

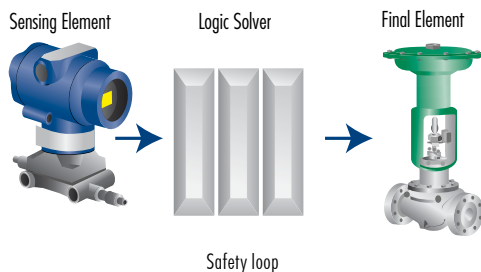
# FUNCTIONAL SAFETY SOLUTIONS in Solenoid Valves



Safety is reality and is part of our daily business. The same applies to ASCO; it is reality and part of your safety. You can rely on our focus on reliable products. Our solenoids in your process installation give you a higher degree of safety. The standards IEC61508 and 61511 state: 'Functional safety is part of the overall safety that depends on a system or equipment operating correctly in response to its inputs.' This applies not only to a new installation but continues over the full service life or 'safety lifecycle'. With our solenoid valves for air operated safety valves we have created a new era. We have designed new hardware that makes your safety management easier. Our improved products and new solutions offer you: 'ease of installation' and 'simplicity in service'.

### THE SAFETY LOOP

The standard addresses a 'dedicated independent layer' of risk reduction by using electric, electronic or programmable electronic systems. A safety system in this context always consists of a sensing element, logic solver and final element that measure, control and act to bring the dangerous process in a safe state within a specified time.



The reliability of these systems is expressed as probability of failure on demand (PFD) and depends on the equipment failure rates and testing frequency. For this purpose components on which safety depends are exposed to detailed failure mode and effect analysis (FMEA). During the life of the safety system its performance gradually degrades. Frequent testing of its functional behaviour is required to maintain overall reliability. Obviously this applies to all components on which safety depends, such as sensors, logic, actuators and solenoids. If testing is made easy and the likelihood of operational mistakes is reduced then both performance and safety improves. This brochure describes solenoids and related systems that fulfil these demands.

### FINAL ELEMENT

The final element consists of a solenoid valve, an actuator and a process safety valve.

Solenoid valves are an essential part in this section, they directly control the on/off valve actuators. In normal operation, the solenoid is energised and open, activating the actuator. When the logic solver is triggered, it de-energises the solenoid, which releases the supply pressure to the actuator, causing the valve to move to its safe position. Safety is highly dependent on the reliability of the solenoid valve. This means that these solenoid valves need to be manufactured to the highest quality standards and tested under the most severe conditions.



### TERMINOLOGY

As in many sectors, functional safety also has its specific terminology. Although you may be an expert, we feel it is valuable to agree upon a common use of terms. Each page has a brief list of abbreviations and terms that are used in this brochure.

## REDUNDANCY WITH SOLENOID VALVES

Two solenoid valves can be used to operate process or shutdown valves. In this full redundancy mode either *reliability* or *availability* of the final element can be increased depending on the piping configuration. Reliability is related to the integrity of the safety loop to perform its safety function, where availability is related to the production to maintain its function. Two solenoid valves connected in series as shown in figure 1 are operated in a *1oo2 voting* by the logic solver. This increases the *reliability* (or PFD) of the system. At the same time however, it decreases the *availability*. In a *1oo2* configuration (HFT = 1), two devices are used to perform one function. If one component safely fails, then the system is tripped. With two devices the likelihood of this happening increases.

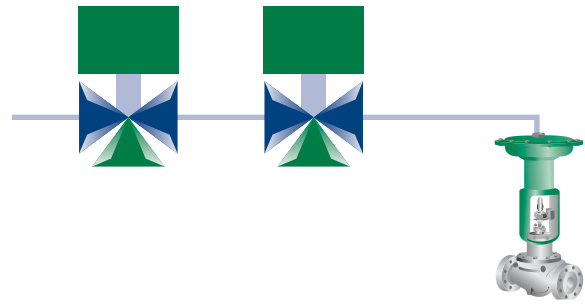


Figure 1

In *2oo2 configuration*, two solenoid valves are connected in parallel as shown in figure 2. The safety valve will still be pressurised if one is de-energised. De-energising the second solenoid valve will remove the actuator pressure and the shutdown valve will operate. This configuration is less sensitive for safe failures, reducing the number of nuisance or spurious trips and increasing the *availability*. However, the *reliability* has gone down.

