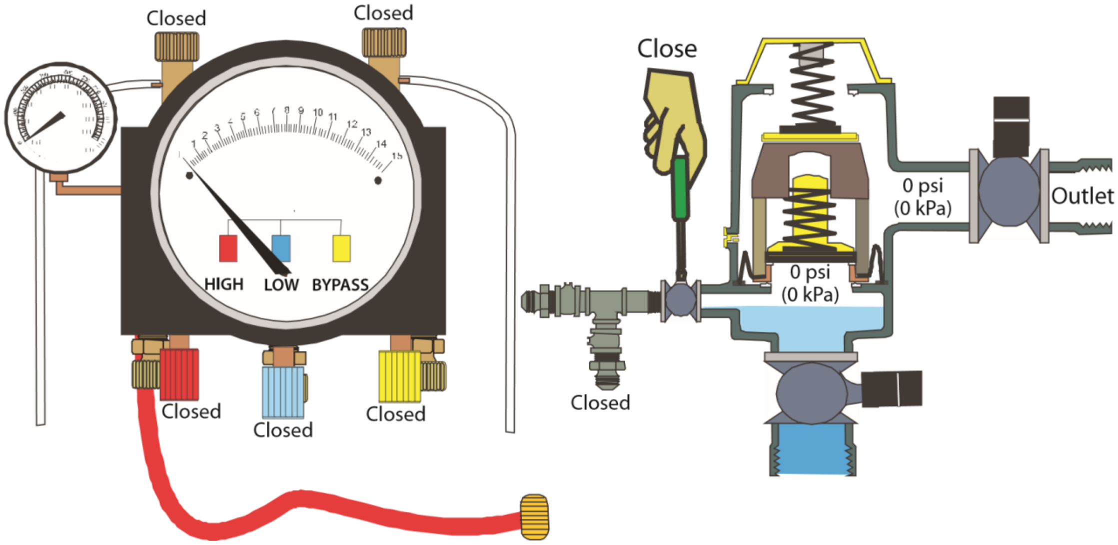
Prepare for next requirement, which is for the check-valve.

4. Close the bleed vent valve

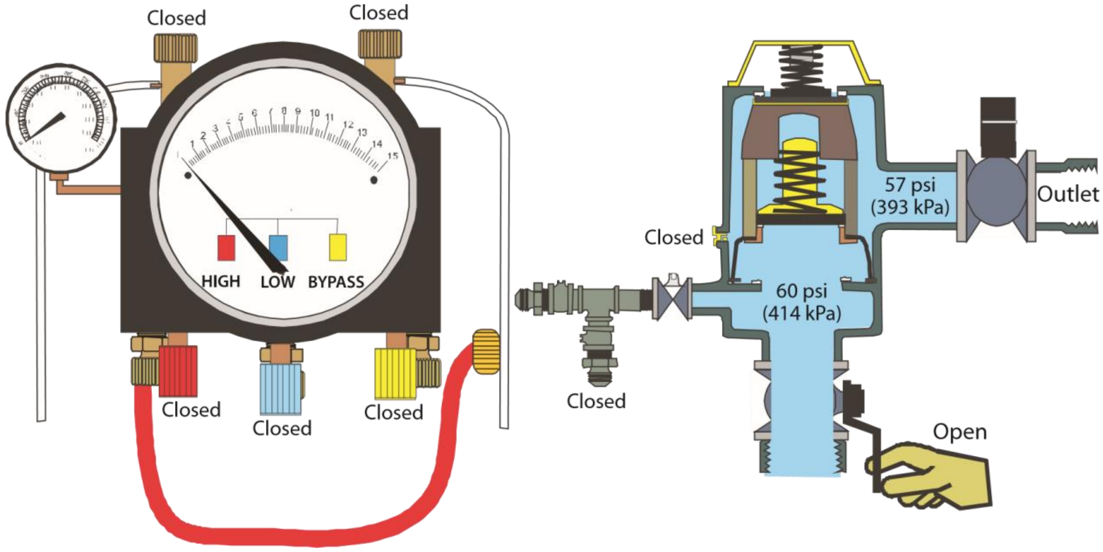


Content

5. Close the test valve

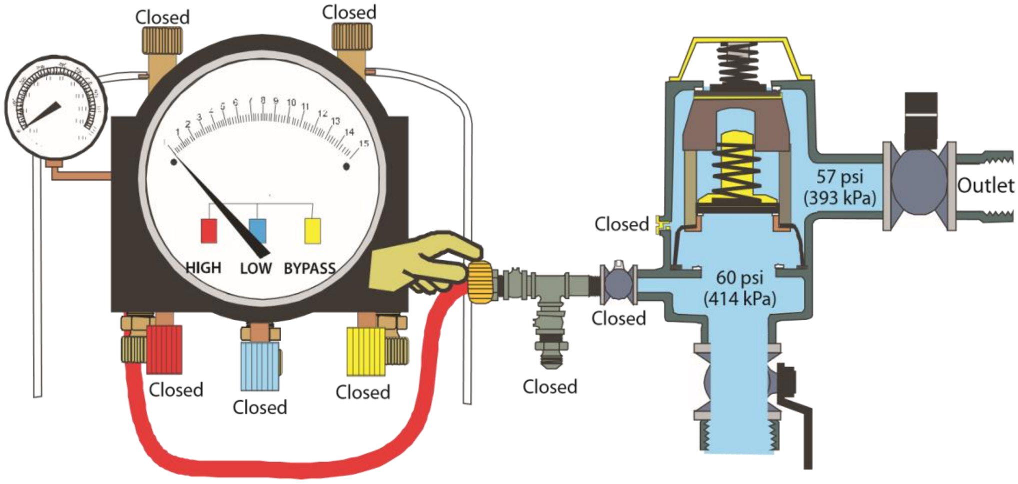


6. Open the shut-off 1 to recharge the valve.

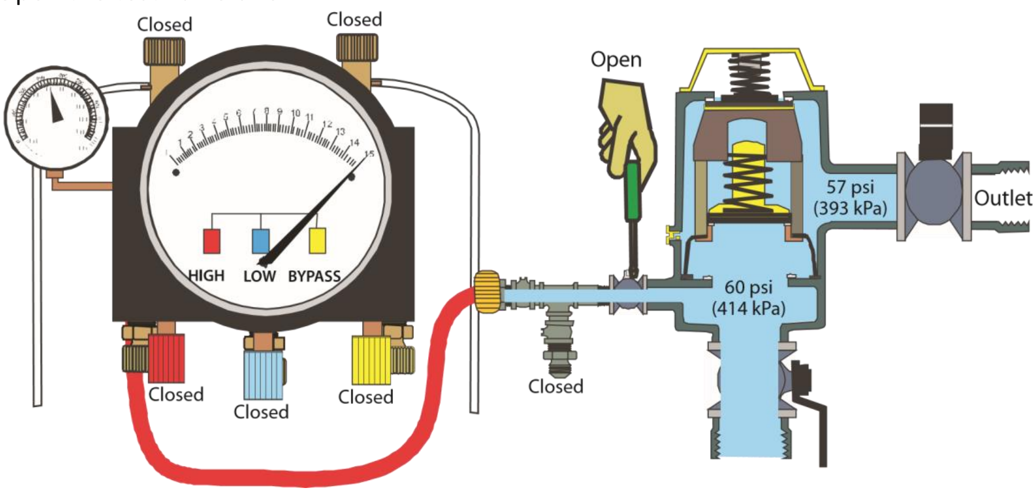


Content

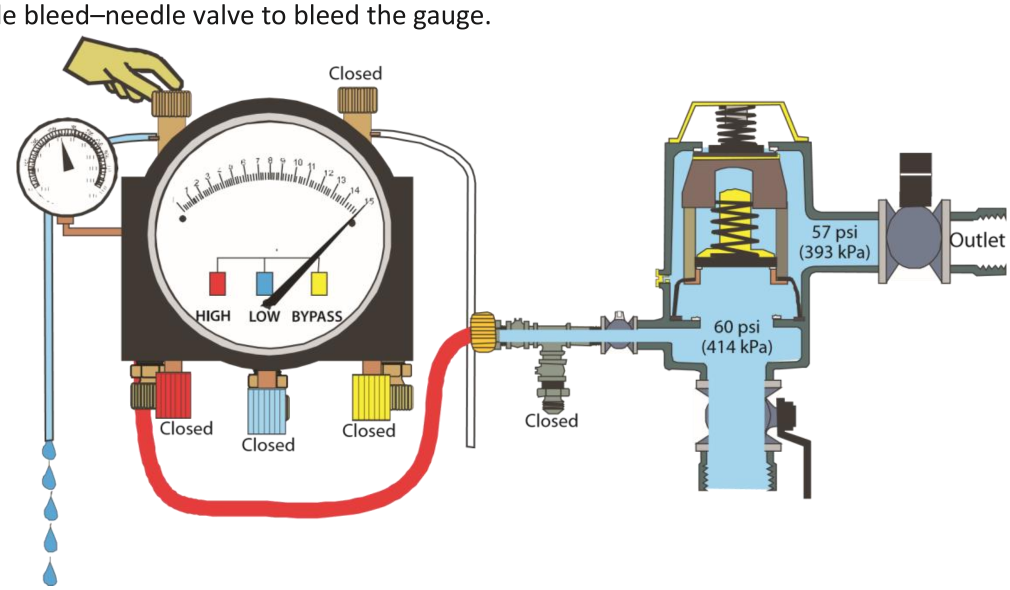
7. Reconnect the gauge to test valve 1.



8. Open the test valve one.

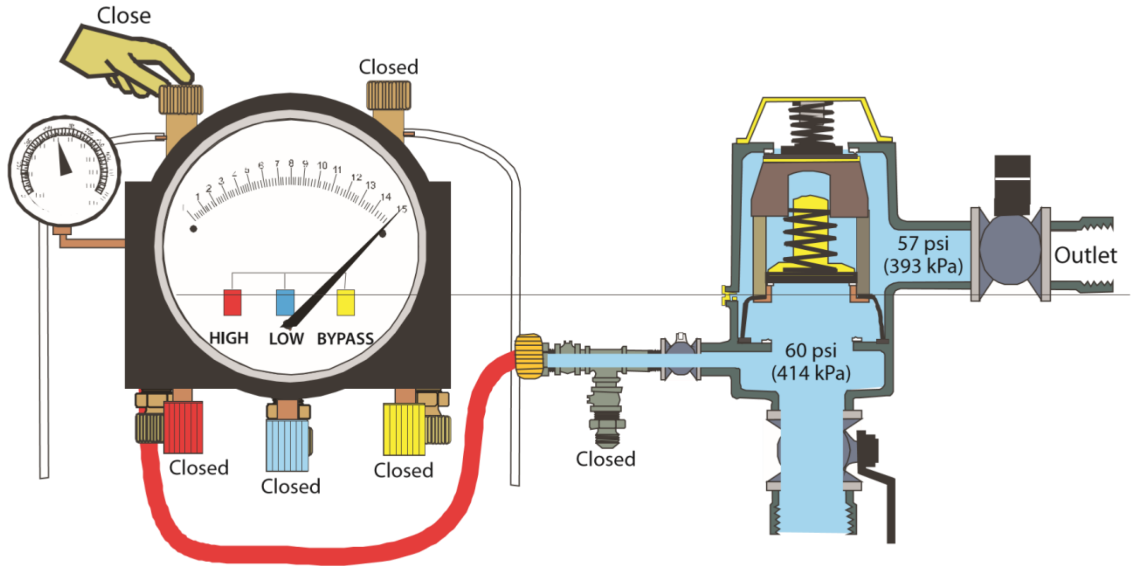


9. Open the high-side bleed–needle valve to bleed the gauge.

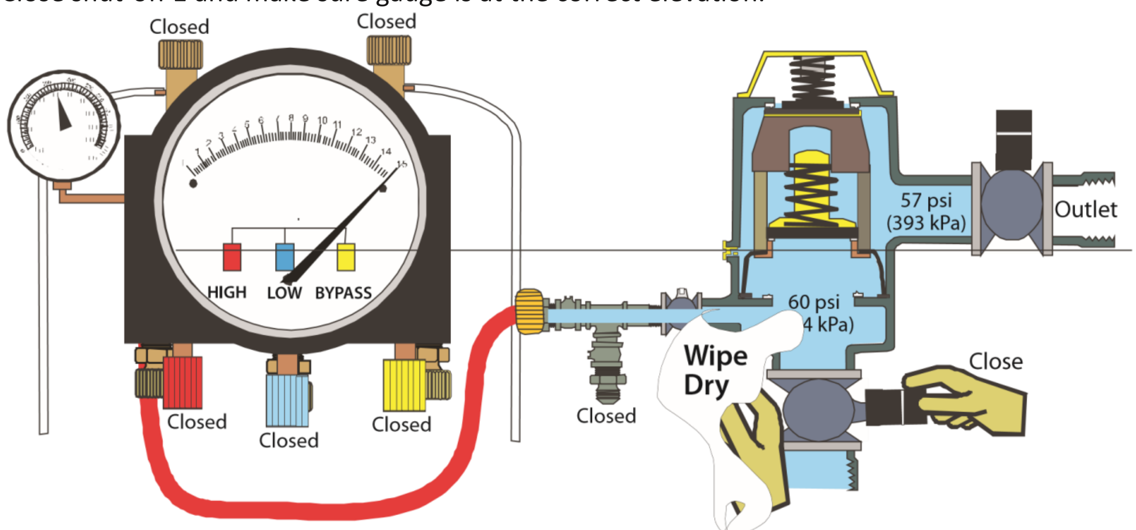


Content

10. Close the high-side bleed-needle valve



11. Close shut-off 1 and make sure gauge is at the correct elevation.



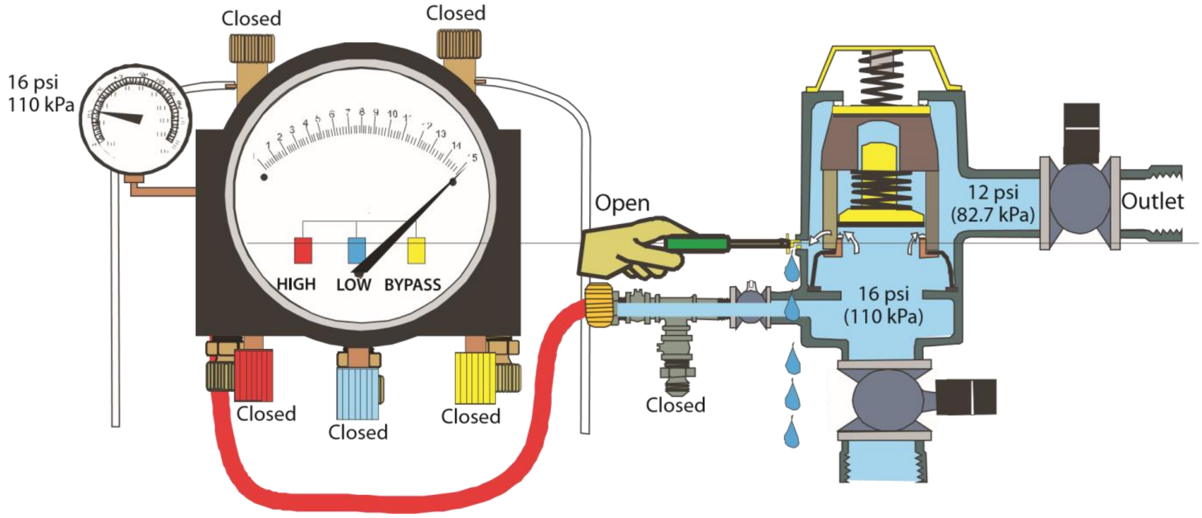
You are now ready to start the check-valve test requirement.

Content

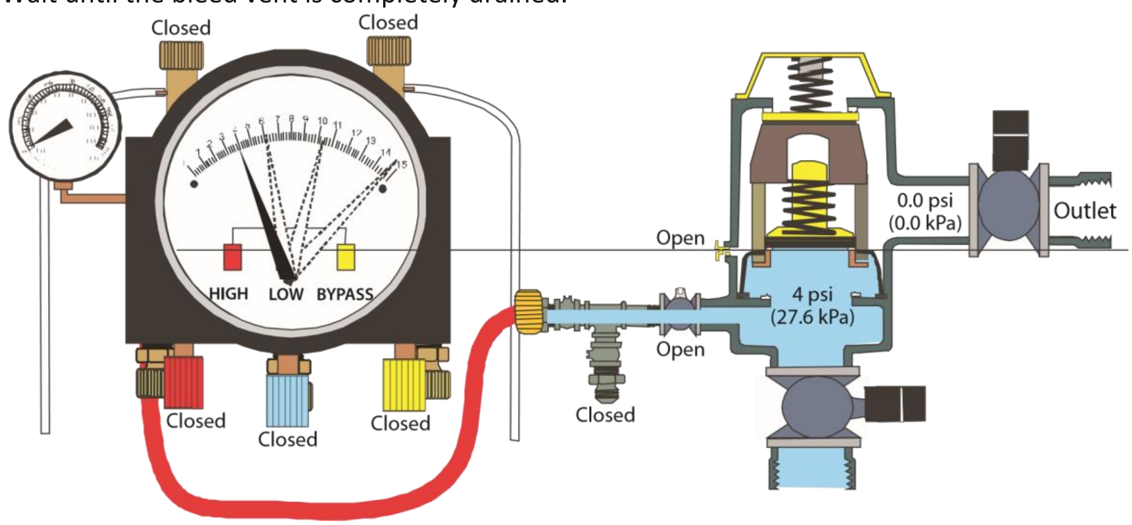
Test the SRPVB check-valve

Requirement
The check-valve shall hold at a steady state at or above 1 psid (6.895kPa) for minimum of two minutes.

1. Open the bleed vent valve

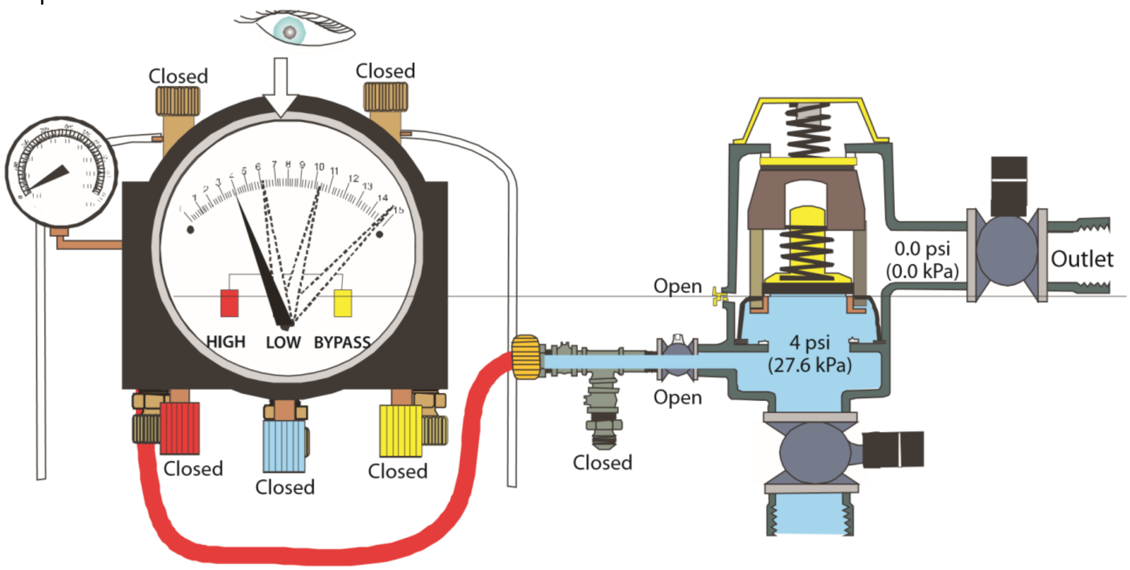


2. Wait until the bleed vent is completely drained.



Content

3. When the bleed screw stops dripping, observe the gauge pressure and wait for the steady state gauge reading for a minimum of two minutes. Record the psid of check valve, if it is at or above 1 psid record as passed. If it is below 1 psid, record as failed. Record the check valve is closed tight, or leaking if psid drops to "0"



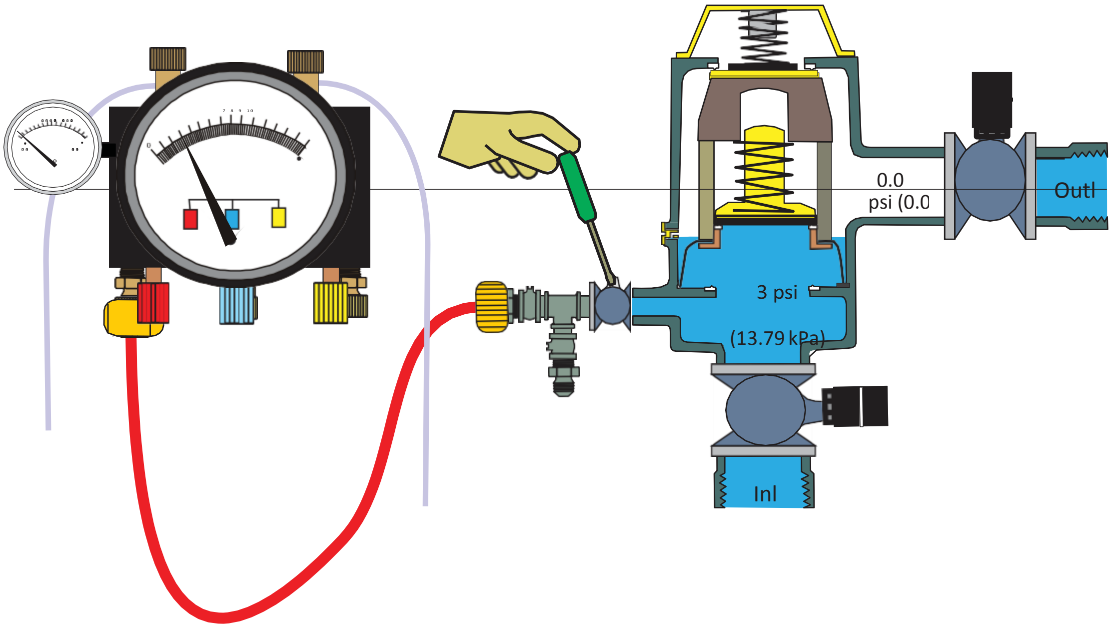
There is one more requirement to complete. Record the static line pressure.

Content

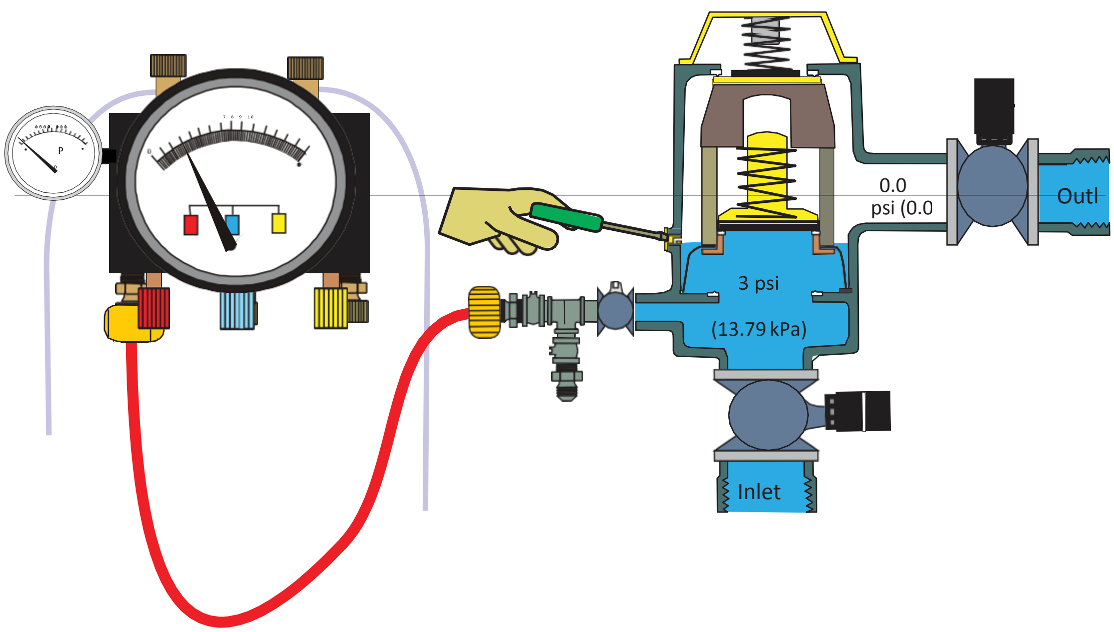
Prepare to obtain the static line pressure.

Requirement
Observe and record the static line pressure at the test-valve.

1. Close the test valve.

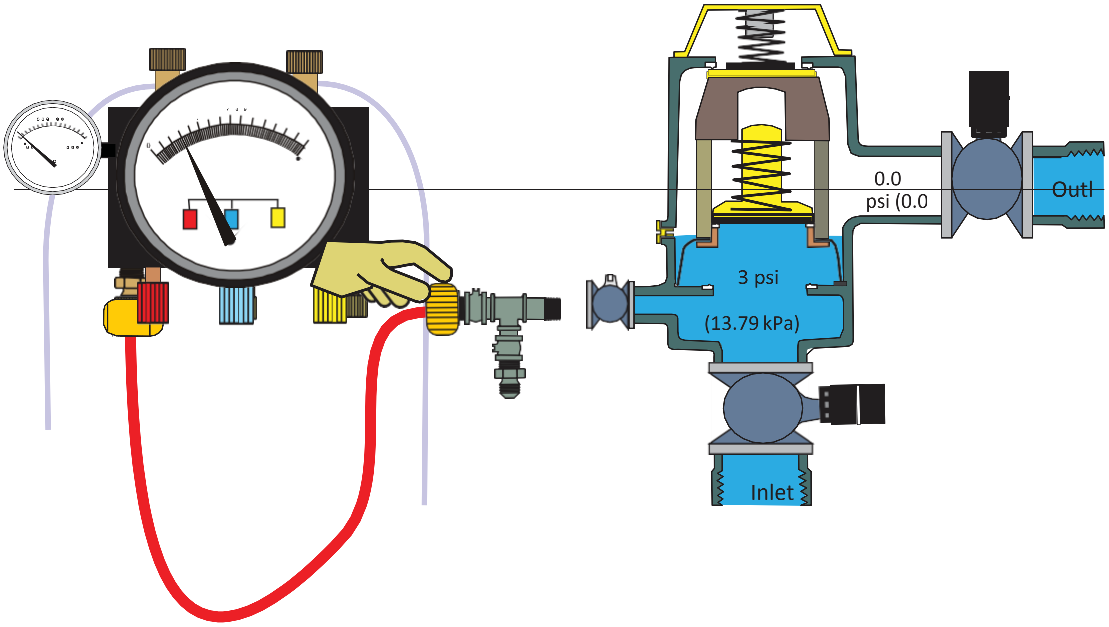


2. Close the bleed-vent screw

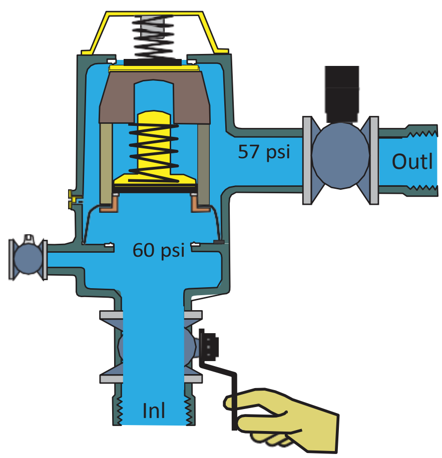


Content

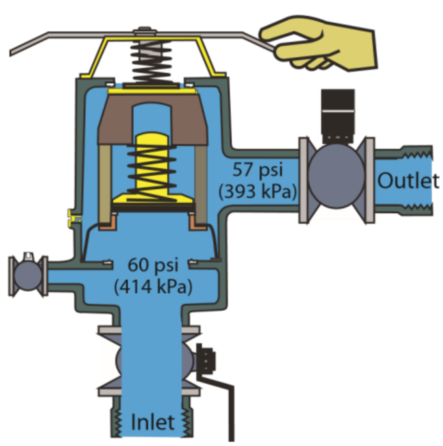
3. Remove the gauge and bleed-valve arrangement



4. Open shut-off 1



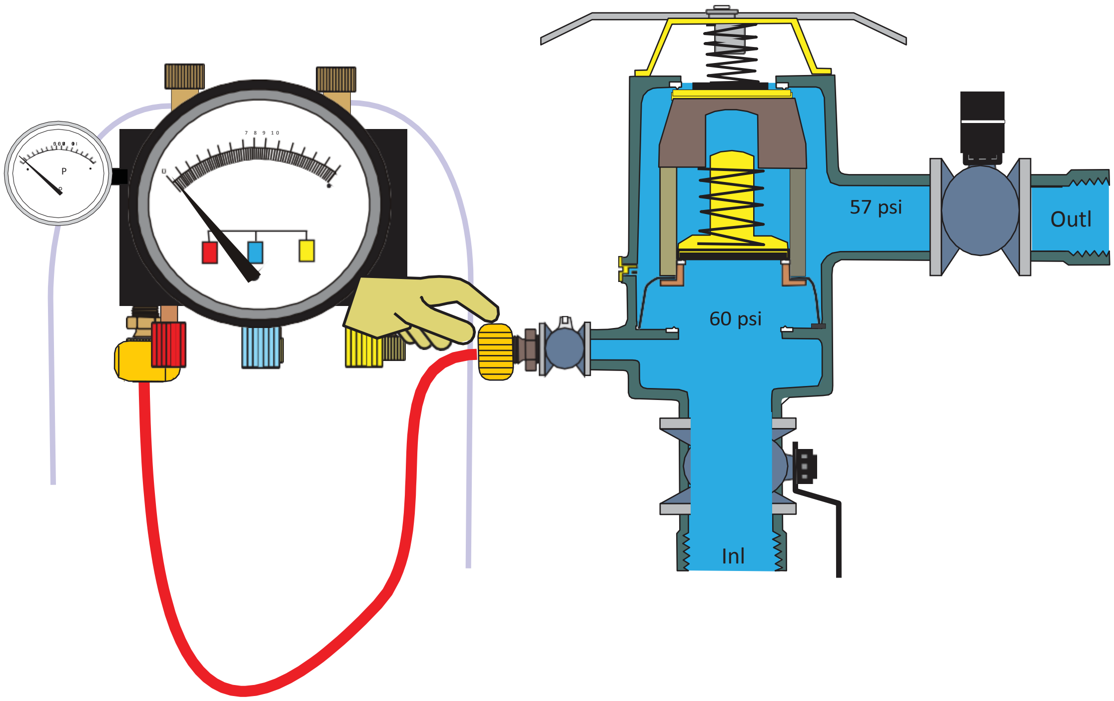
5. Reinstall the canopy



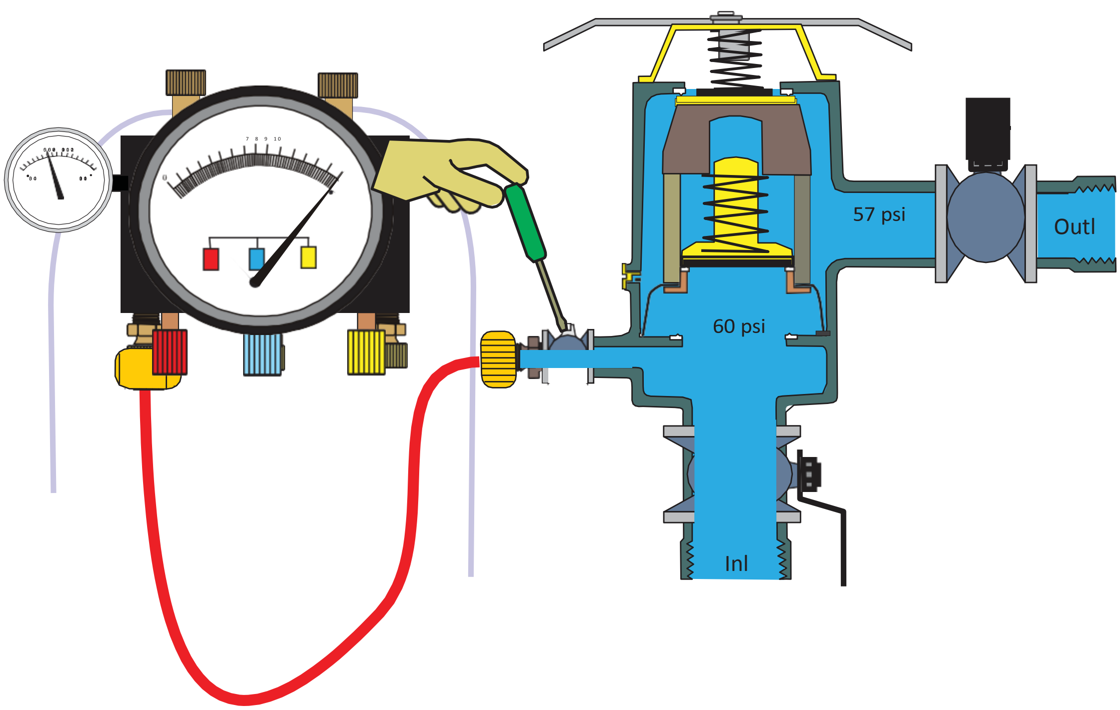
Content

6. Connect a pressure gauge to test valve 1

In this case you may use the differential pressure gauge.

