



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

Senior Design Project Description

Company Name	<i>Apollo Valves manufactured by Conbraco Industries</i>	Date Submitted	<i>11/1/18</i>
Project Title	<i>Backflow Prevention Device Test Stand (APOLLO_BP)</i>	Planned Starting Semester	<i>Spring 2019</i>

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	2
Computer		Systems	
Other ()			

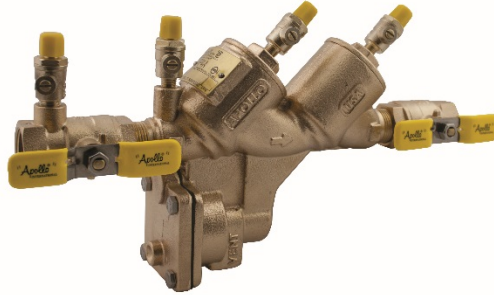
Company and Project Overview:

At Conbraco Industries, we provide Flow Control Devices and Total Piping Systems for the plumbing industry. Our goal is to make it an easier and better buying experience by being the only organization that offers a complete line of flow control devices and piping systems solutions. We feature a full range of valves and connections, including push, press, thread, groove, sweat, and crimp to fit Commercial, Industrial, and Backflow Prevention needs. We operate in 3 locations, the Matthews, NC headquarters, the Pageland, SC brass and bronze plant and foundry, and the Conway, SC stainless steel plant and foundry. We are known for our brand “Apollo Valves”, originally named for their use on the Apollo space program, and our products are Made in the USA.



One of our ball valves

There is an ongoing continuous improvement effort to modernize equipment in our plants. This project is to provide a new backflow prevention device test stand that will make the process more streamlined and easier for the operator. A backflow device, as seen below, must be tested before it is shipped to the customer.



An example of a backflow device that will be tested on the test stand

Project Requirements:

Double Check Valve Assembly (Apollo Model DC4A)

Description:

The device consists of two independently-acting, spring-loaded check valves (normally closed). Two resilient seated shut-off valves and four test cocks complete the assembly. The shut-off valves (normally quarter-turn ball valves) are provided as a means to isolate the backflow device for testing purposes. The test cocks allow for the connection of a differential pressure gauge. Each test cock is a quarter-turn ball valve with slotted stem. The #1 test cock is not needed for production testing and should not be used.

Each check is designed to maintain a minimum of 1.0 psid across the valve during normal operation. If at any time the pressure downstream of the device increases above the supply pressure, both check valves will close to prevent any backflow from occurring.



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Testing Procedure

The DC4A must be tested in the no-flow (static) condition.

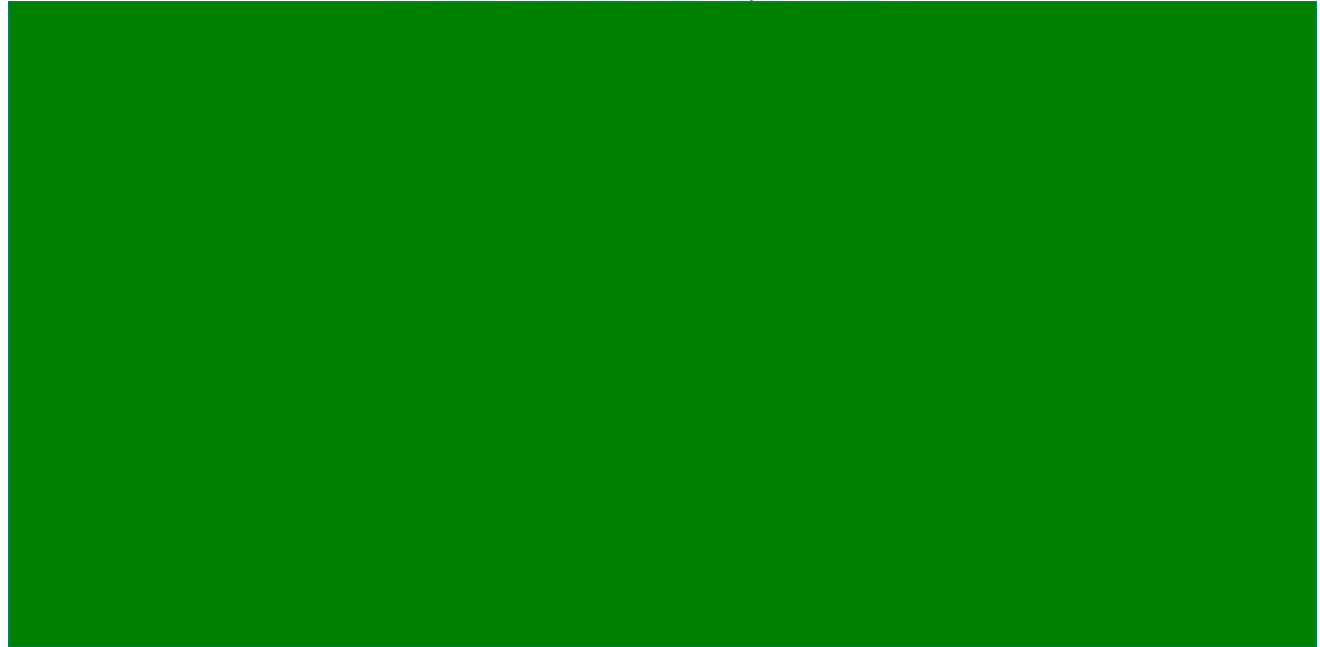
- Each DC assembly must be hydrostatically pressure tested to ensure there are no casting leaks. No leakage is allowed.
- Apollo specifications: The differential pressure (DP) across each check valve must be 1.5-2.5 psid. The inlet test pressure is typical city water pressure, ~60 psi. Each check valve must be tested. Any DP readings outside of the specified range would be unacceptable. This would indicate the valve should be set aside to determine the cause of a low check valve reading.

