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April 13, 2020

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Dear Mr. Shaw:

“A Technical Description: Physical Features and Operation of the Toro EZ-Flo Plus 1-inch Female Globe Valve” is a technical report that describes in detail the parts of the Toro EZ-Flo Plus 1-inch female globe valve as well as its operating cycle. The report was authorized by you during week 7 of the ENGL1102 course.

The report is organized into three main sections: an introduction that provides a definition summarized description of the valve, a main body section that describes each major part in detail, and a conclusion that briefly describes the functional overview and operating cycle of the valve.

Since the report was specifically on the Toro EZ-Flo Plus 1-inch female globe valve, I found it challenging to find sources that were independent of the Toro Company and its distributors. I was able to solve this, however, by referencing sources that dealt with valves that operated in a similar manner to the Toro EZ-Flo Plus 1-inch female globe valve.

I would be more than happy to respond to any questions that you may have regarding the report. You can contact me by email at sammystudent@outlook.com

Sincerely,

Sammy Student
Mechanical Engineering
ENGL1102

Enclosure: “A Technical Description: Physical Features and Operation of the Toro EZ-Flo Plus 1-inch Female Globe Valve”

Northern Alberta Institute of Technology
Edmonton Alberta

**A Technical Description:
Physical Features and Operation of the
Toro EZ-Flo Plus 1-inch female globe valve**

As a submission to
Alan Shaw ENGL1102

Prepared by Sammy Student

ENGL1102 Technical Description
Project Mechanical Engineering
Technology

April 13, 2020

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1.0 INTRODUCTION

1.1 Definition and Purpose

The Toro EZ-Flo Plus 1-inch female globe valve is an irrigation control valve that regulates the flow of water in an irrigation system. When the valve is open water can flow freely downstream, and when it is closed such flow is prevented. The Toro EZ-Flo Plus 1-inch female globe valve has many residential and small-scale commercial irrigation uses because of its heavy-duty construction and dependability. (The TORO Company, n.d.)

1.2 Summarized Description

The Toro EZ-Flo Plus 1-inch female globe valve is made from heavy-duty corrosion- and UV- resistant PVC, glass filled nylon and stainless steel. The valve's jar top design allows the user to reach internal parts without having to remove the entire valve. The cap is all- inclusive, which eliminates screws and other parts that may get lost during removal. The Toro EZ-Flo Plus 1-inch female globe valve can be controlled remotely using an electronic timer that is connected to a solenoid (a device that converts electrical energy into linear motion) (Stryker, n.d.). The overall dimensions of the valve are 5 1/8" H x 3" W x 4" L (The TORO Company, n.d.).

1.3 List of Major Parts

The Toro EZ-Flo Plus 1-inch female globe valve is composed of the following parts (see also Figure 1 below).

- 1) Solenoid Assembly
- 2) Bleed Plug Handle
- 3) Bleed Plug Assembly
- 4) Cover Nut
- 5) External Bleed Screw
- 6) Cover Assembly

- 7) Spring
- 8) Diaphragm Assembly
- 9) Divider
- 10) Body Assembly

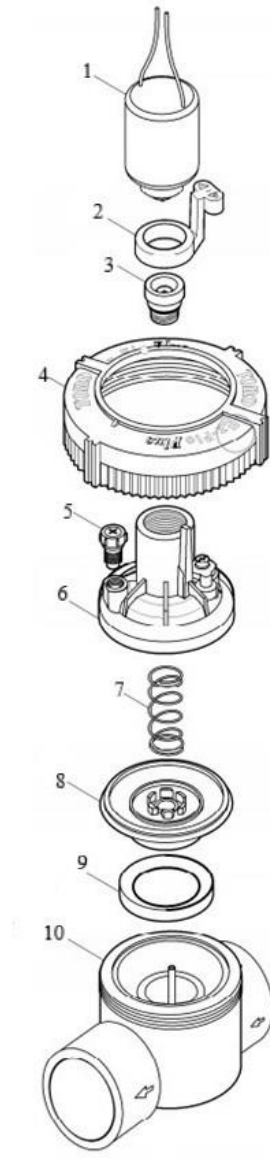


Figure 1: Toro EZ-Flo Plus 1-inch Female Globe Valve Main Parts (The TORO Company, n.d.)

