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# Solenoid Valves

The right solenoid valve for any job.

SPORLAN

# Sporlan Solenoid Valves — General

## Purpose

The primary purpose of an electrically operated solenoid valve is to control automatically the flow of fluids, liquid, or gas. Sporlan Solenoid Valves may be applied on a wide variety of applications.

## Basic Types

There are two basic types of solenoid valves. The most common is the normally-closed type, in which the valve opens when the coil is energized, and closes when the coil is de-energized. The other type is the normally-open valve which opens when the coil is de-energized and closes when the coil is energized. The operation of both types is discussed in the following paragraphs.

## Principles of Operation

Solenoid valve operation is based on the theory of the electromagnet. The solenoid valve coil sets up a magnetic field when electrical current is flowing through it. If a magnetic metal, such as iron or steel, is introduced into the magnetic field, the pull of the field will raise the metal and center it in the hollow core of the coil. By attaching a stem to the magnetic metal or plunger, this principle is used to open the port of the valve. When the electrical circuit to the coil is broken, the magnetic field will collapse and the stem and plunger either will fall by gravity or be pushed down by the kick off spring.

Some solenoid valves are designed with a hammer blow effect. When the coil is energized, the plunger starts upward before the stem. The plunger then picks up the stem by making contact with a collar at the top. The momentum of the plunger assists in opening the valve against the unbalanced pressure across the port.

Solenoid valves are also classified according to the "stem and plunger" action. The two types are discussed in the following sections.

### Direct Acting Solenoid Valves

With this type of valve, the stem and plunger assembly opens the port of the valve directly. This type of construction is limited to the smaller valves with port sizes of less than 1/4 inch. Sporlan Solenoid Valves of this design are the Types A3, E3, MA5A3, 180 Solenoid Pilot Control and W3P1.

## Pilot Operated

### Normally Closed Solenoid Valves

In a pilot operated valve, the stem and plunger assembly opens a pilot port. This releases the pressure on top of the disc, piston or diaphragm which then moves upward and opens the main valve port. Figure 3 illustrates the four phases of the operating cycle of a typical pilot operated valve. The operation is the same whether the valve is a disc, piston or diaphragm type.

Initially the pilot port and the main port are closed as shown in **A**. Pressure at the valve inlet is present on top of the disc as well, because of an equalizer hole drilled through the disc.

When the coil is energized, the stem and plunger assembly is lifted and the pilot port is opened — **B**. The stem and plunger assembly is centered within the coil by the magnetic field. The pilot port, if properly sized for the fluid to be handled, will relieve the pressure on top of the disc. Now the valve inlet pressure will act on a portion of the bottom of the disc, lifting the disc to open the main port — **C**. Once the port is open, the

