

# USC

UNIVERSITY  
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Foundation for  
Cross-Connection  
Control and  
Hydraulic Research

## Bleeding the Test Cocks

In testing the reduced pressure principle backflow prevention assembly it is critical that the relief valve opening point be determined before exercising the relief valve. In the preliminary steps of the field test procedure it is possible to accidentally activate the relief valve. When this happens the relief valve is exercised. If the relief valve had been sticking, exercising it may have loosened it up so that the reading recorded at the time of testing the relief valve is quite different that it would have been had the relief valve not been exercised. When backflow occurs, it never exercises the relief valve first. It just occurs. When it does occur it is important to know how the assembly will react. This is why it is essential that the tester not activate the relief valve before recording the relief valve opening point.

The relief valve is activated when the differential pressure across the first check valve drops to some level. (In a successful test the differential must be greater than 2.0 psid.) This can occur by either dropping the pressure upstream of the first check valve or increasing the pressure downstream of the first check valve. One way to help ensure that the relief valve is not activated prematurely is to have water flow through the assembly. When water flows through a backflow preventer, the pressure drop across the assembly increases (especially at low flows. When the

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## Foundation Receives AWWARF Project

The American Water Works Association Research Foundation (AWWARF) put out a request for proposal earlier this year for the project: *National Assessment of the Impact of Cross Connections in North American Water Supplies*. The Foundation contacted Members to determine which Members would be willing to help with this project by way of in-kind contributions. As a result several water utilities were willing to contribute to the project. This information was included in the Foundation's proposal to the AWWARF. The AWWARF recently announced that the Foundation was awarded the project. The project will take approximately two years and bring in valuable information to all those involved in cross-connection control. This article summarizes the Foundation's proposal. For water utilities still interested in getting involved in this project, please contact the Foundation Office.

### Background

Technical literature and the public press have recorded incidents of backflow of contaminated or polluted substances into the distribution systems of water utilities for well over 100 years. A few water utilities instituted modest cross-connection control programs in the 1930's. However, only recently has there been a marked increase in the number or

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Inside Cross Talk

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Calendar of Events • Training Schedule

## Foundation Membership

The Foundation's Membership Program provides many benefits to the Members of the Foundation. These include: twenty percent discounts on Foundation Training courses for any employee of the Member company/organization, the *List of Approved Backflow Prevention Assemblies*, printed quarterly, and access to the up-to-the-minute version of the List for those Members with Internet access.

Members are encouraged to call the Foundation with technical questions. The Foundation's Engineering Staff is available to assist Members with the various aspects of field testing backflow preventers, installing backflow preventers, administering their cross-connection control program.

ABPA - Indiana Chapter  
Albuquerque Technical Vocational Inst.  
Allied Associates Consulting Engineers  
Allied Signal  
American Backflow Prevention, IL  
Anytime Plumbing  
Arizona Chapter, ABPA  
Austin, City of  
Automatic Rain Company  
Backflow Services  
Backflow Solutions Inc.  
Brooks AFB  
Brunswick County Pub. Util.  
Central Community College  
Desert Botanical Garden  
Douglas County  
Ellensburg, City of  
Environmental Care, Inc.  
Fern Valley Water Dist.  
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SAH Training/Seminars  
Southern Calif. Backflow Cont.  
Sundance Irrigation Training  
Toccoa, City of  
U.A. Local 375 J.A.T.C.  
Union Carbide Corporation