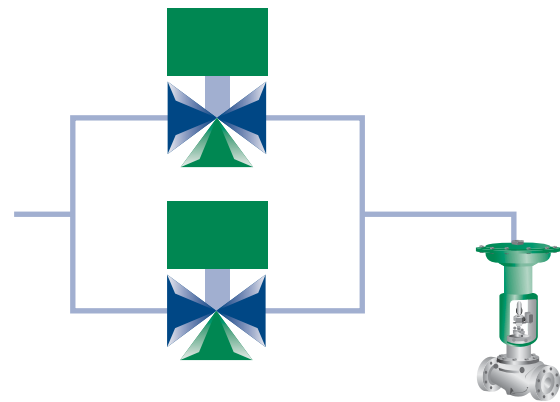


Figure 2

ASCO has a *specific 2oo2 configuration*, in which two solenoid valves are connected in parallel. One outlet port (2) however, is connected to the release port (1) of the other, see figure 3. This provides the same *availability*, but increases the *reliability* or integrity of the final element.

Most redundant solenoid valve installations do not provide indication of safe failure of one of the valves. Generally, online maintenance and testing of solenoid valves is difficult without shutting down the process.

ASCO has re-engineered their solenoid valves to offer higher *reliability*, easier installation and improved capability for testing and diagnosis. In addition, new solutions have been designed that cut engineering effort and greatly reduce the time for installation and testing, particularly when using multiple devices for redundant safety functions.

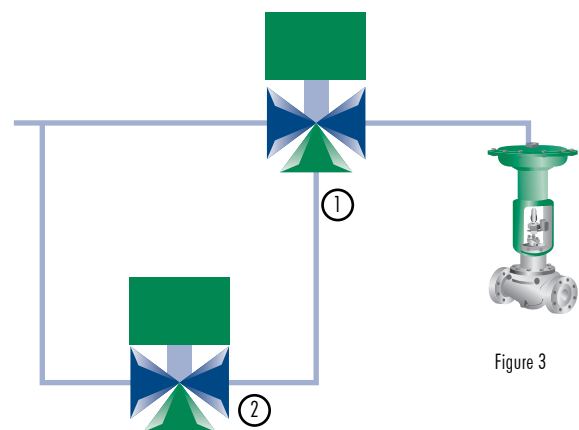


Figure 3

**ACTUATOR** | a mechanical device for moving or controlling a mechanism or system

**AVAILABILITY** | the degree to which a system or subsystem is in a specified operable and committable state at the start of a mission or task

**DANGEROUS FAILURE** | failure which has the potential to put the safety instrumented system in a hazardous or fail-to-function state



Single solenoid certified solenoid valves



Manual reset valves

## SAFETY SOLUTIONS

ASCO has dedicated solutions to operate your safety valve with a high degree of integrity. We have three standard types of safety products for basic installations: single solenoid valves, manual reset valves and redundant (coil) solenoid valves. For more advanced installations, we have developed three different safety systems: bypass panels, actuator control systems and redundant control systems.

### SAFETY PRODUCTS

#### 1. SINGLE SOLENOID VALVES

ASCO 3-way and 5-way solenoids, series 126, 314, 316, 320, 327 and 551/552/553, are the most widely used solenoid valves in the process industry. For spring return actuator applications, these valves are proven in use and have undergone an independent evaluation by TÜV and/or by Exida per IEC 61508 Parts 1 & 2.

All series are certified as capable for use in SIL 3 safety loops. Individual solenoid valves are most commonly used as a single device (1oo1 voting). Two units can easily be piped in series or parallel to provide redundancy (1oo2 or 2oo2 voting). ASCO solenoid valves are used as the primary device for process valve actuation, as well as the shutdown valves when used with (digital) valve positioners for control valve applications.

#### 2. MANUAL RESET VALVES

When you need to manually engage the final control element of your process system, ASCO has a lever or push button operated manual reset valve. These valves are designed with corrosion resistant materials and industrial strength components. ASCO Manual Reset Solenoid Valves are a process industry standard and are also available as tamper-proof.