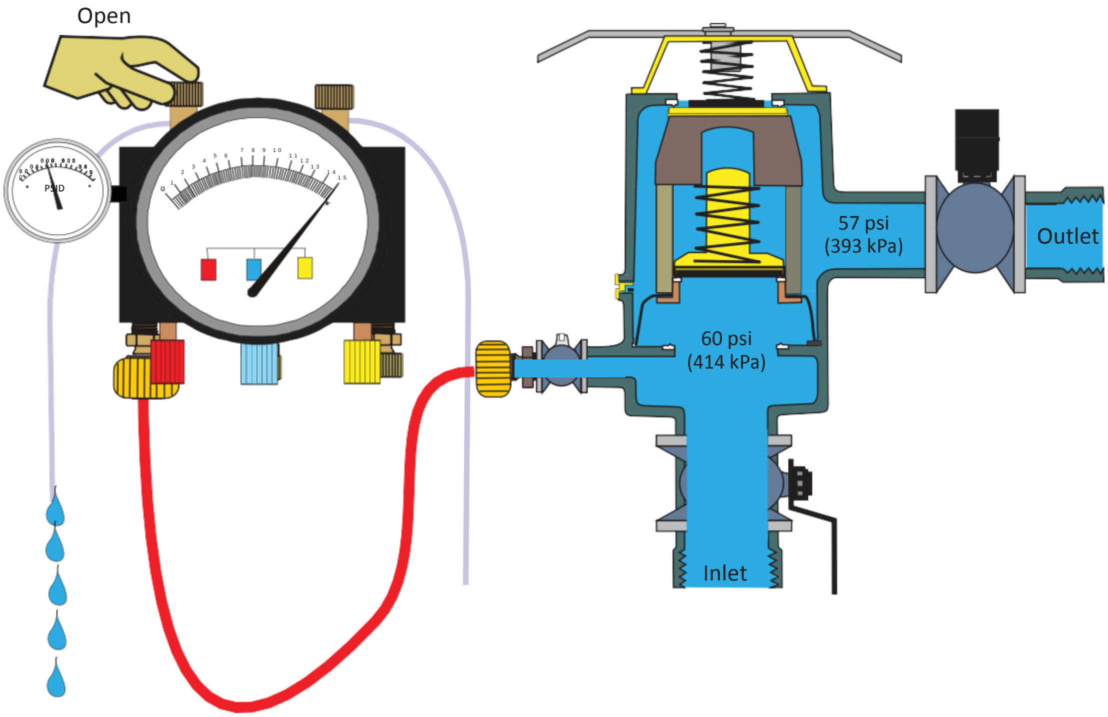


7. Open test-valve

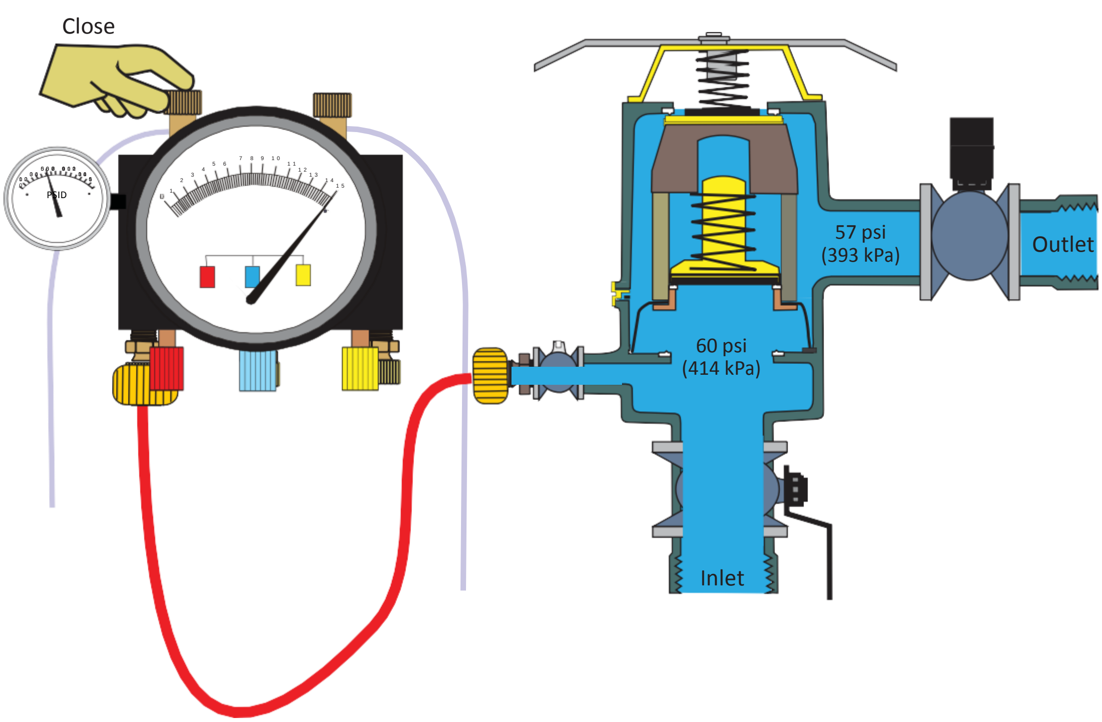


Content

8. Open the high-side bleed-needle valve to remove air from the gauge and hose.

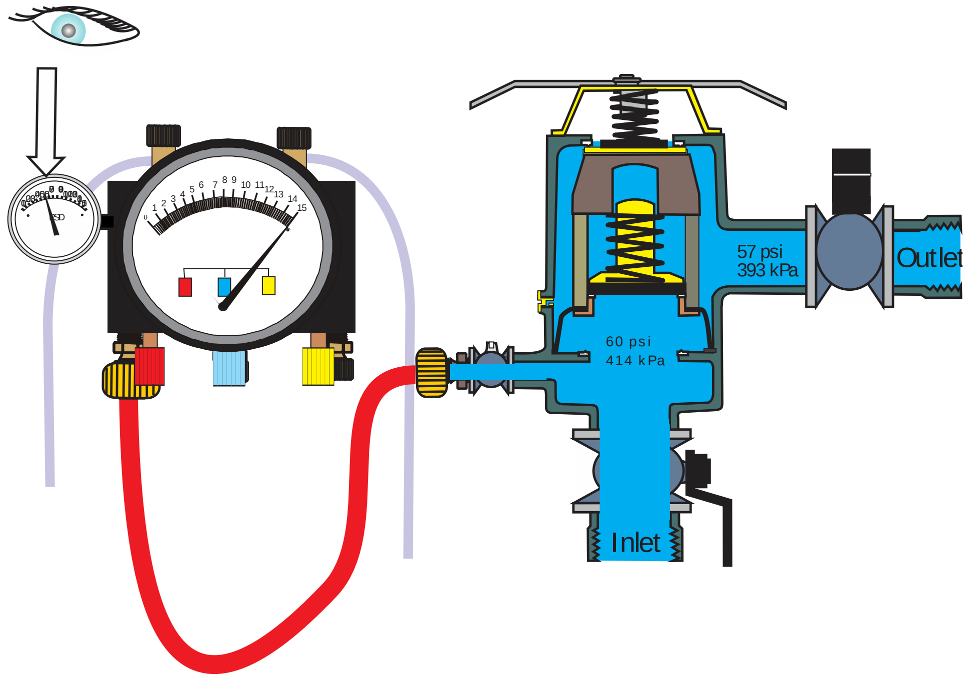


9. Close the high-side bleed-needle valve to remove air from the gauge and hose.



Content

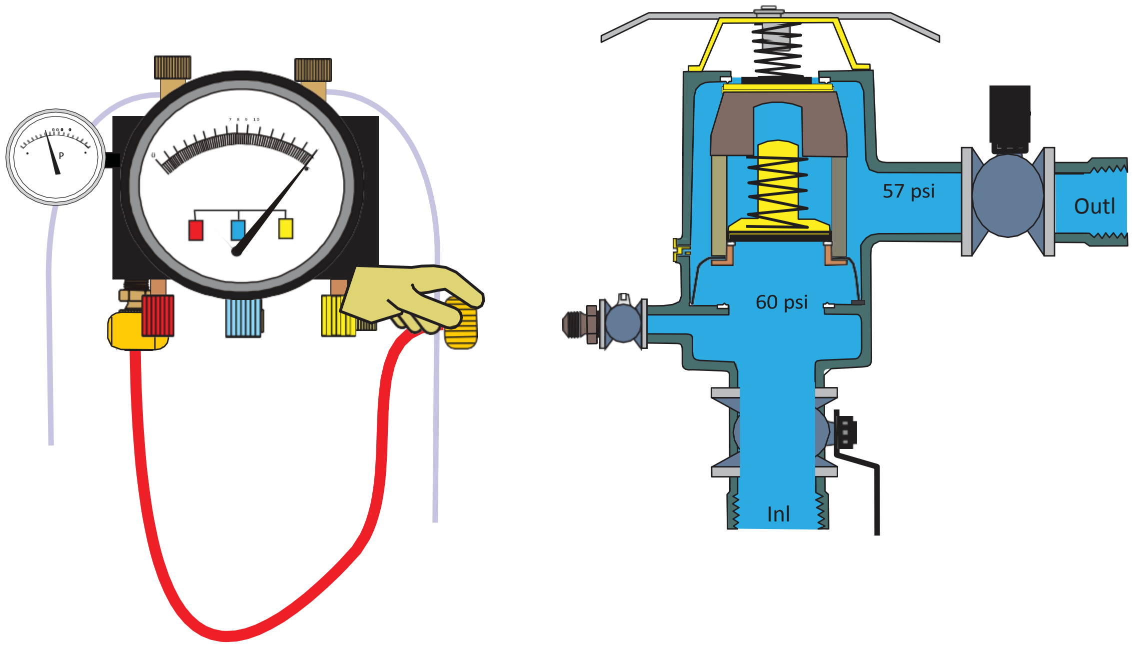
10. Observe the static pressure gauge reading and record the reading on the test report form. If not recorded on the test report form record test results failed



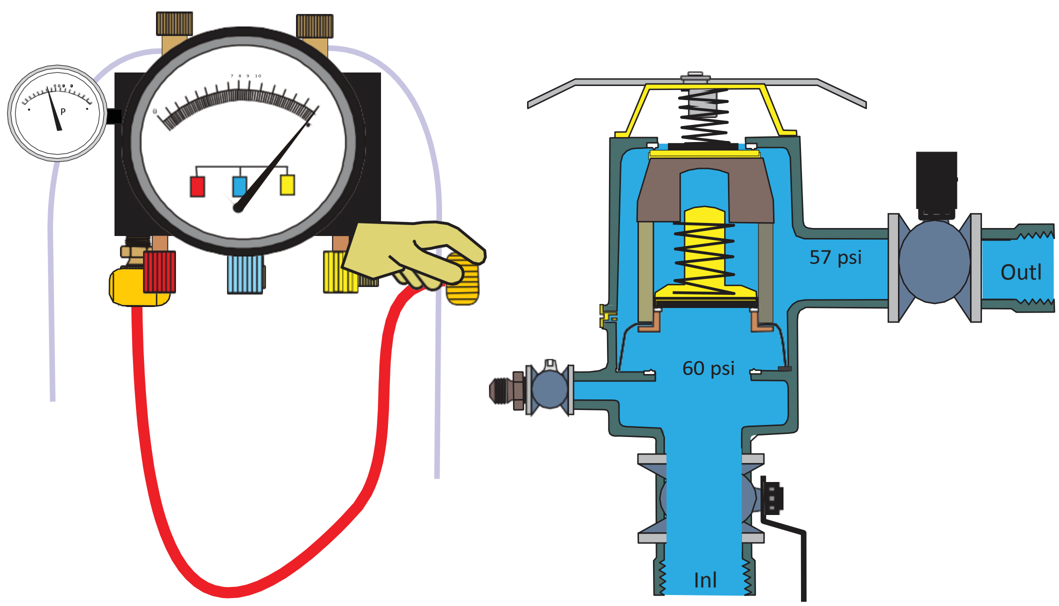
Content

Return the SRPVB to service

1. After recording the static line pressure close the test valve. Make sure the bleed vent-screw is closed.



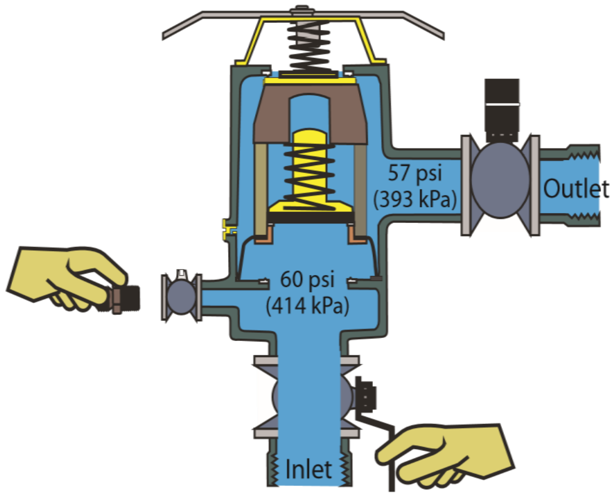
2. Remove the gauge from the SRPVB



Content

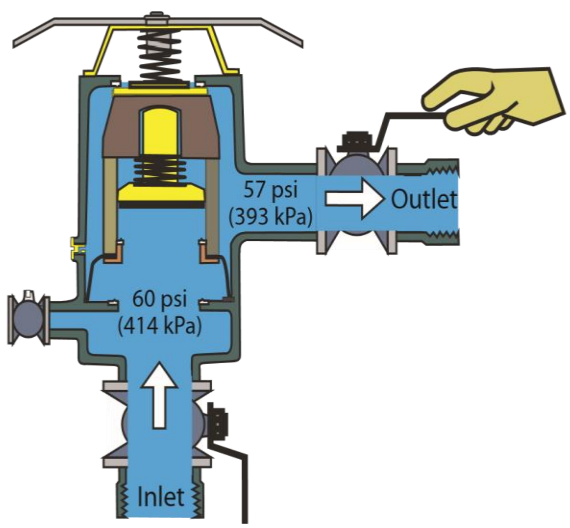
Return to service continued.

3. Remember to remove your adapters. It can be embarrassing to have to come back later to retrieve items you have left behind.
4. Check for leaks, and that the bleed vent screw is closed.
5. Check that shut-off valve 1 is fully open.



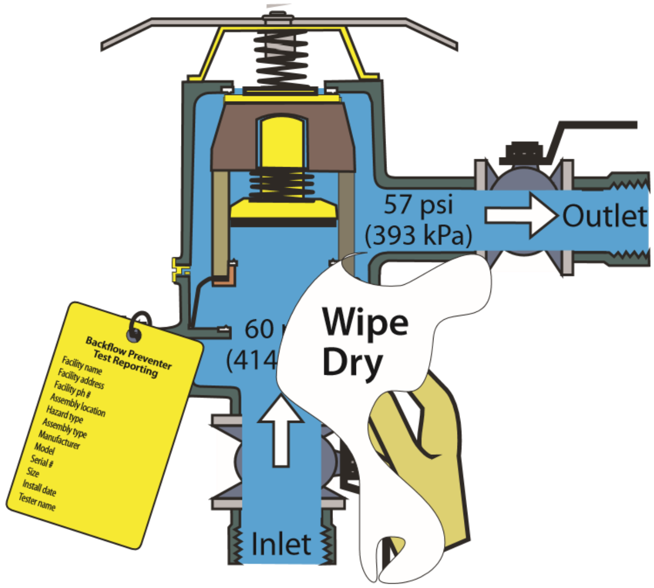
Since the water has been shut off for testing, the possibility of cross connection occurring in the system is increased. Notify the owner/representative and seek permission to turn on the water on as soon as possible.

6. Slowly open shut-off 2



Content

7. Dry off the valve, complete the test tag and attach it to the assembly.



8. Complete test forms and have the owner/representative sign, then send copies one to each appropriate authority.

Drain your gauge before storage

☑ Now complete Self-Test 8 and check your answers.

Content

Self-Test 8

Review the section objectives and then answer the following questions.

1. What is the name of the gauge used to test a RP?
   a. Differential pressure gauge
   b. Duplex gauge
   c. Sight-tube gauge
   d. Compound pressure gauge

2. How often shall a differential pressure gauge be calibrated?
   a. Twice a year
   b. Once a year
   c. Every two years
   d. After each use

3. What minimum increments shall a five-valve differential pressure gauge read?
   a. 0.01 psid
   b. 0.02 psid
   c. 0.2 psid
   d. 2 psid

4. What is the maximum differential pressure gauge reading on the five-valve differential pressure gauge?
   a. 5 psid
   b. 10 psid
   c. 12 psid
   d. 15psid

5. What type of control valves are used on the five-valve differential pressure gauge?
   a. Plug valves
   b. Gate valves
   c. 1⁄8" needle valve
   d. ¼" needle valves

Content

6. What size are the flare connections on the differential pressure gauge?
   a. 37½° flare
   b. ¼" 45° SAE flare
   c. ¼"Compression type
   d. ½" 45° SAE flare

Refer to Figure 1 to answer questions 7-9

7. What is the hose at letter G called?
   a. High pressure side hose
   b. Low pressure side hose
   c. Bypass hose
   d. Red hose

8. What is the object at letter B called?
   a. High-side control valve
   b. Bypass control valve
   c. Low-side control valve
   d. Red control valve

9. What letter indicates the hose to connect to test valve 2 when testing a DCVA check valve 1?
   a. A
   b. G
   c. F
   d. E

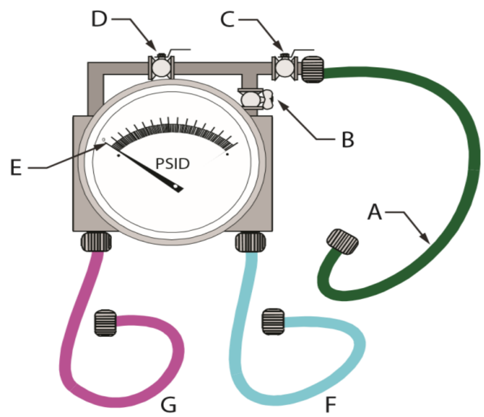


Figure 1

Content

10. If during testing of a RP, the psid reading drops, this would indicate that the pressure in the zone of reduced pressure is increasing.
    a. True
    b. False
11. What is the acceptable minimum diameter of a sight tube?
    a. ¾"
    b. 1"
    c. 1½"
    d. 2"
12. What is the height of the water in a sight-tube when completing a sight-tube test of a DCVA? a. 300mm (12")
    b. 600mm (24")
    c. 686mm (27")
    d. 705mm (27¾")
13. What is used to compensate for a leaking shut-off valve 1 when testing a DCVA with a differential pressure gauge?
    a. Sight-tube
    b. Bleed-off assembly
    c. Bypass hose
    d. Standard pressure gauge
14. What do you do next after testing the relief valve of an RP and you are opening test valve 4?
    a. Open the low-side bleed needle valve
    b. Open the high-side bleed-needle valve
    c. Open the bypass control valve
    d. Close the bypass control valve
15. What is the reason for installing a short tube on a low positioned test valve 3 when testing the check valve 1 of a DCVA using a differential pressure gauge?
    a. To check for leaks
    b. To ensure shut-off 2 is closed
    c. To ensure accurate gauge readings
    d. To determine the line pressure

Content

16. What is the correct position of the differential gauge in relation to the water level in a short tube installed at test valve 3 of a DCVA when testing the test valve 1?
    a. At the bottom of the tube
    b. Above the top of the tube
    c. At the water level in the tube
    d. Below the center line of the DCVA
17. Pretest activities of backflow assemblies include; notify, identify, inspect and test.
    a. True
    b. False
18. The second test requirement of a RP is
    a. check valve 2 shall hold tight against all pressures in reverse direction
    b. the relief valve shall open at or above 2 psid (13.8 kPa)
    c. the buffer shall be a minimum 2 psid (13.8 kPa)
    d. the check valve 1 shall hold tight against all pressures in direction of flow
19. What is the minimum buffer required for a RP?
    a. 3 psid (21 kPa)
    b. 2 psid(13.8 kPa)
    c. 4 psid (28kPa)
    d. 8 psid (55 kPa)
20. What direction of flow is the check valve 1 of a RP tested?
    a. No flow direction
    b. The reverse direction of flow
    c. The direction of flow
    d. Any direction is approved
21. Which of the following test procedure of a RP is approved?
    a. Flush the assembly and piping before starting a test
    b. Notify the owner after you have started the test
    c. Flush the assembly after completing the test to facilitate repairs
    d. Place the end of the bypass hose down into a drain

Content

22. Which test valve is opened first when preparing for the RP test?
    a. test valve 2
    b. test valve 3
    c. test valve 4
    d. test valve 5

23. To calculate the buffer of a RP, what would you do?
    a. Add the relief valve opening psid and apparent psid
    b. Subtract the apparent psid from the actual psid
    c. Subtract the relief valve opening psid from the actual psid
    d. Subtract the actual psid from the relief valve opening psid

24. Open all test valves very quickly to blowout debris quickly.
    a. True
    b. False

25. What test valve is the high-side hose connected to when testing a RP?
    a. test valve 1
    b. test valve 4
    c. test valve 2
    d. test valve 3

26. Which of the following is the last item recorded when testing of a RP?
    a. The check valve 2
    b. The line pressure
    c. The buffer zone
    d. The relief valve port

27. What RP component are you testing when you are connecting the bypass hose to test valve 4?
    a. The relief valve
    b. The check valve 1
    c. The check valve 2
    d. The shut-off 2

Content

28. When testing a RP, what are you doing by connecting a bypass hose from test valve 1 to test valve 4?
    a. Flushing the relief valve
    b. Testing the check valve 1
    c. Flushing the check valve 2
    d. Compensating for a leaking shut-off 2
29. Who determines the number of copies of test forms required?
    a. AHJ
    b. Tester
    c. Owner
    d. Product supplier
30. Why is the water turned on slowly after completing test procedures of an RP?
    a. To avoid relief valve spillage
    b. To avoid water hammer
    c. To avoid the owner
    d. To prevent check valve 1 leakage
31. What is the first requirement of the DCVA test using a three-valve differential gauge?
    a. Check valve 1 closed tight in the direction of flow
    b. Check valve 1 static pressure drop shall be at least 2 psid
    c. Check valve 1 static pressure drop shall be at least 1 psid
    d. Check valve 2 static pressure drop shall be at least 2 psid
32. What component are you testing when you connect the high pressure side hose to test valve 3 of a DCVA using a three-valve differential gauge?
    a. Check valve 1
    b. Check valve 2
    c. Shut-off 1
    d. Shut-off 2
33. Which test step is not a DCVA test procedure using a three-valve differential gauge?
    a. Connect the high-side hose to test valve 2
    b. Coil up unused test hoses
    c. Connect a short tube to the lower downstream test valve 3
    d. Connect the low-side hose to test valve 2

Content

34. Which backflow assembly requires that the 3-valve differential be mounted at the same height of the valve?
    a. RP
    b. DCVA
    c. DuC
    d. AVB

35. What test valve is a 36" (914 mm) sight-tube attached to when testing the check valve 1of a DCVA using the alternate site-tube test procedure?
    a. Test valve 2
    b. Test valve 1
    c. Test valve 3
    d. Test valve 4

36. What pressure is a column of water 27¾" (705mm) high equal to?
    a. 0.2 psi
    b. 0.5 psi
    c. 1 psi
    d. 2 psi

37. What backflow preventer is tested with a confirmation test?
    a. RP
    b. DCVA
    c. AVB
    d. PV

38. What is the second requirement of the first test of a PVB using a 3-valve differential gauge?
    a. The air-inlet valve shall open at not less than 1 psid
    b. The air-inlet valve shall be fully open when the valve body is completely drained
    c. The check valve shall hold a minimum 1 psid pressure drop in the direction of flow
    d. The shut-off shall be closed tight

Content

39. What valve is open first when the water is turned back on after completing the test of the PVB using a three-valve differential gauge?
    a. Shut-off 1
    b. Shut-off 2
    c. test valve 2
    d. test valve 1

40. What component are you testing when you connect the high pressure hose to test valve 2 of a PVB using a three-valve differential gauge?
    a. The air-inlet valve
    b. The canopy
    c. The 2 test valve 2
    d. The check valve

41. What is the purpose of a confirmation test when testing a DCVA with sight-tubes only?
    a. Test the air-inlet valve opening psid
    b. Test the check valve 1 spring psid
    c. To ensure that check valves can hold against reverse flow
    d. Test the check valve 2 spring psid

42. What is the last test requirement recorded when testing a RP with a differential pressure gauge?
    a. Buffer
    b. Line pressure
    c. Actual psid
    d. Relief valve opening psid

43. What test valve should be used when testing for line pressure on any assembly?
    a. 1
    b. 2
    c. 3
    d. 4

Content

44. What is the purpose of continuous regular testing of backflow preventers?
    a. ensure continued cross connection protection
    b. prevent water loss
    c. raise money to support the cross connection program
    d. increase water consumption

45. What other test frequency is there of backflow assemblies besides annually, after maintenance and repair, as often as required by a water purveyor, at initial installation?
    a. Before installation
    b. After each water use
    c. After relocation
    d. Before being relocated

46. What criteria refer to a backflow assembly that currently installed but is not approved?
    a. must be removed
    b. does not need to be tested
    c. must have parts added to bring up to current standards
    d. may remain in service provided it can be tested and functions for the purpose installed

Check your appendix answer key

Have you accomplished your objectives of this chapter 8? Review your Chapter 8 objectives.

If you feel you have accomplished the objectives of Chapter 8, you may wish to proceed to Chapter 9.

Content

Chapter 9 Troubleshooting test procedures, maintenance and repair for backflow preventers

Objectives

After completing this chapter of the course, you will be able to:

- Identify and apply solutions to problems that occur while testing backflow preventers
- Diagnoses plumbing-related systems and components. (backflow preventers)
- Test or arrange for testing of cross-connection control devices according to AHJ

Introduction

Troubleshooting is an integral part of testing and is necessary to avoid unjustified assembly replacement or repair. While testing backflow preventers you may encounter problems relating to the operation of the components being tested. The testing you have done up until now has dealt with assemblies that have had few problems. This chapter will present various problems and solutions that may occur during the testing of backflow preventers. The troubleshooting techniques you will learn here will provide a solid basis for troubleshooting on the job. It is recommended that you take full advantage of the shop/lab facilities to practice troubleshooting procedures.

This chapter does not deal specifically with maintenance and repair procedures of any particular manufactured backflow assemblies.

- You must follow the manufacturer maintenance instructions not this manual.
- All pressures used in the example scenarios in this chapter are for demonstration only.
- Actual pressures in the field will vary depending on the assembly model make and line pressure.

Basic troubleshooting of backflow assemblies

Some basic problems and solutions have been listed to provide a starting point for troubleshooting. Field experience will increase your ability to troubleshoot and repair backflow preventers. Many problems with backflow preventers can be attributed to debris and water quality. Sometimes all that is required is flushing the valve or cleaning and re-assembly. Where debris is a problem, strainers should be installed.

Troubleshooting can be very simple and cost effective or it can be complicated, time consuming and costly. When checking an electric light bulb that is not working your thought process would be to check the switch is on first and if power is present. You would not want to start by replacing the electrical panel, the wiring the switch and finally the light bulb. The same principal applies when troubleshooting a backflow preventer. Choose the path of least resistance the most likely cause of failure, then eliminate all trouble possibilities one by one.

When testing a backflow preventer, a component may fail. You do not have to repair the component right away. It is often possible to complete the test procedure on other components even when one component fails the test. This is not the case if the failed component makes it impossible to determine proper test results for any other component tested. Wait until you finish the assembly test procedures, then complete all repairs at the same time. This may save time and money for you and your customer.

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Trouble shooting procedures in this manual are limited to the examples provided in controlled scenarios. What can happen in the field is not controlled and you will need to rely on your own trouble shooting abilities and knowledge of how the assemblies are designed to work.

Maintenance and repair of a backflow assembly requires a sound understanding of the sequence of operation and the operation and purpose of individual components. The purpose of a repair is to return the assembly to its initial operating specifications. Recall that a backflow assembly must be retested after each maintenance and or repair. The decision to repair an assembly can be an expensive one and also require the water system to be shut down.

