Test Kit Valves

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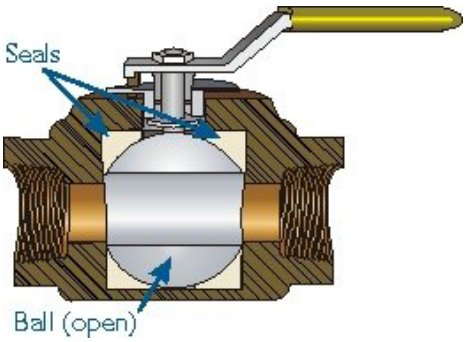
When most people think of backflow test kits they think of differential pressure gauges. Is it analog (dial type) or digital? What is the accuracy? Backflow test kits, however, are assemblies. One of the main components of those assemblies are valves. This article only describes in general the valves used on backflow test kits.

Backflow test kits come in two-valve, three-valve and five-valve varieties. Some of these test kits have valves plumbed in clear view; some have valves hidden by brackets, while others use manifolds. Test kit valves have two jobs; one, is to bleed air from the test kit; two, is to control the flow of water pressure to allow the testing of backflow preventers. The valve type has dramatic effects on how easy it is to perform these tests.

Ball Valve/Plug Valve

The ball or plug valve consists of either a spherical ball or round cylinder with a hole in the center. The ball or cylinder (called a plug) is inserted into a valve body with inlet and outlet ports. There are seals between the inlet port and outlet port and the ball or plug. The ball or plug is attached to a handle that can rotate the ball or plug. If the ball / plug is positioned so the hole is aligned with the inlet and outlet ports you will get full flow. If the ball / plug is positioned so the hole is 90° to the inlet and outlet ports, the valve is closed and you will get no flow. In other words, ball / plug valves go from fully closed to fully open in ¼ turn.

Pro: these valves are very simple and inexpensive. Con: they do not offer much flow control. Ball / plug valves are primarily used as bleed valves on backflow test kits. Because of the lack of flow control in this valve type, backflow test kits must have at least one needle valve. Ball / plug valves are generally not repairable.



Not All Ball/Plug Valves Are Created Equal

Travel Stops

Some ball / plug valves have travel stops built into the design so that you can only turn the handle 90° from closed to open. This makes it easy to get positive shut-off. Other ball / plug valves don't have this travel stop and rotate 360°. This makes it more difficult to determine if the valve is closed. It is also more susceptible to opening if inadvertently being bumped during testing.

Valve Handles

Some ball valves have lever handles, some have tee handles and plug valves have molded tee handles. One type is not better or worse, it is the testers' preference.

NEEDLE VALVES

The needle valve consists of a threaded valve stem (needle) with a tapered tip. The valve body has an inlet port, a valve seat and an outlet port. The valve body has a flow arrow as the inlet enters below the valve seat and the outlet exits above the valve seat. The inlet and outlet are connected by a hole drilled through the valve seat. The male valve stem is inserted through threads in the valve body or in a bonnet assembly. The valve stem is rotated into the valve body until the stem tip seals against the valve seat. The valve is opened by rotating the valve stem out, creating an opening between the valve seat and stem tip. The further the valve stem is backed out the larger the opening, therefore the greater the flow. Multiple turns are required to open / close the valve.

Needle Valve Designs Differ

Flow Control

The needle valve design in and of itself allows for better flow control than a ball valve, which is required for testing relief valve opening points on RP's.

Some needle valve designs offer more flow control than others. The pitch of the threads on the valve stem is a factor. Finer threads (more threads per inch) will allow more flow control than coarse threads. Tapered stem tips allow more flow control than rounded or blunt valve tips. The steeper the taper the more flow can be controlled.

Seat Designs

Needle valves used in backflow test kits utilize one of these seat designs; hard seat, soft tip or replaceable soft seat.

Hard Seat

Hard seat valves have a valve stem made of a harder material, usually stainless steel, and a metal valve seat made of a softer

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material, usually brass. The valve seat is machined into the valve body. This type of valve offers a "hard" positive feel when the valve stem hits the seat, which some testers prefer. If this type valve is over tightened, the hard stem damages / deforms the softer metal seat. Repeated over tightening will lead to valves that do not close leak tight. When this occurs the entire valve must be replaced.

Soft Tip

Soft tip needle valves have a resilient plastic tip attached to the valve stem. This resilient plastic tip is softer than the brass valve seat. This design has a "softer" feel at shut off. The benefit is that the stem tip does not damage or deform the valve seat. Over tightening will cause the valve seat to imbed into the stem tip. Since the stem tip is a resilient plastic, it will spring back toward its original shape.

Repeated over tightening will deform the stem tip which leads to a valve that may require more than ¼ turn to get any flow at all. These valves can be repaired by replacing the valve stem assembly which may cost almost as much as replacing the valve.