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# Bleeding the Test Cocks

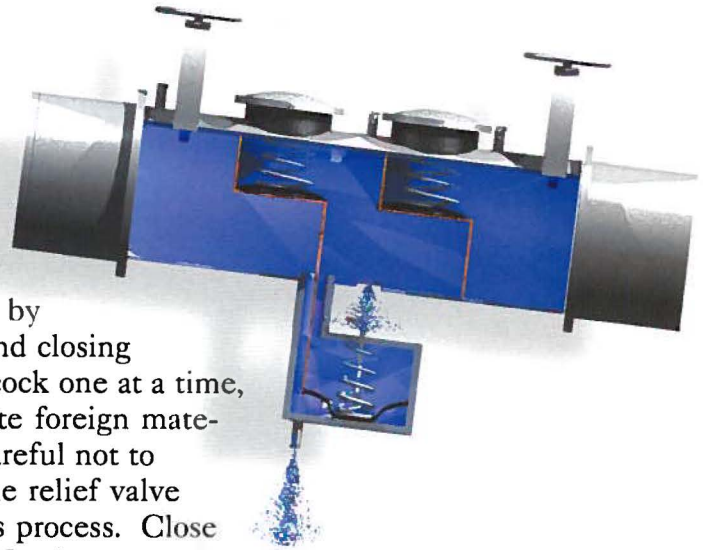
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pressure drop across the whole assembly increases, this is also an indication that the pressure drop across the first check valve increases. This is an indication of the force being used to open the check valve. At a no-flow condition, the pressure drop across the assembly is steady. As water starts to flow through the assembly more pressure is lost due to friction loss and the opening of the check valves. Once the check valves are opened a fair amount there is less force required to keep them open. This is why the flow curves of the various backflow preventers tend to have similar characteristics. One thing consistent in all flow curves is the increase in pressure loss as the flow increases from a no-flow condition.

Because of the pressure loss characteristics of backflow preventers, the possibility of activating a relief valve can be reduced substantially if flow is established through the assembly during certain preliminary steps in field testing. This is why there is a very specific order for bleeding the test cocks on the reduced pressure principle assembly. Step a of Test No. 1 in Section 9.2.2 of the Manual of Cross-Connection Control, Ninth Edition states:

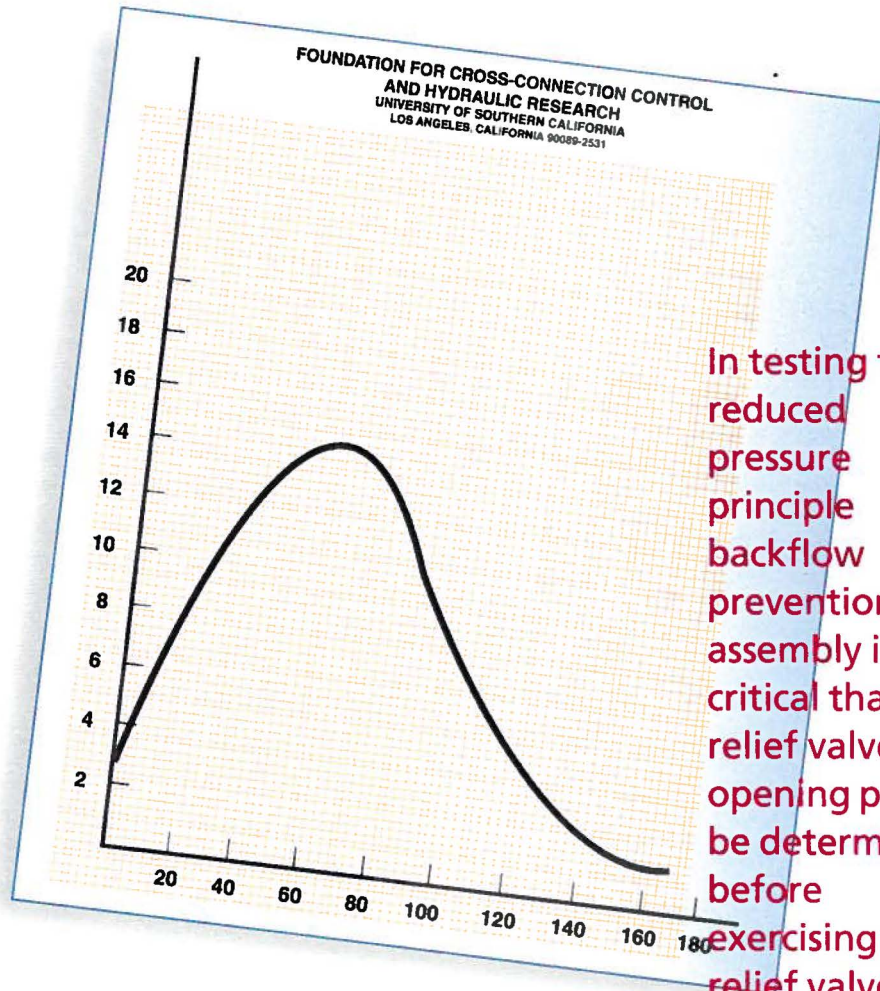
Open No. 4 test cock to establish flow through the unit, then flush water through test

cocks No. 1, No. 2, (open No. 2 test cock slowly), and No. 3, by opening and closing each test cock one at a time, to eliminate foreign material. Be careful not to activate the relief valve during this process. Close test cock No. 4.



