History of Backflow

1840s saw the rise of the industrial North and the plantation South. This led to growth in the cities to support their needs

The Civil War dramatically affected the population split of America.

1870's saw the increase in commercial operations and the newfangled indoor plumbing systems. These were mostly commercial customers. Indoor plumbing wasn't widespread in residences in large cities until around 1900. Many rural areas had indoor plumbing by the 1940s.

Factories began to augment new pressurized plumbing with river water. There were problems with the differences in pressure. Add to that the cotton dust was very flammable. The early fire protection systems required a person to manually turn on a gate valve.

First automatic sprinkler heads appeared in 1897.

Pressurized water systems connected to river water resulted in many employees becoming sick. There was a high rate of absenteeism. Factory owners wanted and needed a way to prevent absenteeism.

First check valves were installed. If the first leaked then another was added. Sometimes there were as many as six check valves in a row. (If one is good, six is better)

The first meeting to realize the need for a plumbing code took place in 1906. More later.

1909 – Patent filed for device for prevention of the return of waste water into water supply pipe. It was 20 years before we started calling these devices vacuum breakers.

1913 – A research paper was presented to the engineering world titled "Public Water Systems Polluted by Private Fire Systems." In the paper it said, "Pressurized water mains are not always secure. Physicists have demonstrated under certain circumstances it is possible for **insuction** to occur.

We now call this backsiphonage.

1914 – US Public Health Service formed.

"Drinking Water Standards for Interstate Water Regulations" was published.

May 1925 was the 45th Annual AWWA Conference in Louisville, KY and the Fire Protection Committee said "Do not connect drinking water to non-drinking water."

June 1930 IAPMO had their first meeting in San Jose, CA

June 30, 1930 was the 50th Annual AWWA Conference in St. Louis, MO.

Committee No. 8 was formed on CCC

At the turn of the last century saw a rather reckless use of pressurized piping systems. (Just like today)

This led to a demand for someone to do something.

Unfortunately in these situations we get one of two possibilities, either politicians or salesmen.

Politicians were busy getting rich because of the Noble Experiment of Prohibition (1920-1933)

[18th Amendment January 17, 1920 – Repealed by 21st Amendment December 5, 1933]

That left it to the salesmen to solve backflow problems. The salesmen and manufacturers were getting creative with check valves, gate valves, and insuction valves.

We should mention here something about the 1933 World's Fair in Chicago

In 1943, during World War II, a supply ship was discovered to have harbor water in its potable water tanks. An investigation revealed that this was caused by a cross-connection between the city water supply and the harbor water. http://www.usc.edu/dept/fccchr/beta/about.html

There were more than twenty incidents along the West Coast from 1942 to 1945.

It started back in 1904 – a company drilling an oil well struck a 104 degree sodium rich water source.

Later this warm water was used to supply water to a new spa named Bimini Baths. After all, in Europe it was the height of luxury to soak in warm mineral baths. The bath operated for a while and then they decided to connect to the LA Public Water Distribution System.

Aug 21, 1933, Norman P Slane arrived at site to conduct a CCC survey for the LA DWP and to install a water meter.

LA DWP had created a CCC group a few years earlier because of problems at LA harbor with ships and fire system water. They had installed many check valves.

Norman Slane met with engineer at Bimini Baths. He was Orien Kersey Entriken.

Slane explained need for CCC and told Entriken to install 2 check valves. (4 for high hazard).

They both agreed not really good enough.

Entriken began to tinker in his basement.

He started with existing product but soon realized he needed something else.

The president of Bimini Bath, Frank Carlton, came down to the basement to discuss this check valve expenditure.

Entriken explained the need for a backflow prevention product. He showed Carlton some of his ides he had tinkered with.

Carlton saw some potential and need for a backflow prevention product and formed E. C. Service Company. (Entriken Carlton Service Company)

They combined check valves, vacuum breakers, and siphon bellows (a form of superior pressure device which opened on backpressure – similar to dual check with atmospheric vent)

They had limited success with EC3 and in 1941 approached an engineer at Cal Tech in Southern California, Leonard Snyder, to help develop product.

First attempt was EC5 which had three check valves. A vacuum breaker installed between CV 1 and CV2. Relief valve on outlet. This was a vertical installation. It was too big and unreliable and they went back to the drawing board.

In 1945 the patent was applied for the model 6. The patent was awarded in 1950.

The model 6 had the novel concept of using the reduced pressure principle instead of backpressure.

In 1945, E.C. Service Company with Entriken, Carlton, and Snyder moved next to a plumbing wholesaler named Lohman Brothers.

Salesman Dave Guinn saw the new EC3 and EC6 and started selling them in Southern California.

Dave quit Lohman Brothers and went to work with E.C. Service Company as a partner.

Entriken, Carlton, Snyder, and Guinn formed **B**ackflow **E**ngineering and **E**quipment **Co**mpany. (BEECO)

This model was sold for service protection mainly.