These manual reset valves are available in two versions: *electrically tripped* and *no-voltage release*. The first one works as follows: with the solenoid valve solenoid de-energised, the handle is raised manually and latches the operator in the 'up' (latched) position. Upon energising the solenoid valve solenoid, the latch is tripped, returning the operator to the 'down' (unlatched) position. If auxiliary air supply to the solenoid valve is lost, then the main valve will shift position. The no-voltage release version operates similarly but in reverse: upon loss of voltage, the latch is tripped.

**FINAL ELEMENT** | part of a safety instrumented system, which implements the physical action necessary to achieve a safe state

**LOGIC SOLVER** | that portion of safety instrumented system that performs one or more logic function(s)

**MooN VOTING (I.E. 1oo2 VOTING)** | safety instrumented system, or part thereof, made up of 'N' independent channels, which are so connected that 'M' channels are sufficient to perform the safety instrumented function



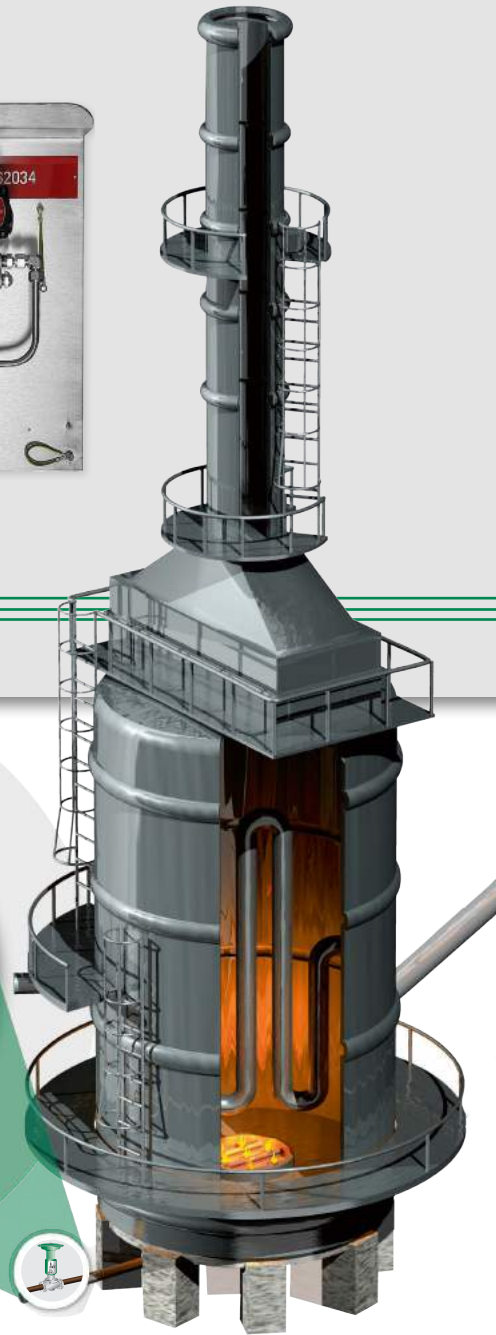
Redundant Solenoid Valves



Redundant Coil Solenoid Valves



Bypass Panels



### 3. REDUNDANT (COIL) SOLENOID VALVES

To increase the integrity of the solenoid valve operation ASCO has designed a valve construction that is operated with two independent coils. Configured in 1oo2 voting, the safety valve is operated if one of the two coils is de-energised. This 1oo2 configuration highly increases the reliability or integrity. Configured in 2oo2 voting, both coils must be de-energised to return the actuator/process valve to its non-operating position. Redundant coil solenoid valves in this 2oo2 configuration are used for high availability applications. There are two coils (solenoid operators) that are redundantly keeping the main solenoid valve in the energised position, which in turn keeps the actuator/process valve in its operating position.