As water flows out of the No. 4 test cock it is flowing through the assembly, thus increasing the

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In testing the reduced pressure principle backflow prevention assembly it is critical that the relief valve opening point be determined before exercising the relief valve.

## Bleeding the Test Cocks

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pressure loss across the No. 1 check valve. This reduces the possibility of activating the relief valve dramatically. This is especially important while opening the No. 2 test cock. The No. 2 test cock is located at a place on the assembly upstream of the number one check valve. Opening this test cock may reduce the pressure upstream of the No. 1 check valve. If this is done suddenly the pressure differential across the No. 1 check valve can drop, discharging the relief valve. This is especially critical when the No. 2 test cock is located in a restricted region on the high side of the relief valve diaphragm as shown in the illustration. If, however, water is flowing through the assembly when the No. 2 test cock is opened, the overall differential across the No. 1 check valve is much higher and, therefore, requires a greater loss of

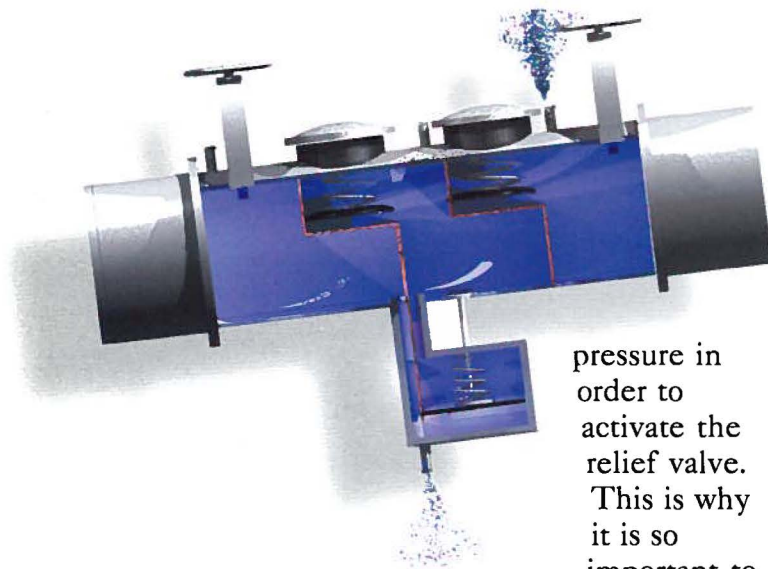
the air from the gage can cause the same effect. When the gage is attached to the assembly, the high side hose is attached to the No. 2 test cock. Therefore, bleeding water from the high side hose, could cause the same effect as bleeding the No. 2 test cock. In order to avoid premature activation of the relief valve in this manner, the *Manual of Cross-Connection Control* states that the tester should open the No. 3 test cock and bleed water from the low side of the gage while opening the No. 2 test cock very slowly.

Section 9.2.2 Test f:  
Maintain the low side bleed needle valve in the open position while test cock No. 2 is opened slowly.

This, again, allows water to flow through the assembly keeping the differential across the No. 1 check valve high. The water continues to flow through the low side bleed needle valve until the No. 2 test cock is opened and the high side bleed needle valve is bled. The low side bleed needle valve is only turned off after the high side is turned off. This ensures that water will continually be flowing through the unit when pressure is dropped from the chamber upstream of the No.1 check valve.

This is an example of how important it is to follow proper field test procedures, even though the details of the procedures—on the surface—may not seem to have an impact on the final outcome of the test. In this case, even the order in which the test cocks are bled is crucial to obtaining proper field data.

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pressure in order to activate the relief valve. This is why it is so important to

have water flowing through the No. 4 test cock when the No. 2 test cock is opened.