On the other side of town in 1939, Engineer Don Griswold began making pressure control valves with a diaphragm valve that was pilot activated. This new company was CLA-VAL.

CLA-VAL had a salesman named Hamilton Pierce who saw BEECO and activity with their model 6. In the late 1940s he began lining up pilot controlled diaphragm valves with relief valves to compete with BEECO.

He had a problem with reliability. When later tested, found did not stop backflow 20 percent of the time. Finally copied the BEECO idea and made a similar RP assembly.

Across the same town another set of events was unfolding.

In the late 1930s, Fred Reinecke Sr. had a franchise to sell Brooks irrigation control valves. He began making BFPs in the lake 1940s

Irrigation systems were only sold to very upscale homes in areas like Hollywood and Beverly Hills.

In 1949, the franchise expired and was not renewed. Fred Sr. had to make a living. He began tinkering with better irrigation valves then what he was currently selling. He saw the need for backflow protection for small or internal protection.

So Fred formed a company to try and sell his new valves. He got his family together. The family members were Fred Jr., Ed, Bill, Charlotte and Fred Sr. (known as the old man) and formed FEBCO.

They saw the need for valves beyond the service connection.

AVB
PVB
Twin check valves

In the early 1950s another person saw the need for smaller backflow preventers for internal applications. John Gustoson owned a medical Equipment company called SMR that sold sterilizers and other medical equipment to hospitals. (Surgical Mechanical Research)

Inspectors wanted check valves so John woke up his engineer Gunther A, Grams and said “make a backflow preventer.”

AVB
PVB
DC

EC (EC3)	1935-45 (patent filed under personal name 1933-35)
BEECO/Hersey	1948-04
SMR	1955-77 then became Neptune
CLA-VAL	1958-08 (Late 1940s or early 1950s**)**

Other companies began getting involved with the original four:

Craneline/BEECO	1977-78
Watts	1966–present
FEBCO	1954-present (sold to Watts In 05)
Toro	1969–76 (sold to Orion)
Craneline	1970–78
Rockwell	1972–78
Lawler	1974–87
Mueller	1975–84
Richwell	1975–78 (Richwell line sold to Neptune)
Orion	1976–99
Viking	1977–84
Neptune	1978–84 (sold to Wilkins)
Ames	1981–97
Rainbird	1983–92
Wilkins	1984–present
Conbraco	1989–present
Buckner	1990–96
Flomatic	1993–present
Hunter	2000-02 (this line is now labeled as Watts)
A R I	2007–present
BEECO/Mifab	2010-present

The influx of manufacturers and different products that had various levels of effectiveness led to the need for some kind of product review process.

In the mid 1930s, the City of LA and NY established city test labs for products used in their areas.

These were mostly local tinkerers who combined existing valves.

There were no product standards or guidance. Usually small plumbing oriented products such as sinks and toilets.

Process was more of an educated guess rather than what was known as product evaluation. Manufacturers usually told them what tests to run.

Late 1938, NY Lab ran a pipe up a 4 story building so they could check for operation with a vacuum.

Back to Los Angeles which was the cradle of backflow product development. There was also concern for product review.

In the early 1940s the Engineering School at University of Southern California began conducting informational training for water purveyors in LA to alert them to the hazards of cross-connections found in LA Harbor since the 1920s.

Inspectors from LA DWP (Department of Water and Power) did some demonstrations on backpressure and backsiphonage and showed effectiveness (or lack of) of early backflow prevention products.

A group of concerned water purveyors wanted an unbiased product review conducted by an educational institution unaffected by manufacturers' influence or the market place.

September 1944 the Board of Trustees at USC established the FCCC at the School of Engineering. This was a non-profit organization created by public and private bequests and operated by the University of Southern California.

Soon after the formation an anonymous donation given to the Foundation allowed them to establish a permanent lab and hire a team of researchers.

Dr. Everett Chloran was the first director of the lab along with E. D. Alterton and William Tibbetts performing Lab Technician duties. (1944-47)

This lab was set up to perform scientific evaluation on a product to assure it stopped backpressure and backsiphonage.

Dr. Kenneth Reynolds was the Director from 1947-65.

In 1965 the name of the lab changed to FCCC & HR.

Professor E. Kent Springer was the Director of the lab from 1965 to 1984.
Dr. J.J. Lee became Director in 1984 and is the current Director.

In 1948 the lab published their first set of lab evaluation procedures in Paper # 5.

Objectives: General Testing Procedures, specifications, Results of tests
Classified BFPREV (early abbreviation)
#1 – DC
#2 – Superior Pressure
#3 – RP
#4 – PVB
Established lab & field evaluations
Critical for field review. First evaluation good for 3 years.
After 1 year field evaluation, granted conditional approval.
After an additional 3-year evaluation, granted full approval.
Field test procedures

Publications:

1959	48-101
1960	1st Edition
1965	2nd Edition
1966	3rd Edition

1969	4th Edition
1974	5th Edition
1979	6th Edition
1982	Revised 6th Edition
1985	7th Edition
1988	8th Edition
1993	9th Edition
2009	10th Edition

Earlier we mentioned first plumbing code meeting took place in 1906.