Typical reasons for maintenance and repair of a backflow assembly:

- Debris from water trapped inside the assembly and caught under valve seats
- Freezing
- Excessive heat
- Normal wear from the internal parts moving thousands of times during the year
- Buildup of mineral deposits inside the valve (poor quality water)
- Manufacturer defects

Typical maintenance and repair practices

- You must be certain a repair is needed and is not the result of an error in your test procedures.
- You need to make sure the repair parts you will need are readily available.
- Parts from similar devices of different manufacturers must not be interchanged.
- You should be able to provide the name or part number of the components of the backflow assembly when ordering parts.
- The components of backflow preventers and the materials they are made of are regulated by cross connection standards. The use of any other component or material not specifically approved for use in backflow preventers is not permitted.
- Plan the repair so the water system is shut down for the minimum time duration.
- Make prior arrangements with the owner to have permission to shut down the water system and again when the water is turned on.
- If a bypass is present, insure the bypass has the same level of protection.
- Use only lubricants that are rated for use on potable water systems.
- Do not use pliers or tools that can damage plastic parts.
- Do not use pipe dopes, oil, grease or solvents on any parts unless specifically directed by the manufacturer's instructions.
- Do not use abrasive cloths or etching cleaners to clean components
- Do not sand or file components.

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Typical maintenance and repair practices continued

- Use a drop cloth. This helps if you drop a small component.
- Remove replace each component carefully. Use manufactures instructions.
- When troubleshooting while using the test the procedures. Always be sure to check your procedures first to ensure you are not at fault.
- Check all connections for leaks when testing. The fault may be due to a leaking hose connection or test gauge component.
- Rinse all parts with clean water prior to assembly.
- Do not force parts. Parts should fit freely together Excess force may cause damage and render the device inoperable.
- Carefully inspect seals, seating surfaces, etc. for damage or debris.
- Test backflow preventer after servicing to insure proper operation.
- In all instances of repair and maintenance the manufacturer's instructions must be followed. The use of non-approved maintenance procedures or replacement parts not specifically identified for a specific backflow preventer is prohibited.
- Warranties will be voided and your liability risk will be increased if you decide not to follow approved maintenance and repair procedures.
- Many manufacturers have designed backflow preventer components as assembled modules; for example, a check-valve 1 modules and a check-valve 2 modules. A faulty module is simply replaced.
- Use caution when removing cover plates of the assemblies. Spring tension on some types of valves is strong and can cause injury if the correct tools are not used. Refer to the manufacturer directions.
- Turning a valve disc over to make temporary repairs is permitted. Using a replacement disc made out of any other material than the material supplied by the manufacturer for that specific valve is not permitted.

Content

Typical maintenance and repair practices continued

Refer to applicable manufacturers parts list and figures to be sure you order the correct parts.

Here is an example showing the names of the inside components of a typical backflow assembly:

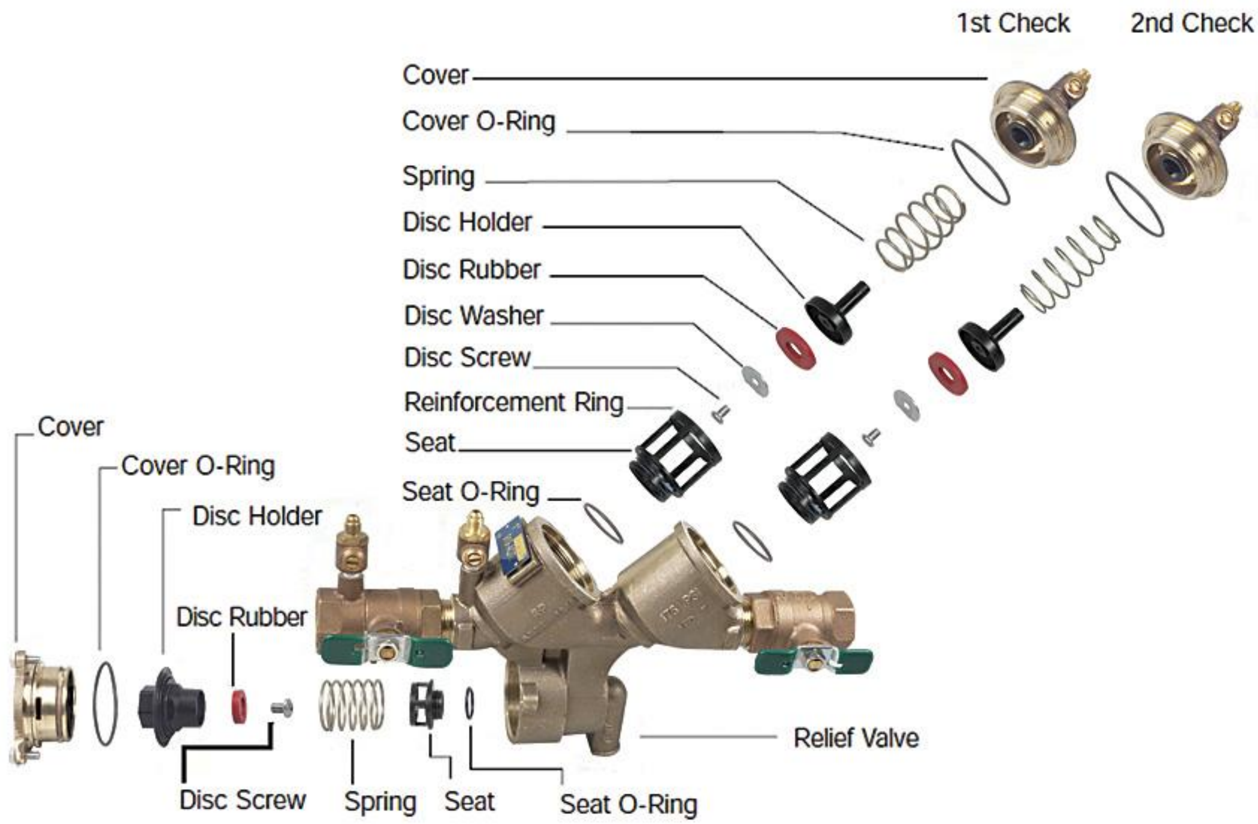

Figure 9- Manufacturers RP parts
Picture courtesy of watts Canada

Content

Regulatory maintenance recommendations

Regulatory authorities may adopt recommended standards for maintenance procedures.

The Canadian Standards Association (CSA) has published some recommended basic maintenance requirements. When a regulatory authority adopts these CSA standards you are obligated to conform to these maintenance requirements.

Here are some examples of CSA maintenance requirements:

- If a backflow preventer has to be removed from a water line and the line is used as the electrical ground, a jumper wire shall be installed.
- When entering a confined space, entry procedures established by the regulatory authority shall be followed.
- Backflow preventers designed for in-line servicing and repair shall not be replaced with a spool or pipe and shall not be reassembled while awaiting delivery of replacement parts if any parts have been removed.

Note: To eliminate the necessity of removal for servicing, many backflow preventers are designed for in-line repairs.

- Once a backflow preventer has been removed, no protection is provided. A false sense of protection can be given when a backflow preventer appears to be still operational.
- Valve springs on large backflow preventers shall be removed with caution. The manufacturer's instructions shall be consulted.
- After repairs are completed, entrapped air shall be bled off.

RP backflow preventers (CSA) maintenance requirements:

- On RP backflow preventers, parts in the upstream check-valve need not be interchangeable with the parts in the downstream check-valve.
- If an RP backflow preventer is continuously leaking from the relief-port, the upstream check valve, the downstream check-valve, or the relief-valve has failed. The check-valves shall be cleaned and the valve seats checked for damage.
- If the downstream shut-off valve of an RP backflow preventer is closed and water begins to be discharged from the relief-port, the upstream check-valve shall be checked for possible leakage.
- If the atmospheric port of DCAPC backflow preventer discharges, the device shall be disassembled thoroughly inspected, cleaned, and reassembled with new parts as necessary, following the manufacturer's instructions.
- DCAPC backflow preventers shall be checked for water and carbon dioxide (C02) leaks before they are returned to service.

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Troubleshooting the RP

Before starting the troubleshooting of the RP test procedures you need to consider some of the following:

1. **The relief-valve can open when you close the shut-off 2 during testing.**
   - A leaking check-valve 1 would be the first thing to check. A leaking check-valve 1 will cause the pressure in the zone of reduced pressure to increase causing the relief-valve to open. Flush the valve, retest. If needed clean components or replace components or module.
2. **The relief valve discharges continuously during a no-flow condition.**
   - The check-valve 1 stem may be fouled. Check the stem and guide. Flush the valve and retest. If problem persists, clean the components or replace components or module.
   - The check-valve 2 may be leaking under a backpressure condition. Flush the valve retest. Clean components or replace components or module.
3. **A relief-valve intermittently discharges in a no-flow condition.** (Before the shut-off 2 is closed.)
   - A valve closed a downstream valve suddenly will cause water hammer. The water hammer may cause check-valve 2 to compress the disk enough to cause the relief-valve to spit. Install water hammer arrestors.
   - Water pressure fluctuations upstream of the backflow preventer during low-flow or no-flow conditions can cause the relief to spit. (nuisance spillage) Provide water hammer arrestors.
4. **The relief valve discharges continuously during both flow and no flow conditions.**
   - The relief-valve is fouled. Try flushing the relief-valve.
   - Damaged diaphragm, allowing water to enter the zone of reduced pressure. Replace relief valve module or individual components. Refer to manufacturer’s instructions.
   - High-side sensing line is blocked preventing line pressure from accessing the diaphragm. Clean the sensing line. Refer to manufacturer’s instructions.
   - The check-valve 1 stem and guide may not be moving freely. Refer to manufacturer’s instructions.
5. **The relief valve will not open during the relief valve test 1.**
   - The shut-off 2 is not closed properly or leaking, this will prevent you from pressurizing the zone of reduced pressure. If you are unable to pressurize the zone of reduced pressure you will not be able to induce the relief-valve to open when you testing. Reopen and close the valve. Retest the check-valve. Use a bypass hose to compensate for minor leaks and then complete the test procedures.
   - You may have not completed the test procedure properly. Check procedures and retest.
   - Relief valve stem and or guides fouled.

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6. **The relief-valve discharges continually during no flow conditions.**
    - Relief-valve is seat or disc is fouled with debris. Refer to manufacturer's instructions.
    - Damaged diaphragm allowing water to pass through to the zone of reduced pressure. Replace diaphragm and refer to manufacturer's instructions.
    - Relief-valve guides or stem fouled or scale buildup.
7. **The relief-valve has a high opening psid high at above 5psid (35kPa).**
    - Relief-valve disc may not be seating fully. Usually found in a relief-valve with rolling diaphragm that has become pinched or twisted, preventing the relief-valve from closing fully. Remove twists or pinches and or remove and replace the diaphragm.
    - Note: A rolling diaphragm is a diaphragm that is not a flat diaphragm. A rolling diaphragm is domed-shaped or molded. Refer to the SRVPA examples in chapter 8 showing a rolled diaphragm. Rolled diaphragms provide easier movement, low friction and better sensitivity, among other advantages.
8. **The relief-valve opens too low**
    - The relief-valve stem travel restricted.
    - Damaged relief-valve components corrosion or scale build up. Clean components or replace each. Replace the relief-valve module.
    - Note: different makes and models or the RP may have different reasons for a low relief-valve opening psid. Refer to manufacturers' instructions.
9. **The check-valve 2 fails to hold backpressure during the test.**
    - Shut-off 2 may not be closed completely. Reseat the shut-off valve.
    - Check-valve 2 seat fouled with debris. Increase the flow through the assembly to try and flush debris off of the seat.
    - Check-valve 2 stem and guide fouled or worn. Clean or replace components or module.
10. **The actual pressure differential measured across check-valve 1 is low during the field test.**
    - The check-valve 1 stem is not moving freely in the guide.
    - Check-valve is fouled with debris. Increase the flow through the check-valve and try to scour debris off the disc and seat. Clean seat, disc and guide. Replace components or module.
    - Upstream pressure fluctuations during the procedure. Reestablish the actual pressure drop by bleeding water from the zone of reduced pressure.

Content

Troubleshooting Guide Reduced Pressure Backflow Preventers. Courtesy watts Canada

Problem	Cause	Should valve be replaced	Solution
A. Valve spits periodically from the vent.	A-1 Fluctuating supply pressure	No	A-1 Install a spring-loaded, soft seated check valve immediately upstream of the device.
	A.2 Fluctuating downstream pressure.	No	A-2 Install a spring-loaded, soft seated check valve downstream of the device as close as possible of the shut off valve
B. Valve drips continually from the vent.	B-1 Fouled first check.	No	B-1 Flush valve. If flushing does not resolve problem, disassemble valve and clean or replace the first check.
	B-2 Damaged or fouled relief valve seat	No	B-2 Clean or replace the relief valve seat
	B-3 Relief valve piston "O" ring not free to move due to pipe scale, dirt or build-up of mineral deposits	No	B-3 Clean, grease or replace the piston "O" ring
	B-4 Excessive backpressure, freezing, or water hammer has distorted the second check.	No	B-4 Eliminate source of excessive backpressure or water hammer in the system downstream of the device. Use Watts No. 601 to dampen out backpressure and No. 15M2 to eliminate water hammer. Replace defective second check assembly. In case of freezing; thaw, disassemble, and inspect internal components. Replace as necessary.

Content

Troubleshooting Guide Reduced Pressure Backflow Preventers. Courtesy watts Canada continued

Problem	Cause	Should valve be replaced	Solution
	B-5 Electrolysis of relief valve seat or first check seats.	No	B-5 Replace relief valve seat or inlet cover. Install dielectric unions (Watts Series 3001 through 3006). Electrically ground the piping system and/or electrically isolate the device with plastic pipe immediately upstream and downstream of the device.
	B-6 Valve improperly reassembled.	No	B-6 If valve is disassembled during installation, caution must be exercised to install check springs in their proper location.
C. Valve exhibits high pressure drop.	C-1 Fouled strainer.	No	C-1 Clean strainer element or replace
	C-2 Valve too small for flows encountered.	Yes	C-2 Install proper size device based upon flow requirements.
D. No water flows downstream of valve	D. Valve installed backwards.	No	D. Install valve in accordance with flow direction arrow.
E. Valve does not test properly	E-1 Follow manufacturer's test procedure	No	E-1, E-2 Clean or replace gate valve with full port ball valves or resilient wedge shutoff valves.
	E-2 Leaky downstream gate valve.	No	
F. Valve quickly and repeatedly fouls following servicing.	F. Debris in pipe line is too fine to be trapped by strainer.	No	F. Install finer mesh strainer element in the strainer.
G. Winterization of backflow preventers.			G. Prevent freeze damage by enclosing in a heated enclosure.

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Troubleshooting a continuously running relief-valve when you arrive to test the valve prior to starting the test procedure.

When you arrive and the relief-valve is discharging some water continuously you will need to determine what is causing the relief-valve discharge.

RP relief-valve is discharging upon arrival to test the RP.

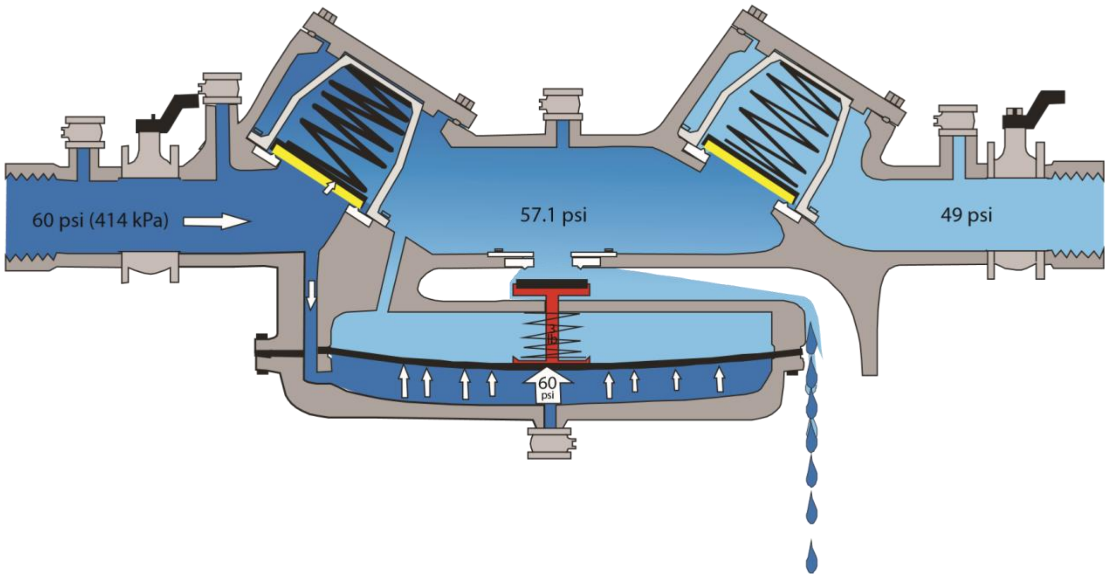

Figure 9-1—Relief valve discharging on arrival

Content

Possible causes relief valve discharging on arrival

1. Faulty relief-valve and debris under relief-valve seat or disk. The valve will not close so water continues to run from the relief-valve port. You could close shut-off 1 and cause the relief-valve to open. Water may flush the debris from the relief-valve.

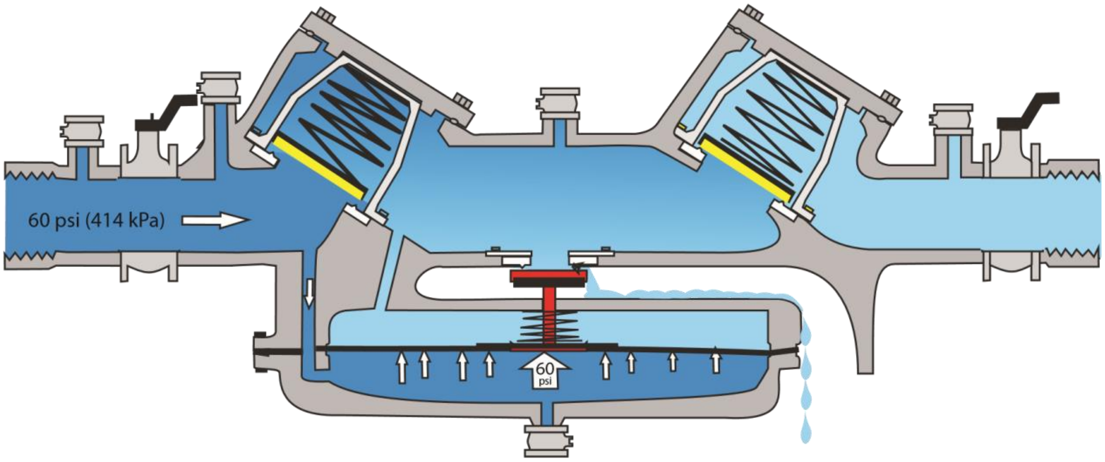

Figure 9-2—Debris under relief-valve seat

2. Faulty check-valve 1, debris is caught under the seat. The check-valve will not close tight. The water enters the zone of reduced pressure causing the zone pressure to increase; therefore, opening the relief-valve and spilling water from the relief valve port when no water is being used in the system. This is called intermittent spillage because it does not show up until the water is not in use or the shut-off 2 is closed.

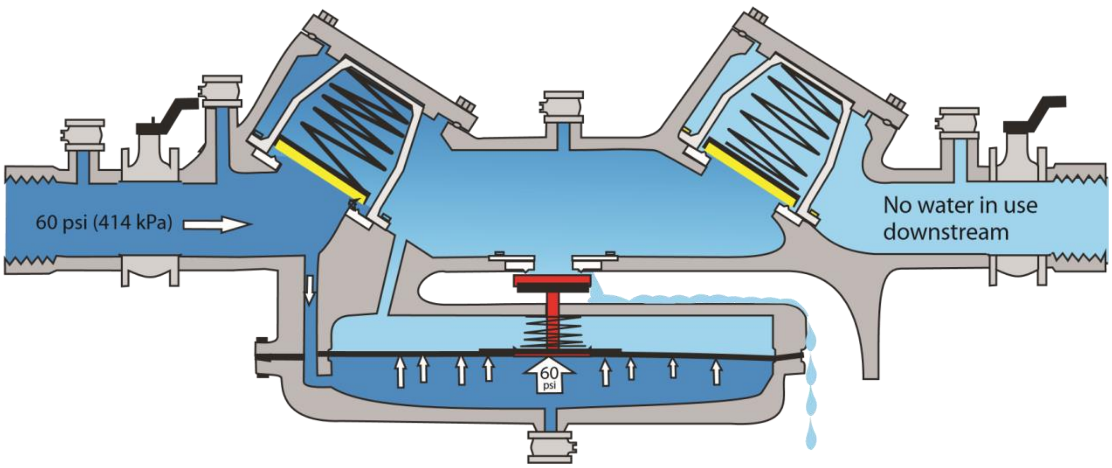

Figure 9-3—Leaking check-valve 1 debris under the seat

Content

RP is discharging upon arrival continued

3. A faulty check-valve 2 and backpressure condition allows water to flow back into the zone of reduced pressure causing the pressure in the zone to increase and eventually opening the relief-valve and spilling water from the relief-valve port.

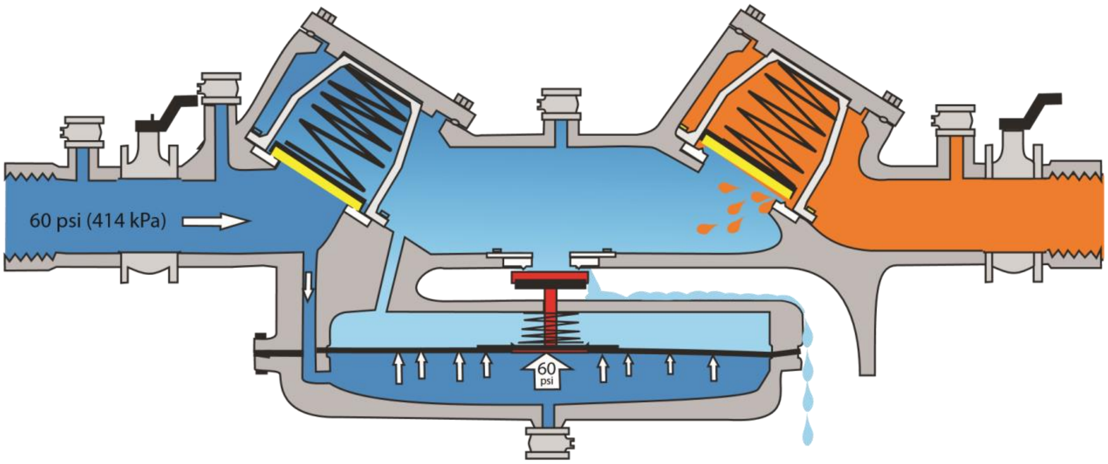

Figure 9-4—Leaking check-valve 2 and backpressure

4. Diaphragm damaged, torn high pressure enters the zone of reduced pressure causing the pressure in the zone to rise and the relief valve to remain open, spilling water from the relief valve port.

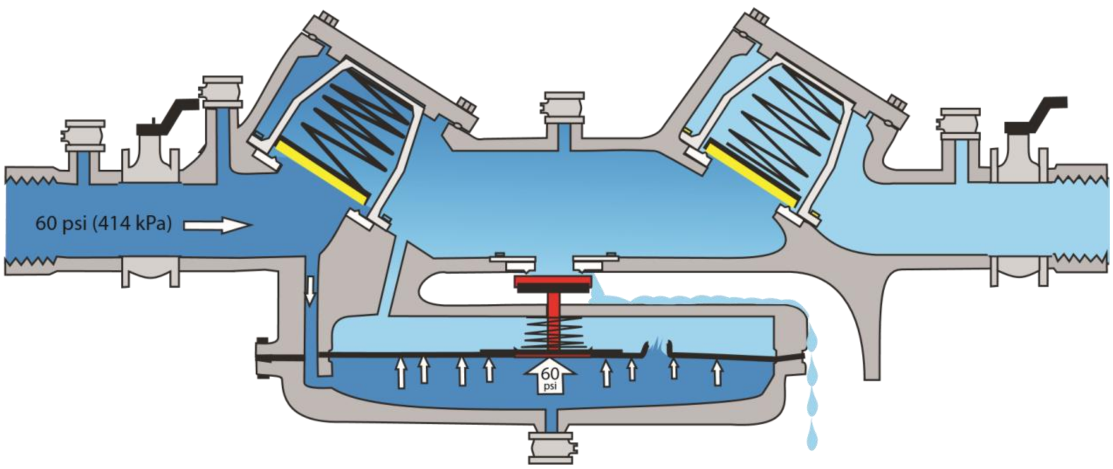

Figure 9-5—Torn diaphragm

Content

RP is discharging upon arrival continued

5. Blocked relief-valve sensing passage. The sensing passage is blocked preventing line pressure from pushing the diaphragm closed. The relief valve spring forces the relief valve open spilling water from the relief-valve port.

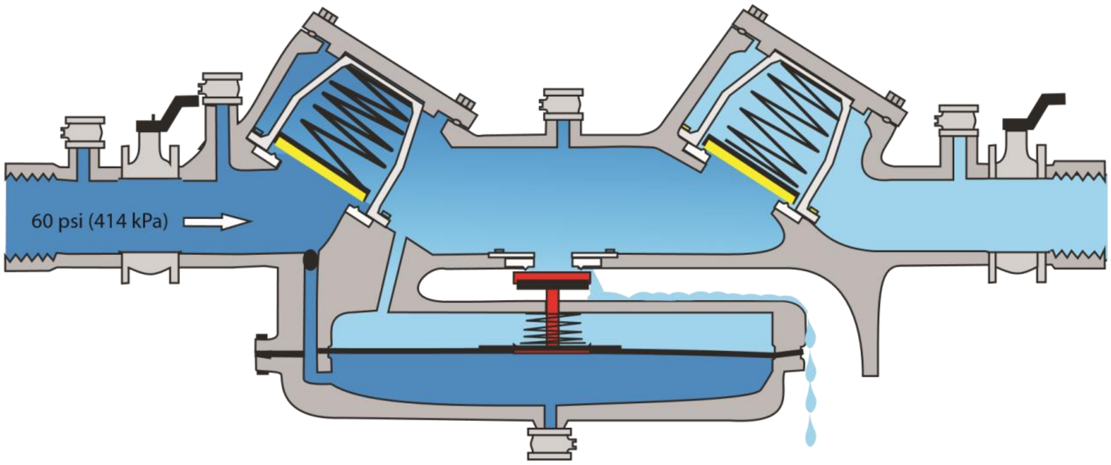

Figure 9-6—Blocked sensing passage

Content

Problems arising during the RP test procedures.

Reference material used for these RP troubleshooting procedures was interoperated from the University of Southern California Foundation for Cross Connection Control and hydraulic Research Manual Tenth Edition. Use these interpreted troubleshooting procedures at your own risk. These trouble shooting procedures are for educational use only. You must comply with the manufactures specifications and the authority having jurisdiction where you are working. Currently there is little if any troubleshooting information in CSA standards, Plumbing Codes and local AHJ bylaws.

Scenario 1 Beginning to test the RP and the relief-valve opens

After hooking up the differential pressure gauge and bleeding the guage and hoses, you close shut-off 2. (Figure 9-7) The relief-valve immediately starts to discharge continuously and the psid reading on the differential valve drops and you suspect that the check valve 1 may be leaking.

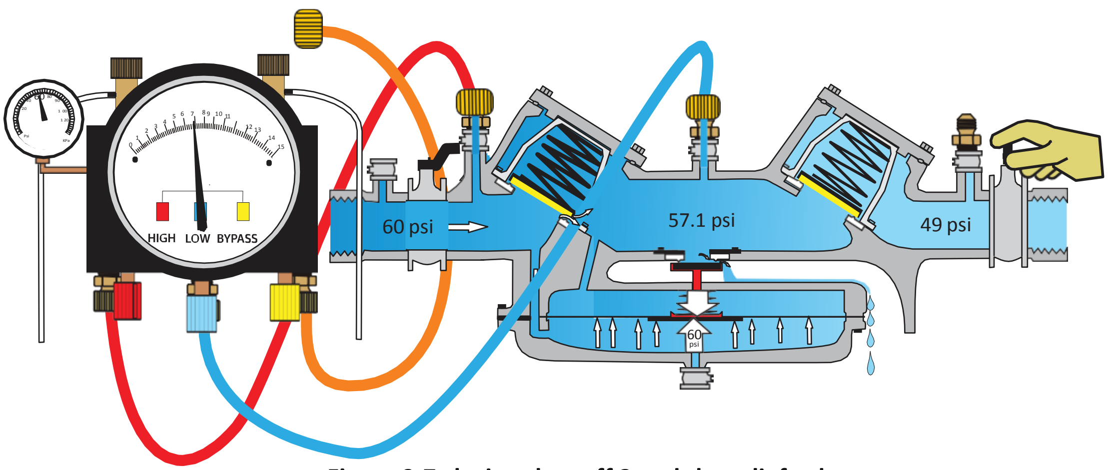

Figure 9-7 closing shut-off 2 and the relief valve open

Solution:

Try flushing the check valve by opening a downstream faucet to induce as much flow as you can to flush debris from the check-valve. If you have sufficient flow to flush out the debris. close the valve to stop the flow. You may be able to complete the full test procedure.; otherwise, the check valve 1will

Remove text from figure box

1. Observe the gauge reading with the relief-valve discharging this is the approximate opening psid of the relief-valve; however, the reading is not accurate.
2. Once you think you have flushed the assembly adequately to remove debris from the check-valve reclose shut-off 1 tight.
3. If the relief-valve is no longer discharging, you can record that the relief-valve had originally discharged and you flushed the assembly as a repair process.
4. You can carry on and complete the rest of the test procedure starting with the noting the apparent pressure and the relief-valve opening Record the first test attempt as valve failure.

If the relief-valve continues to discharge you cannot complete the test procedures and will need to repair the check-valve, Record the repairs that you did and retest the RP completely.

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RP test 1 for troubleshooting when testing the relief-valve

Scenario 1: Beginning the RP relief-valve test procedure and shut-off 2 is not holding tight.

You are slowly opening the low-side control valve (Figure 9-8) to start the test to determine the relief-valve opening psid. You have opened the low-side control valve more than 1/4 of a full turn. The gauge needle has stopped dropping and relief-valve is not opening. Something is not right and you first suspect that the shut-off 2 is not closed tight so pressure cannot build up in the zone and trip the relief valve.