Bleeding the test cocks is not the only way the relief valve can be activated accidentally. Bleeding

# AWWARF Project

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programs across North America.

Although many cross-connection control programs have been initiated in recent decades, there are many utilities, which either do not have a program or do not have a sufficient program to provide for reasonable protection from cross-connections. Part of this is due to a lack of uniform regulations. Another reason many utilities have not initiated or maintained strong cross-connection control programs is that vast quantities of documented data regarding cross-connections are not readily available. This is mostly due to the nature of backflow.

Hydraulic conditions within a piping system change continuously. As a brief example, it is possible for a water main break to cause a drop in system pressure within a region of a water distribution system. Because of cross-connections common to any distribution system, backflow could occur contaminating a portion of the distribution system. As a result of this backflow situation, individuals could ingest the contaminant, or the appearance of water could cause alarm to the water user. Before the source of the contaminant can be discovered, the water main is repaired, water pressure is normalized and the system flushed clean through normal use. This makes it very difficult to document such a backflow incident.

Since there is no Federal reporting requirement for cross-connections, national statistics are not available. There are, however, a number of backflow incidents, which have

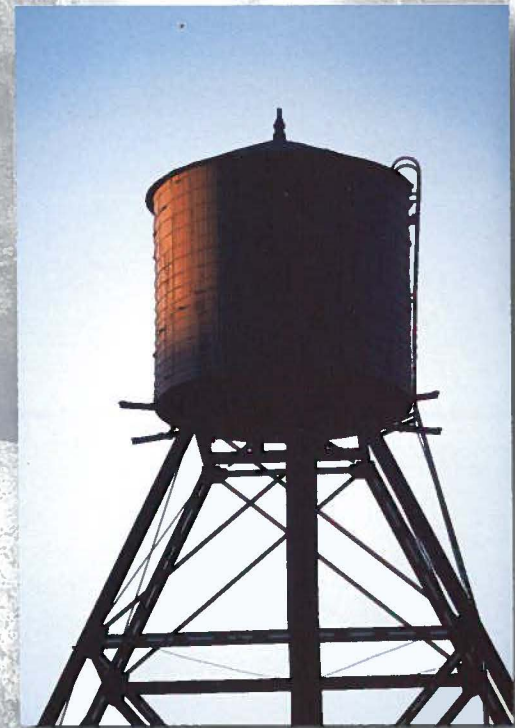
been compiled by the Foundation for Cross-Connection Control and Hydraulic Research. Selected portions of this information is published in the *Manual of Cross-Connection Control*, Ninth Edition. This is by no means all-inclusive, but does give an indication that cross-connections are widespread and nationwide.

## Project Description

### I. Objective

A comprehensive survey will be designed for water utilities, local and state governments. The survey will be designed to determine the extent of existing cross-connections within utility distribution systems as well as within premise piping systems. Additionally, the survey will determine the extent of cross-connections, which have been controlled by an effective means of backflow protection. An assessment of best management practices will be made in order to help determine the most effective means of eliminating contamination and pollution due to cross-connections, and provide the greatest public health benefit. Three computer models covering large utilities and small utilities will be developed to simulate backflow and the effect

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# Foundation Receives AWWARF Project

The survey will determine the extent of existing cross-connections within utility distribution systems as well as within premise piping systems.

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tiveness of cross-connection control.

## II. The Survey

The first task of the project will be to design and conduct a survey covering a large sample of water utilities (over 1000 utilities are planned) concerning the cross-connections and cross-connection control practices and their effectiveness. The survey will quantify information in the following areas.

### 1) *Most Common Types of Cross-Connections*

A cross-connection is defined as follows in the *Manual of Cross-Connection Control*, Ninth Edition:

The term "cross-connection" shall mean any unprotected actual or potential connection or structural arrangement between a public or a consumer's potable water system and any other source or system through which it is possible to introduce into any part of the potable system any used water, industrial fluid, gas, or substance other than the intended potable water with which the system is supplied. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices and other temporary or permanent devices through which or because of which backflow can occur are considered to be cross-connections.

a. The term "direct cross-connection" shall mean a cross-connection which is subject to both backsiphonage and backpressure.

b. The term "indirect cross-connection" shall mean a cross-connection which is subject to backsiphonage only.