Jan 29, 1906, Henry B Davis from Washington, DC called a meeting of 25 local engineers and started brain storming how to solve these pressurized piping problems. (PPP)

This meeting led to two events.

1. Committee eventually created the National Plumbing Code.
2. Group was formed called Society of Sanitary Engineers. (ASSE)

ASSE was involved in code development until late 1960s when they switched to product evaluation.

First standard – Vacuum Breakers on urinals
Ball Cocks
Dishwasher Machine
Garbage Disposals
1971 – RP
1972 – DC
1974 – PVB
1989 – RPDA

What changes did the market and product review process bring to the market since the development of the Model 6?

1. April 1948 - Approval Process – independent –
   3rd party, independent manufactures, field evaluations
2. 1948 - Field test procedures –
   1993 DC direction of flow procedure.
3. 1959 - Lower head loss
   Maximum allowable pressure loss
4. 1969 - In–line repairable –
   No more throw away valves
5. 1973 – Location of Relief Valve
   Relief Valve below Check Valve #1
6. Coatings of ferrous metals –
   Galvanizing, painted, fused epoxy
7. 1985 – Resilient wedge shut-off valves
   Test procedures more reliable
8. Engineered polymers {i.e., plastic} have been allowed, but more prominent since the late 1970's
9. 1993 – Replaceable seats for all assemblies (replaceable seats had previously been required for ferrous bodies. The 9th Ed required replaceable seats for all assemblies)

10. Rubber products – Buna vs. Silicon (chloramine damage) O-rings : (no new requirement to allow silicon elastomer components. This just became a material of choice based upon field experience.)
11. Late 1990s - Flat diaphragm vs. rolling diaphragm
    Smaller bodies and fewer bolts in some cases
12. Various installation orientation
    Approved and checked to work in alternative orientations
    Most RPS are NOT approved in the vertical orientation. ("Z" and "N" patterns)
13. 2009 – 10th Edition Performance based criteria instead of construction based criteria
    No Shore rubber hardness requirements for elastomers used in check valves, relief valves, or air inlet valves. (whatever passes the tests)

Today we have assemblies that are more compact, lighter, easier to install and repair, Lower head loss and less expensive.

Most importantly today the assemblies are more reliable.

We can't talk about backflow prevention products without a quick discussion of field test procedures and test kits.

Early test procedures were developed by the various manufacturers. They may have had a tendency to propose test procedures that showed their product in the best light.

Visual test method – Forerunner of the drive-by method

USC first test procedures in 1948. Latest revisions were scientifically developed to produce the most accurate data most often. This is especially important in non-working conditions.

In 1950s the DC was tested with a sight tube mounted on test cock #3 then open TC #2 and then TC #4.

The RPs were tested with a mercury manometer. No problem unless the mercury accidently flowed into the public water system.

In the early 1950s we had the Barton/ITT/Prime/Cameron gauge which was a metering product for oil wells also had a large use in naval ships

In the late 1960s Watts had a private labeled test gauge from Orange Research. This gauge was originally developed for the filtration industry.

The Mid-West gauges came to the market in the early 1970s. These gauges were also designed for the filtration industry.

The first electronic test gauge was developed in the early 1980s. Cecil Pearson with Duke Products was responsible for the model 100, 75B, 1000, and EZ 900 electronic gauges.

Watts Regulator has taken the Duke 1000 and upgraded to the TK-DL. This gauge has a built-in printer like the 1000 but you can also download the test results to a PC.

USC Field Test Procedures available as a video.

Now let's talk a bit about training.

Ernest Havlina was one of the first backflow instructors. He started teaching at the Trade Tech College in Los Angeles.

USC FCCC & HR conducted awareness seminars in the mid 1950s and began backflow tester training in 1970.

There are over 200 training locations in the U.S. and Canada. Here is a list of a few of these locations.

- USC FCCCHR mid 50's & 1970
- AWWA Conferences after 1959
- Tester Training – LA Trade Tech College 1958
- Pacific NW AWWA Section early 60's
- UF-TREEO Center 1979

Backflow Tester Certification

- Many Local & regional Schools
- 1979 UF-TREEO Center
- 1981 CA NV Section AWWA
- 1984 New England Section AWWA
- 1986 FL Section AWWA offered
- 1994 ABPA
- 1995 ASSE
- 1996 ABC

In conclusion:

We have come a long way in a short time. Selling the ideas of cross-connection control and backflow prevention has been difficult.

So many customers take the high quality of the public water supply for granted. They are just unwilling to spend the money necessary for safe water. Many others do not trust the water system and resort to the less safe and more expensive bottled water.

All of us are sales persons. Network with each other and learn from the experts. This will make you a better professional.

- Les O'Brien –

Most material supplied by Jim Purzycki, BAVCO