## SAFETY SYSTEMS

### 1. BYPASS PANELS

The normal use of solenoid valves in safety systems is a single solenoid valve connected to the actuator of a shutdown or process valve. Part of the safety lifecycle is testing and maintenance of the safety systems. ASCO Bypass panels are designed to improve the way that solenoids can be tested while maintaining the integrity of the system. The panels provide manual testing of the solenoid valves

**PROOF TEST** | test performed to reveal undetected faults in a safety instrumented system so that, if necessary, the system can be restored to its designed functionality

**REDUNDANCY** | use of multiple elements or systems to perform the same function; redundancy can be implemented by identical elements (identical redundancy) or by diverse elements (diverse redundancy)

**RELIABILITY** | the ability of a system or component to perform its required functions under stated conditions for a specified period of time



Actuator Control Systems (ACS)



Redundant Control Systems (RCS)

under operation by using a bypass valve. The proper operation of the solenoid valve can be verified visually and the state of the bypass valve is indicated. The valve can be replaced without removing the air supply. The bypass panels greatly reduce the time required for maintenance. The panels can be used with the majority of the ASCO solenoid valves and are mounted on a stainless steel panel with (sun) shed. Many different configurations are available.

## 2. ACTUATOR CONTROL SYSTEMS (ACS)

Connecting the components of an air controlled safety shutdown valve always requires piping and fittings that are reliable and durable. Filter regulator, one or more solenoids, relief and isolation valves; all need interconnection and mechanical support. ASCO has developed special fittings that allows easy coupling of pneumatic parts with high flexibility, fixed distances, good reliability and robust support. The so-called Actuator Control System (ACS) has inert mounting brackets for manifold support and versatile branching ducts as pipe couplers. These provide a fixed width between the components that do not depend on thread tolerances, and components can rotate and be mounted in a standard mounting pattern without the use of slots.

## 3. REDUNDANT CONTROL SYSTEMS (RCS)

The ASCO RCS is a redundant solenoid valve system that acts as a single 3-way valve. The added features of this system, apart from

an individual valve, include the ability to perform automatic online testing of the redundant solenoid valves, automatic partial stroke testing of the process valve, and online maintenance capabilities. This product is built for high reliability applications and functional safety. The redundant solenoids can operate in 1oo1 Hot Standby mode or in 2oo2 Diagnostic mode. Both modes of operation are certified per IEC 61508 Parts 1 and 2 and are SIL 3 capable. A fully equipped RCS has pressure switches on both the solenoid valves and on the air operated by-pass valve and has two isolation valves.

### RCS 1oo1 HS

Only one solenoid valve is on-line during normal operation, while the second solenoid is in 'hot-standby'. The solenoid trips in the event of a coil failure, which is detected by the pressure switch. Then the second solenoid is automatically energised maintaining pressure to the shutdown valve. This version offers high reliability at the availability of a 2oo2 design.