The survey will determine which types of cross-connections (i.e., direct, or indirect) are most prevalent in distribution systems as well as within user premises. The analysis of this data will determine if specific types of cross-connections are more prevalent in specific geographic regions, or types of systems. Additionally, the types of cross-connections most commonly found in distribution systems will be compared and contrasted with types of cross-connections most commonly found in internal on-premise water systems.

### 2) *History of Backflow Incidents*

A comprehensive analysis of data provided from the survey will determine the history of backflow incidents, which have occurred in water distribution systems and on-premise systems. The analysis will determine if there is a correlation between backflow incidents and efforts on behalf of the administrative authority to abate cross-connections.

### 3) *Financial Impacts*

The financial impacts of backflow incidents will be analyzed including incident response, investigation, clean-up and repair. This information will be valuable to water utilities in determining the ramifications of allowing cross-connections to go unabated. This information will also be analyzed contrasting on-premise incidents to system incidents.



#### 4) *Hydraulic Changes within a Distribution System*

The survey will determine the hydraulic changes within a water distribution system and the changes' potential to create backflow conditions. Changes in system pressures change the direction of the flow of water, by varying high and low pressure regions within a system. A comprehensive analysis of how this affects the potential for backflow will be conducted. Comparisons will be made to see if there are differences based on the age of the water systems, the region of North America, the time of day and the season of the year. As a follow up to a written survey, a physical survey of a sample of water systems may be deemed necessary. Battery operated pressure recorders can be installed at various locations in different water systems to get more comprehensive data. This information can be compared with the historical data on backflow incidents to identify patterns of backflow occurrence under certain hydraulic conditions within the system. Ultimately, this information will help administrative authorities prioritize their backflow prevention program based on hydraulic conditions in the system.

#### 5) *Assessment of the Occurrence of Backpressure and Backsiphonage*

An assessment of the data obtained will show any correlation between the type of backflow, which occurs (i.e., backpressure or backsiphonage) and various water systems and communities.

#### 6) *Types of Cross-Connection Control Programs*

A detailed analysis of cross-connection control programs will determine the major elements of an effective cross-connection control program. The types of programs in effect combined with other elements of the survey will show which specific aspects of a program provide the greatest public health benefit.. This information will also determine if specific aspects, such as public education are helpful in bringing about compliance.

An analysis of the effectiveness of internal protection verses system protection will be conducted. This will be helpful in determining whether one type of cross-connection control program is more effective than another in protecting the potable water supplies. Or, whether both aspects are necessary to ensure the quality of the water within the distribution systems.

#### 7) *Regulations and Enforcement Issues*

The common aspects of the most effective regulations will be isolated from the survey data. The most effective means of enforcement will also be determined. Whether or not a public relations program assists in the overall enforcement of a program will be determined as well as what effect public education has on the enforcement capability of a program. The effectiveness of guidance manuals, specific policies and procedures will also be assessed.



**The next issue of *Cross Talk* will discuss the remaining points of the survey and the other aspects of the project. Any water utilities desiring to participate in the project, should contact the Foundation office.**

## Training Courses

### Tester Course

*Las Vegas, NV*

13-17 September 1999

*Los Angeles, CA*

24-28 January 2000

*Los Angeles, CA*

15-19 May 2000

*Los Angeles, CA*

10-14 July 2000

### Specialist Course

*Las Vegas, NV*

18-22 October 1999

*Los Angeles, CA*

7-11 February 2000

*Los Angeles, CA*

13-17 March 2000

*Los Angeles, CA*

24-28 July 2000

## Upcoming Events

Joint Instrumentation Conference

•Santa Ana, CA

18 August 1999

Inland Counties Backflow Group

•San Bernardino, CA

15 September 1999

Northern California Backflow  
Prevention Association

•Pleasanton, CA

26 August 1999

AWWA Distribution Systems  
Symposium

•Reno, NV

21 September 1999

Tri-State Seminar

•Laughlin, NV

23-25 September 1999

Western Regional Backflow  
Conference

•Las Vegas, NV

4-6 October 1999

Manual Review Committee  
Open Meeting

•Los Angeles, CA

12 October 1999



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