2.0 MAJOR PARTS

2.1 Solenoid Assembly

The solenoid assembly is located on the top of the valve directly above the bleed plug handle. It is composed primarily of black, glass filled nylon. The solenoid assembly is cylindrical in shape and has dimensions of 3/4" W x 1" L. Two black wires protrude from the top end of the solenoid assembly which allow it to be connected to an electronic timer or control panel. The opposite end of the solenoid assembly has male threads, allowing it to be secured to the bleed plug assembly. The solenoid assembly is hollow; the interior is lined with an electric coil that surrounds a ferromagnetic plunger composed of stainless steel. A compressed metal spring between the plunger and the interior wall of the solenoid assembly holds the plunger down. Whenever the solenoid becomes activated, current passing through the electric coil creates an electric field that exerts an upward force on the ferromagnetic plunger. This electromagnetic force is strong enough to overcome the force of the metal spring, and the plunger moves up. The plunger will maintain its new position as long as the solenoid assembly remains activated. The solenoid assembly is AC and DC latching, and has an inrush and holding current of 0.40 amps and 0.20 amps respectively. (TORO, n.d.).

Refer to Figure 2 for a cross-sectional diagram of a generic solenoid valve.

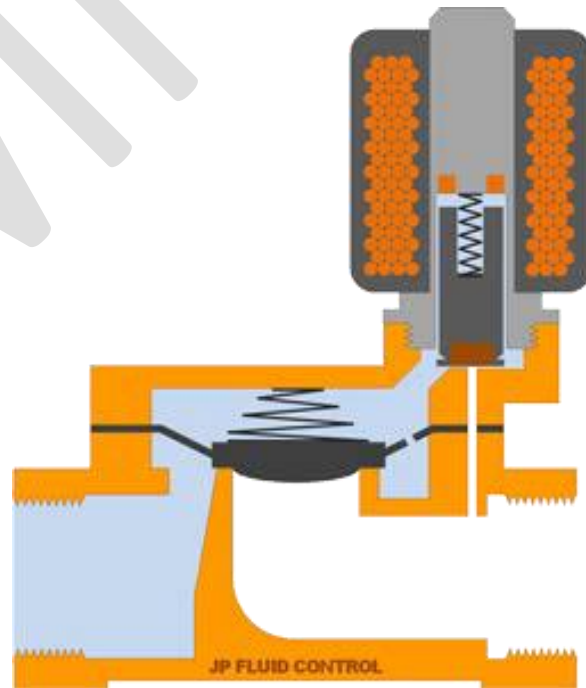


Figure 2: Cross Section of a Generic Solenoid
(Tameson, n.d)

2.2 Bleed Plug Handle

The bleed plug handle is located between the solenoid assembly and cover assembly and is composed of black PVC. The bleed plug handle is ring shaped and has dimensions of 1" W x 3/8" L. Grooves are located on the inside of the ring that match the grooves on the outside of the bleed plug assembly; when the bleed plug handle is rotated, the bleed plug assembly rotates with it. This allows the valve to be opened and controlled manual. Attached to the ring is a plastic nub

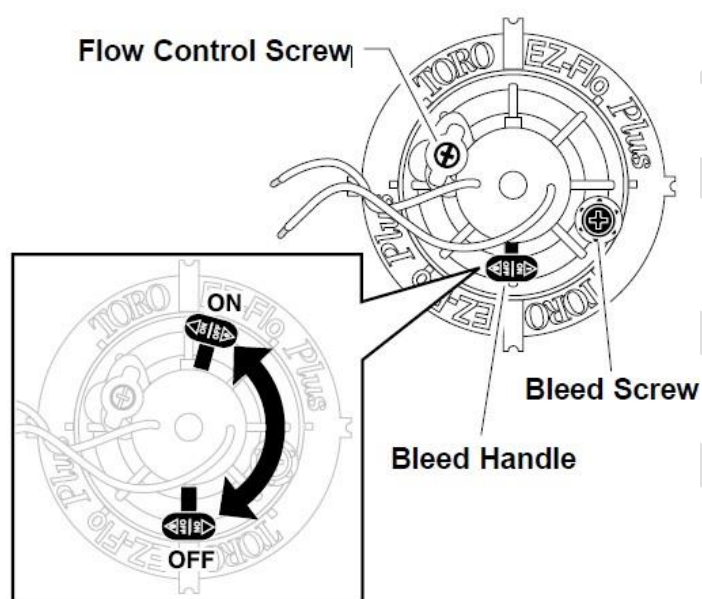


Figure 3: Bleed Plug Handle and Bleed Screw
(TORO, n.d - a)

with on and off labelling, as well as arrows indicating the corresponding direction. The plastic nub allows for easy rotation of the bleed plug handle. It also serves to indicate which direction the user should turn the handle in order to open and close the valve. Moving the bleed plug handle counterclockwise opens the valve, while moving the bleed plug handle clockwise closes the valve (Refer to Figure 3).

