Testing a Reduced Pressure Principle Backflow Preventer

When it Passes & When it Fails

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The Visual Inspection

Before you actually start testing a reduced pressure principle backflow prevention assembly (RP), there are a number of items relating to the installation of the assembly that need to be visually verified. First, is the assembly accessible? Assemblies are generally five (5) feet from a platform and a specific height from the floor). Next, was the assembly installed properly? By this, we mean that it is installed in its approved orientation (horizontal vs. vertical) and not twisted 90° from the approved orientation. We determine if, in our opinion, the assembly was installed in a proper, approved manner. This includes determining that appropriate piping materials were used to connect the assembly to the potable water system. The proper use of materials is important because water is considered potable up to the RP assembly. The piping downstream of the RP assembly is considered a secondary piping system, and therefore the water is no longer considered potable.

Prior to testing, we will ensure that the assembly has been installed according to the manufacturer's instructions. This step includes checking that the proper #1 and #2 shut-off valves have been used, and are present, and that the assembly was installed in the correct direction of flow. We check that there is an air gap fitting installed, and that the air gap fitting is properly drained. An RP's air gap fitting should have a drain pipe from the air gap fitting to a floor drain. The drain pipe is determined by the size of the air gap, and should not be reduced in size.

We also check that all four test cocks are present, and that they are open and free of debris. If one or more of the test cocks are missing, it is impossible to test the RP assembly. At this point, you will need to repair the assembly before you can test it.

Finally, we at CBSI will check to see if the assembly is leaking. If an assembly is leaking, we assume that there is a problem with the assembly, and recommend to the building owner that the device be repaired prior to testing. This is purely a CBSI business protocol that was developed based on past experiences. We have encountered situations that when we started to test an assembly that was leaking, the result was that a part broke while testing, causing us to shut-off the water supply to the building for much longer periods of time than originally anticipated and quoted to the building owner. The water system needed to be shut-down until we could get the necessary parts to the job-site, and rebuild the assembly. Needless to say, our customers were unhappy about the prolonged lack of water.

Once the visual checks have been completed, we can start with the actual testing and trouble-shooting of an RP assembly. Remember at this point to inform the building owner (and / or tenants) that the water supply will be shut-off for short period of time to perform routine maintenance on the system.

Testing

There are several different recognized procedures for testing an RP assembly; and although a procedure's test sequence may differ, the results each is seeking are the same. Each procedure is valid, and we do not recommend or endorse one procedure over another. For the purposes of this article, we are describing the standard RP test procedures and direction of flow test utilizing a 3-valve analog test kit.

The first step in testing an RP assembly is to turn-off the #2 shut-off valve (See Figure 1). If you do not turn-off the #2 shut-off, you will have false results. There are two reasons you cannot get accurate test results for an RP assembly when there is any type of flow condition. First, you cannot simulate a backflow condition when there is flow through the device; and second, the relief valve will not open.

Once you have turned-off the #2 shutoff valve, open all four test cocks (#1 T/C, #2 T/C, #3 T/C and #4 T/C). Flush any debris present in the test cocks; and ensure that water is flowing through all four test cocks. This step serves a dual purpose – it verifies that the test cocks are functioning properly and allow water to flow; and it purges the device of air. Install test adaptors in test cocks #2, #3 and #4. If your test kit does not have a pressure gauge which can help diagnose problems, we recommend that one be installed on test cock #1. At this point, you should take a system pressure reading. Variations in system pressure will affect your readings throughout the tests. Once the adaptors and pressure gauge are installed, hook up the high pressure hose (control valve A) from the test kit to test cock #2, and the low pressure hose (control valve B) to test cock #3.