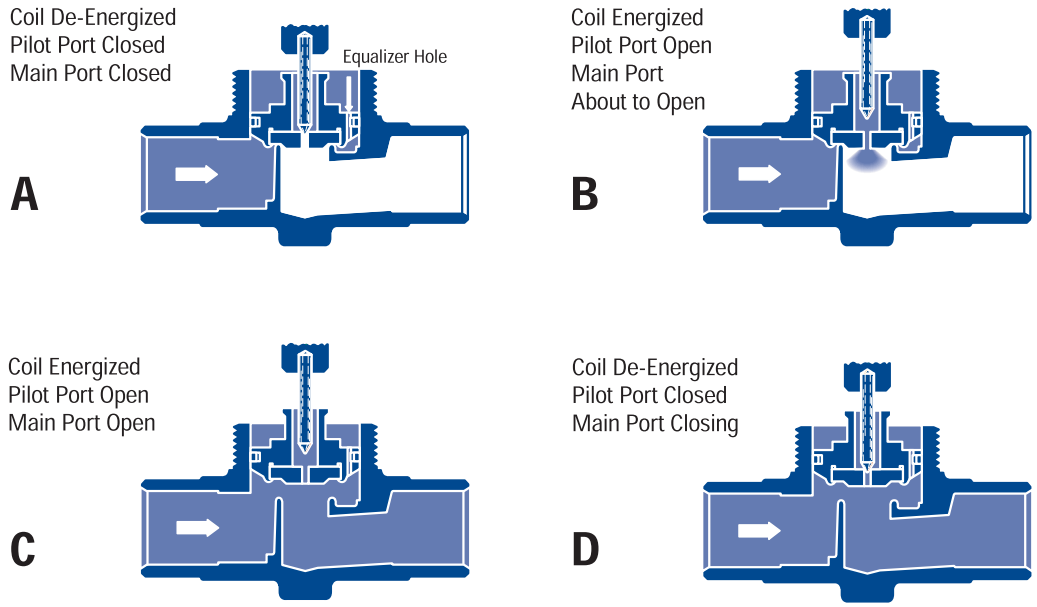


*Figure 3*

# General

## Sporlan Solenoid Valves

disc is held off the seat by the pressure difference across the port. When the coil is de-energized, the stem and plunger assembly drops, due to gravity or the kick off spring, and closes the pilot port. As shown in **D** the pressure above the disc is no longer vented to the downstream side of the valve. Fluid flow and pressure drop causes the pressure above the disc to be higher than below the disc, and the disc drops, closing the main port. In some valves the plunger is spring loaded and does not rely on gravity to close. All Sporlan Solenoid Valves except the A3, E3, W3, MA5A3 and 180 SPC are pilot operated and employ either the floating disc, floating piston or floating diaphragm construction. The pilot operated valves require a very low, 1 psi, pressure differential for full operation.

Normally Open Solenoid Valves operate very similar to the normally closed type. The system pressure is utilized to open and close these valves.

The major difference in the normally open construction is that with the coil de-energized, a spring is used to push the stem and plunger assembly upward holding the pilot port open. This then allows the disc to rise, because of the pressure difference between the bottom and top of the disc, and permits flow to take place.

When the coil is energized, the stem and plunger assembly is pulled DOWN, closing the pilot port. The pressure on top of the disc then equalizes with the incoming pressure and the disc moves down closing the main port. The valve will remain closed as long as the coil is energized.

Direct-Connected Piston Assemblies, with the stem and plunger mechanically connected to the piston, are used on applications where the valve must be sized for very small pressure drop, such as on suction lines. While the pilot operated principle is still used to open the valve, the magnetic pull of the coil is utilized to hold the piston open, preventing possible pulsations. A disadvantage of the direct-connected type is the case where dirt prevents free piston movement and the plunger is unable to center itself in the coil. This will cause overheating of the coil and the danger of coil burnout is present. The "floating piston or disc" type permits independent operation of the plunger to allow a complete magnetic circuit regardless of the piston's position and thereby eliminates the possibility of coil burnout due to restricted piston or disc movement. For additional information, see Page 27, Suction Line Service.

# Design

## Maximum Operating Pressure Differential

The maximum pressure differential against which a solenoid valve can open is generally abbreviated MOPD. This is illustrated in Figure 4.

MOPD ratings are established at 85% of rated voltage and with a hot coil after its maximum temperature is reached. For any given valve and coil design, the factors that effect MOPD are voltage deviation and coil temperature.

## Synthetic Seating

Introduced by Sporlan in 1947, synthetic seating provides permanent seat tightness. Our experience in the use of these superior seating materials provides a reliable basis for durable construction best suited for various applications.

## Solenoid Coil

The interchangeability of solenoid coils is necessarily limited by considerations of the varying requirements of power and plunger movement. Nevertheless, only three coil sizes are required for the extensive line of Sporlan Solenoid Valves. Each coil is interchangeable between a number of valves within a given size range.

## Maximum Rated Pressure

Don't confuse the MOPD rating of a valve with the maximum rated pressure. The rated pressure of a solenoid valve is a design specification indicating the maximum pressure under which the valve should be applied. Actually, the valve must be able to withstand three times its maximum rated pressure and pass fatigue cycle tests, to qualify for listing by Underwriters' Laboratories.

## Manual Lift Stem

Occasionally, circumstances require that a solenoid valve be opened independently of the electrical power. Therefore, a manual lift stem is available on all valves from the B6 and E6 series up through the MA50 series.

*Figure 4*