Reduced Pressure Principle Assembly (Apollo Model RP4A)

Description:

The device consists of two independently-acting, spring-loaded check valves (normally closed), together with a hydraulically dependent, mechanically independent pressure differential relief valve (normally open), located in the zone between the check valves. Two resilient seated shut-off valves and four test cocks complete the assembly. The shut-off valves (normally quarter-turn ball valves) are provided as a means to isolate the backflow device for testing purposes. The test cocks allow for the connection of a differential pressure gauge. Each test cock is a quarter-turn ball valve with slotted stem. The #1 test cock is not needed for production testing and should not be used.

The first check is designed to maintain a minimum of 5 psid across the valve. The second check is designed to maintain a minimum of 1 psid across the valve during normal operation. The relief valve operates on differential pressure. Supply pressure on the inlet side of the first check valve acts against the diaphragm to close the relief valve during normal operation. In the event of a drop in supply pressure, the relief valve will open to maintain the pressure between the check valves (also known as the "zone") at least 2 psid less than the inlet pressure.



Testing Procedure

The RP4A must be tested in the no-flow (static) condition.

- Each RP assembly must be hydrostatically pressure tested to ensure there are no casting leaks. No leakage is allowed.
- Apollo specifications: The differential pressure (DP) across the first check valve must be 6.5-8.5 psid. The DP across the second check valve must be 1.5-2.5 psid. The relief valve opening point must be 2.5-3.5 psid. The inlet test pressure is typical city water pressure, ~60 psi. Any DP readings outside of the specified ranges would be unacceptable. This would indicate the valve should be set aside to determine the cause of a low check valve reading.