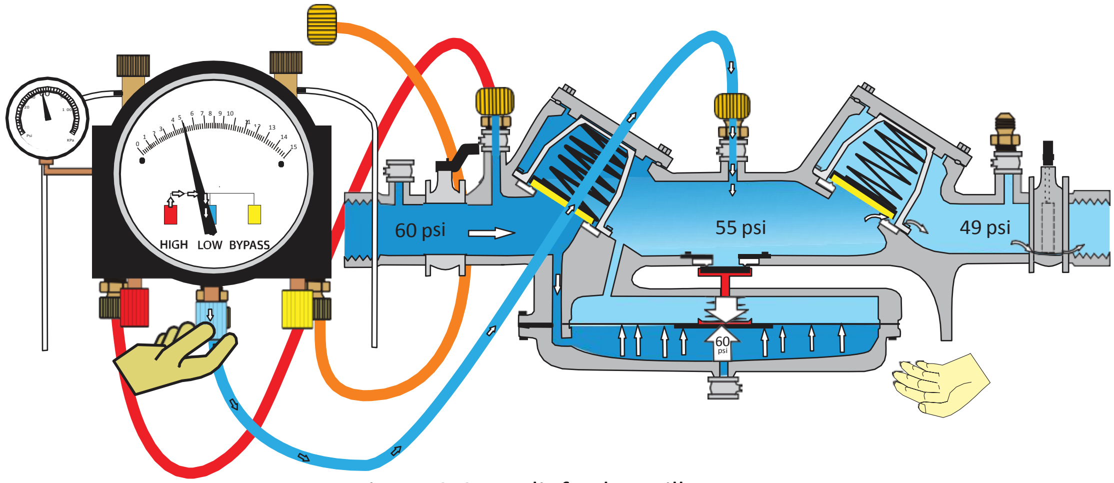

Figure 9-8—Relief valve will not open

Solution scenario 1: Shut-off 2 is not closing tight.

The probable cause of this is that shut-off 2 is not closed tight or is leaking. First ensure that shutoff 2 is closed tight. (Figure 9-9) If this solves the problem, proceed with the normal test procedures.

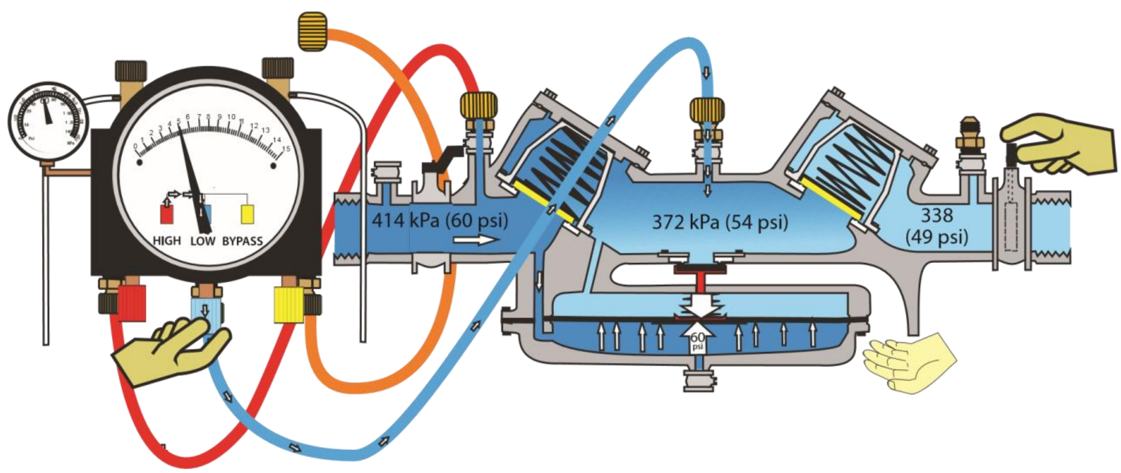

Figure 9-9—Ensure shut-off 2 is closed tight

Content

Completing the RP relief-valve test procedures with a leaking shut-off valve 2

Scenario 1: RP Shut-off 2 is leaking

If the shut-off 2 is leaking (Figure 9-10) after you have tried to close it tight you may be able to can complete the test procedure by connecting a bypass hose from test valve 1 and to test valve 4. Open test-valve 2 and test-valve 4 to introduce line pressure behind the check-valve 2. The pressure may hold the check-valve closed and may compensate for a small leak in the shut-off 2. The test of the relief-valve can be completed. The remaining test of the RP can also be completed.

If the bypass hose is not able to supply sufficient water to complete the relief-valve test, shut-off 2 must be repaired or replaced before completing the test procedure.

You are able to complete the test of the relief valve because you were able to compensate for the leaking shut-off 2 by building up pressure behind the check-valve 2.

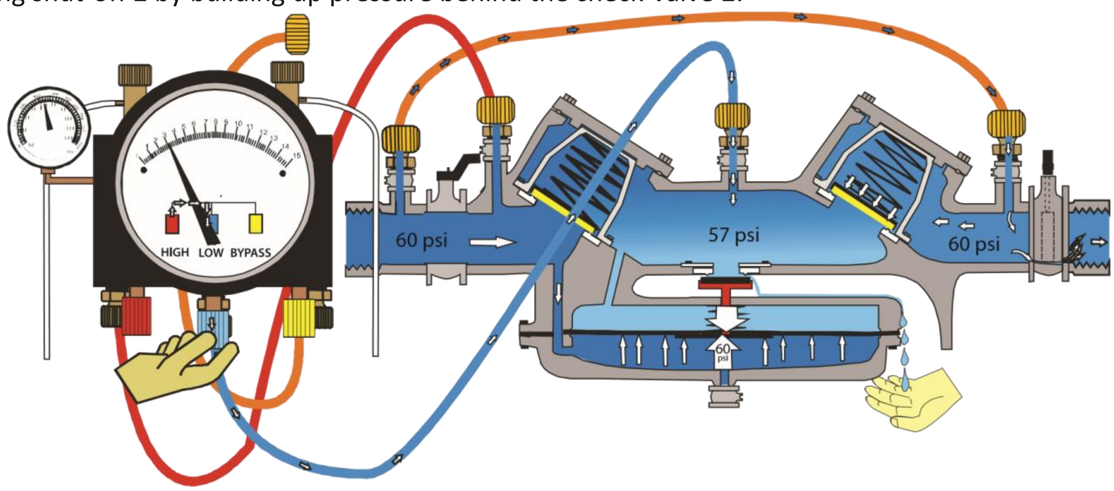

Figure 9-10—Compensating for a leaking shut–off 2

You can now complete the rest of the test procedures.

It must be noted that while this temporary bypass hose remains connected to test-valve 1 and test-valve 4, a cross connection exists. A backpressure backflow condition could occur while completing the test procedure. The tester is responsible to ensure a cross connection does not occur as a result of performing this test. Remove the temporary bypass hose and prepare for the next steps to test check-valve 2 as soon as possible.

The use of the temporary bypass can be helpful otherwise you would need to repair the shut-off valve. On large devices this may be a costly job. Being able to complete the tests with a leaking shut-off may provide some additional time before expensive addition costs. Eventually repairs will be needed if the test requirements cannot be completed accurately.

Content

Check Valve 2 troubleshooting procedures

In figure 9-10 you used the bypass hose to compensate for a leaking shut-off valve 2 when testing the relief-valve. Your next procedure is to test Check-valve 2 in reverse direction. Refer to figure 9-11.

RP Test requirement 2, troubleshooting procedures for the check-valve 2

The following are problems encountered when testing check-valve 2 of the RP

Scenario 1: Opening the bypass control valve and the relief-valve opens. This could be caused by excessive disc compression. (Figure 9-11)

You have opened the bypass control valve to apply pressure to the backside of check-valve 2. You expecting to observe the disc compression; however, the gauge needle continues to drop until the relief-valve opens. You could assume this is an indication that check-valve 2 is leaking; however, you may be wrong. This relief-valve discharge could because by excessive disc compression.

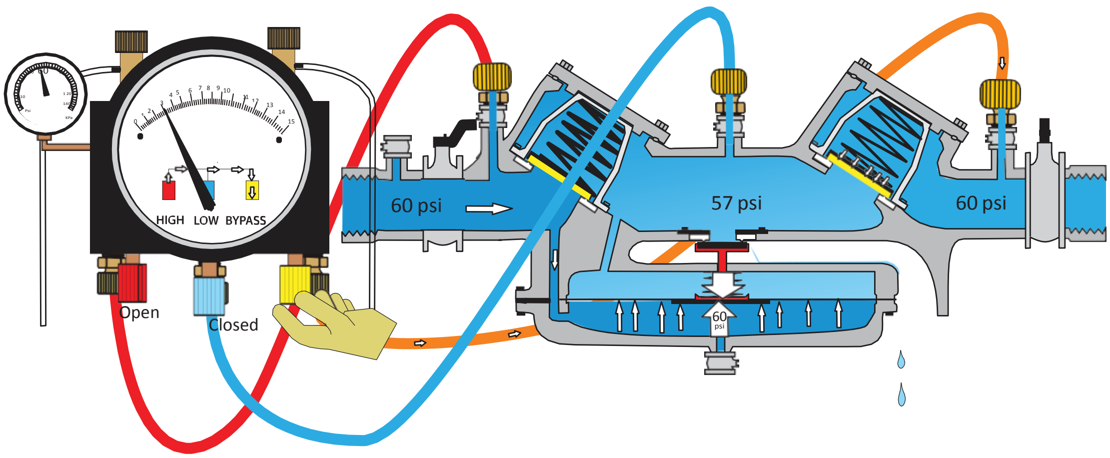

Figure 9-11 relief-valve discharge could be excessive disc compression

To determine if excessive disk compression or a leaking check-valve 2 has occurred refer to Figure 9-12.

Content

Scenario 1 Solution 1 for check-valve 2: Determine if excessive disk compression exists

1. To determine if high disk compression caused the relief-valve to open and not a leaking check-valve you can first reestablish the check-valve 1 apparent pressure. To reestablish the apparent pressure drop, open the low side bleed-needle valve, then close the low-side bleed needle valve (Figure 9-12) as the gauge reaches at or above the original apparent pressure drop.

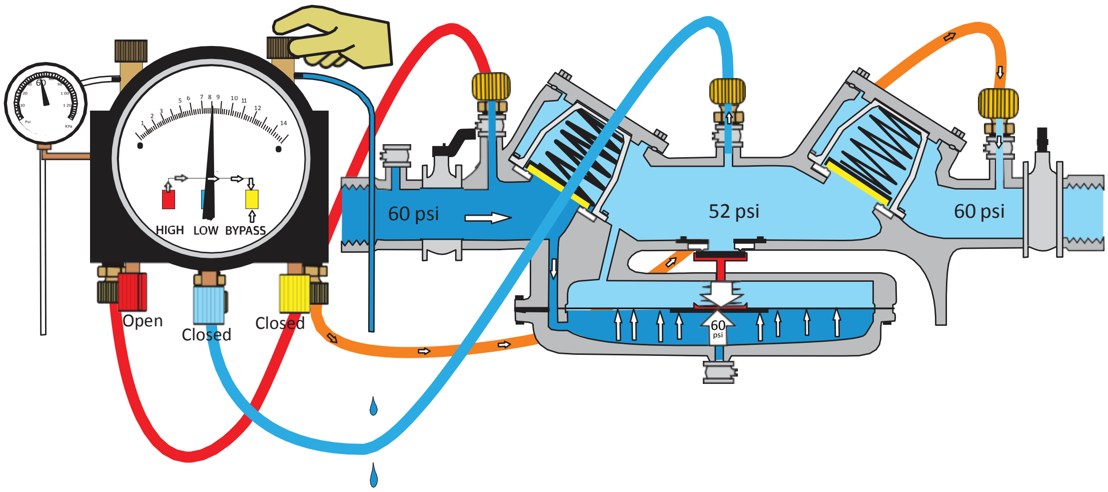

Figure 9-12—Determine if check-valve 2 is leaking or excessive disk compression exists

If the gauge now holds steady for 2 minutes and the relief-valve does not discharge, then check-valve 2 shall be recorded as closed tight. Proceed to the check-valve 1 normal test procedure.

If the gauge does not hold steady and the relief-valve discharges again then check-valve 2 shall be recorded as leaking and failed. The check-valve 1 test procedure cannot be completed, remove test gauge and repairs will need to be completed and the RP tested again.

Additional troubleshooting information

There are some troubleshooting procedures that you can use for testing check-valve 2 when shut-off 2 is leaking. These procedures do not appear in the CSA B64 10 1 standard.

The University of Southern California Cross Connection Manual is a good reference for test procedures including troubleshooting leaking shut-off 2 while testing check-valve 2. Always check with the AHJ do confirm uses of USC troubleshooting procedures.

Provided you have confirmed the relief-valve opening psid passed and check-valve 1 closed tight as passed. You may be able to record the apparent psid you originally observed just prior to the relief-valve test as your actual psid and calculate your buffer

The check-valve 1 and 2 check-valve 2 gauge readings may be lower; however, as long as they hold steady for 2 minutes and meet requirements of the test procedure they can be recorded as passed. Otherwise you must repair or replace the shut-off valve.

Make sure the AHJ approves and you are able to perform the troubleshooting procedures with accuracy and confidence. Otherwise if you are not too of what you are doing, you may just repair or replace the leaking shut-off valve. This is your sole responsible for performing the test procedures correctly.

Content

RPDA: Troubleshooting

Manufacturers producing detector check backflow preventers often use the same bodies as for their normal backflow preventers. They strive to provide good flow characteristics, reliability and costs savings. Bypass piping configurations differ and the location of the bypass piping components including any shut-offs and test-valves differ from manufacturer to manufacturer. Depending on the standards used to build the assemblies, the placement of test-valves and the placement of the bypass piping connections to the mainline assembly body can require additional testing steps. You may need to confirm the flow through the bypass to prove the bypass is not blocked. Blockage of the bypass does not decrease the backflow prevention ability of the assembly. A blocked bypass will prevent the assembly from detecting leaks or water theft and defeat the secondary purpose of the assembly.

The University of Southern California Foundation for Cross Connection Control and Hydraulic Research specifies the requirements for the location of test-valves and the connections of the bypass to the mainline assembly.

USCFCCCHR standard suggests wording similar to the following:

- The bypass piping must attach to the mainline assembly between the shutoff 1 and the check-valve 1, and between the check-valve 2 and the shut-off valve 2.
- The test-valve 4 of the mainline assembly shall not be located on the bypass piping and test-valve 4 shall not be attached to the mainline body at the same location as the bypass piping.

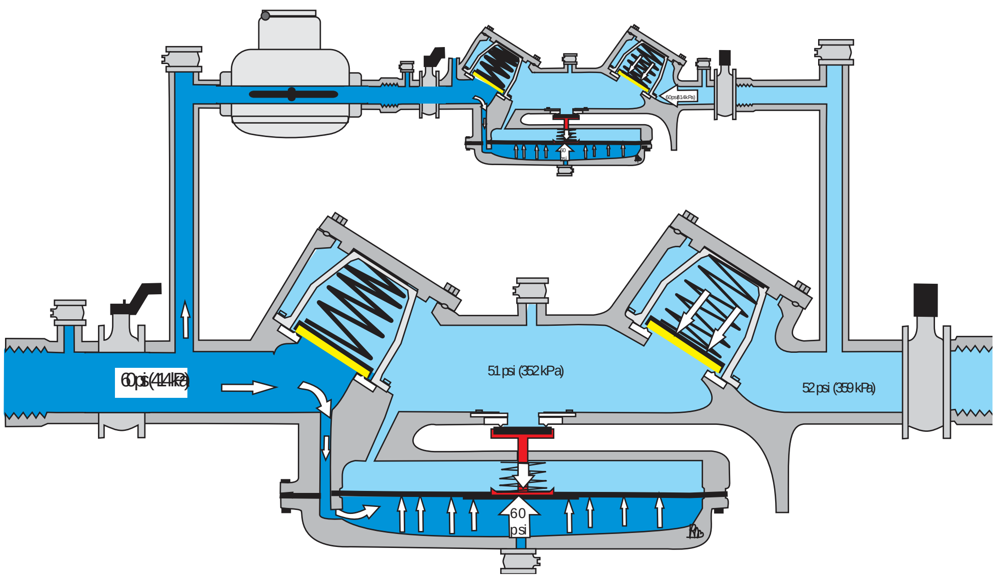

Figure 9-13-Reduced Pressure Detector Assembly

Content

RPDA: Blocked bypass

The following illustration depicts a hypothetical piping arrangement showing blockage of the bypass piping at the letter "A". The by-pass shutoff off is closed for testing.

The blockage at "A" should show-up when you try to flush the mainline test-valves at the start your test procedures after you have closed the bypass shut-off 2.

Open the test-valve 4, if no flow occurs and the test-valve is not plugged, the bypass is probably blocked. If the arrangement is such that you can clear the blockage from the test valve, you can proceed with the test procedure. You will need to refer to the manufacturer's installation and troubleshooting procedures.

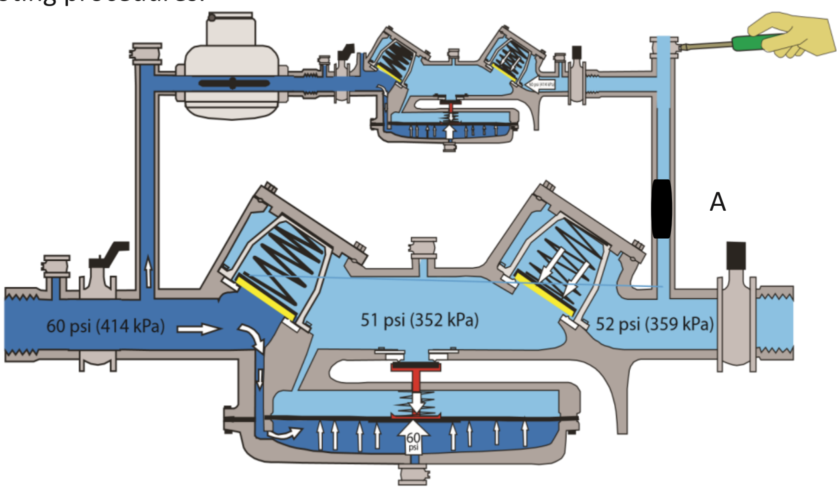

Figure 9-14—Reduced Pressure Detector Assembly

Note: In any case, you need to confirm that the bypass is not blocked no matter what configuration of components you find you will need to confirm flow through the bypass and meter. Any repair procedures you do will need to be reported on the test report form and forwarded to the appropriate AHJ.

Content

Troubleshooting DCVA test procedures:

Scenario 1: DCVA check-valve 1

When testing the check-valve 1 you open the test-valve 3, water continues to run from the sight tube. Water should not be continuously flowing.

When this scenario exists before you start the trouble-shooting procedure you should first observe the gauge reading minimum 2-minute steady state psid but do not record it yet; however, remember it. The reason for observing this psid now is you do not know which of the 3 potential problems are until you open the bleed-valve arrangement. If the problem is a leaking shutoff 2 and check-valve 2 under a backpressure condition the gauge reading will drop to "0". Check valve 1 is ok so you can use this reading as the pressure drop across check valve and closed tight.

The gauge reading may be needed as you proceed to troubleshoot depending on what happens when you open the bleed valve to begin the trouble shooting procedure. Do not jump to conclusions and assume that shut-off 1 is leaking. Three possible causes are listed below the diagram 9-15.

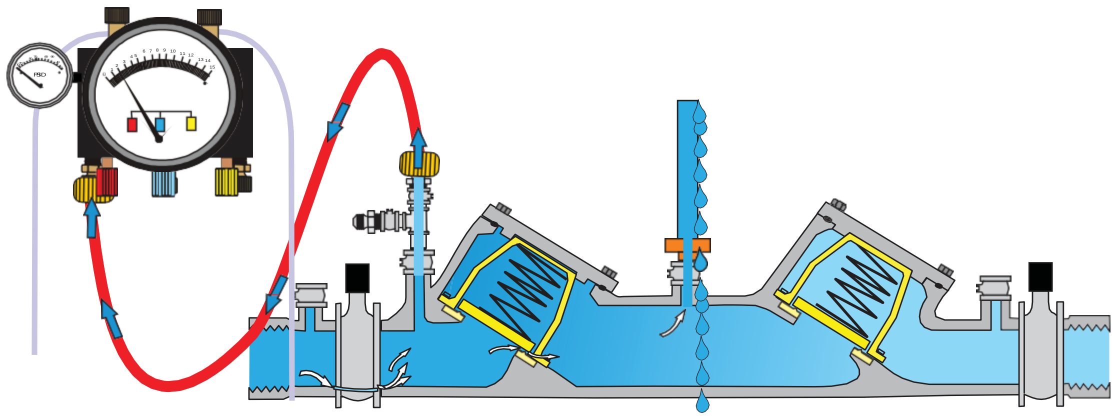

Figure 9-15—Shut-off 1 is not closed properly

In this drawing 9-15 test-valve 2 and 3 are open and water is continuing to flow from the sight-tube.

The reasons for this continued flow could be:

- Problem 1: Failure to close shut-off 1completely or,
- Problem 2: Leaking shut-off 1 or,
- Problem 3: Leaking shut-off 2 and check-valve 2 under a backpressure condition.

You need to determine which one of these problem you have and then find a solution.

Another different problem that could occur at this time is, water receding from test–valve 3 sight-tube.

More about this problem later.

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DCVA check-valve 1 problem 1, failure to close the shut-off 1 tight

When testing the check-valve 1 you open the test-valve 3, water continues to run from the sight tube.

Solution for problem 1: Failure to close shut-off 1 completely.

1. This is the easiest problem to fix simply check to see if shut-off 1 is closed tight. If the flow stops at test-valve 3 you have solved the problem. If flow still continues, check shut-off 2 is closed tight. If that stops the flow, you can wait for the minimum 2-minute steady state then record the pressure differential and check-valve 1 as passed if the psid is at or over 1 psid or failed if the psid is less than 1 psid. You can carry on and complete the RP test procedures

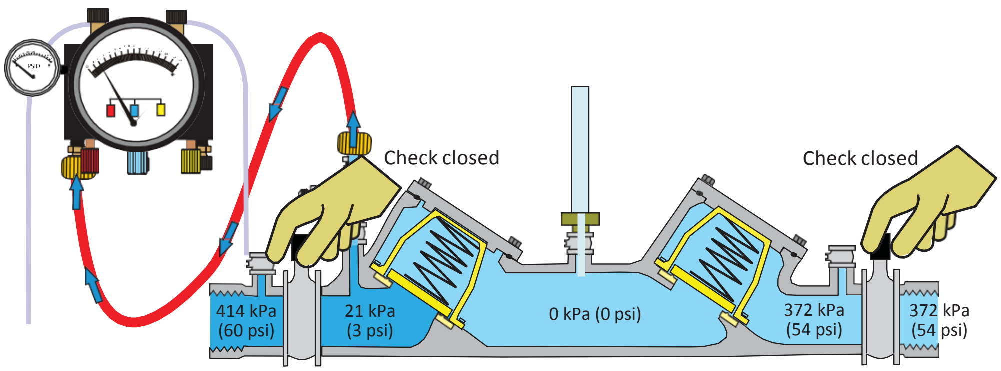

Figure 9-16 Check the shut-off valves are closed tight

3. If the gauge needle drops to "0" Figure 9-17, this would indicate a leaking check-valve just the same as when you are normally testing the DCVA. Record results and you can complete the normal test procedure of the DCVA

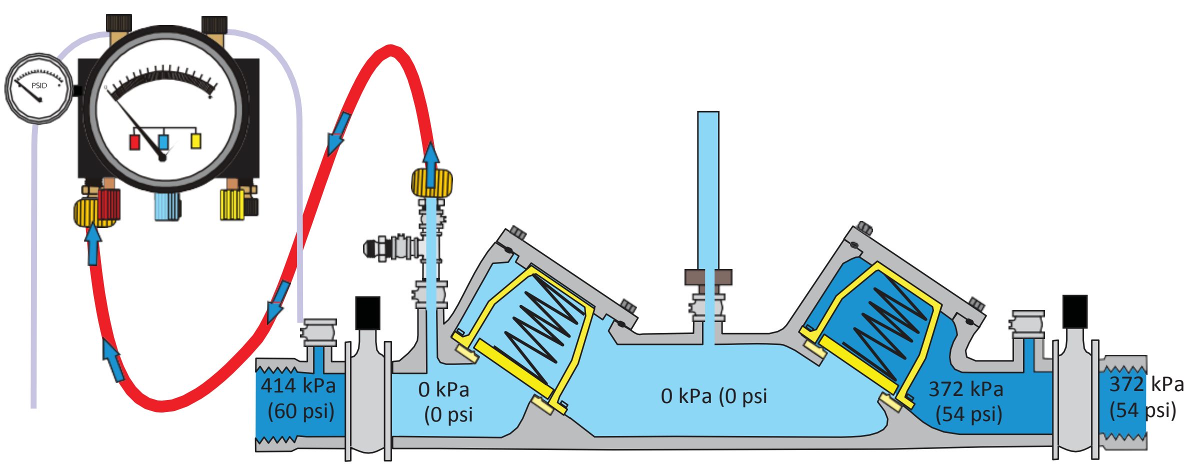

Figure 9-17 "0" psid Indicating check-valve 1 has leaked

Content

DCVA Check-valve 1 problem 2, Leaking shut-off 1

When testing the DCVA check-valve 1, and test-valve 3 is opened, water continues to run from the sight-tube. You first confirm both shut-offs felt tight; however, if water still runs from the sight-tube shut-off 1 may be leaking.

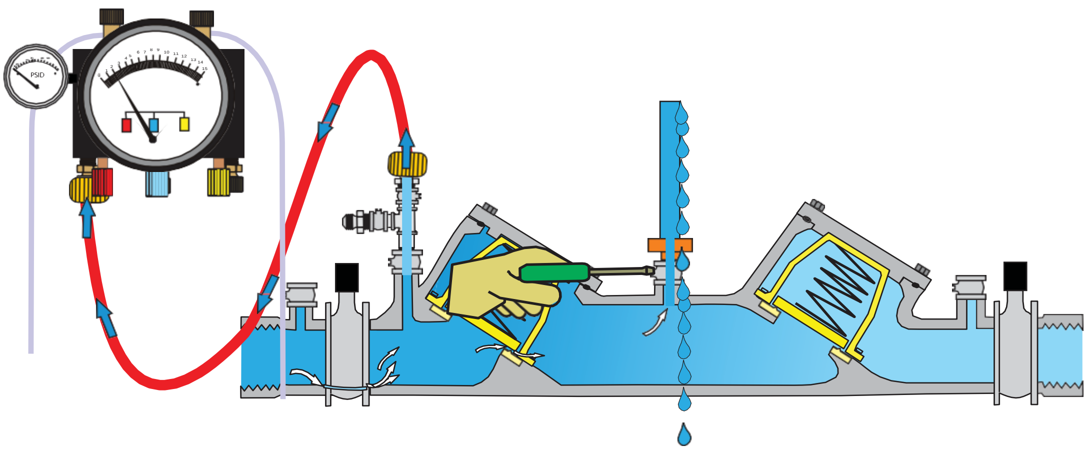

Figure 9-18—Shut-off 1 may be leaking. Both shutoffs feel tight

Shut-off 1 could be faulty and leaking.

- Observe, and note but do not record the differential gauge reading. You may need it later in the test procedure.
- With the previously installed bleed-valve arrangement installed open the bleed-valve and adjust the flow to a slight drip at the sight-tube and just stopped (Figure 9-19).

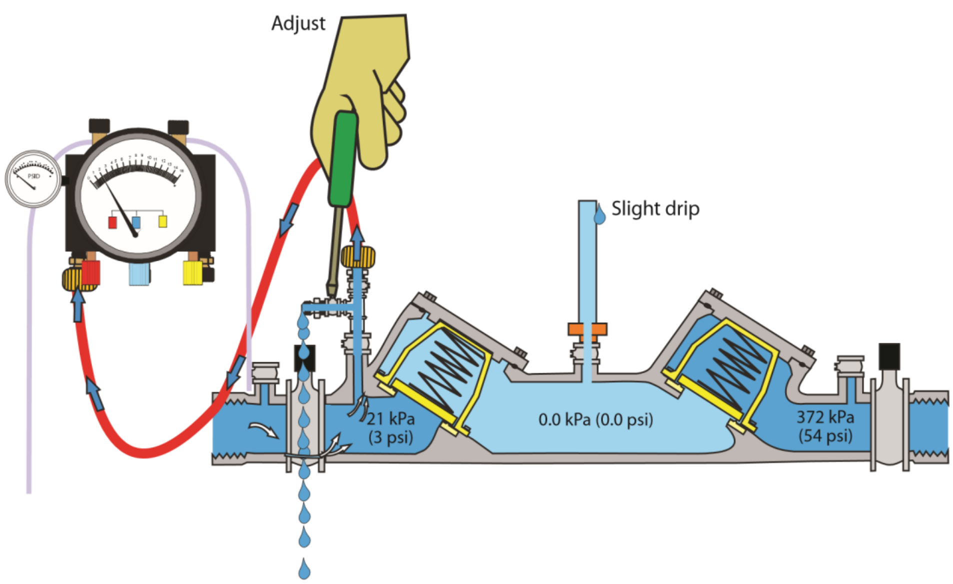

Figure 9-19—Sight tube with a slight drip and just stopped

Content

Referring to figure 9-19, If you are able to adjust the flow to a slight drip (just stopped) and the gauge reading is stabilized, begin the Record the 2-minute minimum stabilized steady-state reading. When 2 minutes is up and the gauge reading has remained steady record the psid reading as the psid across check-valve 1 and closed tight. If psid is at or above 1 psid check-valve passes. If psid lower than 1 psid failed.

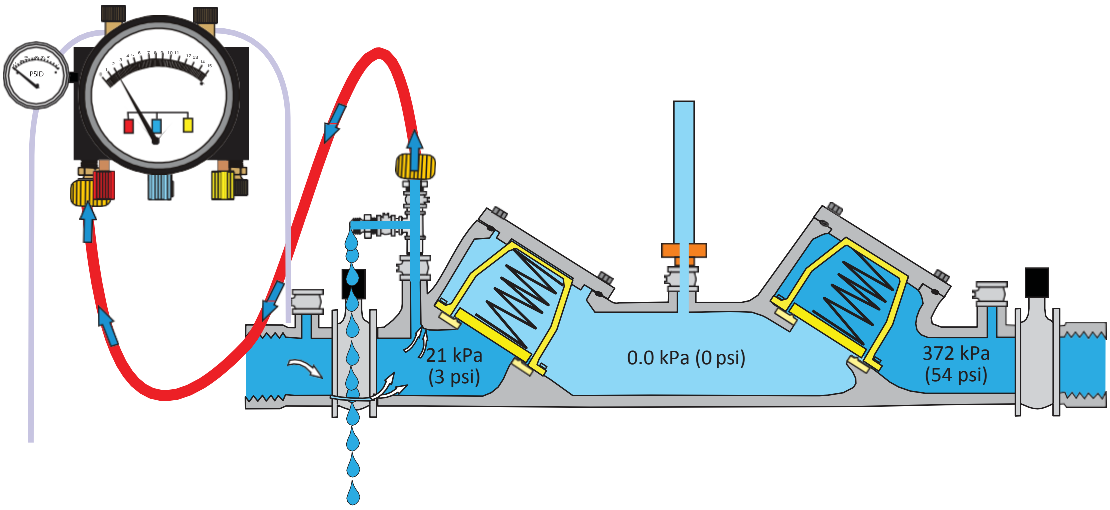

Figure 9-20—Bleed-valve has compensated for leaking shut-off 1

Record shut-off 1 is leaking. Also record you were able to complete the check-valve 1 test. At some point if the shut-off valve leak cannot be compensated it will need to be replaced.