2.3 Bleed Plug Assembly

The bleed plug assembly is located between the solenoid assembly and the cover assembly and is composed of a hard, white plastic. It is cylindrical in shape and has dimensions of 1/2" W x 3/4" L. Female threads on one end of the bleed plug assembly secure it to the solenoid assembly while male threads on the opposite end secure it to the cover assembly. A black, rubber O-ring is positioned halfway up the bleed plug assembly which ensures a

watertight seal between the bleed plug assembly and cover assembly. A small orifice located in the center of the bleed plug assembly allows water to leave the upper chamber and drain into the body assembly (Hunter, n.d. - a); however, the orifice opening is usually blocked by the solenoid plunger. This means that the only time water can leave is when the solenoid is activated (or if the valve is manually opened). A second orifice is located slightly off centered within the bleed plug assembly which allows water from the inlet side to enter the upper chamber.

2.4 Cover Nut

The cover nut is located above the cover assembly and is composed of black, glass filled nylon. It is ring shaped and has dimensions of 2 1/2" W x 1" L. The cover nut has female threads on the inside that secure it the male threaded body assembly. It also has a lip on the top inside edge that keeps the cover assembly securely in place against the force of the spring. The threaded design of the cover nut enables the valve to be easily disassembled for maintenance. Grooves are located on the outside of the cover nut which provide grip while tightening or loosening the cover nut.

2.5 External Bleed Screw

The external bleed screw is located on the upper surface of the cover assembly and is composed of black, glass filled nylon (refer to Figure 3). It is a Philips type screw and has dimensions of 1/8" W x 1/2" L. The external bleed screw threads directly into the cover assembly. Like the bleed plug handle, the external bleed screw can be used to open the valve manually by rotating it counterclockwise one full turn or until water begins discharging past the threads. The external bleed screw can also be removed entirely to help flush debris from the upper diaphragm area (The TORO Company, n.d.).

2.6 Cover Assembly

The cover assembly is located directly on top of the body assembly and is held in place by the cover nut. It is composed of black, glass filled nylon. The cover assembly is roughly circular in shape and has dimensions of 2" W x 1" L. Two female threaded ports can be found on the top of the cover assembly: one for the bleed plug assembly and the other for the external bleed screw. A 1/2" plastic rod extends vertically from the surface of the cover assembly which acts as a stop for the bleed plug handle. The cover assembly also contains a small, central orifice through which the body assembly pilot line can pass.

2.7 Spring

The spring is located between the cover assembly and the diaphragm assembly and is composed of stainless steel. It has dimensions of 3/8" W x 1 1/4" L when uncompressed. The purpose of the spring is to keep the diaphragm assembly in constant contact with the body assembly, thus maintaining a water tight. In order to fit between the cover assembly and the diaphragm assembly the spring must be compressed; this creates a force that pushes the diaphragm assembly down.

2.8 Diaphragm Assembly

The diaphragm assembly is located between the cover assembly and the divider. It consists of a cylindrical shaped base attached to a flat circular disk. The base is composed of black PVC and has dimensions of 1" W x 1/2" L and the disk is composed of black, flexible rubber and has dimensions of 2" W x 1/8" L. The diaphragm assembly rests directly on top of the divider and body assembly and is kept in place by the force of the compressed spring. A small, central orifice in the diaphragm serves two purposes; first, it allows the body assembly pilot line to pass through and, second, it permits a tiny flow of water to cross the diaphragm

assembly and enter the upper chamber. Refer to Figure 4 for a visualization of the diaphragm position in open and closed solenoid valves.