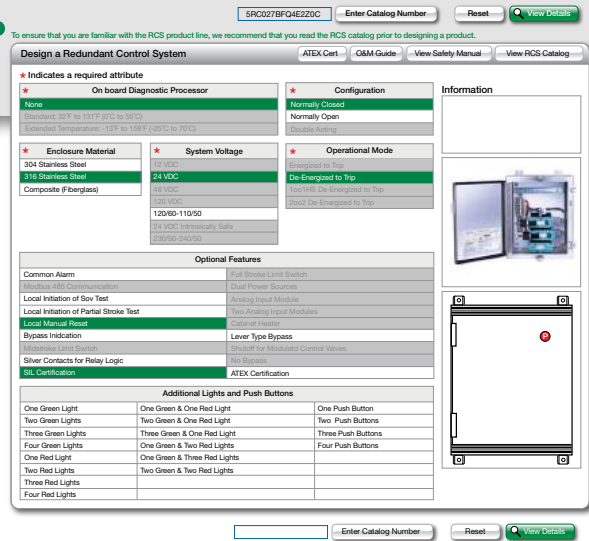
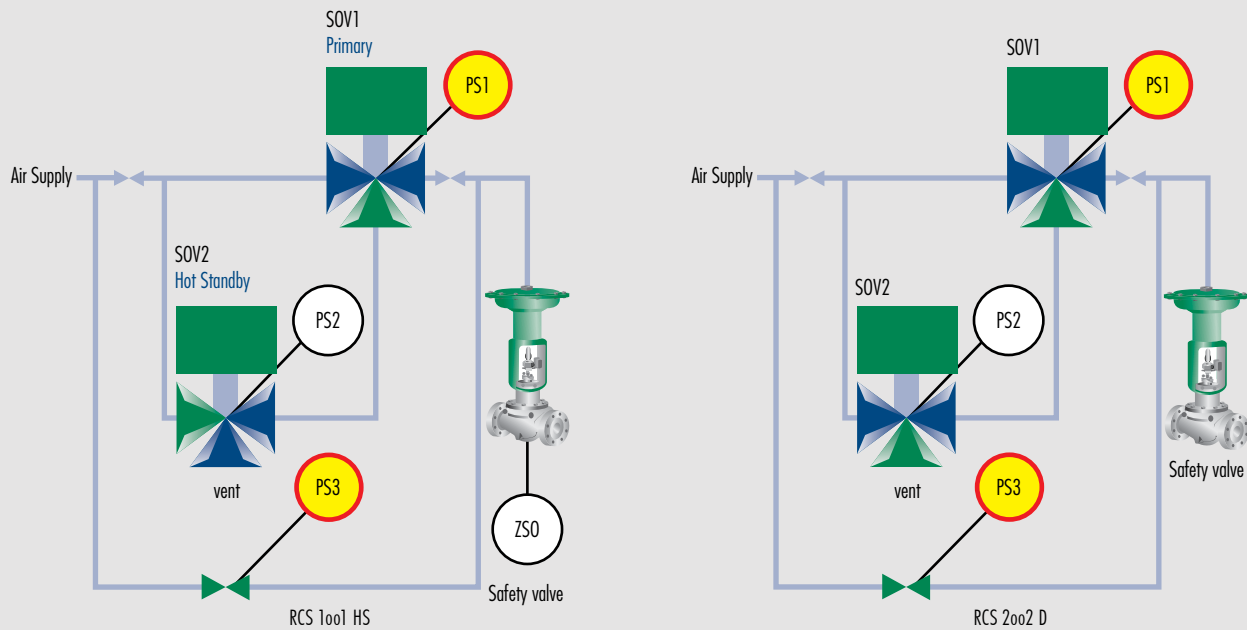
### RCS 2oo2 D

Both solenoids are energised during normal operation. The pressure switches that are connected to the solenoid valves are used as an alarm in the case that one goes to a vent state when not commanded. To shut down the system, both solenoids need to be de-energised. This version provides high availability with the reliability of a 1oo1 design.

**RISK** | combination of the frequency of occurrence of harm and the severity of that harm

**SAFE FAILURE** | failure which does not have the potential to put the safety instrumented system in a hazardous or fail-to-function state

**SAFETY INTEGRITY LEVEL (SIL)** | discrete level (one of four) for specifying the safety integrity requirements of the safety instrumented functions to be allocated to the safety instrumented systems. Safety integrity level 4 has the highest level of safety integrity; safety integrity level 1 has the lowest.



RCS Configurator

## HOW CAN WE HELP YOU?

ASCO simplified the RCS product selection process with an online catalogue number configurator. Once you have determined the needs, you can easily construct a catalogue number by clicking on each feature and then clicking the View Details button. A second screen appears, providing the product catalogue number, product attributes, and various drawings. The configurator is programmed to accept only valid constructions.

In addition to creating a catalogue number, the configurator can also interpret a catalogue number for you. Type a valid 5RC (with

PLC) or 5LC (without PLC) catalogue number into the window next to the Enter Catalogue Number button (CAPs only). The configurator automatically highlights the appropriate construction features.

In order to use the online configurator, go to:  
[www.asco.com/en-us/Pages/configurator-solenoid-valve-series-rcs.aspx](http://www.asco.com/en-us/Pages/configurator-solenoid-valve-series-rcs.aspx)

You can also contact us by calling us or send us an e-mail with your questions.

**SAFETY INSTRUMENTED SYSTEM (SIS)** | instrumented system used to implement one or more safety instrumented functions. An SIS is composed of any combination of sensor (s), logic solver (s), and final elements(s)

**SAFETY LIFECYCLE** | necessary activities involved in the implementation of safety instrumented function(s) occurring during a period of time that starts at the concept phase of a project and finishes when all of the safety instrumented functions are no longer available for use

**SOLENOID VALVE** | an integrated device containing an electrical coil and mechanism that converts energy into linear motion, in order to actuate an air operated valve



“ASCO, global market leader in solenoid valves, combines local presence with functional safety expertise and solutions to help you improve your process safety.”