Excess Flow and Regular Check Valves


Types:
A. Check valves that prevent flow reversal
B. Excess flow check valves that shut off the forward flow in case of high flows caused by pipe rupture

Sizes:
A. From 1 to 72 in. (25 mm to 1.82 m)
B. From 0.5 to 10 in. (12 to 250 mm)

Materials of Construction:
Cast iron, bronze, steel, 304 stainless steel, 316 stainless steel, polyvinyl chloride, polypropylene, polyvinylidene fluoride, chlorinated polyvinyl chloride

Costs:
Function of size and materials. A 3 in. (75 mm) excess flow check valve in cast iron or brass costs about $800; in steel, about $2000; and in all stainless steel, about $5000. A gasoline dispenser protector valve costs about $300.

Partial List of Suppliers:
APCO Controls Div., U.S. Para Plate Corp. (www.usparaplate.com)
Brooks Instrument (www.brooksinstrument.com)
Circle Seal Control (www.circle-seal.com)
Fisher Controls International Co.
HMI (www.tvsproducts.com)
HRL Controls (www.petersoninst.com)
Jordan Valve (www.jordanvalve.com)
Keystone Valve USA, Inc. (www.labco1.com)
Matheson Instruments (www.mathesoninstruments.com)
Metal Goods Mfg. (www.mgmvalve.com)
Rego Products (www.ecii.com)
Tokheim Corp. (www.tokheim.com)
TVS Products (www.tvsproducts.com)
Valcor Engineering Corp. (www.valcor.com)
Val-Matic Valve & Manufacturing Corp. (www.valmatic.com)

INTRODUCTION

Excess flow check valves serve to detect and stop excessive flows from pressurized systems by shutting off the line. These excessive flows can be caused by pipe rupture or by excessive leakage through various devices. The automatic check valve is closed by the pressure drop resulting from the high velocity of outward flow from the pressurized equipment. It is automatically reopened when repairs are made and the flow stops, so that the pressure drop can be eliminated by the slight seepage through the valve.

VALVE DESIGNS

Excess flow valves are normally open, in-line safety devices that act to limit flow of liquids or gases out of a pressurized system. While they will pass normal flow rates, they will close when excessive outward flow rates are reached. This occurs in the event when a pressurized system is opened to atmosphere due to pipe or hose breakage or because of mis-operation.

The excess flow valve consists of a plug, a seat, and a spring all housed or supported in a cylindrical tube. The valve may be threaded so that it can be screwed into the pipeline or can be flanged for tank nozzle mounting (Figure 7.5a).

Operation

Under normal operating conditions, the force generated by the flowing process fluid is directed against the valve head and attempts to close it. A spring is provided to work against this force and to keep the valve open. As flow increases above the normal level to an excessive rate, the force against the
plug and the differential pressure (d/p) across it, overcome the spring force and the valve closes.

There are one or more bleed ports around the plug, so that after valve closure the bleed will allow the pressures to equalization up and downstream of the plug, reopening the valve. However, if a pipe break occurs, the d/p across the valve will remain the same as the pressure difference between the pressurized system and the atmosphere, and the valve will stay closed until the pipe is repaired. Because of the required seepage through these valves, which provides them with their equalizing feature, it should be remembered that they will not give tight shutoff.

**Applications**

One major application of excess flow valves is on large pressurized storage tanks containing liquefied petroleum gas or other dangerous or expensive materials. In such tanks the use of excess flow check valves is recommended by Factory Mutual. For example, liquid propane gas must be stored under relatively high pressures, if it is to be kept in the liquid state. Propane, for one, has a vapor pressure of 192 PSIG at 100°F (1.3 MPa at 37°C).

If a line to or from a propane tank ruptures when the tank contents are at some high storage pressure, a very large amount of propane will quickly escape and will create an extremely hazardous condition. For this reason, it is good practice to install excess flow valves on every piping connection to and from such a storage tank except for the fill and relief lines. The fill line should have a standard check valve (Figure 7.5b), and the pipe leading to the relief line should be unobstructed. For fill line applications special check valves are available from the suppliers listed at the beginning of this section. These check valves allow an unlimited flow in one direction, but very little or none in the other.

Some excess flow valves used for pressurized storage tanks are constructed so that they may be mounted internally to the tank, protecting them from mechanical damage (Figure 7.5c).

**Rupture Disc Leakage**

A second application for excess flow valves is to bleed off pressures that might build up on top of rupture discs (Figure 7.5d). The installation of such safety devices is
recommended by the American Society of Mechanical Engineers code for boilers and pressure vessels.

Rupture discs are differential pressure devices in that the set or burst pressure must appear across the disc before it will rupture. Anytime the downstream side of the rupture disc is sealed away from atmospheric pressure, provision must be made to vent any pressure buildup on the downstream side to atmosphere. Examples of such sealed conditions include when two rupture discs are installed in series or when a relief valve is installed downstream of a rupture disc.

The best way to vent such blocked in spaces is by means of an excess flow valve. The excess flow valve will release small amounts of vapors and release the pressure buildup caused by rupture disc leakage or thermal expansion of the vapors. At the same time, the valve will not pass the large flows that would occur when the disc ruptures.

**Gas Station Application**

Figure 7.5e illustrates a special-purpose excess flow check valve that is installed underground, below the gas pumps in gas stations. The purpose of this valve is to shut off the gas flow if somebody backs into the gas pump and breaks the pipe on the suction side below the pump. This safety shutdown function is achieved by the pilot valve spring, which keeps the valve closed unless there is a vacuum in the pipeline on the suction side of the pump. Therefore, if the suction pipe is broken (at the internationally preweakened safety shear section), the vacuum is lost and the valve closes. This is particularly important in installations where the gas supply tank is elevated and therefore gasoline could otherwise pour out of it through the broken pipe.

**Sizing**

Since excess flow valves are safety devices, it is important that they be sized, selected, and installed properly. As a general rule for sizing, excess flow valves should be rated to close at about 150 to 200% of normal flow. The 150% figure should be used when the normal flow is well defined, or on installations involving larger valve sizes. In the 150 to 200% sizing range, the valve will be insensitive to surges during start-up and normal operation and will not chatter or restrict the flow. However, it will be sensitive and will close against excess flows caused by pipe breakage.

For proper valve selection, it is important to also specify mounting orientation, flow direction, and the flowing process material, since the valve design is a function of these factors.

**Installation**

The piping configuration of the installation must guarantee that the excess flow valve represents the greatest resistance to flow of all the restrictions in the downstream pipeline system. The downstream piping should not contain many bends, elbows, and tees. It should also not be reduced in size below the line size of the excess flow valve.

Excess flow valves will not necessarily respond to pipe breakage if it occurs on the discharge side of a downstream pump. This is because the pump will offer considerable resistance to flow even while running. Similarly, excess flow valves will not necessarily respond to partial pipe ruptures.

**Testing**

One way to check whether an excess flow valve is sized, installed, and functioning properly is to simulate a pipe break downstream of the valve. This is done by opening such a valve to atmosphere that is located away from the excess flow valve at the furthest point in the piping. During such testing, as the valve is opened, product should start to flow out of the system, but it should then stop due to the action of the excess flow valve. This maintenance test should be conducted before start-up and then on a regular schedule at least once a year.

The excess flow check valves must also be protected from foreign materials lodging inside them, which could prevent them from closing. A common cause of excess flow check valve failure is prolonged hammering or tampering with its setting in an attempt to get it to pass more flow than it was designed for.

**Bibliography**