Confirm that the test kit control valves [high (A)], low (B) and vent(C)] are closed prior to gently opening test cock #2. Opening test cock #2 allows you to bleed the gauge. Any air in the gauge or valve will give you a false reading. Open test cock #3, and observe the gauge pressure. It is important to note that this pressure reading may not be accurate if there is any air trapped in the gauge. Place the vent hose in a location where the flow of

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water can be discarded (i.e.: floor drain, container). Open control valve C; open control valve B; and relieve the air from the low pressure hose and the gauge. With control valve B open, open control valve C. At this point all three control valves are open; and you will need to verify that all air has been purged from the gauge. Once the air has been purged, close control valve A, then control valve B, leaving control valve C open. At this point, you will record your first reading of the first check valve. If you close the control valves in reverse order (B before A) or close control valve C, you will have a false reading which could either pass an RP needing repair or fail a functioning RP.

Once you have recorded the first #1 check valve reading, open control valve B. The gauge pressure will increase to approximately ten (10) psid. Open control valve A, and the gauge pressure will drop to approximately zero (0) psid. At this point, the relief valve will not discharge water due to a flow of water through the test gauge. Re-close control valve A to allow the gauge pressure to return to approximately ten (10) psid. Close control valve B. The pressure gauge needle will stabilize on the first check valve differential reading. The rule of thumb for this reading is that it should be five (5) psid or better. If the reading is less than five (5) psid, there should be discharge of water from the relief valve indicating that there is a leak in the #1 check valve. The leak could be caused by a number of problems, including: debris caught in the check valve; seat o-ring has failed; check disk has failed; broken check valve assembly; broken check spring; broken hinge; or a broken guide (the guide aligns the check valve and seat).

After recording the #1 check valve differential pressure reading, connect the vent hose to test cock #4, open test cock #4, and then open control valve A. At this point, the pressure gauge should drop no more than 2-4 psid. This is the #2 check valve's differential pressure reading. If the test gauge reading increases, check the system pressure on the gauge connected to test cock #1. If the system pressure has increased, wait until the system pressure has stabilized before recording the pressure reading.

However, if the pressure reading drops to zero (0) psid, then the #2 check valve has failed and water is leaking from the relief valve. The same problem which can cause the #1 check valve to fail can also cause the #2 check valve to fail. If, however, the pressure drops to zero (0) psid, and there is no leakage from the relief valve, then the #2 check valve is leaking and allowing water to continue to flow through the RP. If the #2 check valve is leaking, you will need to shut-off the #2 test cock to confirm this is the problem. Once you turn off the #2 test cock, the test gauge pressure should drop to zero with no leakage through the relief valve.

The next part of the test procedure is to test the relief discharge valve. Shut-off the #4 test cock; and then close control valve C. You can now disconnect the hose from the test cock C. Force the relief valve to open by slightly opening control valve B. This allows high pressure water to enter the reduced zone causing the gauge needle to fall towards zero (0) psid. The gauge needle movement should be very slow. When the first discharge is noted, record the gauge pressure. In order to pass the test, the gauge pressure should be higher than two (2) psid. If the gauge pressure is lower than two (2) psid, then the relief valve has failed and requires either a new or rebuilt relief valve.

If, upon visual inspection, there is a continuous water discharge from the relief valve and the #1 check valve and the #2 check valve readings are satisfactory, then the leak is being caused by a ruptured relief valve diaphragm, a broken spring or debris caught in the seat or disk. However, intermittent leakage from the discharge valve caused by extreme fluctuations in the system pressure (in excess of the RP's buffer) is normal, and does not indicate a failure in the device.

Once you have recorded the gauge pressure at the point of discharge, shut-off the test cocks, and open shut-off valve #2 to restore the flow of water through the device. Disconnect the test gauge from the RP, and drain it thoroughly.

Conclusion

As stated earlier, this is one simply one way of testing an RP device. There are a wide variety of test kits, including two-, three- to five- valve test kits, analog test kits, and digital test kits which can affect how you test an RP. There are also a variety of test procedures that meet the requirements of the ASSE Series 5000, and will give you the same results. It all depends on what procedure you were taught, and what you are comfortable using.