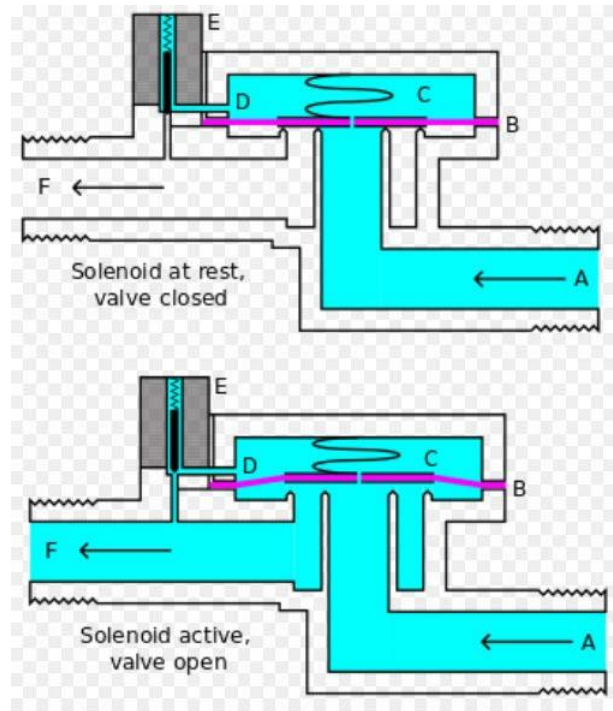


Figure 4: Diaphragm Position in Open and Closed Solenoid Valves (Revolv, n.d.)

2.9 Divider

The divider is located inside the upper rim of the body assembly just below the diaphragm assembly and is composed of brown, glass filled nylon. It is ring shaped and has dimensions of 1 3/4" L x 3/8" W. The divider's shape is complementary to the shape of the diaphragm assembly (as well as the shape of the body assembly wall) so that when assembled there is little space between the mating parts. This prevents water from leaking past the edges of the diaphragm assembly from the lower chamber into the upper chamber (or vice versa). The divider also serves to provide structural support for the diaphragm assembly.

2.10 Body Assembly

The body assembly is located below the cover assembly and houses the spring and diaphragm assembly as well as the divider. It is composed mainly of black PVC and has dimensions of 2" H x 3" W x 4" L. The body assembly consists of an open top cylinder connected to a 1-inch female threaded port on either end, which allow the valve to be connected in line with the rest of the irrigation system. Arrows are printed on the outside of the body assembly that indicate the direction of flow (the valve is unidirectional, which means that it only works in one direction). The top of the body assembly is also threaded so that the cover nut can be secured to the top. A stainless-steel pilot is located at the center of the body assembly

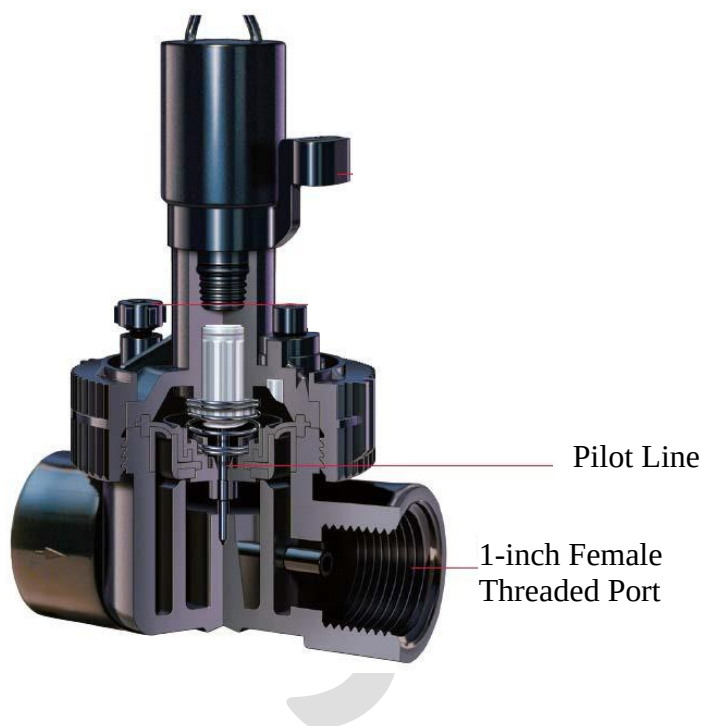


Figure 5: Partial Cross Section of a Body Assembly (TORO, n.d - b)

which extends upwards from the base and aligns with the central orifice in the bleed plug assembly. The pilot line aids in stabilizing the diaphragm assembly. The pilot line also provides a direct pathway for water to leave the central orifice in the bleed plug assembly and enter the outlet port. A baffle within the body assembly interior keeps the inlet and outlet sides separate (with the exception of the pilot line). Refer to Figure 5 for a partial cross-sectional diagram of a body assembly.