- Complete the rest of DCVA test procedures, as normal record and process results, including any repairs or maintenance done.

In this manuals opinion which is not law, if the sight-tube is slightly dripping check-valve 1 is still open so cannot be recorded as closed tight. So just stopped means stop opening the bleed-valve arrangement at the precise moment the slight drip stops. This will allow the check-valve to seat and the gauge reading at that time is the psid drop across check valve 1.

Content

Leaking shut-off continued

If the leaking shut-off 1 flow cannot be compensated (Figure 9-21) by the bleed-valve arrangement the check-valve shall be recorded as leaking. The test procedure for DCVA cannot be complete.

Repairs will have to be completed and a new test procedure will need to be done on the DCVA.

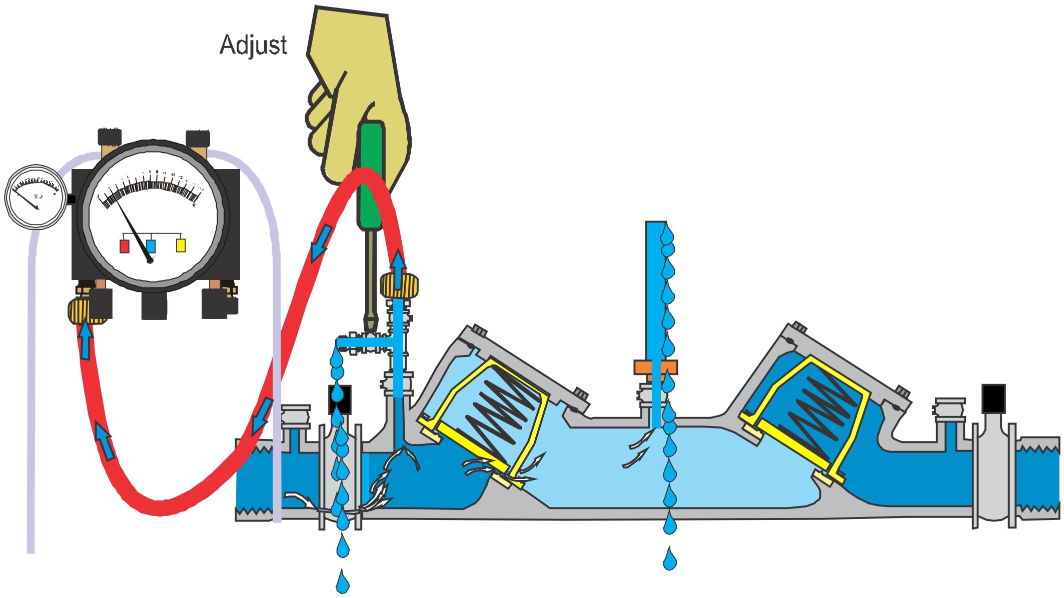

Figure 9-21—Bleed valve has not compensated for leaking shut-off valve. Repairs are needed.

Content

Check-valve 1 problem 3, leaking shut-off 2 and check-valve 2 under a backpressure condition

Scenario 3 problem 3: When testing the DCVA check-valve 1, you have opened test-valve 3 and water has kept running from the short vertical tube. The gauge needle has dropped to "0" and the bleed valve arrangement has stopped running water and water is still running from the sight-tube.

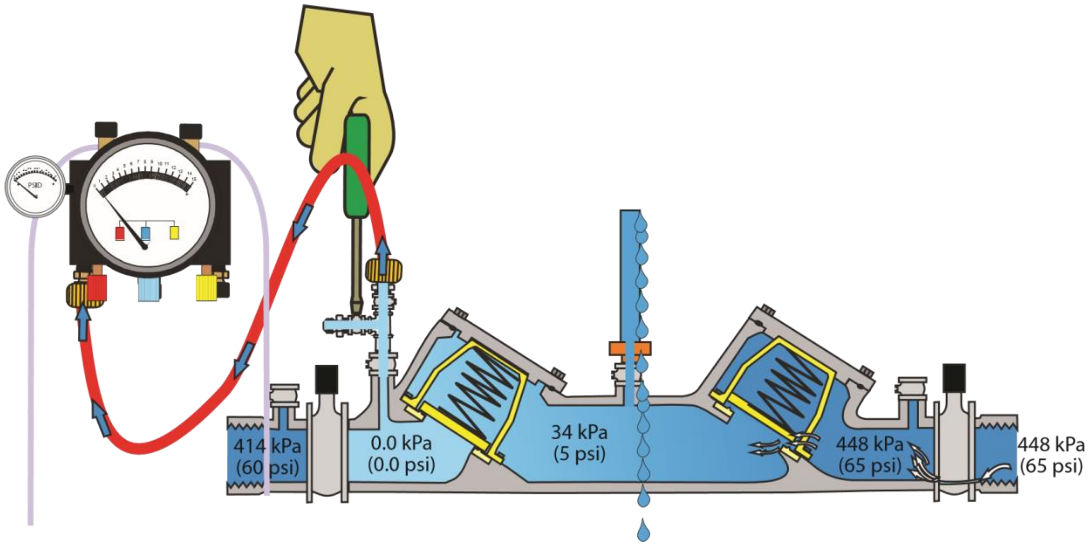

Figure 9-22—Shut-off 2 and check-valve are leaking and backpressure is present.

Solution for problem 3: For leaking shut-off 2 and check-valve 2 under a backpressure condition.

1. Check shut-off 2 is closed properly. If water continues to run, record check-valve 2 and shut-off 2 as leaking.
2. Since the pressure is "0" at test-valve 1, check-valve one must be closed tight and if you remembered to note the psid before opening the bleed-valve arrangement you can record that reading as the check-valve 1 psid. If 1 psid or over passed, if less than 1 psid failed.
3. Remove test equipment
4. Make repairs to the assembly
5. Retest the assembly, record and process results, including repairs maintenance done.

The pressure between the check-valves could be anything up to whatever the back pressure might be depending on the amount of water being back flowed.

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DCVA Check-valve 1 problem 4: Water recedes from test valve 3 sight tube

Scenario problem 4 Check valve 1: When testing the DCVA water recedes from test-valve 3 when test-valve 3 is opened. Water recedes from test-valve 3 this indicates that the check-valve 2 and shut-off 2 are both leaking in the direction of flow. This is allowing water to drain away from test-valve 3.

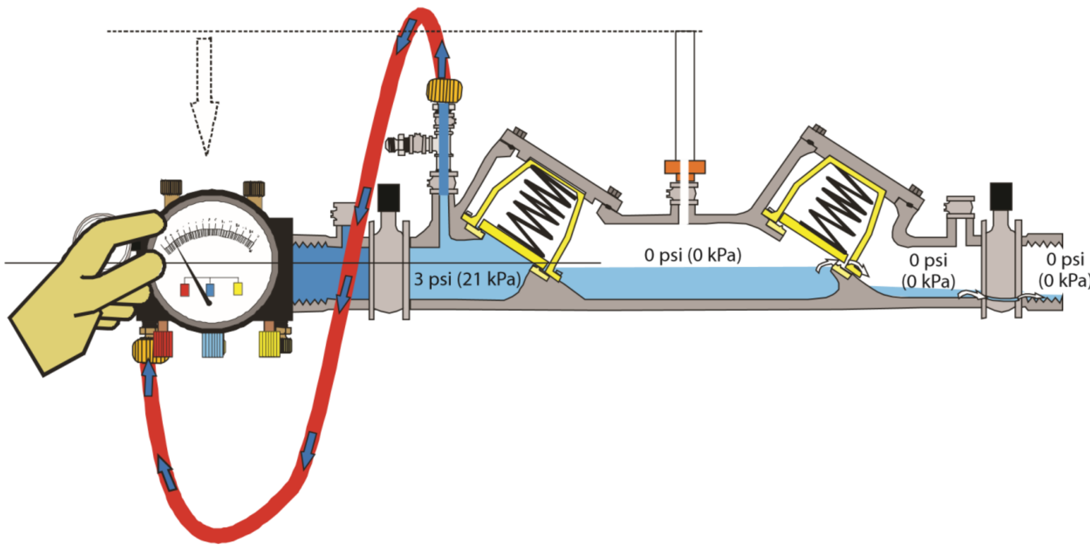

Figure 9-23—Check valve 2 and shut-off 2 both leaking

Solution: For the problem of a leaking shut-off 2 and check-valve 2 under a backpressure condition:

1. Lower the gauge to the centerline of the assembly
2. Record the minimum 2-minute steady state psid reading for check-valve 1
3. If the check-valve was at or above one psid, record it as passed. If the psid is less than one psid, you will need to repair the check-valve.
4. Record that check-valve 2 and shut-off 2 are leaking.

You cannot complete the test procedure for the assembly until you make repairs and retest the assembly. You can then close all the test-valves and remove the equipment, obtain the line pressure, request permission to turn the water on, turn the water on and check for leaks. Complete paper work with all signatures required and copies to those as required by the AHJ.

Content

DCVA check-valve 2 test procedure troubleshooting

These check-valve 2 scenarios, problem and solutions are similar or if not the same as check-valve 1 except your gauge is connected at test-valve 3 and the sight–tube is connected at test-valve 4.

Scenario problem 1 check-valve 2: When testing the DCVA check-valve 2 and you open the test-valve 4, water continues to run from the test-valve 4 sight-tube. Figure 9-24

The reasons for this continued flow could be:

- Problem 1: Failure too close shut-off 1 completely
- Problem 2: Leaking shut-off
- Problem 3: Leaking shut-off 2 or shut-off 1 or both under back pressure condition

Another Problem is:

- Problem 4: Water recedes from test–valve 4 sight-tube

You need to determine which problem is the issue.

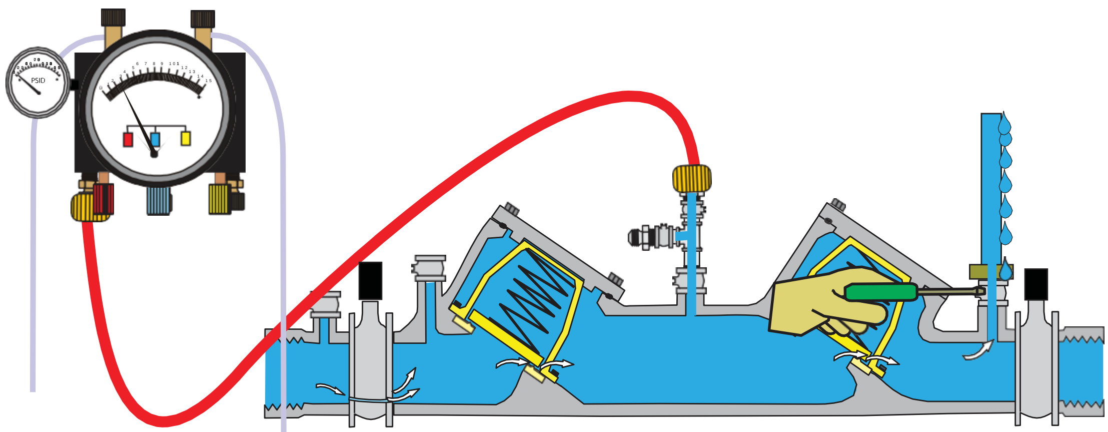

Figure 9-24 Shut-off 1 not closed tight

Content

Scenario solution problem 1, Failure to close the shut-off 1 completely continued

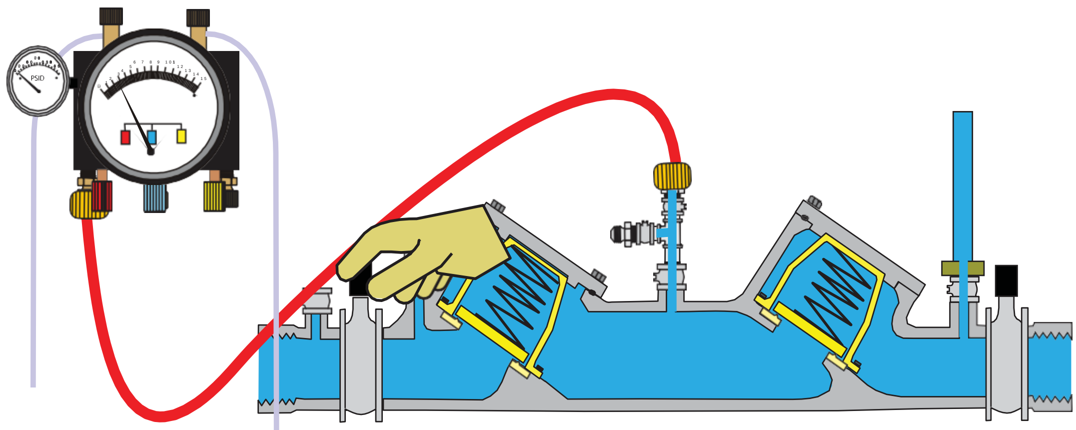

Figure 9-25 Reseat shut-off 1

Solution: For the problem 1 of failure too close shut-off 1 completely:

1. Check the shut-off 1 is closed properly, if this works the problem is solved.
2. Complete the normal test procedure.
3. You can complete the test procedure for the assembly. You can then close all the test valves and remove the equipment, obtain the line pressure, request permission to turn the water on, turn the water on and check for leaks. Complete paper work with all signatures required and copies to those as required by the AHJ.

Content

DCVA check-valve 2 problem 2, shut off 1 leaking

Scenario Problem 2 check valve2 faulty: When testing the check-valve 2 and after first checking the shut-off 1 is closed tightly, you open the test-valve 4, and water continues to run from the test-valve 4 sight-tube. You suspect shut off 1 will not seat and stop water flow from the sight-tube.

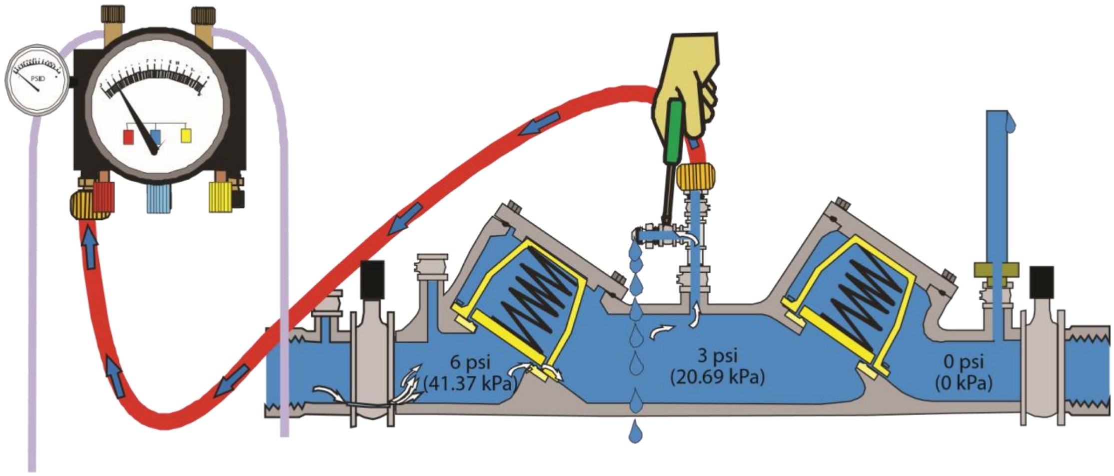

Figure 9-26—Water continues to run from Wrong picture

Scenario problem 2 solution:

1. Observe, and note but do not record the differential gauge reading yet for example before opening the bleed valve arrangement.
2. Open the bleed-valve and adjust the flow to a slight drip (just stopped) at the sight-tube. Record the 2-minute minimum stabilized steady state reading; if the psid is at or above 7 kPa (1 psid) record as passed and closed tight. If the psid is under 7 kPa (1 psid) record as failed passed and under 7 kPa (1 psid) failed.
3. Record shut-off 1 is leaking.
4. Record check-valve 2 is closed tight.
5. You can complete the test procedures for the assembly as normally done.
6. Complete paper work with all signatures required and copies to those as required by the AHJ.

In this manuals opinion which is not law, if the sight-tube is slightly dripping check-valve 1 is still open so cannot be recorded as closed tight. So just stopped means stop opening the bleed-valve arrangement at the precise moment the slight drip stops. This will allow the check-valve to seat and the gauge reading at that time is the psid drop across check-valve 1.

Content

DCVA check-valve 2 problem 3, leaking shut-off 2 or shut-off 1 or both under back pressure condition

Scenario problem 3: When testing the DCVA check-valve 2 you have opened test valve 4. Water is continuing to discharge from test-valve 4 sight-tube. The bleed-valve has stopped running and the gauge
reading has dropped to "0"; however, the test-valve 4 continues to run.

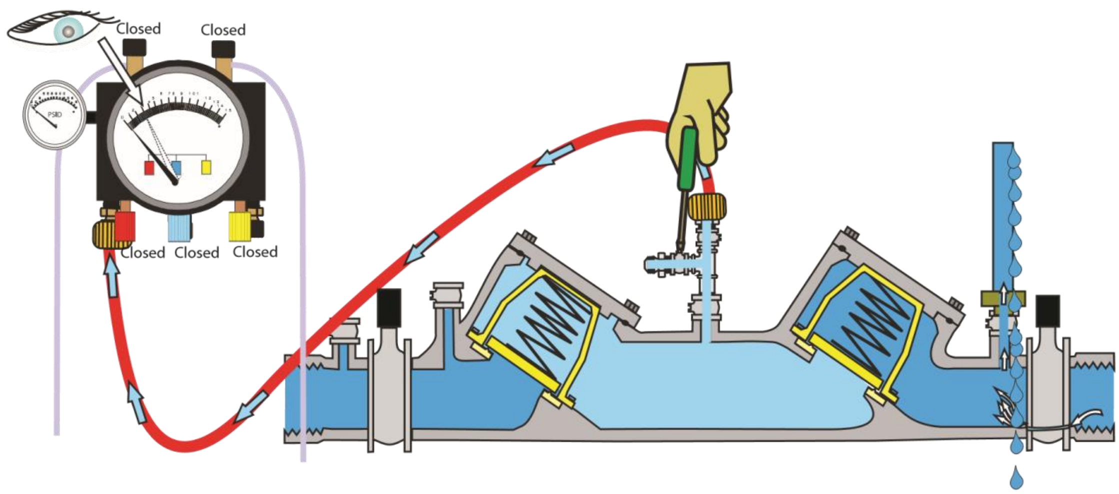

Figure 9-27—Water continues to run from the sight tube

2 Leaking shut-off 2 under a backpressure condition.
The diagram shows that water at test-valve 4 is coming from a leaking shut-off 2 under a backpressure condition:

1. Observe and note the gauge psid before opening the bleed-valve assembly.
2. Observe, and note but do not record the differential gauge reading yet.
3. Open the bleed-valve, the gauge drops to "0" and water still runs from the sight tube
4. Record the gauge pressure originally observed before opening test-valve 3 as the psid for check-valve 2 if at or above 7 kPa (1 psid) the check-valve passes. If the psid was lower than 7 kPa (1psid) record as failed.
5. Record shut-off 2 as leaking; however, no repairs are required because you were able to complete the test of check valve 2
6. Record check valve 2 closed tight. If it was leaking water would be discharging from the bleed valve arrangement so repairs are not required at this time.
7. Remove test equipment
8. If repairs were needed retest the assembly, record and process results, including repairs maintenance done.

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DCVA check-valve 2 problem 4, water recedes from test-valve 4 sight tube

Scenario problem 4: When testing check-valve 2 and test-valve 4 is opened water recedes from test-valve 4 sight-tube.
This indicates that shut-off 2 is leaking in the direction of flow.

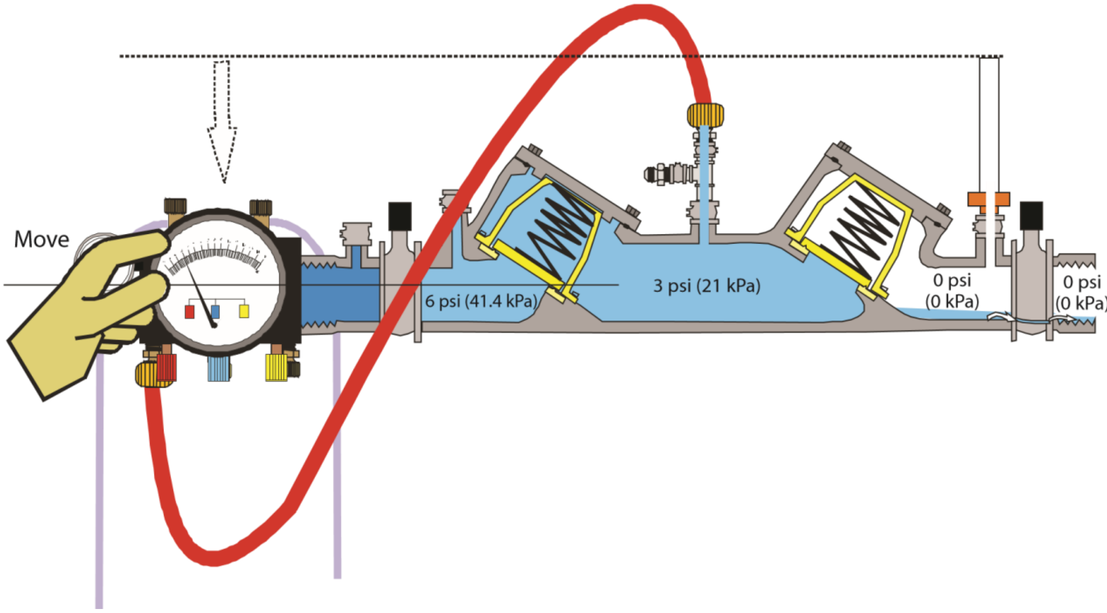

Figure 9-28—Water recedes from test valve 4

Solution problem 4: When water recedes from the test-valve 4 sight-tube

1. Lower the gauge to the centerline of the assembly
2. Record the minimum 2-minute steady state psid reading for check-valve 2
3. Record as passed if the check-valve was at or above 7 kPa (1 psid), record as failed if less than7 kPa (1 psid).
4. If the psid reading is less than 7 kPa
5. Record check-valve 2 as closed tight
6. Record shut off 2 is leaking
7. Complete the test as per normal test procedures
8. Complete paper work with all signatures required and copies to those as required by the AHJ

Note: you may decide that you to need to repair or replace shut-off 2 especially if it prevents you from completing the test requirements; however, unnecessary repairs are costly to the owner.

Content

DCVA check-valve 2, test 2, water continues to run from test-valve 4 sight-tube.

Scenario problem 5, check-valve 2 test procedure: When testing check-valve 2, water continues to run from the sight tube at the test valve 4 and you are not able to adjust the bleed-valve to provide a slight drip at the sight-tube.

The cause in this example is both shut-off valves are leaking. Shut off 2 is leaking in a backpressure condition. Check-valve 1 has been completed earlier test procedure with the leaking shut-off 1 and its psid was passed at or above 7 kPa (1 psid). This procedure only works if test-valve 1 passed the minimum at or above 7 kPa (1psid)1 kPa requirement during the check-valve 1 test procedure.

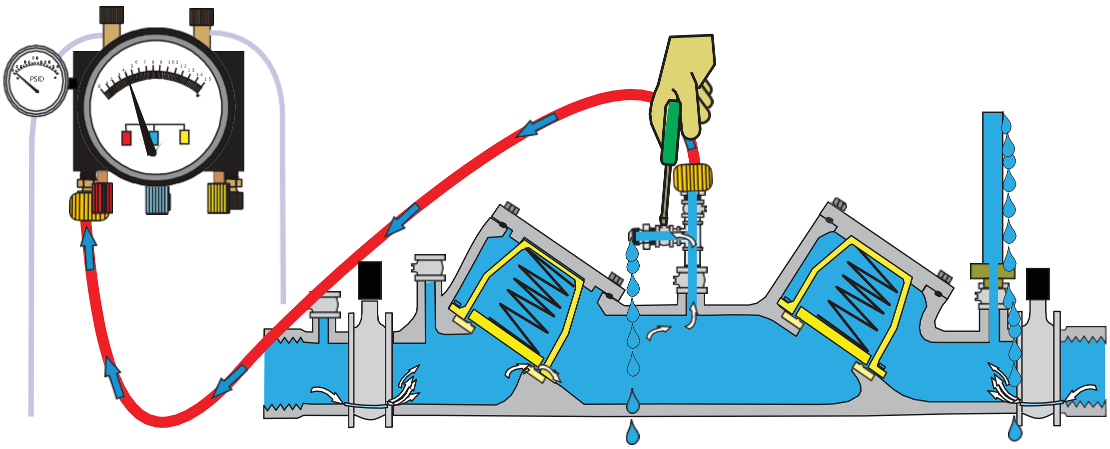

Figure 9-29-Bleed-valve unable to compensate for leaking shut-off 1

Scenario solution for problem 5, water continues to run from test-valve 4 sight-tube

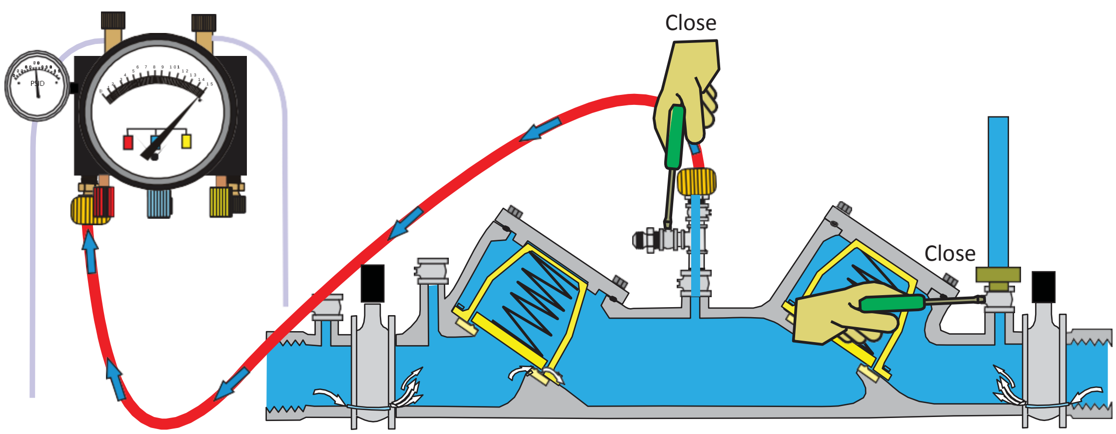

Figure 9-30-Close the bleed-valve and test valve 4

Content

Scenario solution for problem 5, water continues to run from test-valve 4 sight-tube continued

1. Open test-valve 2 and test-valve 4. These both may will compensate for the leaking shut-off

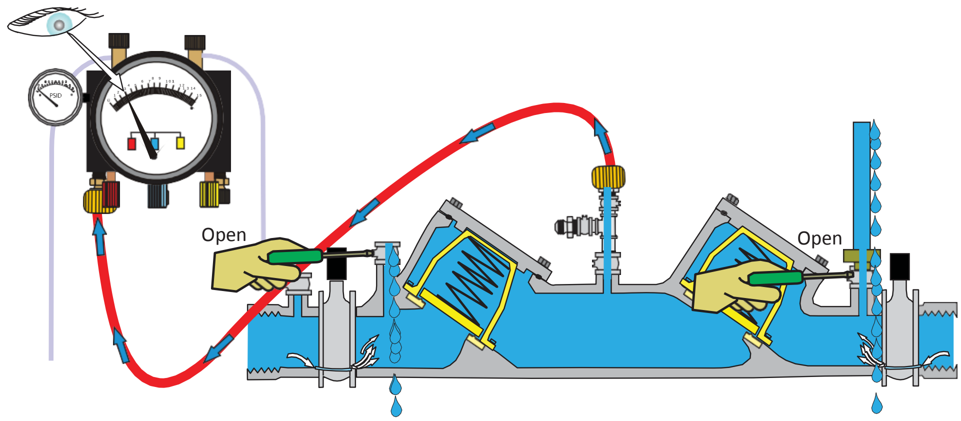

Figure 9-31-Open both test valves

2. Observe the psid for a minimum 2-minute steady state

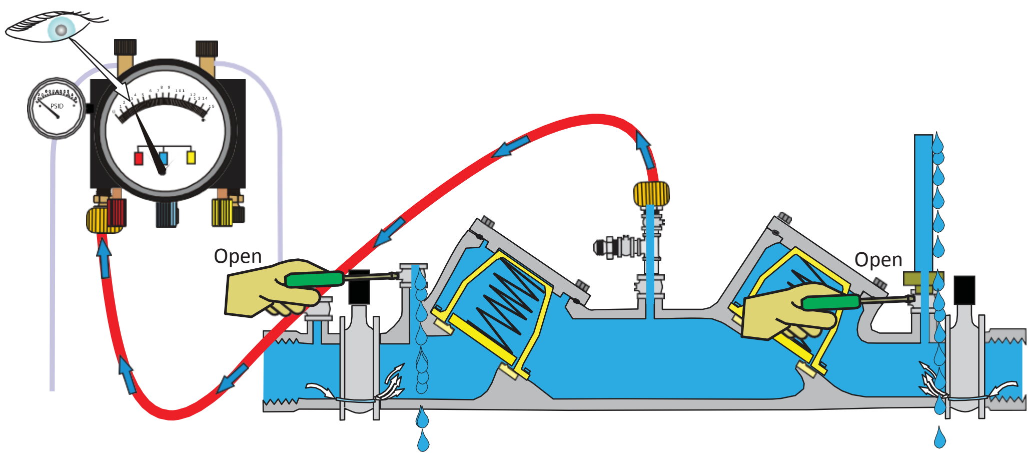

Figure 9-32-Observing the psid for check-valve 2

1. Record the psid for check-valve 2. If the psid is at or above 1 psid the check-valve shall be recorded as passed. If the psid is less than 1 psid the check-valve shall be recorded as failed.
2. You can now complete the test procedure

Note: At some point in time you are going to have to repair the shut of valves.

Content

Troubleshooting the DCDA type blocked bypass

Failure of a backflow assembly to function as designed can usually be attributed to a number of problems. This table lists backflow preventer problems, not including problems encountered when testing with leaking shut-off valves. Refer to figure 9-14 for procedures.

DCVA Problem	DCVA Possible Causes
Check valve psid is too low.	Dirty, worn or damaged seats, discs or guide members hung up, spring weak, debris caught under seat.
Check valves leaking	Dirty, worn or damaged seats, discs or guide members hung up, spring weak, debris caught under seat.

Table 9-1— Causes of backflow preventer problems

Content

Troubleshooting PVB test procedures

When testing the PVBV some troubleshooting problems scenarios can happen.