Replaceable Soft Seat

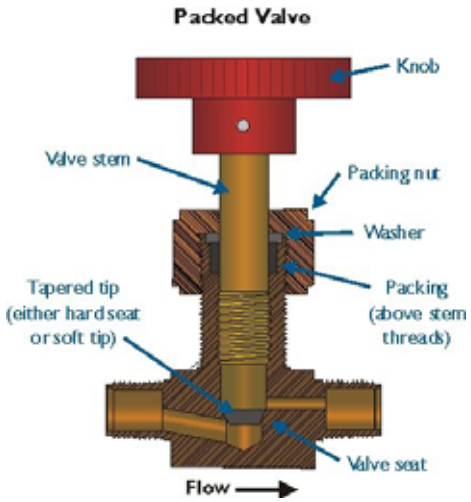
Soft seat needle valves utilize a resilient plastic washer as a valve seat that is separate from the valve body. The valve stem is all metal. Soft seated valves have the same feel and benefits of the soft tip needle valves. The difference is the metal valve stem imbeds into the resilient plastic valve seat. Repeated over tightening will lead to a similar problem as with the soft tip valve. The main difference is that only the valve seat needs to be replaced to repair the valve. This may be more cost effective than replacing the entire valve.

Field experience has yielded that soft tip or soft seated valves have longer field service life than hard seated valves.

Packed Valves Vs. Bonnet Valves

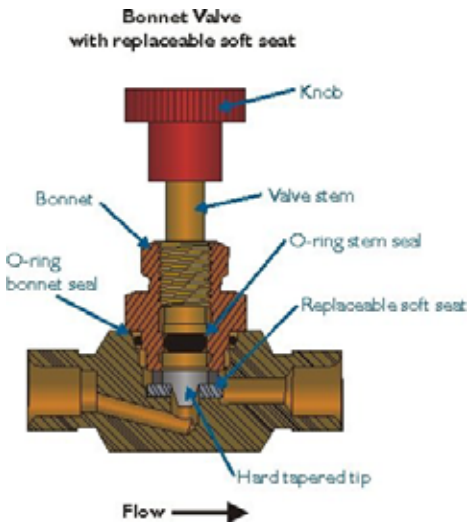
Packed Valves

Packed valves consist of a threaded valve body, a packing assembly and a packing nut. The valve stem threads into the valve body. A packing gland, usually Teflon, is placed on the valve stem above the stem threads. A backup washer and packing nut push the packing into the valve body. Tightening the packing nut compresses the packing gland between the valve body and valve stem creating a pressure tight seal. The valve stem threads are exposed to the process fluid in this design. Packed valves can be hard seated or soft tipped design. If a leak occurs at the valve stem the packing nut can be tightened to stop the leak. If the packing nut is over tightened, then more effort is required to open / close the valve. Repeated valve use can cause the packing nut to loosen or cause the packing gland to wear, leading to minor leakage at the valve stem. This leakage can be stopped by snugging the packing nut. The valve must be replaced when tightening the packing nut either does not stop the leak or creates too much effort to open / close the valve.



Bonnet Valves

Bonnet valves consist of a bonnet assembly and a valve body. The valve stem has a stem seal, usually an o-ring, located on the valve stem below the stem threads. The valve stem is threaded into the bonnet compressing the o-ring creating a pressure tight seal. The bonnet assembly is then threaded into the valve body using another o-ring seal between the body and bonnet. The valve stem threads are not exposed to the process fluid due to the location of the stem seal. This style valve is usually soft seated because the bonnet captures the soft seat between the valve body and bonnet. This style valve can also be hard seated. The main benefit to this design is that it is less prone to stem leakage because there is no packing nut to loosen. The trade off, however, when stem leakage does occur the valve bonnet must be disassembled to replace the stem seal. Fortunately, this occurs infrequently on bonnet style valves.



Valve Handles

Most needle valves have round handles, some have tee handles. Round handles may be machined metal or molded plastic. Round handles may be large, medium or small in diameter. As with ball valves one style is not better or worse, it is the testers' preference.

Bottom Line

If you are going to buy a test kit or replace a valve on your current test kit, "test turn" the valves before you buy. Which valve handles or knobs feel best to your fingers? How will the handle grip if your fingers are wet? How much effort is required to open / close the valve? If your training school has multiple test kits with different valve styles, try them all. Which style valves are the easiest for you to use?

Valve style and quality can drastically affect the time and efficiency of your backflow preventer testing. One test kit testing hundreds of backflow preventers will require thousands of valve actuations. Saving a little bit of money on a one time purchase of a test kit with "cheap" valves may cost you money in the long run.

What is the bottom line? Know the differences in the valve types and select the test kit or valves that will best suit your needs. L