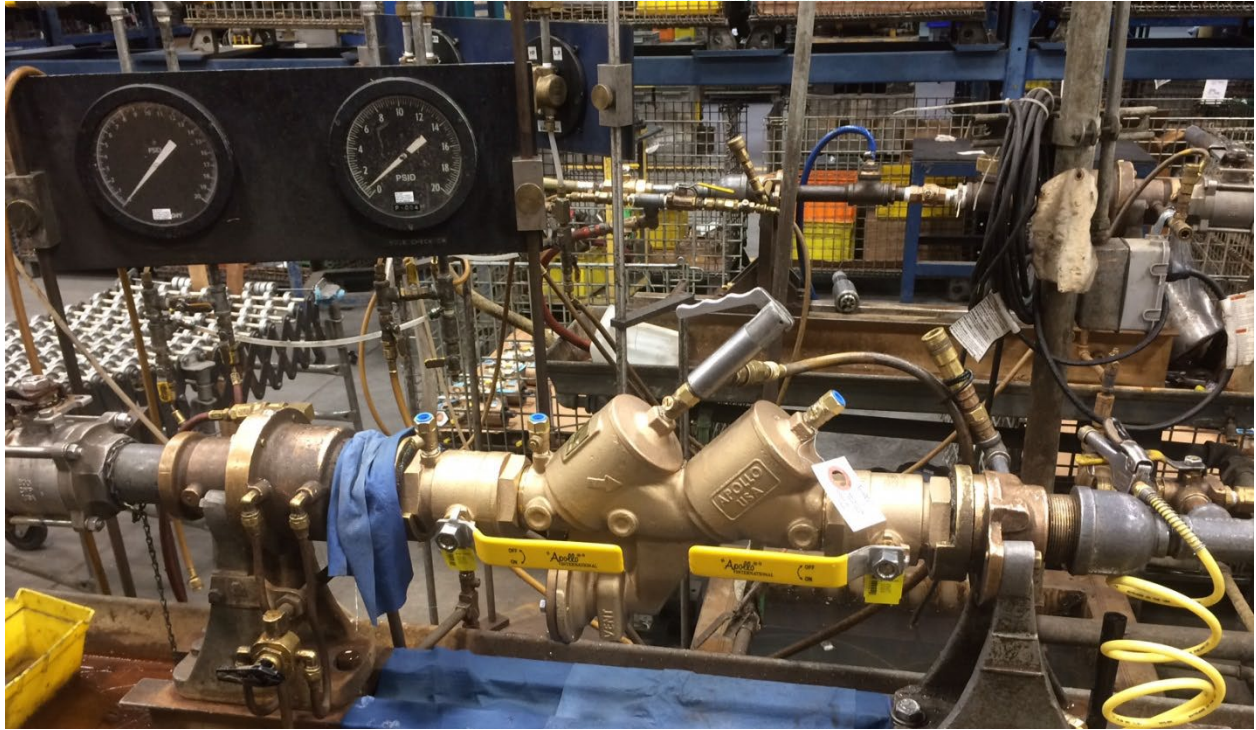
Current Test Setup

The assembled backflow device is installed in the test fixture. Water pressure is used to actuate bumpers which seal against the ball valves that are on both sides of the backflow device. Supply pressure is then applied to the backflow device. Air must be vented from the backflow device before it can be accurately tested. A test connection must be attached to the #3 test cock as shown in the photo below. Readings are taken using a visual gauge and writing them down. Test connections for the upstream and downstream readings are integral to the test stand. Once the test is complete, the backflow is released from the bumpers, the water shaken out, and it is boxed for shipping.



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Scope for New Test Stand

There are three tests results that must be performed and recorded. The first test is the pressure across Test Cock #2 and Test Cock #3. The second test is the pressure across Test Cock #3 and Test Cock #4. The third test is the pressure at which the relief valve begins to discharge (only for RP backflows). If any one of the tests performed yields a result outside the given bounds, there must be a visual alert for the operator to inspect the part.

Another important aspect of the test stand is item tracking and data collection. The test stand will incorporate a Cognex reader, which shall be capable of reading a 2D data matrix which will be dot peened onto the surface of a backflow preventer nameplate. Once the nameplate is attached to the backflow, and before it is placed on the test stand, it is scanned, tying the nameplate serial number and the backflow type together. This all occurs before the backflow is put on the test stand, thus, this is not part of the project. After the completion of all tests on the backflow, test results must be captured with data acquisition. All test data should be stored in one accessible place on the laptop for reference.

The test stand shall be mobile. All backflow devices must be tested with water. The test stand should be fully automated, with the exception of attaching the test connection to the #3 test cock and the scanning of the 2-D data matrix.

The following items will be provided by Conbraco, at no cost to the team:



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- Cognex DataMan 262X reader
- PLC
- Laptop
- Backflow prevention device and nameplates with data matrices
- Any Apollo products (valves, PRVs, etc...) that are specified for use in the test stand

Expected Deliverables/Results:

- The result is to have a fully functioning test stand that will test a backflow prevention device, send test results to a laptop, and tie test data and backflow type to the respective 2-D data matrix.
- All drawings and solid models of test stand.
- Source code for programmed elements
- Test Stand

Disposition of Deliverables at the End of the Project:

Conbraco will take ownership of the property. Electronic files can be handed over onsite. Transportation of test stand from UNCC to Pageland, SC will need to be arranged by Conbraco after the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Experience with solid modeling
- Knowledge of PLCs
- Knowledge of fluid mechanics