Scenario Problems: Testing the PVB air-inlet and check-valve

1. When testing the air-inlet valve, water continues to run from the high-side bleed-needle valve and the bleed-needle valve needs to be opened more than a quarter turn.
2. After closing shut-off 1 when testing the air-inlet valve, the pressure starts to drop before you open the high-side bleed-needle valve, the air-inlet opens, and the gauge drops to zero.
3. When testing the air-inlet valve, the psid drops to zero and the air-inlet fails to open after you open the high-side bleed-needle valve.
4. When testing the check-valve the test-valve 2 will not stop running.
5. When testing the check-valve the pressure drops to zero

Reference CSA B64-10.1

Scenario problem 1: When testing the PVB the inlet-valve the high-side bleed-needle valve has to be opened more than a quarter turn, and or the air-inlet does not open, Shut-off 1 is probably leaking.

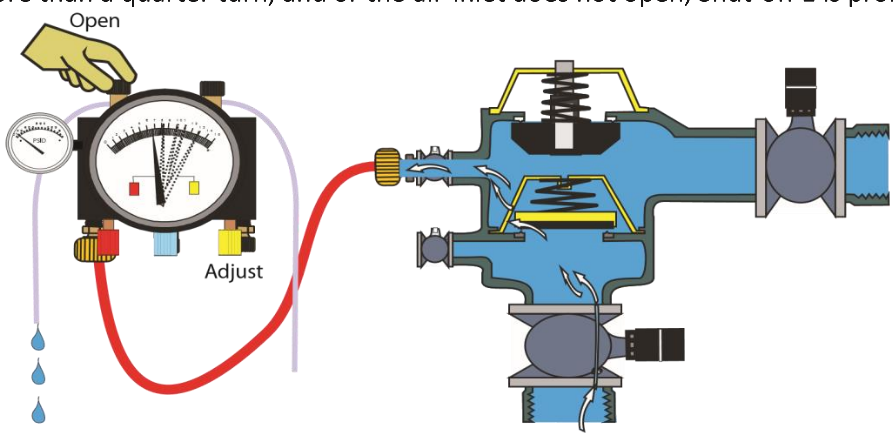

Figure 9-33—Shut-off valve 1 may not be closed all the way

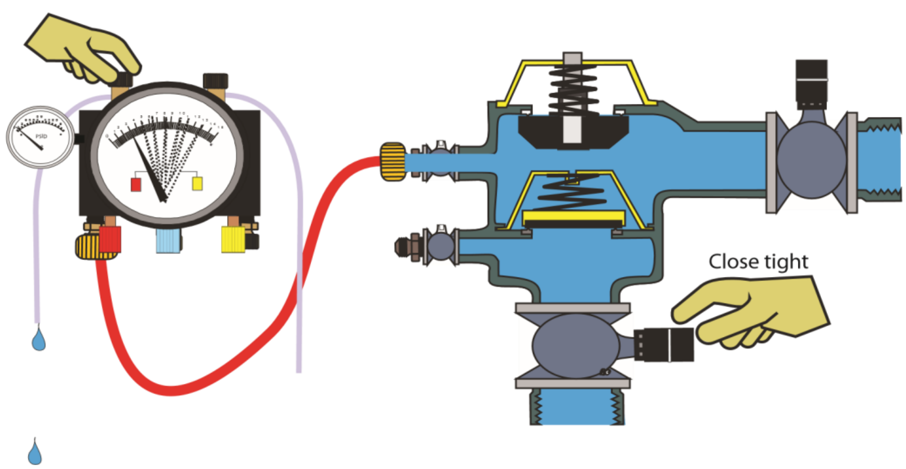

Figure 9-34—Check that shut-off 1 is closed tight

Solution 1: If the closing of the shut-off 1 is tight and solves the problem, you can complete the test procedure.

Content

Scenario problem 1 PVB air-inlet test continued

The high-side bleed-needle valve still has to be opened more than a quarter of a full turn. The water continues to run from the bleed-needle valve and the air-inlet will not open.

Scenario problem 1 Solution:

Close the high-side bleed-needle valve and then you will need to install a bleed-valve arrangement.

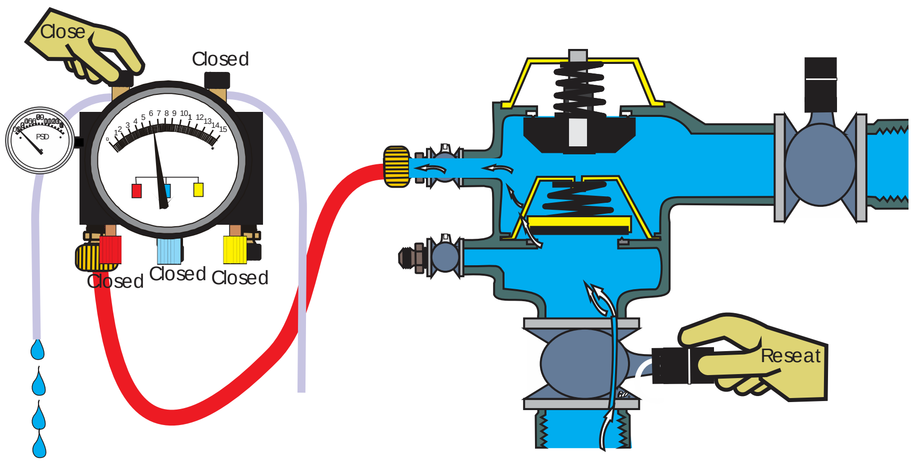

Figure 9-35—Re-seating the shut-off valve 1 does not work

Scenario problem 1 solution continued: Shut-off 1 will not close tight after trying to re-close**.** Figure 9-35

1. Close the high-side bleed-needle valve and install a bleed-valve arrangement to test–valve 1.

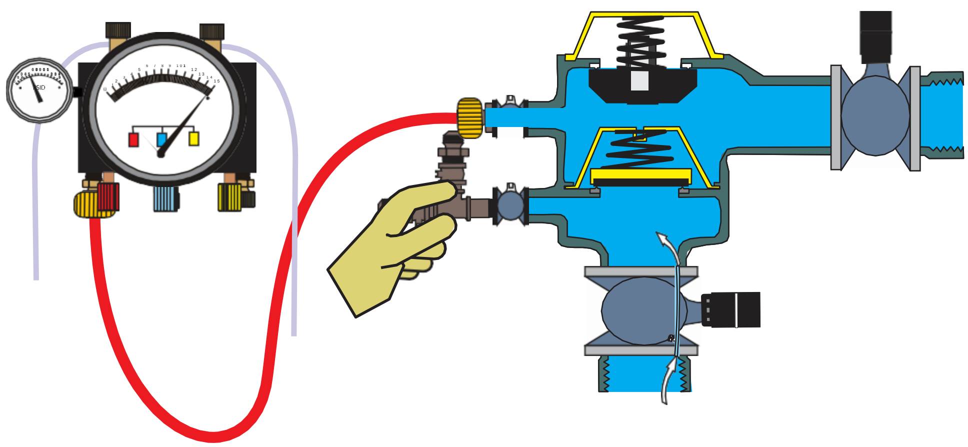

Figure 9-36-Install a bleed-valve arrangement

Content

2. Open test valve 1

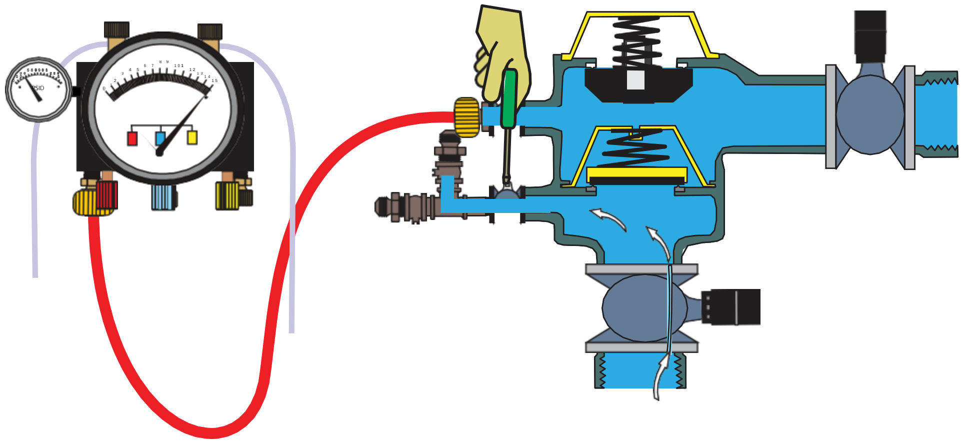

Figure 9-37- Opening test-valve 1

3. Open the high-side bleed-needle valve 9Figure
4. Open the bleed-valve arrangement and adjust the flow to compensate for the leaking-shut off valve 1.
5. If you are able to lower the gauge reading and are able to determine the opening psid of the air-inlet valve you observe the air-inlet opening psid can record the opening psid.

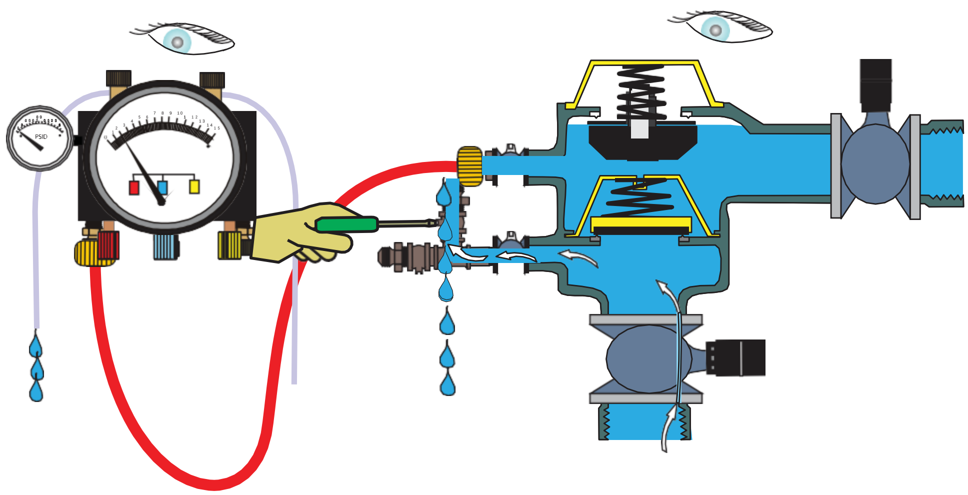

Figure 9-38-Observe and then record the air-inlet valve opening psid.

Content

6. When the high-side bleed-needle valve stops running observe the air-inlet is fully open record results

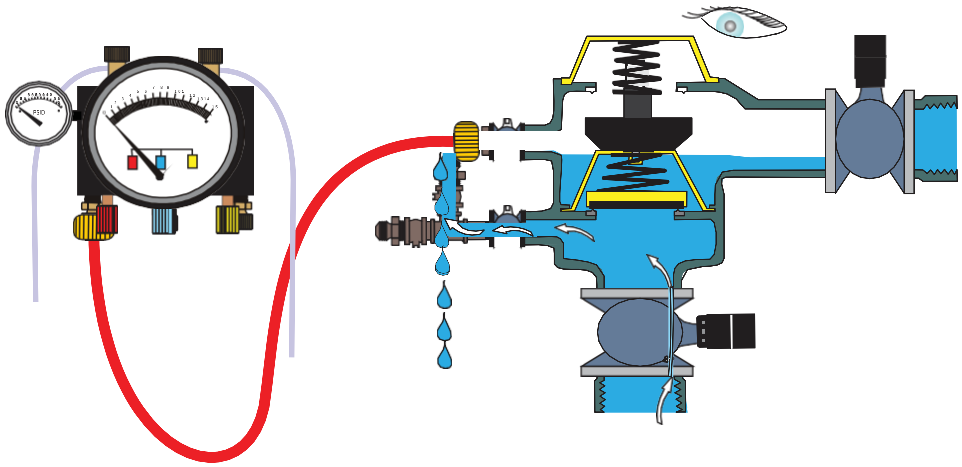

Figure 9-39-Observe the air-inlet fully open

7. Complete the rest of the test-procedures for the PVB.

If the shut-off 1 is leaking too much and the bleed-valve arrangement cannot compensate for the leaking shut-off valve 1, stop the test procedure of the PVB and repair or replace the shut-off valve 1. The PVB must be retested and reports submitted.

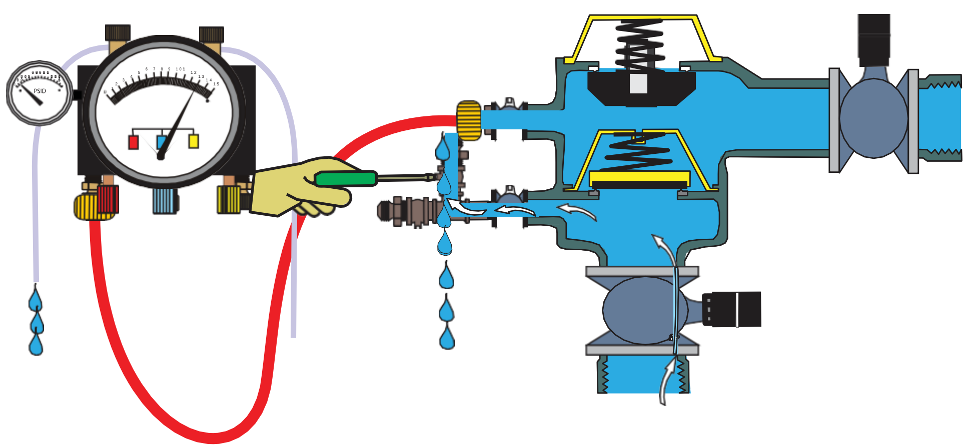

Figure 9-40- Bleed-valve arrangement unable to compensate for leaking shut-of 1

Content

PVB Test Troubleshooting: Air-inlet test with a leaking shut-off 2

Scenario problem 2: When you begin to test the air-inlet valve, and you have just closed shut-off 1 and the pressure starts to drop before you have a chance to open the high-side bleed-needle valve. The air-inlet opens, and the gauge drops to zero. This issue is not addressed in the CSA standard. So the USC manual is used to solve this Problem. Please confirm these steps with the authority having jurisdiction. Otherwise record shut-off 2 is leaking and repair the leaking shut-off and redo the test procedure. Record the second test procedure results.

Scenario Solution:
When closing shut off 1 if you were able to observe the opening Psid of the air-inlet you can:

1. Record the air-inlet opening psid.
2. Record that shut–off 2 is leaking.

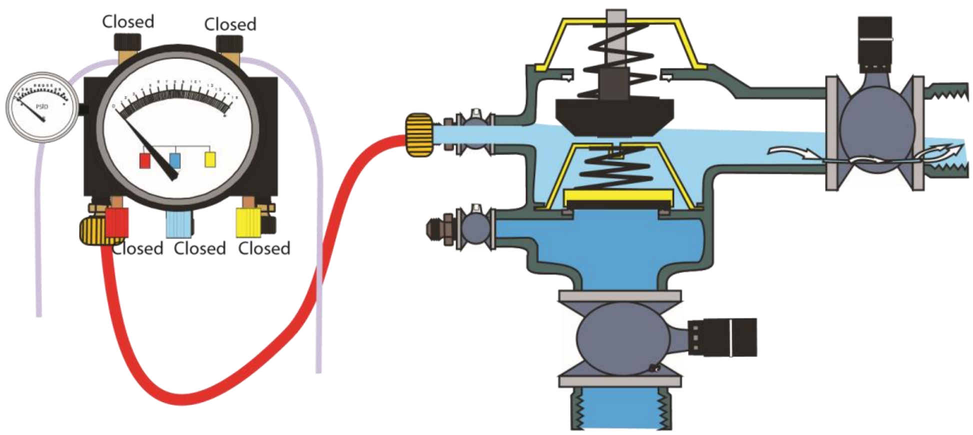

Figure 9-41—Shut-off 2 leaking

3. Remove the high-side hose from test-valve 2 and allow the water to drain from the air-inlet chamber.

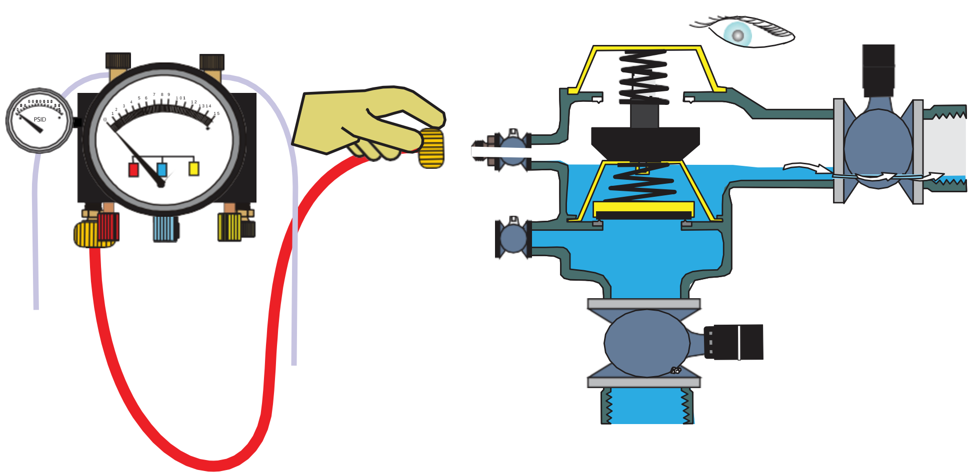

Figure 9-42-Observe and record air-inlet open-fully and shut-off 2 leaking

If you were not able to observe the air-inlet valve opening psid during this troubleshooting procedure you should repair the shut-off valve and retest. Check with AHJ.

Content

PVB Test Troubleshooting: Air-inlet test fails to open.
When you are testing the air-inlet and you open the high-side bleed needle valve and the gauge pressure drops to "0" and the air-inlet fails to open. Air-inlet is stuck closed

Solution:

1. Record air inlet did not open and did not open fully.
2. Complete the test procedures for the check-valve and record results.
3. Remove the air-inlet valve, repair or replace, reinstall air-inlet
4. Record repairs made
5. Retest the PVB valve completely

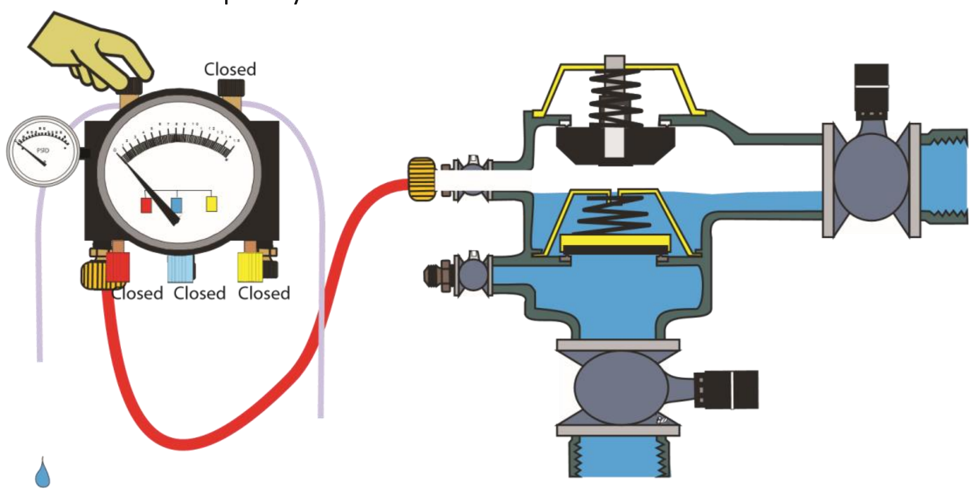

Figure 9-43—Air-inlet has failed to open

Content

Scenario Problem PVB: Air-inlet discharging on arrival

If you find the air-inlet is leaking water upon arrival, there may be a fouled, damaged seat or disk

Solution:

1. Remove debris or replace air-inlet if damaged
2. Make repairs and record repairs made
3. Complete the test procedures for the PVB and record results.

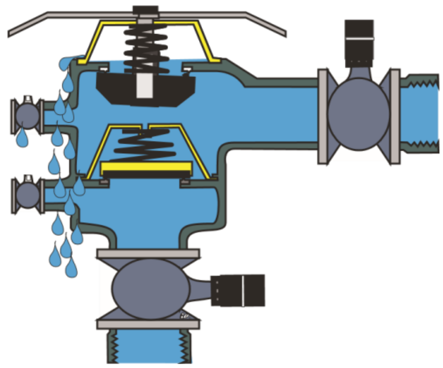

Figure 9-44—Fouled air-inlet seat

PVB check-valve, test valve 2 runs continuously

Scenario problem 4: When testing check-valve 2, water continues to run from the test-valve 2. The shut-off 1 may be leaking.

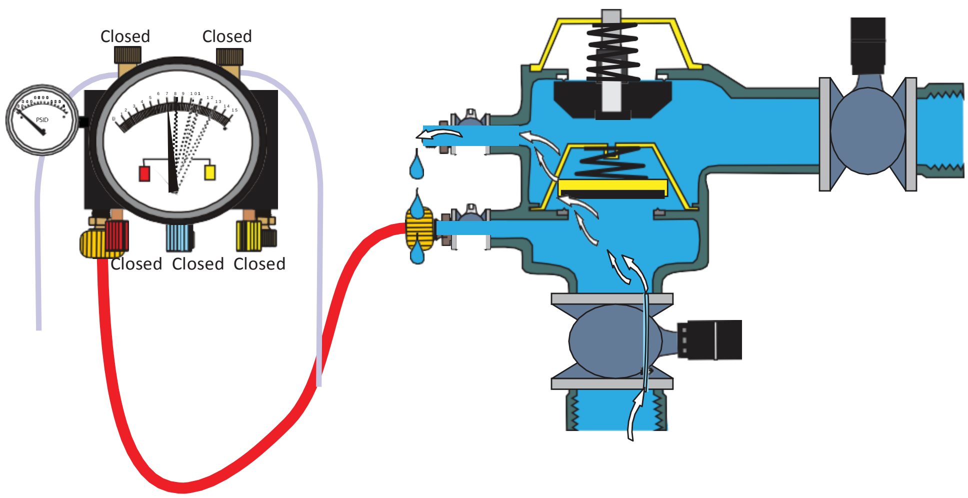

Figure 9-45 Shut-off 1 leaking

Content

Scenario problem 4: Check-valve 2 test and test-valve 2 runs continuously

Scenario solution 1 problem 4

1. Try to reseat the shut-off 1.

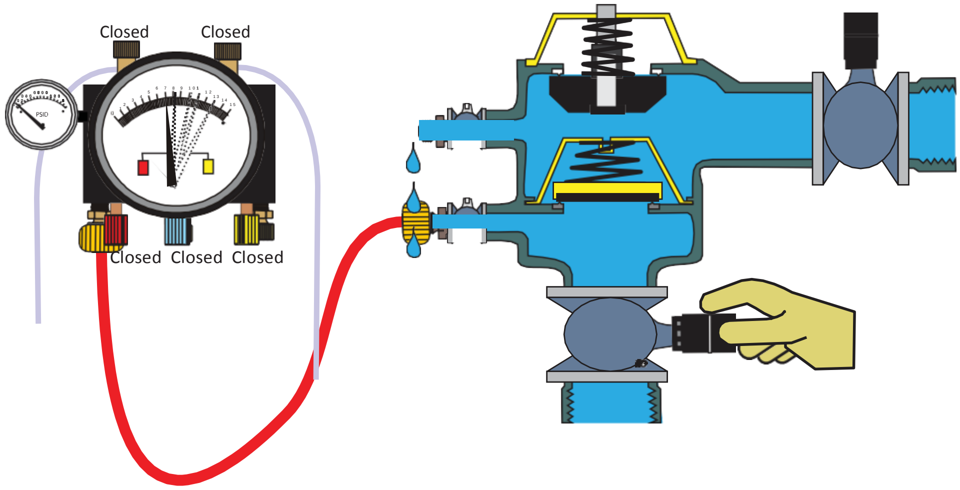

Figure 9-46-Re-seat shut-off 1

If reseating the shut-off 1 works,

1. Complete the test procedure with normal test procedures.
2. Record shut-off one is leaking

Trying to ensure that the shut-off valve 1 is closed tight; however, the test valve continues to discharge.

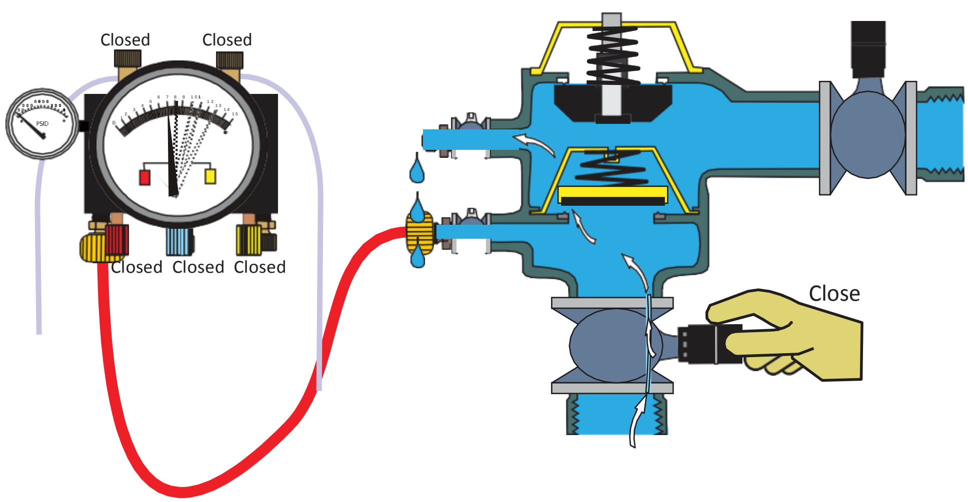

Figure 9-47-Trying to close shut off1 tight

If shut off 1 will not close tight and the test-valve continues to run proceed to the next step.

Content

Scenario 2 problem 4: Shut off valve 1 is leaking and causing continuous discharge at test-valve 2

Scenario 2 problem 4 solution 2:

1. Close both test valves 1 and disconnect gauge from test-valve 1

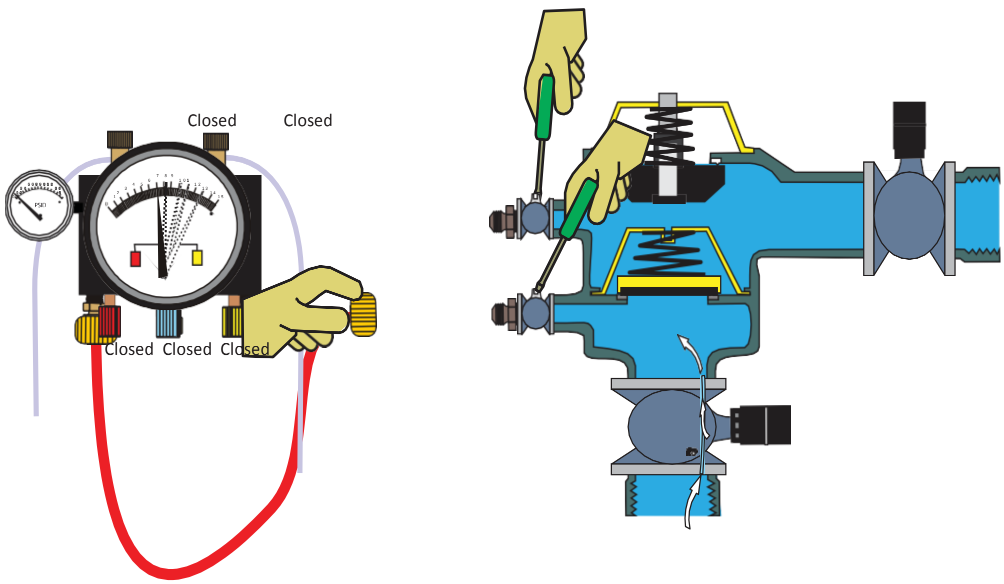

Figure 9-48-close test-valve and remove gauge

2. Install a bleed-valve arrangement at test-valve 1.
3. Reconnect the gauge.

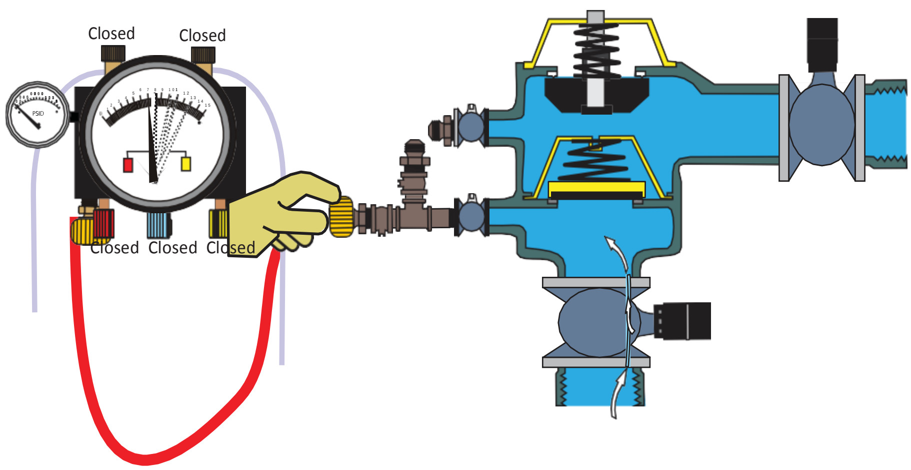

Figure-9-49-Install bleed-valve arrangement and gauge

Content

4. Open test-valve 1and bleed the gauge and hose of air
   open and close high side bleed valve

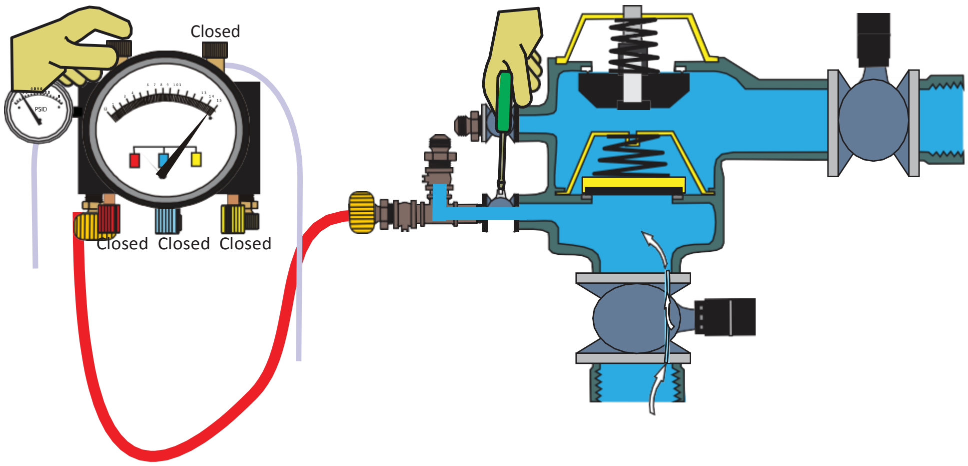

Figure 9-50 -Open test-valve 1 and bleed the gauge and hose

5. Open test-valve 2 and adjust the bleed-valve compensate for the leaking shut- off 1 to a slight drip at test-valve 2 and then just stopped.