3.0 CONCLUSION

3.1 Functional Overview

The Toro EZ-Flo Plus 1-inch female globe valve is used to regulate the flow of water in an irrigation system. Valves are an important element of most irrigation systems since water pressure (and flow) are usually not high enough to operate an entire system at the same time. Using valves such as the Toro EZ-Flo Plus 1-inch female globe valve can divide a system up into smaller zones or areas that can be run one at a time (Sprinkler Master, n.d.). The Toro EZ-Flo Plus 1-inch female globe valve finds application in both residential and commercial projects because of its robust construction, dependable operation, and jar-top design that make servicing quick and easy.

3.2 Operating Cycle

The Toro EZ-Flo Plus 1-inch female globe valve is a type of solenoid valve that operates on the principle of magnetism. Before it can be used by the operator, it must first be connected to a power source. Figure 6 shows the wiring for three solenoid valves and an optional master valve. The wire bundle connecting the control panel and solenoid valves is typically run underground. One wire is

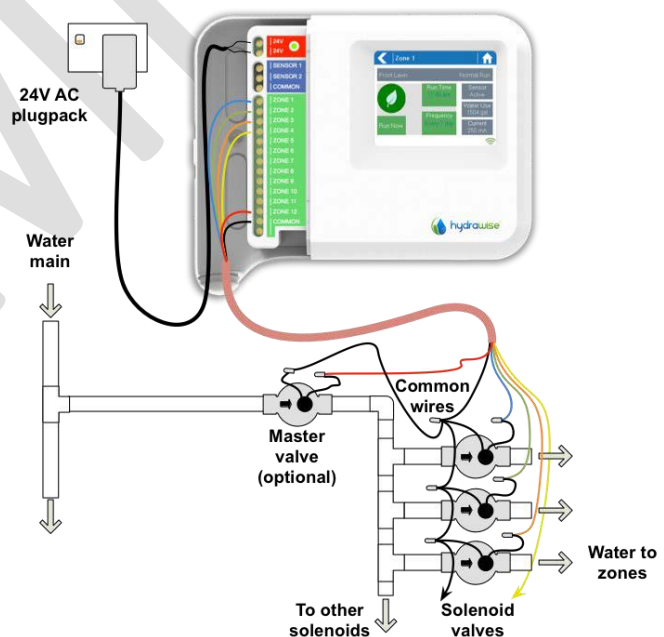


Figure 6: Solenoid Valve Wiring (Hunter, n.d. - b)

needed for each solenoid valve in the system and an additional wire is needed for the common, which connects to every valve. The control panel on the other end has a 24V AC plugpack is

compatible with most household currents. The valve must also be connected in line with the irrigation system and in the proper orientation (flow from the supply must follow the arrows inscribed on the body assembly of the valve). (Zazueta, Smajstrla, & Clark, 1993).

Upon input from the control panel, an electric current will be sent through the wire to the solenoid assembly. As the electric coil within the solenoid assembly becomes energized, a magnetic field is created which pulls the plunger up towards the center of the coil. This will expose the central orifice of the bleed plug assembly, which is normally blocked by the plunger. Water is now free to leak from the upper chamber through the central orifice of the bleed plug assembly and into the pilot line. This will result in a drop in upper chamber pressure. The pressure will continue to drop as more water leaves until the pressure on the inlet side of the valve can push the diaphragm assembly against the spring with enough force to compress it, causing the diaphragm assembly to move away from the body assembly and allowing water to flow straight through the valve.

The valve will remain open as long as water is allowed to leak from the upper chamber; when the solenoid is deactivated the spring inside the solenoid assembly will push the plunger against the central orifice within the bleed plug assembly, preventing water from leaking out of the upper chamber. Water will continue to fill the upper chamber until the pressure in the chamber is equal to the pressure of water at the inlet, at which point the valve will close (because of the positive action of the spring) (Zazueta, Smajstrla, & Clark, 1993).

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