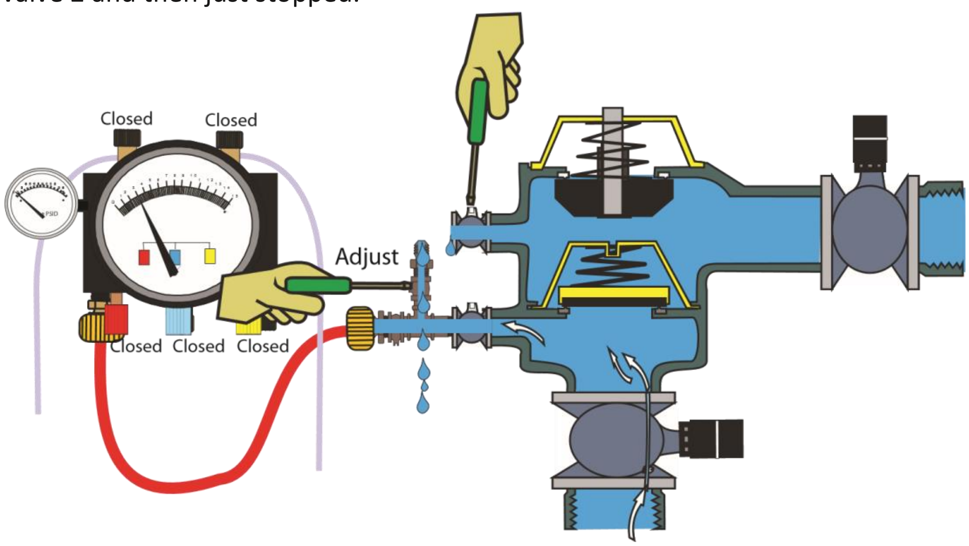

Figure 9-51—Compensating for a leaking shut-off valve

Content

6. Time the 2- minute steady state psid and observe the reading on the gauge.

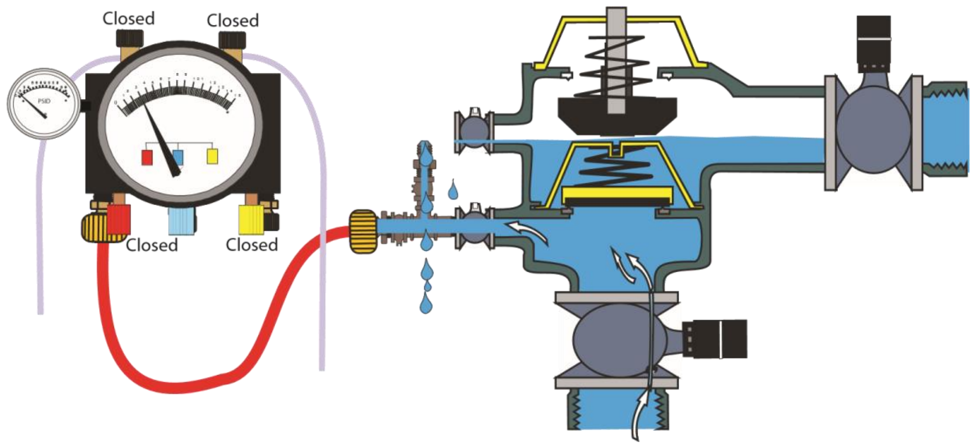

Figure 9-52—Time the steady state pressure, observe and record the gauge reading

7. Record the psid reading as per normal test procedures for the PVB.
8. Complete processing reports and submit reports as per normal procedures including any repairs required.
9. If the shut-off 1 is leaking too much and the bleed–needle arrangement cannot compensate for the leaking shut-off valve 1, stop the test procedure and repair or replace the shut-off valve 1.

The PVB must be retested and reports submitted.

Content

Scenario problem 5: gauge reading drops to "0"

Scenario 5: When testing check-valve 1 and you have opened test-valve 2, the gauge reading drops to "0" psid. Assuming shut-off 1 was closed tight when testing the air-inlet-valve.

Scenario 5 Solution:
The check-valve is leaking. The check-valve will need to be cleaned of debris or repaired and the PVB retested as per normal test procedures.

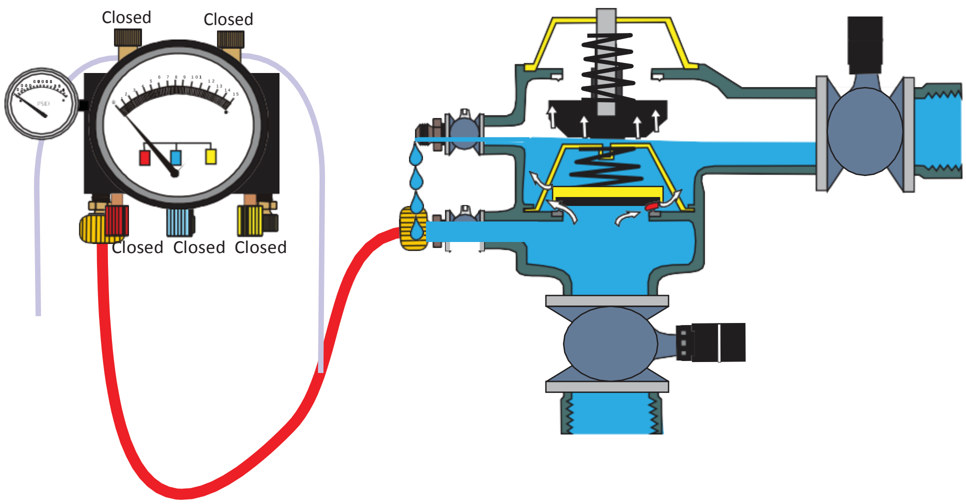

Figure 9-53-Debris under the check-valve seat

You can now close all the test-valves and remove the equipment, obtain the line pressure, request permission to turn the water on, turn the water on and check for leaks. Complete paper work with all signatures required and copies to those as required by the AHJ.

This ends the typical problems you will find. More problems present themselves on the job and you may able to diagnose and correct the problems efficiently and cost effectively.

Content

PVB, SRVB troubleshooting

SYMPTOM	CAUSE:	SOLUTION
1. C heck value fails to hold 1.0 psid minimum	• Debris on sealing surface or guide surfaces or valve surfaces • Damaged seat disc • Weak or broken spring • Poppet broken due to freezing thermal expansion	• Disassemble and clean check • Disassemble and replace seal • Disassemble and replace spring • Replace broken poppet (refer to freeze protection)
2. Poppet fails to open at 1.0 PSIG minimum	• Debris restricting free operation • Poppet seal adhering to bonnet • Weak spring load	• Disassemble and clean check valve surfaces • Disassemble and clean and/or replace damaged parts • Replace bonnet assembly (1/2 - 11/4) • Replace spring (11/2 and larger)
3. Minor leakage through air vent	• Damaged poppet seal • Cracked or damaged poppet • Cracked bonnet or damaged sealing edge • Debris on sealing surface	• Disassemble and replace seal Disassemble and replace poppet seal • Disassemble and replace bonnet assembly • Disassemble and clean
4. Significant discharge through air vent	• Poppet not properly guided • Major poppet or seal failure • Low downstream pressure • Insufficient inlet volume to operate device • Poppet and or bonnet broken	• Disassemble and replace damaged parts • Disassemble and replace damaged parts • Check pressure at No.2 test cock; should • be higher than 5 PSIG • Pressure needs to be increased or partially closed outlet ball valve to create higher pressure on poppet. • Replace broken bonnet/poppet due to thermal expansion (see freeze protection)
5. C hatter during flow conditions	• Worn, damaged or defective check valve guide	• Disassemble and repair or replace guide

Table 9-2— PVB, SRVB troubleshooting

- Some makes and models require have a spring retainers requiring prober installation to ensure proper spring aligned and provide even distribution of spring pressure load on the seat. When not properly reassembled uneven side pressure can result uneven load and possible test failure
- Not all air-inlet valves are spring loaded some use the rubber seal shape and design on the air-inlet valve to generate the opening force.

Missing canopies that have allowed prolonged periods to ultraviolet deterioration of exposed components may cause valve failure. Content

View these videos for repair and maintenance procedure review.

007 DCVA & 009 RP 1/2"-2" Backflow Preventer Repair

Play video

Video Courtesy of Watts regulator

909, 009, 990 and 992 RP Backflow Preventer Repair

Play video

Video Courtesy of Watts regulator

919 ¼" - 2" RP Backflow Preventer Repair

Play video

Video Courtesy of Watts regulator

Ames fire and waterworks repair

Series 400B ½" - 2" RP Backflow Preventer Repair

Play video

Video Courtesy of Ames Fire and waterworks
Installation, Maintenance, & Repair Series 400B information

Content

Ames Fire and waterworks

Series 200B ½" - 2" DCVA Backflow Preventer Repair

Play video

Video Courtesy of Ames Fire and waterworks
Installation, Maintenance, & Repair Series DCVA 200B information

Ames Fire and waterworks

C200 & C300 2.5" - 6" Ames Fire & Waterworks DCVA Backflow Repair

Play video

Video Courtesy of Ames Fire and waterworks

Ames Fire and waterworks

2000SS & 3000SS 2.5" - 6" Ames Fire & Waterworks DCVA Backflow Repair

Play video

Video Courtesy of Ames Fire and waterworks

Ames Fire and waterworks

4000SS & 5000SS 8" - 10" Ames Fire & Waterworks RP Backflow Repair

Play video

Video Courtesy of Ames Fire and waterworks

Content

Now complete Self-Test 9 and check your answers.

Self-Test 9

Review the section objectives and then answer the following questions.

1. When testing a RP, what is the probable cause of a continuously discharging relief valve that begins after closing shut-off 2?
   a. Check valve 1 is leaking
   b. Check valve 2 is leaking
   c. Shut-off 2 is leaking
   d. The relief valve is stuck open

2. When testing a RP, what is the cause of the relief valve failing to open, when opening the low-side control valve to test the relief valve opening psid?
   a. Check valve 1 is leaking
   b. Check valve 2 is leaking
   c. The relief valve is stuck open
   d. Shut-off 2 is leaking or not closed properly

3. When testing a RP with a three-valve differential gauge, what is causing the psid to drop a little bit before reaching a steady state when opening the bypass control valve to test check valve 2?
   a. The relief valve is leaking
   b. Leaking check valve 2
   c. Disc compression
   d. Leaking check valve 1

4. When testing a RP with a 5-valve differential gauge, what would cause a fluctuating psid with an occasional spitting of the relief port?
   a. Leaking shut-off 2
   b. Water hammer upstream of the RP
   c. Water hammer downstream of the RP
   d. A leaking shut-off 1

5. When testing a RP with a 5-valve differential gauge, what would cause the psid to rise when opening the bypass control valve while testing the check valve 2 in reverse direction?
   a. Leaking check valve 2
   b. Leaking shut-off 2 and a backflow condition
   c. Relief valve stuck closed
   d. Shut-off 1 is closed

Content

6. When testing a DCVA with a 5-valve differential gauge, what causes water to continue to discharge from the test valve 3 while testing the check valve1?
   a. Failure to open shut-off 2
   b. Test valve 4 is open
   c. Failure to close shut-off 1
   d. Test valve 1 is leaking
7. When testing a DCVA with a three-valve differential gauge, what causes water to continue to discharge from the test valve 4 while testing the check valve 2?
   a. Test valve 3 is open
   b. Test valve 1 is leaking
   c. Test valve 4 is faulty
   d. Shut-off 1 and shut-off 2 could both be leaking
8. When testing a DCVA with a three-valve differential gauge, water continues to discharge from the test valve 4 while testing the check valve 2; what equipment could be used to troubleshoot the DCVA?
   a. Bleed-off assembly
   b. Short sight tube
   c. Long sight tube
   d. Air compressor
9. When testing a PVBA with a 3-valve differential gauge, why will the low-side control valve have to be opened more than ¼ turn while testing the air-inlet valve?
   a. Bypass control valve is closed
   b. High-side control valve is closed
   c. Shut-off 1 is leaking or not closed properly
   d. Air-inlet valve is leaking
10. When testing a PVB with a three-valve differential gauge, why will the test valve 2 continue to discharge water while testing the check valve?
   a. Test valve 1 is leaking
   b. Shut-off 1 is leaking
   c. Shut-off 2 is closed tight
   d. Check valve is holding tight in the direction of flow

Content

11. When testing a RP, what can cause the relief valve opening psid to be too low?
    a. Relief valve spring weak
    b. Check valve 2 spring too weak
    c. Shut-off 2 is leaking
    d. Shut-off 1 is leaking

12. What most likely will cause the RP relief valve to discharge intermittently?
    a. Check valve 2 is leaking in the direction of flow
    b. Shut-off 1 is partially closed
    c. Shut-off 2 is partially closed
    d. Low buffer and line pressure fluctuations

13. When testing a RP, what will most likely be the cause of the relief valve to fail to open?
    a. Relief valve is stuck
    b. Excessive water pressure fluctuations
    c. Sensing line is blocked
    d. Debris caught under the seat

14. What will most likely cause the RP check valve 1 psid to be too low?
    a. Pressure sensing line blocked
    b. Relief valve spring weak
    c. Strong check 1 valve spring
    d. Weak check valve 1 spring

15. What will most likely be the cause of the DCVA check valves to leak?
    a. Faulty shut-off valves
    b. Faulty test valves
    c. Dirty, worn or damaged seats
    d. Relief valve faulty

16. What causes the PVB air-inlet valve not to open during a back syphonage condition?
    a. Line pressure too high
    b. Air-inlet valve is stuck closed
    c. Shut-off valves faulty
    d. Check valve is leaking

Check your appendix answer key Content

Have you accomplished your objectives of this chapter 9? Review your Chapter 9 objectives.

If you feel you have accomplished the objectives of Chapter 9, you may wish to review all objectives and challenge your assessment examinations.

Chapter 10 Alternate test procedures

Double check valve assembly alternate test procedure using the sight tube

This procedure may not be commonly used currently so you should check with the AHJ responsible to determine its acceptability.

Please refer to the current CSA B64-10.1 standard for this test procedure DCVA and or PVB test requirements using a sight-tube.

Content

Appendix Answer Keys

Self-Test 1

1. a
2. b
3. c
4. b
5. a
6. d
7. a
8. a
9. a
10. a
11. a
12. a
13. a
14. a

Self-Test 2

1. b
2. a
3. d
4. c
5. a
6. d
7. a
8. b
9. d
10. b
11. b

Self-Test 3

1. d
2. b
3. c
4. b
5. c
6. d
7. c
8. c
9. b
10. c
11. a
12. a
13. a
14. a
15. a
16. a
17. a
18. a
19. a

Self-Test 4

1. b
2. b
3. c
4. c
5. d
6. a
7. b
8. d
9. d
10. b
11. a
12. b
13. a
14. b
15. d
16. b
17. c
18. a
19. c
20. b
21. c
22. c

Self-Test 5

1. a
2. a
3. b
4. b
5. a
6. a
7. b
8. b
9. a
10. a
11. b
12. b
13. a
14. d
15. d
16. d
17. a

Content

Self-Test 6

1. a
2. b
3. a
4. c
5. a
6. d
7. c
8. b
9. a
10. b
11. b
12. a
13. c
14. d
15. c
16. d
17. b
18. c
19. d
20. c
21. a
22. d
23. b
24. c
25. a
26. d
27. b
28. a
29. c
30. b
31. b
32. d
33. a
34. d
35. d
36. c
37. d
38. b
39. a
40. c
41. a
42. d
43. b
44. c
45. b
46. b
47. b
48. a
49. b
50. b
51. c
52. b
53. b
54. d
55. b
56. b
57. b
58. a
59. c
60. a
61. b
62. b
63. c
64. b
65. a
66. b
67. a
68. a
69. b
70. d
71. a
72. b
73. a
74. a
75. d
76. a
77. d
78. d
79. b
80. a
81. d
82. d
83. b
84. a
85. a
86. a
87. a
88. b
89. b
90. b
91. b
92. b
93. b
94. a
95. a
96. c
97. d
98. b
99. c
100. d

Content

Chapter 6, table answers 101

Fixture isolation examples	Degree of hazard	Minimum fixture protection	Additional in plant or premise isolation
Bidets	Moderate/severe	AVB	
Hose-bib residential	Minor/moderate	AVB/HCVB	
Hose-bib industrial 1	Severe	AVB/HCVB	RPBA/DCVA
Ice makers	Severe	AG/RPBA	
Steam generator	Moderate	DCVA	
Vending machine	Moderate	DCAPC	
Ornamental Fountains	Moderate	DCVA/AVB /PVB	
Fire sprinkler system without additives	Moderate	DCVA	
Fire sprinkler system with additives	Severe	RPBA	
Trap primer	Severe	AG	
Lawn irrigation with chemical addition 2	Severe	RPBA	
Lawn irrigation with no chemical addition 2	Moderate	DCVA/AVB /PVB	
Domestic hot water heating boilers	Minor	DCAP	
Degreasing equipment	CSA severe Manual moderate	RPBA(CSA) DCVA (CCC manual)	Contradiction
Shampoo basin	Minor	AVB	
Flexible shower heads	Minor	AVB	
Swimming pools	Moderate	DCVA/AG	

Chapter 6, table answers 102

Premise Identification	Degree of Hazard
Sewage treatment plants or sewage pump stations	High
Hospitals, medical/dental centers	High
Metal plating plants	High
Food processing plants	High
Piers and docks, marinas and dry docks	High
Car washes	High
Restricted access premise	High
Shopping centers	Moderate
Mobile home parks	Moderate
Fire sprinkler systems with no chemical additives	Moderate

Premise Identification	Degree of Hazard
Fire sprinkler systems with chemical additives	High
Fuel storage facilities	High
Commercial laundry	High
Dental clinics	High
Steam plant	High
Tall buildings over 9.4m (30ft)	Moderate to high

Self-Test 7

1. a
2. c
3. b
4. d
5. b
6. a
7. c
8. d
9. d
10. c
11. a
12. a
13. b
14. c
15. d
16. a
17. d
18. c
19. b
20. a
21. b
22. a
23. b
24. b
25. a
26. a
27. a
28. b

Self-Test 8

1. a
2. b
3. c
4. d
5. d
6. b
7. a
8. c
9. b
10. a
11. a
12. d
13. b
14. a
15. c
16. c
17. b
18. a
19. a
20. c
21. c
22. c
23. c
24. b
25. c
26. b
27. c
28. d
29. a
30. b
31. c
32. b
33. d
34. b
35. a
36. c
37. b
38. b
39. a
40. a
41. c
42. b
43. a
44. a
45. c
46. d

Content

Self-Test 9

1. a	5. b	9. c	13. a
2. d	6. c	10. b	14. d
3. c	7. d	11. a	15. c
4. b	8. a	12. d	16. C

Content

Appendix A—Abbreviations and Conversions

Table of abbreviations

Valve Description	Abbreviation
Airgap/ Registered Air Gap	AG/RAG
Reduced Pressure Backflow Assembly	RP/ RPBA
Reduced Pressure Detector Assembly	RPDA
Reduced Pressure Detector Assembly Type Ii	RPDA Type II
Double Check Valve Assembly	DCVA
Double Check Detector Assembly	DCDA
Double Check Detector Assembly	DCDA type II
Pressure Vacuum Breaker Assembly	PVB
Spill Resistant Vacuum Breaker Assembly or Spill Resistant Type Pressure Vacuum Breaker	SVBA or SRPVB
Atmospheric Vacuum Breaker	AVB
Dual Check Valve	DCV/DuC
Dual Check with Atmospheric Vent port	DCAP
Dual Check with Vent port	DCVP
Dual Check Valve Type for Fire systems	DuCF
Single Check Valve For Fire systems	SCVAF
Hose Faucet Vacuum Breaker or Hose Connection Vacuum Breaker	HFVB or HCVB
Hose Connection Dual Check Type Vacuum Breaker	HCDVB
Lab faucet Vacuum Breaker	LFVB
Double Wall Heat Exchanger	DW
Single Wall Heat Exchanger	SW
Double Wall Heat Exchanger with Leak Detection	DWP
Thermal Expansion Relief	TER
Lead Free (such as used to describe a Watts "LFN9" lead-free backflow preventer)	LF

Content

Table of Conversions

0.22 Imperial gallon =	1 liter	Miscellaneous formulae
0.26 US gallon =	1 liter	
1 inch =	25.4 mm	
1 psi =	6.895 kPa	
1 degree Fahrenheit (F) =	1.8 degrees Celsius (C)	C° X 1.8 + 32 = F°
212° Fah =	100° C	Is the Boiling point of water
32° Fah=	0° C=	Is the freezing point of water
1 imperial gallon =	1.2 us gallons	
3.28 feet	1 meter	
1 pound =	2.2 kilograms	
1 Imperial GPM =	13.12 liter/sec	
1 US GPM =	11 liters/sec	
1 inch of mercury Hg =	0.4912 psi (3.389 kPa)	
1 inch of water column=	0.0361 psi	
1 inch of mercury =	13.6 inches of water column	

Content

Hodge Sterner Toxicity Scale

Classes of Human Toxicity Based on the Results of Animal Assays According to the Hodge and Sterner Scale

The following table, developed by toxicologists Hodge and Sterner, makes it possible to estimate toxicity in an adult human male based on the oral LD50 in rats, the LC50 by inhalation over four hours in rats and the LD50 by dermal route in rabbits.

Route of Administration

Toxicity Class	Common description	LD50 oral (Single dose for rats) mg/kg	LC50 inhalation (Dose over a 4-hour period for rats) ppm	LD50 dermal (Single application to the skin of rabbits) mg/kg	Probable lethal dose for humans
1	Extremely high toxicity	1 or less	10	5 or less	1 grain (1 drop, contact with mouth)
2	High toxicity	1-50	10-100	5-43	4 ml (1 teaspoon)
3	Moderate toxicity	50-500	100-1,000	44-340	30 ml (1 liquid oz.)
4	Low toxicity	500-5,000	1,000-10,000	350-2,810	600 ml (1 pint)
5	Very low toxicity	5,000-15,000	10,000-100,000	2,820-22,590	1 litre (1 quart)
6	Relatively harmless	15,000 or more	100,000 or more	22,600 or more	more than 1 litre (more than 1 quart)

Table courtesy Human Resources and Skills Development Canada

Note: For those involved with cross connection control and are about to evaluate the particular hazard of a heat transfer fluid this table may be daunting. What level do you assign for potable water classification and do you want the responsibility?

Content

What has atmospheric pressure got to do with cross connection control?

Consider this illustration to discover what atmospheric pressure has to do with cross connection. Atmospheric pressure can force water back into the water main if at any time the water main pressure is lower than atmospheric pressure. Figure B-1

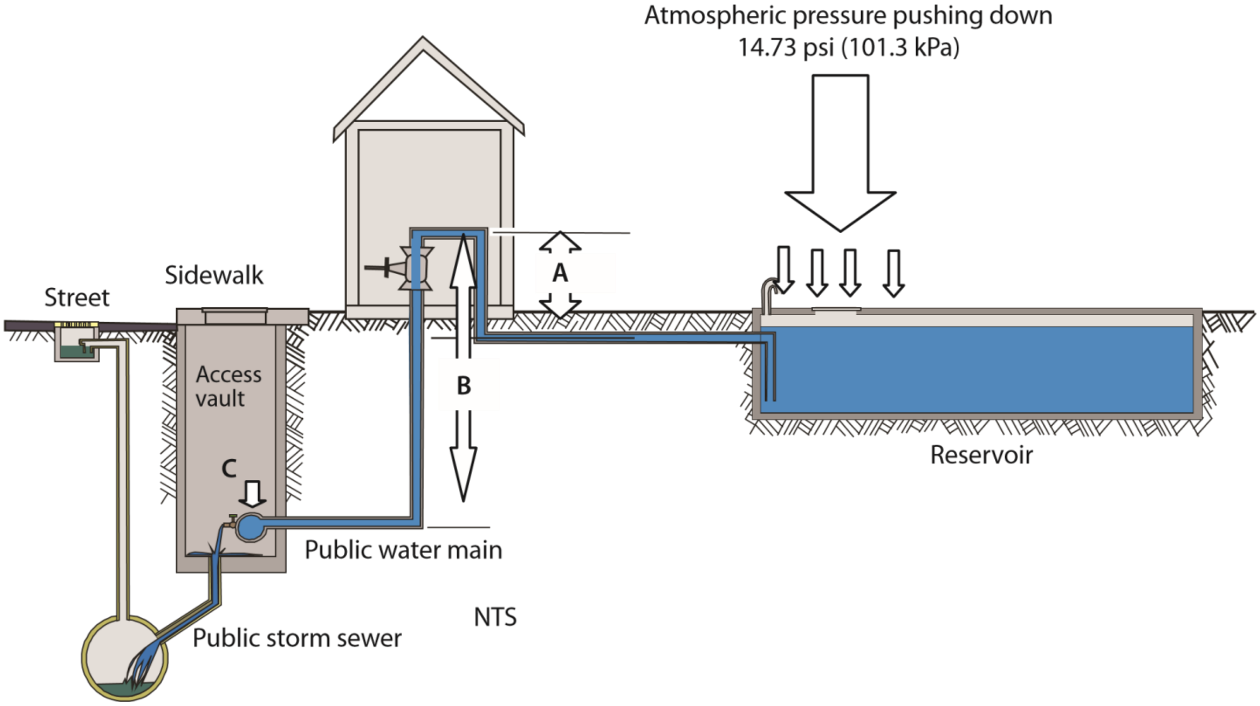

Figure Appendix B-1— Relationship between atmospheric pressure and cross connection control

This drawing depicts drawing the public water system has been shut down for repairs. The water main is currently being drained indirectly into the storm sewer from the access vault. Back-syphonage is occurring as the weight of the water in the leg "B" of the water service pipe is creating a negative pressure (less than atmospheric) upstream. Atmospheric pressure is pushing the reservoir water over leg "A" and back into the water main causing a cross connection. Atmospheric pressure is always present and whenever the water pressure in a water main drops below atmospheric it will act to force non-potable substances back into the potable water main.
(Back-syphonage)

Note: This piping arrangement is designed for the purpose of explaining how atmospheric pressure plays a part in cross connection and possible contamination of the potable water system.

Content

Fire sprinkler system forward flow test procedures

A backflow preventer may require an additional test called a forward flow test when installed on fire sprinkler systems. This test is conducted on new installations and at least annually thereafter. A certified sprinkler fitter with cross connection training would likely complete this test when testing the backflow assembly itself. This initial installation forward flow test is a requirement of the National Fire Protection Association (NFPA)–13. Backflow assembly forward flow test is required annually by NFPA 25.

The purpose of the backflow preventer forward flow test is to ensure the back flow preventer can meet the system flow demand. The reason for mentioning this test in this book is the results of this test may be on some authorities' backflow preventer test forms. If you are not a certified sprinkler fitter and you are testing the backflow preventer you may have to coordinate your test with the sprinkler contractor. In some jurisdictions only a certified sprinkler fitter can work on the sprinkler system including the installation and testing of the back flow preventer.

The following is one example of a backflow preventer forward flow test:

Some jurisdictions in Canada may be requiring similar tests.

Backflow Preventer Forward Flow Test Procedures

This example was extracted from an American State fire marshal office. You will need to consult the AHJ in your area to determine the local requirement

This example test is one method for a typical Light Hazard or Ordinary Group I or II demand; there are other approved methods for conducting the test. This example is very similar to a Main Drain Test, only that flow rates must be calculated. For larger demand systems, other approve method shall be used.

Test Procedure:

1. The automatic fire sprinkler contractor must provide a test outlet in the system downstream of the backflow preventer. The test outlet provided must be large enough to flow a volume of water at least equal to the hydraulically calculated system demand, including inside hose stream demand where applicable. The test outlet from which you will be flowing should be located as close to the backflow preventer as possible to minimize pressure loss due to friction. There are many options available for providing a test outlet. Some examples are: using a bypass around the check valve in the fire department connection, providing a tee in the riser, or an adequately sized main drain. A 2½" Standpipe hose connection or a fire pump test header may also be used to conduct the forward flow test.
2. Locate the pressure gauge on the supply side of the sprinkler riser, and record the static pressure
3. Open the main drain valve slowly, and allow it to run until the water is clear. This may take several minutes.
4. Observe the supply side pressure gauge, and record the pressure displayed once the needle stabilizes. This number is your residual pressure.
5. Record the number of outlets flowed, the outlet size and the pitot pressure read from each outlet or hose stream.
6. Convert the pitot tube readings to gallons per minute (GPM) (Litres per minute).
7. Compare performance test results to the hydraulic calculations. This comparison will verify that the water supply is adequate for proper system operation. Verify the actual flow rate meets or exceeds the designed flow rate.

8. At the completion of the forward flow performance test, conduct the backflow performance test. When both performance tests have been completed and the test results indicate the backflow preventer has passed all test requirements, the system is ready to be placed into service.
9. Complete the backflow assembly test form and summit to the appropriate authority.

Note: If the actual flow rate is less than the designed flow rate then extra steps are needed. You must hydraulically calculate the friction loss from the test outlet being flowed back to the riser connection.

Content

Appendix C—Manufacturers and Contacts

Information is as collected from web pages.

VANCOUVER ISLAND

Allied Instrument Service Ltd.
4286 Panorama Place
Victoria, BC V8X 4X7
Phone: (250) 478-2835
Phone 250-479-8566

I

NTERIOR/OKANAGAN

Interior Instrument Tech Services
1115 St. Paul Street
Kelowna, BC V1Y 2C6
Phone: 250.717.8813
Fax: 250.717.8355
Email: sales@iitsltd.com

LOWER MAINLAND

Shepherd Instrument & Controls Ltd.
5595 Roy Street
Burnaby, BC V5B 3A5
Phone: (604) 299-6300
Fax: (604) 299-8300

Wescan Calibration Services Inc. #9
– 12240 Horseshoe Way
Richmond, BC V7A 4X9
Phone: (604) 275-0600
Fax: (604) 275-0610

Conbraco/ Apollo valves

Andy Fretz Canada Regional Sales Manager
Commercial
Phone: 647-281-3161
Email: andy.fretz@conbraco.com

Barclay Sales Ltd.
British Columbia (Head Office)
1441 Kebet Way, Port Coquitlam,
B.C. V3C 6L3
Toll Free: 1-800-416-3033
Toll Free Fax: 1-800-665-6050

Ames Fire & Waterworks, a Watts Water Technologies Company
1427 N. Market Blvd, Suite 9
Sacramento, CA 95834
Phone: 916.928.0123 Fax: 916.928.9333 www.ames-co.com

Flomatic Corporation
15 Pruyn's Island Drive
Glens Falls, NY 12801
Phone: 1-800-833-2040 Fax: 1-800-314-3155 www.flomatic.com

Manufacturers' contact information as acquired from company web sites:

Apollo valves
Canadian Sales Office & Distribution Centre
#1-178 Pennsylvania Avenue Concord, Ontario L4K 4B1Canada 905-761-6161

FEBCO Canadian Office (A Watts brand)
5435 North Service Road
Burlington, Ontario, Canada L7L 5H7
Phone: 905-332-4090
Fax: 905 332-7068

Watts Canadian Office
5435 North Service Road
Burlington, Ontario, Canada L7L 5H7
Phone: 905-332-4090
Fax: 905-332-7068

zurn Wilkins

Wilkins Water Control Products Canadian contact
Zurn Industries Limited 3544 Nashua Drive Mississauga, Ontario L4V 1L2
Phone 1-905-405-8272

BAVCO
20435 S. Susana Rd.
Long Beach, CA 90810, USA
Phone: 310 639-5231
Phone: 1-800-458-3492
Fax: 310 639-0721

Note: BAVCO may be the largest distributor specializing in the sale of backflow prevention equipment and its many related accessories. They specialize in repair parts but also in any backflow-related equipment. They carry the many test kits, tools and accessories a technician will need to keep the backflow prevention assemblies in proper operation.

Content

Appendix D—Short form test procedures

RP test steps for educational purpose only, not to be used for field testing RP

You must follow the AHJ test procedures in the field on the job.

These steps use key words and phrases to explain steps. There is no troubleshooting on this sheet. There are sets of test procedures for each requirement. Do not run the sets of test procedures together. Finish a requirement steps and record the results before moving on to the next requirement. The BC/Canadian Plumbing Code references CSA B64 10.1 test procedures at the time of installation.

Test preparation for the RP

1. Confirm, seek permission that the water will be shut off Notify, Identify, Inspect and Observe.
2. Slowly open test valve 4, and leave it running, then turn test valve 1 on and off, test valve 2 on and off, test valve 3 on and off, close the test valve 4.
3. Attach high-side gauge hose to the test valve 2.
4. Attach the low-side hose to the test valve 3.
5. Open the test valve 3, open the low-side bleed-valve and leave it running.
6. Open the test valve 2. Open the high-side bleed-valve. When all air is out; close the high-side bleed-valve. Close the low-side bleed-valve. Close the shut-off 2. (Shut-off 1 stays open.)
7. Observe the apparent pressure differential across check valve. (Do not record the apparent psid.)

Requirement 1 of the RP:

The relief valve shall open at or above 2 psid.

1. Open the high-side control valve.
2. Place your hand under the relief valve port and slowly open the low-side control valve, it should not be more than ¼ turn. If it does take more than ¼ turn you may have forgotten to close shut -off 2. (Or it could be leaking)
3. Watch the gauge and observe when the relief valve opens as your hand feels the first drip of water.
4. Record the results. If the psid is at or over 2 psid, record the relief valve passed.
5. Now close the low-side control valve. (The high side control valve remains open.)
6. Pause for a moment, think of what you have just done and then what test requirement is next?

Requirement 2 of the RP:

Check valve 2 shall be closed against all pressures in reverse flow.

1. Open the bypass control valve and bleed the water from the bypass hose.
2. With the water running raise the bypass hose up to test valve 4.
3. Close the bypass valve just as you connect the hose to test valve 4, open test valve 4.
4. Open the low- side bleed-needle valve to re-establish the apparent pressure drop across check valve 1, close low-side bleed- needle valve.
5. Pause for a moment; watch the gauge for the disc compression pressure drop as you open the bypass control valve.
6. Wait for a steady state psid for a minimum of 2 minutes.
7. After 2 minutes at a steady pressure, record that check valve 2 is holding tight. Record the check valve 2 as passed.
8. All valves to remain as they are. The second requirement is complete. Pause

Content

Requirement 3 of the RP:

Check valve 1 shall hold tight in the direction of flow.

1. Open the low-side bleed-needle valve to reestablish the apparent pressure drop across check valve 1, close low-side bleed-needle valve.
2. Do not touch anything else. Simply observe the gauge and valve.
3. Wait for a steady state psid for a minimum of 2 minutes.
4. Record the psid across check valve 1 as the actual pressure drop.
5. Record check valve 1 as closed tight, and record as passed.
6. The third requirement is complete Pause here for a moment.

Requirement 4 of the RP:

Calculate and record a minimum 3 psid buffer is present.

1. Subtract the relief valve opening psid from the actual psid across check valve 1.
2. Record the difference as the buffer, if 3 psid or more, record the buffer has passed.
3. Close all test valves and remove the differential pressure gauge.

Requirement 5 of the RP:

Record the line inlet pressure at the time of test and check the air gap at the relief port.

1. Connect a pressure gauge assembly or the differential pressure gauge with internal pressure gauge to test valve 1 open test valve 1 and bleed the assembly.
2. Take the pressure reading and record it on the test form, if the pressure is recorded on the test form it shall be recorded as passed, if not recorded the test shall be recorded as failed.
3. Close test valve 1, remove the gauge, ensure that shut-off 1 is open, and check the assembly for leaks.
4. Notify and seek permission to turn on the water.
5. Slowly open shut-off 2. Complete test forms and send to appropriate parties or as directed by the AHJ.
6. Check the relief valve air gap and record as passed is the air gap is approved. See RP test requirements in Chapter 8.

Content

DCVA test steps for educational purpose only, not to be used for field testing DCVA

You must follow the AHJ test procedures in the field on the job.

These steps use key words and phrases to explain steps. There is no troubleshooting on this sheet. There are sets of test procedures for each requirement. Do not run the sets of test procedures together. Finish a requirement steps and record the results before moving on to the next requirement. Use the same bleeding procedure of the RP on this DCVA for no other reason than to develop consistent bleed steps. Review the full test procedures first. The BC/Canadian Plumbing Code references CSA B64 10.1 test procedures at the time of installation.

Preparation for test 1 DCVA

1. Confirm, seek permission that the water will be shut off Notify, Identify, Inspect and Observe
2. Bleed the test valves.
3. Mount the gauge at the expected height of the water level in the sight tube when used
4. Coil up any unused hoses at the same height of the gauge or remove unused hose.
5. Install a sight tube on test valve 3.
6. Attach a bleed valve assembly to test valve 2.
7. Attach high-side gauge hose to test valve 2.
8. Slowly open test valve 2, then open high-side bleed-valve, when all air is out, close high-side bleed valve.
9. Fill the sight tube with water.
10. Close the shut off 2 and then close shut-off 1.

Requirement for check valve 1 of the DCVA

- Check valve 1 shall hold tight a minimum 1 psid or more for a minimum of 2 minutes steady.

Test of check valve 1 DCVA.

1. Adjust the gauge center height to the level of the water in the sight tube.
2. Open test valve 3 when the water stops running out observe the gauge steady state reading for a minimum of 2 minutes.
3. Record as passed if 1 psid or more. Record as failed if less than 1 psid.
4. Close the test valves and open shut off 1

Preparation for the test of check valve 2

1. Remove the differential pressure gauge.
2. Move the sight tube from test valve 3 and place it on test valve 4.
3. Remove the bleed valve assembly from test valve 2 and place it on test valve 3.
4. Attach the gauge high-side hose to test valve 3 bleed valve assembly and slowly open test valve 3 (to recharge the gauge)
5. Open slowly the high-side bleed-needle valve and bleed the air from the gauge. Close the high-side bleed-needle valve.
6. Open test valve 4 to fill the site tube. Close the test valve 4 when the sight tube is full. Close the shut off 1 valve.

Requirement for check valve 2 of the DCVA

- Check valve 1 shall hold tight a minimum 1 psid or more for a minimum of 2 minutes steady.

Test of check valve 2 of the DVA

1. Adjust the gauge center height to the level of the water in the sight tube.
2. Open test valve 4. When the water stops running out, observe the gauge for a stabilized reading for a minimum of 2 minutes.
3. Record as passed if the psid of the gauge reads 1 psid or more. If the pressure is less than 1 psid record test as failed.
4. Close all test valves open shutoff valve 1 and remove the differential pressure gauge.

Content

Start the test for the 3rd requirement

Record the line inlet pressure at the time of test.

1. Connect a pressure gauge assembly or the differential pressure gauge with internal pressure gauge to test valve 1. Open test valve 1 and bleed the gauge.
2. Take the pressure reading and record it on the test form. If the pressure is recorded on the test form it shall be recorded as passed. If the pressure is not recorded the test shall be recorded as failed.
3. Close test valve 1 and remove the gauge ensure that shut-off 1 is open. Check the assembly for leaks.
4. Notify and seek permission for the water to be turned on.
5. Slowly open shut-off 2.
6. Complete test forms and send to appropriate parties or as directed by the AHJ.
7. Remove bleed valve assembly, site tube and adapters. Replace caps on test valves when required.

See DCVA test requirements in Chapter 8.

Content

PVB test steps for educational purpose only, not to be used for field testing PVB

You must follow the AHJ test procedures in the field on the job.

These steps use key words and phrases to explain steps. There is no troubleshooting on this sheet. There are sets of test procedures for each requirement. Do not run the sets of test procedures together. Finish a requirement steps and record the results before moving on to the next requirement. The BC/Canadian Plumbing Code references CSA B64 10.1 test procedures at the time of installation.

Test preparation

1. Confirm, seek permission that the water will be shut off Notify, Identify, Inspect and Observe
2. Remove the canopy.
3. Bleed the test valves.
4. Mount the gauge at the height of the valve.
5. Coil up any unused hoses at same height of gauge. Or remove the unused hoses.
6. Attach high side gauge hose to test valve 2.
7. Slowly open test valve 2, then open high-side bleed valve. When all air is out, close high-side bleed valve.
8. Close shut off 2, and then close shut-off 1.

Requirements 1 and 2 for the PVB

- The air-inlet valve opens at or above 1 psid.
- The air-inlet valve is fully opened when the valve body is completely drained.

1. Very slowly open the high-side bleed-needle valve throttle down the psid and count down the psid reading as the gauge psid drops. Be prepared to observe the exact psid that the air-inlet valve opens.
2. Record the psid that the air-inlet valve opens, if the psid is at or above 1 psid the valve is recorded as passed. If the psid is lower than 1psid the valve is recorded as failed.
3. After the air-inlet valve opens, continue to open the bleed needle valve to allow the valve body to completely stop draining.
4. Check if the air-inlet valve has opened fully. If the air-inlet valve is fully opened, record as opened fully and passed. If not open fully, then record as failed.
5. Close the high-side bleed-needle valve and test valve 2.
6. Remove the differential gauge.

Requirement 3 preparation for the PVB

1. Open shut-off 1 to recharge the PVB.
2. Mount the gauge at the height of the valve.
3. Coil up any unused hoses at same height of gauge. Or remove unused hoses.
4. Attach high-side gauge hose to test valve 1.
5. Slowly open test valve 1 and then open high-side bleed valve, when all the air is out, close high -side bleed valve.
6. Close shut off 1. (Shut-off 2 remains closed.)

Requirement 3 test for the PVB

- Check valve 1 shall close tight in the direction of flow.
- Check valve 1 shall hold tight a minimum 1 psid or more for a minimum of 2 minutes' steady state.

1. Open test valve 2 and allow the PVB valve body to completely drain.
2. When the test valve stops dripping and the valve body is completely empty and the gauge holds steady for a minimum of 2 minutes or until stabilization, record the psid, if the psid is at or above 1 psid. Check valve is recorded as closed tight. If the psid is less than 1, then record check valve failed.
3. Close the test valves 1 and 2. Remove the differential pressure gauge and replace the canopy.

Content

Requirement 4 test for the PVB

- Record the line inlet pressure at the time of the test.

1. Open shut off 1 to recharge the valve. Connect a pressure gauge assembly or the differential pressure gauge with internal pressure gauge to test valve 1 open test valve 1. Bleed the assembly by opening and closing the high-side bleed -needle valve.
2. Take the pressure reading and record it on the test form. If the pressure is recorded on the test-form, it shall be recorded as passed. If the pressure is not recorded the test shall be recorded as failed.
3. Close test valve 1 and remove the gauge ensure that shut-off 1 is open. Check the assembly for leaks.
4. Notify and seek permission to turn on the water.
5. Slowly open shut-off 2. Complete test forms and send to appropriate parties or as directed by the AHJ.

See the detailed procedure in Chapter 8.

Content

SRPVB test steps for educational purpose only, not to be used for field testing SRPVB.

You must follow the AHJ test procedures in the field on the job. Currently CSA and Canadian AWWA have 3 valve test procedure versions

These steps use key words and phrases to explain steps. There is no troubleshooting on this sheet. There are sets of test procedures for each requirement. Do not run the sets of test procedures together. Finish a requirement steps and record the results before moving on to the next requirement. The BC/Canadian Plumbing Code references CSA B64 10.1 test procedures at the time of installation.

Test requirements for the SRPVB

- Requirement: The air inlet shall open at or above 1 psid and be fully open when the valve body drains completely.
- Requirement: The check valve shall hold at a steady state at or above 1 psid (6.895 kPa) for a minimum of two minutes.
- The static line pressure shall be measured at the time of the test and recorded on the report form

Air inlet Test set-up using a 5 valve gauge

1. Confirm, seek permission that the water will be shut off Notify, Identify, Inspect and Observe.
2. Remove the canopy observe the air inlet for debris and obvious damage. Do not physically alter.
3. Open and close the bleed vent screw, open and close the test valve to bleed debris
4. Install a bleed-valve assembly on the test valve. Connect the high-side hose to the bleed-valve assembly.
5. Slowly open the test valve. Slowly open the high-side bleed valve. Bleed the air from the hose and gauge. Close the high-side bleed valve.
6. Slowly close shut-off 2 and then close shut-off 1. Ensure the test gauge is at the same level as the vent valve

You are ready to start the air inlet test.

Test procedure air-inlet valve.

Air inlet requirement: The air inlet shall open at or above 1 psid and be fully open when the valve body drains completely

1. Gradually open the bleed screw and gradually open the gauge high side bleed valve, not to quickly
2. Observe the gauge closely and note the air inlet opening PSID
3. Wait for the water to stop running. You can remove the bleed screw and the high side hose from the test valve to allow the valve body to drain completely.
4. When the water stops running from the test valve, check to see the air inlet is fully open.
5. If the air inlet is fully open record air inlet fully open and record the air inlet opening PSID at or above 6.9 PSID as passed
6. If removed, reconnect the high side hose and reinstall bleed screw
7. Close the gauge high-side bleed-needle valve, the bleed screw and the test valve.

Air inlet test complete you are now ready for the check valve test.

Content

Test procedure SRPVB Check Valve

Requirement: The check valve shall hold at a steady state at or above 1 psid (6.895 kPa) for a minimum of two minutes in the direction of flow.

1. Slowly open shutoff valve 1 to recharge the SRPVB.
2. Ensure the differential pressure gauge valves are closed and open the test valve to charge the gauge.
3. Bleed the gauge and hose by opening gauge high side bleed valve,
4. Close the gauge high side bleed valve once air is removed from the gauge and hose. Close shutoff valve 1, Shutoff 2 remains closed
5. Begin the check valve requirement by opening the bleed vent screw. You can remove the bleed vent screw to assist in draining the valve body above the check valve.
6. Wait for the vent screw opening to stop dripping and the gauge reading to stabilize
7. Observe the gauge steady state stabilized pressure at or above 6.9 kPa for a minimum of 2 minutes
8. Record the steady states pressure, if at or above 6.9 kPa as passed.
9. Close the test valve and bleed vent, remove the test gauge and bleed valve assembly if used
10. Slowly open shutoff 1 to recharge the gauge, shutoff 2 should remain closed until after the static line pressure has been acquired. Note the CSA test procedure states to open shutoff 2 at this time, this is likely an error as it must remain closed to get a static line pressure recording.
11. Reinstall the canopy

Record the static line pressure

Requirement

The static line pressure shall be measured at the time of the test and recorded report form

1. Connect the pressure gauge to the test valve
2. Open the test valve and bleed the gauge to remove the air. Close the bleed valve
3. Observe and record the line pressure recorded as passed, or not recorded failed

Return the SRPVB to service

1. Close test valve and remove all equipment
2. Complete all paper work
3. Seek permission (AHJ) to turn the water back on, check to see shut off one is fully open, check for leaks
4. Slowly open shut-off two.
5. Fill out and attach the test tag and complete necessary paper-work with signatures

See the detailed procedure for testing a SPVBA in Chapter 8

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Appendix E—Links to Interesting information Codes and CSA standards CCC bylaws

The Canadian Building/Plumbing Code has adopted enforceable CSA B64.10 requirements which includes installation and testing of back flow preventers following CSA B64-10.1 test procedures at the time of installation in accordance with CSA B64-10 1.

Provincial governments adopting the Canadian code or municipal governments adopting the Provincial Plumbing Code are enforced by local government, and are responsible for enforcing building and plumbing code regulations and licensing and or registering and or issuing permits before construction and plumbing system are installed.

The following is an excerpt from CSA B64 10 "6.1.5 Field testing at installation

Please refer to the entire CSA standard B64-10, CSA B64 10-1, local bylaws and your Plumbing Code to interpret the following excerpts CSA clauses in full context. Always contact the AHJ for interpretation and clarifications.

The following backflow preventers and vacuum breakers shall be field tested in accordance with CSA B64.10.1 at the time of initial installation:

(a) PVB devices;
(b) SRPVB devices;
(c) DCVA and DCVAF backflow preventers;
(d) RP and RPF backflow preventers; and
(e) SCVAF backflow preventers."

CSA B64 10 Annex E of CSA (informative, non-mandatory) written in normative, (mandatory) language suggested Model backflow protection by law bylaw wording.

A selected Clause from CSA for a Model bylaw for enforcement if adopted,

Where required by [insert reference to provincial building code here] and CSA B64.10.1, all backflow preventers shall be inspected and tested (at the owner's expense) to demonstrate that the devices are in proper working condition. B64 10
Some AHJ have adopted

CSA Table 1 Authorized functions

Only those persons listed in the Authorized Functions List (see CSA Table 1) shall carry out the corresponding functions set out in such list.

- Professional engineer with tester's license
- Certified engineering technologist with tester's license*
- Licensed master plumber with contractor's and tester's license
- Journeyman plumber with tester's license† *Required to be employed by a licensed plumbing contractor or licensed fire sprinkler contractor.*
- Apprentice plumber with tester's license‡ *Required to be employed by a licensed plumbing contractor and under the direct supervision of a journeyman plumber or master plumber.*
- Fire system sprinkler fitter with a tester's license
- Lawn irrigation system installer with tester's license

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Remember, always contact the AHJ for interpretation and clarifications.

The following is a summation of the reference to the CSA B64 10 Annex B informative not a mandatory requirement guide to assessment of hazards

When an authority having jurisdiction is administering a local CCC program has several options when determining locations of backflow prevention in any existing buildings.

- The first option is to isolated the building based by location a backflow preventer at the service connection to isolate the building from the municipal water distribution system, Premise Isolation: however, this will not protect occupants within the building.
- The second option is to locate backflow preventer at individual point of use or zones of use; however, changes in the building use, alteration, additions and extension and complexity of piping etc. can leave the public water distribution system at risk to contamination
- The third option would be to combine zone and individual water connection uses and

In Canada the Plumbing codes do not regulate maintenance of buildings after occupancy therefore local governments would adopt bylaws to ensure testing of backflow preventers for maintenance and other purposes are enforced; However, application registration for a permit is a mandatory requirement if the Plumbing water distribution system is extended, altered, renewed or repaired. In such case proper trades qualification is mandatory. Check with the authority having jurisdiction, there may be exceptions to this rule.

CSA B64 10-1 annex B tester qualification include that a tester should be licensed to work on potable water systems (e.g., plumber, sprinkler fitter, steamfitter etc. and also have current liability insurance coverage (with an expiry date no less than 6 months after the date of application for licensing or registration).

The Canadian provincially adopted Building/Plumbing codes typically direct administration licensing registration, issuing permits and code enforcement to the local Municipal Authorities, before a building is constructed and plumbing systems are installed) extended, altered, renewed or repaired a permit must be issued. The design must first be approved as meeting the code requirements, (engineering practice health safety, zoning etc.) Once satisfied with the design etc. The municipality would issue a permit to begin construction. No plumbing system can be installed or after installation be extended, altered, renewed or repaired without a permit. Where the plumbing Code is silent a municipal government can establish requirements and enforce those additional requirements

Canadian standard association requirements such as B64-10 and or B64 10.1 or standards when adopted in a Provincial Plumbing Code are enforceable. Check with the authority having jurisdiction, there may be exceptions to this rule.

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These are the Intent of the Canadian Plumbing Code section cross connection related

Intent of BC/Canadian Plumbing Code regulations water distribution system protection from contamination.

1. 6.2.1.3 To limit the probability that the performance of backflow preventers will fall significantly below expectations, which could lead to the entry of contaminants from surrounding environments under backflow conditions into potable water, which could lead to the contamination of potable water, which could lead to harm to persons. Code objective OH.2-consumption of contaminated water as an objective of this Code is to limit the probability that, as a result of the design or installation of the plumbing system, a person in the building or facility will be exposed to an unacceptable risk of illness due to indoor conditions.
2. 2.6.2.4. (2) To limit the probability that inadequate backflow protection will lead to an inability to resist back-siphonage or back pressure, which could lead to the contamination of potable water systems with water from fire sprinkler/standpipe systems, which could lead to harm to persons.
3. 2.4.2.2. (1) To limit the probability of backflow from drainage systems into rainwater tanks, which could lead to contamination of water in the tank, which could lead to unsanitary conditions, which could lead to harm to persons.
4. 2.6.2.1 (1) To limit the probability that inappropriate design or installation of devices could cause backflow and cause contamination of potable water, which could lead to harm to persons.
5. 2.6.2.9. (1) To limit the probability that an inappropriate location for air gaps will lead to the ingress of noxious vapours from surrounding environments under backflow conditions into water distribution systems, which could lead to contamination of potable water systems, which could lead to harm to persons.
6. 2.6.2.1(2) To limit the probability that inappropriate water treatment devices or apparatus will lead to intrusion of substances into the potable water system, which could lead to contamination of potable water systems, which could lead to harm to persons.
7. 2.6.2.7. (1) To limit the probability that a lack of backflow protection of hose bibbs will lead to back-siphonage, which could lead to contamination of potable water systems, which could lead to harm to persons.
8. 2.6.2.3 (1) To limit the probability that inadequate backflow protection will lead to an inability to resist back pressure from connected sources containing other than potable water, which could lead to contamination of potable water systems, which could lead to harm to persons
9. 2.6.2.3 (2) To limit the probability that inadequate backflow protection will lead to an inability to resist back pressure, which could lead to backflow, which could lead to contamination of potable water supply systems with non-toxic substances, which could lead to harm to persons.
10. 2.6.2.3 (3) To limit the probability that inadequate backflow protection will lead to an inability to resist back pressure, which could lead to backflow of toxic substances, which could lead to contamination of potable water supply systems, which could lead to harm to persons.
11. 2.6.2.4 (1) To exempt certain residential full flow-through fire sprinkler/standpipe systems from the requirement to a have backflow preventer.
12. .2.6.2.4 (2) To limit the probability that inadequate backflow protection will lead to an inability to resist back-siphonage or back pressure, which could lead to the contamination of potable water systems with water from fire sprinkler/standpipe systems, which could lead to harm to persons

13. 2.6.2.4 (3) To limit the probability that inadequate backflow protection will lead to an inability to resist back-siphonage or back pressure from fire department pumper connections, which could lead to the contamination of potable water systems with water from fire sprinkler/standpipe systems, which could lead to harm to persons.
14. 2.6.2.4 (4) To limit the probability that inadequate backflow protection will lead to an inability to resist back-siphonage or back pressure from fire department connections, which could lead to the contamination of potable water systems with water from fire sprinkler/standpipe systems, which could lead to harm to persons
15. 2.6.2.2 (1) To limit the probability that an inappropriate connection will lead to back-siphonage from connected sources other than potable water, which could lead to contamination of potable water systems, which could lead to harm to persons.
16. 2.6.2.2 (2) To limit the probability that inadequate protection will lead to back-siphonage, which could lead to contamination of potable water supply systems, which could lead to harm to persons
17. 2.6.2.5. (1) To limit the probability that interconnection of unregulated private water supply systems with public water systems will lead to the contamination of public water systems, which could lead to harm to persons.
18. 2.6.2.6. (1)To limit the probability that an inability to isolate portions of potable water systems in such buildings or facilities will lead to the spread of contaminated water beyond the premise of origin, which could lead to the spread of a potentially severe health hazard, which could lead to harm to persons.
19. 2.6.2.7. (1) To limit the probability that a lack of backflow protection of hose Bibbs will lead to back-siphonage, which could lead to contamination of potable water systems, which could lead to harm to persons.
20. 2.6.2.8. (1) To limit the probability that contaminants and construction debris in un-cleaned water systems will lead to contamination of potable water systems, which could lead to harm to persons.
21. 2.6.2.9. (1) To limit the probability that an inappropriate location for air gaps will lead to the ingress of noxious vapours from surrounding environments under backflow conditions into water distribution systems, which could lead to contamination of potable water systems, which could lead to harm to persons.
22. 2.6.2.9. (2) To limit the probability that inadequate air gaps will lead to the ingress of waterborne contaminants from surrounding environments into water distribution systems under backflow conditions, which could lead to contamination of potable water systems, which could lead to harm to persons
23. 2.6.2.10. (1) To clarify critical-level for purposes of Sentences 2.6.2.10. (3) and Sentence 2.6.2.10. (4).
24. 2.6.2.10. (2) To limit the probability that an inappropriate location of installation will lead to vacuum breaker failures due to prolonged exposure to water supply pressure, which could lead to the ingress of contaminants from surrounding environments under backflow conditions into potable water supplies, which could lead to contamination of potable water, which could lead to harm to persons.

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25. 2.6.2.10. (3) To limit the probability that an inadequate installed height for vacuum breakers will lead to the entry of contaminants from surrounding environments under back-siphonage conditions into potable water systems, which could lead to contamination of potable water, which could lead to harm to persons.
26. 2.6.2.10. (4) To limit the probability that an inadequate installed height for pressure vacuum breakers will lead to the entry of contaminants from surrounding environments under back-siphonage conditions into potable water systems, which could lead to contamination of potable water, which could lead to harm to persons.
27. 2.6.2.11. (1) To limit the probability that the lack of back-siphonage preventers will lead to the entry of contaminants from water closet tanks or bowls under back-siphonage conditions into potable water systems, which could lead to contamination of potable water, which could lead to harm to persons
28. 2.6.2.12. (1) To limit the probability that the installation of a bypass or other devices that would make backflow preventers ineffective will lead to the entry of contaminants from surrounding environments under backflow conditions into potable water systems, which could lead to contamination of potable water, which could lead to harm to persons.
29. 2.7.1.1. (1) To limit the probability that the interconnection of non-potable and potable water systems will lead to contamination of potable water systems, which could lead to harm to persons.
30. 2.7.2.1. (1) To limit the probability that inadequate identification will lead to the inadvertent interconnection of non-potable and potable water systems, which could lead to contamination of potable water systems, which could lead to harm to persons.
31. 2.7.3.1. (1) To limit the probability that an inappropriate location for non-potable water piping will lead to contamination of potable water or food, which could lead to consumption of contaminated substances, which could lead to harm to persons.

Code Intent clause mobile home water service 2.6.10.1

To limit the probability that:

1)

- 2.6.10.1. (B) termination below ground will lead to backflow of groundwater into potable water systems,
- 2.6.10.1. (c) (i) inadequate protection from mechanical damage, will lead to damage to below-ground pipes during installation or removal of mobile homes, which could lead to leakage or backflow of groundwater into potable water systems,
- 2.6.10.1. (c) (iii)inadequate protection from frost-related movement will lead to damage to below-ground pipes, which could lead to backflow of groundwater into potable water systems, or
- 2.6.10.1. (c) (iv)the lack of a curb stop and a means of draining pipes, which could lead to freezing of water trapped inside pipes, which could lead to damage to pipes, which could lead to backflow of groundwater into potable water systems.

This intent of these clauses is to limit the probability of unsanitary conditions, which could lead to harm to persons.

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CSA requirements enforceable by local governments that have adopted the Canadian Building/Plumbing Code

- Field Testing at Installation: The following backflow preventers and vacuum breakers shall be tested in accordance with CSA B64 10-1 test procedures at the time of installation. PVB, SRPVB, DCVA, DCVAF, RP, RPF, SCVAF Device and Preventers

Examples of water works Cross connection by laws
Surrey BC cross connection bylaw good hazard tables
CRD Cross Connection by-law
Other provinces and cities The Corporation of the City of Brantford CCC bylaw

Labour mobility in Canada

Reference documents

Canadian Agreement on Internal Trade Chapter 7 Labour Mobility
Canadian Trades Certification Red Seal program

The following is for your information as a point of interest and your own interpretation
Canadian and provincial Agreement on Internal Trade (AIT) http://www.ait-aci.ca/wp-content/uploads/2015/09/Labour-Mobility-Guidelines.pdf

Since 1994, professional regulatory bodies and other stakeholders have taken steps to comply voluntarily with the obligations of the Labour Mobility Chapter 7. A great deal of valuable effort has gone into establishing terms for recognition of workers' qualifications. However, barriers which present challenges to labour mobility continue to exist. Provinces and territories have therefore agreed that, after fifteen years, the reasonable period of time initially set out for achieving compliance has expired. **Compliance is now mandatory.**

Chapter 7 Labour Mobility

Article 701: Purpose

The purpose of this Chapter is to eliminate or reduce measures adopted or maintained by the Parties that restrict or impair labour mobility in Canada and, in particular, to enable any worker certified for an occupation by a regulatory authority of one Party to be recognized as qualified for that occupation by all other Parties.

Article 706: Certification of Workers

1. Subject to paragraphs 2, 3, 4 and 6 and Article 708, any worker certified for an occupation by a regulatory authority of a Party shall, upon application, be certified for that occupation by each other Party which regulates that occupation without any requirement for any material additional training, experience, examinations or assessments as part of that certification procedure.
2. Subject to paragraphs 3, 4 and Article 708, each Party shall recognize any worker holding a jurisdictional certification bearing the Red Seal endorsement under the Interprovincial Standards Red Seal Program as qualified to practice the occupation identified in the certification.

AIT Definition: Mutual recognition means the acceptance by a Party of a person, good, service or investment that conforms with an equivalent standard or standards-related measure of another Party without modification, testing, certification, re-naming or undergoing any other duplicative conformity assessment procedure.

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AIT Definition: Certified means that a worker holds a certificate, license, registration or other form of official recognition issued by a regulatory authority of a Party which attests to the worker being qualified and, where, applicable authorized to practice a particular occupation or to use a particular occupational title in the territory of that Party. For greater certainty, "certified" does not include only having work experience in a given occupation gained within a Party where certification is not required in order to practice that occupation;

AIT definition: National Occupational Analysis means a document developed pursuant to the Interprovincial Standards Red Seal Program that details tasks and subtasks performed by workers in a trade.

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